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# DATA MINING TECHNIQUE AS A TOOL FOR INSTRUCTORS' PERFORMANCE EVALUATION IN HIGHER EDUCATIONAL INSTITUTION

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**A0BSTRACT**
*Educational Data Mining (EDM) is an evolving field exploring pedagogical data by applying different machine learning techniques/tools. It can be considered as interdisciplinary research field which provides intrinsic knowledge of teaching and learning process for effective education. The main objective of any educational institution is to provide quality education to its students. One way to achieve highest level of quality in higher education system is by discovering knowledge that predicts teachers' performance. This study presents an efficient system model for evaluation and prediction of teachers' performance in higher institutions of learning using data mining technologies. To achieve the objectives of this work, a two-layered classifier system was designed; it consists of an Artificial Neural Network (ANN) and Decision Tree. The classifier system was tested successfully using case study data from a Nigerian University in the South West of Nigeria. The data consists of academic qualifications for teachers as well as their experiences and grades of students in courses they taught among others. The attribute selected were evaluated using two feature selection methods in order to get a subset of the attributes that would make for a compact and accurate predictive model. The WEKA machine learning tool was used for the mining. The results show that, among the six attributes used, Working Experience, and Rank are rated the best two attributes that contributed mostly to the performance of teachers in this study. Also, considering the time taken to build the models and performance accuracy level, C4.5 decision tree outperformed the other two algorithms (ID3 and MLP) with good performance of 83.5% accuracy level and acceptable kappa statistics of 0.743. It does mean that C4.5 decision tree is best algorithm suitable for predicting teachers' performance in relation to the other two algorithms in this work.*
**Keywords**: Educational Data Mining, Decision Tree, Artificial Neural Networks, Machine learning, WEKA

## 1. INTRODUCTION

Data mining is the process of discovering interesting knowledge from large amounts of data stored in databases, data warehouses, or other information repositories [1].Data mining refers to extracting knowledge from large amount of data. The term data mining is variously named as "Knowledge mining from data", "knowledge mining" or "Knowledge Discovery from Database". However, Data Mining refers to a particular step in the Knowledge discovery process. It consists of particular algorithms that, under acceptable computational efficiency limitations, produce a particular enumeration of patterns (models) over the data [2]. Xingquan and Ian [3] defined data mining as the process of exploration and analysis, by automatic or semiautomatic means, of large quantities of data in order to discover meaningful patterns and rules. Data mining techniques have been in use to solve educational problems and to perform crucial analysis in the educational sector. This is to enhance educational standards and management such as investigating the areas of learning recommendation systems, learning material arrangement, continuous student assessments and evaluation of educational websites.

According to Romero *et al.*, [4], there are increasing research interests using data mining in education. This new emerging field, called Educational Data Mining is concerned with developing methods that discover knowledge from databases originating from educational environments. The data can be personal or academic which can be used to understand students' behavior, to assist instructors, to improve teaching, to evaluate and improve e-learning systems, to improve curriculums and many other benefits. The desire is to extract hidden but useful knowledge from data through data mining tools. The recent decline in the standard of education in most developing countries has necessitated researches that will help proffer solutions to some of the problems. Performance evaluation has been described as a systematic process of evaluating an individual worker's job performance and effectiveness in relation to certain pre-established criteria and organizational objectives [5].

It has been observed that the continuous decline in average academic performance of students at higher educational institution can be traced back to the performance of their teachers. Most organizations use performance appraisal system to evaluate the teacher's performance while some institutions use student rating technique to measure teaching effectiveness of instructors. Efficiencies of these methods have been doubted over the years.

This study proposed to evaluate teacher's performance on the basis of different factors, using data mining techniques. Data mining is a powerful technology for analyzing important information from historical data, thus information needed for this study exist already within the system. This study presents an efficient system model with an algorithm for evaluation of teachers' performance in higher institutions of learning essentially to overcome the limitations of conventional

approaches. The focus of this work is on designing a framework based on academic background factors and socio-economic factors among other factors which can be used predict teacher's performance and recommend necessary actions for improvement.

## 2. REVIEW OF RELATED WORKS

Extensive literature reviews of the EDM research field are provided by Romero and Ventura [6], covering the research efforts in the area between 1995 and 2005. In their paper, they surveyed the application of data mining to traditional educational systems, particular web-based courses, well-known learning content management systems, and adaptive and intelligent web-based educational systems. Another extensive review was carried out by Baker and Yacef [7] covering the period between 2005 and 2009. They reviewed the history and current trends in the field of Educational Data Mining (EDM), considered the methodological profile of research in the early years of EDM, compared to 2008 and 2009, and discussed trends and shifts in the research conducted by this community. Another more recent survey was done by Rajni and Malaya [8], which focused on components, research trends (1998 to 2012) of EDM highlighting its related Tools, Techniques and educational Outcomes. They also highlighted the Challenges in EDM. A study by Varun and Arupama [9] examined the application of data mining techniques in higher educational institution to extract useful information from huge data sets and provided analytical tool to view and use this information for decision making processes by taking real life examples.

Chin-Chia Hsu and Tao Huang [10] conducted a study on the use of data mining technology to evaluate student's academic achievement via multiple channels of enrolment like joint recruitment enrolment, athletic enrolment and application enrolment. A similar study was carried out by Osofisan and Olamiti [11] where they investigated the academic background in relationship with the performance of students in a computer science programme in a Nigerian university. Their study showed that the grade obtained from senior secondary school examination (SSCE) in mathematics is the highest determinant of students' performance using the C4.5 learning algorithm in building the model of the student's performance.

Mardikyan and Badur [12] conducted a study to investigate the factors associated with the assessment of instructors teaching performance using two different data mining techniques: regression analysis and decision trees. For regression analysis the stepwise regression method was used and for decision trees CHAID and CART algorithms were applied.As a result of their study, they found that instructors, who have well prepared course outlines, use satisfactory materials, help the student outside the lectures, grade exams fairly and on time receive higher evaluations.

Hemaid and El-Halees [13]; Surjeet and Saurabh[14] used C4.5, ID3 and CART decision tree algorithms on engineering student's data to predict their performance in the final exam. Prediction models that included all personal, social, psychological and other environmental variables were necessary for the effective prediction of the performance of the students. C4.5 technique has highest accuracy of 67.7778% compared to other methods ID3 and CART algorithms.

A study by Pal and Pal [15] analyzed some numbers of parameters for the derivation of performance prediction indicators needed for teachers performance assessment, monitoring and evaluation. Four classification algorithms (Naïve Bayes, ID3, CART and LAD) based on Weka were used in their study. Their results showed that the best algorithm based on data is Naïve Bayes classification.

Surjeet *et al*, [16] carried out a research on mining educational data to predict student's retention. In the study machine learning algorithms (ID3, C4.5 and ADT) were applied to analyze and extract information from existing student data. Their study established predictive models and showed that machine learning algorithm such as Alternating Decision Tree (ADT) can learn predictive models from the student retention data accumulated from previous year.

Aranuwa and Sellapan [17] used directed modeling that is, an intelligent technique for evaluation of instructors' performance in higher institutions of learning, and proposed an optimal algorithm and designing a system framework suitable for predicting instructors' performance as well as recommended necessary action to be taken to aid school administrators in decision making considering the limitations of the classical methodologies. The proposed system, if fully implemented, will aid school administrators in decision making, provide basis for instructors' performance improvement that will optimize students' academic outcomes and improve standard of education. Consequently, this will contribute to successful achievement of the goals.

A similar study was carried out by Hemaid and El-Halees [13] to examine the factors associated with the assessment of teacher's performance. In this study, data was collected for teachers from the Ministry of Education and Higher Education in Gaza City. They proposed a model to evaluate their performance through the use of techniques of data mining like association, classification rules (Decision Tree, Rule Induction, K-NN, Naïve Bayesian (Kernel)) to determine ways that can help them to better serve the educational process and hopefully improve their performance and thus reflect it on the performance of teachers in the classroom. In each tasks, they presented the extracted knowledge and described its importance in teacher performance domain.

## 3. METHODOLOGY

The study aims at using the classification method of Data mining for the prediction of teachers' performance. The prediction model was developed using the Classification methods of the Data mining technique. The Neural Network data mining technique (the multilayer perceptron algorithm) and Decision Trees methods specifically the ID3 (Iterative Dichotomiser 3) and C4.5 algorithms (the C4.5 is implemented in WEKA by the classifier class: weka.classifiers.trees.J48) were used and their performances were compared to each other. The WEKA 3.6.13 Data mining software tool was also used to carry out the prediction processes.

### 3.1 Data Acquisition

The raw data used in this study was collected from an Academic Department of a University in Ondo State, South West Nigeria. The data included two basic categories of variables, the first group consists 350 records of the teachers' data variables as shown in table 1. The second group of variables includes the students' learning outcome (results) from 2010 to 2015 academics sessions as shown in table 2.

**Table 1: Teachers' Data variable**

| VARIABLE NAME | VARIABLE FORMAT | VARIABLE TYPE |
|---|---|---|
| Teachers' ID | 1,2,3… | Numerical |
| University | Name of university | Categorical |
| Name | Surname and other names | Categorical |
| Gender | Male, Female | Categorical |
| Appointment Status | Permanent, Temporal, Contract | Categorical |
| Employment Status | Old, New | Categorical |
| Rank | Prof, Reader, SL, L1, L2, AL, GA | Categorical |
| Present Age | 20,30,… | Numerical |
| Working Experience | Year | Numerical |
| Highest Qualification | PhD, Master, Bachelor | Categorical |
| Year of last Qualification | 1999, 2000,… | Numerical |
| Professional Qualification | Yes/No | Categorical |

### 3.2 Preprocessing data and feature extraction

The data preprocessing was carefully done to avoid incomplete records. The fields selected for the model include: Appointment status, Rank, University working experience, Highest Qualification, Year of last Qualification, Professional Qualification and Result. The instrument and variable selected for this work were based on pedagogical surveys, facts from literatures and experts in the domain. The reliability and validity of the instruments used construe with the theories posited by the experts on survey design and guidelines for survey design according to Bradburn *et al* [18].

**Table 2: Student's learning outcome**

| VARIABLE NAME | VARIABLE FORMAT | VARIABLE TYPE |
|---|---|---|
| Course ID | 1,2,3… | Numerical |
| Course Name | Name of the course | Categorical |
| Course Lecturer | Name of Lecturer that took the course | Categorical |
| Course Performance | Satisfactory, Average, Poor | Categorically |

### 3.3 System Design

The tasks involve machine learning and classification algorithms; hence in the research work a two-layered classifier system was designed to achieve the objective of the work as shown in figure 1. Layer 1 consists of an Artificial Neural Networks (ANN) and layer 2 is made up of Decision Trees classifiers. These classifiers have been selected because of their performances in various domains. They have both been successfully applied to a variety of real-world classification tasks in industry, business, science and education with good performances. The Neural Networks is known for its predictive accuracy, ability and aptitude to learn and remember [19]. Decision Tree classifiers are considered "white box" classification model as they can provide explanation for their models and can be used directly for decision making [20]. These abilities and aptitude are best suited and of good requirement for any effective and efficient intelligent system.

### 3.4 Analysis Proposed Model

The goal of the proposed system it to aid higher institution management in determining teachers' performance and recommend necessary actions to be taken on individual teacher based on the prediction from the intelligent evaluation system. The proposed system framework subsumes five components: The first and the second components take care of data acquisition and storage, responsible for storing

teachers' data, gathered from different data sources proposed in a data warehouse. The third component is model building, responsible for obtaining knowledge about the teachers, through appropriates classification models. Different classification algorithms are proposed in search for the best model with high predictive accuracy. The fourth component is for mapping pattern in the rules generated with the teacher data to predict performance and the fifth component is the recommendation, responsible for recommending necessary action to be carried out on individual teacher based on the prediction from the intelligent evaluation system as shown in figure 2.

### 3.5 Implementation

The data is analyzed and implemented in WEKA (Waikato Environment for Knowledge Analysis)Version 3.6.13.WEKA contains tools for data preprocessing, classification, regression, clustering, association rules, and visualization. The input data file is accepted in ARFF format. This file contains complete information regarding the set of all attributes and also the values for that attribute. There are 16 decision tree algorithms like ID3, J48, Simple CART etc. that are implemented in WEKA. An ARFF file consists of two distinct sections: the Header section defines attribute name, type and relations, start with a keyword @Relation <data-name> @attribute <attribute-name><type> or {range} and the Data section lists the data records, starts with @Data list of data instances. Any line start with % is the comments.

### 3.6 Dataset Training and Testing

The data set used for this study was stored in a Microsoft Excel spreadsheet named "teacherData.csv". For easy usage, the data was converted into ARFF format, that is, the file with (.arff extension) named as "teacherData.arff". The data was loaded into Weka and the attributes are recognized. The dataset includes 216 (61.89%) permanents, 72(20.34%) temporal and 61 (17.48%) contract staff ranging from professor to assistant lecturer. Out of the total 349 cases included in this study 200 (57.31%) were used as the training set while the remaining 149 (42.69%) were used as the test set.

## 4. RESULTS AND DISCUSSION

The proposed model was developed using WEKA. The model was built with three machine learning algorithms: C4.5 Decision Tree Classification Algorithm, ID3 Decision Tree Classification Algorithm and MLP Neural Network. A comparative analysis of the performance of the models was carried out.

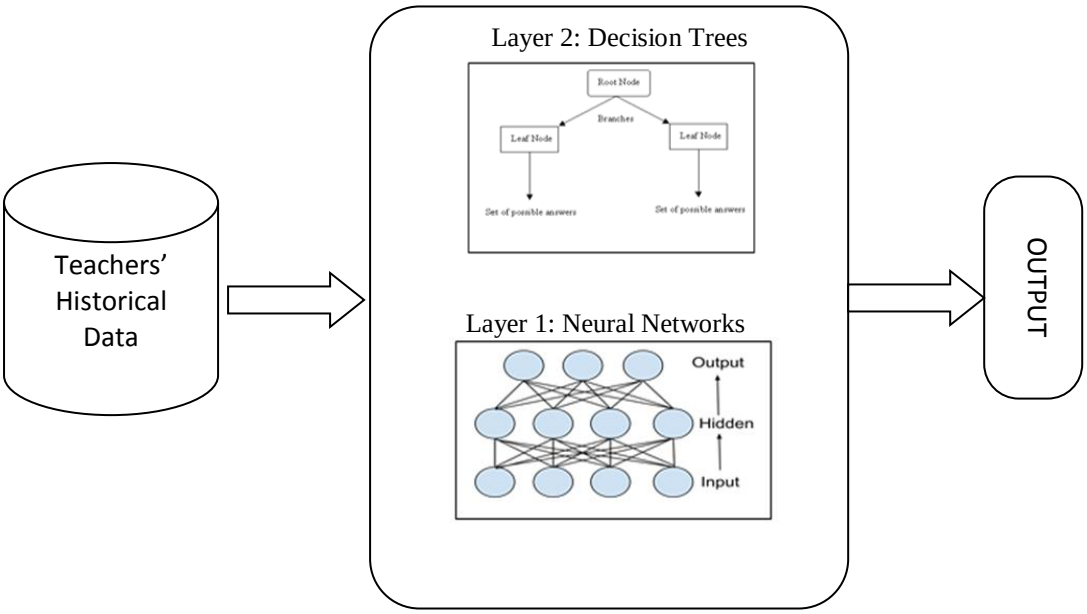


**Fig 1: Two-layered classifier system**

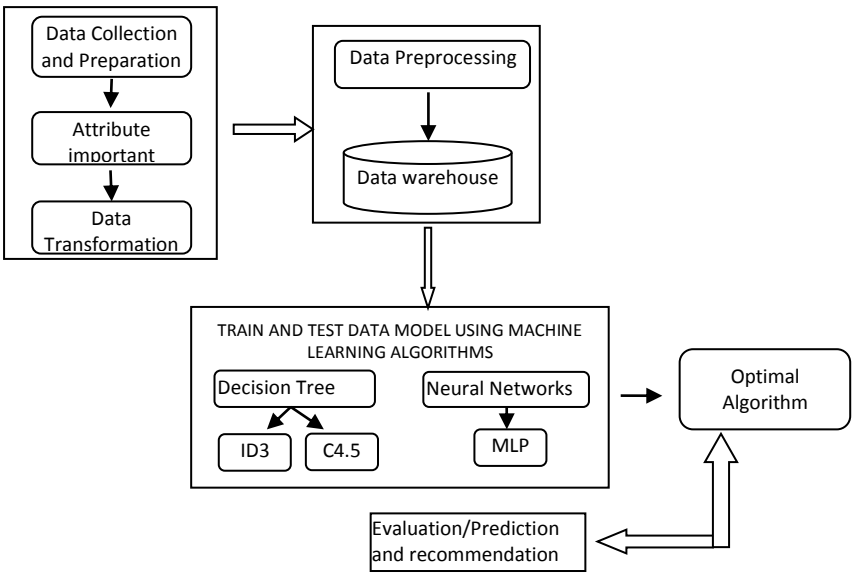


**Fig 2: Architecture of the proposed model**

Attribute importance analysis was first carried out to rank the attributes used in this work by significance using wrapper method and filter method. The results of the two methods construe with each other are shown in table 3 and figure 3.

**Table 3: Attributes Ranking using Information Gain Ratio**

| RANK ATTRIBUTES | VALUES | RANKS |
|---|---|---|
| WORKING_EXPERIENCE | 0.298 | 1 |
| RANK | 0.2605 | 2 |
| YEAR_LAST_QUALIFICATION | 0.2435 | 3 |
| HIGHEST_QUALIFICATION | 0.2349 | 4 |
| APPOINTMENT_STATUS | 0.1483 | 5 |
| PRO_QUALIFICATION | 0.0763 | 6 |

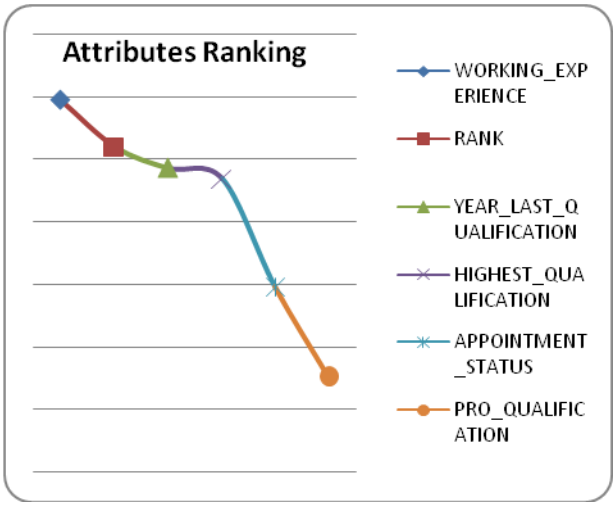


**Figure 3: Information gain ratio of the attributes**

### 4.1 Model Comparison

The Weighted averages of the models were compared using different performance measures like:

- accuracy
- True Negative Rate
- True Positive Rate
- F-Measure and

- ROC.

The best model was then selected using Tables 4, Table 5 and Figure 4. The performances of these models were evaluated based on these criteria:

- Prediction accuracy
- Time taken to build the model and
- Error rate.

These are illustrated in table 5. C4.5 algorithm predicts better than the ID3 and MLP algorithms since its accuracy is the highest compared to others.

The results obtained from the analysis demonstrated a slight higher performance of model built with decision tree (C4.5 algorithm) over neural network (MLP algorithm). Both C4.5 and MLP algorithms results show great superiority over ID3 algorithm in terms of performance. C4.5 algorithm performed better than other algorithms not only in terms of the number of correctly classified instances also in terms of RMSE, MAE, RAE. Neural Network performed well in classification as well as in prediction but suffered from lack of speed. The ID3 Decision Tree was the fastest, but did not perform well at the classification. Also the rules generated makes C4.5 decision tree algorithm clearer and understandable.

**Table 4: Performance Summary of the models.**

| Algorithms | TP Rate | FP Rate | Precision | Recall | F-Measure | ROC Area |
|---|---|---|---|---|---|---|
| ID3 | 0.71 | 0.171 | 0.711 | 0.71 | 0.708 | 0.87 |
| C4.5 | 0.835 | 0.098 | 0.098 | 0.835 | 0.835 | 0.936 |
| MLP | 0.825 | 0.093 | 0.828 | 0.825 | 0.824 | 0.927 |

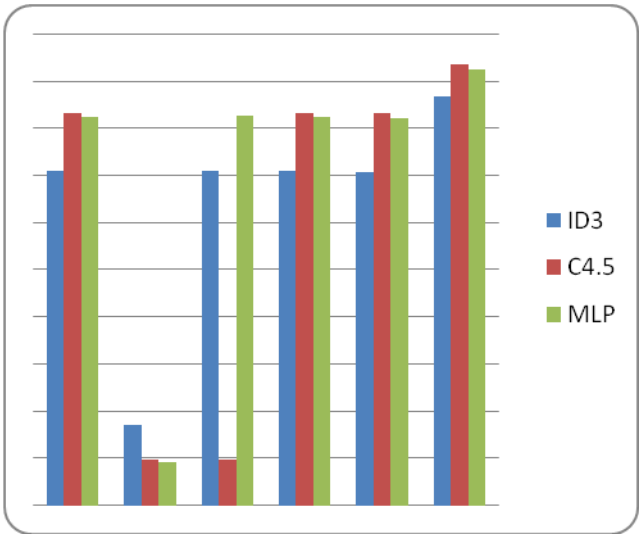

**Figure 4: Comparison between performance measure parameters**

**Table 5: Comparative analysis on the models**

| METRIC | ID3 | C4.5 | MLP |
|---|---|---|---|
| Time take to build the model | 0.02 sec | 0.09 sec | 6.24 sec |
| Correctly classified instances | 71% | 83.5% | 82.5% |
| Incorrectly classified instances | 29% | 16.5% | 17.5% |
| Kappa statistics | 0.5461 | 0.743 | 0.7295 |
| Mean Absolute Error | 0.2513 | 0.167 | 0.1876 |
| Root Mean Squared Error | 0.3545 | 0.289 | 0.3075 |
| Relative Absolute Error | 58.8598% | 39.1273% | 43.9501% |
| Root Relative Squared Error | 76.7465% | 62.5708% | 66.5732% |

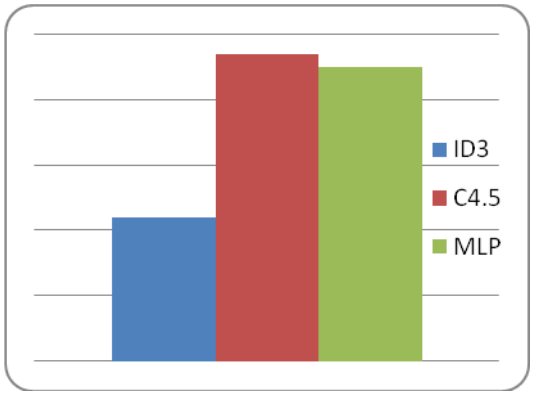


**Figure 6: Prediction Accuracy**

## 5. CONCLUSION

This study confirms that data mining techniques can be applied in the prediction of teachers' performance and the resulting models of this study are worthy of educational testing. To improve upon the classification accuracy of the models further researches should be conducted using different classification algorithms and other data mining techniques such as, Naïve Bayes classifier, genetic algorithm as well as data from other universities. Also, expanded data set with more distinctive attributes (such as subject mastery) to get more accurate results can also be used to carry out predictions to improve the classification accuracy.

## ENDNOTES

[1] Ogunde A.O and Ajibade D.A (2014): A Data Mining System for Predicting University Students' Graduation Grades Using ID3 Decision Tree Algorithm. Journal of Computer Science and Information Technology. March 2014, Vol. 2, No 1, pp 21 – 46.

[2] Albashiri K. A. (2013). Data Partitioning and Association Rule Mining Using a Multi-Agent System. International Journal of Engineering Science and Innovative Technology (IJESIT), Volume 2, Issue 5, pp 161-169.

[3] Xingquan Zhu, Ian Davidson, "Knowledge Discovery and Data Mining: Challenges and Realities", ISBN 9781-59904-252, Hershey, New York, 2007.

[4] Romero C., Ventura S., Garcia E. (2008) Data mining in course management systems: Moodle case study and tutorial, Computers & Education, Vol. 51, No. 1, pp. 368-384, 2008

[5] Abu-Doleh J, Weir D. Dimensions of Performance Appraisal Systems in Jordanian Private and Public Organizations. International Journal of Human Resource *Management*, 2007; 18(1): 75-84.

[6] C. Romero, S. Ventura (2007): "Educational data mining: A Survey from 1995 to 2005", Expert Systems with Applications (33), pp. 135-146,

[7] Baker, R. S. J. D., and K. Yacef. (2009): The State of Educational Data Mining in 2009: AReview and Future Visions.*Journal of Educational Data Mining* 1 (1): 3–17.

[8] Rajni J. and Malaya D.B (2013): A Survey on Educational Data Mining and Research Trends. International Journal of Database Management Systems (IJDMS) Vol.5, No.3

[9] Varun Kumar and AnupamaChadha, "An Empirical Study of the Applications of Data Mining Techniques in Higher Education", International Journal of Advanced Computer Science and Applications, Vol. 2, No.3, March 2011

[10] Chin Chia Hsu and Tao Huang (2006): The use of Data Mining Technology to Evaluate Student's Academic Achievement via multiple Channels of Enrolment. An empirical analysis of St. John's University of Technology.

[11] Osofisan A.O. and Olamiti A.O. (2009): Academic Background of Students and Performance in Computer Science Programme in a Nigerian University. *European Journal of Social Science. Vol. 33 Issues 4. 2009.*

[12] MardikyanS., and Badur B. (2011). Analyzing teaching Performance of Instructors Using Data Mining techniques. Informatics in Education, 2011, Vol. 10, No. 2, pp 245 – 257.

[13] Hemaid and El-Halees (2015): Improving Teacher Performance using DataMiningInternational Journal of Advanced Research in Computer and Communication EngineeringVol. 4, Issue 2, February 2015.

[14] Surjeet K.Y and Saurabh P (2012): Data Mining: A Prediction for Performance Improvement of Engineering Students using Classification World of Computer Science and Information Technology Journal (WCSIT) ISSN: 2221-0741 Vol. 2, No. 2, 51-56, 2012

[15] Pal K. and Pal S. (2013): Evaluation of Teacher's Performance: A Data Mining Approach. International Journal of Computer Science and Mobile Computing. IJCSMC, Vol 2, Issue. 12, Dec., 2013, pg. 359 – 369.

[16] Surjeet K.Y et al, (2012): Mining Educational Data to Predict Student's Retention: A comparative study, volume 10, No 2.

*[17]* Aranuwa F.O., and Sellapan P.,(2013): A data mining model for evaluation ofinstructors'performance in higher institutions of learning usingmachine learning algorithms, *International Journal of Conceptions on Computing and Information Technology Vol. 1, sue 2, Dec' 2013; ISSN: 2345 – 9808*

[18] Bradburn N, Sudman S, WansinkB.Asking Questions: The Definitive Guide to Questionnaire Design. Jossey-Bass, 2004

[19] Zurada JM. (2006): "Introduction to Artificial Neural System", *Jaico Publishing House*,.

[20] Romero C, Olmo JL, Ventura S. (2013): A meta-learning approach for recommending a subset of white-box classification algorithms for Moodle datasets. *Department of Computer Science, University of Cordoba, Spain*,

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# AN ANALYSIS OF CURRENT AWARENESS SERVICES AND SELECTIVE DISSEMINATION OF INFORMATION IN UNIVERSITY OF JOS LIBRARY

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## ABSTRACT
*This study critically examined the Current Awareness Services (CAS) and Selective Dissemination of Information (SDI) in University of Jos Library (UJL). Adopting the survey research design, the study was set to describe CAS and SDI as factors to improving library usage. The types and limitations of CAS and SDI rendered in University of Jos Library were also given major attention in the study. A population of 100 users and 12 staff constituted the sample for the study. Two sets of questionnaires, made up of 29 items each, were used in collecting data. With the aid of proportional statistics, the received data were presented and analysed. The findings therefore revealed the major CAS and SDI services in the UJL in the following proportion; Pasting of list of new arrivals: 20.62%, library display of books: 23.71%, library display of journals and pictures: 22.68%, sensitization or library orientation: 19.59% and General Studies (GST): 25.77%. Based on the above findings, the researcher recommended that there should be improved funding, provision of adequate listing infrastructure, application of modern ICT facilities/solutions to CAS and SDI services, optimal training of subject librarians and users, employment of qualified subject librarians, improved user-staff relationship and an introduction of compulsory user education.*

**Keywords:** Library Services, Subject Librarian, current awareness services, selective dissemination of information, Academic Library

## 1. INTRODUCTION
The major function of any academic library is to support their parent organisational objective which is to provide information resources and services to library users. These services include acquisition, registering, cataloguing, and

dissemination of information resources. Information in a library cannot be effectively disseminated unless library users are aware of its availability. The view of the library as a store house of outdated resources by users who now depend on the internet and its search engines, is a perspective that should be abolished, as current libraries have gone beyond the physical walls of a building which is the visual library. Both the current and future needs of library users should always be kept in mind in order to assist them achieve excellence in their academic pursuits. In this light, academic library play a pivotal role as gateways to information resources, center for creation/recreation of academic activities, the fulcrum of academic life, and the engine of learning that fuels the academic institution. There is not only the need to gear up the old ones but also to initiate the new services with the assistance of the latest information technology so that the total library operations and services can be enhanced. (Tanveer, 2013).

According to Oluremi (1998), CAS is a type of service so designed to keep the readers abreast of latest developments in the library. Selective Dissemination of Information (SDI) on the extensive hand, is a concept that is popular among academic libraries which entails creating a database of users' profiles including their teaching and research interest and making available to them unsolicited but relevant library resources geared towards facilitating swift accomplishment of designated goals (Christopher, 2015). In North America, community needs for informal information are often met by the public library's community awareness service (or information and referral service), though practice is far from standardised. This community outreach program is an important feature in many mostly rural societies, which is also a form of creating awareness to library users. (Encyclopaedia Britannica, 2017).

Today, CAS alerts scholars, researchers, and health care practitioners to recently published literature in their fields of specialisation (Johnson, Osmond, &Holz, 2009). Librarians who provide these services use various methods to keep current with academic and professional literature. It can be provided in many ways such as: text messages, display, routing of periodicals, list of latest additions, list of latest periodical received, topical bibliographical on demand, contents page service, news clipping service, electronic mail and Bulletin Board Services (BBS) (Tanveer, 2013). Federal University of Technology Owerri (FUTO) in Nigeria, provides its CAS and SDI services through the use of social network by reading blogs, group postings and message boards, also by using tools like "Ask a Librarian", "meebo" and "twitter" to ask questions in real time. (Emezie & Nwaohiri, 2016).

The University of Jos Library is an academic library which has users ranging from undergraduates of varying academic areas/degrees, postgraduates, staff, and researchers. UJL provides the following CAS and SDI services: publication of list of new arrivals, sensitisation, library display on journals and pictures. These services are of course, not as effective or wide as those of other libraries such as the Harvard Law Library, InstitutoExpresa (IE) Library, Fiji National University Library and Federal University of Technology Owerri (FUTO).

The researcher at this point deemed it necessary to critically examine CAS and SDI in the University of Jos Library, so as to clarify the concepts, measure how effectively these services are rendered and make significant/attainable recommendations based on outcome of analysis.

The core objectives of the study was therefore targeted at answering the following questions;

1. What is the importance of Current Awareness Services and Selective Dissemination of Information services as a factor in improving Library use?
2. What are the types of Current Awareness Services and Selective Dissemination of Information services rendered in University of Jos Library?
3. What are the challenges experienced in the delivery of Current Awareness Services and Selective Dissemination of Information at the University of Jos Library and suggest needed strategies?

## 2. REVIEW OF RELATED LITERATURE

This section dealt with the review of empirical works related to the research objectives. Although there was no current/in-depth study or research on an analysis of CAS and SDI services in University of Jos Library before this study was initiated, the researcher however, reviewed external but highly relevant literature in this phase of the research.

### 2.1 Importance of CAS and SDI as a factor in improving library use

Librarianship have adopted the concepts of CAS and SDI in other to bring to effectiveness the latest resources available in a library, which ordinarily cannot be known by library users because of the present growing rate of information in the society. Yaya and Uzohue (2015) presented the following as benefits of CAS and SDI;

**Table 1: Benefits of CAS and SDI services**

| Benefits of CAS | Benefits of SDI |
|---|---|
| i. It helps to keep users better informed.<br>ii. It provides access to needed documents.<br>iii. It supports Academic, Professionals and Management skills.<br>iv. It provides information in a preferred format. | i. It brings the right information closer to the user.<br>ii. The information user will have time to concentrate on other matters instead of searching and sourcing for information resources by him.<br>iii. The librarian provides information to the users at their convenient time.<br>iv. It creates a good relationship between the librarian and information users.<br>v. The users will have access to the right information at the right time and place. |

## 2.2 Types of Current Awareness Services and Selective Dissemination of Information Services Rendered in Academic Libraries

According to Childer (1997), "The provision of information and reference services which includes CAS and SDI represents an important part of academic libraries service and may be supplied in a variety of ways within the library system." To this end, the researcher considered the list of CAS types as presented by Tanveer, (2013) which include Display, Routing of periodicals, List of latest additions, List of latest periodical received, Topical bibliographical on demand, Contents page service, News clipping service, Electronic mail and bulletin board services (BBS), Library bulletins and newsletters, Abstract bulletin, and Commercial current content service.

Due to information overload and the cumbersome variety of users in a library, academic libraries have adopted the use of information technology to ease the provision of CAS and SDI thereby using media such as Internet/Web

Technologies, Social Networking, Email Alerts, Relational Databases, Smart phones applications/ SMS services, RSS feeds, etc. (Uzohue & Yaya, 2016).

### 2.3 Challenges experienced in the delivery of Current Awareness Services and Selective Dissemination of Information in Academic Libraries

According to Emezie and Nwaohiri (2016), CAS and SDI services provided using social networks experience challenges such as, majority of users do not visit social networking sites for academic purposes rather they perceive that such sites are mainly for fun and entertainment.

According to Johnson, Osmond & Holz (2009), each method of rendering CAS and SDI services has its challenges which includes: routed print material moves slowly, distributing photocopies is labour intensive, and browsing material requires extra time and active participation. Saved searches involve expert users and continual search amendments. Email alerts flood in-boxes already brimming with unread items.

Dauda (1995) states that, "finance is an indispensable tool for the achievement of the objective of any organization". Without adequate financial support the library cannot effectively play the role of organization and administration of collection, staff maintenance, and procurement of equipment, reference tools, provision of CAS and SDI services, satisfaction of user expectation, and evaluation of services. Every library stands on three legs: its building, collections and staff. However, the tendon that holds each of those legs and ultimately binds together into a whole is money. (Cited in Dogara, 2011).

## 3. METHODOLOGY

The descriptive survey design was adopted for this study. The survey research is used for collection of standardized information from a sample that is considered as representative of a particular group or population. (Akuezuilo & Agu, 2003). The study was conducted in Plateau State which is in the North central geopolitical zone of Nigeria as the University of Jos has a wide range of academic programmes in this region. The population of the study consists of the 12 subject librarians and library users of the University of Jos libraries. The Main library has 44,373 registered users, medical library has 1,756 and the law library has 1,989 according to October 2017 statistics of library users as obtained from the library. Simple random sampling method was used in selecting the needed sample frame as the sampling technique gives equal chance of people to be selected for data collection.

The instrument for data collection was the questionnaire as proven relevant in Popoola (2008) and Dogara's (2011) research works amongst others. The questionnaires were designed by the researcher based on the research questions that were earlier formulated to guide the study. Two sets of questionnaire were used; one for the subject librarians and the other for the registered users of the University of Jos Library.

## 4. RESULT AND DISCUSSION

A total of 114 questionnaires were distributed to University of Jos Library users (all students) and Subject Librarians (staff). 75.26% of the questionnaires were collected from the Main Library, 5.15% from Naraguta campus library, 10.31% from the law library and 9.27% were from the Medical Library.

### 4.1 Student-Users' Result

102 questionnaires were distributed to student library users only and 100 were returned of which 97 were valid.

#### 4.1.1 Demography

Participants in terms of age, ranged from 16-50 years old with the following intervals 16-20, 21-24, 25-30, 31-40, 41-50 at a frequency of 17, 27, 34, 9 and 10 students respectively. 25-30 years made the highest age-class of participants with a percentage of 35.05%. In terms of gender, 62 are male and 35 female while 68 were undergraduates and 29 postgraduates.

#### 4.1.2 Importance of Current Awareness Services and Selective Dissemination of Information services in Library Use

Results showed that 55.67% of participants have received one or more form of CAS and SDI services from University of Jos Library while below average: 43.33% have not received any of CAS and SDI services in the library. However 47.42% of participants acknowledge that forms of CAS and SDI services are averagely rendered, 41.24% assessed that the services are poorly rendered while only 11.34% rated the CAS and SDI services of the University of Jos Library as Good.

The result also showed that UJL users that are aware of CAS and SDI services have not fully received available services in the library. Text messages, routing of periodicals, list of latest periodical received, social network, contents page

service, news clipping service, Electronic mail (email) and Bulletin Board Services scored below the average range of users that have experienced any of these CAS and SDI services in the University of Jos Library. Painfully, 45.36% of the respondents have not patronized any of the received Current Awareness Services and Selective Dissemination of Information services from University of Jos Library while only 2.06% patronized all.

**Table 2: Challenges experience by the University of Jos Library in the dissemination of CAS and SDI Services**

| S/N | CHALLENGES OF CAS AND SDI SERVICES | SA | A | D | SD | TOTAL |
|---|---|---|---|---|---|---|
| **A** | Inadequate GST lecture time | 26 | 44 | 22 | 5 | 97 |
| | | 26.80% | 45.36% | 22.68% | 5.15% | 100% |
| **B** | Lack of adequate user education | 32 | 49 | 15 | 1 | 97 |
| | | 32.99% | 50.52% | 15.46% | 1.03% | 100% |
| **C** | Inadequate GST lecture hall | 45 | 36 | 13 | 3 | 97 |
| | | 46.39% | 37.11% | 13.40% | 3.09% | 100% |
| **D** | Poor library orientation | 35 | 44 | 16 | 2 | 97 |
| | | 36.08% | 45.36% | 16.49% | 2.06% | 100% |
| **E** | Lack of interest by users in the services | 20 | 34 | 34 | 9 | 97 |
| | | 20.62% | 35.05% | 35.05% | 9.27% | 100% |
| **F** | Hostility of library staffs | 22 | 20 | 43 | 12 | 97 |
| | | 22.68% | 20.62% | 44.33% | 12.37% | 100% |

SA (strongly agree), A (agree), D (disagree), SD (strongly disagree).

The above result confirms several challenges experienced in the University of Jos Library in terms of Current Awareness Services and Selective Dissemination of Information services**.** The participants' scores are all above average except for the hostility of staff for which 44% of the respondents disagreed.

### 4.2 Library Staff Result

10 questionnaires were returned from the 12, distributed to subject Librarians**.** 8 were from the Main Library, 1 from the Law Library, 1 from the Medical Library and none from Naraguta Campus.

### 4.2.1 Demography

Three (3) respondents were in the age class of 31-40 years, 4 in the class of 41-50 years and 3 in the class of 51 and above. However, Gender participation was equal, having 5 males and 5 female staff as respondents. Educationally, 5 (or 50%) of the respondents possessed Diploma Certification, 30% with Masters in Library Science (MLS), 1 (or 10%) with Bachelor in Library and Information Science, and 1 (or 10%) with a Doctorate Degree (PHD). All respondents are aware of at least a Current Awareness Services and Selective Dissemination of Information services rendered in University of Jos library.

The respondents confirmed that Pasting of list of new arrivals, library display of books, library display of journals and pictures, sensitization or library orientation and list of latest periodicals received, constitutes the SDI and CAS often rendered in the University of Jos Library. However, 30% of the respondents rated SDI and CAS of the University of Jos Library at average, 70% rated the internet service as good, while No respondent rated the services as excellent or poor.

**Table 3: Challenges experience by the University of Jos Library in the dissemination of CAS and SDI Services**

| S/N | CHALLENGES OF CAS AND SDI SERVICES | SA | A | D | SD | TOTAL |
|---|---|---|---|---|---|---|
| **A** | Inadequate ICT facilities | 6 | 3 | 1 | 0 | 10 |
| | | 60.00% | 30.00% | 10.00% | 0.00% | 100% |
| **B** | Lack of adequate training to subject librarians | 1 | 6 | 2 | 1 | 10 |
| | | 10.0% | 60.00% | 20.00% | 1.00% | 100% |
| **C** | Lack of adequate infrastructure | 3 | 5 | 1 | 1 | 10 |
| | | 30.00% | 50.00% | 10.00% | 10.00% | 100% |
| **D** | Poor library orientation | 2 | 6 | 2 | 0 | 10 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 20.00% | 60.00% | 20.00% | 0.00% | 100% |
| **E** | Insufficient funding | 5 | 4 | 1 | 0 | 10 |
| | | 50.00% | 40.00% | 10.00% | 0.00% | 100% |
| **F** | Lack of interest by users in the services | 2 | 4 | 3 | 1 | 10 |
| | | 20.00% | 40.00% | 30.00% | 10.00% | 100% |

SA (strongly agree), A (agree), D (disagree), SD (strongly disagree).

Table 2 shows that all staff response agreed on the items listed as challenges to rendering CAS and SDI services UJL.

### 4.3 Summary of Findings

The major findings as supported by the results of the survey can be summarized as follows;

1. CAS and SDI bring to effectiveness the latest resources available in a library.
2. A CAS and SDI service enables library users to have prompt access to the right information.
3. CAS and SDI services create a good relationship between the librarian and information users.
4. Pasting of list of new arrivals, library display of books, library display of journals and pictures, sensitization or library orientation, latest pasting received and General Studies (GST) are the major CAS and SDI in the University of Jos Library.
5. Major challenges to CAS and SDI services in University of Jos Library are inadequate GST lecture time and hall, lack of adequate user education, inadequate ICT facilities, inadequate funding, poor infrastructures, and lack of interest by library users.
6. Distributing library resources to interested information users is labour intensive.

## 5. CONCLUSION

This study considered the Analysis of Current Awareness Services and Selective Dissemination of Information Services in the University of Jos Library. The result of the study shows that pasting of list of new arrivals, library display of books, library display of journals and pictures, sensitization or library orientation, latest pasting received and General Studies (GST) are the major Current Awareness Services and Selective Dissemination of Information services rendered in the

University of Jos Library. Text messages, routing of periodicals, list of latest periodical received, social network, contents page service, news clipping service, Electronic mail (email) and Bulletin Board Services are barely rendered.
Current Awareness Services and Selective Dissemination of Information brings about the effectiveness the latest resources available in a library, library users to have access to the right information at the right time and place, create a good relationship between the librarian and information users, supports academic, professional and management skills and keeps users informed. Inadequate GST lecture time and hall, lack of adequate user education, inadequate ICT facilities, inadequate funding, poor infrastructures, and lack of interest by library users are the challenges face by the University of Jos library. It also discovered that provision of adequate GST lecture time, provision of adequate GST lecture hall, provision of effective library orientation to library users and staff, motivation to library users, application of ICT, funding, adequate infrastructure and employment of trained staff are strategies for improved services.

From the foregoing, nine (9) recommendations were made to effectively redress the trend some of these were that Subject librarians/staff should be encouraged to pursue higher levels of education and attain higher professional skills, Library management should have improved funding of the library with the school management as well as explore other avenues for the generation of funds, effort should be made by library management toward the application of ICT in Current Awareness Services and Selective Dissemination of Information Services. Finally, the work has Analise the Current Awareness Services and the Selective Dissemination of Information Services in the University of Jos Library and spells out limitations for the study and how they were overcome, and then draw suggestion for future research.

### 5.2 Suggestion for Further Research

This research work is not conclusive in itself as far as Current Awareness Services and Selective Dissemination of Information in academic libraries is concerned. The following suggestions are made for further research:

1. The influence of Current Awareness Services and Selective Dissemination of Information services in academic libraries on academic performances of users.
2. The study of Current Awareness Services and Selective Dissemination of Information services use by the visually impaired.

**REFERENCES**

Afolabi, M. (1993). Factors Influencing book Theft and Mutilation among Users and Staff in Nigeria Libraries. *Leading Libraries and Information Centers* 1 (3 and 4) 2-8.

Akuezuilo, E.O. &Agu, N. (2003). *Research and statistics in education and social sciences: methods and applications.* Awka: NuelCenti Publishers and Academic Press Ltd.

Childers, T. A. (1997). Using Public Reference collections and Staff. *Library Quarterly,* 6 (2), 159-170.

Christopher, N. (2015). Community-focused selective dissemination of information services for empowering women through information provision and utilization. *Center for learning resources as a catalyst for social change.* Conference proceedings of the Covenant University km10 Idiroko road Canaan land, Ota, Ogun state, Nigeria. Retrieved from: www.ifla.org.00_iroaganachi

Coyle, C., & Vaughn, H. (2008). Social networking: Communication revolution or evolution? *Bell Labs Technical Journal, 13(2)*, 13-18.

Dogara, K.(2011).*Reference and information services delivery in academic libraries in Nasarawa state of Nigeria* (Thesis, The University of Nigeria Nsuka).

Emezie, N. & Nwaohiri, N. (2016). Social network as the enabler for library services: challenges of Nigerian academic libraries. *Journal of Qualitative and Quantitative Methods in Libraries*, 5,107-115.

Encyclopaedia Britannica, (2017). *Current-awareness service*. Retrieved from https://www.britannica.com/topic/current-awareness

Harvard Law School.(2017). *Current awareness services.* Retrieved from http://hls.harvard.edu/library/for-faculty/current-awareness-services/

Instituto deExpresaLibrary.(n.d).*Selective dissemination of information*. Retrieved from http://library.ie.edu/en/services/sdi

Johnson, S.; Osmond, A; & Holz, R(2009). Developing a current awareness service using really simple syndication (RSS). *Journal of Medical Library Association,* 97(1), 52-54.

Johnson, S. M, Osmond, A. & Holz, R. J. (2009). Developing a current awareness service using really simple syndication (RSS). *Journal of the Medical Library Association*. 5, 1-89

Oluremi, J. (1998). *Law libraries in Nigeria: Current awareness service (pp. 138-139).*Nigeria: Nigerian Association of Law libraries.

Popoola, S. O. (2008). Faculty awareness and use of library information and services in Nigerian Universities. *Malaysian Journal of Library & Information Science*. 13(1), 91- 102.

Tanveer, H. (2013). Current awareness services: A case study of the CBHTS Nasinu library at Fiji National University *Chinese Librarianship: an International Electronic Journal, 35*,99-102.

Uzohue, E. C., Yaya, A. J. (2016). Provision of Current Awareness Services and Selective Dissemination of Information by Medical Librarians in Technological Era. *American Journal of Information Science and Computer Engineering*, 2(2), 8-14.

Zebardast, M. & Sharif, H. M. (2016).Providing a suitable model for Selective dissemination of information services (SDI) Case study: libraries and information centers in Iran. *Academic research journals*. 4(2), 71-81.

## POST ANALYSIS OF SNORT INTRUSION FILES USING DATA MINING TECHNIQUES: DECISION TREE AND BAYESIAN NETWORK

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**ABSTRACT**

*Network security is a crucial information technology activity today. Intrusion Detection Systems (IDS) are among the fastest growing technologies in computer security domain. These systems are designed to identify/ prevent any hostile intrusion into a network. Most conventional intrusion detection systems have limitations in the way they log their alerts which snort exhibit is known as the infidelity issue, that is to say snort IDS does not infer the behavior of the network traffic generated, which can result in misinterpretations. Therefore in this project data mining techniques was applied to the logged alert in order to extract hidden knowledge of the traffic pattern. This research investigates the network domain of data mining using the network alerts generated from snort intrusion detection system in order to mine the alerts for re-classification. The data comprised of nine sixty (960) records of alerts. Classification task is used to evaluate the alerts making use of Bayesian Network and Decision Tree methods. The output of the two classification methods – Bayesian Network and Decision Tree are compared to determine the one that gives the best classification results. At the modeling stage, open source software called WEKA 3.6.13 was used. The data set was divided into two sets – - Training and Testing. Sixty eight percent (68%) was used for training while thirty two percent (32%) was used for testing. From the output generated from the experiment, Decision tree outperformed Bayesian network in most aspects and the existing snort with data mining is more reliable and efficient over snort alone. The results obtained from the analysis clearly demonstrated that Decision tree outperformed Bayesian network. Decision tree demonstrated a superior performance than Bayesian network in term of the number of correctly classified instances and also in terms of Root Mean Squared Error, Root Relative Squared Error, Mean Absolute Error, Relative Absolute Error. Bayesian Network outfitted Decision Tree in time taken to build the model but performed poorly at the classification. The time taken for naïve bayes and decision tree classifiers are 0.12 and 0.32 seconds respectively.*

**Keywords:** Intrusion detection, Network, Network threats, Protocols, Data mining, Classification

## 1. INTRODUCTION

Over the past ten years, the number of threats on information systems has significantly increased. Consequently, classical information security technologies such as authentication and cryptography have gained more and more attention.

Meanwhile, intrusion detection systems (IDSs) have emerged as a new approach to detect and protect information systems [1]. An IDS monitors an information system for evidence of attacks. Once attacks have been detected, the IDS raises alerts to report them. The alerts are presented to experts or a knowledge system that evaluates them and initiates an adequate response. It is a challenging task to evaluate intrusion detection alerts and generate an appropriate response [2].

IDSs provide an extra layer of defense to computer networks by gathering and analyzing information in a network in order to identify possible security breaches. If an intrusion is detected, IDS generates a warning called an alert or alarm. Generally, there are two broad of classes of IDSs: signature based and anomaly based. The signature based IDSs generally recognize patterns of attack. This IDS essentially contains attack descriptions or signatures and match them against the audit data stream, looking for evidence of known attacks. A signature -based IDS works similar to anti-virus software. It employs a signature database of well-known attacks, and a successful match with current input raises an alert. Signatures generally target widely used applications or systems for which security vulnerabilities are widely advertised. Anomaly based IDS usually look for deviations from normal usage behavior in order to identify abnormal behavior. Generally, the anomaly detection techniques rely on models of the normal behavior of a computer system. The anomaly based IDSs may focus on the users, the applications, or the network.

Despite several successes linked to IDSs, they are plagued by several issues making the art of accurately detecting intrusions far from perfect [3]. Among the issues that contribute to poor performance of IDSs are: production of overwhelming number of alerts and high number of false positive alerts. It is estimated that an IDS may generate tens of thousands alerts per day. The vast imbalance between interesting alerts and non-interesting alerts has undoubtedly undermined the performance of IDSs [4]. As a result, the important alerts might be misclassified, misinterpreted, delayed or ignored [5].

According to Georgios et al. [6], over the last few years, the research in intrusion detection has focused on the post processing of alerts in order to identify and separate interesting alerts. Identifying and separating interesting alerts has always been challenged by several issues such as IDSs use general signatures that hardly capture all variations of known attacks hence difficult to differentiate legitimate activities from the illegitimates ones. The amount and types of data in corporate are more, so that the vulnerability is increases on data. To manage, analyze and identify the problems on data we need data mining techniques. Data mining technique plays a vital role in intrusion detection. Some

of the application of data mining in intrusion detection are classification, clustering and frequent pattern matching. Intrusion means the vulnerability of the network such as denial of services (DOS), spoofing, spamming, etc. The process of intrusion detection is finding the malicious activities which are in the network to prevent the data integrity, security, confidentiality, worms, viruses and availability. [7].

Snort intrusion detection system alerts will be re-categorized using data mining approach in order to process the network log to help detect network traffic pattern on the campus network. Snort is a fast, signature-based and open-source intrusion detection system. Snort has received great tolerance in the Intrusion Detection System (IDS) market and has been widely recognized as the reliable open source tool [8]. Snort is capable of performing real-time traffic analysis and packet logging on the network. It performs protocol analysis and can detect variety of network attacks by using signature matching algorithms. Snort can be configured as a packet sniffer, packet logger and Network Intrusion Detection System (NIDS). As packet sniffer, it reads the packets off the network. In a packet logger mode, it logs packets to the storage device. NIDS mode enables the Snort to analyze the network traffic against set of defined rules in order to detect intrusion threats.

The current snort intrusion detection detects and profiles malware based on signature profile of the threats which are predetermined. However, malware exhibits different behaviors which snort cannot show. This has caused a major performance bottleneck in the detection system. Therefore, this study proposes to use data mining techniques to process the network input data to help expose malware and non-malware traffic on the network based on alerts generated by snort intrusion detection system.

This study proposed is to re-categorize alerts from snort intrusion detection system using two data mining approaches: Decision Tree and Bayesian Network. Efforts will be directed as developing a database of malware behavior profiles based on snort intrusion detection system alerts and analyzing the alerts so as to re-classify traffic pattern.

## 2. REVIEW OF RELATED WORKS

Recently, researchers have being exploring the field of network security as there are ample number of research papers discussing various problems within the network and providing examples for successful solutions reached by using

data mining. Various machine learning approaches like Association Rule, Support Vector Machine, Decision Tree, Random Forest, Naive Bayes and Clustering have been proposed for detecting and classifying unknown samples into either known malware families or underline those samples that exhibit unseen behavior.

Schultz *et al*, [9] (2001) were the first researchers to introduce the concept of data mining for detecting malwares. They applied three different static features for malware classification: Portable Executable (PE), strings and byte sequences. In the PE approach, the features (like list of DLLs used by the binary, the list of DLL function calls, and number of different system calls used within each DLL) are extracted from DLL information inside PE files. Strings are extracted from the executables based on the text strings that are encoded in program files. The byte sequence approach uses sequences of n bytes extracted from an executable file. They applied a dataset consisted of 4266 files including 3265 malicious and 1001 benign programs. A rule induction algorithm called Ripper was utilized to find patterns in the DLL data. A learning algorithm Naive Bayes was used to find patterns in the string data and n-grams of byte sequences were used as input data for the Multinomial Naive Bayes algorithm. The Naive Bayes algorithm, taking strings as input data, gives the highest classification accuracy of 97.11%. The authors exacted that the rate of detection of malwares using data mining method is twice as compared to signature based method. Later on their results were amended by Kolter, et al. [10] (2004). They used n-gram (instead of non-overlapping byte sequence) and data mining method to detect malicious executables. They used different classifiers including Naive-Bayes, Support Vector Machine, Decision Tree and their boosted versions. They concluded that boosted decision tree generates the best classification results.

Kong *et al*, [11] presented a model for automated malware classification based on structural information (function call graph) of malwares. After extracting the fine grained attributes based on function call graph for each malware sample, the similarity is evaluated for two malware programs by applying discriminate distance metric learning which clusters the malware samples belonging to same family while keeping the different clusters separate by a marginal distance. The authors then applied an ensemble of classifiers that learn from pair wise malware distances to classify malwares into their respective families.

Osunade *et al*, [12] presented a threat characterization framework for attacks from the victim and the aggressor perspective of intrusion using data mining technique. The data mining technique integrates both Frequent Temporal Sequence Association Mining and Fuzzy Logic. Apriori Association Mining

algorithm was used to mine temporal rule patterns from alert sequences while Fuzzy Control System was used to rate exploits. The experiment shows that accurate threat characterization in multiple intrusion perspectives could be actualized using Fuzzy Association Mining. Also, the results proved that sequence of exploits could be used to rate threat and are motivated by victim properties and attacker objectives.

Siddiqui *et al*, [13] applied variable length instruction sequence along with machine learning for detecting worms in the wild. Before disassembling the files, they detect compilers, packers. Sequence reduction was carried out and decision tree and random forest machine learning models were applied for classification. They tested their method on a data set of 2774 including 1444 worms and 1330 benign files.

Anderson *et al*, [14] presented a malware detection algorithm based on the analysis of graphs constructed from dynamically collected instruction traces. A modified version of Ether malware analysis framework was used to collect data. The method uses 2-grams to condition the transition probabilities of a markov chain (treated as a graph). Machinery of graph kernels is used to construct a similarity matrix between instances in the training set. Kernel matrix is constructed by using two distinct measures of similarity: a Gaussian kernel, which measures local similarity between the graph edges and a spectral kernel which measures global similarity between the graphs. From the kernel matrix, a support vector machine is trained to classify the test data. The performance of multiple kernel learning method used in this work is demonstrated by discriminating different instances of malware and benign software. Limitation of this approach is that the computation complexity is very high, thus limiting its use in real world setting.

Tian *et al*, [15] applied an automated tool for extracting API call sequences from executables while these are running in a virtual environment. They used the classifiers available in WEKA library to discriminate malware files from clean files as well as for classifying malwares into their families. They used a data set of 1368 malwares and 456 cleawares to demonstrate their work and achieved an accuracy of over 97%.

Lee *et al*, [16] proposed a method that clusters the malicious programs by using machine learning method. All the samples of data set are executed in a virtual environment and system calls along with their arguments are monitored. A behavioral profile is created on the basis of information recorded regarding sample's interaction with system resources like registry keys, writing files and network activities. The similarity between two profiles is calculated and then by applying k-medoids, different samples are grouped into different clusters. After

completing the training process, the new and unknown samples are assigned to the cluster having medoid closer to the sample i.e. nearest neighbor.

Santos *et al*, [17] proposed a hybrid unknown malware detector called OPEM, which utilizes a set of features obtained from both static and dynamic analysis of malicious code. The static features are obtained by modeling an executable as a sequence of operational codes and dynamic features are obtained by monitoring system calls, operations and raised exceptions. The approach is then validated over two different data sets by considering different learning algorithms for classifiers Decision Tree, K-nearest neighbor, Bayesian network, and Support Vector Machine and it has been found that this hybrid approach enhances the performance of both approaches when run separately.

Raftopoulos *et al*, [18] conducted a sophisticated experiment to assess the security of suspected infected systems in a production environment using data from several independent sources, including intrusion alerts, blacklists, host scanning logs, vulnerability reports, and search engine queries. They found that the false positive rate of their heuristic was 15% and analyze in-depth the root causes of the false positives. Having validated there heuristic, they applied it to their entire trace, and characterize various important properties of 9 thousand infected hosts in total. For example, they found that among the infected hosts, a small number of heavy hitters originate most outbound attacks and that future infections are more likely to occur close to already infected hosts.

Subbulakshmi *et al.,* [19] described a two-phase automatic alert classification system to assist the human analyst in identifying the false positives. In the first phase, the alerts collected from one or more sensors are normalized and similar alerts are grouped to form a meta-alert. These meta-alerts are passively verified with an asset database to find out irrelevant alerts. In addition, an optional alert generalization is also performed for root cause analysis and thereby reduces false positives with human interaction. In the second phase, the reduced alerts are labeled and passed to an alert classifier which uses machine learning techniques for building the classification rules. This helps the analyst in automatic classification of the alerts. The system is tested in real environments and found to be effective in reducing the number of alerts as well as false positives dramatically, and thereby reducing the workload of human analyst.

Srinivas *et al.,* [20] (2007) presented the state-of-the-art of the evolution of intrusion detection technology and address a few intrusion detection techniques and IDS implementations. An overview of computer attack taxonomy and computer attack demystification along with a few detection signatures was presented. Special emphasis is also given to the current IDS limitations. Further

they described few obfuscation techniques applied to recent viruses that were used to thwart commercial grade antivirus tools.

## 3. EXPERIMENTAL DESIGN AND PROCEDURES

### 3.1 Data Acquisition

The data used in this research work was captured from the Information Technology and Media Services (ITeMS), University of Ibadan, Ibadan. A live Snort Intrusion Detection System was deployed on the wireless server called APNearU. Some malware traffic were downloaded from malware-traffic-analysis.net which is a website used by academic security researchers. The data was in packet capture (pcap) format. The generated alerts from Snort have a lot of insignificant information, which needs to be eliminated. The essential details in each alert includes IP Address of source and destination host, alert identification, time stamp, alert length and source with destination port number. The data include some categories of variables, the records of the packet data variables are shown in table.

**Table 1: Packet Data Variables**

| S/N | VARIABLE NAME | VARIABLE FORMAT | VARIABLE TYPE |
|---|---|---|---|
| 1. | Alert Identification | 302, 416, 531,... | Numeric |
| 1. | Alert Time Stamp | 07/17- 10:59:06,… | Numeric |
| 2. | Source IP Address | 192.168.101.66,... | Numeric |
| 3. | Destination IP Address | 100.168.101.53,... | Numeric |
| 4. | Protocol | tcp, http, dns,… | Nominal |
| 5. | Alert Length | 60, 1531,… | Numeric |
| 6. | Source Port Number | 21, 23, 25,… | Numeric |
| 7. | Destination Port Number | 18162, 18161, … | Numeric |

### 3.2 Preprocessing Data Feature Extraction

This is the phase in which irrelevant data are eliminated from the collection, such as data errors, irrelevant fields (i.e header len, time-to live, fragment offset and soon), insignificant information etc. it helps to transform the input features to produce new relevant features. Data needs to be processed because it could be noisy and inconsistent. In the dataset, some classes of data such as fragment offset and sequence number were not selected to be part of the mining process. This is because they do not provide any knowledge for the dataset processing also duplicate data are eliminated.

### 3.3 System Design

In this research work a hybridized classifier system was designed to achieve the aim of the work as shown in figure 1. The Decision Trees and Bayesian Network classifiers have been selected because of their performances in various domains. They have both been successfully deployed to a variety of real-world classification tasks in industry, business, science and education with good performances.

A decision tree is a model that comprises of a root node, branches, and leaf nodes. Each internal node signifies a test on a feature, each branch explains the result of a test, and each leaf node contains a class label. The topmost node in the tree is the root node. The Decision Tree classifiers are considered "white box" classification model as they can provide explanation for their models and can be used directly for decision making. The Bayesian Network classifier uses the Bayes theorem to predict the class as the one that maximizes the posterior probability. The main task is to estimate the joint probability density function for each class, which is modeled via a multivariate normal distribution.

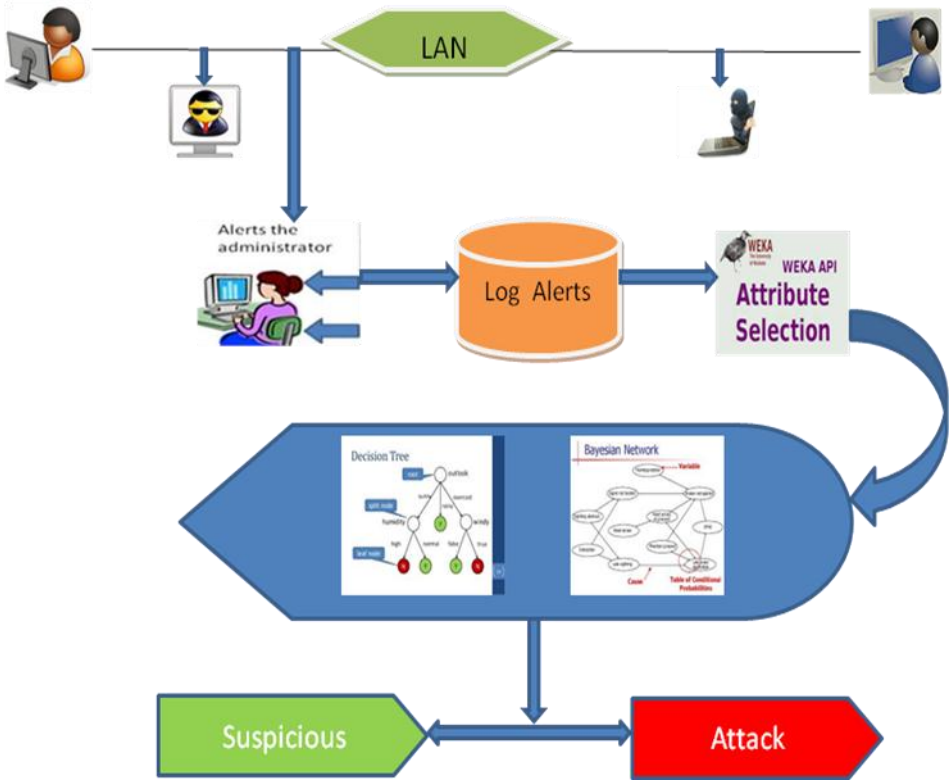


**Figure 1: Methodology Framework**

### 3.4 Snort Intrusion Detection System

In this research work, Snort IDS was deployed on the network in order to detect alerts which will be used in this research work. What snort does was that it logs the flow of packets in the alert log file in packet capture (pcap) format which was later organized into different attributes for further processing using data mining techniques.

Snort was put into operation under command prompt because snort cannot be put into operation as normal network software like wireshark.

The following codes were used to run Snort from command prompt interface:

1. >cd \snort.
2. >cd bin
3. >snort –V
4. >snort –W
5. >snort –i 5 –c c:\snort\etc\snort.conf –T
6. >snort –i 5 –c c:\snort\etc\snort.conf –A console

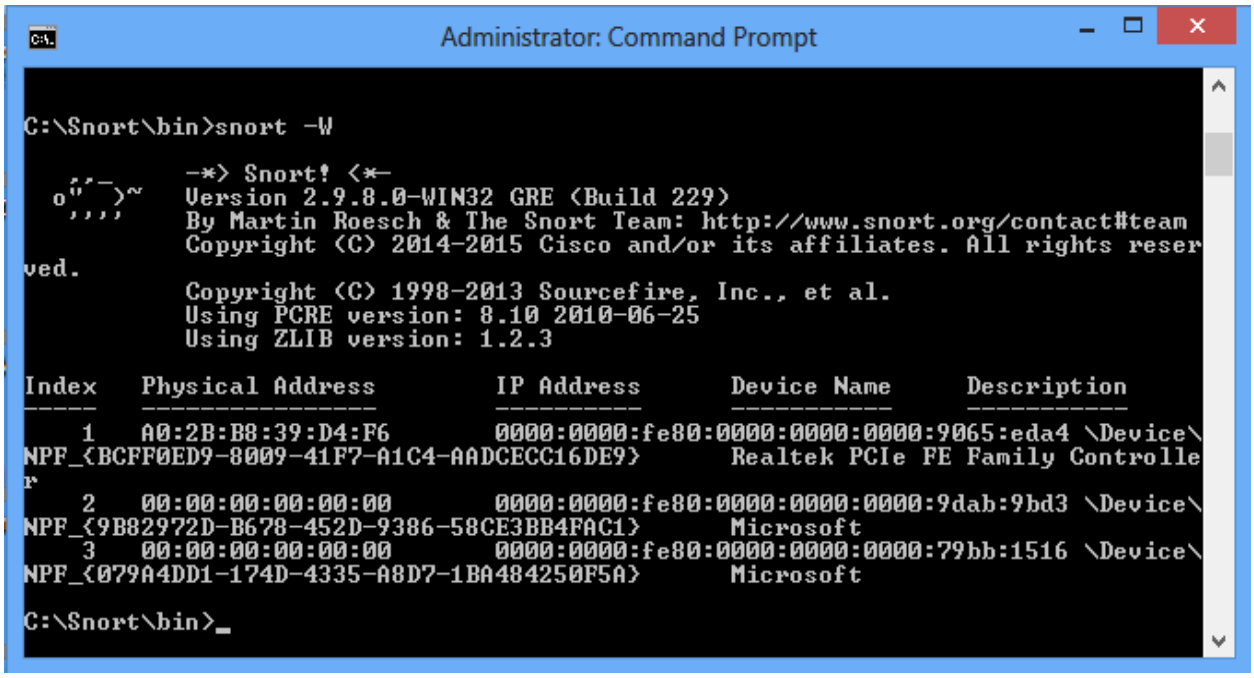


**Figure 2: Snort Working Interface**

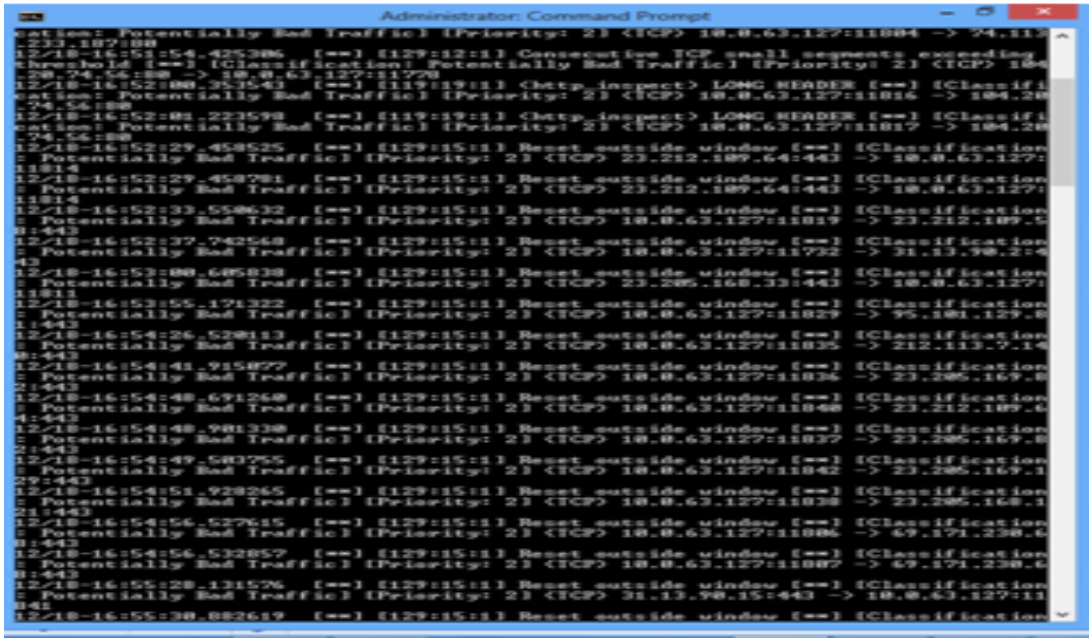

**Figure 3: Network Packet Traffic**

## 4. RESULTS AND DISCUSSION

The dataset consists of eight input variables and an output variable. The input variables are: Alert identification, Time stamp, Source IP Address, Destination IP Address, Protocols, Source port, destination port, Alert length. The output variable was "traffic pattern" which was assigned into the category of Attack traffic and Suspicious traffic

### 4.1 Training Dataset

The training dataset was used to enable the system to observe relationships between input data and predict the final outcomes. This allows the system to learn and develop a relationship between the input and the expected output. Sixty eight percent (68%) of the dataset was used for training making 956 instances.

### 4.2 Testing Dataset

The test dataset instances were then loaded into the system consisting of 320 instances; thirty two percent (32%) of records of malware datasets was used to predict their traffic pattern.

**Table 2: Comparative Analysis on Testing Set**

| **Metrics** | **Value (NaiveBayes)** | **Value (Decision Tree)** |
|---|---|---|
| Time taken to build the model | 0.02 seconds | 0.04 seconds |
| Correctly Classified Instances | 94.6875 % | 96.875 % |
| Incorrectly Classified Instances | 5.3125 % | 3.125 % |
| Kappa statistic | 0.8895 | 0.9336 |
| Mean absolute error | 0.0531 | 0.0501 |
| Root mean squared error | 0.2305 | 0.1583 |

| | | |
|---|---|---|
| Relative absolute error | 11.3689 % | 10.7253 % |
| Root relative squared error | 47.69 % | 32.7565 % |
| Total Number of Instances | 320 | 320 |

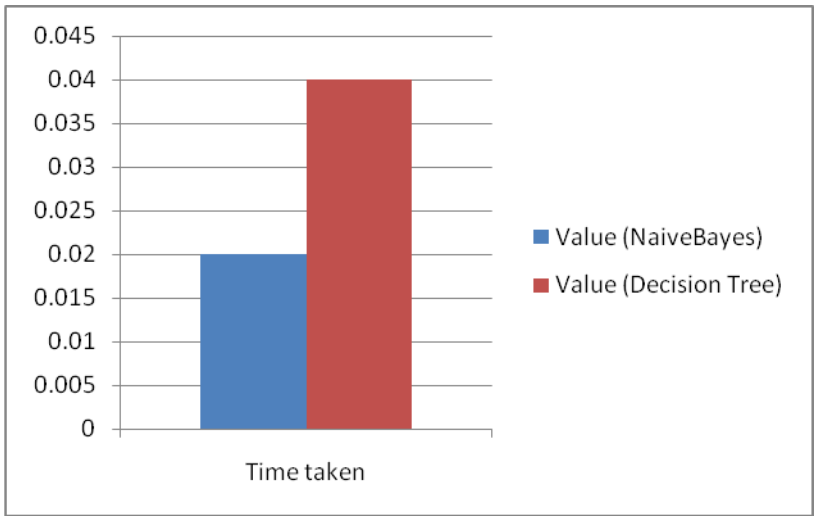


**Figure 4: Time Graph Analysis: Comparing Naivebayes and Decision tree model**

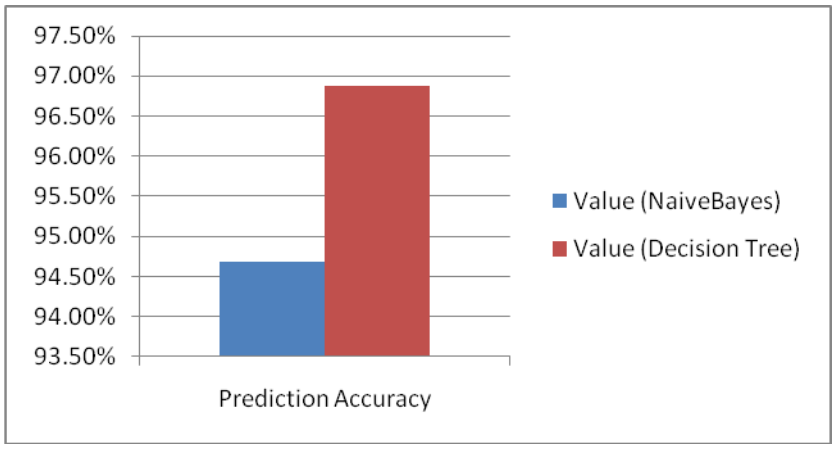


**Figure 5: Prediction Accuracy Graph: Correctly Classified Instances**

### 4.3 Discussion of Results

Results from the experiment in table 4.5a, naïve bayes is better in term of processing time to build its model than the decision tree because it took 0.12 seconds to process the dataset and it took 0.32 seconds for decision tree to complete its model; while decision tree does better in predicting the highest level of classifying accuracy. The main disadvantages of C4.5 classifier was that it took

more CPU time and memory in execution. The disadvantage of naïve bayes model was that it has low classification accuracy.

## 5 CONCLUSION

Snort Intrusion Detection System Alerts was further re-categorized by decision tree and naïve bayes classifiers. From the result generated, decision tree classifier is better than naïve bayes classifier because decision tree classifier provides favorable characteristics such as high classification accuracy and low error metrics. It can be used in boosting classification performance and required in checking the network intrusion alerts. Snort Intrusion Detection System (SIDS) provides an abstract computing environment for data mining tasks, independent of the computer hardware and software on which it executes. Data mining techniques can incorporate the protocol directly and bring about an upgrade on how network traffics are logged. This work can be recommended for network analyst who will have great opportunity to check the logs, pattern of traffics and it will also reduce intruder from their deadly act on the network. In subsequent works, more records of network traffic can be worked on in order to obtain better generalization.

## ENDNOTES

[1] Debar, H., Dacier, M. and Wespi, A. (2000): A revised taxonomy for intrusion detection systems, Annales des Telecommunications, 55, 7-8 (2000) 361-378.

[2] Axelsson, S. (2000): The Base-rate fallacy and the difficulty of intrusion detection, ACM Transactions on Information and System Security, vol 3, pp 186–205.

[3] W. Robertson and W. K. Robertson (2004): "Alert verification determining the success of intrusion attempts", The Proceedings of the Detection of Intrusions and Malware and Vulnerability Assessment, Dortmund, Germany, pp. 25-38.

[4] T. Chyssler, *et al* (2004): "Alarm Reduction and Correlation in Intrusion Detection Systems", Proceedings of the International Workshops on Enabling Technologies, Infrastructures for Collaborative Enterprises, pp. 229-234.

[5] T. Pietraszek (2004): "Using adaptive alert classification to reduce false positives in intrusion detection", The Proceedings of the symposium on Recent Advances in Intrusion Detection (RAID'04), Sophia Antipolis, France, pp. 102-124.

[6] Georgios P. Spathoulas and S. K. Katsikas, "Reducing False Positives in Intrusion Detection System", Computer and Security, vol. 29, no. 1, (2010), pp. 35-44.

[7] M.A.Shanti (2014): Application of Data Mining Using Snort rule for intrusion Detection.

[8] Faeiz Alserhani, *et al* (2009): "Evaluating Intrusion Detection Systems in High Speed Networks", In Press, Fifth International Conference of Information Assurance and Security (IAS 2009), IEEE Computer Society.

[9] Schultz, M., Eskin, E., Zadok, F. and Stolfo, S. (2001): Data Mining Methods for Detection of New Malicious Executables. Proceedings of 2001 IEEE Symposium on Security and Privacy, Oakland, 38-49.

[10] Kolter, J. and Maloof, M. (2004): Learning to Detect Malicious Executables in the Wild. Proceedings of the 10th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 470-478.

[11] Kong, D. and Yan, G. (2013): Discriminant Malware Distance Learning on Structural Information for Automated Malware Classification. Proceedings of the ACM SIGMETRICS/International Conference on Measurement and Modeling of Computer Systems, 347-348.

[12] Osunade O., Adeyemo B. and Oriola, O. (2012): Network Threat Characterization in Multiple Intrusion Perspectives using Data Mining Technique, International Journal of Network Security and Its Applications (IJNSA), Vol.4, No.6.

[13] Siddiqui, M., Wang, M.C. and Lee, J. (2009): Detecting Internet Worms Using Data Mining Techniques. Journal of Systemics, Cybernetics and Informatics, 6, 48-53.

[14] Anderson, B. *et al* (2011): Graph Based Malware Detection Using Dynamic Analysis. Journal in Computer Virology, **7**, 247-258. http://dx.doi.org/10.1007/s11416-011-0152-x.

[15] Tian, R., Islam, M.R., Batten, L. and Versteeg, S. (2010): Differentiating Malware from Cleanwares Using Behavioral Analysis. Proceedings of 5th International Conference on Malicious and Unwanted Software (Malware), Nancy, 19-20.

[16] Lee, T. and Mody, J.J. (2006): Behavioral Classification. Proceedings of the European Institute for Computer Antivirus Research Conference (EICAR'06).

[17] Santos, I., *et al* (2013): A Static-Dynamic Approach for Machine Learning Based Malware Detection. Proceedings of International Conference CISIS'12-ICEUTE'12, Special Sessions Advances in Intelligent Systems and Computing, 189, 271-280.

[18] Raftopoulos E. and Dimitropoulos X (2010): Detecting, Validating and Characterizing Computer Infections in the Wild.

[19] Subbulakshmi T. *et al* (2010): Real Time Classification and Clustering of ids Alerts using Machine Learning Algorithms international journal of artificial intelligence and applications (ijaia), vol. 1, no.1.

[20] Romero C, Olmo JL, Ventura S (2013): A meta-learning approach for recommending a subset of white-box classification algorithms for Moodle datasets. Department of Computer Science, University of Cordoba, Spain.

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# ICT IN EDUCATION AMONG HIGHER EDUCATION STUDENTS (A case study of The Polytechnic, Imesi-Ile, Osun State)

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## ABSTRACT

*Introduction of ICT usage, integration and diffusion has initiated a new age in educational methodologies, thus, it has radically changed traditional methods of teaching and learning patterns in the domain as well as offering contemporary learning experiences to both instructors and students. In this study, we have tried to measure the knowledge of one Higher Educational Institution; Department of Computer Science, the Polytechnic Imesi-Ile, Osun state, Nigeria. Global communication is accelerating at breakneck speed as a result of proliferating Information Communication Technology. ICT helps students to have an open and flexible mind. This will help the students to adjust to the inevitable future changes. One of this is the integration of ICT across the curriculum. At this stage student are introduced to basic programming, modeling and software application of technology everyday life. The study will answer the question of what student can do with ICT and the degree of ICT usage at their level. This project was introduce purposely to standardize* the academic landscape in Nigeria includes the teaching *and learning process, along with the educational programs and courses and the pedagogy or methodology of teaching; the research process, including dissemination and publication. ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underdeveloped constituencies or rural populations groups traditionally excluded from education due to cultural or social reasons such as ethnic countries, girls and women, persons with disabilities, and the elderly, as well as all others who for reasons of cost or because of time constraint are unable to enroll on campus. A questionnaire was designed and distributed on the usage of ICT among final year students at the polytechnic Imesi-Ile in Osun State. The study*

*clearly reflects the level of knowledge that is important slices of higher education students have. And this revealed the usage of ICT education among final year student is still something to write home about, ICT has a very wide coverage among students.*

***Keywords:*** ICT; education; higher education; institution; challenges, issues, opportunity

## INTRODUCTION

Advances in information and communication technologies (ICTs) have posed complex problem for colleges and universities in Sub-Saharan Africa [1], especially in their education programs to reaching the goal of promoting the development of a knowledge society. Education, also called learning is a form of education in which there is normally a separation between teachers and learners. Thus, it includes one which others may refer to as a means of the printed and written word, the telephone, computer conferencing or teleconferencing used to bridge the physical gap between the instructor and the learner.

Education equally involves the provision of whatever educational opportunities that are needed by anyone, anywhere, at any time for those who otherwise would have been denied. Improving the quality of education through the diversification of contents and methods and promoting experimentation, innovation, the diffusion and sharing of information and best practices as well as policy dialogue are UNESCO's strategic objectives in Education [2.3]. By itself, information and communication technologies (ICTs) literacy rate have become key tools that has a revolutionary impact of how we see the world and how we live in it. ICT literacy is the capability (knowledge, skills and aptitude) of a person to identify, search effectively and present specific information in order to build knowledge and develop critical and creative thinking pertinent to a field of study. This phenomenon has given birth to the contemporary and advances in our ways of life. ICTs are having a revolutionary impact on educational methodology at conventional levels globally.

However, this revolution is not widespread and needs to be strengthened to reach a large percentage of the population. In a complex society like Nigeria, many factors affect education. Therefore an interdisciplinary and integrated approach is very necessary to ensure the successful development of Nigeria's economy and society [4]. The academic landscape in Nigeria includes the teaching and learning process, along with the educational programs and courses and the pedagogy or methodology of teaching; the research process, including dissemination and publication. According to the national policy on education, Federal Republic of Nigeria (1989), higher education refers to post-secondary section of the national education system which is given in Universities, Polytechnics and Colleges of Technologies including such courses given by Colleges of Education.

ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underdeveloped constituencies or rural populations groups traditionally excluded from education due to cultural or social reasons such as ethnic countries, girls and women, persons with disabilities, and the elderly, as well as all others who for reasons of cost or because of time constraint are unable to enroll on campus.

- Anytime, anywhere, One defining feature of ICT is their ability to transcend time and space. Make possible asynchronous learning i.e learning characterized by a time lag between the delivery of instruction and its reception by learners. Online course materials, for example, may be accessed 24 hours a day, 7 days a week.

ICT-based educational delivery (e.g. educational programming broadcast over radio or television) also dispenses with the need for all learners and the instructor to be in one physical location.
Additionally, certain type of ICTs. Such as teleconferencing technologies enable instructions to be received simultaneously by multiple geographically dispersed learners (i.e. synchronous learning).

- Access to remote learning resources:
  Teachers and learners no longer have to rely solely on printed books and other materials in physical media housed in libraries (and available in limited quantity) for their educational needs.
  With the Internet and the World Wide Web, a wealth of learning materials in almost every subject and in a variety of media can now be accessed from anywhere at any time of the day and by an unlimited number of people. This is particularly significant for many schools in developing countries, and even some in developed countries, that have limited and outdated library resources. ICTs also facilitate access in resource mentors, experts, researchers, professionals, and business leaders.

This paper seeks to access any impact of ICT usage in education among students of higher education as well as identify the motivation factor for ICT usage among any students.

**CHALLENGES OF ICT**

ICT play a key role as enabler to help us better manage the complex information flow and to integrate such information towards effective policy formulation and planning towards the utmost maximization of human capital and potential in society. Thus, it involves the development of effective and integrated tools as well as training modules to enable their application through effective education agendas [5].

It was noticeable that the high hopes and enormous enthusiasm by the Federal and State governments in the establishment of open and education programs as mentioned above in the review are hampered by the realization that Nigeria is faced with serious challenges. These challenges faced by Nigerian education agendas are in the areas of ICT usage, integration and diffusion. African countries have had to deal with the notion that education amounts to quality education are cheap. That is a misconception. The principle of economies of scale operates from a base of adequate and quality infrastructure, capital provision and machinery; from adequately trained staff, excellent learner support systems and support functions like postal service sand telecommunications provision that are reliable, efficient and affordable. In many African countries none of this can be guaranteed [6]. Inclusive in the challenges faced by education providers is the needed ICT competencies in order for the programs to. ICTs competencies involves but not restricted to the use of an online catalogue to identify and locate resources for a specific information need, keyword search strategies to refine operational Situations, browser and search engine to locate and

retrieve appropriate information and the effective use of other ICTs instructional materials that aid teaching and learning situations.

Obviously, electricity, internet, computers, telecommunications and postal services must be developed to levels that could support the declared state of education [7]. Possibly, another grave challenge facing education at this level is the need for the integration of new ICT knowledge into academic courses and programs. This state of affairs grew mainly from the political isolation that Nigeria experienced during the military eras. Nigeria's professionals were not able to benefit from international assistance or from courses, conferences and seminars abroad (source).

**ICT AND EDUCATION**

Information and Communication Technologies (ICTs) are advances in technologies that provide a rich global resource and collaborative environment for dissemination of ICT literacy materials, interactive discussions, research information, and international exchange of ideas, which are critical for advancing meaningful educational initiatives, training high skilled labor force, and understanding issues related to economic development. ICTs highlight innovative efforts and partnerships and promote ICTs literacy, and facilitate interaction between all sectors of a national economy including external spheres. Higher education institutions across the world have been adopting ICT teaching and learning technologies in an effort to create an environment for both students and their instructors to engage in collaborative learning environment and gain access to information. Access to information through ICT is the amount of information accessible to individuals to support them in trying new strategies; thinking and creativity tha0t are reflective in practice aimed at engaging them to new innovations through the use of ICTs.

Information and communication technologies (ICTs)are indispensable and have been accepted as part of the contemporary world especially in the industrialized societies. In fact, cultures and societies are adjusted to meet the challenges of the knowledge age. The pervasiveness of ICT has brought about rapid changes in technology, social, political, and global economic transformation [8.9]. As such, every nation invests heavily in higher education because it can produce unquantifiable benefits for individuals, organizations and the society as a whole. Education is provided through formal and informal means. Informal settings the conventional (face-to-face instruction) and education (offered with separation in terms of physical location of instructors and students) have been used to provide educational opportunities to recipients. Open-end education though not new in Nigeria has been given much prominence of recent.

Many Nigerians benefited through the open education (correspondence) of Rapid Result College, and Exam Success Correspondence College, among others. It is also a means of providing access to basic information and tertiary education for Nigerians [7].

Notwithstanding the keenness by the federal and state governments to guarantee open-end education in Nigeria, the use and penetration of ICTs in education, teaching and learning has been a major obstacle that may have impeded proper implementation of the program by institutions of higher learning.

## METHODOLOGY

*A. Data collection*

This research employs the use of questionnaires for primary data collection after which the results were subjected to further analysis. The source of data for the study is based on primary data. A questionnaire has been designed and distributed on the usage of ICT among final year students at the Polytechnic Imesi-Ile in Osun State.

The questionnaire has eleven basic questions about the usage of ICT and its related concepts. This research was conducted among 46 students in the Department of Computer Science. TIME FRAME: This study was conducted in the second semester of 2011/2012 academic year.

*B. Data analysis*

The first part of questions was designed to reflect the student degree of interest about ICT. The result shows that majority of students have heard about ICT, the percentage of those that cannot operate computer is just 2.1%, while the percentage of those that can operate computer system is 97.9%, this simply means there exist a large number of computer operators than those that which is very impressive as it shows that people are highly interested in ICT education.

The second part of the questions designed was to know the number of student who owned a computer set, and it was discovered that 98% of the student own a computer set and 2% do not, this also show that the degree of system owner is more compare to the degree of those that do not own a system.

The third part of the questions was designed to know the number of student who has e-mail address because email address is another means of ICT usage which enables a user to send and receive messages to one and many at a time, and it was discovered that 100% of the student has an email address, but only 68.7% are regular users while 31.2% do not use the email regularly.

Another part of the designed questions was to know the number of students who uses a mobile phone because a mobile phone is another type of ICT, and it was discovered that 100% of the student has and use a mobile phone, this is another part of ICT usage among students.

During the research work it was also discovered that 100% of the students use the internet, while 100% use the internet for research work 47.9% of students use internet for socials such as face booking, twitter and many more while 52.1% of the student do not, also 43.7% of the students uses the internet for mailing while 56.3% does not, 10% use the internet for services such as product advertisements, while 90% does not.

Also on the question designed, attempt was made to know the number of student who owns a scanner and also a flash drive, and it was discovered during the research that 4% of the student has a scanner while 96% does not, also 72.9% of the student has flash drive while27.1% does not have a flash drive. The above data analysis is represented in Figure 1

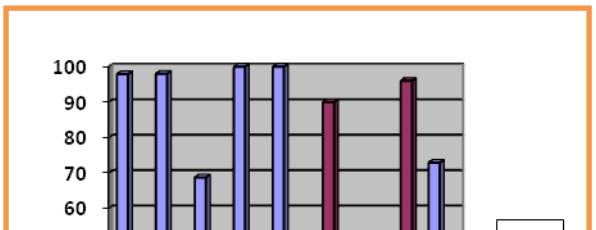

Figure 1: ICT Usage

**LIMITATION**

From the research methodology perspective, this study was characterized by a number of limitations. By design, it was an investigation based on a small size of literature. Therefore, we recommend that bigger studies based on a larger size of literature will be in the right direction, which might also involve quantitative studies. These limitations were considered when evaluating the findings in this study. For instance, they raise the possibility that some differences in opinion may be more a function of research design and contextual factors than a result of any differences in education studies. As with many qualitative studies then, the findings should not be regarded as definitive but as offering educators, researchers, administrators a view of the authors' reality.

**FINDINGS AND DISCUSSION**

The study clearly reflects the level of knowledge that important slices of higher education student have. And it is revealed that the usage of ICT education among final year student is still something to write home about, ICT has a very wide coverage among student.

The direct reasons of the present and wide coverage of ICT among higher institution student could be summarized as follows:

a. There are now ICT educations in higher institution and even from primary education one would have start coming across ICT usage.
b. Technology is advancing day by day, which means if you are not informed you will be deformed.
c. The ministry of Higher Education is now requesting the higher education organization to update their syllabi and study plans based on new fields of study worldwide.
d. Most project work cannot be done without the use of ICT.

## CONCLUSIONS

While students especially in higher education stage are forming a crucial component of society, because they will be the decision makers in the industry, an important attention should be paid to the quality and contents of education that they get in their colleges and universities. Because of the importance of ICT nowadays, the following are highly recommended to cope with the usage of ICT in higher education.

a. Whereas the ministry of Higher Education is responsible for all academic issues, it should require and obligate all higher education organizations to revise and update their majors , syllabi and study plans every two years to enable them to add any new valuable topics or courses.
b. All institution and colleges should organize sanitization workshops for the students on the use of ICT.
c. The students should be encouraged, to always use their e-mail regularly, this will take care of the 52.1% that are not using the internet for mailing purpose.
d. To ensure standardization and uniformity in meeting the global trends in the highly competitive demand for excellence in education programs aimed at producing highly qualified manpower need.
e. Governments in Africa should embark on a comprehensive program of recapitalization of higher education. Therefore, the governments should move from the traditional position of paying lip service or little attention to empowering higher education and education programs to a pro-active stands by funding, monitoring and controlling their implementation as a way of ensuring standard. Accordingly, making sure that adequate and functioning ICT infrastructures are available, like electricity, telecom equipment and effective postal system and making these infrastructures accessible to organizers of education programs and its citizens at large.
f. Infrastructure as well as organization of programs should be better designed so that management and students can have better plan for unanticipated and unintended results that confront them as they operate.

Finally, the findings and nature of this study contain implications for education administrators, teachers, and researchers.

At a broad management level, this study supports decisions by national educational systems to make a balanced investment in education programs and providing resources needed to effectively implement the use, integration and diffusion of ICT in learning rather than paying lip services.

### Endnotes

[1] N.P. Ololube, (2006).The Impact of Professional and Non-professional Teachers' ICT Competencies in Secondary Schools in Nigeria. Journal of Information Technology Impact

[2] UNESCO (2002). Information and Communication Technologies in Teacher education: A Planning Guide. Paris.

[3] UNESCO, (2005). United Nations Decade of education for Sustainable development 2005-2014.

[4] D.Mac-Ikemenjima, (2005). E-Education in Nigeria: Challenges and Prospects. Paper presentation at the 8thUN ICT Task Force Meeting April 13-15, 2005Dublin, Ireland.

[5] M.A.Nwachukwu, M. A. (1994). Development of information technology in Nigeria. In E.P.Drew, & F.G.Foster, (Eds) Information technology in selected countries. Tokyo: The United Nations University.

[6] B.N. Pityana, (2004). Education in Africa: Some Challenges and Perspectives. Paper Presented at the Annual Conference of NADEOSA, St John's College, Johannesburg Pretoria, 25 August 2004.

[7] M.O.Yusuf, (2006). Problems and Prospects of Open and Education in Nigeria.

[8] Turkish Online Journal of Education, J. Zajda, (1995) Defining Excellence and Quality in Education. InJ.Zajda, K.Bacchus, & N. Kach, (Eds). Excellence and quality in Education. Albert Park: James Nicholas Publishers.

[9] M.O. Yusuf, (2005). Information and Communication Technologies and Education: Analyzing the Nigerian National Policy for Information Technology. International Education Journal.

## DESIGN AND IMPLEMENTATION OF PROGRAMMABLE (USER SELECTABLE) MAINS MONITOR WITH SURGE PROTERTOR

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**ABSTRACT**

*Power irregularities and fluctuations are major problems in Nigeria. To prevent and control these abnormalities, the need for mains monitor with surge protector is necessary. Voltage fluctuation is a critical problem for electrical and electronics equipment which could damage power equipment either at low or high voltage. This paper therefore presents the design and construction of programmable (user selectable) mains monitor with surge protector. The paper discusses the design, construction and operation of a programmable (user selectable) mains monitor with surge protector. The design is meant to automatically monitor the mains voltage to ensure that it is within the selected permitted voltage range of 170 – 240VAC. LCD interface was used for the output display. PIC16F689A microcontroller was used to*

*implement the control program. The design is recommended for both household and industrial power equipment protection.*
**Keywords:** Mains monitor; Surge Protector; Programming; LCD; User selectable

## 1. INTRODUCTION

Researches in the field of Electrical Electronics have led to tremendous discoveries and inventions especially in the area of automation and power control. These inventions have been useful in solving the ever-increasing problems posed by power generation, distribution and control, which have been a cause of concern especially in third world countries. The quality of power supplied in Nigeria is so poor that in a day, the power supplied could be as low as 170volts with several spikes (fluctuations) and this situation causes damage to most appliances.

The programmable (user selectable) mains monitor with surge protector is an electronic circuit designed to automatically monitor the mains voltage to ensure that it is within the selected permitted voltage range of 170 – 240VAC. The mains monitor also features a transient voltage arrestor which provides a means to protect home appliance from damaged caused by transient voltages.

Surge protection devices (SPD) are designed to protect against transient surge conditions. Transient surges can reach values of hundreds of thousands of volts or instantaneous current flow of ten thousands of amperes, but typically last than one hundred microseconds in duration. Transient surges generated within a facility typically accounts for 80% of the surge activity. These internally generated transients can be caused by switching power supplies (computers), electronic ballasts (building lighting) and variable frequency drives (air handlers, elevators, etc). The most destructive transient voltage surges can be attributed to lightning and utility load switching; however, experts predict that these two events account for 20% of all transient surge activity.

Electronic systems are designed to refine, extend or supplement the human ability to observe, perceive, communicate, remember, calculate, or reason. A power electronic device, like the programmable (user selectable) mains monitor with surge protector, extends and supplements the human ability to monitor, protect and control. The incorporation of this power electronic device in the home or the office will reduce the electrical hazards and loss of electrical devises posed when mains voltage is erratic and transient condition occur.

## 2. LITERATURE REVIEW

Design and implementation of microcontroller based programmable power changeover (Obasi *et al*, 2015). The paper deals with the design and implementation of microcontroller based programmable power changeover.

Transient: it is a change in the steady state condition of voltage, current, or both. In fact, transients vary widely in current and voltage wave shapes as well as magnitudes. Technically, transient is a sub-cycle disturbance in the AC waveform that is evidenced by a sharp brief discontinuity of the waveform. Transients may be

of either polarity and may be of addictive or subtractive energy to the nominal waveform.

Transients are divided into two categories which are easy to identify; impulsive and oscillatory. If the mains signal is removed, the remaining waveform is the pure component of the transient. The transient is classified in the impulsive category when 77% of the peak-to-peak voltage of the pure component is of one polarity. Each category of transient is subdivided into three types related to the frequencies contained. Each type of transient can be associated with a group of phenomena occurring on the power system.

The impulsive low frequency transient rises in 0.1ms and last more than 1ms. Its companion, the oscillatory low-frequency transient, contains frequency components up to5kHz. These types are the most common transients recorded on a power system. They are not only easily propagated but they can also be amplified by a power system resonance phenomenon. Measurement of these types of transients should be useful for all classes of application (benchmarking, legal, trouble shooting and laboratory).

The medium-frequency impulsive transient lasting between 50ns to 1ms and oscillatory transients between 5 and 500 kHz are less frequent than the low-frequency types but have much higher amplitude. These transients may not propagate as easily as the low-frequency types but may cause arching faults on the power distribution system which result in voltage sag on many user power systems. It is most appropriate to measure these types of transients for trouble shooting and laboratory classes.

High-frequency types with high amplitude can be observed only near where the phenomenon occurs. The high-frequency impulsive transient has duration below 50ns and the frequency of the high frequency oscillatory type ranges between 0.5 and 5MHz. These measurements are useful for laboratory and troubleshooting classes of application.

Sources of Transient Voltages: Transients can be generated internally, or they can come into a facility from external sources. The least common of the two are externally generated transients. They have been described as “electronic rust”

External sources: Lightning is the most well know of the externally generated transients. Most lightning transients are not actually the result of direct lightning strikes; they are most often “induced” onto conductors as lightning strikes near the power line. The large electric fields generated during a discharge can couple into the power system, creating induced transients. A cloud-to-cloud discharge can generate a 70volts per meter electric field. Other externally generated transients may also be imposed on power lines through normal utility operations. Switching of facility loads, opening and closing of disconnects on energized lines, switching of capacitor banks; re-closure operations and tap changing on transformers can all cause transients.

Internal sources: The vast majority of transients are produced within your own facility. The main culprits are device switching, static discharge, and arching. Each time you turn on off load or unload an inductive, you produce a transient. Inductive devices are those devices that use "magnetic mass" to function. Examples of inductive loads are motors and transformers.

Microcontrollers: A microcontroller (also microcomputer, MCU or μC) is a small computer on a single integrated circuit consisting internally of a relatively simple CPU, clock, timers, I/O ports, and memory. A program memory in the form of NOR flash or OTP (one time programmable) ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for small or dedicated applications. Thus, in contrast to the microprocessors, used in personal computers and other high-performance or general purpose applications, simplicity is emphasized. Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, as this is adequate for many typical applications, enabling low power consumption (milliwatts or microwatts).

Embedded Design: A microcontroller can be considered a self-contained system with a processor, memory and peripherals and can be used with an embedded system. (only the software needs be added). The majority of microcontrollers in use today are embedded in other machinery, such as automobiles, telephones, appliances, and peripherals for computer systems. These are called embedded systems. While some embedded systems are very sophisticated, many have minimal requirements for memory and program length, with no operating system, and low software complexity. Typical input and output devices include switches, relays, solenoids, LEDs, small or custom LCD displays, radio frequency devices, and sensors for data such as temperature, humidity, light level etc. embedded systems usually have no keyboard, screen, disks, printers, or other recognized I/O devices of a personal computer, and may lack human interaction devices of any kind.

Transistors: Transistors are active components used basically as amplifiers and switches. The two main types of transistors are: The bipolar transistors whose operation depends on the flow of both minority and majority carriers, and the unipolar or field effect transistors (called FET) in which current is due to majority carriers only (either electrons or holes). The transistor as a switch operates in class A mode. In this mode of bias, the circuit is designed such that current flows without any signal present. The value of bias current is either increased or decreased about its mean value by the input signal (if operated as an amplifier) or ON and OFF by the input signal if operated as a switch.

## 3. METHODOLOGY

Principle of operation; the programmable (user selectable) mains monitor with surge protector is built around a microcontroller, PIC16F689A, programmed to handle the whole mains monitoring unit. It has a user selected permissible input voltage range of 170V - -240V which the microcontroller monitors to ensure that voltages outside this range are not allowed to get to the load. A step-down transformer is designed to take in input as high as 300VAC to provide 12V and 20V output. The 12V output is

rectified to power the transistor-relay switching stage and further regulated to 5V to power the microcontroller circuitry. The 20V output is used for the transient eliminator and mains voltage monitoring stage. The microcontroller is programmed to ensure that when the input voltage exceeds 240VAC the output to load is cut-off and an "UNUSUAL" message is displayed on the liquid crystal display (LCD). When a transient condition occurs, the transient eliminator stage, which hitherto has been "ON", goes "OFF" prompting the microcontroller to disable the output to load via the relay switching stage and display a "TRANSIENT CONDITION" message on the LCD. And when the input voltage is below 170VAC, the LCD displays an "UNUSUAL" message and no voltage is supplied to the load.

The power supply stage generates a regulated voltage to power the active components and also create a stable reference voltage to enable proper calibration of the programmable (user selectable) mains monitor with surge protector. The power supply stage is a linear power supply type that has the step-down transformer, rectifier filter and regulator stages.

A step-down transformer is designed to take in maximum input of 300VAC to provide 12V and 20V output. The 12V output is rectified to power the transistor relay switching stage and further regulated to 5V to power the microcontroller circuitry. The 20V output is used for the transient eliminator and mains voltage monitoring stage. Using a 300V transformer on a 50Hz supply and transformer secondary r.m.s voltage output is 12V.

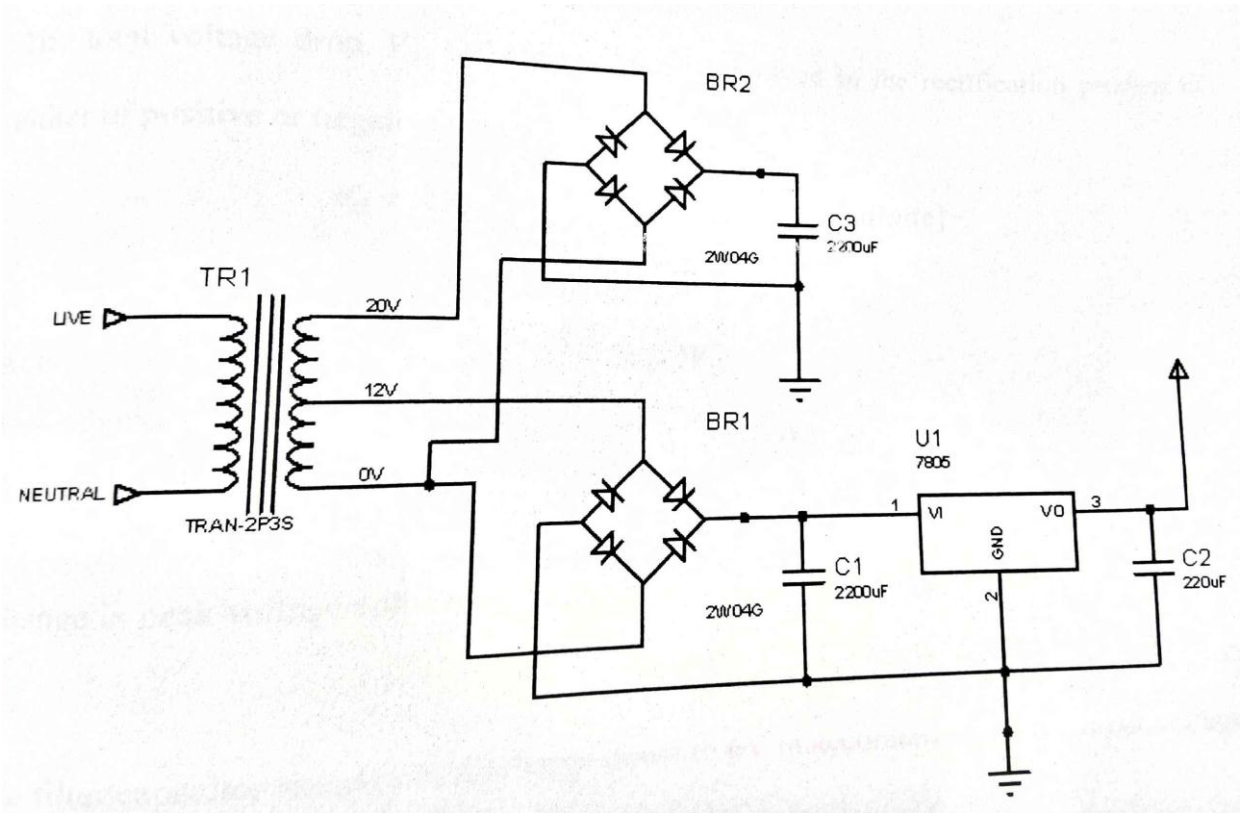


Figure 1: Power Supply Circuit

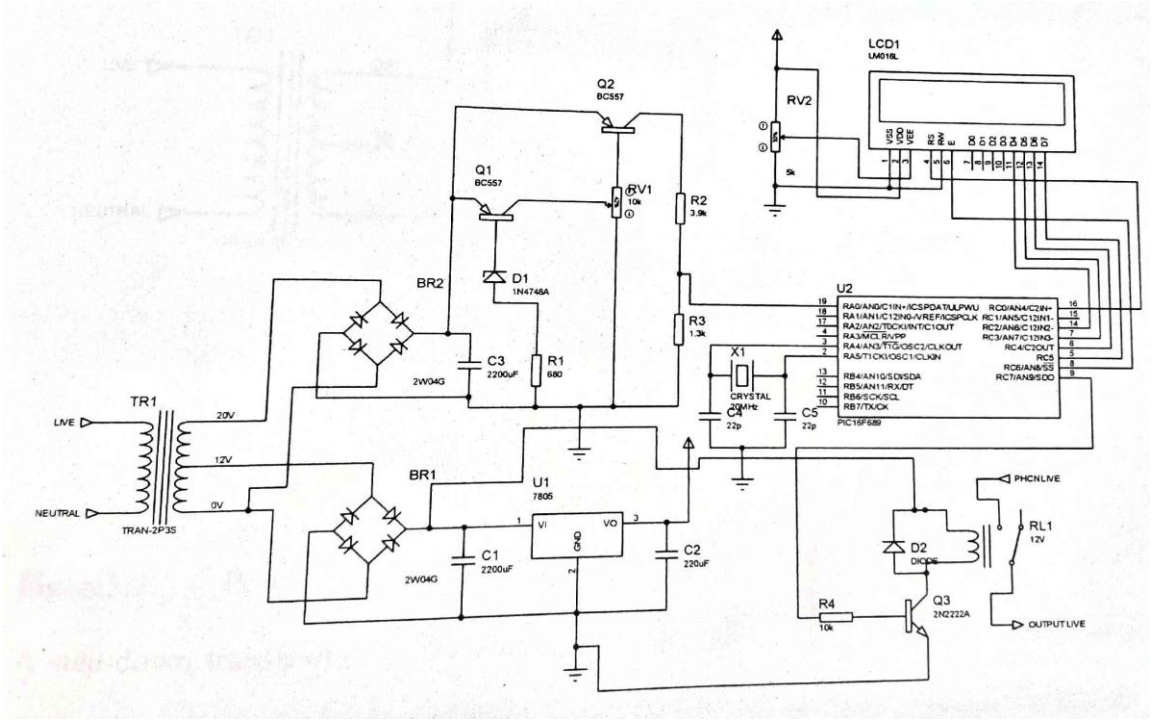


Figure 2: Circuit Diagram

The microcontroller stage, PIC16F689A: It belongs to a class of 8-bit microcontroller of RISC architecture. It is an 18 pin dual in-line package chip. The PIC16F689A is a tiny but complete computer. It has a CPU (central processing unit), program memory (PROM), working memory (RAM), and two input-ports. The CPU is the "brain" of the computer. It reads and executes instructions from the program memory. As it does so, it can store and retrieve data in working memory (RAM). CPUs make a distinction between "registers" located within the CPU and "RAM" outside it; the PIC does not, and its general-purpose working RAM is also known as registers. On the F689, there are 68 bytes of general-purpose RAM, located at addresses C to hex 4F. Besides the general-purpose memory, there is a special "working register" or "register" where the CPU holds the data its working on. There are also several special function registers each of which controls the operation of the PIC in some way. The program memory of the F689 consists of flash EPROM; it can be recorded and erased electrically, and it retains its contents when powered off. Program memory (FLASH) for storing a written program. Since memory made in FLASH technology can be programmed and cleared more than once, it makes this microcontroller suitable for device development. EEPROM - data memory that needs to be saved when there is no supply. It is usually used for storing important data must not be lost if power supply suddenly stops.

## 4. RESULTS AND DISCUSSIONS

The physical realization of the project is very vital. The paper work is transformed into a finished hardware. After carrying out all the paper design and analysis, the work was implemented, constructed and tested to ensure its working ability. The construction of this work was done in three different stages: the implementation of the whole work on a solder-less experiment board, the soldering of the circuits on vero-boards and the coupling of the entire work to the casing.

The implementation of this work was done on the breadboard. The power supply was first derived from a bench power supply in the electronics laboratory. To confirm the workability of the circuits before the power supply stage was soldered. The implementation of the project on bread board was successful and it met the desired design aims with each stage performing as designed.

Testing of programmable (user selectable) mains monitor is done with the use of variac (device used to vary voltage). The mains supply is fed to the input of the variac and the output of the variac is connected to the input protective device and then to the isolator of the household or the machine. When the voltage is varied through the variac, the input protective device would only allow the permissible voltage to flow to the load and such protecting the load. Meanwhile any voltage out of range would be cut off from entering the load and be seen as no voltage supply.

Stage by stage testing was done according to the block representation on the breadboard, before soldering of circuit commenced on vero board. The process of testing and implementation involved the use of some test and measuring equipment's stated below; bench power supply, oscilloscope and digital multi-meter.

## 5. CONCLUSION

The design and implementation of programmable (user selectable) mains monitor with surge protector has been implemented in this paper. It was designed considering some factors such as economic application, design economy, availability of components and research materials, efficiency, compatibility and portability and also durability. The performance of the work after test met design specifications. However, the general operation of the work and performance is dependent on the user who is prone to human error such as entering wrong timing. The design of the programmable mains monitor involved research in both digital and microelectronics.

## REFERENCES

George Loveday (1984), "Essential Electronics" Pitman, United Kingdom.

Jony, I. H., Rahman, M., (2014), Construction of Microcontroller Based Digital Voltmeter, International Journal of Science and Research, 84 – 87.

Julio Sanchez (2007), "Microcontroller Programming" Second Edition, C.R.C. Press, Taylor and Francis Group, Great Britian.

Obasi *et al*, (2015), "Design and implementation of microcontroller based programmable power changeover"

Owen, B., Beginner's Guide to Electronics 4th Edition. Newsness Technical Book, New York, USA: McGraw-Hill Companies Inc., (1995).

R.J. Maddock and D.M. Calcutt (1994) "Electronics A Course for Engineers". Longman, United Kingdom.

Robert I. Boylestad and Louis Nashelsky (2002), "Electronics Devices and Circuit Theory" Eight Edition, Prince-Hall, United Kingdom.

Thereja, B.L. & Thereja, A.K., Electrical Technology, 21st Edition Ram Nagar New Delhi, India: S. Chand and Company Ltd., (2002).

V.K. Mehta (2003), "Principles of Electronic." Second Edition, S.Chand and Company Ltd, India

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# AN ALARM GAS LEAKAGE DETECTOR

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***Abstract***

*Nowadays, home fires have been happening frequently and the threat to human lives and properties is growing in recent years. Liquid Petroleum Gas (LPG) is highly inflammable and can burn even at some distance from the source of leakage. Most fire accidents are caused because of a poor-quality rubber tube or the regulator is not turned off when not in use. Therefore, developing the gas leakage alert system is very essential. Hence, this paper presents a gas leakage alert system to detect the gas leakage and to alarm the people onboard. The design is recommended to protect human and properties from fire outbreak and related hazard.*
.

**Keywords**: Liquid petroleum gas, Gas sensor, Gas Leakage

## 1. INTRODUCTION

Gas leakage leads to various accidents resulting in both material loss and human injuries. The risk of explosion, firing, suffocation are based on their physical properties such toxicity, flammability, etc. The number of deaths due to explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to substandard cylinders, old valves, worn out regulators and lack of awareness in handling gas cylinders. The LPG or propane is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and meager harm to the environment. Natural gas is another widely used fuel in homes. Both gases burns to produce clean energy, however there is a serious problem of their leakage. Being heavier than air, these gases do not disperse easily. It may lead to suffocation when inhaled and may lead to explosion. Some people also have a low sense of smell in such way that they could

not perceive any smell of diffusion talk less of Gas Leakage. Due to the explosion of LPG, the number of deaths has been increased in recent years. To avoid this problem there is a need for a system to detect the leakage of LPG.
Mahalingam *et al*, (2012) presented gas leakage detection as the process of identifying potentially hazardous gas leaked by detecting through means of various sensors. Several designs of LPG detection and alert system have been proposed in the literature. Apeh *et al (2014)* designed kitchen gas leakage detection and automatic gas shut off system.
Soundarya *et al* (2014) presented the cylinder LPG gas leakage detection system
The paper presents a LPG leakage detection and alert system to avoid fire accidents and to provide house safety.

## 2. THEORECTICAL BACKGROUND

### 2.1 Gas Sensor

The MQ-6 sensor has a sensing range of LPG gas content is quick. Whenever there is to acetic acid, which is an organic acid the resulting chemical reaction will produce an electrical current. The difference of potential produced by this as an approximation of overall gas content in the atmosphere.
The internal heating system is a small tube made of this tube, there are heating coils which produce the heat. These coils can draw up to 150mA of current. The alumina tube is covered with tin dioxide, SnO tube is an aurum electrode movable electrons. These movable electrons allow molecules contact the electrode, the ethanol present in the LPG chemically changes into acetic acid and produces a flow of current within the tube. The more LPG gas present the more current is produced.

### 2.2. Capacitor

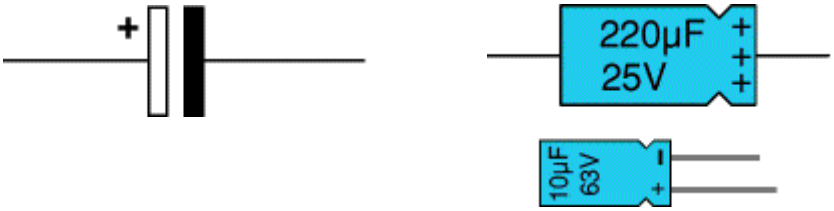


Figure 1: Capacitor

A capacitor (originally known as condenser) is a passive two terminal electrical component used to store energy in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors separated by a dielectric (insulator); for example, one common construction consists of metal foils separated by a thin layer of insulating film. Capacitors are widely used as parts of electrical circuits in many common electrical devices. When there is a potential difference (voltage) across the conductors, a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate. Energy is stored in the electrostatic field.
The capacitance is greatest when there is a narrow separation between large areas of conductor, hence capacitor conductors are often called *plates*, referring to an early

means of construction. In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks, for smoothing the output of power supplies, in the resonant circuits that tune radios to particular frequencies, in electric power transmission systems for stabilizing voltage and power flow.

### 2.3. Transistor

Transistors are active component which are often found in many different electronic circuit. They play their roles in circuit as amplifier or switch component, they have their lead which must be connected the correct way round.

The triode, however, was a fragile device that consumed a lot of power. Physicist Julius Edgar Lilienfeld filed a patent for a field effect transistor (FET) in Canada in 1925, which was intended to be a solid state replacement for the triode. Lilienfeld also filed identical patents in the United States in 1926 and 1928.

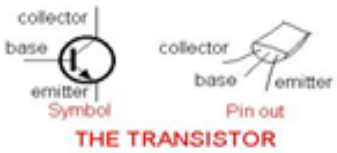


Figure 2: the transistor

### 2.4. Transformer

A transformer is a power converter that transfers energy between two electrical circuits by inductive coupling between two or more windings. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (EMF), or "voltage", in the secondary winding. This effect is called inductive coupling. If a load is connected to the secondary winding, current will flow in this winding, and electrical energy will be transferred from the primary circuit through the transformer to the load. Transformers may be used for AC-to-AC conversion of a single power frequency or for conversion of signal power over a wide range of frequencies, such as audio or radio frequencies.

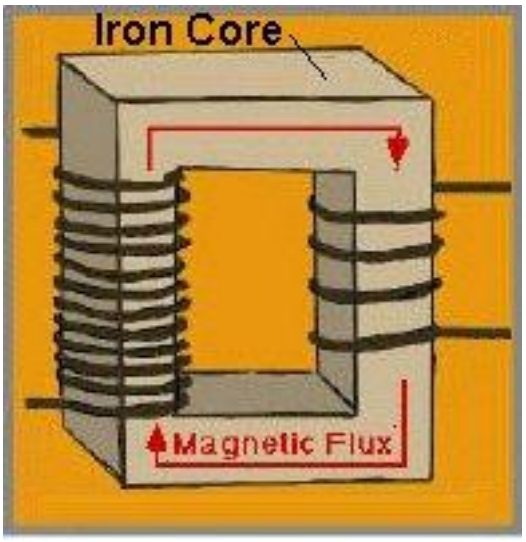


Figure 3: Iron Core

If the secondary has more turn than the primary the transformer is known as a ''step up ''type .however the power output can never be more than the power input.

**2.5. Resistors**

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law:

$I = V/R$

where $I$ is the current through the conductor in units of amperes, $V$ is the potential difference measured across the conductor in units of volts, and $R$ is the resistance of the conductor in units of ohms. The ratio of the voltage applied across a resistor's terminals to the intensity of current in the circuit is called its resistance, and this can be assumed to be a constant (independent of the voltage) for ordinary resistors working within their ratings.

**2.6. Integrated Circuit CM324 & ULN2003:**This is also called microelectronic circuit, microchip or chip, an assembly of electronic components, fabricated as a single unit, in which miniaturized active device (e.g transistors and diodes) and passive devices (e.g, capacitors and resistor) and their interconnections are built up on a thin substrate of semiconductor material (typically silicon). The resulting circuit is thus a small as a few square millimeters. The individual circuit components are generally microscopic in size.

**2.7. Voltage Regulator**

The voltage regulator is one of the most common components to be added to a project. It's the heart of what we call a "built-in" power supply. It allows the project to operate from almost any type of voltage. It can be AC or DC and any voltage (within prescribed limits). The voltage can come from batteries, a plug pack or a transformer. The only other components that need to be added are diodes, a few capacitors and electrolytics and the power-supply section of a project is complete. The voltage

regulator has made the designing of a power supply a relatively simple task. However, before we take the designing too simply, there are a number of features and facts that must be taken into consideration.

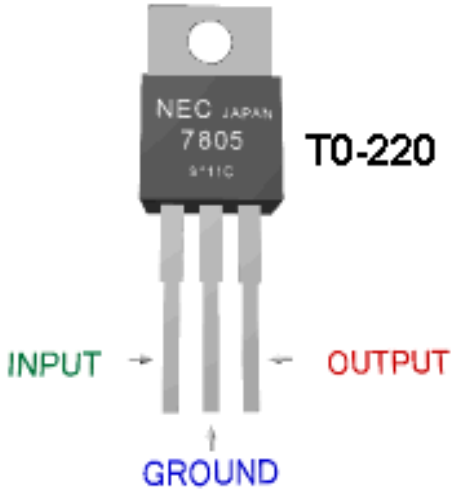


Figure 4: Voltage Regulator

## 3. METHODOLOGY

### 3.1 LPG LEAKAGE DETECTION AND ALERT SYSTEM

The LPG leakage detection and alert system presented in this section is a simple as shown in Figure 1, yet reliable. It is battery operated and hence portable. It is designed in such a way that it can also be operated with ac power supply. To support the latter case, it has a bridge rectifier with a capacitor filter. This is followed by a regulator designed with IC7805 which provides +5V regulated power supply.

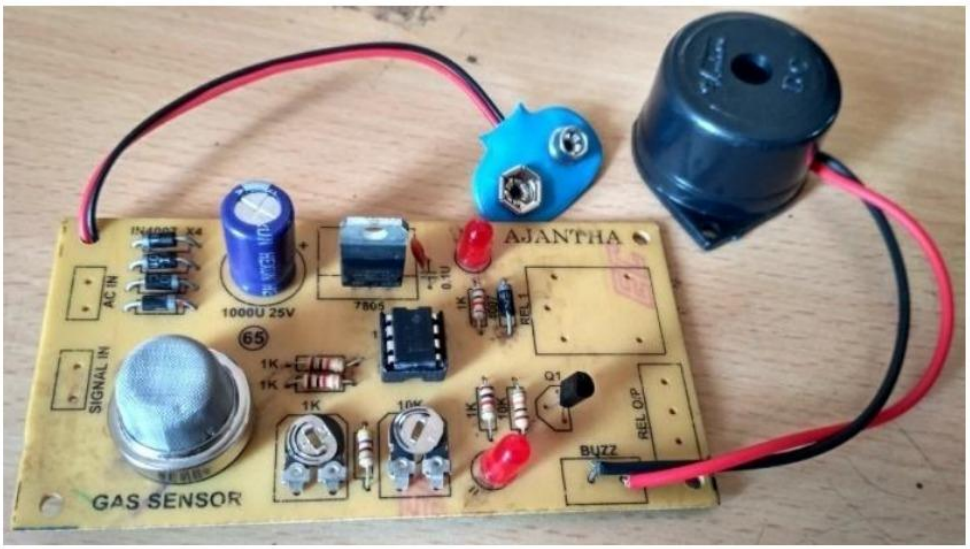


Figure 5: LPG leakage detection and alert system

To detect the LPG, MQ-6 gas sensor is employed. This sensor can be operated at +5V. The sensitivity of this sensor is very high and it has quick response time. It can detect the LPG concentration in the range of 200-10000ppm. The gas sensing layer of this

sensor is made of Tin Dioxide (SnO) and gold (Au) electrodes. The output of the gas sensor is given to LM358dual operational amplifier where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified.

If the sensed voltage is greater than the preset threshold voltage, the operational amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will glow and the buzzer starts to produce alarm sound.

### 3.2 Design Method

The Alarm Gas leakage detector system design is achieved by using top-down approach. The hardware module is designed first as indicated in the block diagram. The software module is developed using C-language. The design focuses mainly on module integration and interface of the system. The system architecture has four different functional units and each unit requires input to generates desired output.

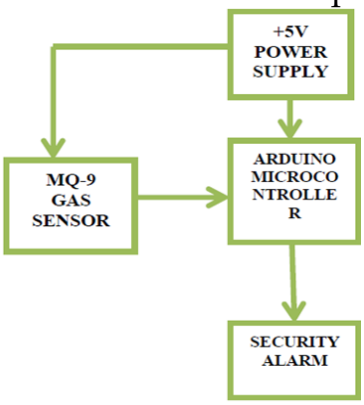


Figure 6: Alarm Gas leakage detector block diagram

**+5 VOLT POWER SUPPLY:** The power supply was designed considering the available resources while meeting the design specifications. Most of the components operates on 5 V DC, while relays operating at 12 V were used, hence the need to step down the normal power supply voltage from mains (Approx. 240 V AC), to a reasonably voltage that will have to be rectified (convert to DC) and further filter to remove unwanted pulsation. The 240 V AC power was stepped down to 12 V AC (12 V RMS value wherein the peak value is around 17 V) as can be seen from the calculation that follows, the 17 V was further regulated using a voltage regulator (LM7805) to 5 V and (LM7812) to 12 V. A transformer of turn ratio of 20:1 was used after calculation for the purpose of stepping down the voltage and rectifier diodes (IN4001) were also used for rectification. A preferred value of 3300 µF was however employed for the filtering of the assumed ripples as the value is higher than the calculated value, hence will filter much more than expected. Fig. 3.2 shows the designed power supply circuit and the results gotten from simulation.

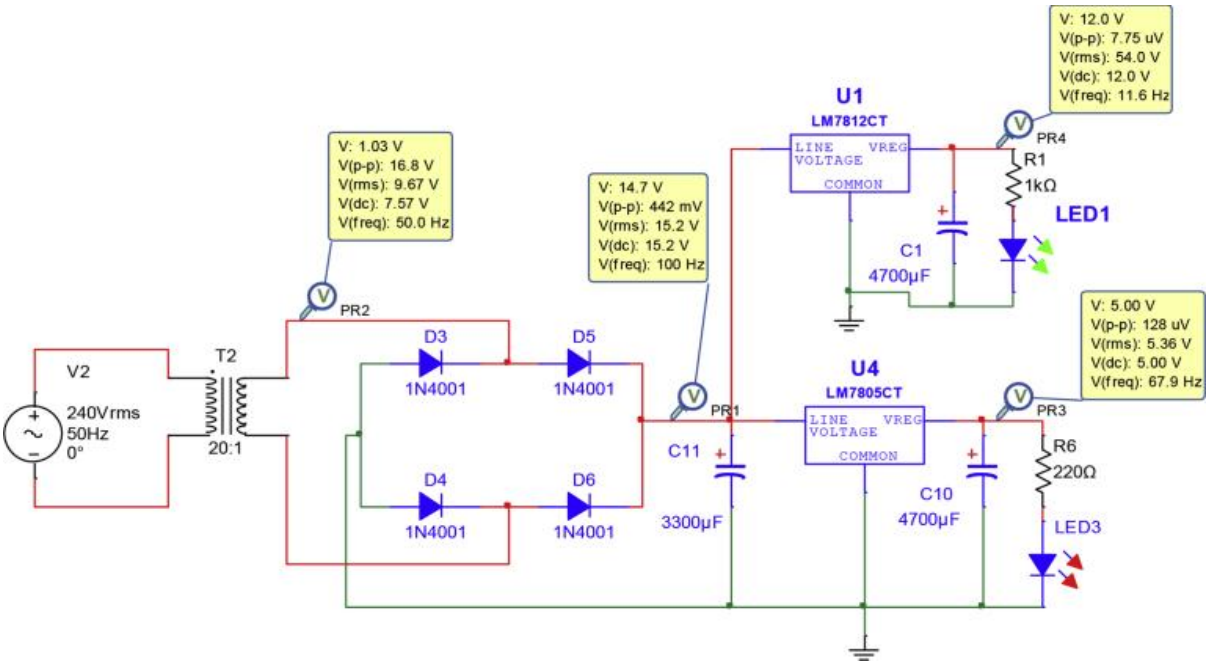


Figure 7: Power supply circuit.

**MQ-6 Sensor unit:** The most common gas leakage at homes/industries are carbon monoxide and liquefied petroleum gas (flammable gases), MQ-6 gas sensor as shown in fig.3.3. is deployed to detect any gas leakages and report to the control unit of the system.

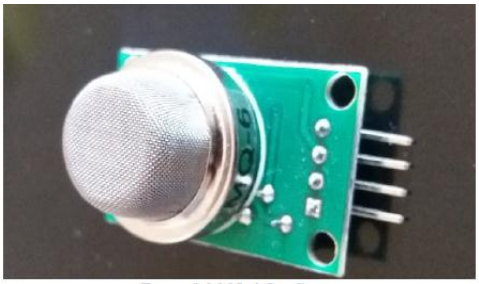

Figure 8: MQ-6 Gas Sensor

MQ-6 is a Semiconductor Sensor designed to detect carbon monoxide/Combustible gas and it does detection by the method of cycle high and low temperature. It detects carbon monoxide when low temperature heated by 1.5V is supplied. The sensor's conductivity is higher along with the gas concentration rising at high temperature (heated by5.0V). It detects Methane, Propane combustible gas and cleans other gases adsorbed under low temperature. The sensor could be used to detect different gases containing carbon monoxide and combustible gases, at low cost and suitable for different applications.

**Security Alarm Unit:** The audio sound system is a transducer that coverts a electrical signal into acoustic energy. The buzzer produces sound based on application of an electrical signal. The buzzer as shown in fig.6 can be used to alert a user of an event corresponding to a switching action, countersignal or sensor input. They are also used in alarm circuit. The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the

other. This, push and pull action, results in a sound wave. Most buzzers produce sound at the range of 2 to 4 kHz. When a gas leakage is sensed, the Integrated Circuit sends signal to the buzzer and it sounds an alarm.

Figure 9: Buzzer Alarm

**Integrated Circuit CM324 & ULN2003:** This is also called microelectronic circuit, microchip or chip, an assembly of electronic components, fabricated as a single unit, in which miniaturized active device (e.g transistors and diodes) and passive devices (e.g, capacitors and resistor) and their interconnections are built up on a thin substrate of semiconductor material (typically silicon). The resulting circuit is thus as small as a few square millimeters. The individual circuit components are generally microscopic in size.

### 3.3 Principles of operation

A cost-effective gas leakage detection and alarming monitoring system was proposed, designed and successfully implemented in this research work. The system has four units namely power supply, gas detector, controller and security alarm. Test was conducted on each of the unit to verify its working capability. From the test, gas detector senses the presence of gas leakage and sends the signal to the controller through its analog input port. The Integrated Circuit CM324 & ULN2003 picks the signal, processes it and security alarm is activated which would attract attention of nearby to take action in order to protect property from dangerous inferno.

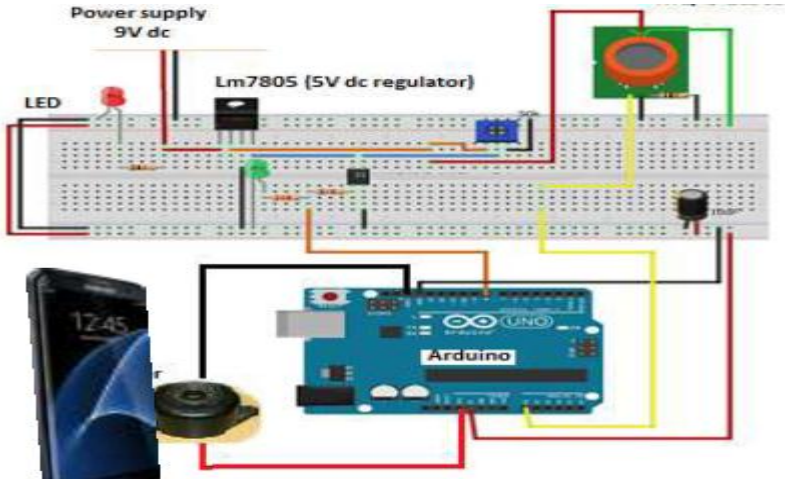


Figure 10: Principles of operation

## 4. RESULT AND DISCUSSION

The design and construction of the Alarm Gas leakage detector takes two major parts which are hardware and software as earlier explained. In hardware section, power supply unit of 9v but regulated to 5v DC was designed, built and tested with Multimeter to ensure constant supply of +5V DC to the system. The MQ-6 sensor was tested by connecting the output pin to the analog input port of the Integrated circuit. The cigarette lighter gas was used to test the performance of the gas sensor and security alarm triggered by the integrated circuit when the gas is detected.

The designed, which is meant to detect gas leakage and alert users through alarm action (by buzzer), was tested as shown in fig.3.5. Physical testing was done to ensure that Gas leakage detection alarming triggers the integrated circuit to alert the Gas owner's for preventive action to be taken in order to avoid any further hazardous effect in the home/industry.

## 5. CONCLUSION

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs mainly due to poor maintenance of equipment and inadequate awareness of the people. Hence, LPG leakage detection is essential to prevent accidents and to save human lives. This paper presented LPG leakage detection and alert system.

This system triggers LED and buzzer to alert people when LPG leakage is detected. This system is very simple and reliable.

## REFERENCES

Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis (2012). "Design and implementation of an economic gas leakage detector." Recent Researches in Applications of Electrical and Computer Engineering, pp. 20-24.

Attia, Hussain A., and Halah Y. Ali. (2016). "Electronic Design of Liquefied Petroleum Gas Leakage Monitoring, Alarm, and Protection System Based on Discrete Components." International Journal of Applied Engineering Research, vol. 11, no. 19, pp. 9721-9726.

Apeh, S. T., K. B. Erameh, and U. Iruansi. (2014) "Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System." Journal of Emerging Trends in Engineering and Applied Sciences, vol. 5, no. 3, pp. 222-228.

T.Soundarya, J.V. Anchitaalagammai, G. Deepa Priya, S.S. Karthick kumar, (2014) "C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety," IOSR Journal of Electronics and Communication Engineering, vol. 9, no. 1, Ver. VI, pp. 53-58, Feb.

Ashish Shrivastava *et al* (2013) "GSM based gas leakage detection system." International Journal of Emerging Trends in Electrical and Electronics, vol. 3, no. 2, pp. 42-45.

Bardeen, Brattain, and Shockley (1947); was the first bipolar point contact transistor.

Physicist Julius Edgar Lilienfeld (2012) "a patent for a field effect transistor (FET)" 1925. Ramya.

**SOURCES OF FAILURES OF ENGINEERING SYSTEMS**

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**Abstract**

*This paper looks into the general concepts of failures of engineering systems. It started by defining what an engineering system is, what a failure is, and what it means when an engineering system is said to fail. It then went further to differentiate between sources and causes of failure; which means what, and which helps the overall condition of the system as far as the field of reliability is concerned. Some techniques such as the Root Cause Analysis (RCA) & "the 5-Why" used in determining the root cause (or sources) of failures of engineering systems were highlighted and explained. The general sources of failures of engineering systems were listed bearing in mind that an endless list is imminent if we are to name individually the sources of failure of engineering systems. Lastly, the paper presents FRACAS which is one of the systems or processes used by engineers in collecting failure data, analyzing the riskiest failures to get to the root cause and implement corrective actions. The corrective action part of this process is the area of concentration here, because mere analysis of failure without taking corrective action amounts to nothing.*

**Keywords:** Engineering Systems, Failure, Sources of Failure, Causes of Failure, Root Cause Analysis, The 5-whys, Root Cause of Failures,

## 1. INTRODUCTION

There's a saying that: "A doctor buries his mistake but the mistake or error of an Engineer buries him". This quote shows how grievous an engineering failure could be. In Engineering, unlike in most other fields, the failure of a system could be disastrous. This is why it is of the utmost importance to have knowledge of all "failure properties" of a system at all level of its manufacturing process; especially at the design stage. By studying failures and their sources, an engineer is able to design a better system in terms of reliability. In our immediate surroundings, there are several systems, both natural and engineered. The solar system is an example of natural system. The engineered systems are designed and manufactured to satisfy human needs and wants. Engineered systems are everywhere ranging from the mobile phone we use to the vehicles we drive to the house we live.

A system is a collection of different elements that interact to produce results that are not obtainable by the elements alone. An automobile is made up of thousands of parts and each part must work with the others if the work is to be as desired. From a functional viewpoint, systems have inputs, process and outputs. Input are the resources put into a system. Processes combine the resources to produce the output which can be a product, service or enterprise. From a physical point of view, the system consists of mechanical, electrical and software components that interact to these functions [4].

Failure, according dictionary.com, can be defined as non-performance of something due, required, or expected. Failure of a system or a product can range from failure of such product to meet market target to physical and functional failure of such product or system. Failure can also be defined as realizing undesirable and unanticipated compromises in the quality of engineered systems. Quality is characterized as resulting from integrated effect of all four attributes: Serviceable (fitness for purpose), Safety, Reliability (freedom from unanticipated degradation in the quality attributes), Compatibility (meets business and social objectives- on time, on budget and happy customer) [5]. Quality is defined [6] as the totality of all the features and characteristics of a product or service that contributes to the satisfaction of a customer's needs. In engineering however, a system is said to have failed if at that point in time such engineering system was not successful in performing the specific function it was designed to perform.

Source is anything or place from which something comes, arises, or is obtained while cause is defined as a person or thing that acts, happens, or exists in such a way that some specific thing happens as a result; simply put, source means origin while cause means the producer of an effect[2]. It can be concluded from the above that when we talk about source of a failure, we are referring to the root cause of that failure; and not the direct/ immediate producer of such failure at that point in time. Therefore, the source of failure of an engineering system is root cause of lack of success (in performance and other functionalities) of such system. The source or root-cause of a failure is the most basic cause (or causes) that can reasonably be identified; and when identified and fixed, will prevent or reduce the failure's occurrence [9]. It is the highest level cause of a problem. It is the "evil at the bottom" that sets in motion, the entire cause-and-effect chain causing the problem(s) [10].

## 2. METHODOLOGY

*"An expert is a man who has made all the mistakes which can be made in a very narrow field"*–Neils Bohr

Failure analysis as a process deals with collection and observation of data to determine the source and cause of failure of a system or a product. It assists the failure analysis engineers, after careful study of failed product or system, in designing and manufacturing a better system with higher level of reliability. Simply put, by studying all the causes and sources of a system's failure, a better and more reliable system can be built. In reality, it is not possible to always avoid failure; it is therefore important to think and talk about what it means to learn from failure.

Although, the removal of a cause (also known as Causal factor) of failure of a system can improve the performance or functionalities of the system but this does not prevent the failure from recurring in the nearest future. The ultimate solution to a failure is by "digging deep" in finding the source or root-cause of the failure, which will with a relatively higher certainty "uproot" the problem and fix the system. Therefore to achieve a near permanent solution to the problem of a system, the source of the problem of such system should be aimed at.

## 2.1 Techniques for finding failure

There are several techniques and processes developed mainly for finding the root cause or sources of failure in engineering. Some are ideal for a complete system, others for components. Following are some of the techniques:

### 2.1.1 The five whys

The Five Whys is a simple question-asking technique that explores the cause-and-effect relationships underlying a particular problem [3]. Primarily, the essence of the 5 Whys Technique is to find the root cause of a problem by repeating the question "why?" five times. The second "why" question is formed on the answer to the first one and this continues till the fifth answer is given. The questioning could go further to a higher level but the fifth iteration is generally sufficient to get to the root cause of a problem.

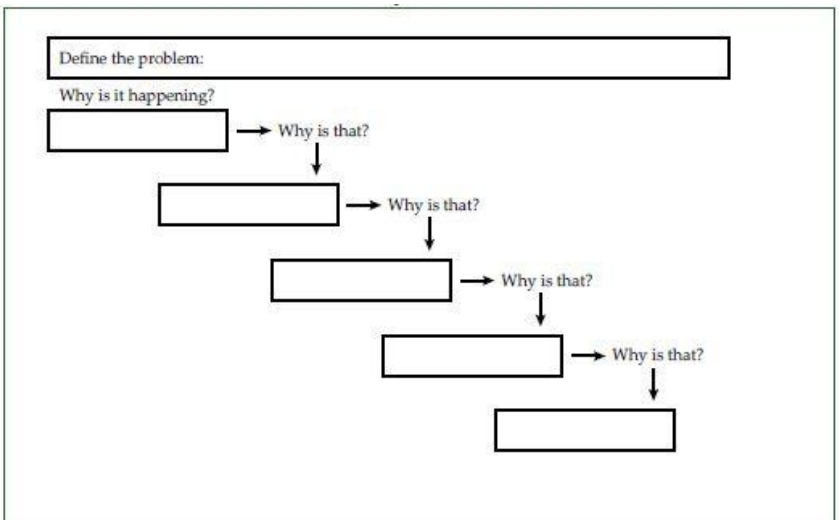
This technique was formally developed by Sakichi Toyoda for Toyota Motor Corporation during the evolution of its manufacturing methodologies.

It is worthy of note that that the last answer points to a process. The real root cause should point towards a process that is not working well or does not work at all which is one of the most important aspects in the five why approach. This means that the only thing we are concerned about is the process and no other thing. Simply put, we do not just ask "why" but "why did the processes fail" [7]

When looking to solve a problem, it helps to begin at the end result, reflect on what caused that, and question the answer five times. This elementary and often effective approach to problem solving promotes deep thinking through questioning, and can be adapted quickly and applied to most problems. Most obviously and directly, the five whys technique relates to the principle of systematic problem-solving: without the intent of the principle, the technique can only be a shell of the process. Hence, there are three key elements for the effective use of the five whys technique:

(i) Accurate and complete statements of problems,
(ii) Complete honesty in answering the questions,
(iii) The determination to get to the bottom of problems and resolving them [3]. The technique was developed by Sakichi Toyoda for the Toyota Industries Corporation.

Fig. 1 is a sample of the five why's techniques worksheet.



### 2.1.2 Root cause analysis [11]

Root cause analysis (RCA) is a process designed for use in investigating and categorizing the root causes of events with safety, health, environmental, quality, reliability and production impacts. The term "event" is used to generically identify occurrences that produce or have the potential to produce these types of consequences.

Simply stated, RCA is a tool designed to help identify not only what and how an event occurred, but also why it happened. Only when investigators are able to determine why an event or failure occurred will they be able to specify workable corrective measures that prevent future events of the type observed.

The RCA is a 4-step process involving the following:

**(i) Data Collection**

**(ii) Causal Factor Charting**

**(iii) Root Cause Identification**

**(iv) Recommendation, Generation and Implementation**

The first step in the analysis is to gather data. Without complete information and an understanding of the event, the causal factors and root causes associated with the event cannot be identified. The majority of time spent analyzing an event is spent in gathering data. This provides a structure for investigators to organize and analyze the information gathered during the investigation and identify gaps and deficiencies in knowledge as the investigation progresses. The causal factor chart is simply a sequence diagram with logic tests that describes the events leading up to a failure, plus the conditions surrounding these events. The investigator begins root cause identification after all the causal factors have been identified. This step involves the use of a decision diagram called the Root Cause Map to identify the underlying reason or reasons for each causal factor. This map the structures of reasoning process of the investigators by helping them answer questions about why particular causal factors exist or occurred. The identification of root causes helps the investigator determine the reasons the event occurred so the problems surrounding the occurrence can be addressed.

Following identification of the root causes for a particular causal factor, achievable recommendations for preventing its recurrence are then generated. The root cause analyst is often not responsible for the implementation of recommendations generated by the analysis. However, if the recommendations are not implemented, the effort expended in performing the analysis is wasted. In addition, the events that

triggered the analysis should be expected to recur. Organizations need to ensure that recommendations are tracked to completion.

## 3. SOURCES OF FAILURES

The field of engineering is a very wide one and if one is to start listing the sources of failures of engineering systems, the list will be an endless one. In the general sense, the sources of failure can be placed under each of the following headings:

1. Processes

2. Operators

3. Management

4. Regulator

5. Government

The list above is like a cadre where reporting and monitoring happens between each of the adjacent levels. On the monitoring side, The Government monitors the Regulator, the Regulator monitors the Management, the management overviews the performance of the system Operators while the Operators check on the Processes. In the level of reporting, it is in the reverse order; the Operators take report from the Processes by studying it. The system Operators brief the Management while the Management report to the Regulatory bodies.

At each of the levels, you have at least one source of system failure to mention; That is to say any source of failure of engineering system you can think of falls under the above mentioned levels of monitoring and reporting [12].

## 4. CORRECTING AND ANALYSIS OF FAILURE

Although finding the root cause of a system's failure is a very important step in the field of engineering, but that alone is not enough. Obtaining the source of failure without applying a correction to such system or using the result obtained to engineer a better system is as good as not analyzing the system. There are several processes used in correcting failure. Below is one of such processes.

### FRACAS

FRACAS stands for Failure Reporting, Analysis and Corrective Action System. It is used to collect data, record and analyze the failure of a system; then plan corrective actions to the failures. The system is a continuous improvement one that utilizes a closed-loop feedback path in which the entire organization works together to collect failure data, prioritize the failures according to risk, analyze the riskiest failures to get to the root cause and implement corrective actions to eliminate repetitive failures[13].

FRACAS can be useful throughout an asset's lifecycle, but it is most valuable as a tool for evaluating failures that could not be eliminated during the design stage. When your system is not meeting the desired or necessary levels of reliability due to the amount of unplanned failures or faults, FRACAS can help. It is implemented such

that the user and the manufacturer of a system or product work together to collect, record, and analyze failures data sets. The user captures predetermined types of data about all problems and submits the data to that supplier. A Failure Review Board (FRB) at the manufacturer end analyzes the failures. The resulting analysis identifies corrective actions that should be implemented and verified to prevent failures from recurring [14].

A simple FRACAS process is as shown in Fig.2

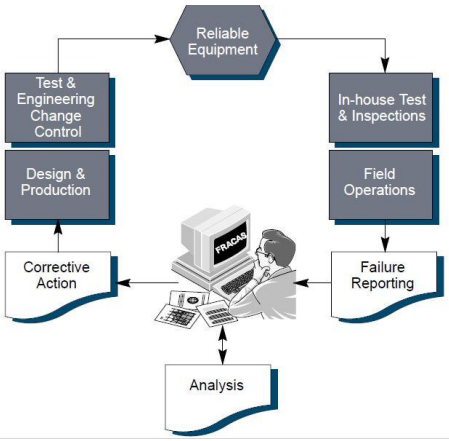



Fig. 2: FRACAS Process [14]

In hing to be taken with levity; doing so ma ot a positive thing but it is an option bec other in the life of an engineered sys neering to study the source of failure.

Th are the "deep" causes of failures. They are , the entire cause-and-effect chain causing the failures. A lot of techniques and processes are in place to collect, analyze data and provide corrections to failures of systems. Therefore, instead of attempting to list all sources of failure, it is sufficient to know at least one technique of failure analysis and apply it to the situation at hand.

**ENDNOTES**

[1]O'Connor, Patrick D. T. (2002), Practical Reliability Engineering (Fourth Ed.), John Wiley &Sons, New York. ISBN 978-0-4708-4462-5.
[2]www.dictionary.com/
[3]"Five Whys Technique"Asian Development Bank. February 2009. Retrievedhttp://www.adb.org(November 22, 2016).
[4]"Introduction to Core Concept of Systems Engineering" Retrieved from http://www.ciese.org/curriculum/seproject/students/SEIntroduction.html. (November 22, 2016)
[5] Bob Bea, "Learning From Failure: Learning from the Recent History of Failures of Engineered Systems" (January 22, 2006), Centre for Catastrophic Risk Management, Department of Civil & Environmental Engineering, 212 McLaughlin Hall, University of California, Berkeley,
[6] Adediran, Y.A, "Introduction to Reliability Engineering"(1st Ed.), Finom Associates, P.O Box 3007, Minna, Nigeria., 2014. ISBN 978-978-52341-2-1.

[7] Taiichi Ohno; foreword by Norman Bodek (1988). Toyota production system: beyond large-scale production. Portland, Oregon: Productivity Press. ISBN 0-915299-14-3.
[8] Khan G Bulsulk "An Introduction to 5-why" Retrieved from http://www.bulsuk.com/2009/03/5-why-finding-root-causes.html?m=1. (November 22, 2016)
[9] Mark Paradies (17 October 2005). "Definition of a Root Cause" Retrieved http://www.taproot.com/archives/120. (November 22, 2016)
[10] "Quality Glossary Definition: Root Cause" Retrieved from http://www.asg.com/learn-about-quality/root-cause-analysis/overview/overview.html (November 23, 2016)
[11] J. J. Rooney & L. N. VandenHeuvel,(2004 July) "Quality Progress: Root cause Analysis for Beginners" American Society for Quality. Retrieved from www.asq.org.
[12] "Sources of Failure", retrieved from http://www.dcs.gla.ac.uk/~johnson/book/parts/chap3.pdf. (November 23, 2016)
[13] "Single Point Lesson:Failure Reporting, Analysis, And Corrective Action System (FRACAS)" Retrieved from http://www.lce.com. (November 23, 2016).
[14] Mario Villacourt, PradeepGovil."Failure Reporting, Analysis, AndCorrective Action System" Retrieved from http://www.sematech.org/docubase/document/2332agen.pdf. (November 23, 2016)

# DIMENSIONS AND ISSUES OF MOBILE AGENT TECHNOLOGY

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**ABSTRACT**
*Mobile Agent is a type of software system which acts "intelligently" on one's behalf with the feature of autonomy, learning ability and most importantly mobility. Now mobile agents are gaining interest in the research community. In this article mobile agents will be addressed as tools for mobile computing. Mobile agents have been used in applications ranging from network management to information management. We present mobile agent concept, characteristics, classification, need, applications and technical constraints in the mobile technology. We also provide a brief case study about how mobile agent is used for information retrieval.*

KEYWORDS: Mobile Agents, Wireless Network

## 1. INTRODUCTION

The rapid development of internet technology has led to an enormous increase in the information access available as a result of sustained research. In this scenario, Mobile agent technology has been proposed as a model to cope up with the requirements of wide-distributed applications. A Mobile Agent is a type of software system which acts "intelligently" on one's behalf with the feature of autonomy, learning ability and most importantly mobility. More specifically, Mobile agent is a process that can transport or migrate its state from one environment to another with its data intact and is capable of performing appropriately in the new environment [1]. When a Mobile Agent moves, it saves its own state and transport this saved state to the new host and then resumes execution from the saved state. This obviously saves the network bandwidth especially in a wireless environment because once the Mobile agent is migrated; the connection between the networks is disconnected.

The remainder of this work is organized as follows: section 2 explains the Mobile Agent Technology concept, section 3 presents the characteristics of Mobile Agents. Based on characteristics, types of mobile agents have been explained in section 4. Section 5 explains the need for Mobile agent technology. The applications of Mobile agent technology are explained in section 6. Section 7 explains the case study for information retrieval from electronic calendars for multiparty event scheduling. The technical constraints in the widespread development of mobile agent technology are presented in section 8, followed by section 9 that concludes our presentation

## 2. MOBILE AGENT TECHNOLOGY CONCEPT AND TERMINOLOGY

The mobile agent in its promising paradigm provides a new means of communication amongst the network nodes. Mobile agents have been evolved from the Mobile-Code approach. Further works extended the approach to mobile –object concept in which the object (code and data) is moved from one machine to another. It will easily replace Client/Server model in future. The mobile agent has further extended this concept by moving code, data and state from one computing environment to other. Mobile agents execute at one machine, move with their state to another machine and resume execution at that new machine. These codes and objects are moved by the external command while mobile agents moved autonomously.
Before the advent of Mobile agents, the communication between the client and server is achieved by different approaches such as message passing, Remote Procedure Call (RPC) and Remote Evaluation (REV). In RPC method, the procedure resides in the server and client sends a data to the procedure that will be executed there, finally the result is back to the client. In REV approach which is different from the RPC, the procedure itself will be sent and the desired result is returned to the client. A Client/Server model is that in which server provides services to the client. The request for services is made by the client through a communication channel whether it is wired or wireless. So, when a client needs a service, it usually sends a request message to the server as shown in fig. 1. In case, the server does not have resources to satisfy the request made by the client, the client sends request to other server having the needed resource to satisfy the client that usually increase the inefficient use of network bandwidth. This also increases the network traffic and causes delays due to the involvement of more servers. These factors prohibit the widespread use of this model in a mobile device, because disconnection is frequent in the wireless environment.

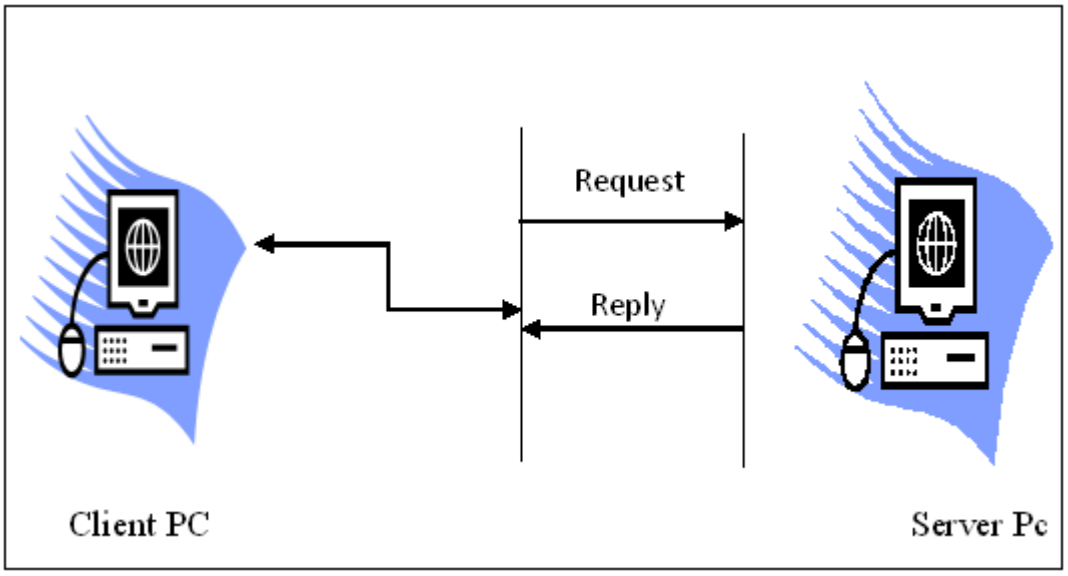


Fig.1 Client/ Server Model

Mobile agent provides solution for this mobile device because they do not depend on the server operation. Once the mobile agent has migrated, the connection between the client and server is disconnected, later when mobile agent finishes its job at the server, then it will reconnect to the client or host with the result shown in fig.2. This clearly saves the network bandwidth especially in the wireless environment where disconnection is frequent and bandwidth play a major role.

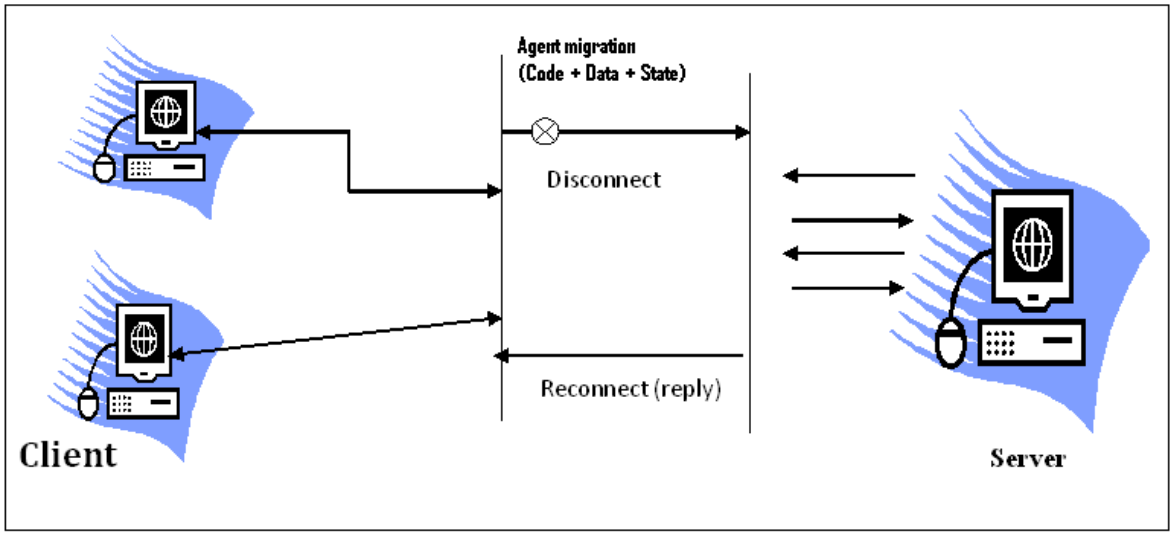


Fig 2 Mobile Agent Model

## 3. MOBILE AGENT CHARACTERISTICS

Mobile agents have different kinds of characteristics [5, 6]. They should be.

- Autonomous: An agent is able to take initiative and exercise a non-trivial degree of control over its own actions.
- Interactive: means Mobile Agents should communicate with other agents and their environment. In addition, mobility is the most important property in the Mobile Agent concept, where agent migrated from one node to another within the same environment or in different environment.
- Coordinative; means perform data transfer with other agents in a given environment.
- Proxy: Mobile agents may act on behalf of someone, so they should have certain degree of autonomy.
- Ragged: Mobile Agents should have the ability to deal with the errors whenever occurred.
- Proactive: means they should be goal oriented.
- Cooperative: means coordinate with other agents to achieve a common goal. Mobile

Agents should have the capability of learning the current environment and modify its behaviour based on this information.

- Intelligent: means Mobile Agent should be too smart in order to act efficiently.

Based on these characteristics, numbers of agents have been proposed by the researchers. It is not required that agents have all these properties .This is determined by the purpose that agents have to achieve. For this we consider an example of Microsoft's software agent [7] which does not need to be mobile and cooperative but it must be smart and proactive.

**4. CLASSIFICATION OF AGENTS**

Numbers of agents have been built based on their purposes. Mobility is the core property in case of all.

- COLLABORATIVE AGENT:-An agent which collaborates with other agents to carry out an intended task. Other agents in this category can be Reactive agents, collaborative Agents or intelligent deliberative agents. Each has a degree of expertise about some area and calls upon the expertise of other agents in the areas where it lacks expertise.
- INTERFACE AGENT: An interface agent can be considered as a program that can also affect the objects in a direct manipulation interface, but without explicit instruction from the user. The interface agent reads input that the user presents to the interface, and it can make changes to the objects the user sees on the screen, though not necessarily one to-one with user actions. The agent may observe many user inputs, over a long period of time, before deciding to take a single action, or a single user input may launch a series of actions on the part of the agent, again, possibly over an extended period of time. The essential characteristics of an interface agent include responsiveness, competence and accessibility.
- INFORMATION AGENT: Information agents are special kind of so-called intelligent software agents. Software agent technology originating from

distributed artificial intelligence is inherently interdisciplinary. Thus, the notion of agency is quite broadly used in literature; it might rather be seen as a tool for analysing systems, not an absolute characterization that divides the world into agents and non-agents. However, intelligent agents are commonly assumed to exhibit autonomous behaviour determined by its pro-activeness, means taking the initiative to satisfy given design objectives and exhibit goal directed behaviour, reactive or deliberative actions, means perceiving the environment and timely change management to meet given design objectives, and social in groups with other agents and/or human users when needed. It depends on the concrete application domain and views on potential solution for a particular problem what an intelligent agent in practice is supposed to do.

- REACTIVE AGENT: Capable of maintaining an on-going interaction with the environment, and responding in a timely fashion to changes that occur in it. Note that the term is now widely used to mean a system that includes no symbolic representation or reasoning: such an AGENT does not reflect on the long-term effects of its actions, and does not consider the co-ordination of activity with other agents. Thus, a REACTIVE AGENT will always respond in a timely fashion to external stimulus.
- SMART AGENT: new forms of software agent that interface with other agents forming an artificial Intelligence system. The acronym" SMART" stands for "System for Managing Agents in Real Time". This is a bit of misnomer because the agents manage themselves and each other by agreeing to become part of the collective whole.
- INTELLIGENT AGENT: have been around for a long time in various forms. The term intelligent agent can refer to any agent that exhibits some amount of intelligence and there is no requirement that the agent have the ability to work with other agents.
- COGNITIVE AGENT: is a software agent that is also an intelligent agent which performs a task with minimum specific directions from the user. It evolves from the concept of virtual personal assistant, a cognitive assistant that learns and organizes.
- An Agent moves from one site to another by meeting with the LOCAL REXEC AGENT. The REXEC Agent expects to find two folders in the briefcase; one is HOST folder that is site, where execution is to be moved and a CONTACT folder that is agent to be executed at that site. The CONTACT folder contains the name of an agent which is a shell or a compiler. This agent would expect to find a CODE folder in the briefcase that contains the source code for an agent which it would then translate and execute .This scheme allows an agent to move to a destination site having different machine language.
- COURIER AGENT which transfers a folder to a specified agent on a specific machine.
- DIFFUSION AGENT, which executes an agent locally and then creates a clone of itself at every site. Scheduling allows the enforcement of policies that tells when and where an agent is executed.

- This scheduling is implemented by BROKER AGENT, which maintains the database of service providers .An Agent needs a given service always consult a broker to identify which agent provides that service.
- REAR GUARD AGENT, it is possible that sites in a computer network will fail. When such a failure occurs, agents at that site will no longer be continuing execution. To solve this problem a REAR GUARD AGENT can be deployed so that the execution can proceed. This agent follows the execution process which moves from one site to another.

When an agent fails, this REAR GUARD AGENT launches a new agent. On resumption, this REAR GUARD Agent terminates its own action.

**5. THE NEED FOR MOBILE AGENT TECHNOLOGY**

The Mobile Agent has its applications in many areas including network management, mobile computing, information management, web services, remote software management and others.

Mobile Agents enhance the performance in these areas by providing the following services:

Efficiency and reduction of network traffic: Mobile agents consume fewer network resources since they move the computation to the data rather than the data to the computation. Also mobile agents can package up a conversation and ship it to a destination host, where the interactions can take place locally, so network traffic is reduced (figure 3).

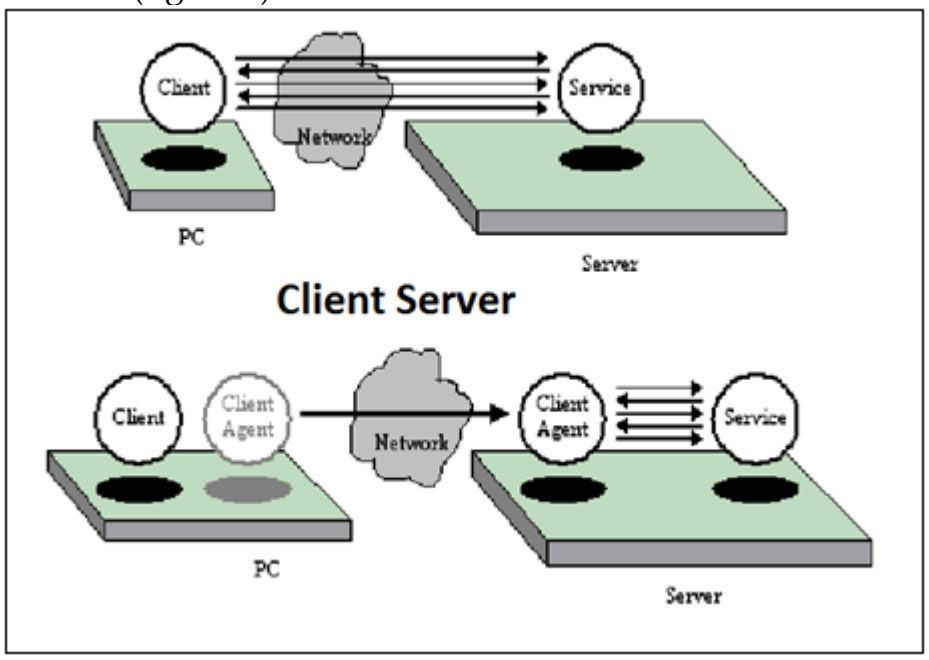


Fig 3: Mobile gent Network Traffic

Asynchronous autonomous interaction: Tasks can be encoded into mobile agents and then dispatched. The mobile agent can operate asynchronously and independent of the sending program. Interaction with real-time entities: Real-time entities require immediate responses to changes in their environment. Controlling these entities from across a potentially large network will incur significant latencies. Mobile agents offer

an alternative to save network latency. Local processing of data: Dealing with vast volumes of data when the data is stored at remote locations, the processing of data over the network is inefficient. Mobile agents allow the processing to be performed locally, instead of transmitting the data over a network. Support for heterogeneous environments: Both the computers and networks on which a mobile agent system is built are heterogeneous in character. As mobile agent systems are generally computer and network independent, they support transparent operation. Convenient development paradigm: The design and construction of distributed systems can be made easier by the use of mobile agents. Mobile agents are inherently distributed in nature and hence are natural candidates for such systems.

There are three basic needs for Mobile Agents to achieve these goals, the Mobile Agent Program, Mobile Agent Platforms and Mobile Agent Creator. Today the mobility is performed by different coding methods. So, the conventional Programming Languages cannot be applied in implementation. However, implementation through java due its independent execution environment is somehow being managed to build distributed applications. The following operation: Creation, Cloning, Dispatching or Migration, Retraction, Activation, Deactivation and finally Disposal have been carried out through java [8, 9]. These operations constitute the mobile agent life cycle. Creation is the first phase in the mobile agent life cycle. Whenever a request is made to the mobile agent, a mobile agent instance is created which means a desired parameter is equipped with the mobile agent to achieve its goal before any further work is done. Cloning refers to creating a copy of the original mobile agent object. This operation is used when the need for another agent with the same feature arises. The migration or Dispatching is used for moving the agent from one node to another by specifying address of the destination. This migration is of two types. One is strong Migration in which the mobile agent itself, its data and its state move.

Second one is weak Migration which includes mobile agent itself and its data. The Retraction function is used whenever agent's source node required that its agent returned to the original host after completion of its job. To start and stop of mobile agent is done by the Activation and

Deactivation operation. Finally Disposal operation is done at the end of the mobile agent life cycle. Fig.4 shows the mobile agent life cycle (operation).

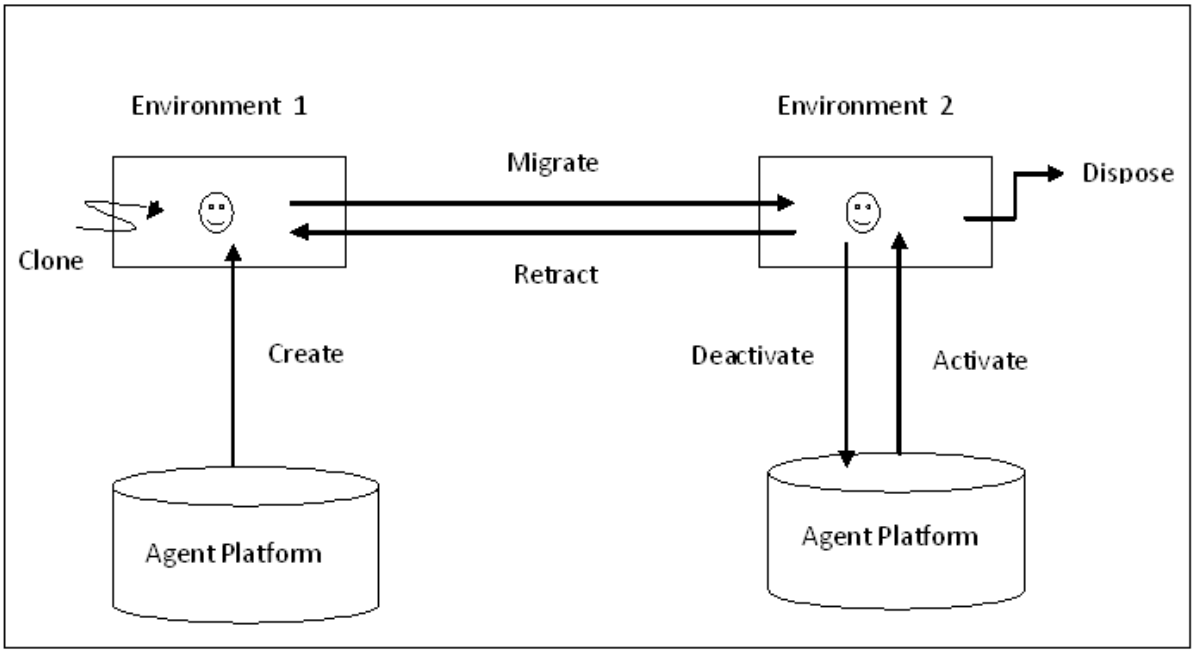


Fig. 4 Mobile Agent life cycle

The second requirement is the mobile agent platform or execution environment. Mobile agent platform must be implemented and exists to run the mobile agent application. Mobile agent platform must have some special characteristics so that the host may know how to deal with the incoming agents and provides the environment to those agents so that they can achieve their goals. For this, the requirement should be platform independence, authentication, secure execution, dynamic class loading, network connectivity and resources control. These requirements should be provided by the mobile agent platform. Over the past few years, numbers of industrial mobile agent platform have been proposed which provides these resources such as Telescript [14], Aglets[8], Concordia[4] and Voyager[10].

The third requirement is the mobile agent creator means developers who developed the mobile agent system based on two main models. The first model which is just as an extension to the operating system function, controls the mobile agent life cycle and provides one platform per host. This model does not give much flexibility because each agent has operated based on their allocated platform and does not operate independently. The second model is compound based model which separates the platform from the host. This separation helps developers to develop a wide range of mobile agent applications because now agents operate autonomously [11].

## 6. APPLICATIONS OF MOBILE AGENT TECHNOLOGY

Mobile agent technology has been used in many areas from network management task to information management. Mobile agents have significantly used in the wireless environment because it supports the disconnected mode. As the mobility has been migrated from the PDA (Personal Digital Assistant) to the network, the PDA could be disconnected and when the mobile agent finishes its job then they can reconnect in the network with the

desired result from the agents. This gives advantage over conventional communication methods such as client/server model, RPC etc.
Mobile agent technology is frequently used in other applications such as data warehouse, software updates, information management tasks such as searching for information, information filtering, information monitoring etc. Mobile agent technology has been also applied in M-commerce for information retrieval regarding the lower price of any particular item. In this, mobile agent have been issued by the PDA and disconnected from the network. This agent will then roams from one node to another on the internet and compare the price. When the mobile agent finds the cheapest result, it will then return to the PDA. This concept of information retrieval is further explained by considering a case study of multiparty event scheduling.

**7. CASE STUDY**

The case study of this research is on information retrieval from electronic calendars for multiparty event scheduling [13]. Many events require the participation of several parties. Before knowing the date when most (not all) participants will be available is all depends on their schedules. But to identify this date is always a typical task when number of targeted participants is large. Today, electronic agendas are stored on server. An application can access them and retrieve information. In case study, we dispatch a mobile agent in the network instead of using client/server paradigm. In this approach, the agent visits the server, access the agendas, retrieve the information and identifies the date. This is explain in figure 5.

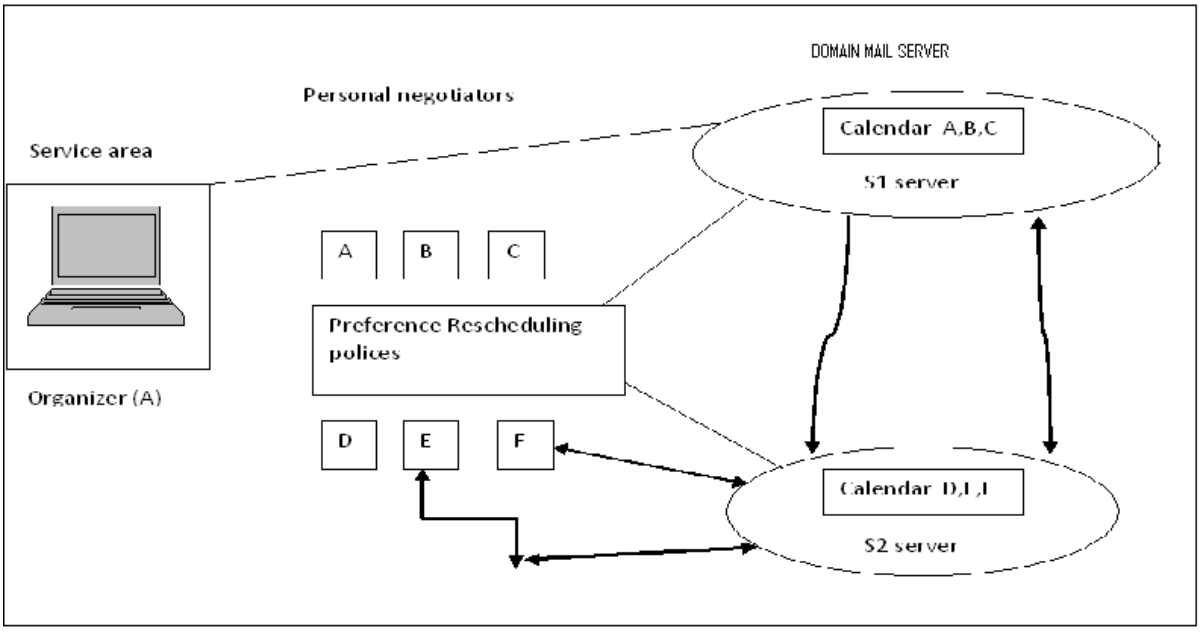


Fig 5. Mobile Agent Scheduler Scenario

The conference has been organized by A and the targeted participants are A itself, B, C, D, E and
F. In this A, B and C are resides in S1 domain and D, E and F resides in S2 domain. There is one server per domain. Each participant has their personal agent who can

work on behalf of them. The condition for conference is that, it will be held only if at least four participant are available and it will take place in a given month (specified). The organizer A gives the name and e-mail address of targeted participant along with the month when the event takes place to his own agent. The agent connect itself to S1 and retrieves the calendars of A, B and C for a given month and process the information to find the date when all three participant will be available. It could be few days. After that the agent moves to S2 and retrieve the information of D, E and F and compare with the dates of A, B and C. The agent finds that two dates are suitable for F but fails to find the date with D and E. Then, this scheduler agent proposes these dates to the agents of D and E and finds that E can reschedule his event but D could not. The agent finally sends a notification to the A, B, C, E and F because four participant are available, which is necessary conditions for events and finally event will take place. This surely increases the performance of the system.

## 8. TECHNICAL CONSTRAINTS

The mobile agent is relatively a new technology and provides new way of communication amongst network nodes. There are number of successful mobile agent applications but still there are some barriers preventing the wide spread of this technology. There are so many reasons; one of them is lack of standard in software and hardware products e.g programming language, protocols and devices. Researchers are working on these standards so that developers can build a powerful applications based on mobile agent technology. The lack of understanding about what the mobile agent should perform is another contributing problem. The infrastructure is not suitable for implementing the mobile agent's technology [12].

There are several issues such as security, privacy, trust, integrity etc. This can explain by considering a case where mobile agents are used in E- commerce or M- commerce for transaction over the internet. It means, Mobile Agent will access the user profile which contains some sensitive information about the users, which may be shared with other agents in the working environment .This information may be modified during transactions. So, trust and privacy lost.

That's why we need some methodology so that information could be send without changes its contents or we can say that, Mobile Agents need to be protected against hosts and hosts need to be protected against mobile agents [2,3].

Other issues such as today's market are based on conventional client/server model. So, we have to rethink in the design so that mobile Agent technology could be employed with ease. To summarise, the table below briefly explains the implication of using Mobile agents:

Table 1: Technical Implications of Mobile Agents

| Technical Issue | Implication for Mobile Agents |
|---|---|

| | |
|---|---|
| Bandwidth | MAs conserve bandwidth, especially for networks which have low bandwidth capacity (e.g wireless network). By replacing continuous communication with an agent directly at the point of information generation, the bandwidth use can be reduced. Instead of sending dozen or even hundreds of queries across the network, sending one agent on a single request the agent can manage this process locally at the remote side. |
| Fault-tolerance | MAs can act or respond on errors that may be encountered within their contexts because of their adaptive and ragged attributes. |
| Flexibility | MAs can give greater flexibility, because new tasks and codes can be added to the system without the need for a fixed code-base. |
| Interaction | MAs enable new type of interaction, such as negotiating agents that travel<br>to server site seeking for the best deal such as comparing prices (e.g ecommerce application). |
| Protocols | MAs are able to move to remote hosts in order to establish channels based on proprietary protocols. |
| Scalability | MAs can carry out their function well (without disruption) when the host system or environment changes in size or volume in order to meet a new user need. |

## 9. CONCLUSION

Mobile agent technology provides a new way of communication over heterogonous network environment. A number of advantages have been proposed and identified which includes: efficiency and reduction of network traffic, asynchronous autonomous interaction, interaction with real-time entities, local processing of data, support for heterogeneous environment and having robust and fault-tolerant

behaviour. However, the security, infrastructure and standardising issues still represent significant constraints. The main thing which we concluded from our findings and investigation is that mobile agent technology has the potential in increasing the performance of networks as well as for software adopting mobile agents. Due to its nature of being a futuristic technology from the programming environment perspective a lot of work is still required before the average programmer can build applications based on the mobile agent technology paradigm with ease.

**REFERENCES**


[1] Aglet platform. (2004). URL: http://www.research.ibm.com/trl/aglets/spec10.htm

[2] Concordia. (1997) "Concordia: An Infrastructure for Collaborating Mobile Agents" Proc. of Workshop On mobile agents MA'97, Berlin, April 7-8th. LNCS 1219, Springer Verlag.

[3] D. Lange, M. Oshima. (1998). Programming and deploying java mobile agents with Aglets, Addison Wesley, ISBN: 0201 32582 9.

[4] Glitho, R.H, E. Olougouna, S. Pierre. (2002) Mobile agents and their use for information retrieval: a brief overview and an elaborate case study, Ericsson Res., Montreal, Que IEEE, Jan/Feb 2002, on page(s):

[5] J. White, telescript technology Mobile Agents, General Magic White paper,

[6] M. Wooldridge. (2002). an introduction to multiagent system, JohnWiley & Sons Ltd, England, ISBN:

[7]MSA.(2004).Microsoftsoftwareagent
URL:http://www.microsoft.com/msagent/default.asp

[8] Objectspace. (2004).Voyager Technical overview, http://www.objectspace.com/voyager

[9] OMG. (2000). Agent technology, green paper, technical report ec#2000-03-01, object management group, march 2000, URL: http://www.jamesodell.com/ec2000-08-01.pdf

[10] P. Morreale. (1998). Agents on the move, spectrum, IEEE, volume: 35 Issue: 4, April 1998, wepage(s) 34-41.

[11] R. Gray, D. Gotz, S. Nog, D. Rus,G. Cybenko Mobile agents for mobile computing, Tech Report URL:ftp://ftp.cs.dartmouth.edu/TR/TR96285.pdf,

[12] Roch H. Glitho. (2002). Mobile Agents and Their use for Information Retreival: A Brief Overview and an Elaborate Case study, IEEE Network January/February 2002.

[13] S. Adnan, J. Datuin, P. Yalamanchili, a survey of mobile agent system, URL:http://www.cs.ucsd.edu/classes/sp00/cse221reports/dat-yal-adn.pdf, 34-41, Volume: 16, issue: 1, ISSN: 0890-8044, INSPEC Accession Number: 7165883.

[14] S.M.Dejan, W.LaForge, D. Chauhan. (1998). Mobile objects and agent (MOA) Proceeding ofnUSENIX COOTS"98, Santa Fe, New Maxico, USA,

# SAFETY EVALUATION OF MECHANICAL EQUIPMENT IN CONSTRUCTION INDUSTRIES

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**ABSTRACT**

*Safety of mechanical equipment in construction companies is of great importance. More user friendly equipment are now being manufactured and maintenance regulations are made so as to make machines safer. Despite these, accidents are still being recorded. Continued accidents and injuries caused as a result of use these mechanical equipment are to be investigated and prevented and therefore the aim of this Study include to, investigate the safety practices in the use of mechanical equipment in construction industries, To evaluate safety effectiveness in the use of mechanical equipment e.g. bulldozers, excavators, payloaders, graders etc., in construction industries, and To develop imaginative proposals to strengthen the industries approach to the control and management of health and safety risks. Possible cause of these accidents are identified from four root areas: machine design, maintenance, human/ personal factors and work issues. Accident records of construction companies were vetted, interviews were conducted with the managers and employees, questionnaires were also administered in order to get the present safety situation of mechanical equipment. Four construction companies whose major activities are road construction were used as samples for the collection*

*of data. The safety in the usage of mechanical equipment was found to still fall below the average in construction companies considered. This is due to the non-use of new machines with better designs for safety and the defective maintenance culture existing in most construction companies.*

**Keyword**: Safety, Mechanical equipment, Construction industries

## *1 INTRODUCTION*

The rate of industrial growth and development is directly proportional to the increase in the use of mechanical equipment. On another hand, the increase in the use of mechanical equipment is associated with resulting mechanical injuries and fatalities. With the rapid industrialization and technological development, most mechanical system are rapidly growing in scale and functionality and it become more and more difficult to guarantee safety practices, thereby resulting into frequent accidents. Therefore there is need to evaluate the safety of mechanical equipment in construction industries in order to prevent accident or reduce it to the minimum. The importance of safety cannot be neglected due to the role it plays in the society. Sudden unexpected event often disrupt the operation of a system and may likely lead to mishap. These sudden events that end up with bad situation are known as accident. However, accidents have become daily occurrence and have found existence in virtually every activity in the industries. Unnecessary accidents involving machines and mechanical equipment continue to happen. Attempts to change the safety culture in the construction industry has been an uphill struggle and of limited success for a number of reasons. The approach has been to legislate, to culture on sites. In addition to these, a longer term strategy for reducing these accidents would be to design inherently safer machinery and to evaluate the safety condition before putting machinery into use in order to reduce the risk of accidents. It is expected that this will require a change in the safety culture and a greater awareness of the human factors pertaining to mechanical design. Current machinery design may not be as risk-free as it could be because, designers do the minimum, or only what is required to satisfy legislation. The requirement for a risk assessment is satisfied when laid over the design process, often at the end of it and is not required to be an integral part of that process. In order to design and produce inherently safer machinery, it is essential for designers to attempt to foresee the risks associated with the use of a piece of machinery. To do this, it is necessary to consider all aspects of design to include:

- How a machine would be used in normal use
- How it might be used in adverse condition
- How it might be miss-used in order to get a job done more quickly or more easily.
- What the state of mind might be of different people who will come into contact with the machinery.

It is true that risk assessment must embrace these aspects, but machinery must be designed taking into account ease and safety in use and 'foreseeable misuse'. The

essential fact is that, to increase safety in use, machineries and equipments must be designed to best fit the people who uses them, rather than for users to adapt/fit to the design presented. If human factor issues are properly accounted for, then the resultant designs will provide a best fit to all the circumstances of human use (and mis-use), providing a safer environment, resulting in a fewer accidents (Crabb, 2000). Over many years, a great deal of effort has gone into reducing the number of injuries and fatalities as a result of use of mechanical equipment. Researches and initiatives from all sides of the industry have produced a long – term reduction in the number of injuries and fatalities; but recently their effects have diminished and numbers of deaths have even risen. Meanwhile, there has only been limited success in tackling the causes of occupational ill health, which still accounts for the premature death and disablement of many thousands of workers in construction industries. Despite countless health and safety initiatives and campaigns, the industry remains dangerous, what is even worse is that almost all of the deaths and injuries that occur are foreseeable and preventable. We have known for years, how to prevent them, but they still happen- often in the same old ways (Gibson, 2002). The safety of a worker also involves his/her good health. A healthy and contented work force gives back to the employer, a number of very tangible benefits in terms of high productivity, high product quality, lower rate of absenteeism, fewer disputes and increased loyalty and a stable workforce which also means less training expenses for new staff (Akpokoje, 1998). Many people already recognize that good health and safety is not only morally right, but also makes good business sense. International agencies, nations, private and public organizations have been investing enormous human and material resources on safety. This is a reflection of the importance of safety programmes. Indeed in recent times, safety engineering, a branch of industrial engineering, primarily concerned with scientific control of accidents, has received considerable research attention (Garette, 1995), (IAEA, 1996) (Rockwell et al 1970). In construction industries, the use of heavy mechanical equipment (such as bulldozers, grader, excavator, pay loader, etc.) are often involved and of course, injuries resulting from such equipment can be very fatal and severe. The importance of safety therefore, cannot be overemphasized due to the fact that accident, no matter how minor it maybe, will definitely have negative effect on productivity and output. Thus in any industry where financial, mechanical and human inputs have been invested, there is need for safety evaluation in order to effect a desirable output. The scope of this study is basically limited to construction industries in Nigeria, such as those in Oyo State, Kwara State, and Lagos State

## 2 *LITERATURE REVIEW*

### 2.1 Hazard

Hazard refers to the risk or chance of losses that are found in industrial establishment. Information in particular is important in property managing workplace hazards. This encompasses an awareness of problem, an understanding of

their nature and a knowledge of how to go about solving them ( Sanders and Mc Cormick, 1987)

### 2.2 Accidents

This occurs in everyday activity. Industrial accident is an unpleasant event that happens in an industrial premise or environment suddenly and unexpectedly with a resultant injury or damage.

#### 2.2.1 Causes of Accidents

Failure to follow known safe procedures, nonexistence and inadequate guarding are common contributing factors (Gardner D. et al, 2000).However major causes of accident associated with mechanical equipment in construction industries, include, disobeying safety rules, inexperience of personnel, human error and risky operation, inadequate safety education and faulty equipment and machine fault. A device which appears to malfunction because it has responded as designed to a bad input is suffering from a command fault (Wikipedia, 2008)

## *3 MATERIALS AND METHODS*

For the purpose of this study, data on some selected mechanical equipment related injuries were collected from selected construction industries. The mechanical equipment studied were collected from selected construction industries. The mechanical equipment studied were mainly earth-moving equipment such as bulldozers, graders, excavators, pay loaders, etc. They were selected because of their common and frequent use in most construction companies. In the survey, injury data from construction activities over a period of time was collected. In order to achieve the stated objectives of this study, some primary data as well as useful information was also collected through:

- Structured interviews
- Self-administered questionnaires
- Record viewing
- Technical checklist

### 3.1 Analysis of Data

Raw data collected from each construction industry was modified and entered into contingency tables using the chi-square ($\chi^2$). The null hypothesis was tested whether to be accepted or rejected at a particular probability to arrive at a reasonable conclusion. The formula used for chi-square is $\frac{(o^i - e^i)^2}{e_i}$ . The data obtained from the four construction companies were also tested for similarity using the ANOVA.

## 4. *RESULTS AND FINDINGS*

### 4.1 Number Of Mechanical Equipment Injuries

Of the 165 people who returned questionnaires, 73(44%) reported that they had experienced an injury while 92 (56%) said that they had seen someone else

injured.There were differences in the way these questions were answered, because some viewed some injuries as minor compared to others and therefore chose not to account for such.

### 4.2 Nature Of The Mechanical Equipment Injuries Reported

Through the oral interviews and the self-administered questionnaires, 124 incidents of injury. For the 101 accidents, for which the nature of injury was recalld; open wounds were the most common injuries(63), followed by crushing (22) and amputation (12)

### 4.3 Factors Associated With Mechanical Equipment Injuries.

#### 4.3.1 Operator Age And Experience

The mean age of workers that are allowed to operate machines in all the companies observed was found to be 26.5 years. The number of experienced workers was also very minimal as the management of these companies make too much frequent changes in machine operators. Of the 165 operators who returned questionnaires, only 30 have worked for a particular company for more than 10years. There was a strong relation between the operator age and experience and the frequency of mechanical equipment injuries. Companies with higher average age and higher level of operator experience had lower number of accidents as viewed from the accident records of the various companies

#### 4.3.2 Operator Literacy

Off all the 165 operators interviewed, none has a tertiary education. Very few of the operators completed their secondary education. Most are either primary or secondary school drop-outs. Some did not even have any form of education. There was a great link between the level of operator literacy and the mechanical equipment injuries encountered.

#### 4.3.3 Machine Age and Model

The mechanical equipment in the various companies were examined and checked. Enquiries as to the age of machine (from manufactured date), the years of usage (years for which it has been involved in continuous use) and the condition of purchase (new or used) were made. Of the companies visited, 192 various types of earthmoving equipment were in constant use. Enquiries showed that the average age of machines was 35 years. It was observed that most of the machines used are old models of between 1976 and 1984. The latest model of earth moving equipment found in use was 1998 model. It was gathered that new models are too expensive and requires high level of technological knowhow which may not be readily available in the country.

#### 4.3.4 Machine Design

A large proportion of machines observed were poorly designed. Of the 192 pieces of machinery examined. 150(78%) were rated as having poor design for safety, 25(13%) were rated as having satisfactory safety design and 17(9%) were rated as having good safety design. The attributes rated for machine design are as follows:

- Existence of traps (between parts)
- Exposed rotating parts (gears, wheels, shafts, spindles)
- Poor control design (knobs in awkward locations)
- No emergency stops
- Exposed moving parts
- Poorly located emergency stops
- Sharp points on the machine exposed (edges, corners, tapers)

Machines often had a combination of design problems. One of the most serious design problem was exposed rotating parts including gears, wheels, shafts and spindles. Companies having the best machine design tended to have the lowest number of mechanical equipment injuries.

### 4.3.5 Machine Guarding

Of the 192 machines observed, 171(89%)) were considered to require guards on account of exposed moving parts and other hazards but only 95(50%) requiring guards actually had them. However, there was no significant correlation between the existence of guards and the number of accidents reported. Some of the machines with guards and the number of accidents reported. Some of the machines with guards have the guards being poorly designed.

Guards were frequently removed; the most common reason given for removal wa that it was difficult to do the job with the guards in place. Several tasks were observed where the work necessitated removal of guards. Employers and employees discussed the difficulty they had finding or making new guards for old machines which were not built with guards.

### 4.3.6 Maintenance of Equipment

Of the 192 pieces of equipment checked, 88(46%) were rated as being in poor condition, while 104 (54%) were rated as having satisfactory or good condition. This data was supported by questionnaire findings regarding maintenance. Machine condition was significantly associated with the number of mechanical equipment injuries. The extent of use of machines is also a very important factor considered. Machine used beyond their working limits or used inappropriately are more likely to develop faults which may affect the occurrence of accidents. It was also reported that when low grade machine parts are used to replace worn out ones, such results into faulty machine operation which often caused accidents in construction companies. Companies which use adequate machine parts and does not work the machines beyond their limit tended to have low injury frequency.

### 4.3.7 Personal Protective Equipment(PPE)

During the examination of the workplace, items of PPE were assessed. It was also noted whether or not workers were actually wearing PPE. There was significant

correlation between the condition of PPE and the number of mechanical equipment injuries reported. Results from interview revealed that the managers find it difficult to make employees wear PPE. Employees on the other hand claimed that necessary PPE were not provided for the management. It was however observed that only few apprentices make use of PPE, while experienced employees were working without PPE. Correspondents also claimed that the use of PPE makes them uncomfortable and inconvenient

### 4.3.8 Respondents report of cause of accidents

The respondents report based on completed and returned questionnaires were also analysed using the Chi – square ($\chi^2$) method of analysis. Table 1, 2, 3, and 4 shows the descriptive and independence statistics of raw scores of factors in the four companies examined. The tables give the mean value, the calculated and table value of chi-square($\chi^2$) for each company under the four factors considered as possible cause of accidents.

The null hypothesis and the alternative hypothesis are based on the four factor being considered as follows:

$H_{1a}$: Present machine design is adequate for the safety of mechanical equipment

$H_{1b}$: Present machine design is inadequate for the safety of mechanical equipment.

$H_{2a}$: Present maintenance level is adequate for the safety of mechanical equipment

$H_{2b}$: Present maintenance level is inadequate for the safety of mechanical equipment

$H_{3a}$: Present human/ personal factors are adequate for the safety of mechanical equipment

$H_{3b}$: Present human/ personal factors is inadequate for the safety of mechanical equipment

$H_{4a}$: Work issues do not affect the safety of mechanical equipment

$H_{4b}$: Work issues affect the safety of mechanical equipment

Table 1: Descriptive and independence statistics for RCC, Ibadan study (n=42)

| No | Factors | Mean | $\chi^2$ (calculate) | $\chi^2$ (table value) $p<0.05$ |
|---|---|---|---|---|
| 1. | Machine Design | 2.33 | 551.18 | 36.42 |
| 2. | Maintenance | 1.99 | 612.99 | 40.11 |
| 3. | Human/personal factors | 2.88 | 475.68 | 47.44 |
| 4. | Work issues | 2.87 | 230.34 | 25.00 |

Table 2: Descriptive and independence statistics for KYFY Global Nig. Ltd study (n=56) Ibadan study (n=56)

| No | Factors | Mean | $\chi^2$ (calculate) | $\chi^2$ (table value) p<0.05 |
|---|---|---|---|---|
| 1. | Machine Design | 2.16 | 550.18 | 36.42 |
| 2. | Maintenace | 2.10 | 516.20 | 40.11 |
| 3. | Human/personal factors | 2.81 | 338.44 | 47.44 |
| 4. | Work issues | 2.88 | 236.84 | 25.00 |

Table 3: Descriptive and independence statistics for BULLETIN construction company Ltd. Study (n=32)

| No | Factors | Mean | $\chi^2$ (calculate) | $\chi^2$ (table value) p<0.05 |
|---|---|---|---|---|
| 1. | Machine Design | 2.31 | 190.67 | 36.42 |
| 2. | Maintenance | 2.30 | 505.86 | 40.11 |
| 3. | Human/personal factors | 2.42 | 134.70 | 47.44 |
| 4. | Work issues | 2.50 | 60.85 | 25.00 |

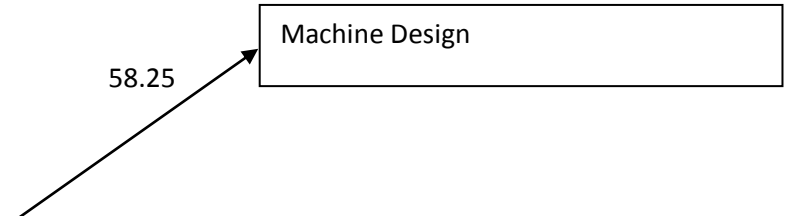
Table 4: Descriptive and independence statistics for FIRST AUG Ltd study (n=35)

| No | Factors | Mean | $\chi^2$ (calculate) | $\chi^2$ (table value) p<0.05 |
|---|---|---|---|---|
| 1. | Machine Design | 2.10 | 112.56 | 36.42 |
| 2. | Maintenace | 2.00 | 114.42 | 40.11 |
| 3. | Human/personal factors | 2.46 | 114.86 | 47.44 |
| 4. | Work issues | 2.52 | 72.0 | 25.00 |

Considering the calculated values and table values of chi-square ($\chi^2$) obtained at 5% level of significance for the factors, for all the four companies, the calculated values exceeds the table value. All the null hypothesis will therefore be rejected while the alternative hypothesis will be accepted.

The man of values obtained for the factors of the various companies also shows that based on machine design and maintenance, the mean approaches the value of 2 for human/ personal factors the mean approaches the value of 3.

The following set of figures shows the model for the four companies with their mean values expressed as percentage.



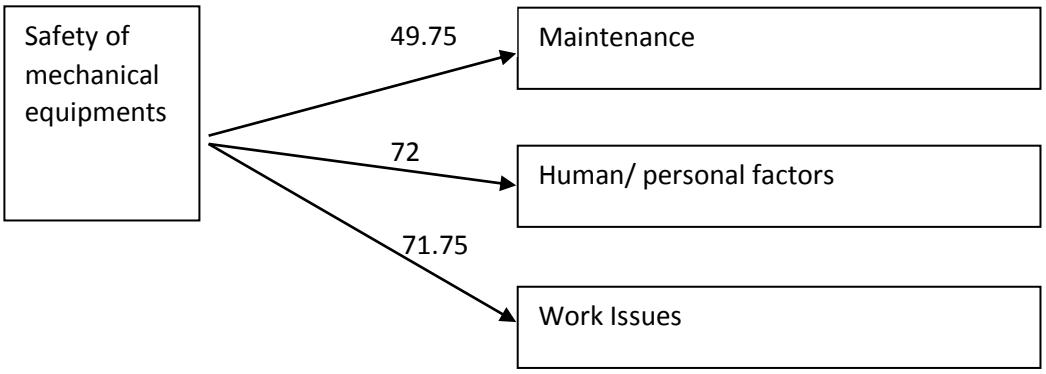



**FIG. 1**: The modified structural model of Rcc, Ibadan with the mean of each factor expressed as a percentage

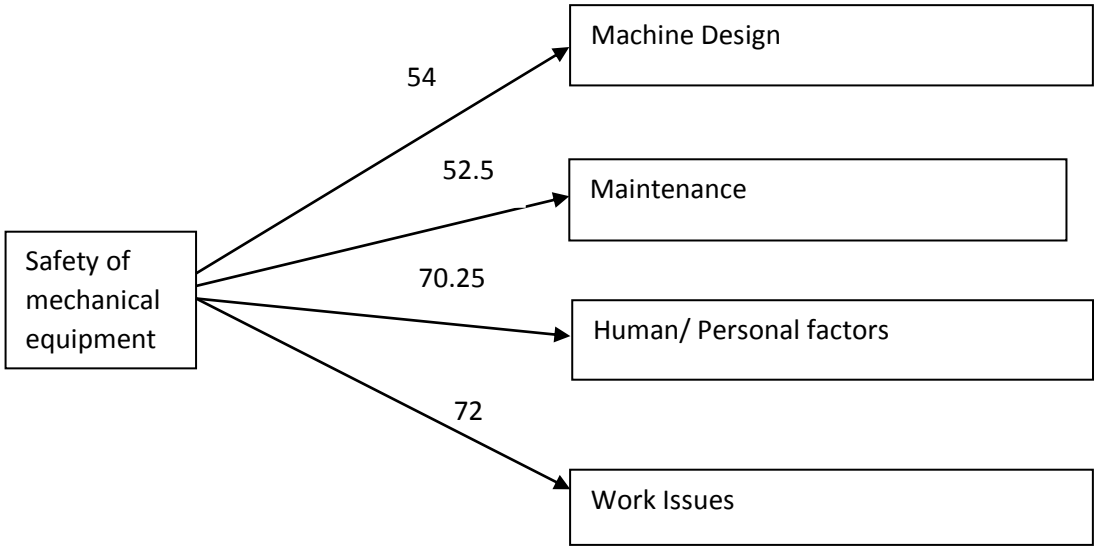
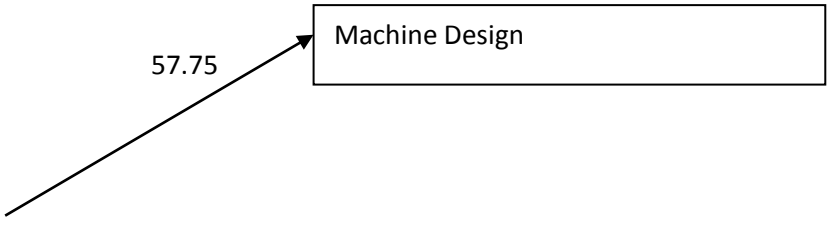



**FIG 2:** The modified structural model of KYFY, Global Nigeria Ltd. with the mean of each factor expressed as a percentage



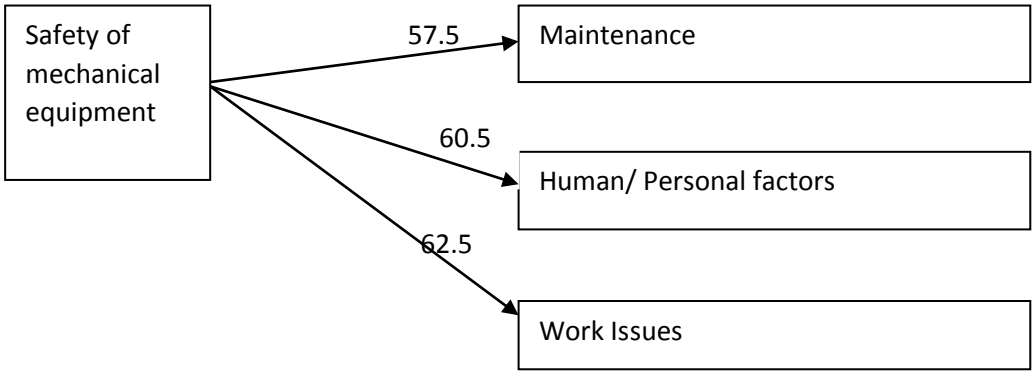



**FIG 3:** The modified structural model of BULLETIN construction company Ltd with the mean of each factor expressed as a percentage.

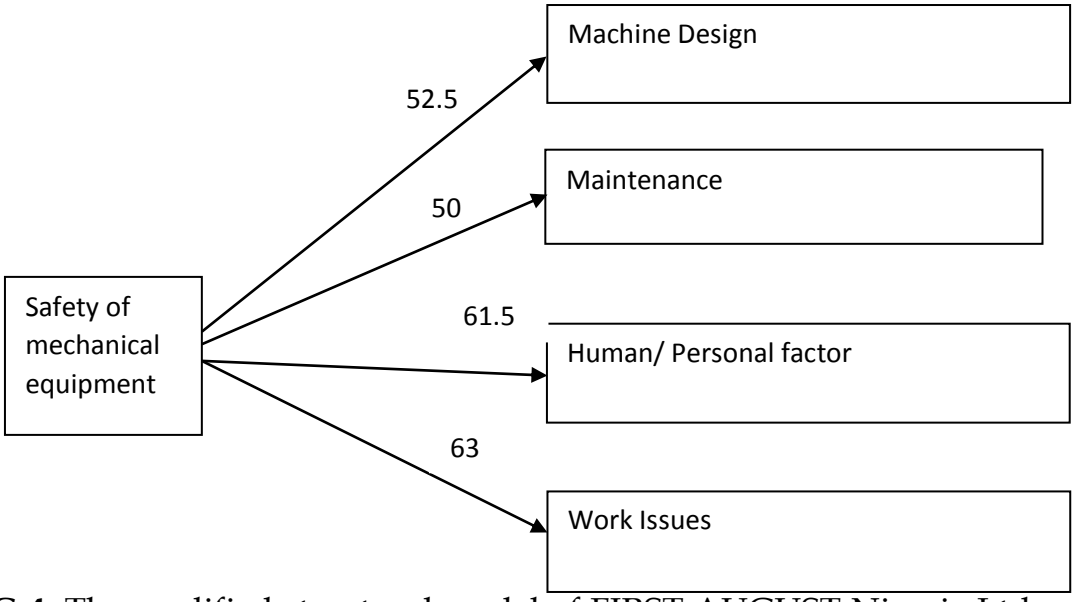



**FIG 4:** The modified structural model of FIRST AUGUST Nigeria Ltd. with the mean of each factor expressed as a percentage

Table 5: Results obtained after applying of variance (ANOVA) to the data of the four companies

| Source of error | Sum of squares | Variance estimate | Df | F(cal) | F(table) |
|---|---|---|---|---|---|
| Between the group | 94.61 | 31.53 | 3 | 0.4137 | 3.49 |
| Within the group | 820.14 | 76.23 | 12 | | |

| | | |
|---|---|---|
| Total | 914.75 | 15 |

For ANOVA, the following hypothesis were proposed:

$H_o$ there is no significant difference between the data obtained from the four companies.

$H_1$ there is significant difference between the data obtained from the four companies.

Note that the calculations for table 5

From table 5, the value calculated for 'f' is less than the table value obtained for 'f' at 5% level of significance. Consequently, the null hypothesis $H_o$ will be accepted and the alternative hypothesis ($H_1$) will be rejected

### *4.4 FINDINGS*

The study shows that machinery in construction companies were generally old, damaged and not well maintained. Most of the machineries accessed had poor or non- existence safety features, particularly relating to guarding and emergency stops. Lack of safety features was related to the age of the machinery. Older equipment were often manufactured without safety and as machines became older, guards were more likely to be lost or damaged. Although for some machines, low costs guards could be devised which would not be a cheap or easy exercise.

Guards were frequently removed, the most common reason given by respondents was that it was difficult to do the job with the guards in place and several tasks were observed where th workpiece was not suitable for the machine or necessitated removal of guards. The study also indicated that personal protective equipment were not in full use in construction companies. The main reason given by the respondents was inadequacy of the PPE and the discomfort available ones cause.

Poor machine condition was perceived by interviewees to be one of the most important causes of mechanical equipment injuries and observation of machine condition confirmed this is a major problem. The age and condition of the machineries used in construction companies also contribute to machine malfunctions which in turn lead to unsafe conditions. There were also indications that most of the machineries purchased are second hand. The possibility of restricting the sale of old and poorly designed equipment should be further investigated.

The analysis of questionnaire using the chi- square ($\chi^2$) also shows on the average for the four companies that the present machine design, maintenance level, human/ personal factors and work issues in the companies are not adequate enough and does not encourage safety. The mean of the factors expressed as a percentage shows that for machine design and maintenance, the rating is still at the average (between 50- 60%) while human/ personal factors and work issues are still okay (60-70%)

Finally, the ANOVA analysis shows that the data obtained from the four sample companies are very similar reflecting that almost the same approach is given to safety in the companies

## 5. *CONCLUSION*

The study evaluates the safety of mechanical equipment in four construction companies. With reference to the results obtained, the following conditions can be drawn:

(i) Even though mechanical equipment with high safety standards is now being manufactured, they are yet to be in use in the country. Old machineries whose design still poses safety threats are in use and therefore create an unsafe environment in the workplace.

(ii) Maintenance culture in construction companies is still not very adequate in the country. With increase maintenance level, the workplace environment will be made safer.

(iii) Safety of mechanical equipment greatly depends on human factors relating to its operation and use. Non adherence to the safety regulations pertaining to the use of mechanical equipment is one important factor responsible for the unsafe condition in workplaces

(iv) Pressures on operators and inadequate safety awareness programmes by the management also influences the continued unsafe conditions in companies.

## *REFERENCES*


Akpokoje (1998): vehicle safety Evaluation model, an unpublished M.Sc Thesis in Industrial engineering, University of Ibadan.

Crabb R. J (2000): Health and Safety in the Agricultural Engineering Design Process. Journal of health and safety. Retrieved Feb.12, 2008 from http://www.hse.gov.co.uk.

Gardener D, Cross J. A, Fonteyn P. N, Carlopio J, Shikdar A(1999): Mechanical Equipment injuries in small manufacturing businesses. Journal of safety. Retrieved Feb. 22, 2008 from http://www, Elsevier.com/locatesci.

Garette T. K. (1995): Full Braking Systems. The Automobile Engineering Journal.

Gibson John (2002): Revitalizing Health and safety in construction. Retrieved Feb. 22,2008 from http://www.hse.gov.co.uk Pg 1-8.

International Atomic Energy Agency (IAEA), Vienna (1996): Human Reliability Analysis in Probabilistic Safety Assessment for Nuclear plants, Journal of safety practice.

Rockwell T.H, Bluse V. D and Clevinge T. K. (1970): Development and Application of Non- accident measure of flying safety performance Journal of safety Research. Pp.2, 4.

Sanders M. S, Mc Cormick E. J. (1987): Human factor in Engineering and Design, Mc Graw Hill, New York.

## THE WOES OF SCIENTIFIC REALISM

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***Abstract***

*This paper investigated the disagreement between Realists and Anti-realists on the observable and unobservable distinction in scientific practice. While the realists maintain that machines*

*and gadgets can simulate the human act of perception there-by making all realities under the screen of science observable, the anti-realists or the instrumentalists insist that what cannot be observed with the human senses even if detected with gadgets are not observable. This paper contended against the realist position which says that machines can simulate the human activity of perception. Hence the distinction between what is observable and unobservable is shown to be indisputable.*

## INTRODUCTION

In metaphysics there is a long standing argument between followers of realism (the view that the physical world exists independently of human thought and perception) and the apologists of idealism (the view that the existence of the physical world is dependent on human perception) (Ozumba, 2001). Realism is further broken down to three different types: ultra or transcendental realism which Plato represents, and which holds that the real things exist in a realm other than this physical one (Copleston, 1985). Naïve or Nominal realism which Philosophers like G. E. Moore represent hold that things in this physical world are real as we perceive them. There is also scientific realism (our focal point in this discourse), which holds that the real is that which is correctly described by a scientific theory (Okasha 2002; Chalmers 1982).

But there is another controversy between the scientific realists and their opponents, the anti-realists or the instrumentalists, that controversy concerns the triumvirate: the observable, the un-observable or both with regards to scientific theory. The realists as we shall henceforth call the scientific realists, suggest that scientific theory can describe both the observable and the unobservable worlds while the instrumentalists deny the possibility of a scientific theory correctly describing the un-observable world. It is here that our argument in this paper takes shape for how can science, the opponent of metaphysics, admit of metaphysical explanation? And how can metaphysics become useful in scientific theorizing? In other words, how can the metaphysical form a foundation for the scientific? We are not interested in the pragmatics of such theories nor in whatever claims the realist may make in defense of their position but in the empirical-transcendental harmony inside the realist world of the observable and the unobservable.

In his paper, "Computing Machinery and Intelligence", Tuning (1950) had made a bogus claim that one day machines might be able to outwit men. Can it be taken in this respect, that the realist position that the so-called unobservable in the scientific theories are actually observable because scientific equipment can detect them? Does it now mean that the Turing's claim some six decades ago is now a reality? He said,

> Our superiority can be only felt on such an occasion in relation to the one machine over which we scored our petty triumph. There would be no question of triumphing simultaneously over *all machines*. In short, then, there might be men cleverer than any given machine, but then again might be other machines cleverer again and so on (p. 445).

Do we then conclude that the time for machine superiority over men has arrived? And by so doing justify the realist claim and set aside for good all objections to the possibility of machine observation of the physical realities to which human organs

have proven ineffective or complete failure as assumed. A very good back-up perhaps, to this realist ascendency is the chess game experiment of May 1997 between Garry Kasparov, the best (human) chess player ever known in a six-game match with Deep Blue, a chess program running on an IBM super computer capable of massive parallel-processing – dividing up a larger problem into smaller problems and working on a number of the smaller problems simultaneously (Furman and Avila, 2000). Deep Blue was said to have won the match with two wins, one loss and three draws. The significance of this machine triumph to the realist position is that where human ability elapses should not be construed as the standard, that is to say that scientific machines, in our context (microscopes, binoculars, particle detectors etc.,) can do even better. But how true is this supposition? Does what the scientific equipment do qualify as observation or better put, perception? Is there any difference between scientific detection and sensual perception? If there is, are there other things which men can do, that machines cannot, as a justification of this difference?

**WHAT MEN CAN DO WHICH MACHINES CANNOT DO**

Artificial Intelligence has to do with the study of the possibility of machines possessing intelligence and judgment. So far, machines have been built with the capability of solving mathematical problems, play chess, sort mail, guide missiles, assemble auto engines, and diagnose illnesses, read books and converse with people even. This is, according to Lycan (2000), what we might call intelligent behavior. But if machines now share with humans, the quality of being intelligent, does that in every shade make them capable of doing everything a human can? Or are there other things, which contribute to the uniqueness of humans that machines cannot do? It is important we make this digression from philosophy of science to Artificial Intelligence so that we might reach a platform upon which to effectively trace the sameness or differences between humans and androids; not in terms of looks but behavior.

In May 1997 as we earlier stated, an IBM super computer called Deep Blue (capable of massive parallel-processing-dividing up a larger problem into smaller problems and working on a number of the smaller problems simultaneously) defeated the Grand Master Gary Kasparov, the best (human) chess player the world has ever known. This feat confirmed to a large extent that there could be machines that would outwit humans. Turing had proposed a test – the Turing test as it has come to be known – for determining whether a given machine is intelligent (Turing, 1950). But the question may yet shift a little from whether machines can be intelligent to how intelligent they can be? For all the Turing test experiments conducted so far, have shown, if little, that such super machines are virtually too intelligent by half. A good example is ELIZA, a computer program written in 1996 by Professor Joseph Weizenbaum, in Massachusetts Institute of Technology (M.I.T). Following a simple set of instructions, ELIZA constructs *intelligent* responses to patient input to mimic the role of a Rogerian Psychotherapist. Although initially impressive, further interaction between ELIZA and the patient would eventually reveal that the therapist is a Fraud (Furman and Avila, 2000). Yet another of these experiments was the one involving Parry, a computer program created in 1971 by Kenneth Colby, a

psychiatrist at Stanford University, Parry was programmed to respond to questions in the manner of a Schizophrenic with a paranoid fixation that he is a mafia target. Colby set up a test in which Parry was interviewed alongside a number of genuine paranoid patients and the results were then assessed by a panel of psychiatrists. No one on the panel guessed that Parry was not a real patient (Dupre, 2007).

However, the question to be asked here is: Did Parry pass the test? The answer is not affirmative because for the test to pass for a proper Turing test, the panel should have been told that one of the patients was a computer and the task was to identify which, in which case Parry would have very easily revealed itself when questioned more broadly.

But even if any machines were to pass the Turing test, in the past or future time, the Turing test itself has long been shown to be defective. In 1980, the U. S. Philosopher, John Searle created a thought experiment called The Chinese Room. In it, he proved that producing appropriate outputs, according to rules provided by a program is precisely what a digital computer does.

A computer program, however sophisticated, is no more than, and could never be more than, a mindless manipulator of symbols –it can have no understanding of meaning, or semantics. Just as there is no understanding within the Chinese Room so there is none in a computer program: no understanding, no intelligence, no mind and never more than a simulation of these things (Searle, 2000; Dupre, 2007).

Thomas Nagel has wielded a decisive opinion that attempts to understand the mind by analogy with man-made computers is a mere waste of time. A strong argument that machines cannot behave like humans is weaved around *consciousness*. Following a functionalist point of view, one of the supporters of computer intelligence, Lycan (2000), raises interesting questions: if a computer responded to injury in the appropriate way, would such android have the mental state 'being in pain'? If so, would the android be conscious? His answer is "yes, it would be conscious". All of the reasons one has for believing that other people are conscious turns out to be reasons that one could have for believing that a machine is conscious (Lycan, 97-102). But Functionalism (like behaviourism) is a software solution to the theory of mind in computer terms. It defines mental phenomena in terms of inputs and outputs, with no consideration of the hardware platform (dualist, physicalist, whatever) on which the software is running. The problem, of course, is that focusing on inputs and outputs threatens to lead us straight back into the Chinese Room. In which case, functionalism meets the same dead end as behaviourism. Looking at machines from the outside (as Turing and Lycan suggest) an android, appears to be conscious of its environment. But is it? Is it conscious in the same way as humans are? Morton Hunt argues that one basic difference between human and machine consciousness is that humans are conscious of being conscious (103-107). Hunt quotes Donald Norman as follows:

> We don't have any program today that are self-aware or that even begin to approach consciousness such as human beings have. I see this as a critical difference between human intelligence and artificial intelligence. The human

> mind is aware of itself as an identity, it can introspect, it can examine its own ideas and react to them- not just with thoughts about them but with emotions. We can't begin to simulate consciousness on a computer and perhaps never will (103-104).

Hunt therefore, makes it clear that even if machines can be conscious (which they cannot), they would still not be aware of their consciousness.

Searle agrees with Hunt that there are things which humans can do which computers cannot. Turing and Lycan have suggested that androids are capable of being intelligent – and probably even having mental states. But does intelligence imply consciousness and comprehension? The answer is obviously no! Searle proves it with his ingenious thought experiment – The Chinese Room. In it, Searle imagines himself- an English speaker not knowing a word of Chinese – confined within a room into which batches of Chinese scripts are posted. He is already equipped with a pile of Chinese symbols and copious rule book, in English, which explains how he is to post out certain combinations of symbols in response to strings of symbols in the batches posted to him. In time, he gets so adept at his task that, from the point of view of someone outside the room, his responses are indistinguishable from those of a native Chinese speaker. In other words the inputs and outputs into and out of the room are exactly as they would be if he had a full understanding of Chinese. Yet all he is doing is manipulating uninterpreted formal symbols; he understands nothing (Searle, 109-114; Dupre, 38). It is this John Searle's ingenious creation that has so far silenced the pro Turing's and defied all known arguments in favour of machines behaving as well as humans.

Also, in consideration of the target in this paper, the researchers shall discuss further things that humans can do which machines cannot. Humans can show emotion, they are dexterous or display skills and are teachable. If an android is programmed to sort mails, mails it will sort. Firstly, it will neither be interested or uninterested, happy or sad about the job. Secondly if it is removed from the office and taken to a farm, it will not be able to display any other skill besides sorting mails. Thirdly, if a certain farmer were humane enough to teach the android a few emergency farm skills, it would not be able to learn. Whereas in these three cases that the android failed, any human, citrus paribus, will succeed. Humans can get excited, angry, they can be happy or sad, they can feel all sorts of emotions, they can learn from the scratch, they can even get interested or uninterested over something; androids do not share these experiences, on the other hand. They execute whatever task they have been programmed to execute without further consideration. They have neither intuition nor consideration instinct. In other words, they do not know what is right or wrong, what is pitiable, what is partial and what is abominable nor do they know what forgiveness is or what no forgiveness is. In short, they do not have any knowledge, only programs. If an android were to become manager in a company which has employee rule: "any staff who comes to work late will be fired". And one day, his secretary (a human) comes to work two seconds late because her only child had died that morning, such an android will fire his secretary but there are no sensible humans

in the world who would apply that rule in the said circumstance – reason being the presence of consideration instincts in them, which machines lack.

Humans have nerves, blood, neurons connected to their brains, which is why they could feel, learn, know, understand and even perceive. Machines on the other hand, have cables, circuits, sensors which explain why where humans perceive for example, they can but detect. In the following section, we shall trace the line of distinction between sensual perception and electronic detection.

**DETECTION OR PERCEPTION: THE WOES OF SCIENTIFIC REALISM.**

When for example, an android is built by scientists programmed to produce results over what lay beyond man's observatory powers, such a super machine has to be equipped for this task. Because they truly wished it (here, we shall refer to the robot as Bruce) to be like human in every inch, they had to fit Bruce with body parts equivalent to those of humans. As a result they fitted him with prothetic body parts, synthetic arteries, neural fibers, carbonized sensors etc. They wanted Bruce to behave, feel and gather knowledge of the intangible automatic corpuscles in every inch as a human would. And then the time to let Bruce enter his new natural environment came, Bruce walks a few dozen meters around a designated field before returning to the laboratory with results. When his memory was analyzed, it was discovered Bruce had *noticed* the presence of observable things as trees, plants, insects etc., also, he *noticed* in addition, the presence of other things like micro-organisms, protons, neutrons, electrons, the quarks etc. The inevitable question that lays bare is: How do we interpret the word *notice* in Bruce's experience, perception or detection?

The main point in the debate between realism and instrumentalism is the distinction between things that are observable and things that are not. Okasha (2002) makes a case that "so far we have simply taken this distinction for granted – tables and chairs are observable, atoms and electrons are not. But in fact the distinction is quite philosophically problematic" (p. 66). For the instrumentalists, it is imperative that the distinction is maintained if they were to win the debate that certain things are unobservable. And for the realists, it is as important that the distinction is eliminated if they must win the argument that everything is observable.

When the realists close the door against the observable/unobservable dichotomy, they open by default yet another door leading to other problems. One of such problems has to do with the relation between observation/perception and detection. Things like the subatomic particles are obviously not observable in the ordinary sense, but scientists have long established that their presence could be detected by some gadgets like particle detectors. One such particle detector is the cloud chamber, a closed container filled with air that has been saturated with water-vapour. When charged, particles like electron pass through the chamber, they collide with neutral atoms in the air, converting them into ions; water vapour condenses around these ions causing liquid droplets to form, which can be seen with naked eyes. We can follow the part of an electron through the cloud chambers by watching the tracks of these liquid droplets.

Realists claim that this makes electrons observable to human senses. But does it? The answer is safer "no" than "yes". The cloud chambers merely helps us to detect the presence of electrons not observe them. The liquid droplets are just tracks not electrons themselves, so watching them does not mean we are watching electrons. It is like watching the smoke trail of a high speed space rocket; this does not mean observing the rocket itself.

Maxwell, a staunch realist has argued that observing with eyes and detecting with instruments all lie on a smooth continuum (Maxwell cited in Okasha2002, p.67). For him there is no difference, if not, how do we know the dividing line? If something can only be seen with the help of sophisticated scientific instruments, does it count as observable or detectable? How sophisticated can the instrumentation be, before we have a case of detecting rather than observing? This argument is not decisive.

Fraassen (cited in Okasha, 2002), a contemporary instrumentalist describes Maxwell's argument as simply making the word "observable" vague and insists that even as at that, the dividing line would still exist.

In this paper, we have chosen to substitute the word "observation" for "perception", which is a broader term than observation, for it encompasses the five senses required in empirical pursuit of knowledge. The reason for this is twofold: in the event of the word observation being limited to accommodate what the realists' claim the scientists do with the corpuscles, the word "perception", broader as it is, will suffice. And where the word "perception" could not suffice, it would at least give us a clear vision that there is a boundary between observable and unobservable. Anyone who has done this analysis well will face the very obvious, that whatever cannot be perceived without the help of instrumentation(s) is at least not observable. We do not say here that such unobservable things do not exist nor do we speak otherwise, what we posit is that if they cannot be perceived (philosophically speaking), then the issue falls within the arm bit of our "safer no than yes" explanation. What this means in philosophy is that Corpuscles are mere imaginations or at least, metaphysical realities, but empirically speaking, they cannot be said to be real.

The scientists' claim of detecting these corpuscles, we have not and do not intend to doubt but that these *detectable* particles are, or at least are synonymous with physical, empirical realities, we make bold to reject, for wherein they are not perceivable, they are incorporeal or unintelligible or both.

The most stunning of this revelation is that the key question has an obvious answer: it is not whether the electronic gadgets can perceive like the human organs but rather how well can they imitate the human act of perception? This follows the obvious fact that these machines cannot perceive. They do not have nerve endings and neurons connected to a brain like humans; they only have cables and circuits which do not pass for sense organs.

Thus, we are here confronted with the question: what does observable objects consist of? To this Locke (2000) replies, "sensation convinces us, that there are solid extended substances" (p. 225). And Descartes (2000) adds, "Thus extension in length, breadth

and depth, constitutes the nature of corporeal substances" (p.218). What this means is that for anything to be observable or perceptible, it must therefore be physical, material or corporeal, "for the existence of an idea" according to Berkeley (1982), "consists in being perceived" (p. 227). Although Berkeley speaks of the ideas in the mind, he nevertheless refers to the physical objects without which perception could not take place.

By insisting that there is no divide between what is observable and what is not, the realists declare unequivocally, that everything described by scientific theories is observable. But atom and its sub-particles are not observable and by this is meant not perceivable. How then can a scientific theory describe something without the sensation of that thing? It is not clear to us how one might perceive something which has no extension. Berkeley (1982) echoes this view that it is impossible to perceive anything without recourse to its material form. This shows that sensual perception has to do with material things. It is an empirical tool which involves the use of the human five senses to obtain knowledge of the world or the extended objects. "And this extended object", in the contention of Descartes (2000) "is called by us either body or matter" (p. 218). The Marxist dialectics has described the world better than the Hegelian version of it because matter stood at the center of Marxist world (Mukhi, 2008). While for Hegel it is the absolute or idea or mind or spirit (Durant, 1961). And there was no way we could perceive the absolute spirit, herein likened to the intangible atom and its sub-particles. Berkeley (1982) has bemoaned, that the existence of things without the relation of their being perceived is unintelligible. And Hume (1993) suggests that everything we know about existents arises entirely from experience. What we draw here is that atom and its sub-particles which are not amenable to human senses are unintelligible to the empiricist philosopher. And that would be metaphysics-and it would make a realist a metaphysician. Ayer (2001) has written:

> One way of attacking a metaphysician who claimed to have knowledge of a reality which transcended the phenomenal world would to enquire from what premises his propositions were deduced. Must he not begin, as other men do, with the evidences of his senses? And if so, what valid process of reasoning can possibly lead him to the conception of transcendental reality? (p. 160)

And this type of position opposed to metaphysics was also the goal of the Logical Positivists. It means that anything that cannot be perceived using human senses should not be classified as a physical reality

When the realist claims that the aid of instrumentation enables the scientist to observe (perceive) those aspects of reality beyond the sensual powers of humans, we wonder aloud, if this exercise be called perception, whose is it: That of the scientist or the instrument? Yet, again as much as we disagree that the exercise belongs to the scientist, we also reject that it qualifies as perception in the first place. We may flatly tag the machine exercise "detection", a kind of *sensorous* or machine experience which is neither sensual nor conscious. So there is a line between perception and detection. The first is a human experience the latter is a machine experience. But there is no

sense in, and there is no way the machine experience could become a human experience. Also, in-as-much-as whatever the machines do could be described figuratively, as "experience", it can never be called perception, for the machine does not possess sense organs.

Therefore, all the scientific theories that describe the sections of the intangible world, which the realist insists make a correct description of the world are here shown to be false theories. Ayer (2001) supports this position in the following line:

> For we shall maintain that no statement which refers to a "reality" transcending the limits of all possible sense-experience can possibly have any literal significance; from which it must follow that the labour of those who have striven to describe such a reality have all been devoted to the production of nonsense (p. 160).

## CONCLUSION

What we have done here is not prioritizing sense experience over the other sources of knowledge; this would be far from the point of this paper. We have rather shown that, however the realist might dispute it, the distinction between observable and unobservable still exists and that what the instrumentations do is not perception but detection. Also, we have not denied the peculiar weaknesses associated with perception as a source of knowledge; that too was not the goal of this paper. The point is, no matter how limited the empiricist picture of human knowledge might be, it at least, could not be accused of being fanciful. Plato's world of ideas could not be pointed to, or demonstrated (just like atom and its sub-particles), in the ordinary world affairs. But the very objects of the empiricist's perception were the actual features of everyone's experience (Popkin and Stroll, 1981). In other words, the empiricist philosopher is sure that, latent in the scientific theories are things which are observable and those that are not, and that the machine experience can never be compared to that of humans.

Thus the one question left for the realists now is not whether the observable/unobservable distinction can be shown not to exist or whether the so-called unobservable by the aid of super-scientific instrumentation can be made observable, for the possibility of these have become very remote, but rather, how else could scientific realism be rescued? We leave them to bother on that!

## REFERENCES


Ayer Jules (2001). The Elimination of Metaphysics. Lindberg J. (ed.). *Analytic Philosophy Beginnings to the Present.* California: Mayfield.

Berkeley George (1982). *A Treatise Concerning the Principles of Human Knowledge.* Indianapolis: Hackett.

Chalmers, Alan (1982). *What is this Thing Called Science?* Queensland: University of Queensland Press.

Colby,Kenneth (1971). Artificial Paranoia. *Artificial Intelligence*, *2.1,* 1-25.

Copleston, Fredrick (1985). *A History of Western Philosophy*. New York: Image Books.

Descartes Rene (2000). Substance. In Furman, Todd and Avila, Mitchell (Ed.). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy, pp.216-221*. California: Mayfield.

Dupre Ben (2007). *50 Philosophy Ideas You Really Need to Know*. London: Quercus.

Durant Will (1961). *The Story of Philosophy.* New York: Simon and Schuster.

Furman Todd and Avila Mitchell, (Ed.) (2000). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy*. California: Mayfield.

Hume, David (1993). An Inquiry Concerning Human Understanding BK. II, IV-VII. In Joel Feinberg(ed.). *Reason and Responsibility: Readings in Some Basic Problems of Philosophy*. California: Wadsworth.

Hunt Morton (2000). What the Human Mind Can Do that the Computer Can't. in Furman, Todd and Avila, Mitchell,(Ed.). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy*. California: Mayfield.

Locke John (2000). An Essay Concerning Human Understanding. In Furman, Todd and Avila, Mitchell, (Ed.). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy*. California: Mayfield.

Lycan William (2000). Machine Consciousness. In Furman, Todd and Avila, Mitchell,(Ed). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy*. California: Mayfield.

Mautner Thomas (2000). *The Penguin Dictionary of Philosophy*. London: Penguin.

Moore George. E (2001). "Proof of an External World". In Lindberg, J. (ed.). *Analytic Philosophy Beginnings to the Present*. California: Mayfield.

Mukhi H.R. (2002). *Political Thought*.12th ed. Delhi: SBD.

Okasha Samir (2002). *Philosophy of Science: A very Short Introduction*. New York: Oxford.

Ozumba Godfrey (2001). *A Concise Introduction to Epistemology.* Calabar: Jochrisam.

Popkin R. and Stroll A (1981). *Philosophy Made Simple.* London: William Heinemann.

Searle John (2000). Minds, Brains and Programs. In Furman, Todd and Avila, Mitchell,(Ed.). *The Canon and its Critics: A Multi-perspective Introduction to Philosophy,* pp.108-114. California: Mayfield.

Turing Alan (1950). Computing Machinery and Intelligence. *Mind, New Series. 59, 433-460.*

Weizenbaum Joseph (1966). ELIZA — A Computer Program For the Study of Natural Language Communication between Man and Machine. Communications of the ACM, 9. 1, 36–45.

Winograd Terry (1997). *Procedures as a Representation for Data in a Computer Program for Understanding Natural Language*. MIT AI Technical Report 235, February.

# EMPIRICISM VERSES RATIONALISM: MATTERS ARISING IN MEDICAL PRACTICE

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***Abstract***
*The two schools, Rationalism and Empiricism have been at loggerheads over what constitutes the ultimate source of knowledge. This is the focal point of epistemology, the branch of philosophy devoted to studying the nature, sources and limits of knowledge. However, in medical practice, these concern ways of thinking in diagnosis and therapeutics. The Empirical and the Rationalist philosophies are two logical and consistent thought structures which are in all respects entirely antagonistic to one another, one favoring the senses and the other favoring the mind. This paper is therefore concerned with the existence of a conflict in therapeutics between what are called the Empirical and the Rationalist philosophies.*

## INTRODUCTION

Rationalism and empiricism have been at loggerheads over what constitutes the ultimate source of knowledge. This is the focal point of epistemology, the branch of philosophy devoted to studying the nature, sources and limits of knowledge. According to Markie (2000) the defining questions of epistemology include the following.

1. What is the nature of propositional knowledge: knowledge that a particular proposition about the world is true? Knowing a particular proposition requires both that we believe it and that it be true, but it also clearly requires something more, something that distinguishes knowledge from a lucky guess. Let's call this additional element 'warrant'.
2. How can we gain knowledge? We can form true beliefs just by making some lucky guesses. How we can gain warranted beliefs is unclear. Moreover, to know the world, we must think about it, and it is not clear how we gain the concepts we use in thought or what assurance, if any.
3. What are the limits of our knowledge? Some aspects of the world may be within the limits of our thought but beyond the limits of our knowledge; faced

> with competing descriptions of them, we cannot know which description is true. Some aspects of the world may even be beyond the limits of our thought, so that we cannot form intelligible descriptions of them, let alone know that a particular description is true.

Markie (2000) indicates that the disagreement between rationalists and empiricists primarily concerns the second question, regarding the sources of our concepts and knowledge. This paper is concerned with the existence of a conflict in therapeutics between the Empiricists and Rationalists philosophers from ancient times to date. Physicians were aware of this conflict up until the year 1800 or thereabouts, and medical histories written before that time discuss this conflict which dates back to Roman and Greek times. But after the mid-nineteenth century, when medicine was taken over by technology, this primordial conflict was forgotten. However, the opposition between these two ways of thinking about medicine continued, even though underground. The Empirical and the Rationalist philosophies are two logical and consistent thought structures which are in all respects entirely antagonistic to one another. The great medical thinkers have belonged to one or the other of these two traditions. Minor thinkers, who are by definition less rigorous in their theorizing, have usually, represented eclectic combinations of the two major traditions.

The greatest Empirical thinker in the field of medicine is Samuel Hahnemann, the founder of homeopathy. He established a system which, as we know, continues to this day. However, since Hahnemann there have been others who are perhaps better known, such as, Louis Pasteur, Emil von Behring, or Elie Metchni-koff, the founders of bacteriology (Coulter, 1994). These thinkers are also to be classified in the Empirical tradition. The Empirical and Rationalist approaches to therapeutics can be exemplified in various therapeutic modalities. The thinkers we have just mentioned are well known for their contributions to pharmacological medicine and to immunology. According to Coulter (159) some of the major Rationalist thinkers of modern times were: the French physiologist, Claude Bernard, who died in 1878; Robert Koch, a founder of bacteriology, and Paul Ehrlich, the founder of modern pharmacology. The medicine we today call "scientific" and which the homeopaths call "allopathic" represents Rationalism in a relatively pure form, whereas such "alternative" medical disciplines as homeopathy, classical osteopathy, chiropractic, acupuncture in its classical form, and undoubtedly Orthomolecular medicine, represent an Empirical way of going about therapeutics.

**BOUNDARY BETWEEN RATIONALISM AND EMPIRICISM**

Our thesis is that there is an ongoing and fundamental tension between these two different ways of thinking. While these ways of thinking can be complementary, the tension persists, exploding around specific clinical and legal controversies. Understanding the tension between rationalism and empiricism provides important background in considering the role of expert advice.

Rationalism as a method of scientific thought dates back to the time of Aristotle and Galen. A hypothesis is first generated following certain observations, basic research,

or an intuitive leap. Corroborative evidence is then sought to substantiate the hypothesis. Depending on how critical the individual may be, a varying amount of corroborative evidence is collected until the hypothesis is translated into a 'natural law' or dogma (in medical practice, the expression 'treatment of choice' indicates that the process is complete). There are many inherent dangers in this process, which are best illustrated by the following examples, quoted by Bryan Magee (17) in his delightful little paperback on the philosophy of Popper. Having observed that all swans swimming on the lake of your local park are white, you may generate the hypothesis that all swans are white; travelling round the country you- will corroborate this theory by all the other white swans that are seen. So convinced are you in your own mind of the rightness of these observations, that when you go to Australia and chance to see some swan-like birds that are black, the inevitable response is to suggest that these birds are not swans but some other species altogether.

The same spurious logic applies according to Baum (505) in political theory: Karl Marx's prophecies about a utopian culture have been adopted by the so-called peoples democracies as natural laws, and if the application of 'scientific' Marxism is associated with failure of the crops or a disastrous economy, it is never the fault of the political doctrine but always the fault of saboteurs or agents of the CIA. Coming back a little closer to the subject under discussion, this is precisely the manner by which practitioners on the medical fringe rationalize their approach. Richard Peto is fond of quoting the example of the quack who advocated mountain climbing for the cure of cancer. A number of patients with 'incurable cancer' are assembled at the foot of the mountain and assured that those who climb to the top will live a long time. Some die before even attempting the ascent, and the quack, with a sigh of heartfelt grief, will say: 'If only they would have come earlier'. Another group of patients die half way up the mountain, but they of course did not complete the treatment so could not hope to benefit; whereas a small residual percent reach the top of the mountain and may live for a number of years, confirming yet again the benefits of the fresh alpine air and vigorous exercise. This is of course an extreme example, but the human tragedies associated with the use of anecdotal evidence to support the claims of the medical fringe are countless, and the current experience with Laetrile in the United States of America is merely the latest of a long line of 'cancer cures' whose only justification is wrapped up in the conceptual rationalism of the dark ages. Sad to say, even the practitioners of 20th century high technology mainstream medicine are often guilty, in a much more subtle way, when they abandon 'science" in favour of 'art' in the management of the individual patient. According to Baum experience that there are skilled physicians whose judgment and therapy produce better results than those less skilled, but I would suggest that the critical analysis of these skills will demonstrate that the former readily learns from his mistakes, whereas the latter fails to recognize his mistakes and therefore rationalizes away his failures. The art of good medicine is therefore a cleverly disguised science and there is no shame in accepting this doctrine (505). Furthermore, if we could analyze this gentle science, the good practitioners could pass on their skills which would otherwise die with them cloaked in mystique.

On the other hand, in the blossoming of the arts and literature the Renaissance saw a revolution in scientific philosophy. Francis Bacon was perhaps one of the most influential leaders of this revolution. In Volume I of his book entitled 'The Advancement of Learning' he wrote as follows: 'If a man will begin with certainties he shall end in doubts, but if he will be content to begin with doubts he shall end in certainties'. In the 20th century, Sir Karl Popper (1959) has been the most influential of this breed of scientific philosopher, taking the argument to its logical conclusion: 'Once put forward, none of our anticipations are dogmatically upheld, our method of research is not to defend them in order to prove how right we were, on the contrary, we try to overthrow them. Using all the weapons of our logical mathematical and technical armory, we try to prove that our anticipations were false. Those among us who are unwilling to expose their ideas to refutation do not take part in the scientific game'. Thus the modern scientist starts off with a modest assumption that no individual, or for that matter no generation, is gifted with a complete insight into any of nature's enigmas. Progress in science is always an approximation to the truth; an hypothesis is allowed to stand as long as it is the best available to explain the observed facts. New data must never be rejected in favour of the hypothesis, but new hypotheses must continually be evolved to fit the available data.

In practical terms, the first stage of the generation of an hypothesis by the modern scientific empiricist is the same as the process that dates back to classical times. As a result of certain observations, combined with an intuitive leap, an hypothesis is created and this act of creation must be applauded as an expression of the artistic gifts of the human intellect. It is at the next stage that the pathways of the rationalist and empiricist radically diverge. Experiments are then designed to falsify the hypothesis, not to corroborate it. It is conceivable that the hypothesis does not lend itself to falsification, in which case the scientific thinker has wandered into the realms of non-science or faith. Almost inevitably the properly designed experiment will demonstrate defects in the hypothesis, in parallel with the acquisition of new data. But again it is possible for one hypothesis to explain all observations for so long that the temptation to translate it into a natural law or dogma will become irresistible. We were all taught the 'laws' of Newtonian physics at school, but even these irrefutable laws were falsified by the ultimate observation that light may bend in a gravitational field. It has taken Einsteinian physics to explain this phenomenon, whilst at the same time accounting for the excellent way that previously observed physical phenomena fitted the Newtonian theory.

**EMPIRICISM VS. RATIONALISM: MATTERS ARISING**

The Hippocratic tradition rests on many authors, not just the historical Hippocrates of course, but a plethora of later writers through antiquity, from Greece to Alexandria to Rome. This chapter focuses on two major sects of that tradition that dominated in Alexandria from the fourth century B.C. through Roman times. The dominant medical influence in the classical age was rationalism. Tracing its origin from Thessalos and Drakan, the sons of Hippocrates, rationalism is the oldest of the sects.

Thessalos and Drakans emphasized the importance of natural philosophy in medicine, believing that "where observation failed, reason might suffice"( Major, 150). The fundamental theory was the doctrine of "humours" as first taught by Pythagoras: The body of man has in itself blood, phlegm, yellow bile, and black bile: . . . [N]ow he enjoys the most perfect health when those elements are duly proportioned to one another in respect of compounding power and bulk and when they are perfectly mingled. Pain is felt when one of these elements is in defect or excess or is isolated in the body without being compounded with all the others (Major, 123). Thus, health was seen as the proper mixture of humours and disease was an imbalance. Most medical writing dealt with disputes about the nature of the humours, what the substances were, and how the balance of humours was altered by flow and constriction. From the perspective of the development of modern ideas about medicine, this interest is important primarily because it motivated the first focused research in human anatomy in Alexandria in the third and second century B.C. For the purposes of my argument, however, it should be stressed that the focus was on how disease develops or, in modern parlance, on mechanisms of disease.

This emphasis became a lens through which all of clinical medicine was seen. Medical advances were understood to come from deductions concerning physiology, and the clinical implications were derived directly from the understanding of the humours. Thus, diagnosis was the recognition of the current balance of the humours, and a disease resulting from an excess of a particular humour might be treated with a procedure or a substance that depleted that humour. There was a tendency to think of disease as having a single cause: a specific disbalance of the humours. Prognosis was relatively less important than other clinical questions (Prioreschi, 474). The empiricists were a splinter group that detached itself from the rationalists in the later part of the third century B.C. They rose in protest against the dried formalization of the rationalist school and in response to the anatomic discoveries. These discoveries, while brilliant, had contributed little to healing the sick. Furthermore, there was concern about the ethics of the dissection, and particularly the vivisection, practiced by the anatomists of that era. The empiricists rejected abstractions and general medical theories in favor of observation. They based their practice on the recollection of past observations and the knowledge of how similar symptoms had developed, what their outcomes were, and the determination of similarity between the case at hand and previous cases. As Celsus, a later Roman writer, argued, if theoretical reasoning would have been sufficient, philosophers would be the best physicians . . . . Often the cause of disease is known, for example, in cases of injuries or wounds, but this does not help in the treatment. As the cause of disease is uncertain and incomprehensible, we should rely on . . . what experience has taught us. Authority was a target, "since neither the philosophers nor the physicians can agree among themselves, therefore one's reliance should be placed on no man's argument, on no man's authority." ( Prioreschi, 547) To the empiricists, disease was not an entity but a group of systems, each of which required treatment. Experience was their lodestar: As Celsus later framed it, it is not how we digest, but what is digestible that matters (Major, 151). As a consequence, the main interest of empiricists lay in therapeutics

more than in mechanisms of disease. Pharmacology and surgery were their preferred means to treat disease, and their writings are dominated by discussions of specific symptoms, remedies, similarities, and outcomes. The emphasis on therapy had an impact on how other kinds of clinical questions were addressed. The empiricists did not value looking for the "prime causes" of diseases. Diagnosis emphasized the recognition of discrete symptoms. In contrast to the rationalists, the empiricists believed that outcomes was the most important issue, with prognosis as a secondary focus.

Furthermore, the tension between rationalism and empiricism illuminates many current policy disagreements and private injuries. Most prominent are questions of clinical causation. From the rationalist perspective, the causation of disease begins at the cellular level with small changes that alter development and trigger disease. Historically, as we have seen, the perceived cause of disease was relatively simple (a disbalance of humours). Similarly, our modern understanding of, for example, the development of cancer may have very simple origins (external radiation, for example) followed by complex intermediary events. Moreover, in public discourse, it is not uncommon for patients, their physicians, and public officials to have strong and simple beliefs about specific agents and their impact. By contrast, an empiricist view is that causation is multifactorial and may be different in different settings (Rothman, 10-16). This difference in understanding of causality is at the root of many of the disagreements about causation in both policy and private injury.

The controversy around silicone breast implants provides an example of how this tension plays out in public discourse. For many years, there has been some concern that silicone exposure may cause autoimmune diseases, especially systemic sclerosis. Silicone is used in many different ways. The administration of drugs and parenteral fluids, as well as dialysis and cardiac bypass, depends on liquid silicone. But the highest profile use is in silicone breast implants for women who require reconstruction after breast cancer surgery or for cosmetic reasons. The question of causation has become very controversial, fired by litigation as well as scientific dissent.

The judge overseeing discovery in all federal cases involving silicone-gelfilled breast implants appointed a neutral group of experts to review the evidence formally. This group, led by Dr. Barbara Hulka at the University of North Carolina, did a formal meta-analysis of studies of the relationship between breast implants and autoimmune disease (Janowsky and others, 781). They found no association between silicone breast implants and a variety of different autoimmune diseases, with summary odds ratio of .69 (95%CI: .62-.78) (Newton, 306). Indeed, because the analysis resulted in an odds ratio significantly less than one, the results suggest that silicone breast implants may protect against autoimmune diseases. Furthermore, using standard techniques for evaluating the impact of the exposure on the population, they concluded that breast implants have minimal effect on women developing connective tissue disorders (Newton, 306). Providing an overview of the controversy, Marcia Angell,

the editor of the *New England Journal of Medicine,* asked the rhetorical question, "when will science prevail?" (Angell, 1695) The science she defended was that of the empiricists. Scientific reaction has been sharp. The first letter published in response to the study, written by Eugene Goldberg, took up the issue of what kind of science was being used:

> As an educator and academic biomedical scientist, I found the lengthy special article. . . to be inconsistent with the scientific standards we have come to expect from the journals . . . . [I]ts credibility is lost because of total disregard of a substantial body of scientifically sound data on the extraordinary rate of implant failure (now estimated to involve rupture and gross leakage of silicone in 50 percent of cases after approximately eight years), the substantial degradation of the silicone shell and gel with time, the pain and disfigurement that result from contraction of the fibrous capsule, the chronic inflammation due to immune-system responses involving phagocytosis of fine silicone droplets by macrophages and giant cells and the spread of silicone throughout the body (Goldberg, p.1154)

At issue is what kind of science is used to address causation. What Angell defines as science is modern epidemiology, a careful examination of a variety of studies of the association between exposure and disease in different settings. Some of the published commentary quarrels with the epidemiological methods used by Hulka and her colleagues; such commentary shares a focus on patient outcomes with Hulka and is a very familiar part of the empiricist tradition. By contrast, what Goldberg construes as science are the modern biomedical sciences. Each argument he gives is a possible mechanism of disease.

**RATIONALIST TRIUMPH**

What we understand as modern medicine has at its roots a triumph of rationalism: the emphasis on the search for basic mechanisms of disease and the development of therapeutic tools derived from them. At the turn of the last century, what we think of as modern medicine was understood as allopathic medicine. It was one of a variety of "sects," which included homeopathy, osteopathy, and herbalism. Despite the clinical breakthroughs in anesthesia, antisepsis/asepsis, bacteriology, and pathology, allopathic medicine was by no means the most significant of the sects. Indeed, the homeopathic tradition was in the ascendancy, having many medical schools and taking care of the elite.

A key event in the development of medicine in the United States was the publication of the Flexner report. Abraham Flexner was a representative of the Carnegie Foundation, whose major interest was in promoting the development of the modern university. As part of that effort, Flexner was commissioned to study the structure and function of medical education. Over four years, he visited all 152 medical colleges in the United States and summarized his findings in what has come to be known as the Flexner report. That report, with the public and private outrage that

accompanied it, transformed American medicine. Within thirty years, over half of the medical schools in the United States closed, and those that remained, while heterogenous, were much closer to the Flexnerian model: substantial emphasis on basic science, integrated into the university structure, and having a close affiliation with a teaching hospital.

Flexner understood himself to be writing about the structure of modern medical schools. For our purposes, however, Flexner's report is valuable because it provides a window on the thinking about rationalism and empiricism at the time of the founding of modern medicine. Flexner was contemptuous of the practitioners of his day, whom he saw almost as mere empiricists, giving out medications by rote in response to symptoms. Describing the education system he wanted to destroy, Flexner observed:

> The student's part was, parrot like, to absorb. His medical education consisted largely in getting by heart a prearranged system of correspondences,—an array of symptoms so set off against a parallel array of doses that, if he noticed the one, he had only to write down the other: a coated tongue—a course of calomel; a shivery back—a round quinine. (21)

Surveying the achievements of Robert Koch, Robert Lister, and particularly the new Johns Hopkins Medical School, Flexner's vision was that the modern physician should be a scientist, trained in the habits and discipline of the basic sciences of anatomy, physiology, pathology, and microbiology. He compared the clinician to the researcher explicitly:

> The main intellectual tool of the investigator is the working hypothesis, or theory, as it is more commonly called. The scientist is confronted by a definite situation; he observes it for the purpose of taking in all the facts. These suggest to him a line of action. He constructs a hypothesis, as we say. Upon this he acts, and the practical outcome of this procedure refutes, confirms, or modifies his theory. Between theory and fact, his mind flies like a shuttle; and theory is helpful and important just to the degree in which it enables him to understand and relate, and control phenomena. This is essentially the technique of research: wherein it is irrelevant to bedside practice? The physician, too, is confronted by a definite situation. He must needs seize its details, and only by powers of observation trained in actual experimentation will enable him to do so. The patient's history, conditions and symptoms form his data. The progress of science and the scientific practice of medicine employ, therefore, exactly the same technique (Flexner, 55).

At the heart of the modern medical school is the investigation of the basic mechanisms of disease. Flexner argued that having faculty doing research is absolutely critical to the new medical school because the researcher's constant attention to the fundamental mechanisms of disease provides the right milieu for physicians in training. While practicing physicians must, as a matter of practicality,

spend their time taking care of patients and cannot focus on research, their temper and temperament have been formed by teachers who are honed at the edge of basic science. Flexner created a temple of medicine, in which the high priests are scientists who illuminate the basic processes of disease. While it is important not to oversimplify Flexner's views—the way of thinking he embraced emphasized the importance of fitting facts to theories—his was a triumph of rationalism over empiricism.

Flexner's vision has been profoundly amplified by the changes in science as mechanisms of disease have moved farther from the bedside, and in the financing of medical schools as external support for research has skyrocketed since World War II. The orthodoxy of modern medicine is rationalist; a large majority of physicians within academic medical centers and in practice are subspecialists who are experts in a particular set of diseases and focus on particular organ systems or diseases. Mechanisms of disease dominate medical school curriculum, as well as much of clinical training.

**EMPIRICIST RESPONSE**

The rise of clinical epidemiology in the latter half of the twentieth century represented the empiricists' response to the rationalists. The traditional roots of epidemiology were the Hippocratic emphasis on the distribution of disease in space and time and the empiricist tradition. In 1946, John Paul argued for the application of epidemiology to clinical problems (Paul, 539-41). This approach was elaborated by David Sackett at McMaster, Alvan Feinstein at Yale, and others in the 1960s and 1970s in a series of books and articles Arguing that clinical epidemiology is "the basic science of clinical medicine,"( Newton, 304). Sackett and others took the general approaches of epidemiology—defining a population and assessing exposures— and addressed them to the fundamental clinical questions of causation, therapy, diagnosis, and prognosis. The focus on clinical questions underscored the importance of studies with humans and emphasized patient-centered outcomes. Moreover, use of epidemiologic methods allowed standardized assessment ("critical appraisal") of the strength of study designs. The movement has had different names in different decades and with different audiences: Critical Appraisal of the Literature, Outcomes Research, Practice Guidelines, and Evidence-Based Medicine.

In the 1990s, the term "Evidence-Based Medicine" ("EBM") began to be used to label this general area of work. Sackett defines EBM as "the conscientious, explicit and judicious use of best current evidence in making decisions about the care of individual patients." (Newton, 304). What constitutes evidence is in the mind of the beholder, but the territory Sackett claimed included studies on humans that include patient-centered outcomes. While EBM has had many different expressions, a common approach has been to summarize the available literature around specific questions of clinical management. It is common for techniques of meta-analysis, the statistical combination of similar trials, to achieve a more precise estimate of effect.

A good example of EBM is the approach taken by David C. Slawson and Allen F. Shaughnessey to review the available clinical literature for practicing clinicians. (Newton, 304). Writing about the challenges faced by practicing physicians as they try to keep up to date, they distinguish between POEMs and DOEs. POEM stands for "Patient Oriented Evidence that Matters," meaning methodologically strong studies that apply to patients with symptoms similar to the physician's patients and change practice. DOE stands for "Disease Oriented Evidence," or evidence that relates to the pathophysiology of disease, or uses biochemical markers as outcomes. Practicing physicians should search for POEMs and use DOEs only when there is nothing better. The critique of traditional biomedical medical research is radical: The vast majority of published medical work falls into the category of DOEs. This approach has been incorporated into a series of magazines and new products for practicing clinicians, and its significance has been likened to Dolly the sheep by the editors of the British Medical Journal (Winston, 913).

The reaction provoked by EBM has been sharp, as one would anticipate from its impiety and antagonism to clinical experts. The tenor of the discussion can be seen in this comment by a British clinician:

> The rise of Evidence Based Medicine has been one of the more remarkable phenomena of the British health scene during the 1990's . . . . The "fall" of EBM is rather different; since it involves a quasi-theological "fall from grace": a loss of clinical, scientific and educational integrity, even to the point of decline into a "state of sin" (if seeking and clinging to power at any cost is seen as sinful). The moral decline would—in the normal course of events—be followed in due course by loss of status, income and power. However, the EBM barnacle may prove difficult to dislodge now [sic] it has a grip on the minds of politicians and managers. **(**Charlton & Miles, pp.371-374)

For the purposes of this argument, the emphasis on EBM represents a renaissance of empiricist thinking cast into modern language. The key questions of epidemiology—accounting for bias and chance—represent a modern treatment, with modern analytic tools, of the empiricists' central question: How does one learn from experience? How does one separate out the role of bias and chance? What is going on in medicine now is a war of cultures between those for whom the mechanisms of disease constitute the best kind of evidence and those who think that appropriately analyzed outcomes are critical.

**CONCLUSION**

The Rationalist way of thinking is very congruent with the overall structure of thought in the late twentieth century. We think in engineering terms, in causes and effects. Hence these physicians equate "science" with knowledge of mechanisms of action. If an Orthomolecular nutritionist announces: we have observed this vitamin's effect and want to use it even though we do not understand its mechanism, they do not recognize this as "scientific." Empiricism has always considered carefully controlled observation to be reliable knowledge. It rejects as a matter of principle any

excessively elaborate knowledge of the internal workings of the organism. Because, while one can know such mechanisms in general one can never know whether such knowledge is true for a single concrete individual.

However, empiricism and rationalism have limitations. The limitations of empiricism were demonstrated early on in the philosophy of Descartes. In Meditations on First Philosophy he implies that while sense perception is adequate for "things near to us" (for example things in an empirical sphere), the senses are unable to inform reality in "things very far away" (for example things in an ethical sphere) ( Descartes, 18). Scripture confirms this limitation of human reasoning by showing that while man is an empirically reasoning being and held responsible for what that reasoning deduces,(Rom. 1:20) his reasoning ability is limited in its capacity to know God fully on its own. Thus a dilemma is present. According to Duffer (6) human beings are built to function in an empirical sphere but are unable on their own to gain total insight into the ethical sphere. This is the source of frustration for empirical young physicians confronted with ethical questions. The result is apathy toward ethical discussion so common in today's student-physician.

What knowledge source should inform decision making in an ethical sphere? Descartes' rationalism confirms that sense perception alone has no foundational role in answering this question. These answers must come from beyond our sensory understanding of the situation. This source for Descartes was "first principles" or "objects of intuition." (Schouls, 33). Hume went even further in showing that not only was empirical reasoning inadequate for answering questions of an ethical sort but so was Descartes' rationalism. Others have offered alternative explanations for this knowledge source. These alternatives fall short because they are fundamentally bound by the use of human deductive reasoning in a non-deductive sphere. When an empiricist or rationalist confronts an ethical situation, pragmatism, agnosticism, or subjective value systems are the only logical solutions.

However, a revelational knowledge source claims to provide insight from beyond the empirical sphere into the ethical sphere. This is the fundamental task of revelation. ( Gal.1: 11-12) This is not to imply that revelational truths are irrational, only that their source is not limited by empirical sense or rationally derived. John Baillie describes revelation as a revealing from divine subject to human subject truths that were previously a mystery (i.e., beyond our ability to deduce them). Further, he states, "the mystery described is nothing less than God's own will and purpose."(Baillie, 28) In fact, the application of revealed principles in ethical situations, their call on us to decision and response, their reliance on faith rather than deductive reasoning for their reception and the hope this faith creates in a Revealer form the core of our relationship with God (Rom. 8: 24-25). This is what fulfills the search for a soul. God in His infinite wisdom has gifted humankind with the ability to empirically reason and rationally deduce. But in His infinite wisdom He has also seen fit to limit the capacity of this reasoning ability so that a faith relationship can be fostered with Him through encounter with His revelation. It is through this relationship that revelation

regarding Himself and the beyond can occur. It is through this relationship that our lives can attempt to imitate His revelation alone that provides answers for the relational question of life, death, family, and the hereafter. Thus "Revelational ethics" are necessary to inform the answers to questions such as "Why should Mrs. Stella Obasanjo be allowed to die?"

**REFERENCES**


Abraham, Medical (1960). *Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching*.

Angell, Marcia (1992). "Breast Implants: Protection or Paternalism?", *NEW ENG. J. MED, 326,* 1695.

Baillie, J. (1956). *The Idea of Revelation in Recent Thought*. New York: Columbia University Press.

Baum, Michael (1981). Scientific empiricism and clinical medicine: a discussion paper. *Journal of the Royal Society of Medicine, 74.* 504-509

Charlton, B.G. & A. Miles (1998). The Rise and Fall of EBM. *Q. J. MED. 91.* 371-74.

Coulter, Harris (1994). Empiricism vs. Rationalism in Medicine. *Journal of Orthomolecular Medicine. 9, 3.* 159-166.

Descartes, R. (1980). *Meditations on First Philosophy*. Trans. Laurence I. Lafleur. Indianapolis: Bobbs-Merrill.

Goldberg, Eugene (1996). Evaluating the Health Risks of Breast Implants. *NEW ENG. J. MED. 335*. 1154.

Janowsky, Esther et al. (2000). Meta-Analyses of the Relation Between Silicone Breast Implants and the Risk of Connective-Tissue Diseases. *342 NEW ENG. J. MED 781*.

Jules, Mitchel (2006). *History of Medicne*. Retrieved 20th February 2012. www.targethealth.com.

Magee, B (1973). *Popper*. Glasgow: Fontana/Collins.

Major, Ralph (1954). *A History of Medicine*. London: Hutchinson.

Markie, Peter. "Rationalism vs. Empiricism." *Stanford Encyclopedia of Philosophy*. Retrieved 20th February 2012. www.stanford.plato.org.

Newton ,Warren (2000). Rationalism and Empiricism in Modern Medicine. *Law and Contemporary Problems 64, 4*.10-15.

Paul, J.R (1938). Clinical Epidemiology. J. *Clinical Investigation*. *17. 539,* 539-41.

Popper, K. R (1959).*The Logic of Scientific Discovery*. London: Hutchinson.

Prioreschi, Plinio (1996). *A History of Medicine*. New York: Oxford University Press.

Schouls, P. (1980). *The Imposition of Method*, New York: Oxford University Press.

Winston, Robert (1997). The Promise of Cloning for Human Medicine. *BRIT. MED. J. 314,* 913.

# DESIGN OF MICRO-CONTROLLER BASED ANDROID APPLIANCES SYSTEM FOR A REMOTE ACCESS

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**ABSTRACT**
*This paper presents the planning and construction of android appliances control. It takes the advantage of the long distance communication capability of the android phone and its ability to interface with micro controller to implement a switch system. The completion of this design ends up in a switching system which will be controlled from any place using SMS. The design was achieved by connecting a programmed GSM Module using attention (AT) command with a programmable device that is being programmed in programming language. Instruction was sent from any phone or android to a remote phone connected to the programmable system. If the password is correct, the instruction is carried out and also the appliances connected to the system is switched on or off. The strategy used is that of the principle of wireless communication incorporated with embedded system.*

**Keywords:** Assembly Language, GSM Module, Instruction, Micro controller and Switching

## 1. INTRODUCTION

This design introduced an application among the rising applications of the GSM technology. We tend to introduce the design of a complete encompassing system

with ability to manage and control home gadget regionally using inbuilt input and output supplementary. Remotely, through the android phone, the house owner can watch and manage the house gadget set by causation commands within the type of SMS messages and receive the gadget standing as well. There are two parts in this system, namely; hardware and software. The hardware design contain a stand-alone encompassing system that's supported eight-bit micro controller, an interface and a driver circuit to attach the devices to the micro controller and a GSM modem. SMS messages are the means provided by the GSM modem to the house owner and the system to communicate. The system software driver is developed using communicative assembly language programming platform (Boylestad & Nashelsky, 2017). This design could be a way to execute the concept of wireless interaction of android and a micro controller.

The scope of this SMS operated device is vast in areas of managing devices at home like microwaves, air conditioners and lighting points and so forth. The device uses AT89S52 microcontroller being created by atmel corporation as the system control unit. The relay driver and the microcontroller has the aptitude of dominant up to eight (8) appliances, however this design will limit its scope to regulate one appliance. Every of the appliances works severally to every other counting on which one is being activated or deactivated by the user.

The design aim to offer an effective result that may provide controlling of home gadget remotely in the absence of house owner no matter the space separating the user and the device using android. The target embodies;

1. To style the ability supply
2. To program the GSM module to receive message with the android and the other software package
3. To design the voltage level device unit
4. To design the programmable circuit
5. To program the microprocessor

## 2. REVIEW OF RELATED WORKS

A control system is one that undertakes some function, checks its success and takes additional action till the objective is achieved (Holt, 2018 & Boylestad, 2017). This extension may include improvement in performance of system and inflated flexibility, since microcontrollers are often programmed to carry out completely different tasks such as data analysis, and control of physical, electrical or mechanical quantities. The control system enforced in this design uses the android phone to control a group of electrical appliances. It also takes the advantage of the android phone long distance communication skills to implement a control theme from anywhere and with any android phone.

Some folks in the field of embedded systems has done several related work based on this SMS home appliances system based on the most problem they are facing is the controllability of the device. They will only use one specific phone to control the system but in this new design, any phone can be used no matter the manufacturer and any GSM operator may also be used. The most factors the user has to know is to

induce the user manual to understand the working rule of the projected system (Edward, 2014 & Bernard, 2012).

Another difference between the new system and the previous system is that the previous system that has been done to date uses a network router as their GSM modem which is not readily found all over but the new system uses an android phone as the GSM modem connected to the system which is quickly found everywhere and is cheaper than the old system (Gupta et al, 2003). In the old system, once the router connected to the modem is switched off, the complete system will finish off and any appliances connected to the system will stop working but in this new system; it is freelance on the modem connected to it. Once the modem is off, the devices will still maintain their stand and no need to reprogram the modem anymore, within the previous work that has being done so far, it is not password secured; anybody can just send message to simply power the appliances but in this new design, the system will be secured using password that has already being programmed into the system.

## 3. METHODOLOGY

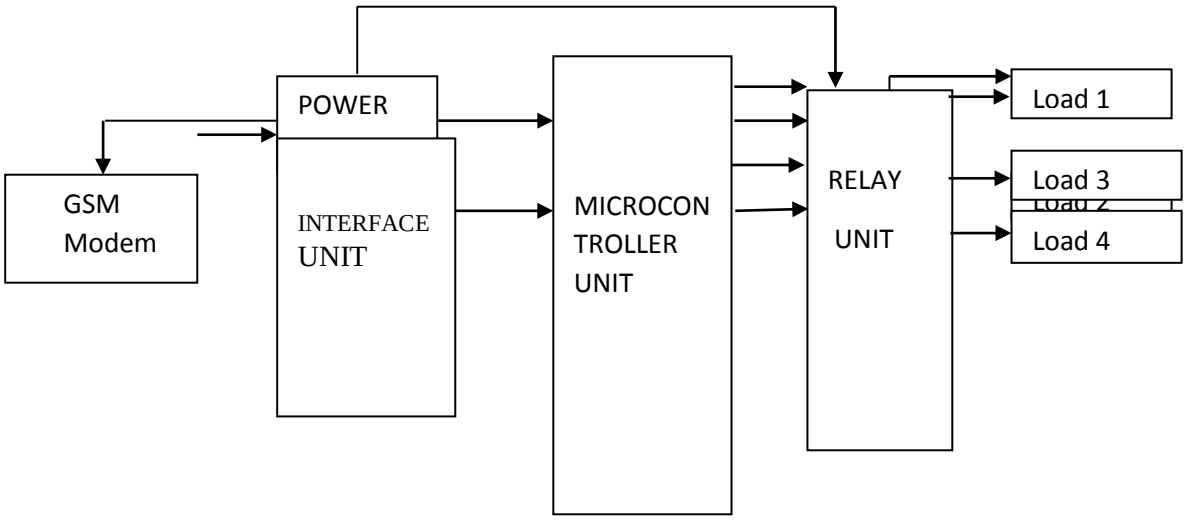



Fig 1: Block Diagram of a SMS Operated switch. (Source: designed with proteus)

### 3.2 Design of the Microcontroller unit.

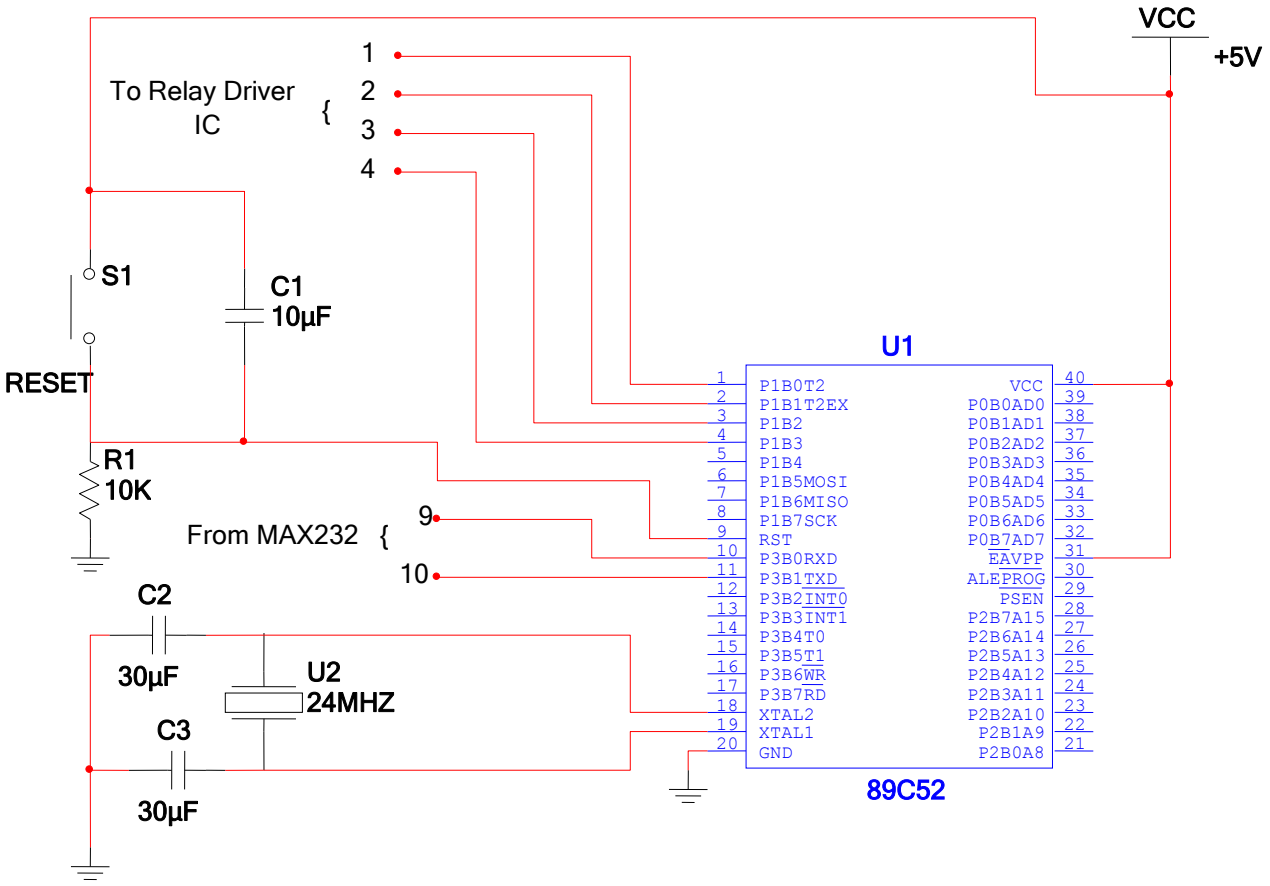



Fig 2: Circuit Diagram of the microcontroller unit

### 3.3 Design of the Interface unit

#### 3.3.1 The GSM Modem

To interface the GSM modem with the microcontroller, hands-free is used to hold the signal from android phone to transmit to the micro controller. The operating voltage of the GSM modem is 3.3 V and provides 3.7 volt at logic 1 and 0 v at logic 0. Max 232 IC is utilizing to have the amount equal to micro controller. It can sense input voltage not up to 2V.

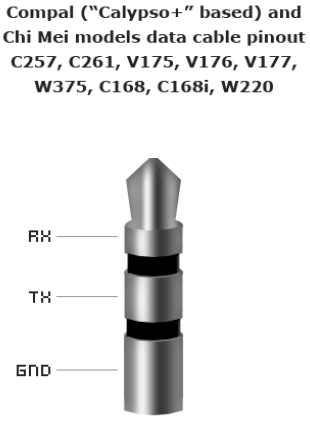
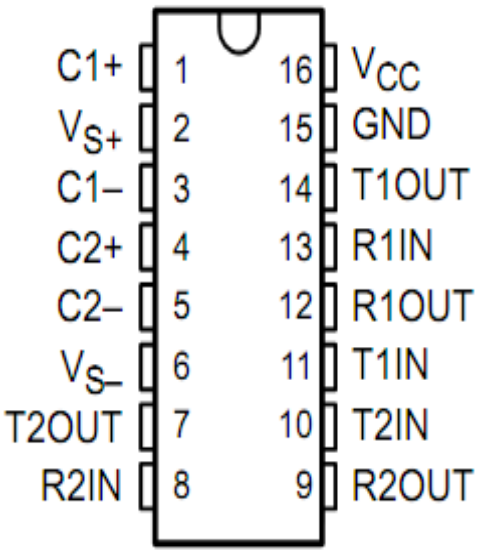



Fig 3: Hands Free Connector

### 3.3.2 Description of MAX232 IC

It is a twin driver or receiver that has an electrical phenomenon voltage generator to produce EIA-232 voltage levels from one 5-V supply. EIA-232 inputs can be changed to 5-V TTL/CMOS levels by each receiver. The receivers also have a regular threshold of 1.3 V and a regular physical phenomenon of 0.5 V, and might settle for ±30-V inputs. TTL/CMOS input levels is changed to EIA-232 levels by each driver.




**Function Tables**

**EACH DRIVER**

| INPUT TIN | OUTPUT TOUT |
|---|---|
| L | H |
| H | L |

H = high level, L = low level

**EACH RECEIVER**

| INPUT RIN | OUTPUT ROUT |
|---|---|
| L | H |
| H | L |

H = high level, L = low level

Fig 4: Pin Diagram of MAX232

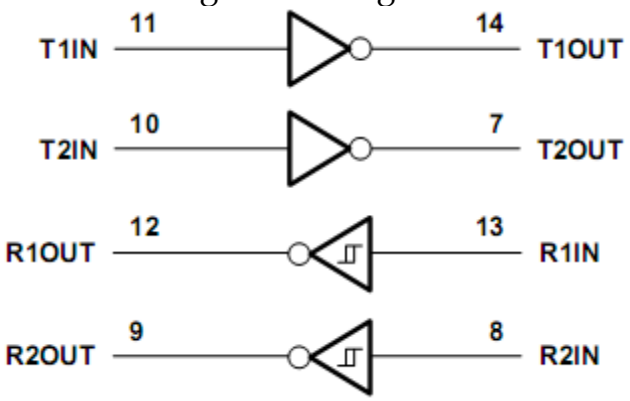



Fig 5: logic diagram (positive logic)

The figure below is the complete circuit diagram of the Interface of the android phone with the microcontroller by MAX232

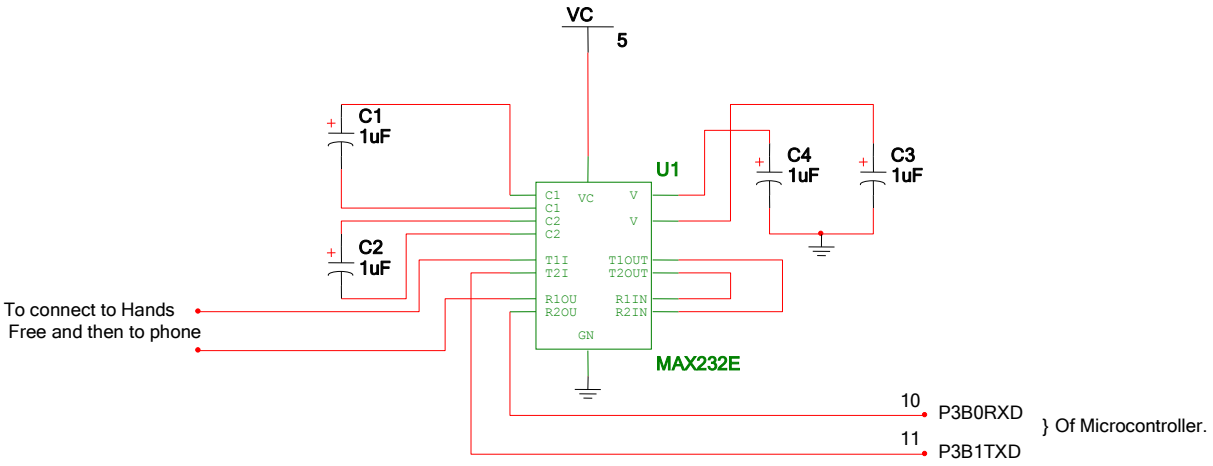



Fig 6: Circuit Diagram of the interface unit

Putting a diode throughout the coil such as in the diagram above can subdue harmful action. Throughout the "ON" state of the semiconductor, the diode is back-biased; it sets as an electric circuit and doesn't have an effect on anything. However, when the diode forward-bias, it means the transistor is turns OFF and the voltage throughout the coil is reverse, hence it places the diode in its "ON" state. The present through the electrical device established during the "ON" state of the transistor can then still flow through the diode eliminating the severe modification in current level.

The below figure is the circuit diagram of the relay unit.

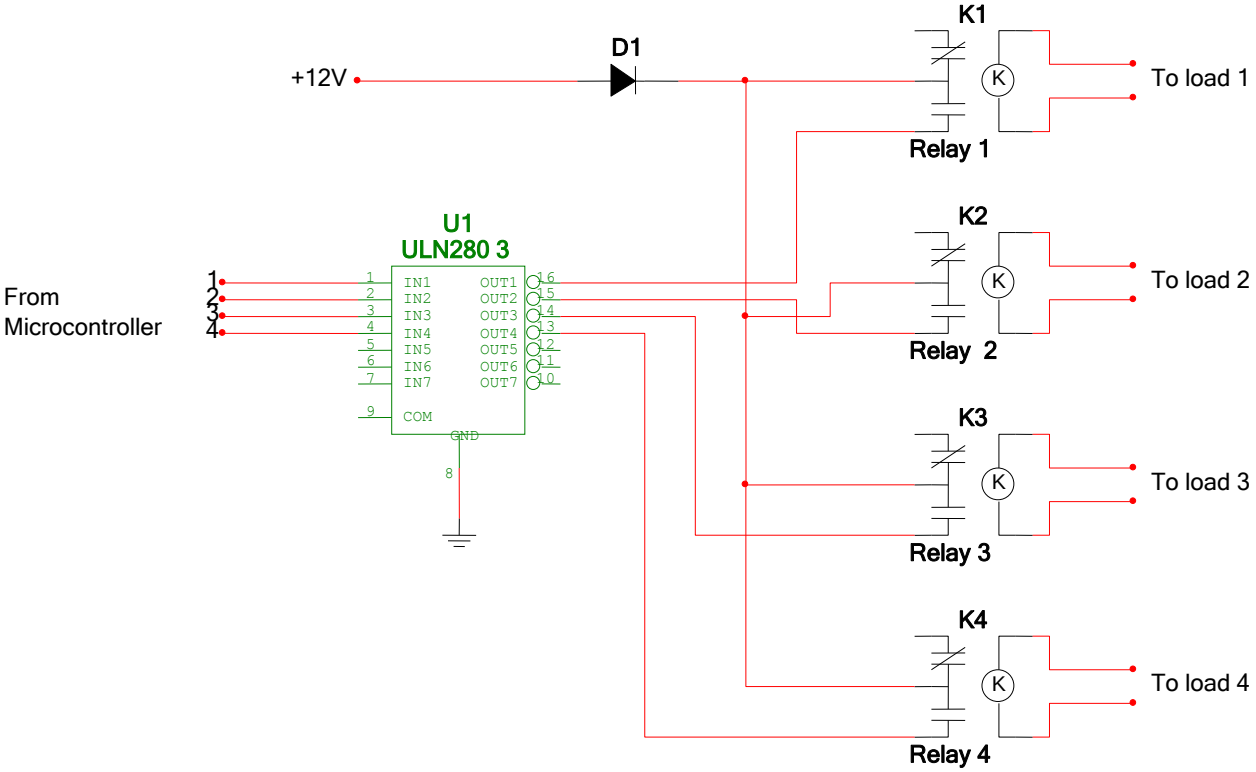



Fig 7: Circuit Diagram of the Relay Unit

## 3.8 Complete Circuit Diagram

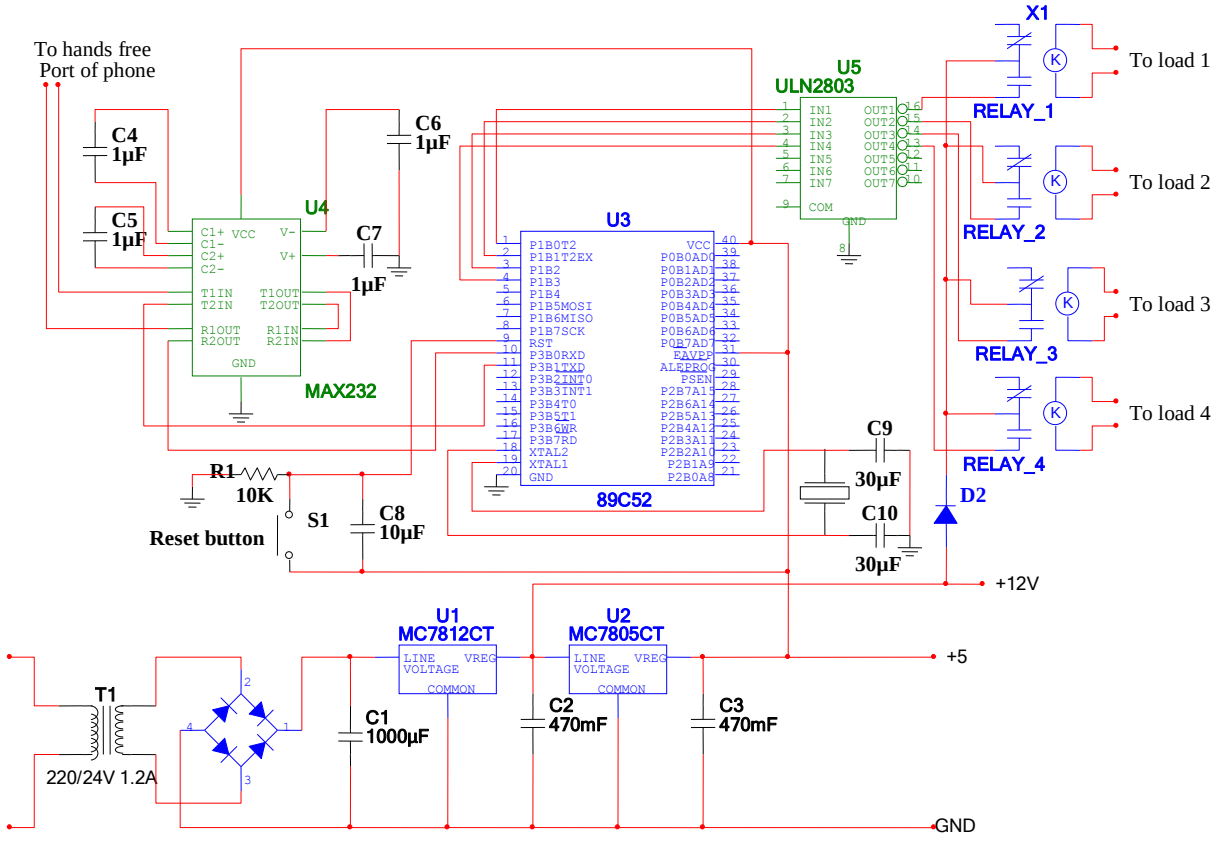



Fig 8: Complete Circuit Diagram of a SMS Operated Switch/SMS Appliance Control

Fig 3.7 and 3.8 above are the developed working circuits for the design. The experimental and practical analysis was done on proteus 9.2 and the simulation was done to get the required result.

## 4. RESULT AND DISCUSSION

The device was tested for each appliance connected to its four output sockets. The results were as follows:

2. To show on or off the television, a user should send “1200 ON1 “ to turn on the television and “1200 OFF1” to turn off the television
3. To show on or off the radio, a user has to send “1200 ON2” to turn on the radio and “1200 OFF2” to turn off the radio
4. To show on or off the PC. A user will send “1200 ON3” to turn on the computer and “1200 OFF3” to turn off the computer
5. To show on or off the refrigerator. A user will send “1200 ON4” to turn on the fridge and “1200 OFF4” to turn off the fridge.

The messages can be send to any variety that is within the modem connected to the programmed system. Any android phone can be used to send the message; what the entire user wants is to follow the above format before turning on or off any of the appliances.

## 5. CONCLUSION

From the testing and result obtained, it can be seen that the design conferred a way of controlling a set of appliances by the android phone through sending SMS with an embedded microcontroller system. Specifically, it demonstrates the chance of extending the practicality of the android phone from the standard use as a means of communicating between people separated by distance to the control of appliances from anywhere. Whereas the design has its limitations, it provides a chance for future enlargement of the current design in future years.

## REFERENCES

Bernard Grob. & Mitchel E. (2012). Basic electronics, 9th Ed., Western Wisconsin Technical College, written in United States of America.

Edward Hughes. (2014). Electrical and Electronic Technology, 8th Ed, Pearson Education ltd, pp 541-551.

Holt, Charles A. (2018). Electronic Circuits: Digital and Analog, published by John Wiley & Sons, Inc. Canada.

Klertz, William. (2016) Digital Electronics With VHDL, Quartus II Version, Pearson Education Inc., higher Saddle River, New Jersey 07458.

Nashelsky, L. & Boylestad, R. (2017). Electronic Devices and Circuit Theory, 9th Edition. Printed by Kindersley Dorling. India, Non-public limited.

# DESIGN AND IMPLEMENTATION OF ELECTRONIC TRAFFIC LIGHT

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## ABSTRACT

*The control of traffic at road junction, which was done purely by human effort, proves to be inefficient owing to the increasing rate of both motorists as well as the complexity of road networks. This inadequacy brought about the use of discrete solid-state electronics up to the usage of a computer controlled microprocessor, but the intelligence of this method was still limited to meet the demand of modern age. Thus, the need for the development of a microcontroller-based standard traffic light control system. Traffic lights are signalling devices situated on the road at intersection points which are used to control the completing flows of traffic. In generally, a traffic light consists of a set of three lights. They are red, yellow and green. This paper explores the design and implementation of a microcontroller-based standard traffic light system for road intersection control. The traffic light system is designed using Programmable Integrated Circuit (PIC) 16F84A microcontroller, power section, crystal oscillator and light emitting diode (LED). Then, for effective traffic control, the PIC is implemented via an IC programmer using a mikroC program written in C- language. The developed traffic light control system is tested by constructing a prototype that resembles the real application. The overall system design for the implementation of developed microcontroller-based traffic light control system entails four subunits. The subunits include the power supply unit, the sensing unit, the control unit and LED display unit. The functionality of the prototype shows that the developed system can be used for a real life traffic control at road intersection. Besides, the developed system can be employed as a training kit in learning traffic light control system design and operation. Also, it can be used as a teaching aid in schools for various road users.*

Keywords: Electronic Traffic Light, PIC, MikroC,

## 1. INTRODUCTION

Nowadays, vehicular travel is increasing through the world and many countries are facing many problems at traffic light intersection which are caused many accidents between the emergency vehicle and other vehicle. Traffic light control at the intersection point is a matter of concern in large cities. As the number of road users constantly increase and resources provided by current infrastructures are limited, modern control of traffic will become a very important issue in the future. One way to develop traffic light flow and safety of the current transportation system is to apply a modern traffic light control system. Traffic light controlled by microcontroller is becoming a common place in many cities because these units can easily adjust for different timing sequence.

Traffic lights are signalling devices situated on the road at intersection points which are used to control the completing flows of traffic. In generally, a traffic light consists of a set of three lights. They are red, yellow and green. When illuminated the red

light, it indicates for vehicles facing the light to stop and the yellow light indicates caution to prepare for stop short of the intersection. The green light is to proceed in the direction denoted. The traffic light sequence may differ from other, and they may be special rules or set of lights for traffic turning in the particular direction.
After installation of this system we will not have to stop all vehicles on the road at the time of passing of the junction which would have adverse implication over common citizen some time.

## 2. LIETERATURE REVIEW

Ever since Roman times, society has tried to control traffic. Even the fabled Roman road system created a conflict between pedestrian and equine travellers. However, a practical solution was not developed until the mid-nineteenth century, when J. P. Knight, a railway signalling engineer, created the first traffic signal, which was installed near Westminster Abbey in London, England in 1868. Unfortunately, the device exploded, killing a police officer, and its use was discontinued after being in operation for only a short time.
The modern traffic light was invented in America. New York had a three colour System in 1918 that was operated manually from a tower in the middle of the Street. Other cities soon adopted the idea of having someone on the scene to control the lights. Garrett Morgan, inventor of the gas mask, also developed traffic signalling devices. Having witnessed an accident between a car and a carriage, Morgan felt compelled to devise a system to prevent such collisions at street intersections. In 1923 he patented an electric traffic light system using a pole with a cross section on which the words STOP and GO were illuminated.

These basic designs were soon improved. In 1926 the first automatic signals Were installed in London; they depended on a timer to activate them. In the 1930s vehicle-activated lights were created in which cars rolled over half-buried rubber tubes. Air in the tubes was displaced by the weight of the car rolling over them, and the increased pressure operated an electric contact, activating the lights. But these tubes wore out quickly. A better idea was the inductive-loop device: a loop of wire was imbedded in the road itself and connected to a box controlling the lights; a current of electricity passed through the loop, and when the steel body of a car passed overhead, it produced a signal that activated the light.

Today, traffic is automatically routed onto limited access highways courtesy of a computer activated guidance system that determines traffic volume on the Highway. Global positioning satellite systems (GPS) are installed in many cars. These systems connect with a satellite and inform drivers where they are and Possible routes to their destination. Such systems will eventually enable a drive to determine the best route to a destination given prevailing traffic conditions.
A large number of approaches are presented to minimize the problems of the traffic light jams, bellow a literature survey for some solution in the last few years:
**Ganiyu R. A., 2014** Introduced a traffic light control system; the design consists of the microcontroller, and light emitting diode (LED). The sensing unit is designed

utilizing a pressure switch which will sense the weight of any car that steps on it. When the pressure switch is pushed, a logic one is applied on the microcontroller to inform the control unit that there is car at that particular node. The system was designed to sample all the lanes in turn to detect whether there is an automobile on any lane and this action added a period of 15sec to the delay time by the microcontroller which is configuring the traffic light action.

**Sachin Jaiswal, 2013** Presented control system consist of microcontroller, IR sensors, in line of sight configuration across the loads to detect the density at the traffic signal, and for VIP automobile RF transmitters are installed on it while the receivers installed on traffic light control circuit to control the state of the traffic light. Three levels of jam and delays are defined high, medium, low density.

**Rashid Hussian, 2013** Presents system of Intelligent Traffic Routing using a Wireless Sensor Networks. The Wireless sensor network technology is used to sense presence of Traffic near any node and then able to route the Traffic based on density in the desired road. The system uses microcontroller with the Wireless sensor for Traffic management.

**A. Ms PromilaSinhmar, 2012** Propose multiple traffic light control and monitoring system. The system is based on microcontroller. The system contains IR sensors are mounted on the sides of roads respectively. The IR sensors network sense the vehicle passed through it. Microcontroller controls the IR system and counts the number of vehicles passing on the road. The vehicle count is stored in microcontroller memory. Based on a different vehicle count, the microcontroller takes decision and updates the traffic light delays as a result. Administrator sitting on the computer can command system (microcontroller) to down-load recorded data, update light delays, erase memory, etc. Thus administrator of a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent.

**Shilpa S. Chavan, 2009** Introduced Intelligent Traffic Light Controller, which consist of infrared sensor mounted on the road to detect the vehicles, this acts as an input to the ITLC unit. This input signal indicates the length of vehicles on each road. The controller generates output signals for Red, Green and Orange Signal and monitors their timings, taking into consideration the length of vehicles on each road. The same information is transmitted to the mobile user which will request for congestion status. If a vehicle driver at junction sends SMS on GSM mobile phone to ITLC unit, the driver will get a message indicting congestion status of the road. The microcontroller that used is AT89c51.

## 3. SYSTEM ANALYSIS

### 3.1 BASIC COMPONENT USED

#### 3.1.1 Light Emitting Diode

A light-emitting diode (LED) is a two-lead semiconductor light source as shown in figure 2. It is a p–n junction diode, which emits light when activated..

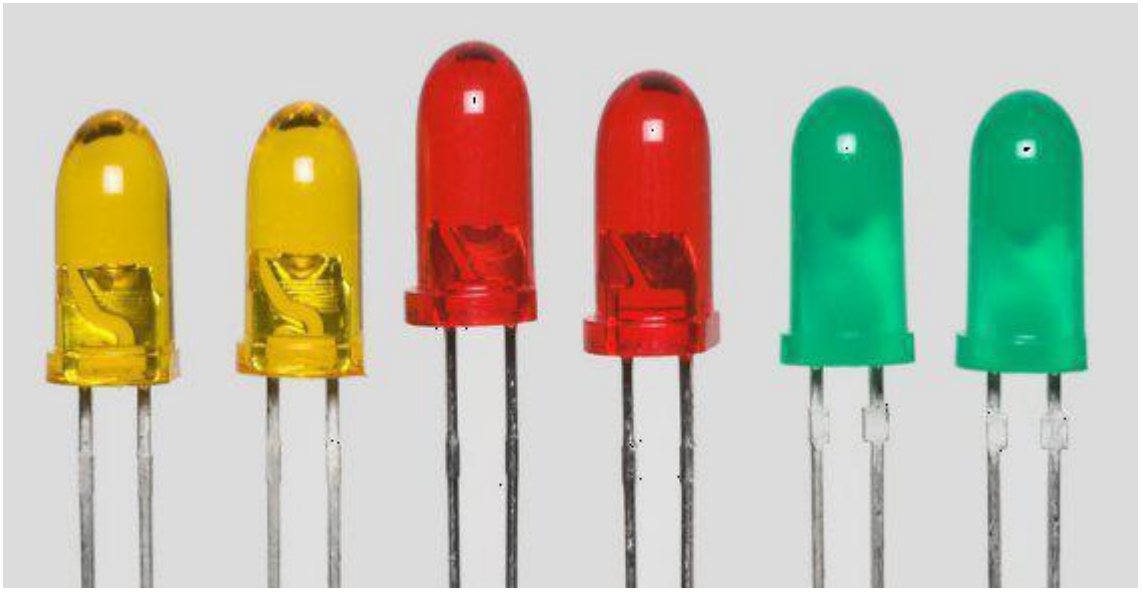

*Fig.1 LED lights*

### 3.1.2 Resistors

A **resistor** is a passivetwo-terminalelectrical component that implements electrical resistance as a circuit element.

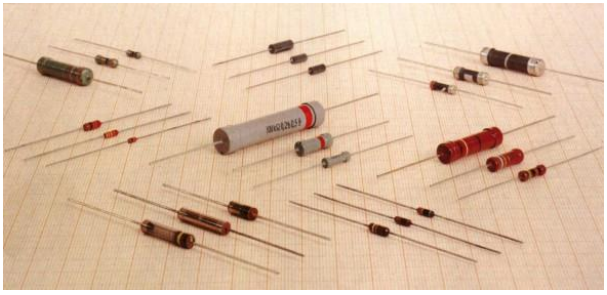

*Fig. 2a: Some low-power resistors*

*Fig. 2b: High-power resistors and rheostats*

### 3.1.3 Microcontroller (PIC16F84A)

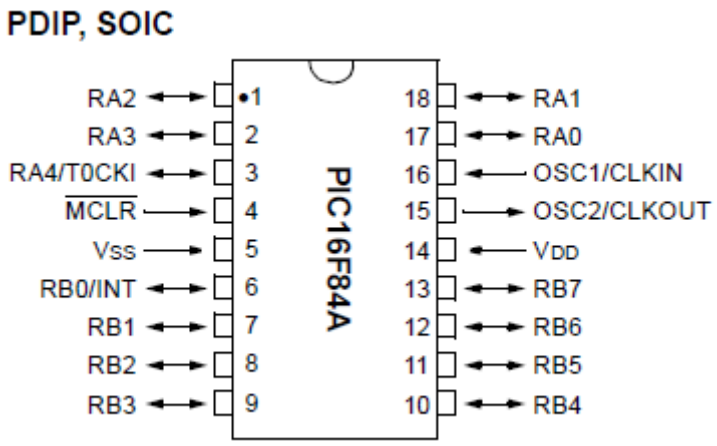


*Fig 3: Microcontroller*

This microcontroller acts like the brain of this project. The microcontroller chip that has been selected for this purpose is PIC16F84A manufactured by Microchip.

### 3.1.4 Crystal Oscillator

Quartz crystal oscillators were developed for high-stability frequency references


*Fig 4: Frequency standard*

### 3.1.5 Diode


*Fig 5: Diode*

In electronics, a **diode** is a two-terminal electronic component with an asymmetric transfer characteristic, with low (ideally zero) resistance to current flow in one direction, and high (ideally infinite) resistance in the other.

### 3.1.6 Capacitor

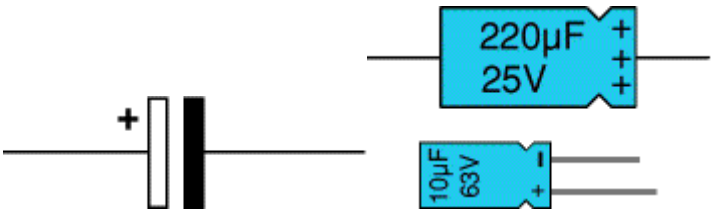


*Fig 5: Capacitor*

A **capacitor** (originally known as **condenser**) is a passive two terminal electrical component used to store energy in an electric field.

### 3.1.7 Transistor

Transistor are active component which are often found in many different electronic circuit. They play their roles in circuit as amplifier or switch+ component. they have their lead which must be connected at the correct way round, The two type of stand transistor are NPN and PNP , with different circuit symbol .


*Fig 7: Transistor*

## 4. HARDWARE DESIGN

### 4.1 Power supply unit

The system is powered by the 240V AC mains. The 240V is applied to a step down transformer, which stepped the voltage from 240 to the required 12 volts AC. The output of the transformer is then passed through a rectifier which converts the AC supply to a DC voltage. The output of the rectifier is filtered by connecting a capacitor across its terminals to remove the AC ripples. The filtered output is then passed through a regulator that will limit the voltage to 5V needed by the TTL IC (PIC16F84A). The output of the regulator is supplied to every part of the circuit.

### 4.2 Control unit

The control unit is basically a programmable interface controller (PIC), which serves as the traffic controller based on the program written and sent into its flash memory and with consideration for the input signals that comes from the pressure sensors. The PORTB register of the PIC is used to control the LED display while the PORTA register is used to sense the input from the pressure sensors. Fig. 2 shows the control unit of a four way traffic controller. A crystal oscillator of 8MHz is connected to the oscillator input and output pins with a coupling capacitor of 22pF.

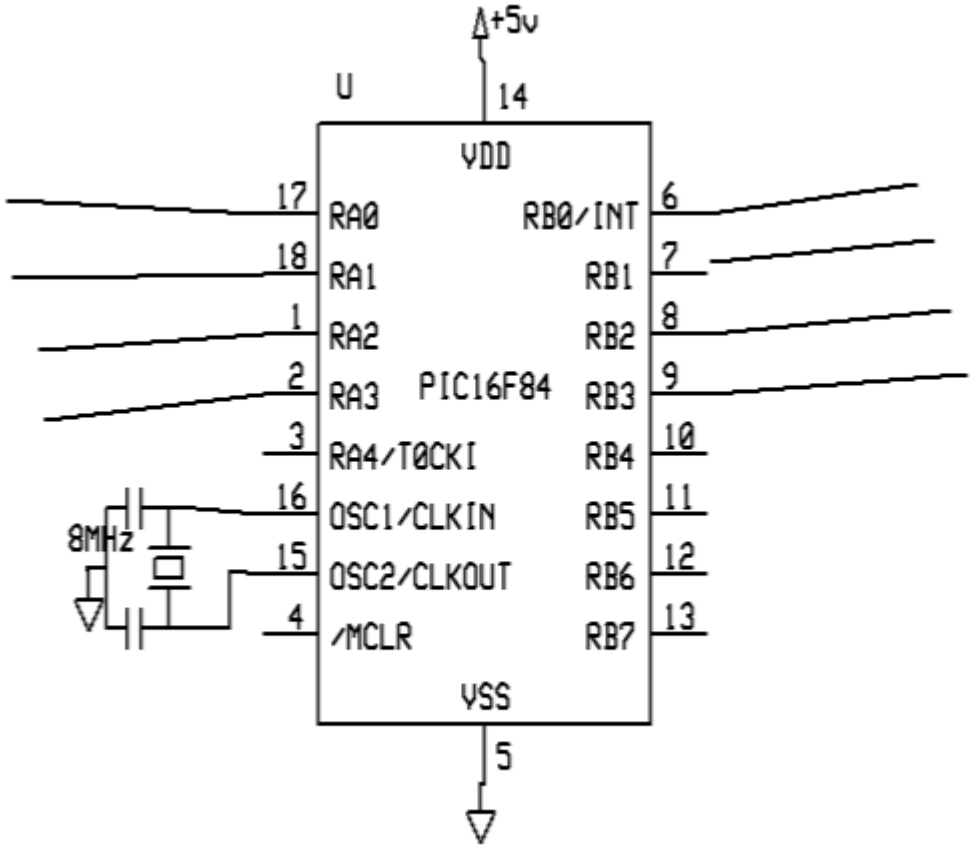


*Fig. 8: Control unit of a standard traffic light controller*

### 4.3 The Microcontroller

A microcontroller is a complete computer on a chip having the elements of a basic micro-processor along with other specialized functions. The PIC16F84A microcontroller employed in this work belongs to the mid-range family of the PICmicro® microcontroller devices. Its program memory contains 1K words, which translates to 1024 instructions, since each 14-bit program memory word is the same width as each device instruction. The data memory (RAM) contains 68 bytes. There are also 13 I/O pins that are user-configured on a pin-to-pin basis. Some pins are multiplexed with other device functions. These functions include:

- External interrupt
- Change on PORTB interrupts
- Timer clock input

## 5. SOFTWARE DESIGN

The microcontroller is a very resourceful chip and can be programmed to carry out a number of functions. The PIC16F84A was programmed with the aid of the computer software known as MikroC IDE; mikroC is a registered trade mark of mikro-Elektronika. The C language was used to program the IC on this software. The software generated the hexadecimal equivalent of the code written which was loaded into the linker(IC prog IDE) that transfers the hexadecimal file into the memory of the IC.

### 5.1 Design Details

The overall design of the microcontroller for road intersection is depicted in Fig. 4. Three different colour LEDs are placed on the lanes for displaying purposes.

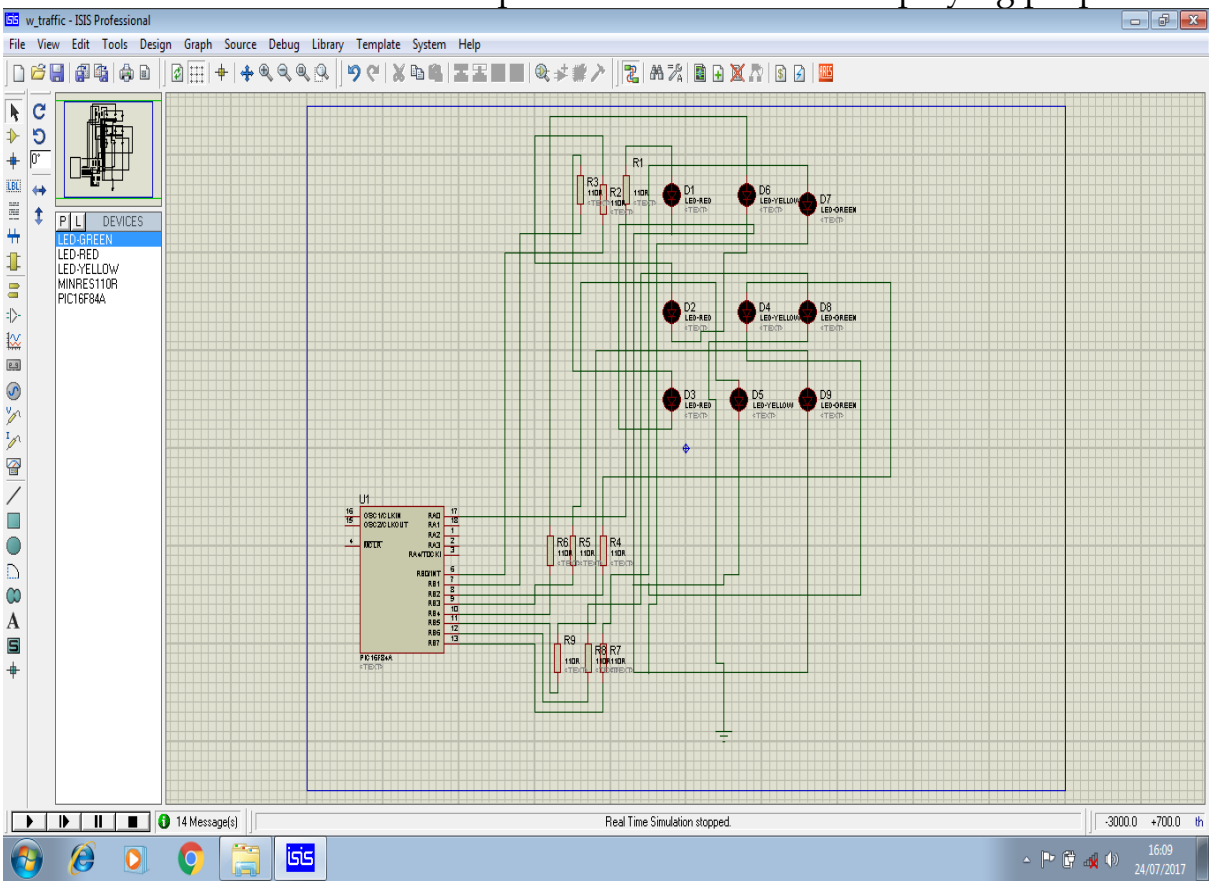


*Fig. 9: Complete circuit diagram of the designed microcontroller-based traffic light system*

## 6. THE SYSTEM OPERATION

The microcontroller-based traffic light system for road intersection control was developed to direct the movement of vehicles meeting at a road junction without any collision. To achieve this, the microcontroller allocates time for each path when the vehicles along that path will move and the other vehicles from the other path will stop. When the time allocated for a specific path has been exhausted, the **red light** will be ON meaning stop and the next line will be ON (**green light**) which means the vehicle in that path should start moving. When the time is about to be exhausted, **the yellow light** will be ON in the third path informing the vehicles in that path to be ready to move, and after some seconds the green light will be ON.

## 7. CONCLUSION

This paper has been successfully presented a functional and low cost microcontroller-based traffic light system for road intersection control. The traffic light system is designed using programmable integrated circuit (pic) 16f84a microcontroller, power section, crystal oscillator and light emitting diode (led). Then, for effective traffic control, the pic is implemented via an IC programmer using a mikroc program

written in c- language. The developed traffic light control system is tested by designing a prototype that resembles the real application. The functionality of the prototype shows that the developed system can be used for a real life traffic control at road intersection. Also, developed system can be employed as a training kit in learning traffic light control system.

## REFERENCES


N. M. Z. Hashim, et al (2013), "Traffic Light Control System For Emergency Vehicles Using Radio Frequency", IOSR Journal Of Engineering, vol. 3, no. 7, pp. 43-52, 2013.

R. Al-Alawi, (2009) "Web-Based Intelligent Traffic Management System", Proceedings Of The World Congress On Engineering And Computer Science (WCECS), vol.1, 2009, San Francisco, USA.

Polland, Justin: (2008) "The Eccentric Engineer: The History of Traffic Light Is Full Of Twists and Turns" 2008. Engineering and Technology-iet-3 (15):93 page 93

Mcshane, C. (1999). "The Origins and Globalization of Traffic Control Signal" Journal Of Urban History. 25(3). 379-404 page 382

Andreas Richter (2005*) Geschwindigeitsvogabeantichtsignalanlagenduv*page 33-34
Traffic Light Sequence *drivingtestips.bic*


# PROTOTYPE AUTOMATIC STREET LIGHT


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## ABSTRACT

*The automatic street light control is an electric device designed to provide an alternative to the switching system of existing one. The automatic street light control become imperative to overcome the shortcoming of the previous and presently existing methods of switching to control light supply. Automatic street light made use photoelectric device as sensor, it sense light and darkness so that light will automatically switch ON and OF. It is made up of different unit to perform and serves its purpose. This paper aims at designing automatic street light system. Nowadays, human has become too busy, and is unable to find time even to switch the lights whenever not necessary. The present system is like the street lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. This is the best solution for electrical power wastage. In this system the two sensors are used which are light dependent resistor LDR sensor to indicate a day /night and the photoelectric sensors to detect the movement on the street. The Microcontroller PIC16F877A is used as brain to control the street light system. Where the programming language used for developing the software to the microcontroller is C- language. Finally, the system has been successfully designed and implemented as prototype system. It is suitable for use at home areas where illumination is important.*

**Keywords**: Street light, LDR, photoelectric sensor, microcontroller, energy saving and circuit design.

## 1. INTRODUCTION

Automatic street light control model is an electronic device designed to provide illumination whenever there is darkness. There is need for this device to serve as illumination after that the radiant light from the sun seizes. This device came into use when civilization and modernization tends to increase and the replacement of the earlier method of illumination like the one will control switches was made. Early method was no all ideal because of the cost and stress involved of human being. The device consists of main power supply unit to be able to serve its purpose. According to B.L Theraja (1979) circuit, it consists of a resistor connected in sense across the output terminals of the voltage regulator. Obviously, it eliminates the necessity of providing separate DC power supplies to different electronic circuit working on different DC levels, from fig1 that is really required for conversion from AC to DC is a transformer and a rectifier (in fact, even the transformer could be eliminated if no voltage transformation is required). The rectifier, filter, and voltage regulator are mere refinement of a DC power supply though they are essential for most applications except for battery charging and running small DC motor. Jones M. H (2008) The SSC (supply station controller) is installed inside the supply station and controls group of lamps per feeder. In addition to this, the SSC is equipped with a sensor, which generates alarms in the case of the stations door being opened, thus ensuring the security and integrity of the supply station. It automatically switches ON when there is darkness and OFF when there light. This is designed to provide illumination wherever there is darkness, to reduce the strength of human being and to reduce the rate of road accident. The major criticism of street lighting is that it can actually cause accidents if misused, and cause light pollution.[D.A.U Fleet fire (2003)] Discusses on the essential implementation aspect of energy conservation with respect to solar energy. This is simple yet powerful concept by which it uses transistor as

switch. Automatic streetlight switches ON when the night falls and turns OFF when the sun rises. By using the system manual works are 100% removed and also energy consumption. The automatic streetlight control operates on 12vDC supply ,it has a photoconductive device whose resistance change proportionally to extent of illumination which switches ON or OFF the L.E.D with the used of transistor as a switches, light dependent resistor, a photo conductive device has been used as the traducer to convert light energy into electrical energy. Power supply to the circuit is applied from the regulated power supply. The A.C input i.e. 220v, DC voltage is required to operate electronic component and these voltage are 9v or 12. But those voltages cannot be obtained directly. L. Hilborn (2007) effective methods for the usage of nonrenewable resources needed to be developed. The automatic street light control is a therefore designed and developed to replace existing ones. It is made up of different unit to perform and serve its purpose. It is suitable for use at home areas where illumination is paramount importance. The internet of things (IoT)is always giving unprecedented answers for the customary issues looked by man. One of the real obstacles in city is we are spending huge expenses on street light. To control the street light based on detection of sunlight by implemented with smart embedded system.

## 2. LITERATURE REVIEW

The earliest lamps were used by Greek and Roman civilizations, where light primarily served the purpose of security, both to protect the wanderer from tripping over something on the path as well as keeping the potential robbers at bay. At that time oil lamps were used predominantly as they provided a long-lasting and moderate flam. The Romans had a word 'laternarius which was a term for a slave responsible for lighting up the oil lamps in front of their villas.

Before incandescent lamps, candle lighting was employed in cities. The earliest lamps required that a lamplighter tour the town at dusk, lighting each of the lamps, but later designs employed ignition devices that would automatically strike the flame when the gas supply was activated. The earliest of such street lamps were built in the Empire, the first modern street lamps, which used kerosene, were introduced in Lviv in what was then the Austrian Empire in 1853.ss

The first electric street lighting employed are lamps, initially the 'Electric candle', 'Jablotchkoff candle' or 'Yablochkov candle' developed by the Russian Pavel Yablochkov in 1875. This was a carbo are lamp employing alternating current, which ensured that both electrodes were consumed at equal rates. Yablochkov candles were first used to light the Grands Magasins du Louvre, Paris where 80 were deployed-improvement which was one of the reasons why Paris earned its 'City of Lights" nickname. Soon after, experimental arrays of arc lamps were used to light Holborn viaduct and the Thames embankment in London- the first electric street lighting in Britain. More than 4,000 were in use by 1881, thought by then an improved differential arc lamp had been developed by friedrich von Hefner- Alteneck of Siemens and Halske.

To avoid having the entire system go dark if a single lamp burned out, each street lamp was equipped with a device that ensured that the circuit would remain intact.

Early series street lights were equipped with isolation transformers. That would allow current to pass across the transformer whether the bulb worked or not. Later the film cutout was invented. The film cutout was a small disk of insulating film that separated two contacts connected to the two wires leading to the lamp. If the lamp failed (an open circuit), the current through the string became zero, causing the voltage of the circuit (thousands of volts) to be imposed across the insulating film, penetrating it (see ohm's law). In this way, the failed lamp was bypassed an automatic voltage regulator, preventing the current from increasing lamp was replaced; a new piece of film was installed, once again separating the contacts in the cutout. This system was recognizable by the large porcelain insulator separating the lamp and reflector from the mounting arm. This was necessary because the two contacts in the lamp's base may have operated at several thousand volts above ground/ earth.

Today, street lighting commonly uses high-intensity discharge lamps, often HPS high pressure sodium lamps. Such lamps provide the greatest amount of photonic illumination for the least consumption of electricity. However, when isotopic/photonic light calculations are used, it can be seen how inappropriate HPS lamps are for night lighting. White light sources have been shown to double driver peripheral vision and increase driver break

Reaction time at least 25%.when S/P light calculations are used; HPS lamp performance needs to be reduced by a minimum value of 75%. This is now a standard design criterion for Australian roads.

A study comparing metal halide and high-pressure sodium lamps showed that at equal photo light levels, a street scene illuminated at night by a metal halide lighting system was reliably seen as brighter as and safer than the same scene illuminated by a high pressure sodium system. New street lighting technologies, such as LED or induction lights, emit a white light that provides high levels of isotopic lumens allowing street lights with lower wattages and lower photo pic lumens to replace existing street lights. However, there have been no formal specifications written around photonics/isotopic adjustments for different types of light sources, causing many municipalities and street departments to hold back on implementation of these new technologies until the standards are updated.

Photovoltaic powered LED luminaries are gaining wider acceptance. Preliminary field tests show that some LED luminaries are energy-efficient and perform well in testing environments. In 2007, the civil twilight collective created a vanned of
the conventional LED streetlight, namely the lunar light. This streetlight design thus reduces energy consumption as well as light pollution.

Street lighting systems require ongoing maintenance, which can be classified as either reactive or preventative. Reactive maintenance is a direct response to a lighting failure, such as replacing a discharge lamp after it has failed, or replacing an entire lighting unit after it has been hit by a vehicle. Preventative maintenance is scheduled replacement of lighting components, for example replacing all of the discharge lamps in an area of the city when they have reached 85% of their expected life.

## 3. POWER SUPPLY TO THE SYSTEM

This introduces the operation of AC power supply into DC power supply circuit build using filters, rectifier and then voltage regulator starting with an AC, voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain a desired fixed DC, voltage.

The power supply unit is a component that supplies electrical power to every other component in the system by converting standard 220V, 50/60HZ, DC. Accepted to the microcircuit. A block diagram containing the parts of typical power supply and the voltage at various points in the unit is shown in fig1.

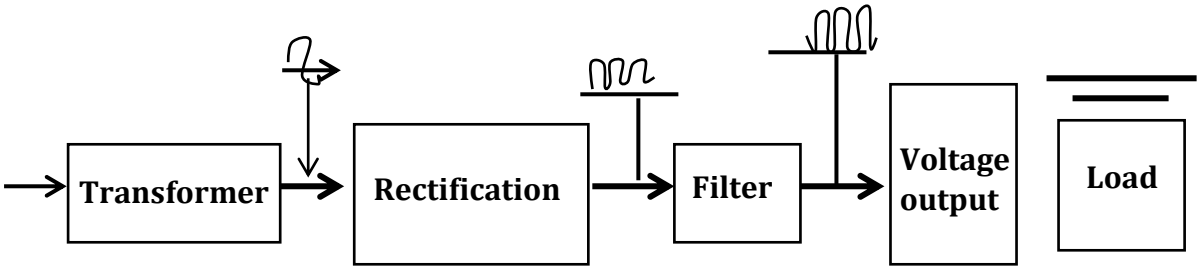



*Fig 1: Rectification Circuit*

Rectification is the conversion of AC the most important rectifying component in modern use is the semi – conductor diode. Severer rectifier circuit is shown in the figure 2, below.

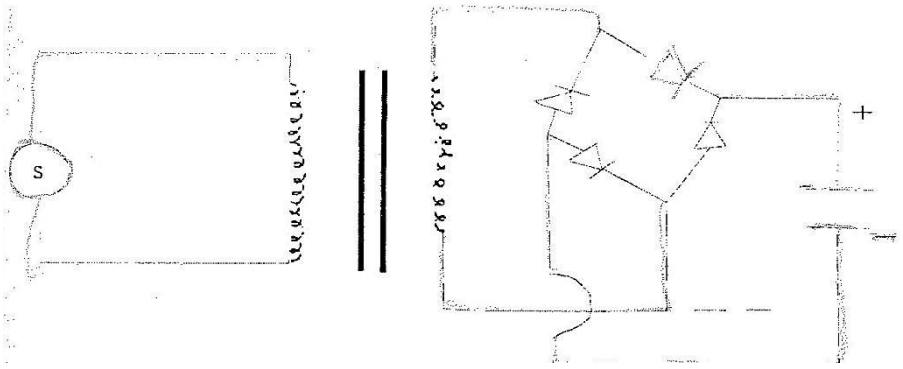



*Fig 2: Full Wave Bridge Rectifier Circuit*

Full wave rectification is universally used in electronics and produces pulse DC at twice the supply frequency. This can be achieved with two diode if a center – tapped transformer is used, or with four diode connected in a bridge configuration is the most widely used nowadays, requiring a secondary winding without a center tap on the transformer. Four diodes arranged in the bride with four terminals or lead is commonly available and known as bridge rectifier. The rectification employed in this construction is full wave bridge rectification. The diagram in fig. 2. c point A will be positive with respect to ground G point B will be negative with respect to ground G. if the batteries are now reversed, then A will be negative , and Position with respect to G the A. C supply reverses each half-cycle. Therefore, a will be position and B negative, with respect to G on one half-cycle and the position on the other half-cycle.

## 4. NO LOAD VOLTAGE

No load voltage is the output with the load open circuit i.e. when the load is removed a simple power supply with no load resistance reservoir capacitance charge up to the peak voltage as normal. However, with THE ABSENT OF A load resistor, the capacitor retains the charge across its peak voltage without any ripple. The no load voltage is therefore the highest terminal voltage if the main supply is supply is used there is no load terminal voltage.

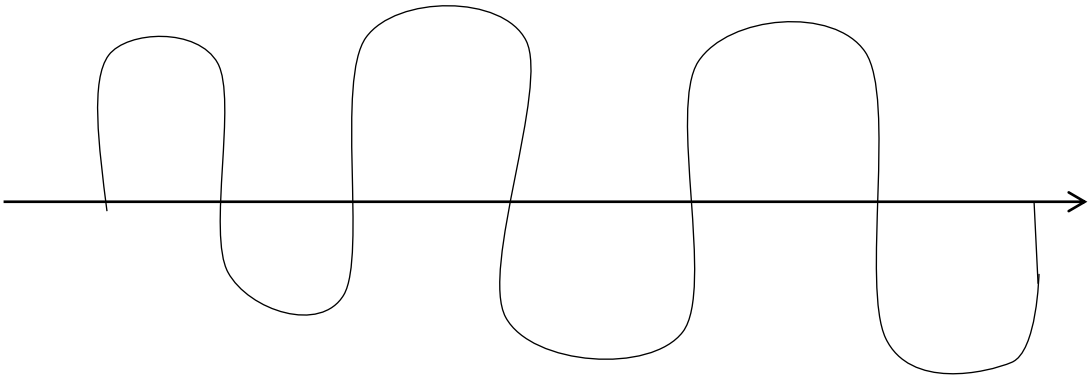


*Fig 3: No Load Voltage*

## 5. METHODOLOGY

### 5.1 COMPONET SELECTION

#### 5.1.1 Transformers

A transformer is a component that can be technically be defined as an inductor, because it is conductor, because it is constructed by placing two coils in close proximity to each other. One of the main applications of transformer is to step up or down an AC voltage. The diagram below shows the typical schematic of a transformer.

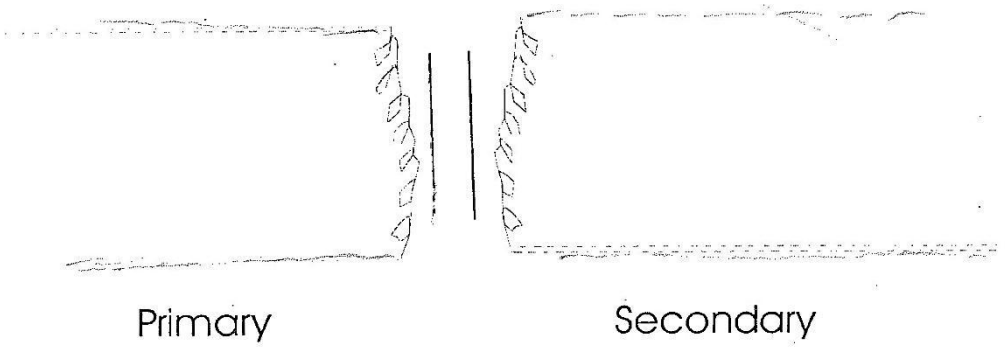
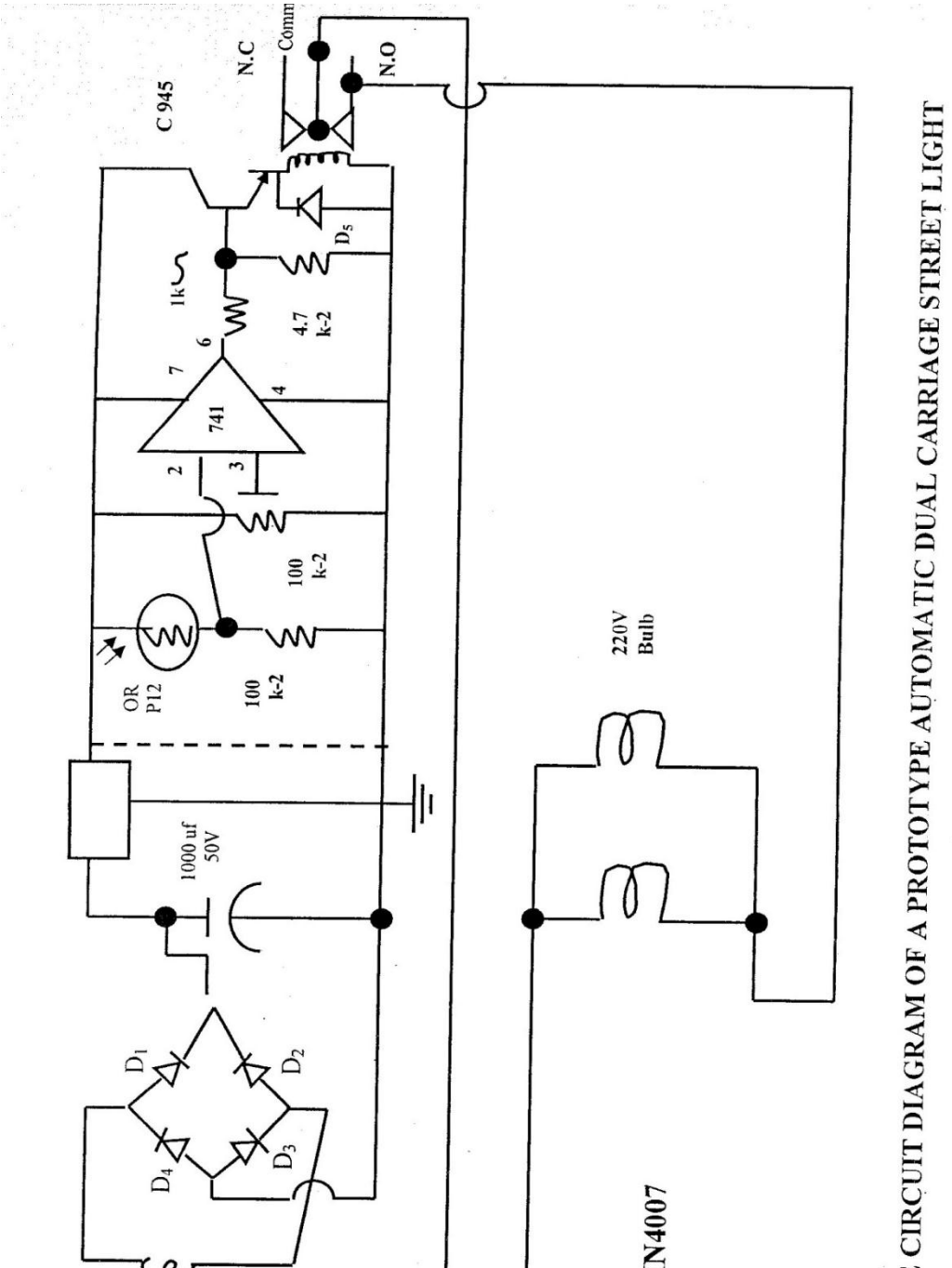



*Fig 4: Transformers*

Transformer are widely available commercially in a large of sizes, power rating and electrical configuration and are designed for operation at a specific frequency usually 50, 60, or 400HZ.




CIRCUIT DIAGRAM OF A PROTOTYPE AUTOMATIC DUAL CARRIAGE STREET LIGHT

## 5.2 OPERATION OF THE SYSTEM

The director current voltage that powers the circuit is derived from a two anode step down transformer. Bridge rectification was used for the two – anode transformer. The output from the transformer is then passed to the filter stage, when will smoothen it with capacitor. This smoothing is necessary in order to remove all forms of ripple and is connected to a resistor, which act as a regulator limiting the flow current so that there would not be excessive flow of current. This current thus flow through the photoelectric deice, it carries it to be conductive and provides a low needs light to work. When light strikes the photoelectric device, is carries it to be conductive and provide a low resistive path, this prevent the transistor from charging to a voltage in significant and prevent the circuit system to trigger on, but when there is darkness the resistance is very high and voltage will be enough to trigger their system to flow through it. Then the current will flow into the comparator stage in which it will vary the current to a particular voltage level set up for the system to work and the light indicator will be on, indicating the presence of current flow in the system. After this, the relay will be energized the contact will close and complete the circuit foe current to pass to the bulbs that have been connected to the system.

## 6. TEST AND RESULTS

Various tests are carried out on the design and construction of the automatic street light control system and the results obtained are as follows:

i. The first test was carried out is on the secondary terminal (output) of the 220/12v transformer, which was connecting the secondary terminal to a cathode ray oscilloscope (CRO) as shown in the diagram below it can be noted from the result that the output voltage is still alternating

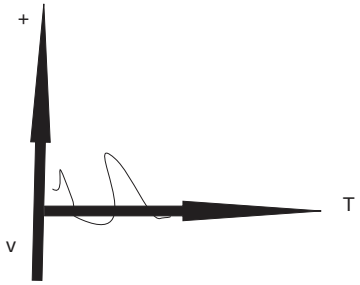



**Fig 6**

ii. The other test that was also carried out is on the diodes, the test on the diode with the help of cathode ray oscilloscope and the result obtained is a unidirectional pulsating output at twice the frequency of the output which

shown that input AC cycle has been rectified was observe. The output voltage is show as:

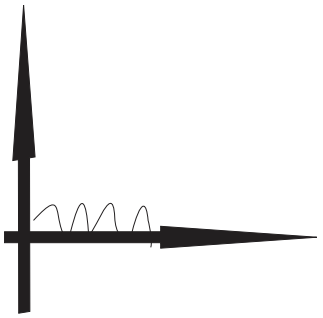


**Fig 7**

iii. The third test was carried out on the smoothing circuit as shown in the diagram below and the result also collected.

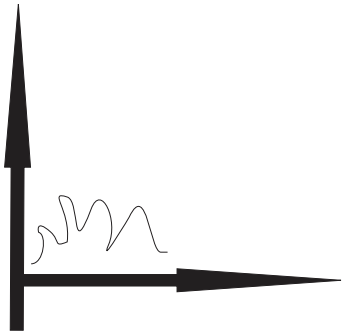


**Fig 8**

iv. The test was carried out after the complete construction of the project as it was connected or plugged in the power source and all bubs bring its illumination.

## 6. CONCLUSION

The automatic street light has exposed the student (s) to the practical knowledge of electrical and electronics and the system or method of joining component together, therefore, the basic principle of all electronic circuit will be well known to every

Electrical electronics and computer engineering students during time project construction. In the future to use motion sensor to detect surrounding movements to turn a street light ON and OFF.

**REFERENCES**


B.L Theraja (1979) ''Electrical technology'' 17th Edition, New Delhi, Rajedra Rinda

Jones M.H**. A** (2008) Practical introduction to Electronic circuits, Third Edition.

D.A LJ Fleet Fire (2003); Thomas Edition and pioneer of published by McGraw Hills books.

L. Hilborn (2007) Electric circuit analysis, second edition London: oxford publisher.

Hodder& Stoughon (2007) Digital system book, second edition Great Britain: Malcolm plant.

V.A Venikoy (1962) Electrical network performance, Spain: Gats publisher.

Mangesh V. Kulkami, Chetan A. Harti, Vyas R. Murnal, Suraj R. Kulkarni (Nov 2016).

Mustafa Saad, Hossan, Abdoalgadar, Muammer Mohammed (Nov 2014).

Abdalhaliu Farij, Ahamed Salah, Abdaroof Abdaljatil, Mustafa Saad ( Jan. 2015)

R. Suresh, K.S. Rari Kumar, A.S.K. Kaushik. B, karishna Chaitanya (Dec 2015).

G. Srilekha, Anitha Raju, M. Nishitha, K. Akhila, (March 2018).

# AUTOMATED SMART HOME SYSTEM USING IoT

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**ABSTRACT**

*Smart Home technology is the future of residential related technology which is designed to deliver and distribute number of services inside and outside the house via networked devices in which all the different applications and the intelligence behind them are integrated and interconnected. These smart devices have the potential to share information with each other given the permanent availability to access the broadband internet connection. Hence, Smart Home Technology has become part of IoT (Internet of Things). In this work, a home model is analyzed to demonstrate an energy efficient IoT based smart home. Several Multiphysics simulations were carried out focusing on the kitchen of the home model. A motion sensor with a surveillance camera was used as part of the home security system. Coupled with the home light and HVAC control systems, the smart system can remotely control the lighting and heating or cooling when an occupant enters or leaves the kitchen. The main purposes of this paper is to design and implement a HAS (Home Authomation System) using IoT, capable of controlling and automating the next systems: lightening, cooling, gate locking and seismic warning, through an easy and convenient Android application. The proposed system has a great flexibility based on Wi-Fi technology used to interconnect and control a part of the modules (the relay, LEDs) and its distributed sensors (motion sensor) to HAS server, all being developed around Arduino Uno. The Android application is named "HomeControl", and it represents the key to an automated home. More and more solutions based on IoT are being developed to transform homes into smart ones, but the problem is that the benefits of home automa- tion are still not clear to everyone as they are not promoted enough, so we cannot talk about a broad mass of consumers already using integrated or DIY solutions to improve their lives. In this paper, we will present a home automation system using Arduino Uno integrated with relevant modules which are used to allow remote control of lights or fans, changes being made on the basis of different sensors data. The system is designed to be*

*low cost and expandable, bringing accessibility, convenience and energy efficiency. And in general I would recomend that the* ESP8266 Wi-Fi Module should be equiped with a standard Wi-Fi security so as to protect the network from intrusion.

***Keywords***: *Home automation, Smart Home, Arduino Uno, Appliances remote control, IoT*

## 1. INTRODUCTION

Despite the popularity gained in the ’80s, home automation has never reached the market, especially because of economic reasons, whereas installing applications, purchasing devices, and maintenance were very expensive. Apart from costs, another problem was that applications integrated into an automated system are considered to be open information systems, so they could be attacked at any time by malicious persons or controlled by unauthorized individuals. It took more than two decades before technology win the battle against security doubts and the concept “home automation” became reality.

In the current context, home automation system has less to do with its predecessor, the domotic system, because it is based on a revolutionary concept: IoT (“Internet of Things”), which represented the beginning of a new era for technology. It represented the moment when the technology had the capacity to change fiction into reality through simple developments of automated systems, wirelessly interconnected and managed using only one mobile device, a better idea than domotics, which required a multitude of interconnected computers to manage related applications of domestic appliances.

Before describing the system and its functionalities I want to clarify the difference between “home automation” and “smart home”, because I noticed they are usually used as synonyms by general public and even by experts. The first concept was designed to integrate household appliances, relying solely on the use of subroutines in order to ease and improve people's lifestyles. The system we have implemented and I will present in the next sections is based on this concept, because it has no intelligence, the devices being automated according to my preferences using programming languages. “Smart home” was a term used for the first time in the mid-1980s during the boom of the domotic system and has its origins in “home automation”, but it is a much wider concept that includes a large range of features, technologies and industries, all interconnected through IoT. [1] Therefore, we can say that “home automation” lies at the heart of the intelligent houses known today, a fully interconnected concept that has learning abili- ties. That being said, through artificial intelli- gence the system learns the behavior of the in- habitants and can take independent decisions. Nowadays systems have enhanced capabili- ties, allowing monitoring and control of home from a single mobile/web application, managing security and providing remote healthcare, or even reducing energy consumption as a result of optimization algorithms. Fiction has been transposed as much as possible into reality, so today we are facing with talking houses that originally existed only in books or films and integrated technologies where everything is interconnected and the possibilities are endless.

## 2. LITERATURE REVIEW

The aim of this section is to establish a base of the existing literature, and to present different HAS with their features, benefits or limitations.

Shortcomings of existing technologies were mentioned in 2013 in a paper which introduced a convenient and flexible smart home system based on IoT. There was presented a demo version of the system which used a phone to query and control the system locally and remotely. The experimental results shown that the system could provide a realtime management for the home and it is considered that with the introduction of IoT the research and implementation of home automation are get- ting more popular. [2]

In 2014, another paper presented a flexible, lowcost automated home system, which is based on a mobile application for Android which communicates with the microweb server from the Arduino Ethernet. The proposed design is based on the management control of energy systems such as lightings, security, heating, air conditioning, fire or intrusion detection using a siren and email noti- fications. [3]

In the same year, another relevant paper presented the necessary background regarding the IoT paradigm. They evaluated a subset of 50 important projects based on research and commercial solutions appeared over the last decade (2001-2011). A major objective of this paper was to help elderly/ handicapped people by controlling various home appliances and provide security using Android phone/tablet. So, the solution is designed for an Android phone upon a home automation system which uses Arduino Mega ADK and embedded devices/sensors. [4]

In April 2016, according to a study made by Comcast on how the notion of house automation is understood, with an emphasis on how people want to use this solution, the result obtained has clearly demonstrated that the most of them want to benefit from the functionalities of a smart home without too much effort, leaving everything in the providers of such services' jobs. [5]

However, the existing works were mainly focused on switching and controlling home ap- pliances or connected devices rather than remotely monitoring of home environment which is the focus of nowadays systems.

## 3. SYSTEM ANALYSIS

In my opinion home automation systems (HAS) face three main challenges: high costs, vulnerability, and difficulty in achieving secu- rity. The main purposes of this paper is to design and implement a HAS using IoT, capable of controlling and automating the next sys- tems: lightening, cooling, gate locking and seismic warning, through an easy and convenient Android application. The proposed sys- tem has a great flexibility based on Wi-Fi technology used to interconnect and control a part of the modules (the relay, LEDs) and its distributed sensors (motion sensor) to HAS server, all being developed around Arduino Uno. The Android application is named "HomeControl", and it represents the key to an automated home. Besides remote control of devices and a lot of discussion when we have guests, this application was designed to ease the lives of those who use it, helping them to manage efficiently their time or costs, because it was developed from the idea of energy efficiency,

aspects that are not neglected today at all.
When time becomes too short, the solution is to try avoid the routine or other things that does not need us physically, becoming others' duties. By automating various actions previ- ously undertaken by humans, the possibility of time decrease becomes a real benefit. For example, if the living-room temperature exceeds a preset value, the user can choose to turn the air conditioning automatically on, and also set the operating time. Activating or deactivating sensors is also an important requirement as there may be times when we want a different behavior of the HAS. In case of an evening party at the pool, users would cer- tainly not want the lighting in the yard to be based on motion detection, but permanent. Gate control is another great advantage of the DIY home automation system I implemented. If one resident is upstairs and another one comes with luggage or has no keys, he/she can open him/her with just a click from the mobile device used. Another advantage of SI achieved is to be effective and prompt in get- ting a response on vibration monitoring that is designed to simulate a possible earthquake. Depending on the sensitivity chosen in the application and assuming the sensor is active, its role is to start the buzzer, which will notify the residents of the house that an earthquake is happening. Does it seem complicated? No, rather ideal.

## 4. SYSTEM DESIGN AND IMPLEMENTATION

In this section we will detail the functionalities of the software component through which the control of the hardware components is achieved, together with the objectives defined in the previous paragraph and we will present the design methodology on the basis of which the information system was developed. we will also give an overview of the system by representing the activities undertaken by a user through a mobile device, using the CASE tool Visual Paradigm. The functional requirements underlying the development of the "HomeControl" application will be determined and modeled using the use case diagram (Figure 1). This illustrates the interaction between the system and the users, or other external com- ponents named actors, and the actions they want to accomplish.

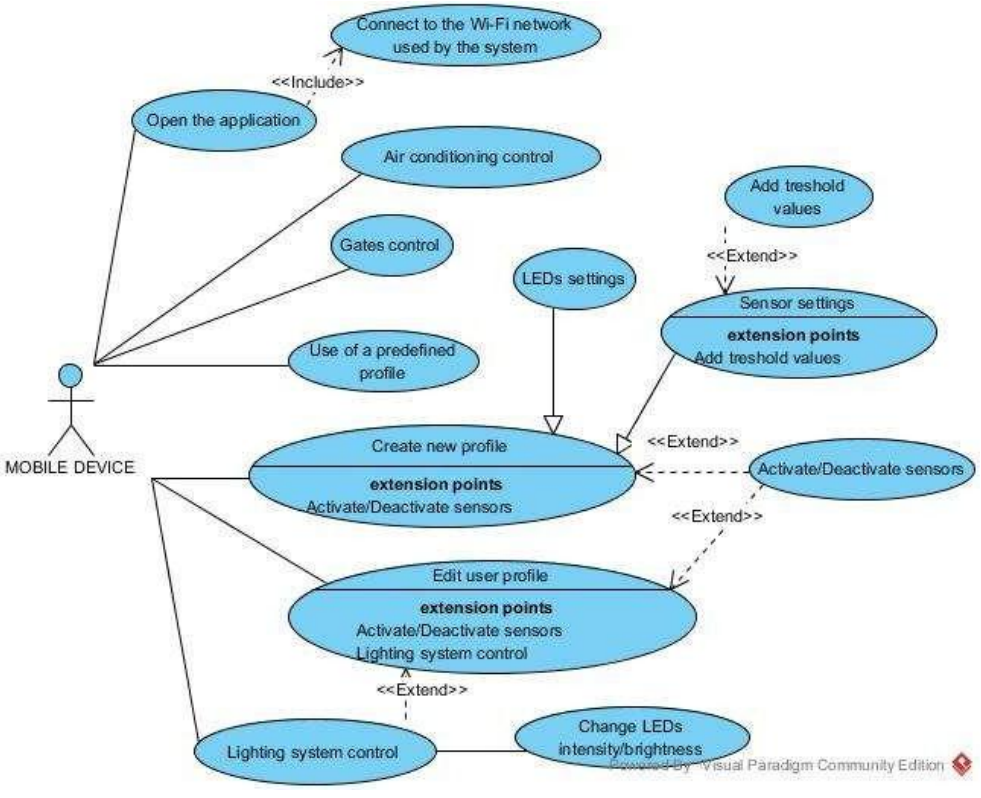

**Fig. 1.** Use Case Diagram – HomeControl Application

### 4.1 Proposed Home Automation System

The proposed model of the HAS is shown in the Figure 3 and it consists of different modules.

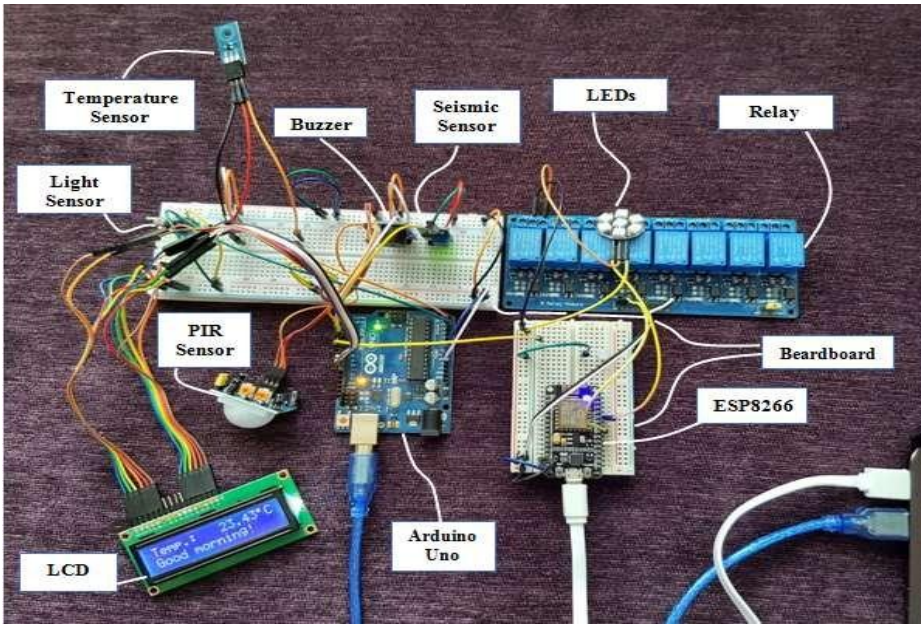


**Fig. 3.** Proposed HAS Setup

Some of them are based on sensors like: temperature, motion, light or seismic, through which is retrieved the data from the environment. The rest: Wi-Fi, LEDs, buzzer, relay and the stepper motor have independent functions that control and modify the system behavior. The picture provides an overview of the circuit, and the highlighted components will be described in the next section.

As a simple mention, because we will detail further how the system was created, two breadboards were used to multiply the number of pins belonging to Arduino Uno/ ESP8266 board, integrating the elements of the circuit as we wished. The main purpose of the system was to automate the following elements: lighting system (using LEDs), air conditioning (using a mini-propeller) or the gate (using a stepper motor) and to manage the environmental information received from the following sensors: motion, light, seismic or temperature. For controlling the system, we mentioned before that we developed a mobile application named "HomeControl", in order to connect exhaustively various devices belonging hypothetically to subsystems of a house, improving the life quality of the inhabitants.

### 4.2 Hardware Design

#### 4.2.1 Arduino Uno

Arduino Uno is an open-source development board that can be resembled with a

mini computer. It is built around the ATmega328P microprocessor which allows it to capture and interpret environmental data from a series of sensors and perform various actions on connected devices, such as displaying information obtained on an LCD screen, changing the LEDs colors and so on. The microprocessor is capable of running code very similar to C++, having some domain-specific libraries which add alternative names for some types and customizes functions. [6] The technical specifications of the board will be presented later in Table 1, along with the ESP8266 characteristics and the components are shown in Figure 4.

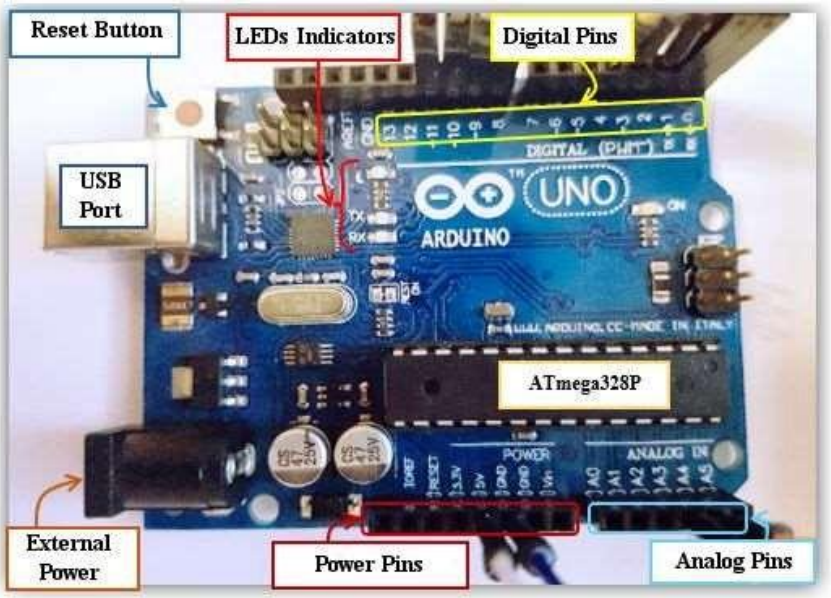


*Fig. 4: Arduino Uno board*

In the implemented system, the role of Arduino Uno is to control and integrate some of the modules used, hosting the code that manages their behavior. So we are talking about the integration of the following modules: motion sensor, temperature sensor, light sensor, seismic sensor, LCD screen and buzzer.

### 4.2.2 ESP8266 Wi-Fi Module

The ESP8266 Wi-Fi Module is a System on a Chip (SOC) with integrated TCP/IP protocol that allows any other microcontroller to access the Wi-Fi network. This integrated circuit (Figure 5) is built on a microcontroller (not a microprocessor, because it does not have RAM, flash or I/O ports) and has advanced peripherals such as the ESP-12 Wi-Fi module. It can operate independently and perform ac- tions better than Arduino Uno.

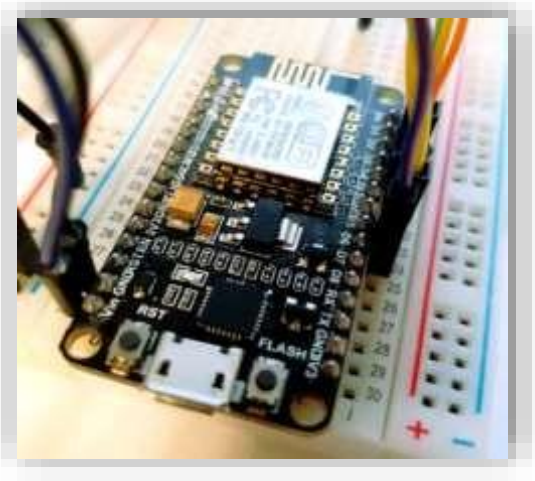

*Fig. 5: WiFi Nodemcu module with ESP8266*

Via the GPIO pins, the board can be integrated with specific sensors or devices, having enough processing and storage capacity. ESP8266 is capable of hosting and taking overnall wireless network functions from another application processor. [6] Its specifications are detailed in Table 1.

**Table 1.** Technical specifications for Arduino Uno and ESP8266 (Source: [7] and [8])

| TechnicalSpecs/ Board | Arduino UnoR3 | ESP8266-12E |
|---|---|---|
| **Operating Voltage** | 5V | 3.3V |
| **Microcontroller** | ATmega328P | ESP8266 |
| **Digital I/O pins** | 14 ( 6 PWM ) | 13 (9 PWM) |
| **Analog Input Pins** | 6 | 1 |
| **Flash Memory** | 32 KB | 1MB |
| **SRAM** | 2 KB | 64KB |
| **EEPROM** | 1 KB | - |
| **Clock Speed** | 16 MHz | 80 Mhz |
| **External power** | Yes | No |

The ESP8266 module has three modes of op- eration:

1. Access Point (AP) - The Wi-Fi module acts as a wireless network or access point (hence the name), allowing other devices to connect to it. A bidirectional communication is estab- lished between the module and the devices connected to it via Wi-Fi.
2. Station (STA) - The ESP8266 module can connect to an access point (AP), such as the Wi-Fi router used in the home. This allows any device connected at the same Wi-Fi network to communicate with the module remotely, building a local network.
3. Access point and station in this mode, it acts both in AP and STA mode.

In the system we implemented, we used the Wi-Fi module in STA mode, to represent a control point between the objects connected to the network and the mobile device, also connected to the same network as ESP8266. This module allows the users to create an autonomous web server using various libraries by which the client (the mobile application) can efficiently control and manage the LEDs, light sensor, motion sensor and the stepper motor attached to the gate, receiving power through the 8-relay module. Thus, through the mobile application that connects to the HTTP server and sends requests, various responses are returned depending on the needs of each user.

### 4.2.3 The Breadboard

The breadboard (Figure 6) is a device that connects the electronic components very easily and without soldering, using male to male wires (with pins at both ends).

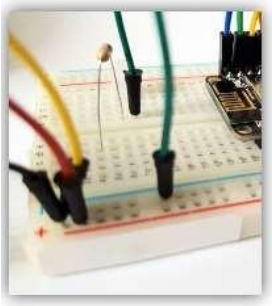

*Fig. 6: The breadboard*

Its role in making the circuit is to allow the supply and connection of as many modules as possible, representing a bridge between components and a major power supplier.

### 4.2.4 The Relay Module

The 8 electromechanical relay module from the next picture (Figure 7) allows 8 different electrical devices to be controlled via 8 Arduino digital ports. [6]
Its role within the circuit is to turn on/off the power of the devices connected to it: the LEDs, the light and motions sensors or the stepper motor, using the information received from the Wi-Fi module.

*Fig. 7: The Relay Module*

It plays a key role when it is desired to activate the "sleep" mode, because it stops power for some devices and reduces energy consumption.

### 4.2.5 The Stepper Motor Module

The stepper motor module shown in Figure 8 is used in the circuit to automate the gates from the front yard.

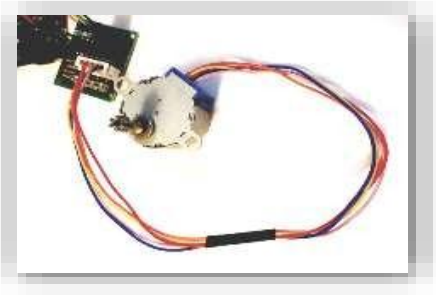

*Fig. 8: Stepper Motor Module*

Their control is done by a simple click, representing a great benefit for the homeowners, since it will be much easier for them to come into with their cars or if they have luggage and it is not at their fingertips to open the gates by themselves.

### 4.2.6 LCD Module

The LCD from Figure 9 has a 2-rows and 16-columns character matrix, which are used to display various information.

*Fig. 9: The LCD*

Its function within the circuit is to display temperature in real time, being a copy of a digital thermometer, and also to display air conditioning information.

### 4.2.7 Temperature Sensor

The temperature sensor (Figure 10) is a component that perceives environmental temperature changes and sends signals to the Arduino board.

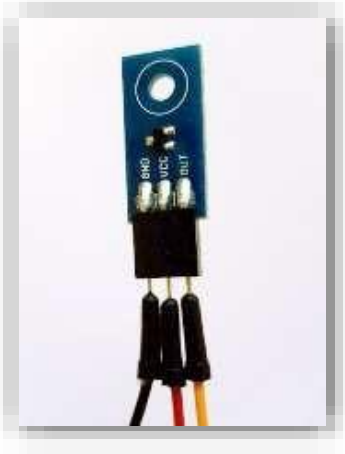


*Fig. 10. Temperature Sensor*

Within the system, its functionality is to start the fan/air conditioning if the temperature exceeds the preset threshold measured with a potentiometer.

The temperature is displayed in real-time using an LCD and these three components: the temperature sensor, the potentiometer and the liquid crystal display, were being designed to simulate an automated thermostat.

### 4.2.8 Motion Sensor

The motion sensor from Figure 11 is based on IR (Infrared) technology and is used to detect the presence of a human/object at a distance up to 7m. [6]

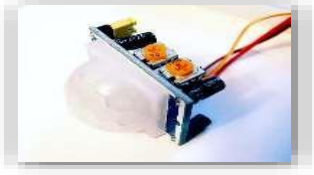

*Fig. 11: PIR (Motion) Sensor*

We chose to use it with the light sensor to control the automatic lighting in the garden. When it gets dark and a person arrive at home or leaves, the LEDs will light up, allowing him/her to lock/unlock quickly and easily.

### 4.2.8 Light Sensor

The light sensor shown in Figure 12 is a component which retrieves data from the environment and we used it to control the lighting system around the house. It detects intensity changes of light, and helps the users to achieve an optimal energy control along with the motion sensor.

*Fig. 12: Light Sensor*

As long as its functionality is activated, the LEDs in the yard will be on only at night when motion is detected.

### 4.2.9 Seismic Sensor

The seismic sensor (Figure 13, left) is a component that senses mechanical vibration. In order to accomplish the project I decided to complete its functionality using a buzzer.


*Fig. 13. Seismic Sensor (left) and buzzer (right)*

When vibrations greater than a preset value are detected, illustrating the case of an earthquake, the buzzer will turn on an alarm to alert the users.

### 4.210 LEDs Module

For the lighting system control we used both RGB LEDs and NeoPixel LEDs (Figure 14) that allow creating different ambient light pro- files.

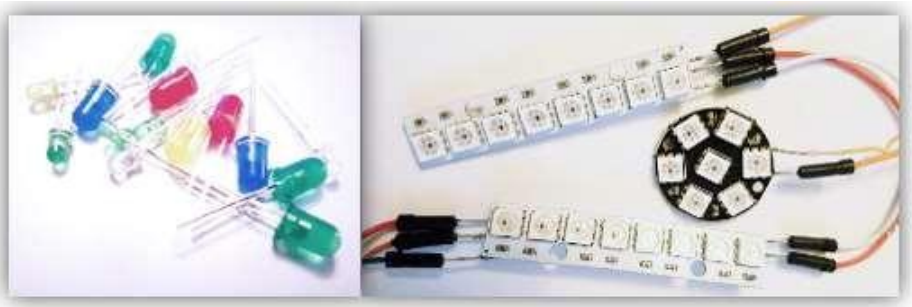

*Fig. 14: RGB LEDs (a) and NeoPixel (b)*

In the mobile application, the user has the ability to change the intensity of the lights, but also to choose a predefined environmental program such as "reading", "disco" or "relaxing" which imitate the reality obtained for example with Philips Hue.

### 4.3 Software Design

The information system presented in this paper has been implemented by highlighting the facilities offered by the Arduino and Android platforms, along with the utility of the SQLite SGBD. The interface between the user and the database is represented by the mobile application and was created using Android Studio IDE. Regarding the back-end part, the data- base control and management is made from the mobile application, while the elements that make up the circuit are controlled through the mobile application, Arduino and Wi-Fi board.

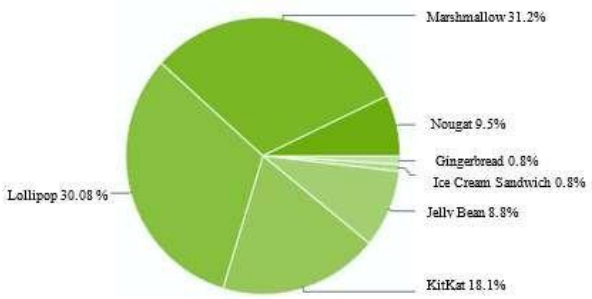


*Fig. 15: Android Platform Versions, June 2017 (Source:[9])*

The application, "HomeControl" was developed on the Android OS using version 6.0 "Marshmallow", which has associated level 23 of the programming interface (API). According to the next chart (Figure 15), this version is the most used at the moment, and because the device we own supports this version we chose it.

In the circumstances that it is possible to make an application compatible with one or more versions of the Android platform we chose as minimum SDK the API level 21, which corresponds to version 5.0 "Lollipop", thus covering around 63% of the devices which are currently using the Android OS. The development for controlling and managing the elements that make up the circuit meant programming the Arduino microcontroller and the Wi-Fi module through special rules for organizing written code in C ++. Thus, we created two programs (called sketches) one for each component mentioned before, using the official development environment Arduino IDE.

### 6. 4.4 Setup Implementation

In this section we will describe how we connected a part of the hardware components to obtain the system, starting from Arduino Uno and ESP8266 boards, to some specific devices connected and controlled by them.

We will start with the Arduino board, which according to the technical specifications from Table 1, has 14 digital pins used to send only signals, 6 analog pins to receive/send data from/to the connected components and 5 power supply pins, all shown in Figure 4 from section 4. In the following presentations, the power supply pin (plus) is called Vcc, the minus is called Gnd, and the one used to receive/send

signals or data Out or $D_0$. This board can be powered externally or directly from the computer via USB and the sensors are used to receive environmental information, on the basis of which we have decided what actions should happen.
Under these circumstances, to Arduino Uno we decided to connect modules that do not require changing parameters just thresholds, such as the light sensor, motion sensor, seismic sensor, LCD screen or the buzzer, and we are going to describe how they were connected to the board in the following paragraphs. Since Arduino has a limited number of power pins, we needed to use a breadboard to supply power to all the components and create an explicit circuit.

So, the generally connection used to power all the modules is noted in the paper as relation X and involved the next two steps:

**1** We linked the Vcc (+) to the breadboard power line (+)
**2** I linked the Gnd (-) to the breadboard ground line (-)

The concept of these two links mentioned above and represented in Figure 16 is also used to link all the modules to the breadboard, so we will start to detail how the light sensor connects.

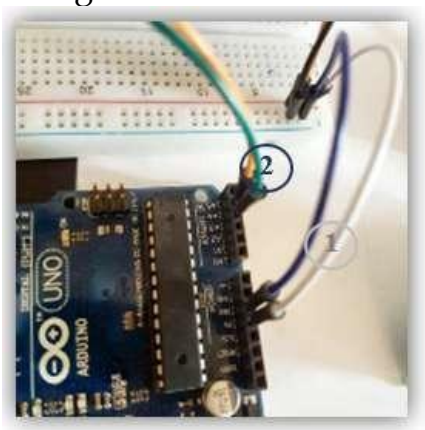


**Fig. 16.** Standard links between Arduino and breadboard

To get the information from the light sensor we connected the Out pin ($D_0$) to the third ana- log pin of Arduino **1**, and to supply power to the module I applied the relation X (links no **2** and **3**), using the breadboard. All these connections are shown in Figure 17.

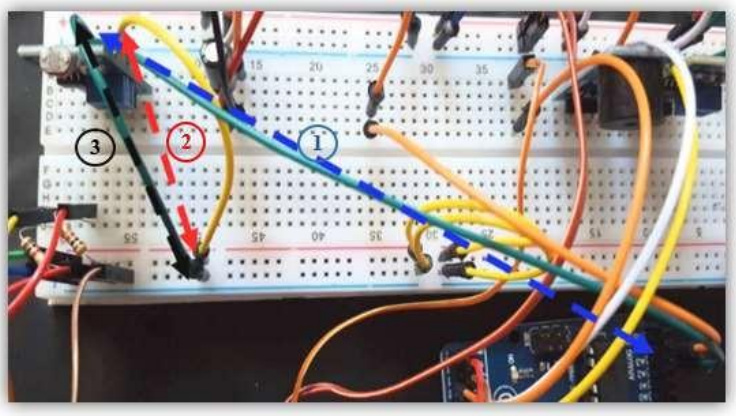


**Fig. 17.** Light Sensor Connection

The module is linked to an analog pin because values are read by the sensor and they need to be transferred to Arduino for further interpretation.
The next connected sensor is the temperature one. The way it receives power is identical to what we have previously presented for the breadboard and the light sensor (relation X: links no **2** and **3**). To receive information from the temperature sensor, we coupled its signal pin $D_0$ to the 4th analog pin from Arduino **1**. Figure 18 also shows the links between the bread- board and the Arduino Uno.
As the light sensor, this one is connected to an analog pin too, because environmental values are read and transmitted to Arduino for interpretation.

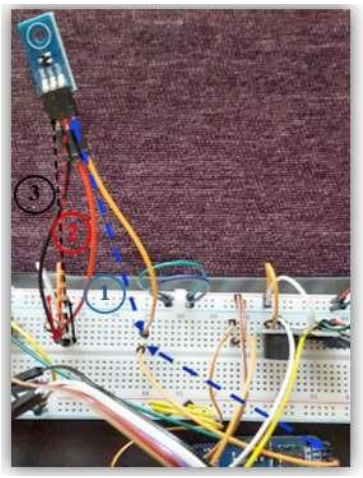


**Fig. 18.** Temperature Sensor Connection

The following two components: the seismic sensor and the buzzer will be presented in parallel. The way they receive power is the same as we have previously presented (relation X: links no **2** and **3**).
To get information from the seismic sensor I linked the output pin $D_0$ to the 4th Arduino digital pin **1**, and regarding the buzzer we linked the Out pin, $D_0$, to the 3rd digital pin from Arduino **1'**. The connections described can be seen in the figures shown below 19 (front) and 20 (back).

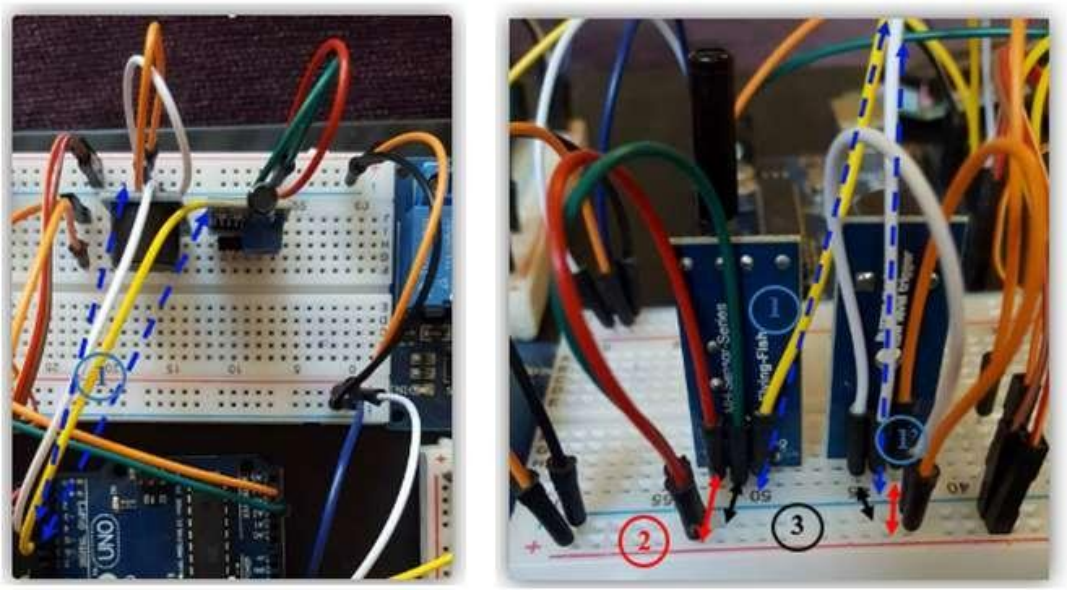

**Fig. 19.** Seismic Sensor and Buzzer Connections (back – left, front - right)

When the specialized sensor detects a vibration, signals will be sent to the board, and if this vibration exceeds the threshold preset in application, signals will be sent to the buzzer, which will produce a series of sounds such as an earthquake warning.
The last two components for which we described the way they are connected in the system are the 8-relay module and the LEDs module.

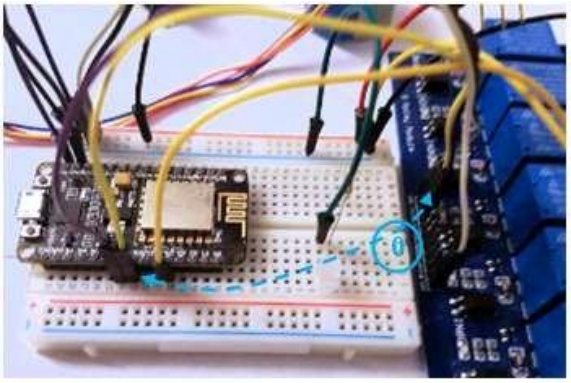

**Fig. 20.** Relay Module connected to ESP8266

They are connected and controlled by the ESP8266. In order to benefit from the module's functionality, we linked its Vcc (+) pin to the breadboard plus the Gnd (-) pin to minus (relation X). In order to manage the power supply through the first relay of the module, we coupled the IN1 pin to the GPIO_14 pin of the ESP board **0**, as

shown in Figures 20 and 21. Running one of the relays involves writing the LOW value on the GPIO pin of the Wi-Fi board with which it is paired. Thus, by pressing the existing button in the mobile application, used to control the lights, a request to the server will start the relay. Regarding the lights supply power, there will be written LOW on GPIO_14 to start the relay so that the LEDs are on. Otherwise, HIGH will be written on GPIO_14 to stop the relay and the power of the lights.

The last connection explained is for the Ne- oPixel LEDs. To connect this module in order to perform various light changes, We linked the elements as follows: the input of the first relay was connected to the breadboard power line (plus) **1** and its output to the Vcc (+) **1'** pin of the LEDs, so setting on/off the relay will cause the lights to go on/off too.

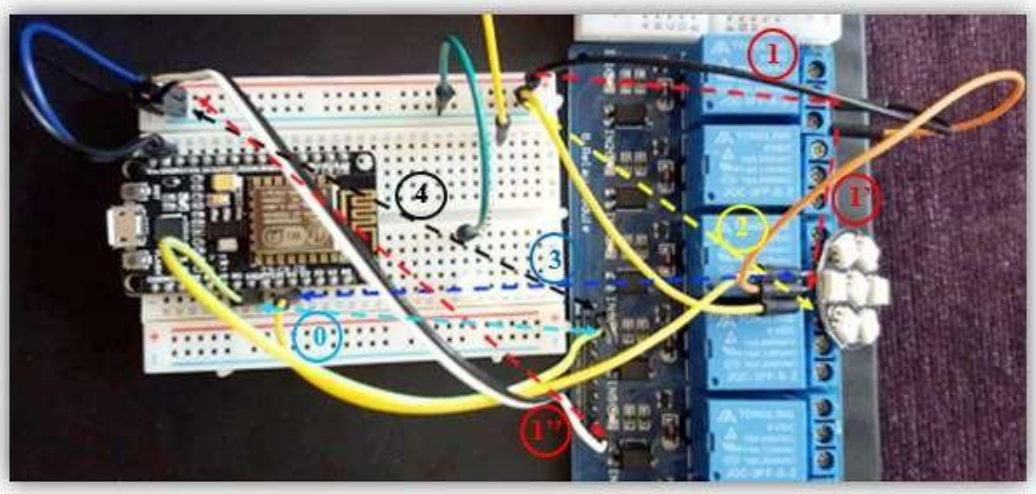


**Fig. 21.** NeoPixel LEDs connection

Gnd (-) of the LEDs is linked to breadboard minus (ground line) **2**, and the IN pin to the GPIO_2 pin of the ESP board **3**.Using this digital pin, information such as: light intensity or shades obtained by combining RGB base colors is transmitted.

The breadboard to which the 2 modules above are linked has the power line powered by the Vin pin of the ESP **1''** and the ground line from the Gnd Pin of the board. **4**

## 7. 5 RESULTS AND FINDINGS

As I mentioned before, the mobile application we have developed has the purpose of controlling various components belonging hypothetically to subsystems from a dwelling, in order to improve the life quality of the users.

When the HomeControl application opens, the menu (Figure 22) appears and it allows the users to manage and control different devices in their house. The application runs in background a method by which every mobile device is identified and saved in the database according to its MAC address, and it is not necessary to create an account.

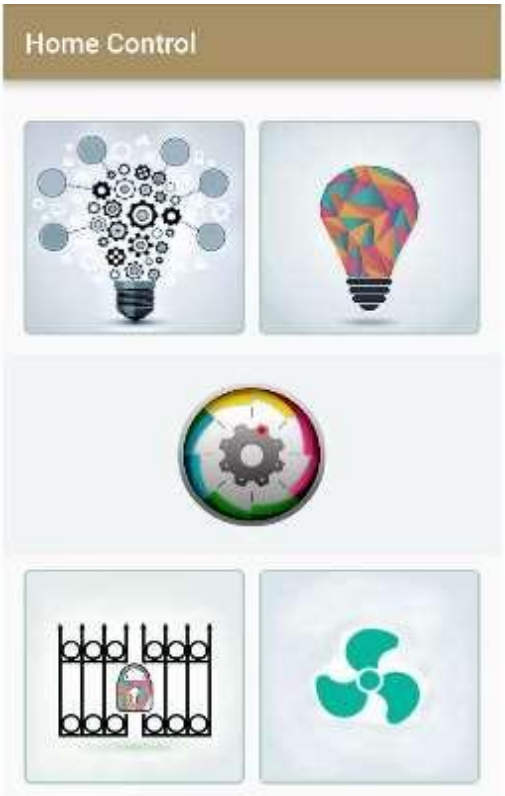


**Fig. 22.** Application menu – HomeControl

In the previous section I mentioned the automated components and their behavior and now we are going to present their functionalities through some images.

1) Temperature control - according to a preset value in the application the air conditioning will start automatically, but it can also be started manually pressing the 4$^{th}$ menu button.

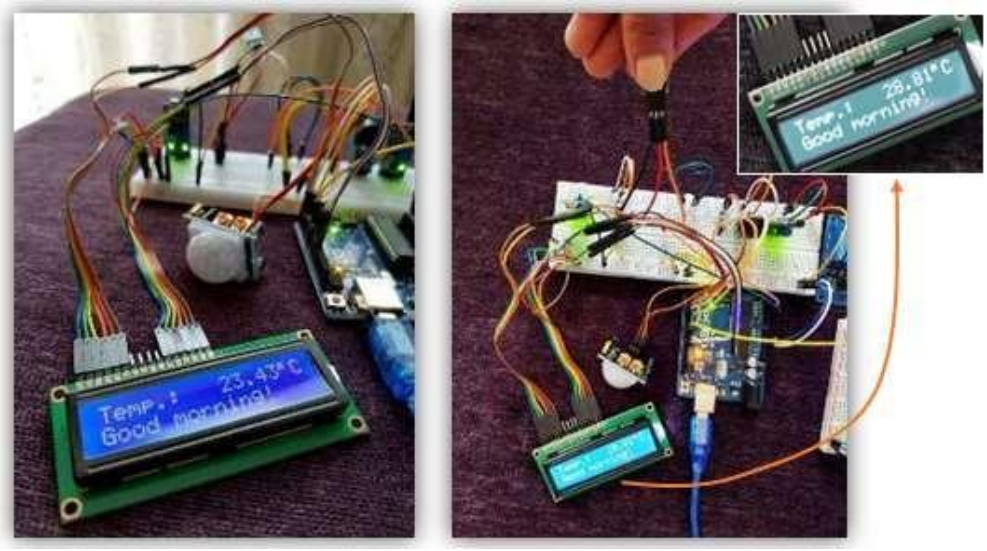


**Fig. 23.** Temperature Module – measurement display

In Figure 23 are presented the temperature changes happened at the intervention of external factors, increasing from 23.43 ° C to 28.81
° C.

2) Control of the lighting system assures the management of the courtyard lamps based on the light and motion sensors, for which intensities will be set as threshold trigger and also

for the house lighting system, giving the user different possibilities regarding LEDs colors, such as Philips Hue bulbs. The courtyard LEDs and the others used only for mono- chrome light can be controlled manually using the first button from the menu as shown in Figure 24, left.

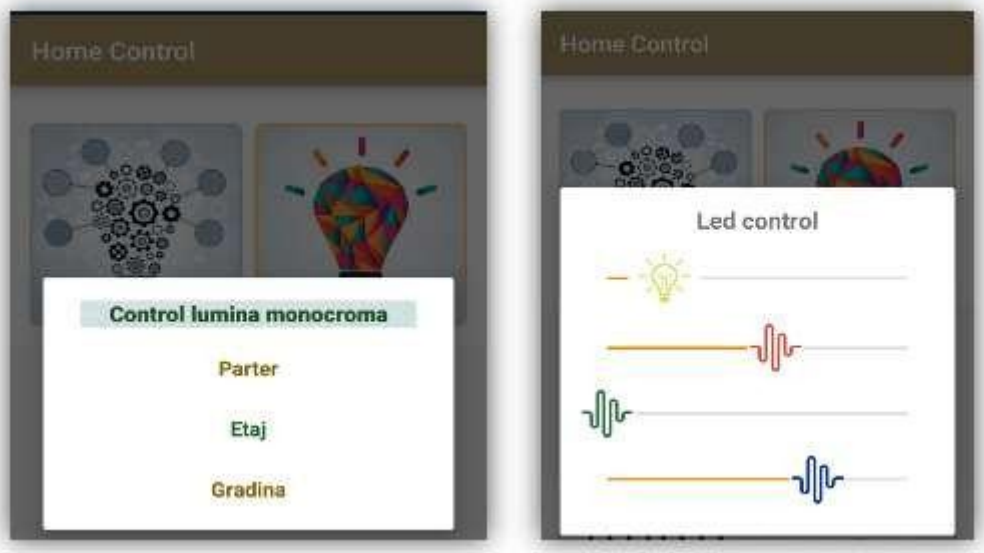


**Fig. 24.** Monochrome LEDs Control (left) and NeoPixel LEDs Control (right)

To create various light games from the application menu, the user can select the top right button that renders initially a monochrome light with a brightness of 10% (Figure 24, right), having the possibility to change the LEDs' colors in real time or to create a new lighting profile from Settings, the button placed in the center of the menu.

In Figure 25 is presented the result of combining red, green and blue colors at different intensities.

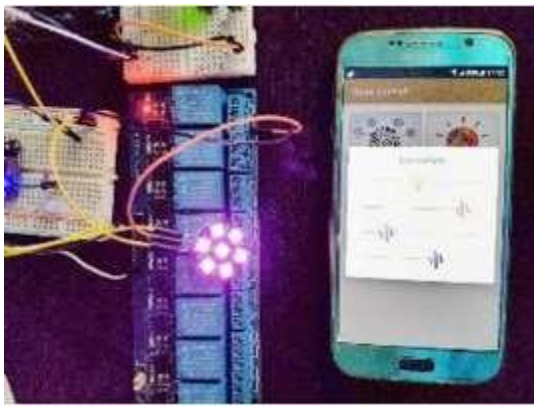

**Fig. 25.** NeoPixel LEDs Control

3) Earthquake warning is based on a seismic sensor that detects vibrations. When is exceeded a preset value, the alarm (buzzer) will be turned on to notify the inhabitants about the incident.

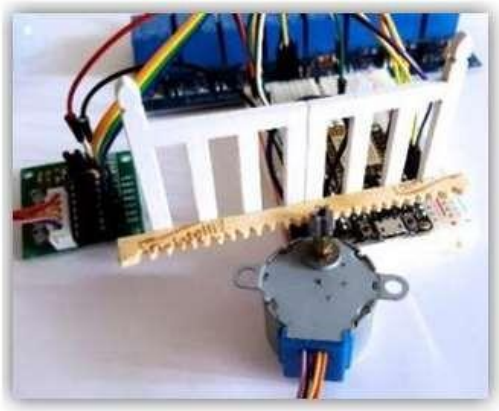

**Fig. 26.** Stepper Motor Control

4) Gate automation was realized using a stepper motor (Figure 26) and we think it represents a big advantage for those who own an automated house. For example, when they are in their cars or they have big luggage, only one click can represent the rescue.

## 8. 6 CONCLUSION

From my point of view, the information system is in its start-up phase, which we would call it a first version. In this sense, we already have ideas on future developments and we started to document about the upgrade implementation. Therefore, in the future we're going to move the local database on the server, to implement the voice control option and also to integrate multiple sensors into the circuit to increase the system complexity and provide as many functionalities as possible.

We started from a great wish and a small scale implementation, but we chose not to stop just to that. Through the research for this paper we find out a lot of interesting things and we started to take small steps to automate my home and benefit from different functionalities like the ones of the system described. If everything spins around IoT, the choice to walk into an automated house is absolutely normal for me, and we think we would like our home much more than we do now because we are very excited when it comes about technology. The fact that we can control various household appliances through the latest technologies was an objective that we have proposed to achieve from half a year ago and now we almost reach it. Although such technology is quite complex at its core, we think that a flexible and user-friendly interface makes the products (automated systems) friendly but especially useful.

We are impressed by the evolution of technology and at the same time we feel lucky to have the opportunity to benefit from things that many decades ago were just fantasies written or illustrated in animations or movies.

## 9. REFERENCES


[1] M. Miller, (2013), The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing The World. (pp 81-83). Indianapolis, IN: Que.

[2] Y. Liu Y., (2015), Study on Smart Home System Based on Internet of Things Technology. In Informatics and Management Science IV. vol. 207, (pp. 73-81). W. Du, Ed: Springer London.

[3] S. Kumar, (2017), Ubiquitous Smart Home System Using Android Application. In Inter- national Journal of Computer Networks & Communications (IJCNC) Vol.6, No.1. Retrieved April 04, 2017, from https://www.researchgate.net/publication/260127438_Ubiquitous_Smart_Home_System_Using_An- droid_Application

[4] C. Perera, A. Zaslavsky, Christen P. & Georgakopoulos D. (2013), Context Aware Computing for The Internet of Things: A Survey. In IEEE Communica- tions Surveys & Tutorial. Retrieved May 06, 2017 from http://ieeex-plore.ieee.org/document/6512846/

[5] The Safe & Smart Home: Security in the Smart Home Era. (n.d.). Retrieved April 12, 2017 from http://corporate.com- cast.com/images/August_Xfinity-Safe-and-Secure-Study-Report.pdf

[6] Hardware components details. Retrieved March 22, 2017 from www.robofun.ro

[7] Arduino Board Technical Specs. Retrieved April, 2017 from https://www.ar- duino.cc/en/main/arduinoBoardUno

[8] ESP8266 Board Technical Specs. Retrieved April, 2017 from https://en.wik- ipedia.org/wiki/NodeMCU

[9] Android Platform Versions. Retrieved June, 2017 from https://developer.an- droid.com/about/dashboards/index.h

# HUMAN RESOURCE MANAGEMENT AND ACADEMIC STAFF PRODUCTIVITY IN SOUTHWEST NIGERIA UNIVERSITIES

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## ABSTRACT

*The study examined human resource management and productivity of academic staff in the universities in Southwest, Nigeria. It looked at the level of human resource management and the level of productivity of academic staff in the Universities. It equally assessed the relationship between human resource management and productivity of academic staff. The descriptive survey design was used. The population of this study consisted of 154 Deans, 849 Heads of Department and 11,828 academic staff in Southwest Nigeria Universities. The sample was one thousand eight hundred (1,800) respondents, comprising 20 Deans, 70 Heads of Department and 1,710 academic staff. Multistage sampling procedure which involved simple random sampling, stratified random sampling and proportional stratified random sampling techniques were used to select the sample. Two self-designed instruments were used, Questionnaire on Human Resource Management (QHRM) for academic staff and Productivity of Academic Staff Questionnaire (PASQ) for Deans and Heads of Departments. To establish the reliability of the instruments, the test-retest method was used. They were found to be 0.74 and 0.71 for QHRM and PASQ respectively. The data collected were analyzed using descriptive and inferential statistics such as percentage; mean and standard deviation, Pearson's product moment correlation and regression analysis. The only hypothesis raised for the study was tested at 0. 05 level of significance. The study revealed that the level of human resource management and the level of productivity of academic staff in southwest Nigeria universities were moderate. The study also showed that human resource management and productivity of academic staff were significantly related. Based on the findings of this study, it was recommended that academic staff should be more committed to their job to ensure qualitative teaching, research and community services for better productivity. The managers should encourage the academic staff to be more productive in areas of teaching, research and community services.*

**KEY WORDS:** Human Resources Management, Productivity, Academic Staff, Teaching, Research, Community Services.

## INTRODUCTION

Universities are agencies saddled with the task of extending the frontier of knowledge for the overall benefit of the society. The strategic position occupied by Universities all over the world in national development is beyond doubt. Their contributions to social, political and economic development of a nation cannot be

over- emphasized. This is why many nations invest heavily in university education. The objectives of university education may not be achieved without proper human resource management (Ogbodo and Nwaoku 2007). Human resources in the universities need to be well managed, in order to make them more productive and thus enhance the effectiveness of the university system.

However, Uche (2012) reiterated that the key functions of higher education are teaching, research and community service. The academic staff are required to teach, carry out research and disseminate information for the development of the society and the educational system. The accomplishment of the goals of higher education depends on the quality of academic staff who imparts knowledge to the students, disseminate their research findings to improve products, services and people and transmit societal values to the students.

An effective organization is one which succeeds in making people understand that cooperating or supporting the leader to achieve organizational goals also helps them to achieve their own goals. A group of people becomes an organization when they cooperate with each other to achieve common goals. Singh and Vohta (2005) found in their study that strategic human resource can play a role in a small enterprise in the engineering sector. In today's context, Strategic Human Resource Management has become a necessity for organizations.

According to Archibald and Feldman (2011), human resource management is a term that emerged during the 1970s and won wider acceptance in 1980s. Sheikh (2003) defines human resource management as the planning, organizing, directing and controlling of procurement, utilization, compensation and maintenance of human resources. Human resource management is the development of human resources in the organization. It is concerned with improvement of the abilities, skills of existing human resources and abilities to acquire new knowledge needed to attain organizational goals and individual aspirations.

Bello- Imam, Oshionebo and Ojeifo (2007) stated that human resource management in any organization focuses strongly on developing the management team. It accords managers wider latitude in managing the personnel working with them in the pursuit of bottom-line results. In this regard, line managers make much more profound personnel decisions than before. Human resource management emphasizes the management of the organization's culture as the responsibility of all members of senior management. Wright and McMahan (1992) in their study consider that not only human resource management practices should be linked to organizational strategy, but these practices also need to be strategically linked to each other to ensure that they promote the same goals.

Jossy (1993) presents a nature of human resource management to include the function of employment, development and compensation- These functions are performed primarily by the human resource managers in consultation with other departments. Also, human resource management is an extension of general management. It is concerned with promoting and stimulating competent work force to make their fullest contribution to the concerned. It exists to advise and assist the

managers in human resource matters. Therefore, human resource department is a staff department of an organization. It lays emphasis on action rather than making lengthy schedules, plans, and work methods. The problems and grievances of people at work can be solved more effectively through rational human resource policies.

Jossy (1993) further explained that human resource management is based on human orientation. It also motivates the employees through its effective incentive plans so that the employees provide fullest co-operation. Similarly, Cole (2002) asserts that human resource management concept operate at strategic, operational and intermediate levels in an organization. Therefore, human resource management as the name implies deals with work force in any organization. The human resource department pays attention to both the growth and happiness of the people working in an organization.

To McGraw-Hill (2003), human resource management refers to the policies, practices and systems that influence employees' behaviour, attitude and performance. Many companies refer to Human Recource Management as involving "people practices". Archibald and Feldman (2011) concur with the above definition but with a better explanation as follows: To have a major impact on enterprises, human resource management has to be diffused across an economy, rather than remain islands of excellence. Nevertheless, promoting excellent models of human resource management stimulates interest in better people management. Human resource management has three basic goals, which contribute to achieving management objectives. The first is integration of human resource management in two senses: integrating human resource management into an organization's corporate strategy, and ensuring human resource management view in the decisions and actions of line managers. Integration in the first sense involves selecting the human resource management options consistent with (and which promote) the particular corporate strategy.

Without human resource and their proper management, no organization will be productive or be successful. The human resource function is of a continuous nature. It cannot be turned on and off like water from a faucet; it cannot be practiced only one hour each day or one day a week. Human resource management is mainly concerned with the satisfaction of physical, social and egoistic need of the employees at all levels covering both 'blue-collar' and 'white-collar' employees. In its simplest form, productivity can be defined as achieving the maximum output of a process with the use of minimum inputs. Organizations are in continuous search of the best technology and methods of using minimum inputs to produce maximum outputs to become competitive and survive in the market.

Nwachukwu (1998) sees input, punctuality and promptness, elimination of wastes in all forms, justifying your pay, improvement in all aspects of life, producing more and more of better quality as productivity. Corroborating this,

Inyang (1995) defined productivity as the output and input ratio within a given time frame and with special attention to quality and the efficient use of resources, doing the right things the right way and getting more output within less input.

Lunenburg and Ornstein (2008) define productivity at the most basic level to mean quantity of outputs delivered per unit of input utilized (labor, capital services, and purchased inputs). The research conducted by Boselie (2009) showed that there is a need for alternative theories to get a better understanding of human resource management in particular with regard to the shaping of the employment relationship in organizations. This view may be urgent for educational productivity.

Educational productivity is to improve the quality and quantity of educational opportunities for all. In this sense, Lunenburg and Ornstein did not separate effectiveness from productivity. Both terms are used interchangeably by them. Nwachukwu (1998) explores the major causes of low productivity in Nigeria as economic, sociological, managerial and technological. In economic factors, there should be correlation between effort expended by an employee and the reward that he receives in the organization. When an employee believes that equity does not prevail, he is bound to withhold a measure. Sociological factors take effect when employees treasure a sense of belonging to their organization and would resent any effort on the part of management to perceive and treat them only as agents of production. Many Nigerian employees lack sense of belonging to their organization and they behave as strangers. They do the least to avoid losing their employment. As long as employees feel that they do not belong, there is a tendency for them not to have full sense of commitment and dedication.

Considering managerial factors, as it is widely known, the success or failure of an organization depends on management. An unproductive and undisciplined supervisor can hardly motivate employees. Many Nigerian managers are lacking in the elementary principles of organizational behaviour. Many also do not appreciate the importance of performance evaluation and feedbacks. Employees get frustrated and productivity suffers. Management influence, and in fact determines the productivity of the subordinates. Where a manager is known for integrity, initiative, a sense of justice and emotional stability, productivity is usually satisfactory. Employees in the public sector tend to enjoy guaranteed employment even in the face of cross negligence of duty. Since the government does not attempt to maximize profit, redundant employees are retained, jobs overlap and man hours are wasted.

Relating to technological factors, technology involves the use of new ideas, techniques, innovation, methods and materials to achieve an objective. In the educational system, the use of obsolete equipment is common. Modern information techniques have not been put to general use in our educational system. For instance, electronic computers, fax, e-mail and internet are only available in a handful of institutions in the education sector.

In the research of Katou and Budhwar (2015,) they concluded that Human Resource Management has a positive impact on productivity, through employee skills, attitudes, and behaviour. Additionally, the study finds that a 10 per cent

increase in the extent of the systematic use of Human Resource practices will lead to a 3.27 per cent increase in the total production. The research of Shen and Benson (2014) revealed that socially responsible human resource management is an indirect predictor of individual task performance and extra-role helping behaviour through the mediation of individual level organizational identification.

The study conducted by Hagler and Erthal (2009) with the view to investigate the factors contributing to productivity in creating business email messages. They discover that business E mail messages help in efficiency and effective productivity.

The above discussion is directly on educational productivity that has much to do with motivation, sense of belonging, manager's effort and new ideas/ technology. It can then be inferred that productivity is not just a matter of each worker working harder. The largest gains in productivity can come from management's working smarter. Management works smarter by making the job easier and simpler for the workers.

However, the study of Nehle and Riemsdijk (2006) found out that, there is relationship between human resource practices and organizational performance. Also, Ayesha, Nosheen, Reema, and Muhammad (2012) discovered that all the seven basic variables of human resource management which include incentive pay, recruitment and selection, work teams, employment security, flexible job assignment, skills training and communication influence staff productivity.

Furthermore, the findings of the research conducted by Huselid (1995) reveals that, proper human resource management practices have much impact on turnover, productivity, and corporate financial performance. Also, the research of Krishnan and Singh (2011) find out that horizontal and vertical fit of human resource practices can have an influence on the organizational performance.

Nevertheless, the study by Adekoya (1999) finds out that School productivity is independent of organizational inputs such as total enrolment, teaching strengths, and class size and teacher /student ratio. He also found out that, School size and teacher/student ratio correlates with co-efficient of 0.61 and that School productivity did not significantly correlates with any of the organizational inputs. From the review, it could be gathered that productivity is the measurement of how well resources are brought together in organizations and utilized for accomplishing a set of results. Productivity is reaching the highest level of performance with the least expenditure of resources.

## PURPOSE OF THE STUDY

The purpose of this study was to investigate the relationship between human resource management and productivity of academic staff in the Southwest Nigeria Universities. Also, the study also investigated the level of human resource management and the level of productivity of the academic staff. Besides the study made recommendations based on the findings.

## RESEARCH QUESTIONS

1. What is the level of human resource management in the Southwest Nigeria Universities?
2. What is the level of productivity of academic staff in the Southwest Nigeria Universities?

**RESEARCH HYPOTHESES**

1. There is no significant relationship between human resource management and productivity of academic staff in the Southwest Nigeria Universities?

**METHODOLOGY**

The study adopted descriptive research of the survey design. The population of this study consisted of 154 Deans, 849 Heads of Department and 11,828 academic staff in Southwest Nigeria Universities.

The sample of this study was (1,800) respondents, comprising 20 Deans, 70 Heads of Department and 1,710 academic staff but with 1495 questionnaire retrievable for analysis. Multistage sampling procedure which involves simple random sampling, stratified random sampling and proportional stratified random sampling techniques were used to select the states, universities and individuals that were used for the study.

Two sets of self-designed instruments were used for this study. The first instrument was Questionnaire on Human Resource Management (QHRM). The second instrument was Productivity of Academic Staff Questionnaire (PASQ). These were used to collect relevant data from the subjects. The instruments were validated based on the judgments of experts in Educational Management and tests and Measurements in Ekiti State University. Reliability coefficients of 0.74 and 0. 71 were obtained for QHRM and PASQ respectively using test re-test method. Two research questions and one hypothesis were postulated. The data were analyzed using frequency counts, percentage, mean, standard deviation and Pearson Moment Correlation Coefficient. The hypothesis raised were tested at 0.05 level of significance.

**RESULTS**

**Question 1:** What is the level of human resource management in the Southwest Nigeria Universities?

In analyzing this question, the scores on human resource management were used. Mean, percentage, standard deviation and frequency count were used to illustrate the responses to items 1-33 in section B of QHRM. To determine the level of human resource management of academic staff in the universities of the southwest, Nigeria, (low, moderate and high), the mean score and standard deviation of responses to the human resource management instrument were used.

The low level was determined by subtracting the standard deviation score from the mean score (94.05 – 15.24 = 78.81). The moderate level of human resource management was determined by the mean score of the responses on human resource management (94.05) while high level of human resource management was determined by adding the mean score and the standard deviation score of the responses on human resource management (94.05 + 15.24 = 109.29). Therefore, the low level of human resource management starts from 0 to 78.81; the moderate level of human resource management starts from 78.82 to 109.28 and the high level of human resource management starts from 109.9 to 132.

**Table1: Level of human resource management in Universities of Southwest Nigeria**

| **Level of Human Resource Management** | **Frequency** | **Percentage** |
|---|---|---|
| Low (0-78.81) | 117 | 7.8 |
| Moderate (78.82-109.28) | 1094 | 73.2 |
| High (109.29-132) | 284 | 19.0 |
| Total | 1495 | 100 |

Table 1 revealed the level of Human Resource Management. The result showed that out of 1495 academic staff sampled, 117 representing 7.8 percent had low level. Those who had moderate level were 1094 representing 73.2 percent while those with high level were 284 representing 19 percent. This showed that the level of human resource management was moderate.

**Question 2:** What is the level of productivity of academic staff in the Southwest Nigeria Universities?

In analyzing the above question, the scores on productivity of academic staff in teaching, research and community services were used. Mean, percentage, standard deviation and frequency count were used to illustrate the responses in items 1-27 in section C of PASQ. To determine the level of productivity of academic staff in the universities of the southwest, Nigeria, (low, moderate and high), the mean score and standard deviation of responses of the academic staff productivity instrument of (teaching, research and community services) were used.

The low level was determined by subtracting the standard deviation score from the mean score (113.00 – 9.06 = 103.94). The moderate level of productivity of academic staff was determined by the mean score of the responses on productivity of academic staff (113.00) while high level of productivity of academic staff was determined by adding the mean score and the standard deviation score of the responses on productivity of academic staff (113.00 + 9.06= 122.06). Therefore, the low level of human resource management starts from 0 to 103.94; the moderate level of human resource management starts from 103.95 to 122.05 and the high level of human resource management starts from 122.06 to135.

**Table 2: Level of productivity of academic staff in the Universities in Southwest Nigeria**

| Level of Productivity of Academic Staff | Frequency | Percentage |
|---|---|---|
| Low (0-103.94) | 187 | 11.9 |
| Moderate (103.95-122.05) | 1038 | 69.0 |
| High (122.06-135) | 270 | 19.1 |
| Total | 1495 | 100 |

Table 2 revealed the level of Productivity of Academic Staff. The result showed that out of 72 respondents sampled, 9 representing 11.9 percent had low level. Those who had moderate level were 50 representing 69.0 percent while those with high level were 13 representing 19.1 percent. This showed that the level of productivity of academic staff is moderate.

**Hypotheses Testing**

**Hypothesis 1:**

There is no significant relationship between human resource management and productivity of academic staff.

In testing the hypothesis, scores relating to human resource management were computed using items 1-33 of QHRM while productivity of academic staff scores were computed using items 1-27 of PASQ. The scores (human resource management and productivity of academic staff) were subjected to statistical analysis using Pearson Product Moment Correlation at 0.05 level of significance. The result is presented in table 3.

**Table 3: Pearson Product Correlation of Human Resource Management and Productivity of Academic Staff**

| Variable | N | Mean | SD | r-cal | r-table |
|---|---|---|---|---|---|
| Human Resource Management | 1495 | 94.05 | 15.235 | 0.462* | 0.195 |
| Productivity of Academic Staff | 1495 | 113.00 | 9.061 | | |

*P <0.05

Table 3 revealed that the relationship between human resource management and productivity of academic staff is statistically significant at 0.05 level. ($r=0.462$, $p<0.05$). Thus the null hypothesis is rejected. This implies that there was significant positive relationship between human resource management and productivity of academic staff.

**DISCUSSION**

The study revealed that the level of the human resource management in the universities of the southwest is moderate. It implies that human resource managers

(Deans and heads of department) are managing the academic staff well to perform their duties in teaching, research and community services. What can be responsible for this finding may be the fact that, the resource managers still perform well in their respective responsibilities. The finding is in line with Singh and Vohta (2005) that strategic human resource management has become a necessity for organizations.

The study revealed that the level of the productivity of academic staff in the universities of the southwest is moderate. This implies that academic staff are teaching well and their research work is also going on as expected. They are equally performing well in their contribution to community services. The finding may be due to the fact that without the academic staff making progress in these areas, they may not be promoted and their job security will be at stake. The finding is in support of Heap (2013) that the productivity level of the organization depends far more on the overall effectiveness of the various systems, processes and procedures that link the individuals together into a working 'school'.

The study showed that there is significant relationship between human resource management and productivity of academic staff in the Universities of the southwest Nigeria. This implies that proper management of academic staff in the universities of the southwest will improve their productivity. What may be responsible for this finding is the fact that an organization will not succeed without the proper management of its personnel. The implication of not managing the human resource well is that turnover will increase while performance will reduce. This finding is in agreement with the study of Nehle and Riemsdijk (2006), Ayesha, Nosheen, Reema, and Muhammad (2012), Huselid (1995) and Krishnan and Singh (2011). They all maintained that human resource management and productivity are related. The finding however negates the study of Adekoya (1999) which found out that school productivity is independent of organizational inputs such as total enrolment, teaching strengths, and class size and teacher /student ratio and he concluded that school productivity did not significantly correlate with any of the organizational inputs.

## CONCLUSION

Based on the findings of this study, it can be concluded that human resource management and productivity of academic staff in the southwest Nigeria was fairly good. Human resource management was related to productivity of academic staff in the southwest Nigeria Universities.

## RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made: in view of the fact that the levels of human resource management and productivity of academic staff in southwest Nigeria Universities are moderate, academic staff should be more committed to their job to ensure qualitative teaching, research and community services for better productivity. The managers should encourage the academic staff to be more productive. Other areas on which the

academic staff should be enhanced are, participating as editors of books and journals, contributing to knowledge through book writing and through regular research publications. Moreover, they should give more advisory services to community members, organize seminars on skill acquisition for the less privilege and participate as a committee member to serve the community.

**REFERENCES**


Adekoya, S.O. (1999). *Productivity of secondary education in Lagos State: implications for educational planning and policy.* Unpublished Ph.D Dissertation for the Department of Educational Administration of University of Lagos.

Archibald, R.B. & Feldman D.H. (2011). *Why does college cost so much?* Oxford, England: Oxford University Press.

Ayesha J, Nosheen N, Reema Y. & Muhammad A.N. (2012). Human Resource Management and Productivity: A Comparative Study among Banks in Bahawalpur Division. *European Journal of Business Management, 4 (8): 253-280.*

Bello- Imam, I.B, Oshionebo, B.O, & Ojeifo, S.A. (2007). *Fundamentals of human Resources management in Nigeria.* Ibadan. College Press and Publishers Ltd.

Boselie, P. (2009). A balanced approach to understanding the shaping of human resource management in organizations. *Management revue, 16 (2): 230-214.*

Brinkerhoff, R. O. & Dressier, D. E. (1990). Productivity measurement: A guide for managers and evaluators. *Newbury Park, CA: Sage.*

Cole, G. A. (2002). *Personnel and human resource management.* TJ International Ltd. Padstow, Cornwall.

Hagler, B. E. & Erthal M. (2009). Measuring future worker productivity via business. Email message creation: Implications for education. *The Journal of Research in Business Education. 51(3): 45-56.*

Heap J. (2013). Improving the Productivity of Education - beyond Time Management. *Magazine article of Management Services57 (3):* 83-101.

Huselid, M.A. (1995). The Impact of Human Resource Management Practices on Turnover, Productivity, and Corporate Financial Performance. *The Academy of Management Journal, 38(3): 635-672.*

Inyang, L. A. (1995). Strategies for promotion of productivity at the work place. *A Paper presented at the llorin National Productivity Day Symposium, February 21.*

Jossey B. (1993). **http://www.managementstudyguide.com/elements-of-personnel-management.htm.**

Katou A.A. & Budhwar P. (2015). Human resource management and organisational productivity: A systems approach based empirical analysis", Journal of Organizational Effectiveness: People and Performance, Vol. 2 (3): 244 – 266.

Krishnan, S.K. & Singh M. (2011). Strategic human resource management: A three-stage process model and its influencing factors. *South Asian Journal of Management, 18 (1): 34-53.*

Lunenburg, F.C, & Ornstein A.N. (2008). *Educational Administration: Concept and Practices.* Ward worth, USA.

McGraw-Hill. I (2003). *Human Resource Management: Gaining a competitive Advantage.* McGraw-Hill Companies Inc. NY.

Nehles, A. C. Riemsdijk M. (2006). Implementing human resource management successfully: A first-line management challenge. *Management Revue, 17 (3): 17-29.*

Nwachukwu, C. C. (1992). *Management: Theory and practice.* Lagos: Academy Press.

Ogbodo, C.M. & Nwaoku, N.A. (2007). Quality Assurance in Higher Education. *Paper presented at the second Regional Conference on Reforms and Revitalization in Higher Education*, held at IITA, Ibadan, Nigeria, August 13-16, 2007.

Shen J. & Benson J. (2014) How socially Responsible Human Resourse management affects employee work behaviuor. *Journal of management. Vol 42 (6): 1723-1746.*

Singh, M. &Vohra, N. (2005). Strategic human resource management in small enterprises. *Journal of Entrepreneur ship, 14 (1): 57-70.*

Uche C.M. (2012). Students' Perception of Academic Staff Quality: A Measure of Quality Assurance in South-South Nigerian Higher Institutions. *International Journal of Education Science, 4(2): 163-173.*

Wright, P. M. & McMahan, G. C. (1992). Theoretical perspectives for strategic human resource management", *Journal of Management, 18 (2):295-320.*