

**PROCEEDINGS OF
EIE's 2ND INTERNATIONAL CONFERENCE ON COMPUTING,
ENERGY, NETWORKING, ROBOTICS AND
TELECOMMUNICATIONS**

eieCon2012

Editors

**Samuel N. John
Charles U. Ndujiuba
Frank A. Ibikunle
Jeremiah O. Onaolapo**



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Foreword

On behalf of eieCon2012 Conference Planning Committee (CPC), I am glad to introduce this collection of papers to be presented at EIE's 2nd International Conference on Computing, Energy, Networking, Robotics and Telecommunications (eieCon2012), November 21 through 23, 2012, at Covenant University, Ogun State, Nigeria.

We express our gratitude to the Chancellor and Chairman, Board of Regents of Covenant University, Bishop (Dr.) David O. Oyedepo and the following personalities for their unflinching support:

- Professor C.K. Ayo - Vice Chancellor, Covenant University
- Pastor (Dr.) Ubong Ntia - Registrar, Covenant University
- Professor S.S. Adefila - Dean, College of Science and Technology

The Conference Planning Committee would like to thank everyone that submitted papers. The papers presented in this book of proceedings were subjected to double blind peer-review and were found worthy of inclusion and presentation by our erudite team of reviewers.

We are very grateful to the many colleagues who helped in organizing the conference. We would like to thank the members of eieCon2012 Conference Planning Committee for their outstanding work. The eieCon2012 Conference Planning Committee (CPC) members were:

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To every other person who contributed to the success of this conference, please accept our wholehearted appreciation.

Charles U. Ndujiuba (PhD)

Chairman, eieCon2012 CPC

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eieCon2012 Conference Papers

Position Control of Pick and Place Robotic Arm

Ms. Shweta Patil and Dr. Sanjay Lakshminarayan

Department of Electrical Engineering

M. S. R. I. T, Bangalore

Shweta.p042@gmail.com, Sanjay.laks@gmail.com

Abstract: *The control of a robotic arm has been a challenge since earlier days of robots. In this paper kinematic modeling is used to control the robotic arm. Here kinematic homogenous 4×4 matrix calculation is used to control the 5-axes articulated robot arm. With this approach it is possible to develop algorithms for controlling movements. Actual robotic arm has been designed using auto CAD drawings. Simulation was carried out by EDGE CAM software. Joints are moved using servo motors. Intelligence behind the robotic arm is 8051 microcontroller. Now robotic arm is to be developed and able to work in the line by picking and placing components.*

Key words: *kinematics, auto CAD, EDGE CAM software, articulated, DOF.*

I. INTRODUCTION

Vision of manufacturers is to minimize human intervention in handling critical environmental applications with so much advancement and research works carried out cross the world, this dream can be absolutely made into reality in the age of automation with the current technology. Pick and place robots are unable to provide solutions in all applications. However, the deficiency of degrees of freedoms(DOF) makes the control of manipulators with 5-DOF a very difficult task to follow a given trajectory with a desired final position [1]. In this paper 5-DOF manipulator is designed and analyzed in order to gain an in depth understanding of positioning issues and solving with the use of kinematic modeling method.

We designed a 5-DOF articulated manipulator; this device can generate 4×4 homogenous matrix to solve the position and orientation of end-effector from base. Position here, refers to position control in space of end-effector of robot arm of last link or base. Position control is fairly easy to understand in spaces of higher dimensionality, rotation or orientation will rapidly become more complex [1]. Designed 5-DOF robot arm consists of 5 axes to generate arbitrary position in a specified space and last link is needed to control the orientation. This developed kinematic model has been fabricated using auto CAD drawings and arm movements visualized by EDGE CAM software. The fabrication is done by 5 RC servo motors for joints moments. The intelligence

behind the robotic arm is microcontroller 8051 which is activated by an Infra Red sensor.

The paper is organized as follows, In section II & III, a brief description about mathematical model in kinematics. In section IV, a brief discussion about design criteria of 5-dof robotic arm. Section V, represents simulation results. and finally implementation and conclusion are drawn in section VI & VII.

II. KINEMATIC ANALYSIS ALGORITHM

Robot arm kinematics deals with the analytical study of geometry motion of robot arm from fixed reference of coordinate system as a function of time without regard to movements that causes the motion. Thus, it deals with analytical description function of time in particular the relation between joint variable space and position variation of end effector from base[2] [5]. Articulated 5-DOF robotic arm is designed by direct and inverse kinematic analysis methods. Direct kinematics usually refers to home position of geometric link parameters. It is used to find the position and orientation of end effector. Inverse kinematics usually refers to position and orientation of end effector. It helps to find joint variables to archive correct position of source location part [3].

This simple block diagram indicates the relationship between direct and inverse kinematics problem as shown in Fig 1. [5]

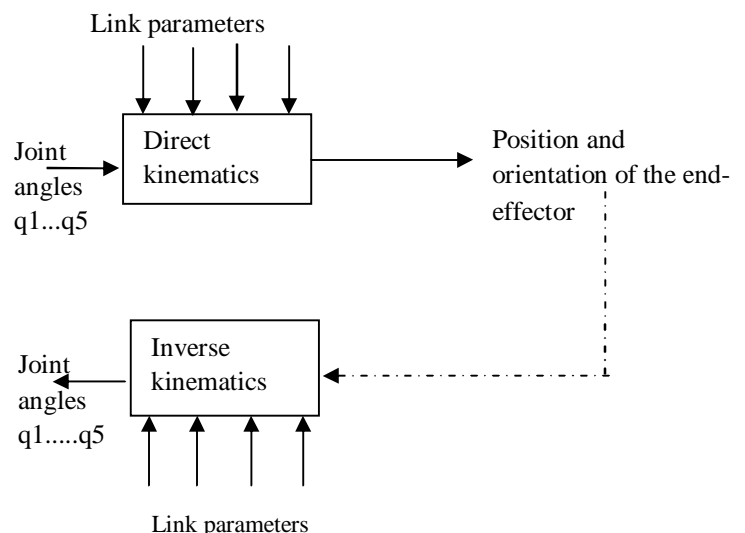


Fig. 1 Direct and Inverse kinematics problems[5].

III. DIRECT AND INVERSE KINEMATIC ANALYSIS

A. Direct kinematic analysis

Denavit-Hartenberg algorithm helps to find the position and orientation of end-effector with respect to base [5]. Totally 20 Parameters are involved in 5-DOF robotic arm design. Namely;

- Joint variables are given by [2],
 $q = \{ q_1, q_2, q_3, q_4, q_5 \}$
- Joint distances are given by [2],
 $d = \{ d_1, d_2, d_3, d_4, d_5 \}$
- Link lengths are given by [2],
 $a = \{ a_1, a_2, a_3, a_4, a_5 \}$
- Twist angles are given by [2],
 $\alpha = \{ \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5 \}$

Following are the steps involved in DH algorithm in direct kinematics modeling method [5].

Step 1: Establish a co-ordinate system of SLD of robot arm.

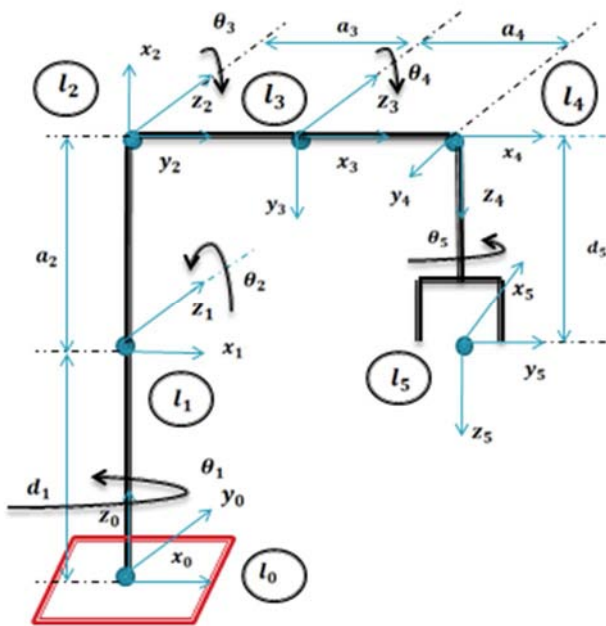


Fig. 2. Link coordinates SLD of 5-DOF robot arm [2]

Where,

- l_0 to l_5 : Six unit frames.
- d : Tool length
- q_1 to q_5 : Joint variables

- P : Tool-tip
- d_1 : Height of shoulder from base
- q_1, q_2, q_3, q_4, q_5 : Rotary joints
- a_1, a_2, a_3, a_4, a_5 : Link lengths

This designed robot arm consists of 5 number of arms, namely- base, shoulder, elbow, wrist and gripper. Fig 2. SLD helps to design rough sketch of sequencing of the servo motors at a particular joint. Here, base motor is mounted vertically on horizontal plane. Shoulder, elbow and wrist motors are mounted on base plane. Gripper motor is mounted at wrist joint vertically on horizontal plane [2]. All joints are rotatory /articulated in nature. so that, $q_i = \theta_i$ is the joint variable.

Step 2: Initialize and loop.

For each, $i=1,2,3,4,5$, to perform the next steps

Step 3: Establish KP table [5].

KP value is written at home position of robotic arm is as shown in below table:

AXIS	TYPE	$\theta(i)$ in deg	$d(i)$ in cm	$a(i)$ in cm	$\alpha(i)$ in rad
1	Base	0	21	0	$-\pi/2$
2	shoulder	-90	0	18	0
3	Elbow	90	0	10	0
4	Wrist	0	0	8	$-\pi/2$
5	Gripper	-90	6	0	0

Table 1. DH kinematic parameter table.

Step 4: Establish link transformation matrix for each joint [6].

According to Euler's link transformation matrix;

$$T = \begin{bmatrix} C\theta & -C\alpha S\theta & S\alpha S\theta & a C\theta \\ S\theta & C\alpha C\theta & -S\alpha C\theta & a S\theta \\ 0 & S\alpha & C\alpha & d \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1)$$

Obtain the various fundamental 4x4 homogenous co-ordinates transformation matrices T_1, T_2, T_3, T_4, T_5

Putting $i=1, 2, 3, 4, 5$

$$T = \begin{bmatrix} C & 0 & -S & 0 & C & -S & 0 & a C \\ S & 0 & C & 0 & S & C & 0 & a S \\ 0 & -1 & 0 & d & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \end{bmatrix} \quad (2)$$

$$T = \begin{bmatrix} c & -s & 0 & 0 \\ s & c & 0 & 0 \\ 0 & 0 & 1 & d \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Step 5: Establish the arm matrix.

$$T(q) = T_1 T_2 T_3 T_4 T_5 \quad (3)$$

$$T = T_1 T_2 T_3 T_4 T_5 \quad (4)$$

$$T = [T_1 T_2 T_3] [T_4 T_5] \quad (5)$$

$$T = T_1 T_2 \quad (6)$$

$$T = T_1 T_2 \quad (7)$$

From equation 5,(Product of each link transformation matrix we arrive at final arm matrix) T is,

$$\begin{bmatrix} c C + s S & -c C + s S & -C S & C(a C + a C + a C - d S) \\ s C + c S & -s C - c S & -S S & S(a C + a C + a C - d S) \\ -C S & S S & C & d - a S - a S - a S - d S \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (8)$$

Step 6: Establish home position matrix.

To check this weather the matrix obtained is correct or not. Evaluate it at the home position by putting the value of the angle of initial home position of rotatory angles,

Substitute $\theta = (0, -90, 90, 0, -90)$ in the arm matrix (from equation 8).

$$(HPM) = \begin{bmatrix} x & 0 & 1 & 0 & a & +a \\ y & 1 & 0 & 0 & 0 & \\ z & 0 & 0 & -1 & d + a & -d \\ & 0 & 0 & 0 & 1 & \end{bmatrix} \quad (9)$$

Step 7: Establish the modeling Equation

Obtain the arm equations by equating; $T = T(HPM)$

$$R = C C C + S S = 0 \quad (10)$$

$$R = S C C - C S = 1 \quad (11)$$

$$R = -C S = 0 \quad (12)$$

$$R = -C S C + S C = 1 \quad (13)$$

$$R = -S S C - C C = 0 \quad (14)$$

$$R = S S = 0 \quad (15)$$

$$R = -C = -1 \quad (16)$$

$$P = C (a C + a C + a C - d S) = a + a \quad (17)$$

$$P = S (a C + a C + a C - d S) = 0 \quad (18)$$

$$P = d - a S - a S - a S - d S = d + a - d \quad (19)$$

Modeling equations can be used to find the position and orientation of robot arm by giving the value of joint variables and geometric link parameters namely, a and d [2], [3].

B. Inverse kinematics analysis

In order to control the position and orientation of end- effector of a robot arm to reach its object, the inverse kinematics solution is more important [5]. In this project, inverse kinematics problem is solved by geometric approach method. This method provides more insight into solving simple manipulators with rotatory joints [2] [7].

IV. DESIGN CRITERIA OF 5-DOF ROBOTIC ARM

Static robot arm consists of generally 3-components which performs the following tasks [11].

- Mechanical arm: The mechanical design of robot consists of five numbers of axes - base, shoulder, elbow, wrist and gripper. Aluminum material is used to build the static robotic arm.
- Actuators: RC servo motors are used to move the joints of robotic arm to achieve the desired position as shown in Fig 3.
- Controller: This process is achieved by microcontroller 8051 software.

A. Servo motor

Servo motor is a geared DC motor with positional feedback that allows rotor to be positioned accurately [4]. Internally, a servo consists of DC motor, potentiometer and control circuit. The control circuitry compares an angular position, determined by a control signal, to the current position of the motor shaft as shown in Fig 4. The motor shaft's angular position is often determined by a potentiometer, which is rotated by the motor shaft. A potentiometer is a three-terminal resistor, whose center connection has variable resistance, usually controlled by a slider or dial. The potentiometer acts as a variable voltage divider. The voltage from the center connection of the potentiometer represents the angular position the motor shaft is in. Other methods to determine angular position and rotation exist for bigger servos, but a potentiometer is the most common for small servos. The built-in controller generates an internal signal from the voltage

controlled by the potentiometer, compares it to the control signal, and then provides power to the dc motor to rotate the shaft in the appropriate direction to match the two. Servos usually require a pulse-width modulated control signal [4].



Fig .3. RC servo motor

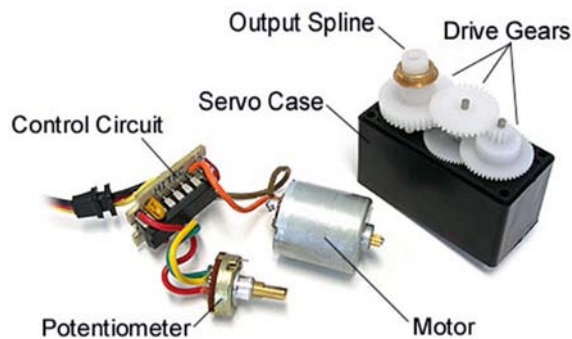


Fig. 4. Internal components of servo motor [4].

B. Software design

The PCA is a special module, in Philips P89V51RD2 which includes a special 16-bit Timer that has five 16-bit capture/compare modules associated with it. All of the PCA modules can be used as PWM outputs. Output frequency depends on the source for the PCA timer. All of the modules will have the same frequency of output because they all share one and only PCA timer. These modules are associated with PORT 1. It can be connected to robotic arm servo motor to control the position of arm moment [10].

V. SIMULATION RESULTS

A user friendly GUI was developed in EDGE CAM mechanical software. It helps to visualize arm moment to avoid collision between adjust joints of the arm, it develops by using auto CAD drawings and the generated 4x4 homogenous matrices, Fig. 5 represents the simulation result.

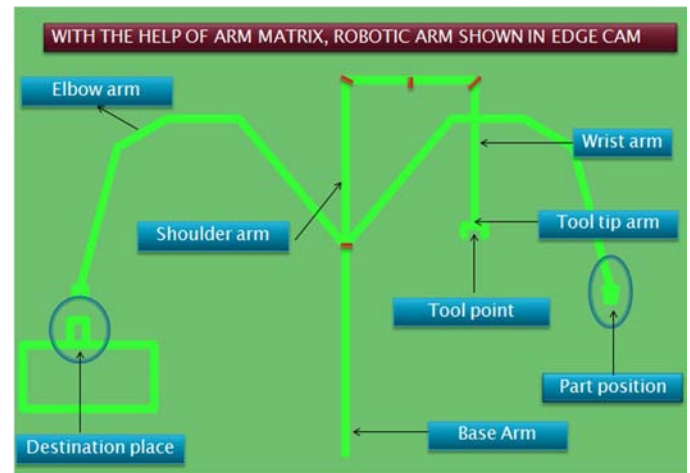


Fig. 5. Work space of robotic arm is developed in EDGE CAM software.

VI. IMPLEMENTATION

A modular reconfigurable robot for molding machine work cell implemented is as shown in the Fig 6. This is a joint project between M.S.R.I.T, Bangalore and INDO-MIM Pvt. Ltd. The fabricated 5-DOF articulated robot arm was introduced for real time molding machine operation. And it controls the pick and place task line in a molding machine operation.



Fig 6. Modular reconfigurable robot arm installed for molding machine operation

VII. CONCLUSION

Kinematic Modeling method is used to find position and orientation of the end effector with respect to base. Arm moment is visualized using EDGE CAM simulation software. A Hardware part of pick and place robotic arm is implemented using microcontroller 8051. Joint moments are carried out using servo motor.

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Practical Control of Switching Overvoltages by Switch-Sync Controller

Amin Samanfar
Islamic Azad University
Khoramabad Branch
,Khoramabad, Iran
e-mail:mohghoco@yahoo.com

Behrooz Vahidi, Mohsen Ghorat
Deputy of Supervision on Transmission Grid
Iran Grid Management Company (IGMC)
Tehran, Iran
ghorat@igmc.ir

Abstract—When a transmission line is energized by closing a line circuit breaker, some switching transitions are generated in the power system including the line and the supply network. A traditional method is used to limit switching overvoltage to the acceptable levels. In this method circuit breakers are equipped with pre-insertion resistors. Although these resistors limit the switching overvoltage, they make the circuit breakers more complex and expensive.

The need for pre-insertion resistors is eliminated by using of switch-sync controllers for closing and reclosing the circuit breakers. Using the switchsync controllers in conjunction with surge arresters could provide acceptable results. In this paper, the switching overvoltage for a transmission line is performed when the line circuit breakers are equipped with appropriately designed switchsync controller. The transient based EMTWorks software is used to model an appropriate power system and various simulations are performed. Statistical studies have been done to determine the maximum switching overvoltage when a switchsync relay for transmission lines is used.

Index Terms—Overvoltage, switchsync, switching, statistical, Substation, Modeling

I. INTRODUCTION

The switching transition t in a transmission system cannot be prevented as its total suppression is extremely difficult. However, its magnitudes have to be limited to become compatible with insulation level of the system equipment. The transmission line energization is a typical maneuver, whose transient magnitude is influenced by the system configuration as well as by the equipment characteristics. Consequently, overvoltage control measures have to be adopted providing suitable protection for the network.

When an overhead transmission line is energized by closing the line circuit breaker, some switching transitions are generated not only on the line, but also in the supply network. Transmission line switching transient and its severity depend on the difference between the supply and the line voltages at the instant of energization. If energization occurs at an instant when the difference between supply voltage and the line voltage is high, a large traveling wave would be injected on the transmission line. At the time this wave reaches the open far end of the line, it gets reflected and a high transient overvoltage is experienced. The calculation of switching overvoltage is fundamental for appropriate insulation design of many power system components.

For long EHV lines, pre-insertion resistors traditionally are used to limit switching overvoltage. As a "second line-of-defense", surge arresters usually are located at line-ends in the substations. A trend in recent years has been tried to

find alternatives for the pre-insertion resistors by more active use of arresters or by controlled switching [1, 2, 3]. A traditional method of limiting this switching overvoltage to acceptable levels is to use circuit breakers equipped with preinsertion resistors. These resistors provide efficient limitation of the switching overvoltage, but make the circuit breakers mechanically more complex and expensive. However, efficient limitation of the overvoltage along the lines by surge arresters has first been possible with the introduction of high-energy polymer-housed surge arresters that permit easy installation out on the lines. Further reduction of the switching overvoltage can be achieved by using of an additional arrester in the middle of the line or by the application of special arresters with lower protection level and higher discharge energy capability.

Another method to reduce the switching transition is synchronous switching. It is a method for eliminating transient overvoltage through time controlled switching operations. Closing commands to circuit breaker are delayed in such a way that contact separation will occur at the optimum time instant related to the phase angle. Successful field experiences have been presented during the last years using synchronized control maneuvers of capacitors banks and shunt reactors in high-voltage systems. [4,5]

The objective of this paper is to analyze the overvoltage levels generated in a transmission line during the energization maneuver for distinct mitigation devices. Such survey is basic to infer the performance of the "conventional methods" as it is the case of the surge arresters versus the controlled switching breakers. Finally a comparative analysis of these three trends of overvoltage mitigation is made and it is determined the best technical conditions for the optimization of the energization process.

II. DESCRIPTION OF THE STUDIED TRANSMISSION SYSTEM

Iran has extensive grid network. Its demand is about 42000 MW. It has 421 substations of 230/63 kV and 174 substations of 400/230 kV. This simulation is executed on Anjirak substation. Anjirak is one of the most important substations and is in the center of Iranian power grid. This substation has three level voltage and is 400/230/63 kV. There are three transformers of 400/230/63 kV and 200MVA. There are 5 line of 400kV to 5 different substations and 8 lines of 230kV to 6 different substations. Three reactors of 50 MVAR are connected on 3 lines of 400kV. Anjirak is shown in Fig.1.

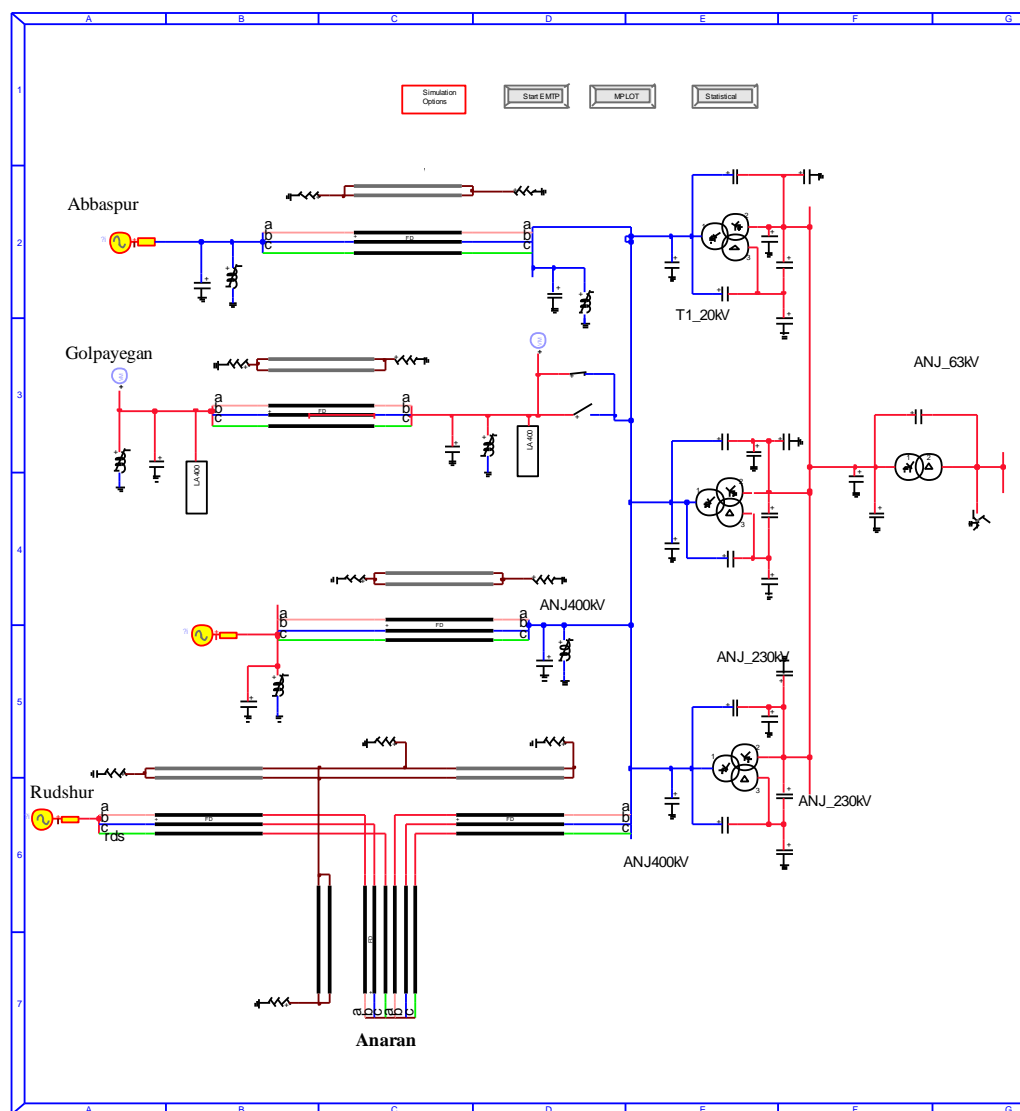


Fig. 1 400 kV Transmission line between Anjirak and Abbaspur substations

III. SYSTEM REQUIPMENTS AND MODELING

A. Transformer

For switching surge transient studies, a reduced order representation with less detail is used rather than a model that used for insulation studies. Usually a lumped parameter coupled-winding model with a sufficient number of R-LC elements to give the appropriate impedance characteristics at the terminal within the frequency range of interest. The nonlinear characteristic of the core should usually be included, although the frequency characteristic of the core is often ignored. This may be an oversimplification as the eddy current effect prevents the flux from entering the core steel at high frequencies thereby making the transformer appear to be air-cored. This effect begins to be significant even at frequencies in the order of 3-5 kHz.

Transformer models are represented with this existing information: MVA rating, winding configuration and voltage, tap change range and normal setting, leakage reactance between windings, knee point of transformer core saturation characteristic in per unit of rate flux or voltage, and estimated saturated air core reactance [3].

The 200 MVA, 400/230/63 kV, step-down auto-transformers are represented by saturable transformer models with three windings: H.T, B.T and M.T. The

saturation characteristics of these auto-transformers are determined. The step up transformers are represented by saturable transformer models with two windings. All transformers are represented by one equivalent in each substation. The total leakage impedance of transformers is presented in H.T winding. Saturation characteristic is represented to an internal node of the same H.T winding [3].

B. Transmission line

The transmission line represented in network, dimensions and data are required. This can be given at the tower, and include conductor sag. Shield wire dimensions and resistance are also provided. The required data for the transmission line include: transmission line conductor diameter and resistance per unit length of transmission line, phase transformation data and distance between phase bundle, spacing between phases, shield wire diameter and resistance per unit length, height of each conductor and shield wire at the tower and sag to midspan, tower dimensions, and ground conductivity [2], [6].

With the reference to the EMTP line model, the selected transmission line models are frequency dependent phase model base on traveling time and characteristic impedance of the line [10]. The 265 km length of the line between Anjirak and Abbaspur is the longest line with voltage level of 400 kV. The type of line is curlw 3 bundle.

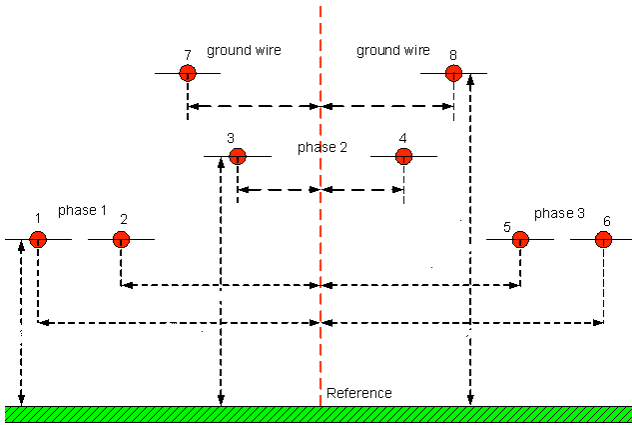


Fig. 2 Coordinate of transmission line

Number of phases=3
 Number of bundles=2
 Conductor=Curlew
 Number of shield wire=2
 Shield wire=Alumweld 7 No. 8,115.6kcmil

TABLE I. PHASE COORDINATION

phase	Coordination (x,y)
1	(6.5,22)
2	(0,22)
3	(-6.5,22)
Shield wire1	(4,26)
Shield wire2	(-4,26)

C. Switchgear

Switchgear includes circuit breakers, Circuit switchers, vacuum switches and other devices which make or break circuits. In switching surge studies, the switch is often modelled as an ideal conductor (zero impedance) when closed, and an open circuit (infinite impedance) when open. Transient programs allow various options to vary the closing time ranging from one-shot deterministic closings to multishot statistical or systematic closings.

D. Surge Arresters

Although surge arresters are complex devices, they are very important in the determination of economic insulation level. It is the best way to choose arresters with the lowest possible protective consistent with the remainder of the system. The installed location and rating of surge arresters are provided. The maximum ratings, and in particular the energy absorption capability will be determined with study and characteristic V-I of surge arresters are provided [3], [7].

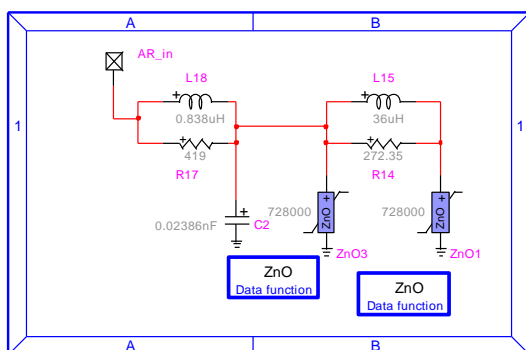


Fig. 3 Arrester model

E. Sources and Network Equivalent

In switching transient studies, the source is modeled as an ideal sine-wave source. Generators are modeled as a voltage behind a (subtransient) Thevenin impedance. Often a network equivalent is used in order to simplify the representation of the portion of the power network not under study[3].

Some typical network equivalents are shown in Fig. 4 represents the short circuit impedance (Thevenin equivalent) of the connected system. The X/R ratio is selected to represent the damping. This equivalent may be used to reduce connected lines to simple equivalent surge impedance and where the lines are long enough so that reflections are not of concerning in the system under study. In such a case it may not be possible to lump the source and lines into one equivalent impedance. Thevenin impedance from Abbaspur is shown in table II.

F. Uniform Distribution Switching

EMTP software provides a statistical switch for overvoltage switching studies. The closing time of a statistical switch is selected randomly according to the probability distribution, which is usually uniform or normal (Gaussian). It is generally assumed that the closing event of an independent breaker pole may occur at any point of voltage signal with equal likelihood. Therefore, the uniform distribution, shown in Fig. 5, is considered for statistical switches. In order to cover all possible switching conditions in the network, the switch of each phase is considered as a statistical switch with uniform probability distribution having the Standard Deviation of 5 ms [4].

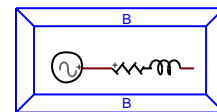


Fig. 4 Thevenin impedance model

TABLE II. THEVENIN IMPEDANCE

Impedance	Z
Positive	1.47+i15.2
Negative	1.58+i14.2
Zero	0.91+i9.1

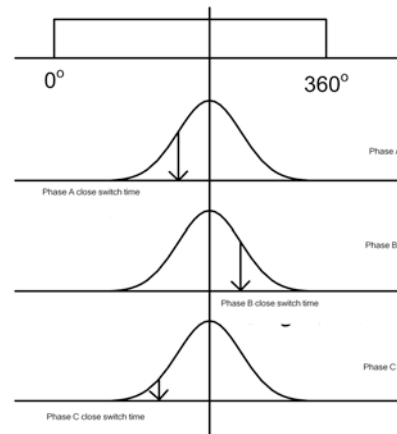


Fig. 5 Uniform distribution

G. Number of Switching

If the number of switching simulation studies increases, the simulation time and accuracy increases and vice versa.

As a rule of thumb, no less than 100 runs must be performed to obtain a switching overvoltage distribution accurate enough. Nevertheless, the number of enough switching should be increased when the amount of standard deviation increases [8].

H. Modeling of Trapped Charge on Transmission Lines

In switching surge studies, one must also simulate cases where it is assumed that the line to be energized has trapped charges on it, while the feeding network behind the circuit breaker will be in normal ac steady-state condition. This produces the highest overvoltage in the network. This applies to lines without shunt reactors only, because shunt reactors connected to the line (or inductive potential transformers) would drain off the trapped charges. The severity of the overvoltage in cases with trapped charges depends on the polarity of the trapped charges and the inserting instants of the breaker poles. There are two ways of simulating trapped charges in the EMTP [7]:

- 1) Use the override "initial conditions" feature of the EMTP
- 2) Let the circuit breaker opening action of switches trap a charge, before the circuit breakers are closed again.

First way is used in this simulation. Initial conditions for different phases include: $V_a=1.05pu$, $V_b=-1.05pu$, $V_c=1.05pu$.

I. Switchsync Relay

Controlled switching is a method for reduction of harmful transitions via time controlled switching operations. Closing or opening commands to the circuit breaker are delayed in such a way that making or contact separation will occur at the optimum time instant related to the phase angle. Controlled switching has been used in the past to eliminate harmful electrical transients upon planned switching of mainly capacitor banks, shunt reactors and power transformers. The method is also gaining acceptance for re-energizing of EHV transmission lines to replace traditional pre-insertion resistors. By means of switchsync controllers, both energizing and deenergizing operations can be controlled with regard to the point-on-wave position to mitigate harmful transients [7]. Proper operation of switchsync relays requires practically fixed operating time. Therefore, the breaker operating time should be approximately constant. For some of the variants, a motor drive is incorporated as an alternative. All these circuit breakers have stable operating times, which vary only to a limited extent with factors such as ambient temperature and control voltage. For moderate variation of these factors, the opening and closing times will typically show a variation of less than plus/minus 0.5 ms. Similarly, after a long idle time, either in closed or opened position, the circuit breakers will have stable operating times, even upon the first operation [9-10].

At the closing instant, the circuit breaker is controlled to make the current when the instantaneous phase to ground voltages is close to zero. In this procedure, high overvoltage is limited irrespective to the actual trapped charge. This is a straightforward method, and the obtained overvoltage level is often acceptable, especially when this method applied in conjunction with surge arresters.

Due to variation of parameters, switchsync controllers must be chosen based on case-by-case basis and often require an assessment of the system switching overvoltage. The best configuration to reduce switching overvoltage is

combination of switchsync and surge arresters. The surge arresters may be placed at line ends, as a normal part of the protection system for the substations, or may also be placed along the line [11]. Statistical switching studies using switchsync relay, determine the necessity of surge arrester along the line.

J. Statistical Switching Standard Deviation

As mentioned in section II-B, in order to cover all the possible states in switching studies without using a switchsync relay, the standard deviation of the statistical switch was set to 5 ms. In the case that the breaker uses a switchsync relay, the switching instant is predefined, and the only problem is the error which might occur for the breaker at the closing instant. Inasmuch as switchsync relay is a simple digital relay and no complexities exist in its algorithm, the error related to it is negligible [9]. The breaker error arises when the closing instant of the switch differs in each switching due to the environmental conditions, so this type of relay is only suggested for repeatable breakers. Besides, the switchsync relay may not be correctly adjusted with the breakers that yield an error in detecting the zero crossing of the voltage. These errors can be modeled by statistical switches in statistical switching studies. As such, the standard deviation of switch represents the error of breaker and switchsync relay set.

IV. SIMULATION RESULT

Switching overvoltage for line between substation Anjirak and Abbaspur with voltage level of 400kV is simulated. Switching overvoltage has been analyzed in three different states, such as:

- Without arrester and switchsync
- With arrester and without switchsync
- With arrester and switchsync

The Line is energized from Anjirak. Simulation is done for 200 times. Overvoltage at the end of the line is shown in Fig. 5. Phase b has the most overvoltage so only this phase is chosen.

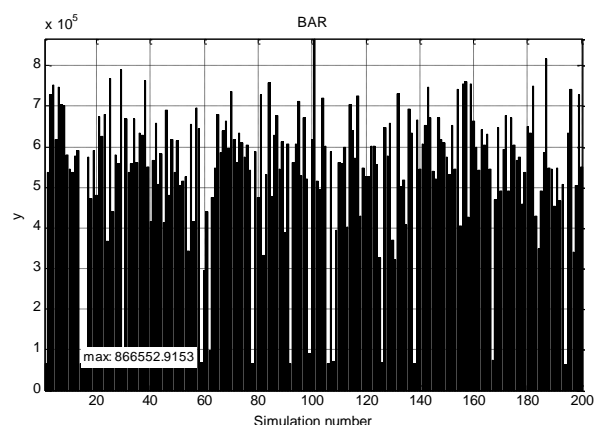


Fig. 6 switching overvoltage with no control voltage

Maximum overvoltage is about 2.6pu. This can be harmful for insulation coordination, so it must be reduce to a logical border. For this reason arresters are used in both ends of the line. The Line is energized from Anjirak, then the simulation is repeated.

At the presence of arrester, maximum overvoltage is reduced to 1.8pu. Arrester could reduce overvoltage to

protect equipment from being damaged. There is important to know that arrester could be damaged by high energy absorption.. Fig. 8 is depicted the energy absorption of arrester..

Energy absorption in phase b is 100522j. switchsync can be used to reduce the energy absorption of arrester and overvoltage. By selecting a proper time for closing the C.B. according section (II-I) with proper time for closing time, energy absorption and overvoltage are reduced. Simulation is executed again with arrester and switchsync. az Line is energized from Anjirak.

Simultaneous using of arrester and switchsync, the overvoltage is reduced to 1.74pu. The results show a little effect on overvoltage but energy absorption has more change which are shown in Fig. 10.

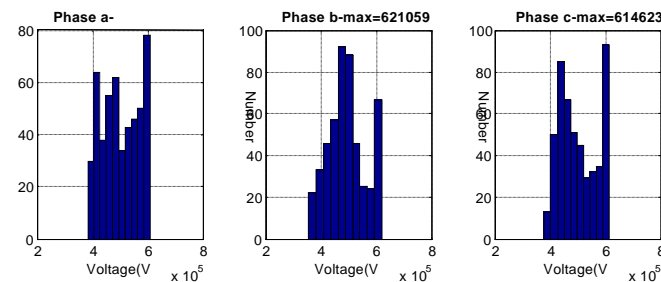


Fig. 7 switching overvoltage with arrester

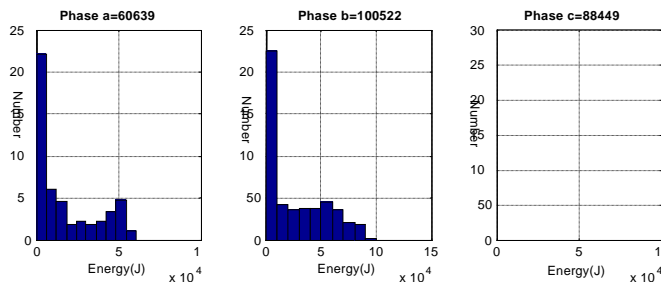


Fig. 8 Arrester energy absorption

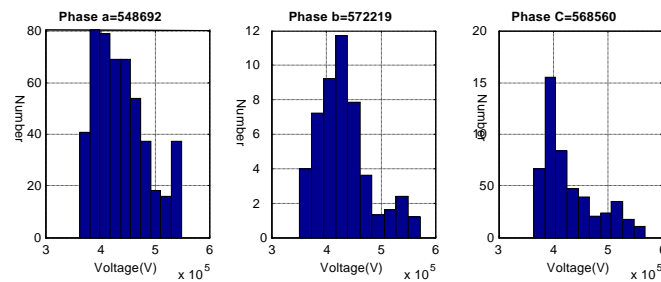


Fig. 9 Switching overvoltage with conjunction of arrester and switchsync

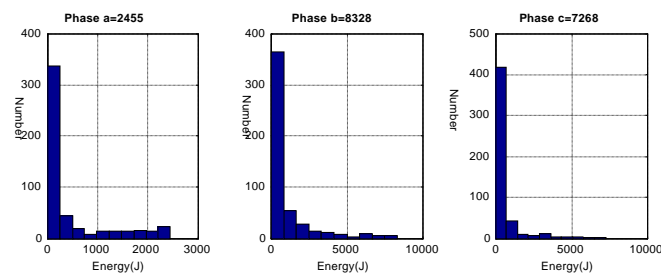


Fig. 10 Arrester Energy absorption when switchsync is used

According to Fig. 9, energy absorption in this state is reduced to 8328j. switchsync could reduce the energy absorption and it can protect arrester from damage so Simultaneous using of them is necessary.

Fig. 10 shows the maximum switching overvoltage along the transmission line for these cases. As shown in this figure, arrester has significant effect on decreasing the switching overvoltage. The switchsync relay method also decreases switching overvoltage by about 0.06pu.

Overvoltage at the middle of line is more than the both ends of the line because of existing arresters.

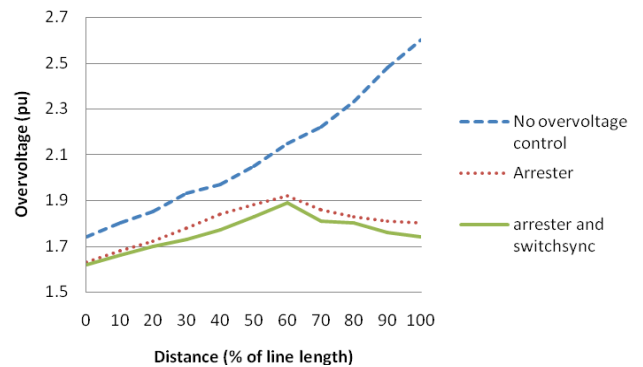


Fig. 11 line overvoltage profile for different simulation

V. CONCLUSION

Preinsertion resistors provide efficient limitation of the switching overvoltage, but make the circuit breakers mechanically more complex and also more expensive. Controlled closing and reclosing of line circuit breakers using switchsync relay can reduce line switching overvoltage. Simulation is done for Anjirak substation which is one of the most important substations in Iran electrical network. The aim of this paper is to suggest a solution for reducing switching overvoltage of the longest line in Iranian power grid. Overvoltage with no overvoltage controller was 2.7pu and with only arrester was 1.8pu and with the conjunction of arrester and switchsync was 1.74pu. switchsync is important to protect arrester because when there is switchsync in network, energy absorption with arrester is very low. According to this result Using both arrester and switchsync is necessary for insulation coordination in this substation.

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Behrooz Vahidi (M' 2000, SM' 2004) was born in Abadan, Iran in 1953. He received the B.S. in electrical engineering from Sharif University of Technology, Tehran, Iran in 1980 and M.S. degree in electrical engineering from Amirkabir University of Technology, Tehran, Iran in 1989. He also received his Ph.D. in electrical engineering from UMIST, Manchester, UK in 1997. From 1980 to 1986 he worked in the field of high voltage in industry as chief engineer. From 1989 to present he has been with the department of electrical engineering of Amirkabir University of Technology where he is now an associate professor. His main fields of research are high voltage, electrical insulation, power system transient, and lightning protection and pulse power technology. He has authored and co-authored 120 papers and four books on high voltage engineering and power system.

DESIGN AND IMPLEMENTATION OF A MICROPROCESSOR BASED TEMPERATURE CONTROLLER WITH REAL TIME DISPLAY

¹Samuel Ndueso John, ²Charles Ndujiuba, ³Oladeinde Ifedayo Oluwaseyi, ⁴Ibeanu Charity Onyinye

^{1,2,3,4}Department of Electrical and Information Engineering, Covenant University, Ota, Ogun State

Abstract: The objective of the project was to automate and control temperature for a server room. The system is allowed entry of a desired room temperature within a prescribed range and to exhibit overshoot and steady-state temperature error of less than 1 degree displaying the value in real time. The details of the design developed, based on a PIC18F452 microcontroller are described. Time, cost and energy are saved by delivering power efficiently using this system. It can be applied in industries, auditoriums, green house buildings, server rooms and nuclear facilities. It is shown that the solution requires broad knowledge drawn from several engineering disciplines including electrical, mechanical, and control systems engineering.

Keywords: Temperature, Sensor, Display, Control, Microcontroller, Real Time.

1 INTRODUCTION

Most people still rely on electricity as it has proven itself to be an integral part of our lives – a grand sector of the nation's economy depends on power. The average temperature in Nigeria ranges from 23 degrees Celsius to 34 degrees Celsius and proper cooling is needed to make the body feel comfortable at all times. Temperature is a physical property of a body that underlies the common notions of hot and cold. Temperature plays an important role in all fields of natural science, including physics, geology, chemistry, atmospheric sciences and biology. [1]

Temperature control as defined by Wikipedia.com is a process in which the temperature value of an object is taken and the passage of heat energy into or out of the object is adjusted to achieve a desired temperature. [2]

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) have listings for suggested temperature values and air flow rates in different types of buildings and different environmental circumstances. For example, a single office in a building has an occupancy ratio per square meter of 0.1. The room temperature recommended is 21.1 degrees Celsius (70 degrees Fahrenheit). A comfortable room temperature depends on individual needs and other factors. According to the West Midlands Public Health Observatory (UK), 22 degrees Celsius (71.6 degrees Fahrenheit) is the recommended living room temperature and 18 degrees Celsius (64.4 degrees Fahrenheit) is a good bedroom temperature. [3]

Section 2 gives a more detailed statement of the problem, including performance specifications, and Section 3 describes the students' design. Section 4 makes up the bulk of the paper, and discusses in some detail several aspects of the design process which offer unique pedagogical opportunities. Finally, Section 5 offers some conclusions.

2 PROBLEM STATEMENT

In the Nigerian society today, prototypes of implemented designs or schematic diagrams are not recognized or carried out here, instead they are taken out of the country to be designed or implemented. A policy to protect the production of such products where Nigeria has comparative production cost advantage has to be created.

3 PROJECT SIGNIFICANCE

A temperature controller is a closed loop control system which senses the temperature of the environment and compares it with a user-fed threshold temperature value and changes the speed of fan accordingly. Such kind of product prototype is of great importance in industrial applications, as a little or abrupt change in the required temperature may bring voids in the functioning of systems or deteriorate the quality of the product being manufactured. Office Buildings, Auditoriums, Nuclear Plants and Pharmaceutical Industries, including Green House Buildings can make use of this intelligent technology. Table 3.1 shows the system specification.

There are three main functions of this system:

- ❖ To monitor the recent value of temperature within the set range using the temperature sensor.
- ❖ To track the changes in temperature to change the speed of the fan proportionally.
- ❖ To display actual temperature values in degrees Celsius.

Table 3.1: Temperature Controller Specifications

Temperature Sensor	
Range	(-)70°C - 150°C
Accuracy	0.5°C
LCD	
Operating Temperature	(-)30°C - 75°C
Operating Voltage	5V

4 METHODOLOGY

This shows the steps involved in the design and implementation of the system.

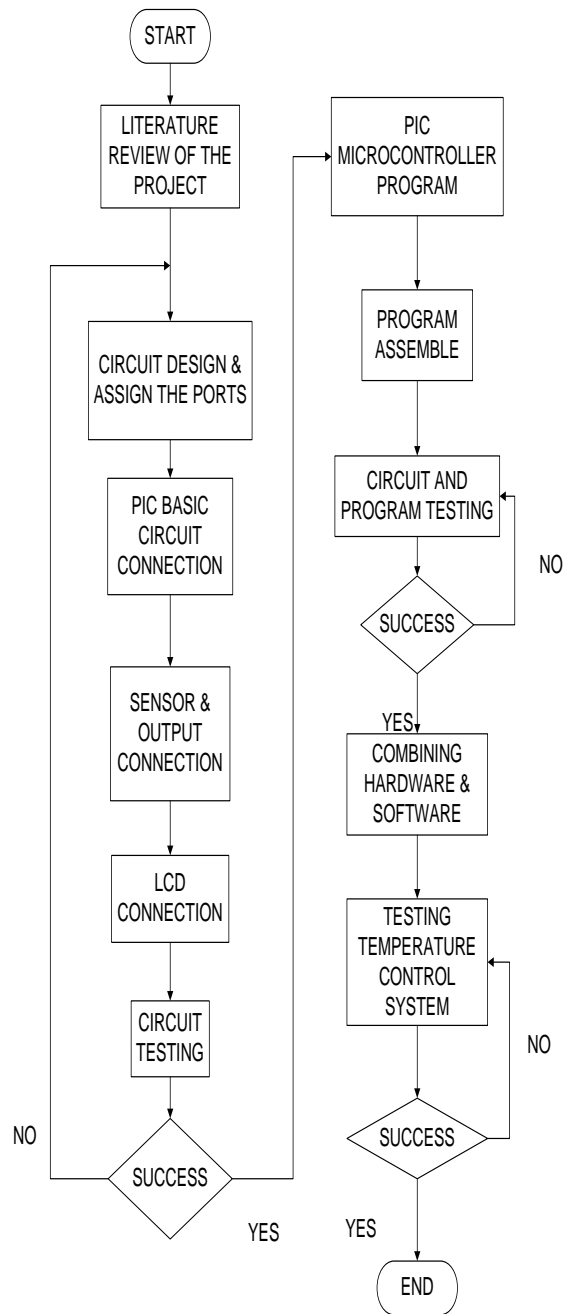


Figure 4.1: Methodology applied in the production of the system

5 SYSTEM DESIGN

The requirements for digital temperature displays and fan control alone are enough to dictate that a microcontroller-based design is likely the most appropriate. Figure 3.1 shows a block diagram of the hardware design.

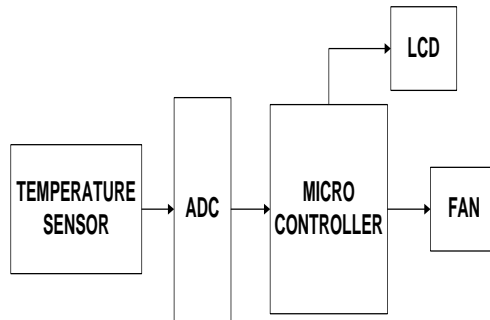


Figure 3.1: Temperature Controller Hardware Block Diagram

The microcontroller, PIC18F452, is the heart of the system. It accepts inputs from a semiconductor type temperature sensor, LM35 which allows for the measurement of the current room temperature, and it is then displayed using LCD. All these inputs and outputs are accommodated by parallel ports on the microcontroller. Finally, a pulse-width modulation (PWM) output on the microcontroller is used to drive the fan. Figure 3.2 shows the schematic diagram of the output electronics and the interfacing to the PIC18F452. The LCD display is driven by Hitachi HD44780 LCD controller connected to pins RD0–RD5 (Port D) configured as output pins. A potentiometer is connected to Pin 3 (VEE) of the LCD for changing contrast level. Finally, Pin 17 (CCP1) on Port C which connects fan operating on the principle of PWM which controls the fan speed by turning the fan on and off continuously at a switching frequency that is much faster than what would affect the load

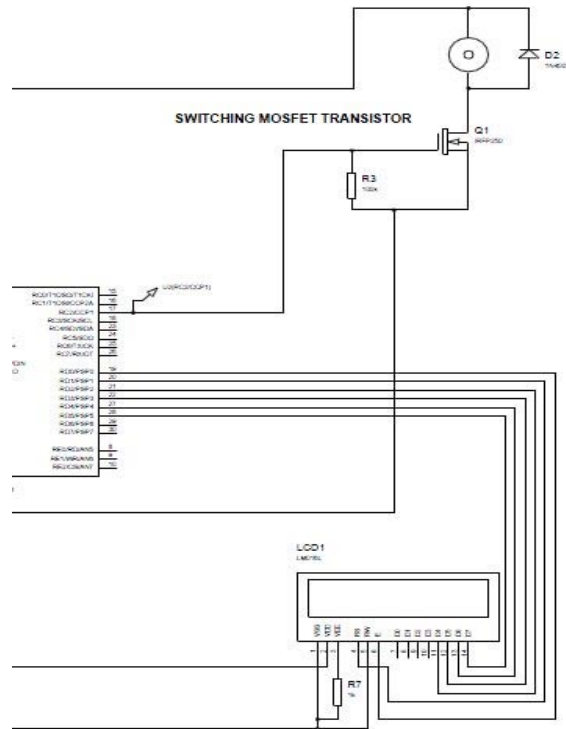


Figure 3.2: Schematic Diagram of the output interfacing with the microcontroller

The fan always gets full 12V when turned on. The pulse width (length) defines the fan power. The power is the relation between the duty cycle and off time. The duty cycle is linearly proportional to the fan speed. Figure 3.3 shows the relation between the PWM pulse and the fan speed. The green line indicates the fan speed.

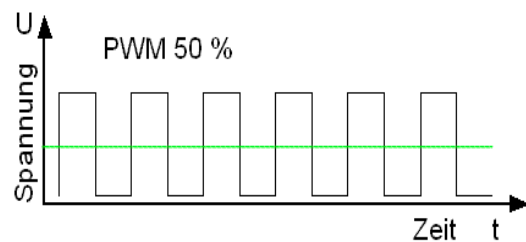


Figure 3.3: Relationship between the PWM pulse and fan speed

Duty cycle is expressed in percent, 100% being fully on. It is calculated using the formula;

$$\text{Duty Cycle} = \frac{T_{ON}}{T_{Total}} \times 100\%$$

The power needed to operate this system requires transformation and rectification. Full wave rectification was used to produce the necessary DC voltage required: 12V and 5V as seen in Figure 3.4. The voltage from the mains (220/240V AC) is stepped down by a transformer to 12V AC, then rectified to 12V DC by a diode bridge. The 12V DC passes through the voltage regulator to give a clean 5V DC.

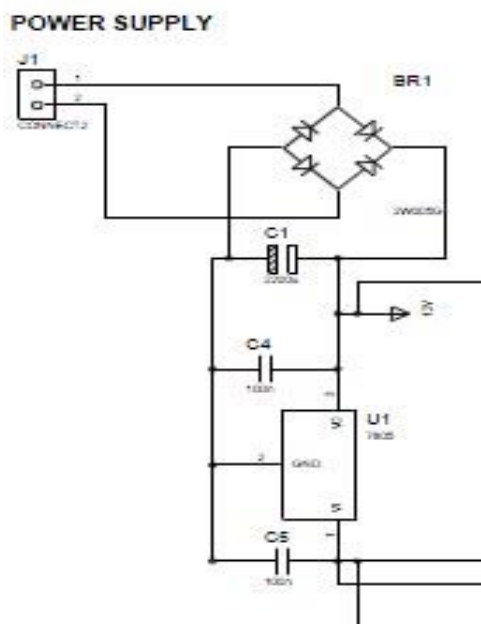


Figure 3.4: Schematic Diagram of the Power Supply Unit

Software on the PIC18F452 implements the temperature control algorithm, maintains the temperature value display, and controls the speed of the fan in response to temperature input. Figure 3.5 shows the flowchart of the process in the display system.

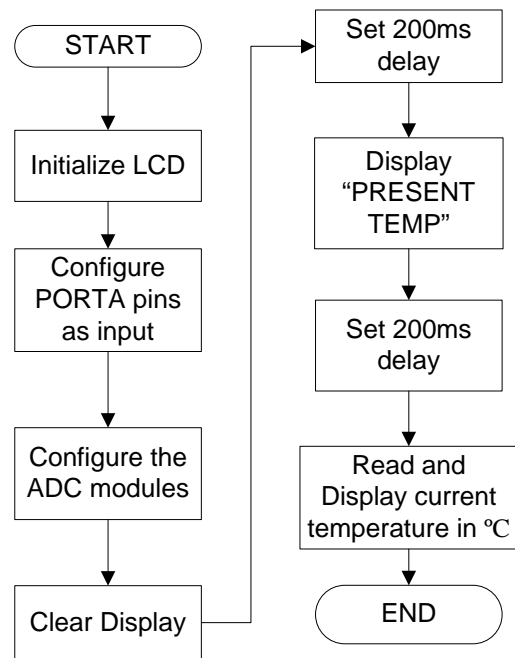


Figure 3.5: Flowchart of the display system

6 TESTING AND ANALYSIS

The hardware components were tested before being implemented on PCB, while the programming was simulated with the circuit design using PROTEUS, a virtual environment used in replicating the real life environment before implementation. The implementation and testing phase are divided into two sections which are the hardware section and the software section.

Microcontroller Application Development

Bread boarding of the peripheral hardware, development of microcontroller software, and final debugging and testing of the custom printed-circuit board for the microcontroller and peripherals all require a development environment which was simulated with PROTEUS.

Printed-Circuit Board

The layout of a simple (though definitely not trivial) printed-circuit board is another practical learning opportunity presented by this project. The final board layout, with package outlines, is shown in Figure 3.6. The relative simplicity of the circuit makes manual placement and routing practical. The layout software used was ARES package and the board was fabricated in-house.

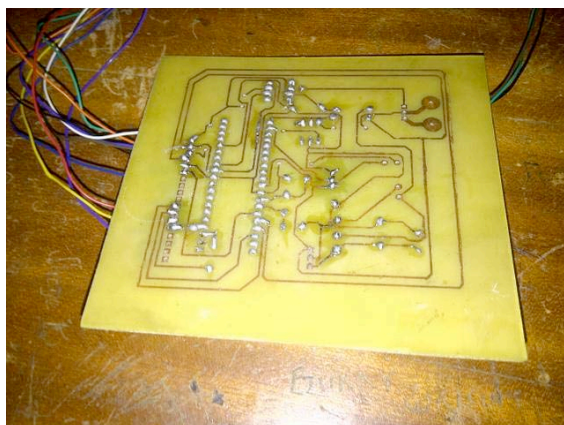


Figure 3.6: Layout for the Microcontroller Board

7 CONCLUSION

In this work, the aim has been to describe an interdisciplinary, undergraduate engineering design project: a microcontroller-based temperature control system with actual temperature display. Development of the project included the use of a microcontroller with simple peripherals, the opportunity to usefully apply introductory level modeling of physical systems and design of closed-loop controls, and the need for relatively simple experimentation (for model validation) and simulation (for detailed performance prediction). Also desirable are some of the technology related aspects of the problem including practical use of switching components and temperature sensors (requiring knowledge of PWM and calibration techniques, respectively), microcontroller selection, use of development systems, and also production of printed circuit board.

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Design and Simulation of Wave Shaping Schemes for a Virtual Data Communication and Impaired Link Environment System for Advanced ICT Education

Ali D. Odiba, Agboje O. E.

Department of Electrical and Information Engineering
Covenant University, Nigeria

Abstract - Design and Simulation of Waves Shaping Schemes for a Virtual Data Communication and Impaired Link Environment System for Advanced ICT Education is aimed at providing a simulator for the performance of digital filtering of signals for data communication experiments with the aid of MATLAB. A fundamental aspect of signal processing is filtering. Filtering involves the manipulation of the spectrum of a signal by passing or blocking certain portions of the spectrum, depending on the frequency of those portions. This work is designed to provide a flexible platform for teaching the operations of waves shaping schemes (lowpass, bandpass and highpass) modelled over an additive white Gaussian noise (AWGN) channel.

Keywords – Lowpass, Bandpass, Highpass, MATLAB.

I. INTRODUCTION

The entire Simulation and Implementation bothers on creating a software teaching tool for simulating digital communication systems. This is done to study the viability of the communication system, besides, the use of this virtual laboratory will enable Data Communication students view and understand the interplay between the different communication systems.

The idea of simulating physical systems before they are built is not new as it is a common practice in systems engineering. For example, a satellite system was simulated before it was physically built. To summarise, the purpose of a simulation laboratory is not only to test the feasibility of the different parts of the hardware implementation but also to establish the maximum performance of the system. The master simulator design which is required to test the performance of the wave shaping schemes implemented in this project

follows processes which include signal generation, Channel Coding and Decoding, Frequency - Time Domain Representation of Signals, Digital Modulation and Demodulation, Communication Channel Impairments. Below is a block diagram of the master simulator.

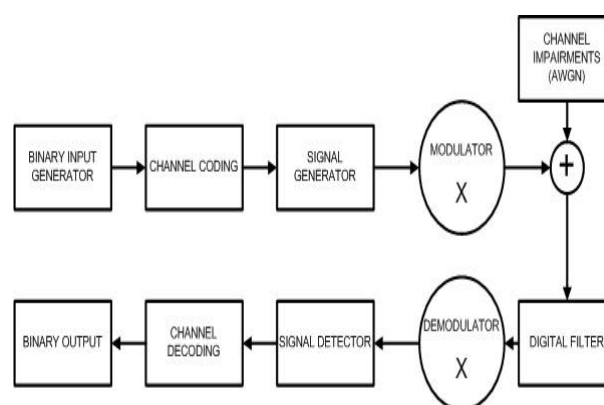


Fig 1.1 Block Diagram of the Master Simulator

Source: Computer Simulation of Digital Modems for Satellite Mobile Communications (PhD Thesis)[1]

II. DESIGN OF THE MASTER SIMULATOR

A. SIGNAL GENERATION

A signal is a function that conveys information about the behaviour or attributes of some phenomenon[2]. In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a message between observers, among other possibilities[3].

The signal to be first generated is based on the simulator user's input of a 4- bits data into the system. The program written to accept this input must be able to verify the validity of the input string and when not valid the program displays an error message requiring the user another chance to

enter a valid input. The number of trials the user is also limited to ensure system efficiency.

B. CHANNEL CODING AND DECODING

Channel coding schemes are specially designed to improve error performance of signals through communication channels. Channel coding schemes can be grouped into block codes in which specific numbers of bits are added to message bits for error detection and correction.

The Channel coding scheme used in the master simulator is the hamming encoder and decoder. this choice is based on the fact that the system is a just a test system. The encoding of the 4-bits input is computed by multiplying the input by the 7 columns of the hamming encoder G matrix as specified and stored in the program. the output of the encoder is a 7 message bits array and the addition of a check bit making 8-bits which serve as the baseband signal to be modulated before transmission over the communication channel.

C. DIGITAL MODULATION AND DEMODULATION

We modulate to increase the frequency of a signal to enable multiplexing with other signals for efficient transmission. To transmit a signal over a communication channel, a pure carrier is generated at the transmitter, the carrier is modulated with the information to be transmitted. Any reliably detectable change in signal characteristics can carry information. At the receiver the signal modifications or changes are demodulated and detected[4].

Modulation can be computed by either time domain multiplication of the baseband signal and a carrier signal or their frequency domain convolution. This project employs time domain multiplication of the signals to generate the modulated signal. Therefore the program is written to generate the a carrier signal which is sinusoidal in this case. Both the baseband and carrier signal are sampled at equal rates and then multiplied to generate the desired modulated signal.

D. FREQUENCY-TIME DOMAIN REPRESENTATION OF SIGNALS

As signals moves through the communication channel, it is important that one can view it's behaviour both in time and frequency domains. the

time domain representation of the signal is produced by a simulated oscilloscope and the frequency domain representation is computed by a Fast Fourier Transformation (FFT) of the time domain representation of the signal. The FFT computation is made easy by the used of MATLAB inbuilt function that performs the computation.

E. COMMUNICATION CHANNEL IMPAIRMENTS

With any communications system, it must be recognized that the output signal will differ from the transmitted signal due to various channel transmission impairments. For digital signals, bit errors are introduced: A binary 1 is transformed into a binary 0 and vice versa. For the master simulator, Additive White Gaussian Noise (AWGN) is added to the modulated signal to simulate the communication channel impairment. A program is written in MATLAB to generate the AWGN that is then added to the modulated signal. The process is a linear addition of wideband or white noise with a constant spectral density and a Gaussian distribution of amplitude to an input signal .

III. DESIGN OF WAVES SHAPING SCHEMES (FIR FILTERS)

A filter is a frequency selective device that removes unwanted information from the original message signal. Unwanted signals can be noise or other undesired information. Digital filters are more versatile when compared to the analog filters in their characteristics such as programming flexibility, ability to handle both low as well as high frequency signals accurately.

A finite impulse response filter of length M with input $x(n)$ and output $y(n)$ is described by the difference equation

$$y(n) = b_0x(n) + b_1x(n-1) + \dots + b_{M-1}x(n-M+1) \\ = \sum_{k=0}^{M-1} b_k x(n-k)$$

where b_k is the set of filter coefficients. The transfer function of this filter in z domain can be represented as

$$H(z) = \sum_{k=0}^{M-1} h(k) z^{-k}$$

The desired frequency response specification for linear phase filter is the Fourier transform of the

desired impulse response, and this can be represented as

$$H_d(\omega) = \sum_{n=0}^{\infty} h_d(n) e^{-j\omega n}$$

Truncation is performed by multiplying desired sample response with a window function in time domain which gives sample response of filter represented as

$$h(n) = h_d(n)w(n)$$

where $w(n)$ is the window function. The window function used in this project is the hamming window which is defined by

$$w(n) = 0.54 - 0.46 \cos \frac{2\pi n}{M-1}$$

filtering of signals can be computed either by the convolution of the time domain signal and the filter coefficients or the multiplication of the frequency domain characteristics of the signal and filter coefficients. This project employs the multiplication process. The process involves computing the desired filter coefficients, computing the FFT of the filter coefficients to get the frequency response of the filter, computing the FFT of the signal, multiplying this frequency responses and finally computing the inverse fourier transform (IFFT) of the multiplied responses to get the desired filtered signal.

A. DESIGN OF FIR LOWPASS FILTER

lowpass filters pass low-frequency signals but attenuates (reduces the amplitude of) signals with frequencies higher than the cut-off frequency. The actual amount of attenuation for each frequency depends on filter design methodology. The MATLAB function `fir1` is used to design and generate filter coefficients which is then used to filter the input signal in frequency domain. The filter designed in this project is a 63rd order filter due to the large number of sample of the input signal. A low cut- off frequency is however varied based on application

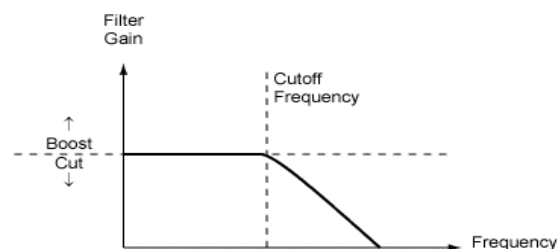


Fig 3.7 Lowpass Filter Diagram.

Source: audiomulch.com

B. DESIGN OF FIR BANDPASS FILTER

Bandpass filters pass frequencies within a certain range and attenuates frequencies outside that range. The MATLAB function `fir1` is also used to design and generate filter coefficients which is then used to filter the input signal in frequency domain. The filter designed in this project is a 63rd order filter due to the large number of sample of the input signal. Two cut- off frequencies are however specified for bandpass filters based on application to only pass this specified frequencies.

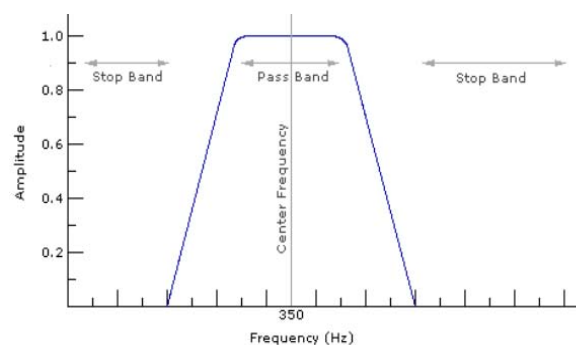


Fig 3.8 Bandpass Filter Diagram.

Source: beausievers.com

C. DESIGN OF FIR HIGHPASS FILTER

Highpass filters pass high-frequency signals but attenuates signals with frequencies lower than the cut-off frequency. They offer easy passage of a high-frequency signal and difficult passage to a low-frequency signal. The MATLAB function `fir1` is used to design and generate filter coefficients which is then used to filter the input signal in frequency domain. The filter designed in this project is a 63rd order filter due to the large number of sample of the input signal. A high cut- off frequency is however varied based on application.

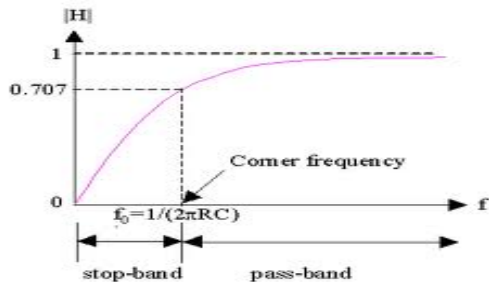


Fig 3.9 Highpass Filter Diagram
Source: cs.wright.edu

IV. DIGITAL FILTERING TESTING RESULTS

A graphical user interface (GUI) has been created for the simulator users to interact and perform experiments. A diagram of this GUI is shown in the figure below

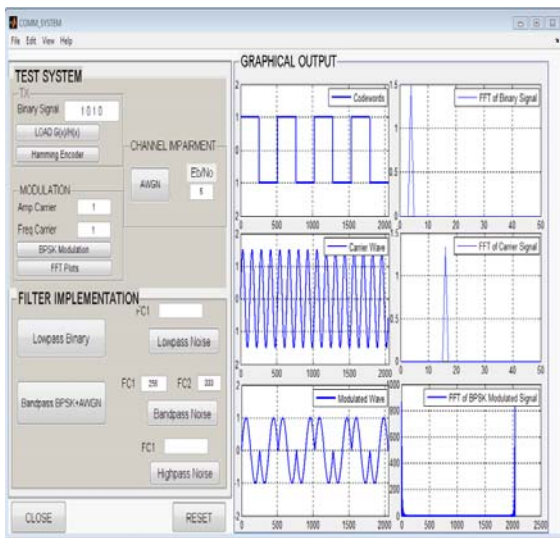


Fig 4.1 Master Simulator GUI Diagram

The generated 8-bits baseband signal, the carrier signal and the modulated signal and their spectral representations:

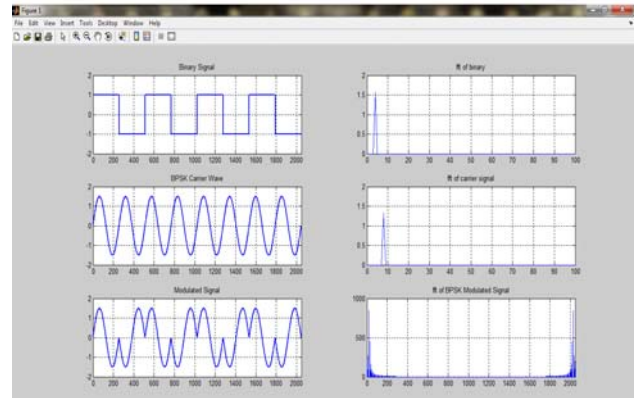


fig 4.2: 8-bits baseband signal, the carrier signal and the modulated signal and their spectrum representations.

Channel impairment (Additive White Gaussian Noise) Representations at different noise levels:

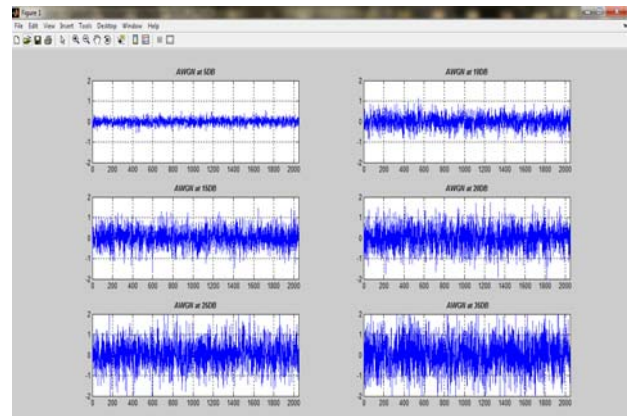


Fig 4.3 Channel impairment (Additive White Gaussian Noise) Representations

Bandpass filtered noisy BPSK modulated signal response:

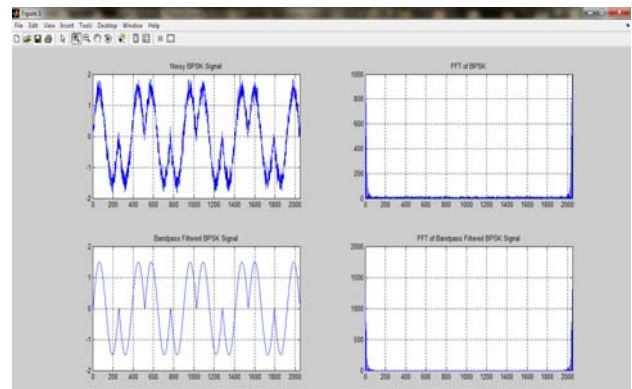


Fig 4.4 Bandpass Filtered Noisy BPSK Signal Representation

Lowpass filtered noise response:

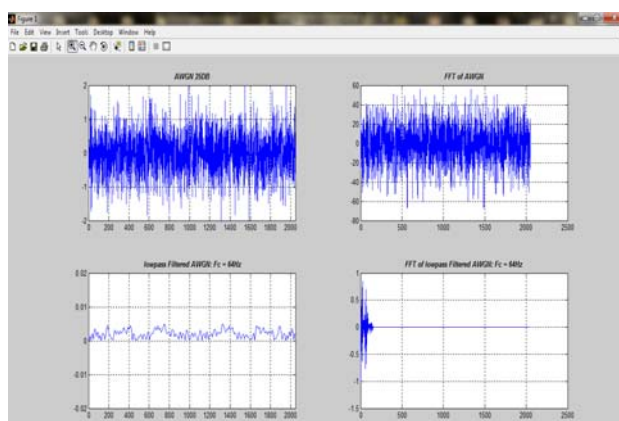


Fig 4.5 Lowpass Filtered Noise Representation

Bandpass filtered noise response at two selected cut-off frequencies:

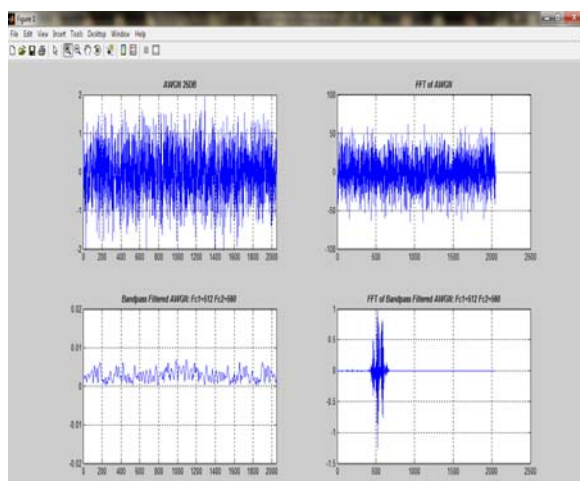


Fig 4.6 Bandpass Filtered Noise Representation

Highpass filtered noise representation:

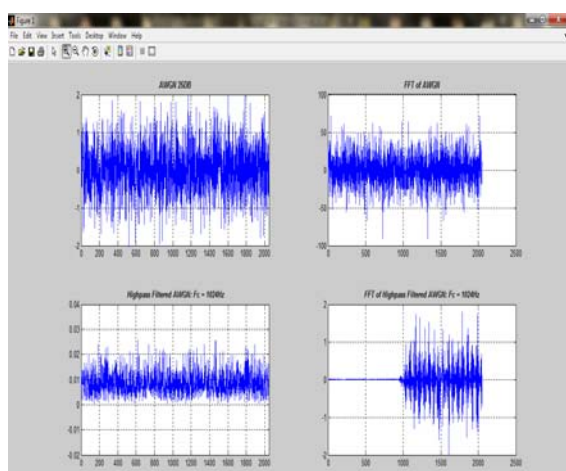


Fig 4.7 Highpass Filtered Noise Representation

V. CONCLUSION

The project design has taken into consideration the fact that digital signal processing is a field requiring a high level of precision and system accuracy if correct and acceptable results must be obtained. Utmost adherence to system specification and requirements have to be taken in the selection of software libraries, algorithms and functions used; those chosen must be thoroughly tested and peer-reviewed. This paper presents a software implementation of digital filters using MATLAB GUI in a user friendly environment. The developed software is useful for students in performing digital filters experiments. The evaluated performance using the specific theoretical filter parameters match the performance with the software. The software is working properly towards accurate results upon testing.

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Control of DC Motor's Speed Using Fuzzy Logic Controller and Luo Converter

Alfred Baghramian

Department of electrical engineering
University of Guilan
Rasht, Iran
alfred@guilan.ac.ir

Hasan Ghorbani Eshyani

Department of electrical engineering
University of Guilan
Rasht, Iran
ghorbani13891389@gmail.com

Abstract—Luo converters are new DC/DC converters in power electronic circuits. Since the power electronics systems become very complex recently, fuzzy controllers are proper for these systems. This paper discusses about design and MATLAB simulation of a Super Lift Luo converter using fuzzy Logic controller (FLC). The proposed FLC in this paper controls the speed of a DC motor.

Keywords—DC/DC Converters, Super Lift Luo Converter, State Space Modeling, Fuzzy Controller, DC Motor

I. INTRODUCTION

DC-DC converters are used to convert a DC power at one voltage level to another one. The output voltage of Pulse Width Modulation (PWM) based DC-DC converters can be varied by varying their duty cycle. These converters with several outputs are widely used in power electronic industries, computer systems, communication equipments and medical equipments. In recent years, all modern electronic systems require power supply with high reliability, high efficiency, cheap, simple, low weight with high quality and capability of easy control. Super Lift Luo converters are new series of DC/DC Converters that have very low ripple of voltage and current and have output wave with high quality, high power density and high transfer voltage gain and don't have circuit elements parasitic limits of traditional converters. Super Lift Luo converters have very high voltage transfer gains in geometric progression on stage-by-stage [1-5].

This paper uses a fuzzy controller for controlling voltage level of a Super Lift Luo with positive output in continues current mode (CCM) which is used to control the speed of a DC motor. The controller application is improved by designing of good input and output and

brain of the fuzzy controller parameters and obtained proper power and dynamic response. Traditional frequency ways for designing of controllers of DC/DC converters are based on small signal model and the validation of small signal model is limited by changes of operation point. Frequency domain methods designed controllers are depended on the system operating point, elements of system parasitic characteristics and load and line situations. The good stability of large signal model obtained only with reducing of boundary width that it is a main reason of slow dynamic response [6-8]. Two ways proposed by "Tse et al" for acquisition rapid frequency response [8]. One way is to develop a more accurate non-linear model of the converters based on which the controller is designed. Another way is artificial intelligence using people experience for making decision. Among variation techniques of artificial Intelligence, fuzzy logic is most popular for controlling of systems. An intelligent controller, with proper design, works very well even with approximate model of systems. In all DC/DC converters, the output voltage and power transfer efficiency are limited by parasitic of electronic and power electronic elements. However, in calculation, traditional converters can produce high voltage with high efficiency. Luo converters are new DC/DC converters that they are developed. These converters overcome on above limiter effects and for increasing of voltage use re-lift and triple-lift techniques. These converters produce high voltage from low voltage of photovoltaic in operation. In Luo converter with positive output, the input and output voltage are positive. Fuzzy controllers work very well for nonlinear, time variant and complex systems such as DC/DC converters and power electronics. This paper uses a fuzzy controller for Super

Lift Luo Converter for controlling of voltage level for controlling of DC motor speed. This paper simulate in MATLAB software.

II. MATHEMATICAL MODELING AND CIRCUIT ANALYSIS

The figure F.1 shows a Super Lift Luo circuit with positive output [1].

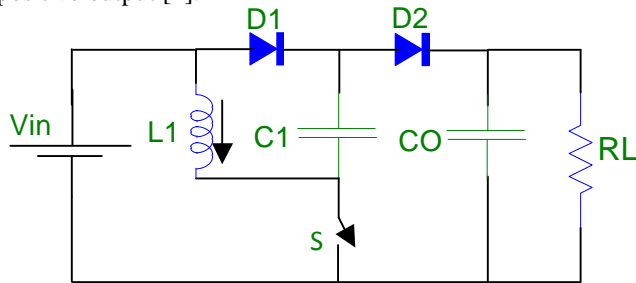


Figure 1.Super Lift Luo converter with positive output

This converter consists of Vin, capacitors Co and C1, inductor L1, power switch IGBT and freewheel diodes D1 and D2. Also, it has a voltage lift circuit (VLC). VLC consists of diode D1 and capacitor C1. The equivalent circuits are shown in figure 2.

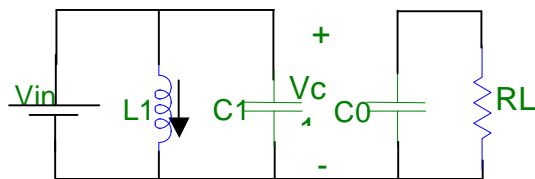


Figure 2.a.The equivalent circuit when S is ON

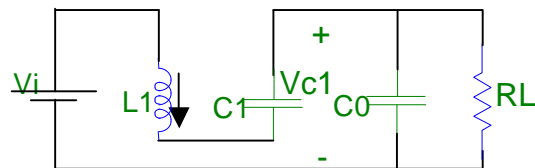


Figure 2.b.The equivalent circuit when S is OFF

To attention to equivalent circuits, when The S is ON, the voltage across of C1 (Vc1) reach to Vin rapidly. At this time, the diode D2 is OFF then its current is zero and the output current is $i_{D2} = \frac{v_o}{R}$. When switch S is OFF, according to figure 2.b, the inductor L1 current flows to the capacitor C1, diode D2 and output port. From the capacitor Co charge balance under equation:

$$\frac{1}{T} \int_0^T i_{D2} dt = I_o \text{ or } \frac{1}{T} \int_{kT}^{(k+1)T} i_{L1} dt = I_o \quad (1)$$

The current average of L1 obtains from the above equation. $i_{L1} = \frac{1}{1-K} I_o$

The voltage variation of capacitor C1 from VLC is obtained:

$$\Delta v_{C1} = \frac{1}{C_1} \int_{kT}^{(k+1)T} i_{L1} dt \rightarrow \Delta v_{C1} = \frac{v_o}{RC_1 f} \quad (2)$$

When the switch S is ON, the across voltage of inductor L1 is Vin and when the switch S is OFF then it is Vc1- Vo+Vin. The balance equation for inductor L1 follows:

$$\int_0^{kT} V_{indt} + \int_{kT}^{(k+1)T} (V_{C1} + V_{in} - V_o) dt = 0 \quad (3)$$

Replacing the integrate of vC1 in (3), considering Vc1 linearity, when the switch S is OFF, the VTG of converter in CCM is found as

$$VTG = \frac{1}{\lambda} \frac{2-k}{1-k} \quad (4)$$

(λ1 obtained from replacing above)

III. -MATHEMATICAL MODELING OF STATE DOMAIN

The v1, v2, v3 are selected as state variables that they are iL1, Vc0, Vc1 queuing. According to Figure 2.a and 2.b, when the switch S is ON, the state equations obtains from (4) and when the switch S is OFF, the state equations obtains from (5) [6].

$$\begin{cases} \dot{v}_1 = \frac{1}{L} Vin \\ \dot{v}_2 = \frac{1}{C_1 R_{in}} Vin - \frac{1}{C_1} v_1 \\ \dot{v}_3 = -\frac{1}{RC} \end{cases} \quad (5) \quad \begin{cases} \dot{v}_1 = \frac{1}{L_1} Vin + \frac{1}{L_1} v_2 - \frac{1}{L_1} v_3 \\ \dot{v}_2 = -\frac{1}{C_1} v_1 \\ \dot{v}_3 = \frac{1}{C_o} v_1 - \frac{1}{RC} \end{cases} \quad (6)$$

The state equations are in matrix as

$$\begin{bmatrix} \dot{v}_1 \\ \dot{v}_2 \\ \dot{v}_3 \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{L_1} & -\frac{1}{L_1} \\ -\frac{1}{C_1} & 0 & 0 \\ \frac{1}{C_o} & 0 & -\frac{1}{RC_o} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} + \begin{bmatrix} \frac{1}{L_1} Vin \\ 0 \\ 0 \end{bmatrix}$$

$$+ \begin{bmatrix} -\frac{1}{L_1} v_2 + \frac{1}{L_1} v_3 \\ \frac{1}{R_{in} C_1} Vin \\ -\frac{1}{C_o} v_1 \end{bmatrix} \alpha; \alpha = \begin{cases} 1; S = ON \\ 0; S = OFF \end{cases} \quad (7)$$

IV. Designing of Fuzzy Controller

The Fuzzy Logic controllers design according of only people experiences about converter dynamics, without considering converter parameters, variation or even operation points. In this way, the controller can use for controlling of another power converters only with a little change it. In this paper, we got sample from DC motor speed and according of that, the width of pulses for controlling of IGBT and output voltage, after that, the speed is controlled. The fuzzy controller block diagram for Super Lift Luo for controlling of DC motor speed is shown in figure (3). The several parameters in fuzzy logic controller for controlling of DC motor speed introduce in rest of paper.

A. INTRODUCING OF INPUTS AND OUTPUTS

In this stage, we introduce all inputs that it affects on system. The aim of paper is, the output signal reach to reference. The inputs are:

- a. The value of differences between output speed and reference signal. e
- b. The variation rate of error signal that is mentioned in a. $de = e_n - e_{n-1}$

n is number of switching of system. e and de are inputs that they are got sample. The width of pulse is output signal for controlling of IGBT (dk).

B. FUZZIFICATION

The inputs are converted to suitable linguistic values by fuzzification that it is possible to use fuzzy setting labels. The inputs domain is divided to several desired shapes for Mamdani type system. In this designed system, we consider five domains for e and de . For e and de , we obtain:

TABLE I. ERROR AND RATE OF ERROR

The speed is very higher than set point	-2
The speed is higher than set point	-1
The speed is about set point	0
The speed is very lower than set point	1
The speed is lower than set point	2
The rate of speed is very low	-2
The rate of speed is low	-1
The rate of speed is about zero	0
The rate of speed is high	1
The rate of speed is very high	2

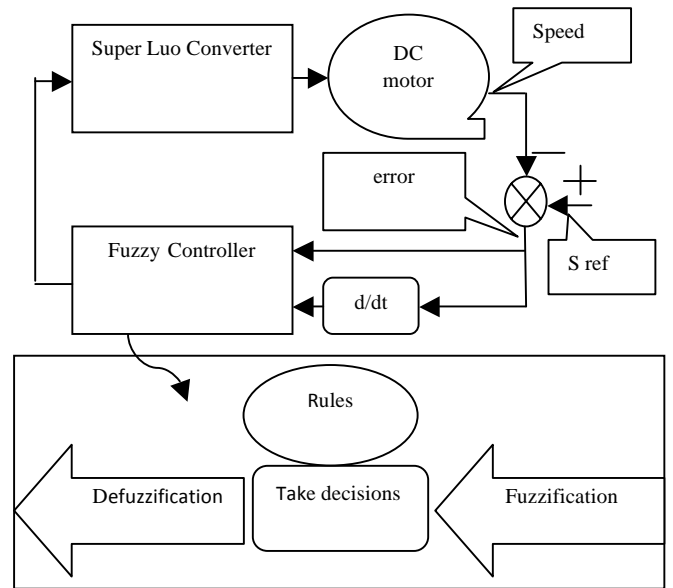


Figure 3.Fuzzy controller block diagram for controlling of DC motor speed

The fuzzy levels may be variant region by necessary accurate. In this paper, the fuzzy controller uses the triangular membership function for e and de as figure (4).

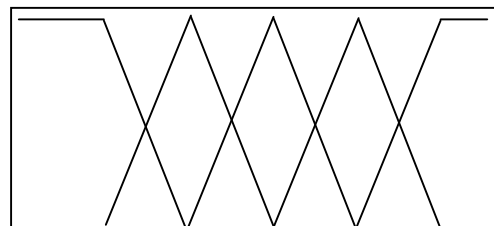


Figure 4.e and de membership functions

C. RULES TABLE

The rules connecting the inputs and the output singletons are based on the understanding of the system. Normally, the rules are created according to "ifthen....". The inputs are combined by AND operator. The rules, that uses in this paper obtained:

TABLE II. THE FUZZY CONTROLLER RULE TABLE

Duty cycle		The rate of error variants				
		-2	-1	0	1	2
The error of speed	-2	-2	-2	-2	-2	-2
	-1	-2	-2	-1	1	2
	0	-2	-1	0	1	2
	1	-2	0	1	2	2
	2	2	2	2	2	2

The inference result of each rule consists of two parts:

- 1- The compatibility (weighing factor), ω_i , of the individual rule.
- 2- Arid the degree of change of duty cycle, C_i , according to the rule.

The weighing factor ω_i is obtained by applying the min operation on the $\mu_e(e)$ and $\mu_{de}(de)$, where e and de are the singleton inputs of e and de . C_i is looked up from the rule table, which shows the mapping from the product space of e and de to C_i . The inferred singleton output of each rule can therefore be written as

$$Z_i = \min\{\mu_e(e_o), \mu_{de}(de_o)\}, C_i = \omega_i * c_i \quad (8)$$

The derivation of the fuzzy control rules is heuristic in nature and based on the following criteria:

- 1- When the DC motor speed is far from the set point, the change of duty cycle must be large so as to bring the output to the set point quickly.
- 2- When DC motor speed is approaching the set point, a small change of duty cycle is necessary.
- 3- When the DC motor speed is near the set point and is approaching it rapidly, the duty cycle must be kept constant so as to prevent overshoot.
- 4- When the set point is reached and the speed is still changing, the duty cycle must be changed a little bit to prevent the output from moving away.
- 5- When the set point is reached and the output is steady, the duty cycle remains unchanged.
- 6- When the output is above the set point the sign of the change of duty cycle must be negative and vice versa.

D. DEFUZZIFICATION

After collecting results, we must be making defuzzification. Therefore, dk is made. In this paper, we used the method of center of gravity. The duty cycle's resultant changes can be obtained:

$$Z = \delta dk = \frac{\sum_{i=1}^N Z_i}{\sum_{i=1}^N \omega_i} = \frac{\sum_{i=1}^N \omega_i C_i}{\sum_{i=1}^N \omega_i} \quad (9)$$

Where N is the maximum number of effective rules. For each sampling, ω_i is obtained using the min operation and C_i obtained using rules table. The controller output is duty cycle. It is found:

$$dk = dk-1 + \mu \delta dk \quad (10)$$

- Where δdk is the change of duty cycle. It is inferred by the fuzzy controller at the k th sampling and μ is the gain factor of the fuzzy controller.

V. SIMULATION

The circuit for simulation found in figure (5). The close loop response found figures (6-8). These responses obtained by changing of pulse width to IGBT controlling signal by fuzzy controller in MATLAB software. The speed control on nominal torque and 20 percent over torque performed very well, as it is viewed in simulation results. In figure (6), the adjusting of speed on 180rad/sec performed and the speed change viewed in figure (7), when we apply 20 percent over torque. In the figure (8), we see that the speed is controlled on 180 rad/sec, when the DC power supply reduces 20 percent. In figure (9), we show the response of system with old controller PI for comparing. As it shown, at first, the response gets an overshoot and after that, it reaches to reference speed. Also, with applying 20 percent torque, the system reaches to approximately final value with large fluctuations.

TABLE III. PARAMETERS OF TEST CIRCUIT AND MOTOR

The circuit parameters	values
Input voltage	72 volts
Output voltage	Changes about 240 volts
R11	0/15 ohms
L1	10 μ H
C1	2/5 mH
Co	800 μ F
D1	Ideal
D2	Ideal
Switching frequency	50000 HZ
K	0/05 ~ 0.98
S	Ideal
M	5 HP 240V 1750 RPM FIELD:150V Ra=0.78 Ω La=0.016H Rf=150 Ω Lf=112.5H Laf=1.234H

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THE CURRENT AND FUTURE CHALLENGES OF ELECTRICITY MARKET IN NIGERIA IN THE FACE OF DEREGULATION PROCESS

Titus Olugbenga Koledoye*¹, Abdul-Ganiyu A. Jumah¹, Phillips D. A²

¹Department of Electrical/Electronic Engineering, Yaba College of Technology, Nigeria.

²Department of Computer Engineering, Yaba College of Technology, Nigeria.

E-mail: *koledoyetitus@gmail.com, galileosp@yahoo.co.uk, olokunola@yahoo.com

* Corresponding author

ABSTRACT

Electricity is fundamental and inevitable to our daily living as it lighting our environment, powers our homes, schools, hospitals, offices, businesses, and aid industrialization, It is a known phenomena that the economic growth of a nation rides on the wheel of electricity. While telecommunication market in Nigeria has recorded advancement and stability, electricity market in Nigeria is facing mix challenges ranging from slow growth in generation capacity (generation capacity per population index), market deregulation process interference by Government, power lines and equipment vandalism, poor maintenance of existing power system and corruption. In the face of global electricity market trend which focuses on building a cleaner, more diverse and more sustainable electricity mix, secure electricity market investment system that is quality and security proven and affordable, a concerned Nigeria will want to ask "where are we?" This paper focuses on the challenges facing electricity market in Nigeria and suggests possible ways of building a sustainable electricity market in Nigeria.

KEY WORDS: Electricity Market, Mix Challenges, Global Market Trend, Economic Growth, Where Are We?

I. INTRODUCTION

Electricity market has been a sensitive arena that continually attracts global attention and forms a top agenda on the to-do menu of virtually all governments globally. The threat it poses to a country's national economic sustainability, development and appreciable growth is conspicuously visible in the way each country of the world seek and exploit various alternative energy sources of generating electricity in the most economical and environmental friendly way. In the current United States of America (USA) presidential debate, electricity generation capacity increase has been a major strategy highlighted by both contestants as the roadmap to job creation and national economic improvement. The trend of economic growth in some Middle

(UAE) and Qatar (which is taking world attention) cannot be dissociated from their electric power consumption per capita growth over the years. Likewise, Nigeria had been able to trace the collapse of the industrial sector, small and medium scale businesses and economic standstill (or backwardness) of the nation to the inadequate and erratic state of the country's electricity market – several commitment by different government of Nigeria, both financial and human capital, has been thrown behind the power sector in Nigeria with its attendance still continuous with target set.

II. NIGERIA AND ENERGY

Nigeria is considered as one of the energy rich country in the world. Nigeria is rated among the top Oil Producer in Africa, second in natural gas reserve (with an estimate of 176trillion cubic feet) and estimated 2 billion metric tonnes of coal. Nigeria is also rich in water, wind and sun energy from which appreciable electricity can be generated. With the abundance of energy resources, Nigeria need not import energy to achieve a sustainable generating capacity suffices the targeted economic growth and also has excess generation to sell to neighbouring countries.

III. NIGERIA ELECTRICITY REFORMS HISTORICAL TREND

Electricity grow from few kilowatts used to serve the colonial masters in Lagos, Nigeria in the late 19th century to the Electricity Corporation of Nigeria (ECN) established by Act of parliament in 1951. A decade later (1962), Niger Dams Authority (NDA) was set up to develop hydro electricity which was merged with ECN to form National Electric Power Authority (NEPA) in 1972.

Decline in electricity generation capacity in an ever increasing population, with no visible plan to commensurately increase generating capacity, cause electric power demand to increasingly overshoot available supply. By year 2000, the problem sent Nigeria into electricity supply crisis, which caused the Federal Executive Council (FEC) in year 2001 to approve the National Electric Power Policy (NEPP), which called for fundamental changes to ownership, control and regulation of the power sector. The 2001 NEPP actually set the roadmap for Nigeria's power sector privatization, but due to the bureaucracy in government, the policy could not be signed into

law until 2005. The signed document became the Electric Power Sector Reform Act Of 2005.

The ESPR Act 2005 translated NEPA into the newly incorporated Power Holding Company of Nigeria (PHCN) Plc – comprising of 18 separate successor companies that took over the assets, liabilities and employees of NEPA, and responsible for the generation (6 companies), transmission (a company) and distribution (11 companies).

The PHCN's incorporated successors in the unbundling process are given in Table 1.

Table 1: PHCN Plc Successor Companies

Generating Company (Genco)	Transmission Company (Transco)	Distribution Company (Disco)
<ul style="list-style-type: none"> * Kainji Power Plc * Shiroro Power Plc * Ughelli Power Plc * Sapele Power Plc * Afam Power Plc * Geregu Power Plc 	<ul style="list-style-type: none"> * Transmission Company of Nigeria; 	<ul style="list-style-type: none"> * Eko Electricity Distribution Co. Plc * Ikeja Electricity Distribution Co. Plc * Ibadan Electricity Distribution Co. Plc * Benin Electricity Distribution Co. Plc * Abuja Electricity Distribution Co. Plc * Port Harcourt Elect. Distrib. Co. Plc * Enugu Electricity Distribution Co. Plc * Kaduna Electricity Distribution Co. Plc * Kano Electricity Distribution Co. Plc * Jos Electricity Distribution Co. Plc * Yola Electricity Distribution Co. Plc

The problems or challenges which birth the reforms as highlighted by the government are as follows;

- a. Limited access to infrastructure,
- b. Inadequate power generating capacity
- c. Inefficient usage capacity
- d. Lack of capital for investment
- e. Ineffective regulation
- f. High technical losses and vandalism
- g. Insufficient transmission and distribution facilities.
- h. Inefficient use of electricity by consumers
- i. Inappropriate industries and market structure
- j. Unclear description of roles and responsibilities. [C]

With the problems identified, the Reform Bill sought solution through achieving the following five (5) objectives;

- a. Unbundled NEPA through 18 separate successor companies incorporated in PHCN.
- b. Privatized the unbundled entities
- c. Established a regulatory Agency (The new Nigerian Electricity Regulating Commission (NERC)).
- d. Established a rural electrification agency and fund (the same infested with corruption to the tune of N52billion causing its suspension between 2006 and 2009)
- e. Established Electric Power Consumer Assistance Fund.

IV. THE CURRENT CHALLENGES IN THE ON-GOING ELECTRICITY MARKET REFORM PROCESS

To confront the problems identified by the Government, decision to embark on increasing generation capacity and, subsequently, expansion of the transmission and distribution lines become key issues as shown in Table 2.

TABLE 2: PRESENT AND FUTURE ELECTRICITY GENERATION INFRASTRATURE PLAN IN NIGERIA

S/N	GENERATING STATION	STATE	TYPE	INSTALLED CAPACITY (MW)	STATUS	TOTAL (MW)
1.	Egbin	Lagos	Thermal	1320	Existing	
2.	Delta	Delta	“	912	“	
3.	Sapele	Delta	“	1020	“	
4.	Geregu	Kogi	“	434	“	
5.	Omotosho	Ondo	“	335	“	
6.	Olorunshogo	Ogun	“	335	“	
7.	Afam	Rivers	“	726	“	
1-7	Total Capacity of Thermal Station for Divestiture					5,062
8.	Ijora	Lagos	Thermal	40	Existing	
9.	Orji	Rivers	“	20	“	
10.	Alaoji	Abia	“	961	IPP	
11.	Omoku	Rivers	“	230	“	
12.	Rain/Ube	Bayelsa	“	225	“	
13.	Sapele	Delta	“	451	“	
14.	Eyaen	Edo	“	451	“	
15.	Egema	Imo	“	338	“	
16.	Calabar	C/Rivers	“	563	“	
17.	AES	Lagos	“	300	“	
18.	Okpai (AGIP)	Delta	“	480	“	
19.	Obajana	Kogi	“	350	“	
20.	Omoku	Rivers	“	150	New IPP	
21.	Ibom Power	Akwa Ibom	“	190	IPP	
22.	Ethiope Energy Ltd		“	2800	New IPP	
23.	Farm Electric Power Supply		“	150	“	
24.	ICS Power		“	624	“	
25.	Supertek Ltd		“	1000	“	
26.	Mabon Ltd		“	39	“	
27.	Geometric Ltd		“	140	“	
28.	Western Tech & Energy Ltd		“	1000	“	
29.	Anita Enegy Ltd		“	136	New IPP	
30.	Lotus & Bressour Nig Ltd		“	60	“ “	
31.	First Independent Power Co. Ltd (Eleme)		“	95	IPP	
32.	First Ind. Power Co. (Trans Amadi)		“	136	New IPP	
33.	First Ind. Power Co. (Omoku)		“	340	“ “	
34.	Hudson Power Station Ltd		“	200	“ “	
35.	Ibafo Power Station		“	640	“ “	
36.	Shell Petroleum Dev. Co. Ltd		“	624	IPP	
37.	Agbara Shoreline		“	1800	New IPP	
38.	Index Power Thermal Ltd		“	1800	“ “	
39.	Shell Dist. Co. Ltd		“	100	“ “	
40.	Olorunshogo Phase 2	Ogun	“	676	New IPP	
41.	Omotosho Phase 2	Ondo	“	451	“ “	
1-41	Total Installed Capacity of Thermal Generating Station					22 171

43.	Jebba	“	“	578	“	
44.	Shiroro	“	“	600	“	
45.	Mambilla	Taraba	“	2600	Planned	
46.	Zungeru	Niger	“	950	“	
42-46	Total Installed Capacity of Hydro generating station					5,488
Current total of present and future Electricity generation infrastructure plan in Nigeria						27,659MW

Seeing the infrastructure plan for Electricity generation in table 2, it looks like government is taking bold steps towards confronting the epileptic electricity challenges of the past two and a half

decade. Even in August 2010, the government drew a “Roadmap for Power Sector Reform” in which target set for increase in capacity of each sub-sector of the electricity market are represented in table 3.

Table 3: Targeted increase in Generation, Transmission and Distribution Capacity

Time	Available Generation Capacity (MW)	Transmission Capacity (MW)		Distribution Capacity (MW)
		330 KV lines	132 KV lines	
July 2010	4612	5155	6677	5758
December 2010	5379	5515	7328	6334
April, 2011	7033	5995	7328	6900
December, 2011	9769	6555	7488	7485
December, 2012	11879	7866	8986	8061
December, 2013	14218	8653	9885	9059

Source: Roadmap for Power Sector Reform – Presidency, August 2010

With all these plans and targets with huge investment disbursed to achieve these, it is just right to ask

* “where are we” in this power sector reform journey?

* Are we getting it right?

* Is the vision 20:2020 which largely depend on the power sector reform visible as we draw close to 2020?

These are just few needed questions to ask amongst many, and answers to them depend on each individual paradigm view.

It is a general knowledge, based on figures, that the figures in table 3 to date are far above the achieved actual figures. The challenges currently include;

- * Slow growth in generation capacity.
- * Market deregulation process delay and interference by Government.

- * Power lines and equipment vandalisation.
- * Poor maintenance of existing power system.
- * Corruption.

A. Slow Growth in Generation Capacity

Since year 2000, awareness of improving the electric power sector as pivot for economic growth in Nigeria, and consequence steps taken (such as huge investment committed to make more recovery from existing plant capacities and increase generation through IPPs, and the birth of Reform Act of 2005) to achieve this by various government, there has been slow or no growth in generation capacity. (Even the table 3 set up by Government confirms this). Table 4, showing the average generation capacity over the years the awareness became prominent is a clear indicator to slow growth generation capacity.

Table 4: Electricity Generation Capacity in Nigeria

Year	Total Generation Capacity (GWh)	Average Generation Capacity (MW)	Per Capita consumption (kW)
1999	16,089	1837	0.151
2000	14,727	1681	0.134
2001	15,463	1765	0.138
2002	21,544	2459	0.178
2003	20,183	2304	0.172
2004	24,275	2771	0.201
2005	23,539	2687	0.187
2006	23,110	2638	0.178
2007	22,978	2623	0.177

2009	18,817	2148	0.139
2010	24,872	2839	0.179
2011	23,652	2700	0.167
2012(Oct.)	-	4100	-

Source: World Bank (Energy Information Administration), (www.eia.doe.gov/emeu/iea)

August, 2010 was historical in Nigeria power generation capacity which reached 3,800MW from the previous 2,800MW at the onset of the present administration, but the success was cut short by the crash of the transmission infrastructure as it could not wheel that quantum of power [a].

5000MW from IPPs lunched in 2005 by the Federal Government was to add nearly 5000MW to the generation capacity by 2008 [b]. This dream is yet to be realized as at 2012. Even the per capita consumption, as shown in Table

4, is among the least in the world and very far from the 1kW set standard.

Several observations and comments by experienced observers see the cause of slow growth in generation to be due to transmission and distribution infrastructure problems, corruption, lingering dispute between the Federal Government and Power Sector workers and bureaucratic approach of government.

B. Market Deregulation Process Delay and interference by Government

This is clearly visible from the government approach to matter related to the process and the recent outcome of the generation plants bidding as commented below;

- * The National Electric Power Policy (NEPP) for power sector privatization in Nigeria, which called for changes to ownership, control and regulation of power sector, was approved by the Executive arm of Government in year 2000, but due to delay within the arms of Government, the policy was not signed into law until 2005.
- * Multiple Committee and Task Force set up by government create bureaucratic delay in process. Government set up "Presidential" Action Committee on Power (PACP) with a view to eliminating red tape and the often over-bureaucratic and inefficient nature of decision-making in government. The same government set up "Presidential" Task Force (PTF) on power saying it will be the engine room that drives the PACP vision. The two groups are "Presidential" set on the same task – what kind of bureaucratic nature in decision-making is taken care of by the government other than increasing administrative costs, time delay process and conflict of superiority by the two bodies?
- * On creation of Rural Electrification Agency (REA) aside the 11 distribution companies (DISCOs) in the power sector unbundling

"We have DISCOs who are also mandated by the law to ensure that electricity reaches the rural parts of the country. This is not right when you look at the bureaucracy it will create, the cost implications and the propensity for corruption". [f]

- * Lagos Chamber of Commerce and Industry in a recent forum states:
"It is heartrending that the choice of locations of many of the Independent Power Projects (IPPs) was informed more by politics than the economics of power generation. Access to a major input in power generation, which is gas, was not sufficiently taken into account. This reality has badly affected the cost profile of the IPPs".
- * Just before the outcome of the generation company bidding, the MD/CEO of Power System, a game player in the reform process, in a Channels Televisions interview said;
"The privatization process is not transparent enough... Gas pipelines are yet to be available to some of the recent IPPs commissioned."

C. Power Lines and Equipment vandalism

Vandalization, especially of the transmission infrastructures and underground cables around the distribution network has been a common occurrence, even before the on-going reforms. Most times, the vandalism is blamed on the power brokers behind power Generators importers.

Recently, the Contractor handling the Olorunshogo IPP Plant in a nationwide broadcast expressed his ordeals in the hands of the Vandals, despite all the financial settlement made to the chiefs and settlers of the Plants environment to ensure security of infrastructures. The news captured the transmission lines and equipment terribly vandalized. The vandalization is one of the current challenges that will likely translate into future in the reformation process, as vandalization has been a way of forcing government and multinational with business stake to a roundtable settlement.

D. Poor Maintenance of Existing Power System

Over the years of electricity infrastructures in Nigeria, the poor maintenance has been one of the major causes of epileptic nature of power supply, even when generation capacity rises, its utilization is limited by the malfunctioning of the transmission and

maintenance carried out by the power sector workers is fault clearing one while scheduled maintenance for healthy function and life extension of such infrastructure is non-existence.

I recall an experience as a Electrical Engineer in charge of utilities in a multinational manufacturing company with a dedicated private gas turbine generator, the PHCN (then known as NEPA) was contacted to give the company a dedicated supply for the period our gas turbine will be overhauled (a kind of periodic maintenance exercise). The result was a nuisance tripping within every 15 to 25 minutes of supply. This left us with no choice than to fall on diesel generating plant for the period of maintenance, a decision that caused many employees their jobs at the end of the financial year (because of the cost incurred on diesel).

E. Corruption

The menace of corruption in this nation has set the nation backward among her contemporaries. Corruption is an ubiquitous that has ravaged every sector of the economy in Nigeria, including the power sector. Reform is not spared from its venom. The following corruptions in the power sector make national news.

- * The power sector corruption scam to the tune of Sixteen (16) Billion Naira during Obasanjo's government died with no visible prosecution and recovery of loots.
- * Rural Electrification Agency (REA) formed through the Power Sector Reform Agenda in 2006 was suspended in 2009 due to an alleged ₦5.2 billion fraud involving top management of REA, the officials of the Ministry of Power and some members of National Assembly [a]
- * The puzzle surrounding the ₦88 billion PHCN workers pension fund accrued from the 7.5% deductions from workers salary that is causing distortion in the reform process is a worrisome saga.
- * For 2 decades, the Federal Government claimed to be spending an average of \$2 billion annually to sustain the power sector with an average generation capacity stuck at 2000MW over the period [b]. If such amount as \$40 billion was truly committed to the State-owned power sector over the two decades, there should be a definite growth in the Sector, if truly the current set of \$3.5billion investment per year for the next 10 years would raise the generation capacity to 40,000MW, as projected in the reform agenda.
- * Among the alleged corruption against Prof. Barth Nnaji (past Minister of Power) includes the collection of ₦395 million from PHCN (allegedly for the media for 3 months), collection of ₦280 million from PHCN (allegedly for the Nigerian Army), collection of ₦200 million from PHCN for an unknown

million from PHCN for a bullet-proof car, etc [g]

All these are indications of entrenched corruption mix among arms of Government and top power brokers.

V. THE FUTURE CHALLENGES OF THE ELECTRICITY REFORM PROCESS

The future challenges that will confront Electricity Reform process in Nigeria, being what it is now, will include;

- * Keeping pace with the world clean energy campaign.
- * Meeting up with the world Electricity market current pursuit, which focuses on economy of generation at affordable price and power generation mix trend.
- * Gas availability due to IPP stations remote locations and vulnerability to vandals in such remote locations and distance to gas source of such stations will cause.
- * Securing of gas infrastructures.
- * Adequacy of investment in gas infrastructures
- * Security and adequacy of the transmission lines,
- * Inherent labour issues.
- * Risk of investment in the sector.
- * Revenue recovery of the power consumed.
- * Finally, achieving the 1kW per capita generation accepted power consumption standard rate..

VI. POSSIBLE WAYS OF BUILDING A SUSTAINABLE ELECTRICITY MARKET

The following discussion among others will contribute to building a sustainable Electricity Market in Nigeria.

- * An industrial favourable tariff system like that of South Africa, the industries being a bulk power purchase.
- * Honesty in tackling corruption.
- * Government investment at any level of play in the Electricity Market should not be based on politics or quota system but strictly on integrity, competence and professionalism. A complete de-politicises and de-quotalise electricity market system to harness best result possible.
- * Encourage foreign participation based on experience, financial capacity and performance record.
- * Reduce the number of thermal generating plants locations and increase their generating capacity to avoid the complexity of gas pipeline network,

reduce risk of vandal and achieve cost savings.

- * Set up an effective environmental Agency for carbon emission control.
- * Set up team from relevant ministries to continuously work on building sustainable electricity market in Nigeria that is favourable to the Nation's economic growth.

VII. CONCLUSION

To achieve a sustainable Electricity Market that will ensure national economic growth target towards vision 20:2020, all hands must be on deck by monitoring the Power Reform process, criticize, encourage and praise where necessary rather than folding arms and calling it a government thing.

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Discovering Linear Restraint for Software Validation

Jude Peter Eyo

Rose Izevbizua

Department of Computer Science, Info. Tech. & Mathematics
Igbinedion University

ABSTRACT

Software is constantly being validated on test techniques which consist in enumerative execution of the application a high number of times. It is not realistic to achieve 100% coverage hence the possibility of runtime error occurrence is inevitable, however the software is considered to be validated.

Software validation needs techniques of program analysis; several techniques had been proposed which includes Flow-base, Semantic-based, Inference-based, Abstract interpretation and Random testing; each of these techniques has its own advantages and disadvantages.

This research work combines different techniques with a view of using their respective best quality to extract the linear restraint among variables in a source program. The restraints can be used for validation of software before the actual execution of the software.

In this research, we reason about abstraction and discover all the restraint in the source program.

The work uses Widening and Affine operations for loop and non-deterministic execution of conditionals respectively.

Keywords: Linear restraints; Program analysis; Affine arithmetic; Widening

INTRODUCTION

The purpose of this research is to provide a model for discovering linear restraint among program variable; the discovered restraint can be used to validate software thereby producing a run-time error-free software.

In discovering restraint, a crucial analysis of the program is essential. The field of program analysis is concerned with algorithm that computes information about dynamic behavior of programs by a static analysis. A complete program analysis comprises of intra-procedural analysis and inter-procedural analysis.

Intra-procedural analysis treats bodies of single procedures (or methods) in isolation; inter-procedural analysis can be context-insensitive or context-sensitive. Context-insensitivity assumes conservatively that a procedure, say $A(\text{caller})$, having a set of call sites (A_S) defined as $A_S = \{ a_1, a_2, \dots, a_n \}$ can call a procedure $B(\text{callee})$ from a_2 and procedure B on completion of its task (or otherwise) can return to $a_m \ni a_m \in A_S$, this limits the quality of the computed information thereby producing a weak information about a context of the procedure which may affect the other context. The context-sensitive inter-procedural analysis mirrors the actual call/return behavior of programs thus its program path is said to be feasible (Muller-Olm and Seidl, 2004). An analysis is precise (with respect to a given class of program) if it computes for every program point say τ of a program all valid relations of the given form which are valid along every feasible program path

Parameters which can be used to construct a program analysis includes Completeness, Computational complexity, Simplicity and Soundness.

The completeness of an analysis is a measure of how precise the analysis is, if some property holds of some program, then can the analysis reason about it? Any sound and complete program analysis is undecidable (**Landi, 1992**) cited in **Gulwani and Necula(2005)**, thus there is a class of programs that the analysis can not precisely reason about thereby reporting false positive. In an attempt to increase the precision of an analysis, the trade-off is that of increased computational complexity (or running time) of the analysis. The simplicity of an analysis is another factor important in the design of an analysis in terms of its description or its implementation.

BACKGROUND

This research attempts to discover relations not stated explicitly by discovering the linear assertions that can be deduced from the semantics of the program. Several approaches have been proposed and used by different researcher to achieve this purpose. Each approach has its limitations; this work has combined different approaches and done some adjustment to existing approaches to achieve the desired result.

In discovering linear restraint among variables of a program, linear equality and linear inequality (the former being a special case of the latter) is discovered.

“A certain number of classical data flow analysis techniques are included in (or generalized by) the determination of linear equality relations among program variables. For example, constant propagation can be understood as the discovery of very simple linear equality relations among variables (such as $x = 1, y = 5$). However, the resolution of the more general issue of determining linear equality relations among variables allows the discovery of symbolic constants such as $x = N, y = 5 * N + 1$ ”(Cousot and Halbwachs, 1978. p. 84).

Similarly, common sub-expressions can be recognized which are not formally identical but are semantically equivalent because of the relationships among variables. Furthermore, loop invariant computations as well as loop induction variables (modified inside the loop by the same loop invariant quantity) can be determined on non-syntactic basis.

The main use of the inequality relationship is to determine at compile time whether the value of an expression is within a specific numeric or symbolic sub-range of the integers or real numbers such as compile time overflow, integer sub-range and array bound checking. **Cousot and Halbwachs(1978)** gave an example of discovering linear restraint to determine if array access are correct.

PROPOSED MODEL

The proposed model is a combination of three complementary techniques of program analysis; the flow-based technique, semantic-based technique and the random testing technique. The idea behind the combination of these techniques is to retain the strengths of the various techniques within one technique. The soundness produced by the flow-based and semantic technique is combined with the simplicity and efficiency of the random testing technique. However, the resulting soundness is not 100% but can be made to be close to 100% by controlling various parameters.

We illustrate the model with **figure 1**, which is similar to the work of Gulvana and Necular 2003. In the analysis of the program depicted by the flow chart in figure 1, the value of the variable i is obtained uniformly at random. The node labeled Π_9 is undefined (\perp) at the start of the program (it is a loop junction node), it becomes defined only after the first iteration of the loop.

The first active/defined node is the non-deterministic test node which we labeled Π_1 , our interpreter executes both the True and False (Π_2, Π_3) path in parallel and produces an output result which is an affine join of the two path. This result is the value of Π_4 and the weight used for the affine operation is chosen at random such that the value of the weight must not be 0 or 1, this restriction compels our interpreter to produce a result that reflects both paths executed in parallel.

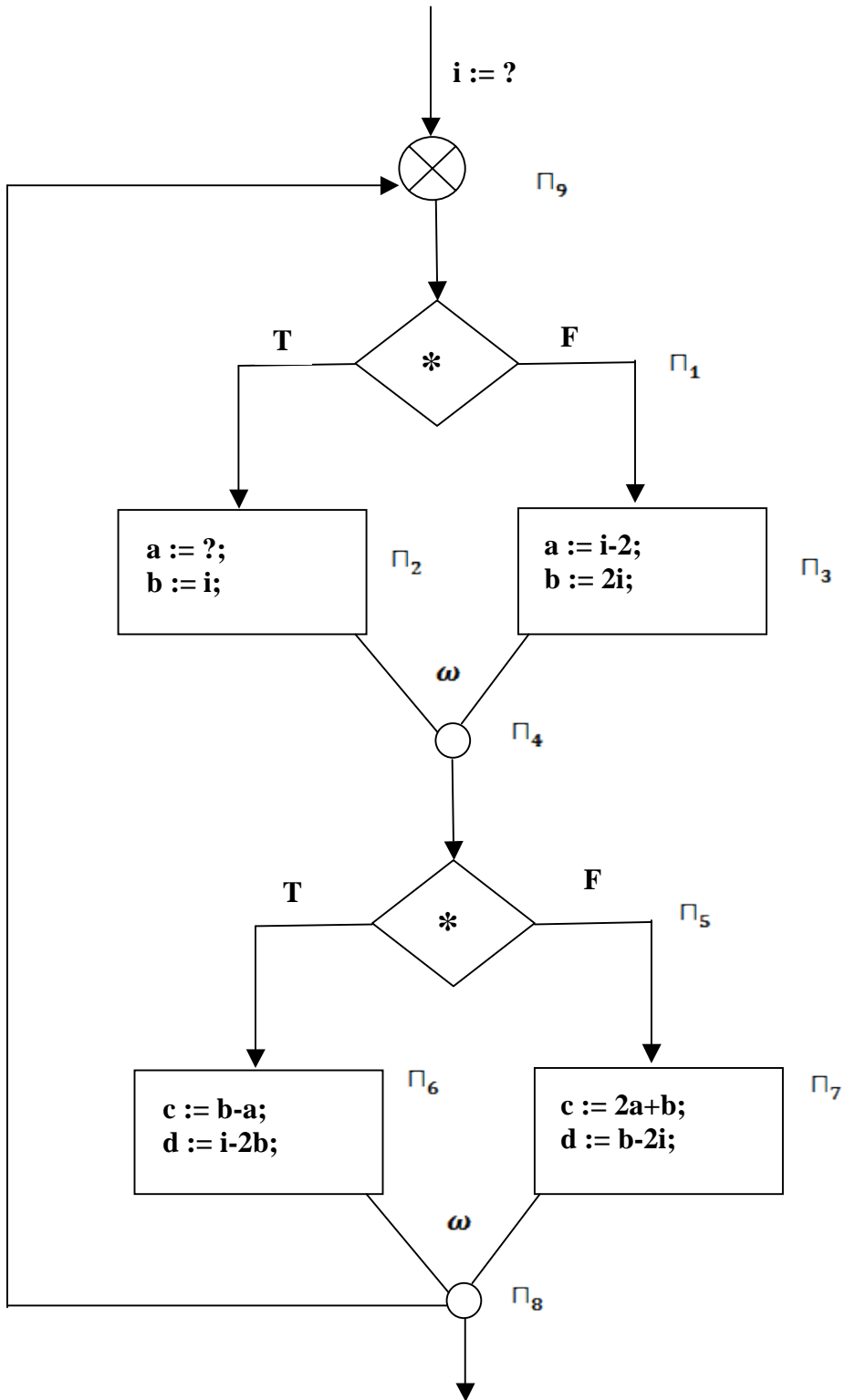


Figure 1: A diagrammatic view of the proposed model.

When the interpreter gets to Π_5 , again it executes both path of the test node as it did in Π_1 . The affine join operation of Π_6 and Π_7 gives the value of Π_8 which marks the end of an iteration.

The interpreter now uses a widening operator to deal with the loop junction, so the values at Π_9 will be an affine join of the immediate value of Π_8 and the value of i which was gotten randomly.

The above process continues until the loop terminates before it moves to any node after Π_8 or terminates as the case may be.

The interpreter uses two operations to achieve its functionality, the ***Affine Join*** operation and ***Widening*** operations.

OPERATIONS

AFFINE JOIN OPERATION

Whenever the probabilistic interpreter reaches a test node, it executes both the true and false branches, thus when it reaches a join point, there are two program states (figure 2) $\varphi_1 = \{(v, [l_1, u_1])\}$ and $\varphi_2 = \{(v, [l_2, u_2])\}$ each coming from either side of the join point, the random interpreter uses the affine join operation to combine the two state together and produce a single state with the context φ such that $\varphi = \{(\omega * (v, [l_1, u_1]) \cup ((1 - \omega) * (v, [l_2, u_2])))\}$ with the properties of the two component state. The state φ is achieved by computing the weighted average of the φ_1 and φ_2 using the weight ω and $1 - \omega$ respectively. However, the weight is not strictly random, the interpreter should not have a value of 0 or 1 because such value will not reflect the parallel execution of both φ_1 and φ_2 .

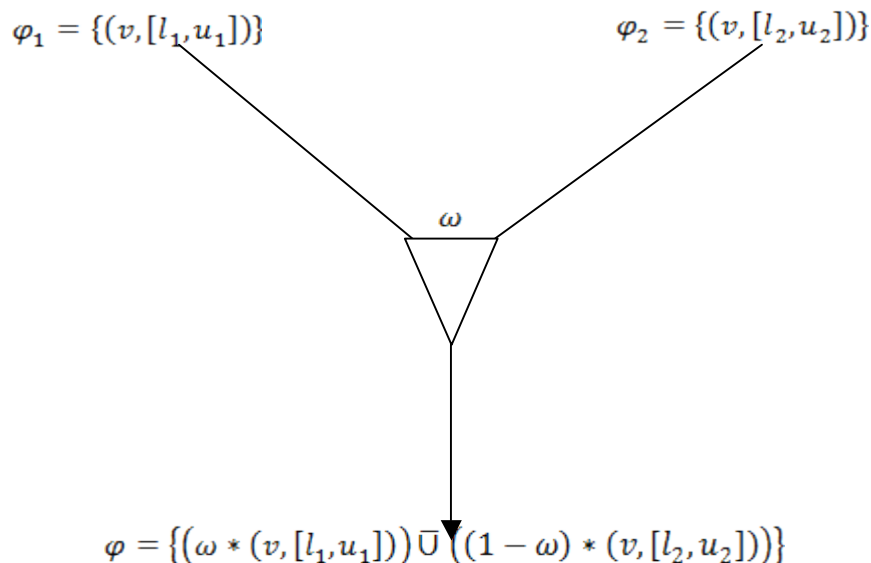


Figure 2: A simple junction node showing context

State φ satisfies two properties:

- (i) φ satisfies all linear restraint that are satisfied by φ_1 and φ_2 .
- (ii) Given any linear restraint that is not satisfied by at least φ_1 or φ_2 , φ will also not satisfy the restraint.

Geometrically, a program state of n variables correspond to a point in n –dimensional space. The affine join of such points $\varphi_1, \varphi_2, \dots, \varphi_n$ correspond to drawing a line between those points and choosing a point φ randomly on that line; the two properties above can be explained geometrically using figure 3 as:

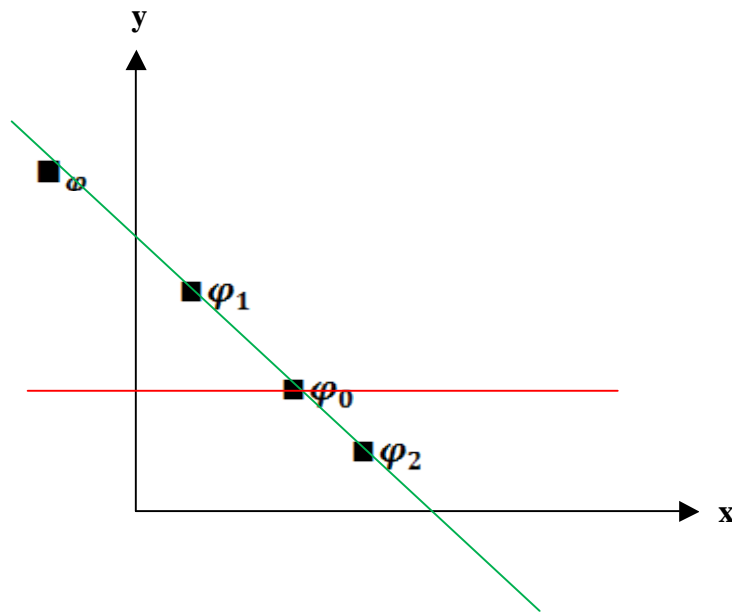


Figure 3: A geometric interpretation of the affine join operation.

- (i) Any linear restraint that is satisfied by both φ_1 and φ_2 can be represented by a hyperplane that passes through both φ_1 and φ_2 and also through the line joining φ_1 and φ_2 . Since φ lies on same line, then the hyperplane also passes through φ and thus φ also satisfies the corresponding linear restraint that the hyperplane represents.
- (ii) Any linear restraint that is not satisfied by at least one of the points φ_1 and φ_2 is represented geometrically by a hyperplane that does not pass through at least one of φ_1 or φ_2 , and thus also does not contain the line joining φ_1 and φ_2 . The hyperplane intersect the line joining φ_1 and φ_2 in at most one point say φ_0 . The probability that φ satisfies this restraint is same as the probability that the point φ_0 is chosen during the process of picking the point randomly, this probability is extremely small because there are so many points on the line.

WIDENING OPERATION

The widening operator is used to implement looping in the interpretation of the program. Details of how the widening operator functions is contained in our earlier discussion titled “ Proposed model”. We present below, a loop junction node showing context.

If the j^{th} pass on a loop junction node (figure 4) has associated the context S_j to the output arc α of that node (or S_0 has been initialized to the null context), then the context associated to α on the $(j+1)^{th}$ pass will be:

$$S_{j+1} = S_j \bar{\bar{V}} \left(\bigcup_{i \in [1,m]} C_{i,j+1} \right)$$

$$C_{(1,j+1)} = C_{(0,j)}$$

$$C_{(2,j+1)} = \{(v, [a_2, b_2])\}$$

ω_{j+1}



$$C_{(0,j)} = \{(\omega_j * (v, [a_1, b_1])) \cup ((1 - \omega_j) * (v, [a_2, b_2]))\}$$

-
-
-
-
-

$$C_{(0,j+1=m)} = \{(\omega_{j+1} * C_{(0,j)}) \cup ((1 - \omega_{j+1}) * (v, [a_2, b_2]))\}$$

\exists for $j = 1..m, \omega_j \neq \omega_{j+1}$

And

$$C_{(2,j)} = C_{(2,j+1)} \dots C_{(2,m)} = (v, [a_2, b_2])$$

RESULTS

The proposed model is able to discover both intentional and extensional properties with high probability. It is simple and efficient. It is capable of discovering every linear restraint in the source code.

COMPARISON OF OUR MODEL WITH OTHER MODELS

Table 1: A Comparison of some Models of Analysis with our proposed model

	Flow Based	Semantic Based	Inference Based	Random Testing	Abstract Interpretation	Proposed model
Main Focus	<i>Intensional properties</i>	<i>Extensional properties</i>		<i>To find bugs in programs</i>	<i>Intensional and Extensional properties</i>	<i>Intensional and Extensional properties</i>
Implementation	<i>Efficient</i>	<i>Computationally too costly</i>	<i>Uses logical formular to denote semantic entities</i>	<i>Simple and efficient</i>	<i>Calculates analysis rather than specify them</i>	<i>Simple and efficient. Calculautes rather than specify</i>
Basis of technique	<i>NA</i>	<i>Domain Theory</i>	<i>Hindley Milner Type Inference</i>	<i>Randomization</i>	<i>Low-level notion of operational semantics</i>	<i>Randomization and Low-level notion of operational semantics</i>
Fixed Point Computation	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>Widening</i>	<i>Widening</i>

The research is able to discover restraints among program variables. We are able to discover both intentional and extensional properties which are useful to:

- i. Determine at compile time whether the value for an expression is within a specific numeric or symbolic sub-range and array bound checking.
- ii. Identify several loop invariant and loop induction variables.

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Active Inductor and Capacitor for DCS receiver band (1.71GHz – 1.785GHz) using multi-MESFET Negative Resistance Circuit

Ndujiuba C.U; John S. N
Covenant University, Dept. of Electrical and
Information Engineering, Ota, Nigeria.

E-mail:

charles.ndujiuba@covenantuniversity.edu.ng,
samuel.john@covenantuniversity.edu.ng

Abstract: Traditional spiral inductors are usually large, bulky, and difficult to model, hence active inductors look very attractive particularly because of their tuning capability. The basic idea of this design is to realize an active inductor and capacitor that could be used to substitute the spiral inductors and lumped capacitors in Monolithic Microwave Integrated Circuit (MMIC) active filters. The resulting negative resistance serves to compensate the pass-band insertion loss. The benefits of reduced cost, small size and weight justify the effort to develop fully integrated Radio Frequency (RF) and Microwave systems using MMIC technology. In line with this interest, this work will lay a key foundation on which the step toward full integration can be made. For proof of concept, a 5GHz active capacitor using single MESFET negative resistance was designed, simulated and fabricated by GEC F20 Foundry. The test and measurement was done using HP8510 Network Analyzer. The simulated and measured results compared well. Following on this concept, an active inductor for dcs receiver band (1.71GHz – 1.785GHz) using multi-MESFET negative resistance circuit was designed and simulated. The results obtained show constant inductor and negative resistance values within the desired frequency band.

Introduction: It is appropriate to describe negative resistance as a source of electrical energy as against a positive resistance which absorbs (sinks) electrical energy. The Tunnel diode, Gunn and IMPATT diodes and few other two terminal devices can exhibit negative resistance at RF frequencies when biased appropriately. Application of d.c. bias to a bipolar or field-effect transistor, however, requires a suitable series or parallel feedback to induce negative resistance. The frequency range over which the negative resistance is present in the diodes is determined by the physical mechanisms in the device as well as the feedback topology chosen for the circuit. All negative resistance devices are one-port networks. The basic structure consists of a transistor, such as a MESFET, and a simple reactance feedback element Z as shown in Figure 1 [1].

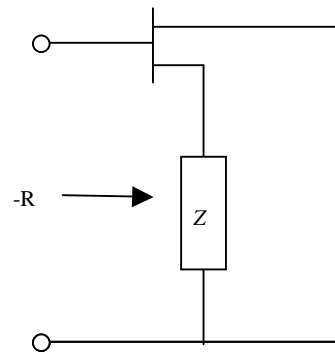


Figure 1. Basic Negative Resistance circuit

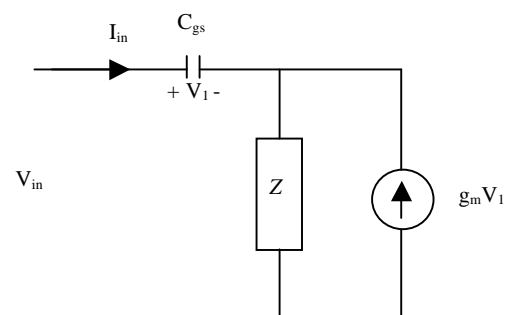


Figure 2. Model of Figure 1.

If the MESFET is modelled by its input capacitor C_{gs} , and related current generator as shown in

Figure 2, the input impedance seen at the circuit terminal can be calculated as

$$Z_{in} = Z + Z_{gs} + g_m Z_{gs} Z \quad (1)$$

As the equation shows, the term which can produce negative resistance is $g_m Z_{gs} Z$ where $Z_{gs} = \frac{-j}{\omega C_{gs}}$. It therefore follows that the element Z must be a capacitor, which results in a negative resistance value of

$$R_{in} = \frac{-g_m}{\omega^2 C_{gs}} \quad (2)$$

It is also possible to use an inductor as the feedback element, but in a different circuit configuration, as shown in Figure 3 [2], in which two similar MESFETs are used.

Here, the analysis of the circuit in Figure 3, given in equation (3), shows that the term which produces the negative resistance is $g_m Z_{gs}^2$

$$Z_{in} = 2Z_{gs} + g_m Z_{gs}^2 + Z_L \quad (3)$$

$$+ 2g_m Z_{gs} Z_L + g_m^2 Z_{gs}^2 Z_L \quad \text{where}$$

$$Z_{gs} = \frac{1}{j\omega C_{gs}} \quad \text{and} \quad Z_L = j\omega L$$

In each configuration, the circuit input impedance is a frequency-dependent negative resistance in series with a reactance.

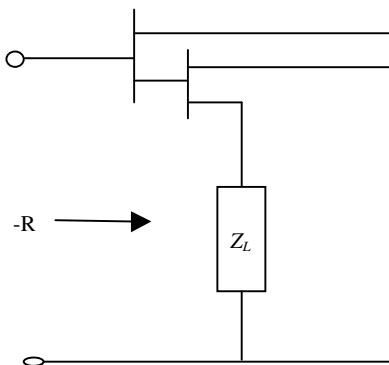


Figure 3. Another configuration of Negative Resistance circuit

Active Capacitor using single-MESFET Negative Resistance Circuit

The complexity or simplicity of the negative resistance circuit largely depends on the bias circuitry. The design is based upon the serial feedback of a single MESFET, using self-bias arrangement to enable the use of a single bias source. The corresponding circuit is shown in Figure 4 while the chosen dc bias operating point is shown in Figure 5, for the four-finger $75\mu m$ gate width (4x75) MESFET operating at

$$I_{ds} = \frac{I_{dss}}{2} = 25mA \quad \text{for} \quad V_d = 2.5V$$

$$V_d = 2.5 V$$

$$C_1 = 1.0 pF$$

$$C_2 = 1.5 pF$$

$$C_3 = 1.5 pF$$

$$L_1 = 0.5 nH$$

$$L_2 = 8.6 nH$$

$$L_3 = 3.5 nH$$

$$R_1 = 2.5 k\Omega$$

$$R_2 = 20\Omega$$

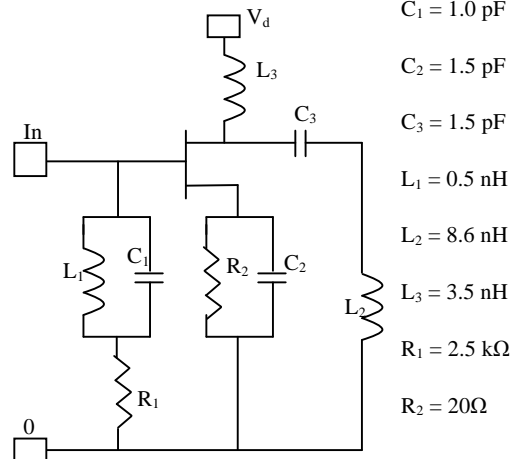


Figure 4. Schematic of the 1-MESFET active capacitor with negative resistance

The bias circuit uses a source resistor R_2 which sets the dc operating point of the negative resistance circuit, provides automatic transient protection and also decreases the effect of variations of the drain current I_{ds} with respect to temperature and I_{dss} . The source bypass capacitor C_2 also serves as the capacitive serial feedback component. The resistor R_2 sets the gate bias voltage, V_g .

Analysis of the Active Capacitance/Negative Resistance Circuit

The small-signal model of the negative resistance circuit of Figure 4 is shown in Figure 6. The analysis of the circuit is as follows:

$$I_{in} = I_1 + I_2 \quad (4)$$

where I_{in} is the input current, I_1 the gate bias current, and I_2 the current flowing into the active device.

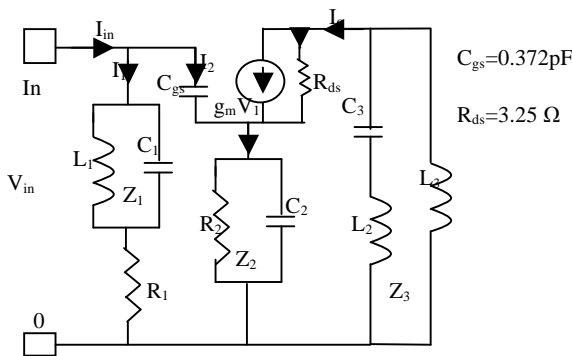


Figure 6. Small-signal model of Figure 4

$$I_1 = \frac{V_{in}}{Z_1 + R_1} \quad (5)$$

$$V_1 = I_2 Z_{gs} = \left(I_{in} - \frac{V_{in}}{Z_1 + R_1} \right) Z_{gs} \quad (6)$$

where V_1 is the gate-source bias voltage (V_{gs}), which is set by the resistor R_2 .

$$\begin{aligned} V_2 &= (I_2 + I_o) Z_2 \\ &= V_{in} - \left(I_{in} - \frac{V_{in}}{Z_1 + R_1} \right) Z_{gs} \end{aligned} \quad (7)$$

Here V_2 is the voltage across the self-biasing circuit Z_2 , which is formed by the resistor R_2 which sets the dc operating point, and the source bypass capacitor C_2 , while I_o is the drain current (I_d).

$$I_o = g_m V_1 + \frac{V_2 + I_o Z_3}{R_{ds}} = \frac{g_m V_1 R_{ds} + V_2}{R_{ds} + Z_3} \quad (8)$$

$$\begin{aligned} V_2 &= \frac{Z_2 [(I_{in}(Z_1 + R_1) - V_{in})(R_{ds} - Z_3 + g_m X_{gs} R_{ds})]}{(Z_1 + R_1)(R_{ds} - Z_3 - Z_2)} \\ &= V_{in} - \left(I_{in} - \frac{V_{in}}{Z_1 + R_1} \right) X_{gs} \end{aligned} \quad (9)$$

The input impedance of the negative resistance circuit (a negative resistance in series with a reactance), Z_{in} , therefore becomes

$$\begin{aligned} Z_{in} &= \frac{V_{in}}{I_{in}} \\ &= \frac{Z_2(Z_1 + R_1) [(R_{ds} - Z_3 + g_m X_{gs} R_{ds}) + X_{gs}(Z_1 + R_1)(R_{ds} - Z_3 - Z_2)]}{(Z_1 + R_1 + X_{gs})(R_{ds} - Z_3 - Z_2) + Z_2(R_{ds} - Z_3 + g_m X_{gs} R_{ds})} \end{aligned} \quad (10)$$

where

$$Z_1 = \frac{j\omega L_1}{1 - \omega^2 L_1 C_1} \equiv jX_1 \quad (11)$$

$$Z_2 = \frac{R_2 - j\omega C_2 R_2^2}{1 + \omega^2 C_2^2 R_2^2} \equiv R - jX_2 \quad (12)$$

$$Z_3 = \frac{j\omega C_3 (L_3 - \omega^2 L_2 L_3 C_3)}{C_3 (1 - \omega^2 C_3 (L_2 + L_3))} \equiv jX_3 \quad (13)$$

Using the MATLAB software, the real and imaginary parts of the calculated input impedance Z_{in} (equation 10), are plotted against frequency as shown in figures 7(a) and 7(b) respectively.

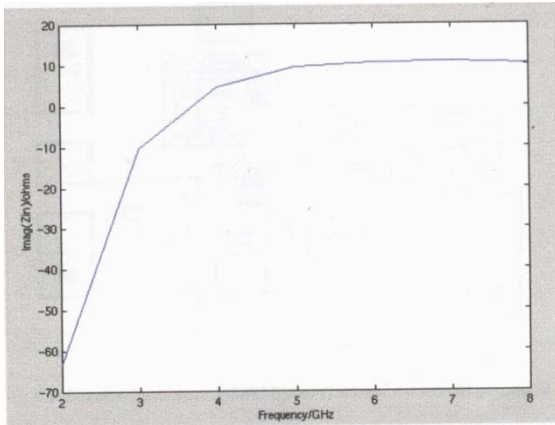


Figure 7(a): Calculate Real(Z_{in}) response of the MMIC Negative Resistance for

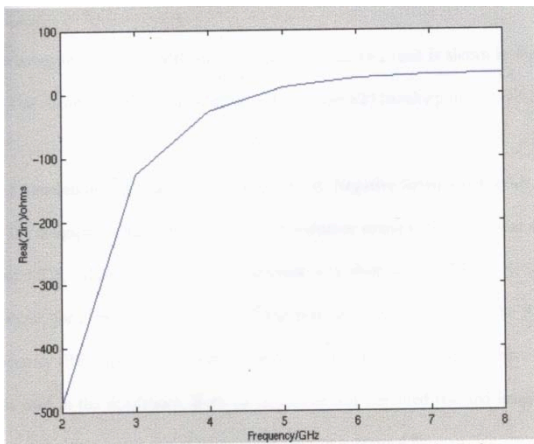


Figure 7(b): Calculate Imag(Z_{in}) response of the MMIC Negative Resistance for $V_d = 2.5V, I_{ds} = \frac{I_{dss}}{2} = 25mA$

The layout of the final MMIC of this negative resistance/active capacitance circuit is shown in figure 8. This circuit was fabricated using the GEC- Marconi F20 foundry process.

Simulation and measurement of the MMIC Negative Resistance/Active Capacitance Circuit.

The design and simulation of the negative resistance/active capacitance circuit in figure 4 was done using MDS, while the test and measurement was done using HP8510 Network Analyzer, for drain voltage (V_d) at 2.5V and drain current (I_d) at 25 mA. The Radio Frequency models of the circuit components and the interconnectors have also been used in the simulations. Both the simulation and measured real and imaginary parts of the input

impedance of the circuit are shown in figure 9. Inspection of figures 7 and 9 show that the measured performance of the negative resistance circuit compares well with the calculated results than it does with the simulated. This is due to the discrepancy between the measured S-parameter data and the S-parameter data of the library models of the GEC MESFETs which caused severe shift in frequency of the simulated result This problem was overlooked at this stage of the research because here the priority was to obtain a flat frequency response and a reasonable value (few ohms) of negative resistance that is sufficient to compensate the passband insertion loss of a distributed filter [3]. However, within the frequency band of interest (4GHz – 5GHz), the calculated, the simulated and the measured results produced a flat negative resistance of about -30Ω.

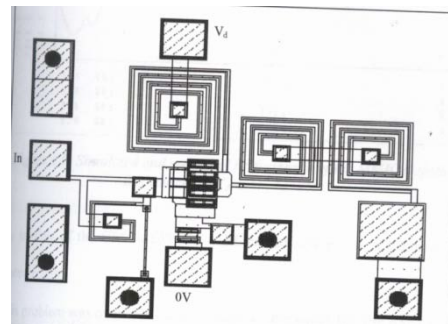


Figure 8: Negative Resistance layout (1.02mmx0.95mm) generated using CadenceMMIC

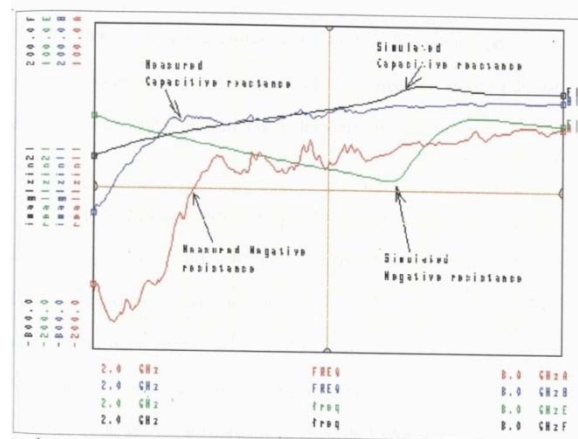


Figure 9: Simulated and measured performance of the MMIC Negative Resistance for $V_d = 2.5V, I_d = 25mA$

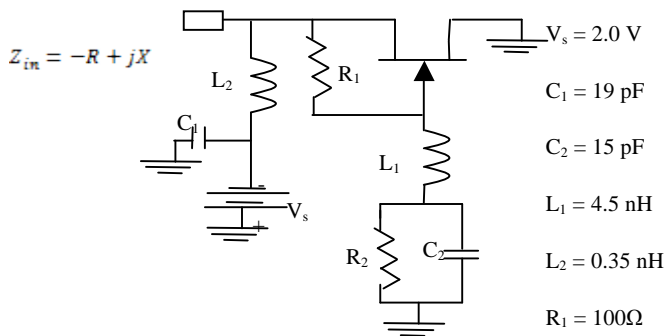


Figure 10: Schematic of the Active Inductor using a single MESFET Negative Resistance circuit

Active Inductor using a single-MESFET Negative Resistance circuit

An active inductor in a filter structure can have a negative loss factor, that is gain, whereas the capacitors remain passive and lossy. Here, we have chosen even more simpler circuit arrangement to enable the use of a

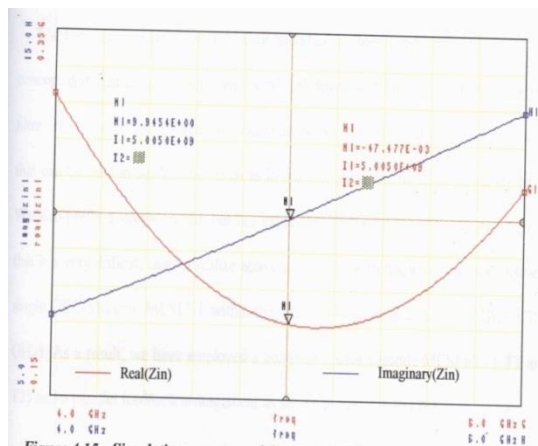


Figure 11: Simulation response of the single-MESFET Active Inductor with Negative Resistance

single bias source. The schematic of the common-drain circuit is shown in figure 10, with a single source bias voltage [4]. The resistor R_T sets the source-gate voltage V_{gs} , C_T is the source bias capacitor, while L_T and C_2 are the gate bias inductor and capacitor respectively.

For the source voltage of $V_s = -2.2V$, and current $I = 85mA$, the simulated result is shown in figure

11. It is important that constant negative resistance and inductor values be obtained within the frequency band of interest. This circuit is to form the resonator inductor of a pass-band filter operating at a centre frequency of 5GHz, with a 2% fractional bandwidth (BW = 100 MHz) [5]. Figure 15 shows a flat negative resistance of -0.047Ω between 4.8 GHz and 5.4 GHz, and a linear inductive reactance between 4 GHz and 6 GHz.

Active Inductor for DCS Receiver band (1.71GHz – 1.785GHz) using multi-MESFET Negative Resistance circuit

The two previous negative resistance/active reactance circuits have been used mainly for proof-of-concept demonstration for applications in: (a) distributed filter and (b) MMIC active filter. Now we design a circuit to realize an active inductor with negative resistance that can be used in applications such as in the mobile communication frequency band. We also prefer a simple circuit, but our experience in the course of this work suggests that it is a very difficult task to realize active inductance with negative resistance using a single GEC-Marconi MESFET within the DCS 1800 receiver band (1.71GHz – 1.785GHz). As a result, we have employed a common-source cascade MESFETs T1 and T2) and a parallel feedback arrangement as shown in figure 16 [6]. A common-gate MESFET (T3) is used in the feedback circuit instead of a resistor. As in the last circuit, there is no measured result as it is an integral part of a MMIC active filter, but its simulated response is shown in figure 17, from where constant inductor and negative resistance values can be seen within the desired frequency band (1.5GHz – 2.0GHz). The potential usefulness of the active inductor is employed in the design of fully integrated filters.

Conclusion: The main objective in this work was to investigate the concept of active capacitor and inductor with negative resistance. We designed

and fabricated a negative resistance circuit capable of producing appreciable amount of negative resistance over a wide frequency band. Although the measured performance of the first negative resistance circuit showed some discrepancies with the simulated performance using foundry models, it compares very well with the calculated results. However, in all the three cases of calculated, the simulated, and the measured, satisfactory negative resistance values were realized for the desired range of frequencies. The advantages of using negative resistance elements are that they are comparably easy to construct, they require no external pump source, only dc bias; they have relatively wide bandwidth, and they are capable of working at high frequencies. The disadvantages are that they have relatively high noise figures, and they are potentially unstable. The solution to this problem is being studied as part of further work to this project.

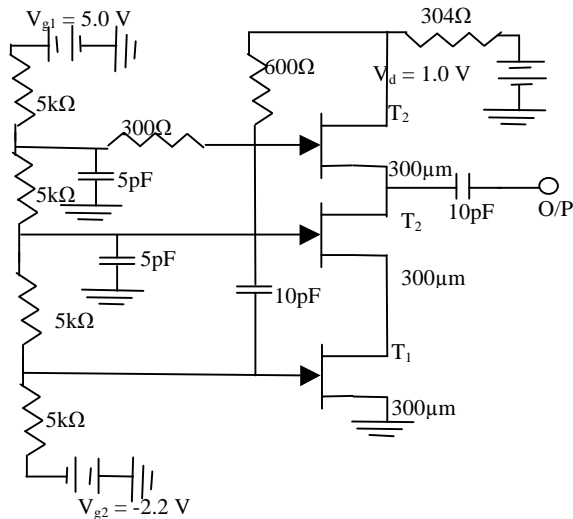


Figure 12: Schematic of the multi-MESFET Active Inductor with Negative Resistance for dcs receiver

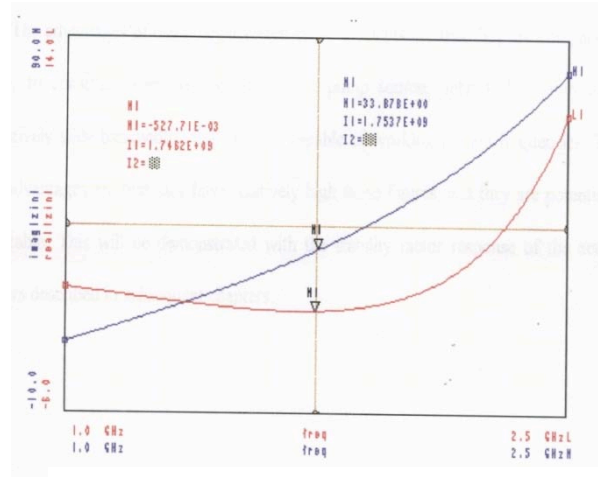


Figure 13: Simulated real and imaginary parts of the input impedance response of the multi-FET Active Inductor for dcs receiver band

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Development of Web-based Interactive Map Using Object-Oriented Programming Concept

Adeyinka A. Adewale and Jeremiah O. Onaolapo

Abstract — The program incorporates an interactive map which responds to origin and destination selection, by analyzing the relative positions of both locations and creating real-time routes on the road network to display to the user the required path from the origin to the destination and the approximate distance/time required. System design is based on the Model-View-Controller (MVC) design pattern, and the application has been developed using Adobe Flash CS3 (with ActionScript).

Keywords — Adobe Flash CS3, Algorithm, Design Pattern, High Power Object Oriented Programming, Model-View-Controller, real-time mapping.

I. INTRODUCTION

THE problems of navigation have always been a contemplated Tissue with various institutions and companies deploying solutions to help people get from place to place, reducing the chances of losing their way and ending up at the wrong destination. Various solutions such as high-powered Global Positioning Systems (GPS) and other devices have been developed, which require costly equipment that communicate with satellites which in turn beam back their present geographic location, direction, distance from final destination and the route to traverse to get to this final destination. Such systems are difficult to acquire due to high cost of equipment and deployment.

As a result, there is need for an economic solution that is accessible to all users (the Internet being the most preferred option) without any need to acquire specialized equipment. This project seeks to solve those problems by harnessing the power of a leading graphic application that allows development of PC-specific multimedia and web applications; Adobe Flash CS3 and incorporating its full-fledged object oriented programming language, ActionScript 3.0, to implement all its aspects [1].

Studies have shown that object-oriented approach to software development (compared with traditional approach) results in increased product flexibility and reduced complexity

[2]. In addition, object-oriented design patterns help to ensure reusability and consistency in software development projects if handled properly [3].

The Model-View-Controller (MVC) design paradigm was applied in the course of this software development project, since MVC architecture helps to decouple user interface presentation from business logic and data retrieval, hence simplifying interactions between objects [4]. Most interactive applications nowadays are developed based on MVC design pattern [5], for instance, a web application generator [6].

The Adobe Flash CS3 Integrated Development Environment (IDE) is equipped with tools that were used to design all graphical components of the project; it also works in conjunction with other Adobe Creative Suite applications such as Adobe Photoshop [1]. These other applications can speed up workflow and also provide additional content not present in the Flash IDE for graphical component design. The components can then be manipulated using some of the functions and tools to create interactive properties and behaviors that would improve user experience in the application.

ActionScript 3.0 is embedded and associated with Flash projects as backend coding to provide exceptional features and control that cannot be provided by the IDE tools, but similar to those provided by languages like Java and C. These two parts of the Flash package can be merged together to create an application with high user interactivity and also powerful algorithms which could be deployed to multiple users as an online application [1].

II. WEB MAP

Most maps are two-dimensional; representing position data on a two-axis Cartesian-system, or three-dimensional representation of geometric space. Either could be presented in an interactive and/or dynamic manner. The advent of technology has greatly advanced the functionality of maps via the use of electronic maps that have been implemented to provide extra features such as rainfall levels, population distribution etc. Demographic data integrated into these maps makes for more efficient analysis and better decision-making. One of such map is the Geographic Information System (GIS) map. GIS is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information [7].

While the first web maps were primarily static, due to

Corresponding Adeyinka A. Adewale is a Lecturer in the Department of Electrical and Information Engineering, Covenant University, PMB 1023 Ota, Nigeria (phone: +234.806.885.5772; e-mail: ade.adewale@covenantuniversity.edu.ng).

Jeremiah O. Onaolapo is a Research Fellow in the Department of Electrical and Information Engineering, Covenant University, PMB 1023 Ota, Nigeria (phone: +234.813.225.2885; e-mail: jeremiah.onaolapo@covenantuniversity.edu.ng).

technical restrictions, today's web maps can be fully interactive and integrate multiple media. This means that both web mapping and web cartography also have to deal with interactivity, usability and multimedia issues. Static web pages are view-only with no animation and interactivity. They are only created once, often manually and infrequently updated. Typical graphics formats for static web maps are Portable Network Graphics (PNG), Joint Photographic Experts Group (JPEG), Graphics Interchange Format (GIF) or Tagged Image File Format (TIFF) for raster files, Scalable Vector Graphics (SVG), Portable Document Format (PDF) or Small Web Format (SWF) for vector files. Web maps are created dynamically on demand each time the user reloads the web page, often from dynamic data sources, such as databases.

There are general-purpose navigation sites developed by Yahoo! Corporation [8] and Google [9], both leading search engine applications. They exist on the internet as platform-independent applications that are easily accessible by users. An interactive map display contains worldwide geographical information about all locations on the planet. Geographical maps make use of static maps, aerial satellite imagery or a hybrid of both to provide geographic information to users, including traffic route display capabilities. Development tools are Adobe Flex Builder and ActionScript 3.0, eXtensible Markup Language (XML) and backend support includes map servers, database and aerial satellite updates. Others examples of navigation sites are Rail Europe [10] and Flash Earth [11]. These are global maps containing worldwide geographical information about all locations on the planet.

Meanwhile, the classification of web map interactivity can be done from three perspectives: navigation techniques, support for collaboration, and data sources available. Navigation techniques refer to the way a user can change the viewpoint of the map, such as through zooming and panning. Support for collaboration refers to an application's ability to allow multiple people to communicate ideas. For example, the map software may allow users to chat in real-time or write comments on the map for later viewers. Data source availability refers to the options available for displaying different data on the map, such as displaying different layers. In this report more emphasis would be laid on map interactivity. The statistical analysis in Fig. 1 explains interactivity of a finite sample of maps.

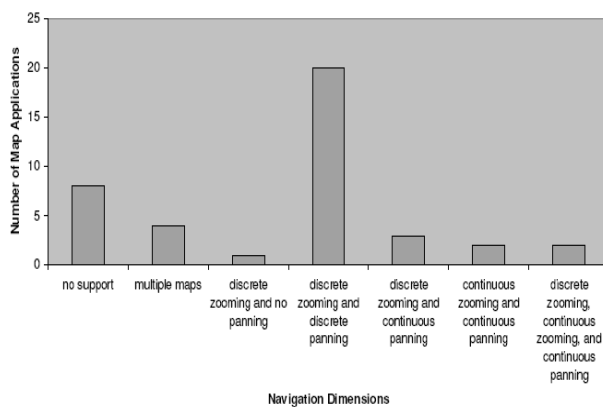


Fig.1. Map survey results from navigational dimension of classification.

From the reviews highlighted above, the provision of navigational facilities over the web has reached a high level of maturity and everyone wants to partake; from institutions that want to increase their international ratings to organizations that offer services from usage to actual development.

III. APPLICATION DESIGN AND DEVELOPMENT

To optimize the look-and-feel of the application, the Graphical User Interface (GUI) was designed using the Adobe Photoshop application as our editing application to design and create all the site graphical components. Adobe Flash and Photoshop work interchangeably as they are part of the same production suite package, with content easily interchangeable between the two.

Preloaders are essential to flash applications as they ensure that all components and assets necessary for it to run effectively are loaded into the user cache memory before the application initializes. This is done to increase both the speed and ensure proper functioning of the application due to its dependencies on these assets. The preloader acts to load all components of the application; the SWF file, XML file and all other assets that are embedded into the application.

The code implementation pattern of choice is the Model-View-Controller framework pattern [3][5]. The model is the content being loaded into Flash, the controller class handles the actual loading of the external SWF and XML files and the view displays the loaded content, as shown in Fig. 2 below.

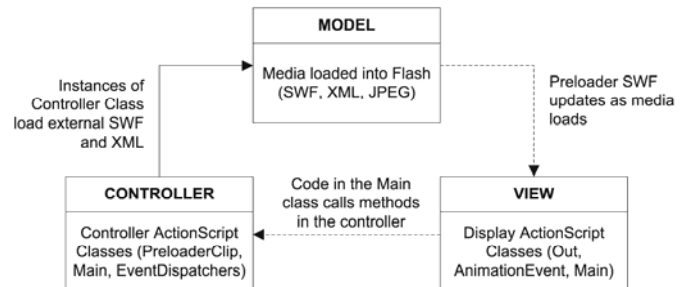


Fig. 2. Model-View-Controller interaction for the Preloader.

The pages are interrelated by a collection of buttons, which can be likened to hyperlinks on traditional HyperText Markup Language (HTML) websites, and how these hyperlinks relate together to form a web of movement. Every page is equipped with a set of icons that act as hyperlinks to enable the user move within pages and get to the feature required. This is illustrated with the chart below in Fig. 3 below.

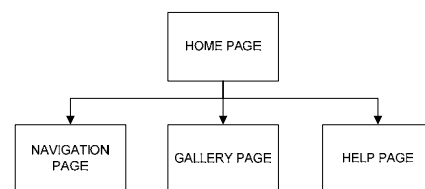


Fig. 3. Block diagram of system modules, which also define navigation flow within site pages.

The InfoBoxx class makes use of the XML class to display brief information to the user about the specific location clicked. Fig. 4 illustrates MVC interaction for Navigation Page.

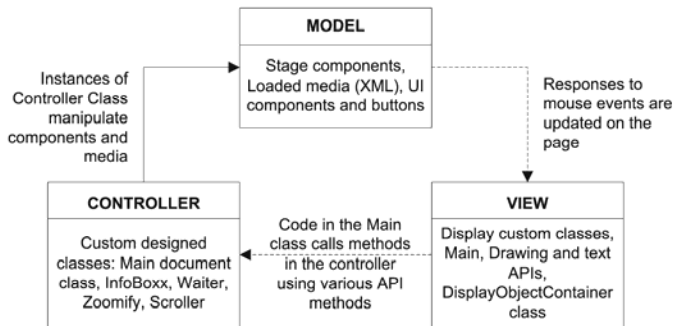


Fig. 4. Model-View-Controller Interaction for Navigation Page.

To make the map usable and optimized for both Flash and our application, the map was converted into vector-based graphic components which exist on different layers; allowing each element to be unique. Using Adobe Photoshop CS3 (a high-end graphic program for photo editing, vector drawings and other media), which supports compositing and layering the map layers, each element was designed and organized according to similarities and functions. Below (Fig. 5) is a cross-section of the map, displaying a snapshot of map conversion.



Fig. 5. Converted Covenant University Master Plan.

Besides the look-and-feel that can be added to the objects to improve user perception, the buttons also possess instance names which can be referenced through ActionScript [1] to allow them perform their functions. The following code snippet is the main function that allows these buttons to work as they should by employing timeline labels (frame identifiers which can be referenced using ActionScript).

```
navigationButtonInstance.addEventListener(
MouseEvent.CLICK, function )
function (){
```

```
MainTimeLine.goAndStop( "LocationLabel" );
}
```

IV. IMPLEMENTING THE ROUTING FEATURE

The routing feature is the core function of the web app and this is implemented using User Interface (UI) components; combo boxes for user to select locations from a list (and for application to collect variables) and a 'navigate' button to start the routing process. The combo boxes fetch their data directly from an external XML file that contains location names and details. The XML file allows easy updating of information with as regards locations, as it is external to the application. The code snippet below shows a sketch form of the code listing to implement this feature.

```
var xmlObject:XML = new XML();
var xmlLoaderObject:URLLoader =
new URLLoader();
xmlLoaderObject.load(new URLRequest("file.xml"));
xmlLoaderObject.addEventListener(
Event.COMPLETE, function);
function (){
xmlObject = XML( );
originComboBox.dataProvider = new
DataProvider(xmlObject);
destinationComboBox.dataProvider = new
DataProvider(xmlObject);
}
```

Location inputs are collected from the combo boxes when user selects a specific option from the list, as shown in the listing below, while Fig. 6 shows the location combo boxes.

```
originComboBox.addEventListener(Event.CHANGE,
functionCollectOrigin);
destinationCB.addEventListener(Event
```

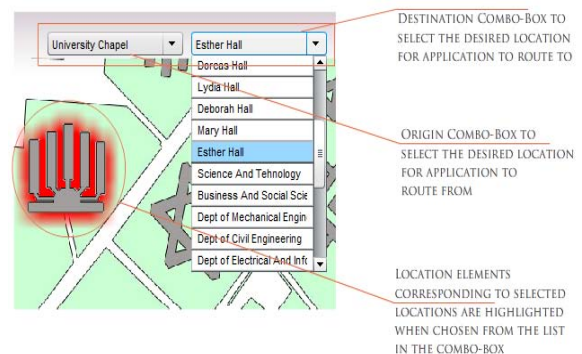


Fig. 6. The combo boxes used to collect location inputs for origin and destination.

After the user has selected the location pair of interest, to view the evaluated route it is necessary to click the navigate button. It is the means by which the algorithm begins the iterative process of analyzing the road point structure. The

code snippet below shows a sketch form of the code needed to implement this function, while Fig. 7 shows a computed route.

```

Navigate_btn.addEventListener(Event.CHANGE,
function);
function () {
    collectInputsfunction ();
    conditionalIterationFunction ();
}

```

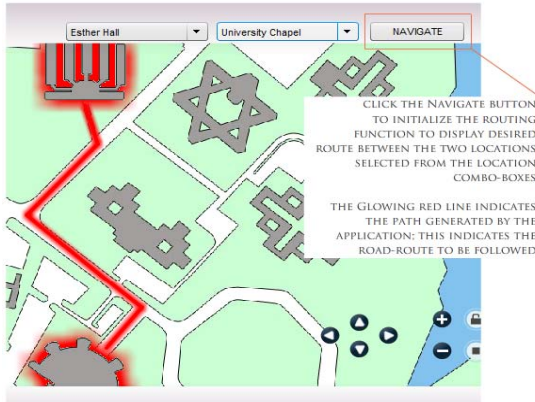


Fig. 7. Cross section of the application showing UI components and a sample path routed based on locations indicated in the combo boxes.

During the routing process, various elements are added and removed from stage; the Caution box which pops up when an invalid pair of locations are chosen, the processing box with a processing meter that plays while the routing algorithm is executed and the direction box which displays the textual directions, distance and time required to cover the computed distance. The processing box is invoked by calling the waiter class, so that the processing message box, which exists as a component in the library, is added to stage. It is invoked once the routing algorithm is executed and it serves to give the user visual feedback of the execution process. The code snippet below illustrates the process described above.

```

processingObject:Waiter;
if ( isRoutingBegin ) {
    processingObject = new Waiter ( objectParameter );
}

```

The caution message box also exists in the library and an instance of it is added to the stage in the event that a user selects an invalid pair of locations and tries to initialize the routing function. The asset is also invoked by calling the waiter class.

```

cautionObject:Waiter;
if ( invalidLocationInput ) {
    cautionObject = new Waiter ( objectParameter );
}

```

The Direction Box is invoked once the iteration process is

complete, by adding an instance of the Direction object on stage (see Fig. 7).

```

directionObject:Direction;
if ( iterationEnded ) {
    directionObject = new Direction( textDirection,
distance, requiredTime );
}

```

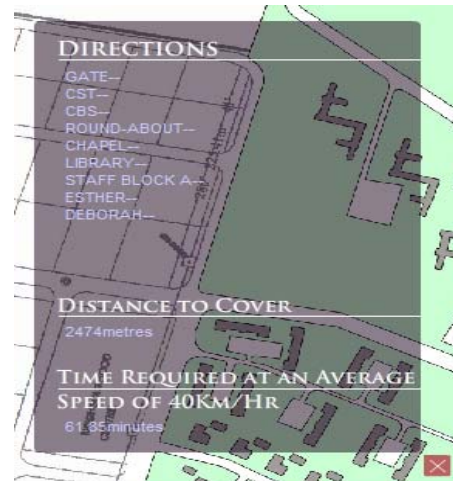


Fig. 8. Direction box showing information about the routed path.

V. CONCLUSION

This interactive map application satisfactorily provides preplanned journey arrangement for the user, allowing him or her to know the geographic structure of the case study location before setting out on the journey. Users can use the application from any computer with internet connection, and usually regardless of what operating system that computer is running. Installation is not required - updates and distribution of the application are handled instantly and automatically. In addition, being a web-based application, it is less prone to viral infection than running an actual executable.

Also, we have been able to implement user-interface behaviors not obtainable using only the HTML widgets available to standard browser-based web applications. Network traffic will be significantly reduced because an application-specific client engine can be more intelligent than a standard web browser when deciding what data needs to be exchanged with servers especially when based on OOP concepts. This can speed up individual requests or responses because less data is being transferred for each interaction, and overall network overhead load is reduced.

However, a major improvement on this application would be to develop a mobile version so as to ensure mobile access to the real-time navigation feature, that is, an effective hardware-independent GPS application that users can access on the move.

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GOOGLE+: A BOOST TO E-LEARNING EDUCATION & TRAINING @ COVENANT UNIVERSITY

WOGU, IKEDINACHI AYODELE POWER

Department of Psychology, School of Human Resource Development, College of Development Studies,
Covenant University, Ota Ogun State, Nigeria.

ike.wogu@covenantuniversity.edu.ng, wogupower@yahoo.com

ABSTRACT

Just as the advancement in Information Technology (IT) continues to evolve and change rapidly over the past few decades, the art of learning, acquiring and dispersing knowledge and information have also continued to evolve rapidly. These rapid innovations and improvements in IT were designed with the aim of boosting knowledge and education at just the click of the button. Some of the most outstanding innovations and inventions in the (IT) world, which have influenced education and learning in this decade are found in social networks such as Yahoo, Google, Face book, twitter, You Tube, to mention but a few. However, recent studies conducted in this regard revealed that these current innovations and advancements in IT have constituted grave challenges to the knowledge and learning process.

The teachers / lecturers of this century, during the process of seeking to transfer knowledge to their student, are often faced with the dilemma of finding how best to gainfully occupy the minds of their students within and outside the class room environment. The students who more often than not, distracted by incoming messages, videos, picture of friends, or simply text messages from friends via i-phones, laptops, i-pods, or even i-pads etc. The respondent instantly cannot resist the urge to quickly read and send back a reply via either of the means mentioned here. Other students who log on to either of the networks for a specific task are easily distracted or carried away by say, a fresh advertisement or alternate information which

dramatically catches the attention of the students. Consequently, they are drawn and carried away by the new piece of information that drastically - in most cases - changes their trend of thought before they are fully aware of the harm done by the distraction.

While applying the simple survey methods of research, this paper shall examine the findings of an ongoing study with two groups of students who offer University Wide Courses (UWC) here at Covenant University. Results from the pilot study conducted gives us reasons to argue that a resent product by Google simply known as "Google+" may be that much desired formula that teachers and lectures all over the world, need to boost the teaching and learning experiences of both teachers, students and researchers within and outside the classroom environment.

1. INTRODUCTION

The quest for Knowledge in recent times has continued to increase all over the world. It has been realized among the developed and developing countries that nothing ensures development as much as education does. To this end, countries and governments continue to invest more and more in education and learning by building and funding various knowledge based projects in Universities and other institutions of higher learning. Studies recently carried out in this respect reveal those countries, governments and some None Profit Organizations (NGO's) who embarks on such projects do so because they believe that education is the soul of

development. Consequently, countries like America and Great Britain, two of the leading nations of the world, have been known to have more Universities sited and established in their countries. Universities

from these two countries are listed among the top 100 Universities in the world. The 2010 / 2011 top 100 Universities of the world presents the under listed top ten universities in their order of ranking: ^[1]

1	University of Cambridge	United Kingdom	L	VH	FC
2	Harvard University	United States	L	VH	FC
3	Yale University	United States	M	VH	FC
4	UCL (University College London)	United Kingdom	L	VH	FC
5	Massachusetts Institute of Technology (MIT)	United States	M	VH	CO
6	University of Oxford	United Kingdom	L	VH	FC
7	Imperial College London	United Kingdom	L	VH	FC
8	University of Chicago	United States	M	VH	FC
9	California Institute of Technology (Caltech)	United States	S	VH	CO
10	Princeton University	United States	M	VH	CO

Notice that the Universities that made the first top ten listing, come from these two great nations of the world. (USA = 6), (Great Britain 4) with University of Cambridge toping the chart, followed closely by Harvard University. It can be rightly inferred that these two great nations of the world were able to achieve this great fits because of the emphasis they have continued to place on education and learning. Their increasing quest to acquire more knowledge and fresh avenues through which knowledge acquisition and knowledge transfer can be made easier by the minute, has clearly played out in these countries as represented in the above chart.

The need to diversify and multiply the modes of communication and knowledge all over the world has lead to the development and generation of various search engines and social networks which have been hosted on the internet, haven accepted the internet as

one of the 21st century system which have come to make knowledge acquisition and dissemination more easier than the world would have thought possible some 20 years ago. No doubt, the internet has brought knowledge closer to every individual seeking to acquire one form of knowledge or the other. Today every kind of knowledge you require or think of is readily made available at just a click of the button. However, one of the major problems with this new wave and medium of acquiring and disseminating knowledge is that the students seeking this knowledge are often exposed to all manner of information on the web, one that does more harm to the individual than the anticipated good it was initially designed to achieve.

2. THE MAIN ISSUE AT STAKE (PROBLEM)

Some of the social net-works and search engines more frequently used today for the purpose of

learning and education include: *Yahoo, Google, Facebook, Twitter, You-tube, Moodle*, just to mention but a few. These social networks and search engines were designed to aid communication and the dissemination of knowledge and information all over the world. However, recent studies reveal that most of these search engines and social networks constitute grave hindrances to the process of acquiring the right kind of knowledge, the one that makes for easy dissemination of knowledge among students and other individuals and the kind that ultimately fosters the development on the individual and the society at large.

Preliminary studies conducted in this area identifies most of these social networks as some of the factors that constitute a major distraction to students who are often carried away by some of the services, applications and utilities provided by these networks, whose initial intentions are to provide sure ways of acquiring or disseminating knowledge. Consequently, the use of the internet via some of these social networks and search engines, have become detrimental to positive knowledge acquisitions and dissemination.

A study recently conducted over a few years period revealed that teachers and lecturers have had to contend with the problems of distractions and lose of focus by the students during class sessions. This is because students easily fall prey to the temptation of chatting with friends, surfing the net on face-book or on twitter, etc. usually either gossiping or communicating via text messages, about matters that most often than not, do not concern the subject in focus or the topic of the class in session. On other occasions, they students have been known to simply wish quickly react, respond or exchange pleasantries, pictures and posts, on very current matters or issues happening around their surroundings etc with the

person on the other side of the network. Other studies show that these distractions often come as a result of the students' resolve to engage themselves with other things other than their studies when they begin to find their two hours lecture either "too long", "not fun enough", or "just boring" as the case may be. The lecturer is therefore caught in the dilemma of looking for ways of make his class room sessions - no matters how short or long the class might be - very captivating, educative and engaging for his students in the face of all these multiple distractions and situations that contends with the time he has to spend with his students for qualitative learning and education.

Results of pilot studies carried out on these problems as it affects the 21st century teacher / lecturer and his classroom, tends to affirm the increasing reality of the class teachers' dilemma, a dilemma that is seriously reducing the quality of education and learning that is intended for this new (*Jet Age and IT*) generation. The quality of learning and education that is intended to ensure the student gets a place in the highly competitive global village, a world of high Information and communication technology (ITC) which has very limited spaces for only the best in every sector of life.

3. METHOD OF STUDY

The methodology applied in the first phase of this research is simply that of the *survey* method since what we have done in this study can be largely regarded as a "descriptive research." A descriptive research describes, analyses and interprets conditions that are in existence. It describes systematically the facts, qualities or characteristics of a given populations, event or area of interest as factually and accurately as possible with the view to proffering answers and solutions to questions asked about the problem of study.

4. AIMS AND OBJECTIVES OF THE STUDY

1. To clearly capture and identify the degree of dilemma which the 21st century class teacher / lecturer is forced to grapple with in the process of disseminating knowledge and information, a business that is often hampered by the rising number of social networks on the internet and new IT gadgets which are readily available to students.
2. To generally introduced a method (**Google+ apps** package) as a process or method that makes the art of teaching - acquiring knowledge & information or the general art of learning and education among faculty and students - easier and more fun than ever before.
3. To clearly show how the use of the new **“Google+ apps”** package during lectures and class room sessions can enhance the quality of knowledge, learning and time spent with the student during the process of acquiring and disseminating information.
4. To affirm that the use of the **“Google+ apps”** package for the purpose of acquiring knowledge and disseminating quality knowledge and information is without prejudice, perhaps, the most outstanding social apps compared to all other social networks and applications available on the internet for the purpose of learning, knowledge and education.

5. WHAT IS E-LEARNING?

E-learning refers to the use of information and communications technology (ICT) to enhance and/or support learning in tertiary education. ^[2] But this covers a wide range of systems, from students using e-mail and accessing course work on line while following a course on campus, to programs offered entirely online. E-learning can be divided into several

different types. In all cases, the e-learn is a campus-based institution method which is often used to offering certain courses online so they can be assessed by anyone or a group of persons at anytime. The use of e-learning however is usually tied to the Internet or other online network to a large extent.

Web-supplemented courses focus on classroom-based teaching but include elements such as putting a course outline and lecture notes on line, use of e-mail and links to online resources.

Web-dependent courses require students to use the Internet for key elements of the program such as online discussions, assessment, or online project/collaborative work, but without significant reduction in classroom time. In *mixed mode* courses situation however, the e-learning element begins to replace classroom time. Online discussions, assessment, or project/collaborative work replace some face-to-face teaching and learning. But significant campus attendance remains part of the mix. And when courses are offered *fully online*, students can follow courses offered by a university in one city from another town, country or time zone.

6. E-LEARNING AND EDUCATION

Studies conducted not too long ago in America by the Sloan Foundation ^[3] reports that by year 2006, 3.5 million students were participating in on-line learning at institutions of higher education all over the United States. According to the same report, “there has been an increase of around 12–14 percent per year on average in enrollments for fully online learning over the five years period (2004–2009) in the US post-secondary system,”^[4] compared with an average of approximately 2 per cent increase per year in enrollments overall. Allen and Seaman (2009) ^[5] claim that almost a quarter of all students in post-secondary education were taking fully online courses

in 2008. Another report by Ambient Insight Research [6] suggests that in 2009, 44 percent of post-secondary students in the USA were taking some or all of their courses online, and it has been projected that this figure would rise to 81 percent by 2014. Thus it can be seen that e-learning is moving rapidly from the margins to being a predominant form of post-secondary education, at least in the USA and now most parts of the developed and developing countries of the world.

Many higher education (private) 'for-profit' institutions, now offer on-line classes. By contrast, only about half of government 'non-profit' schools offer them. The Sloan report, based on a poll of academic leaders, indicated that students generally appear to be at least as satisfied with their on-line classes as they are with traditional ones. Private institutions may become more involved with on-line presentations as the cost of instituting such a system decreases. In all, online education is rapidly increasing, and online 'doctoral programs' have even developed at leading research universities all around the world. [7] This notwithstanding, some higher institution in developing countries like some found in Nigerian Universities, tend to shy away from embracing the use of e-learning based systems as one of the method of studying in these institutions.

7. COVENANT UNIVERSITY'S MANDATE ON EDUCATION

Covenant University's (CU) vision is "To be a World Class University, committed to raising a new generation of leaders in all fields of human endeavor". [8] Its mission statement is "To train students who will be mentally resourceful, intellectually equipped, entrepreneurially self dependent, futuristically visionary, responsibility sensitive and emotionally stable through a human development based curriculum with emphasis on

developing the Total Man". [9] With the above vision and mission clearly stated, the University is set out to run with the 'mandate' outlined below:

Raising a new generation of leaders through a qualitative and life applicable, and life training system that focuses on value and skill development. It also has the mandate to "Raising a new generation of leaders through a broad base qualitative education built on sound biblical principles culminating in the birth of pathfinders, pace-setters and trail blazers". It also is poised to "Raising a 'new generations' of leaders who will redeem the battered image of the black race and restore her lost glory as this trained army of reformers begin to build the old wastes, repair the wasted cities and raise the desolations of many generations. [10]

A study of the above mandate reveals the drive behind the founding philosophy on which Covenant University is founded upon. Her founding philosophy is "*a departure philosophy*" [11], one that earnestly seeks a departure from *form to skill*, a departure from *Knowledge to empowerment*, a departure from *legalism to realism*, a departure from *points to facts*, a departure from *mathe-matics to life-matics*, to mention but a few.

Consequently, the above mentioned standards are the basis for existence and study here at CU. Faculty and members of management are therefore committed to ensuring that all programs and taught courses are designed and administered with the view to achieving all these setout goals. To this effect, emphasis are placed on some very important courses – both University and College Wide Courses - that have been designed to equip students with all the necessary tools needed to achieving the above mentioned mandates etc. Some of these courses include those which The National University's Commission (NUC),

have made mandatory prerequisite for all students seeking degrees from Universities all over Nigeria.

Two of these courses include:

1, Introduction to Philosophy, Logic & Human Existence, (GST211) 2, Introduction to The History & Philosophy of Science (GST311).

Other course designed by the University to help achieve the above aims and objectives include The Total Man Concept (TMC), some Human Development course (HMD) taken at the college level in the University to mention but a few. These courses in a lot of ways, have aided the achievement of the goals mention in the above context.

8. E-LEARNING @ COVENANT UNIVERSITY (CU)

The seeming complexity and misconceptions that goes with the study of some of the courses mentioned in the above context, (The University and College Wide Courses) which have been known to have very large number of students registered per semester, has been a challenge in time past. This may be because lecturers are forced to grapple with the scenarios that transpire in these individual classes, classes which have students numbering up to 2000 during a single class or test periods. These challenge (very large number of students sited for a class session) have cause professors, lectures and teachers responsible for these classes to continue to seek out ways and methods through which the wealth and value of the knowledge embedded in their courses can be passed successfully to all students in their class room as requested by their course compact and curriculum for the semester. May I also note that these large classes simply makes room for easy distractions and lose of concentration amongst the students who often will hide under the guise of these large numbers to engage in other activities which are often not part of the subject being taught in class.

That the introduction of e-learning (Moodle) as one of the methods of teaching and handling these courses at CU, by some of the lectures in charge of the above mentioned courses, have drastically changes the seeming complexity and difficulty often associated with teaching these courses. Since the introduction of the use of e-learning among faculty and students offering the courses in question, a general improvement in class participation between students and members of faculty, both during class and off class hours have been noted. This is because of some of the facilities and functions which the e-learning system offers both lecturers and students. Time and the want for space will fail me to outline all these facilities and functions here. However, a few of them include, constant access to lecture notes and materials for the lecture, access to other online recourses and materials on the subject of lectures, online submission of assignments, projects etc, automatic grading systems and immediate access of grade by students, reduced or no cost of printing to assignments projects etc, to mention just a few.

There has also been a general improvement in the quality of class participation which have influenced the grades recorded by students since the introduction of e-learning system, when compared to the kind of class participation and quality of grades that were recorded in the past.

E-learn at CU, even though is still very much at the test stage, has proven to be very resourceful and user friendly. The privilege it provides for both students and members of faculty is more than can be captured here on paper. Some e-Learning environments take place in a traditional class room; others allow students to attend classes from the confines of their halls of residences, student's centers or from their homes or other locations as the prevailing circumstance or situations may demand. E-learning now allows

lecturers to record and either present their lectures to groups of students via video conferencing in advance or live during a class session. They can now also read assignments, grade scripts, or post assignments, projects, etc to students from anywhere and at anytime of the day, while in a car, in traffic, or while away on official assignment from the campus or on a field trip in a faraway land. He can therefore monitor the progress of his students and assist anyone who needs his attention on any urgent matters that might not wait till the next class session.

9. THE GOOGLE+ EXPERIENCE @ CU

E-learning is becoming increasingly prominent in tertiary education, with Universities increasing provision and more students signing up. However, some universities are yet to embrace this method. However, the big question is, Is the e-learning system actually changing the way Universities teach and students learn, or is it simply a case of students typing up their essays on computers and professors sending them course reading lists or work assignments by e-mail? Well the truth is; for persons' who have nursed such thoughts in their minds, may have not gone too far from the truth. If we must be fair in our judgment, it will not be out of place to acknowledge that, where things are left to continue the way they are going right now, the whole e-learning business will soon fully assume the position conceived above in the not too distant future. Where this becomes the case, the initial aim of enhancing the modes of transferring learning and knowledge will be defeated. Some members of faculty and students I have had to work with in the past were beginning to think in this line before we had the encounter with the “**Google+ apps**”, an application that made a whole lot of difference to the e-learning business. It really changed everything.

With over eight years of experience in the teaching of these University wide courses and with a burning

desires to finding better ways of correcting the misconceptions and the supposed complexities associated with the courses, my recent experience with Nmachi, “A Special facilitator” from Google Nigeria, here at Covenant University and subsequently, my three days experiences and training sessions at the just concluded “Google Training Sessions for selected members of faculties in a few Nigerian Universities in the month of June 2012, seem to have provided the answers to the questions I and some of my students were beginning to raise about the use of e-learning as a methods of enhanced learning and teaching. I therefore make bold to say that by this recent experiences, my days of searching for a way out may be over for good.

Going by the discoveries and information I now have about this all new application from Google, I wish to infer that where this applications are successfully lunched and introduced to the teachers and students offering these University wide courses, it will go a long way in dealing with the dilemma that both teachers and students face as a result of the possible distractions which exist in the 21st century classroom. Results observed in the pilot study conducted in the month of March through the month of June revealed that the use of **Google+** has in many ways ameliorated the fears of many students who develop phobias for these university and college wide courses. Instead, a high level of interest and class participation has been observed. This we also believe may have been responsible for the high success rates achieved in terms of the grades which were recorded in the pilot study conducted with a college wide course HMD 321 and HMD 121. Both courses had a combined capacity of over 300 students. The success experienced here are indicative of the kind of success that could be achieved when we apply the use of Google+ to the much larger University Wide courses

(GST211 & GST311) which has an estimated combined strength of about 4,000 students.

10. THE STUDY WITH THE GOOGLE+ APPS @ CU

Just Recently, between the months of March and June, a pilot study was carried out with two different groups of students at Covenant University: **HMD 121 students** (148) and **HMD 321 students** (155) total (**303 students**) with a team of Google Ambassadors in Covenant University and a resource trainee personnel from Google (Miss. Nmachi) who helped introduce the group of students to a special package that was designed by Google to help bridge the possible gaps in the area of learning and education. The package by Google is a social network solely designed to boost education and make the art of learning and teaching more fun and easy for every class of student, researcher and members of faculty all over the world. Unlike other social networks or packages which are designed just for the purpose of play, fun and entertainment only.

For two sessions, within the period of three weeks, the faculty member responsible for the courses and students from both groups were taken through training sessions on Google apps and most of all the applications that the "New **Google+**" had to offer to students and members of faculties who choose to use the application for teaching and lecturing or carrying out assignments and projects, etc.

11. SPECIAL GOOGLE+ APPS FEATURES

The training sessions with the New **Google+ apps** revealed that lecturers could, via the applications made available to them on the **Google+** platform, really come up with ways of occupying their students during and after lectures and classroom sessions without the students getting bored or really tired of wanting to acquire more knowledge and information.

The package "**Google+**" further presented a platform where they (the students and the lecturers) could still play or share knowledge based information easily. Other things they could share or do include: their class projects, class assignments, term papers, questionnaires multiple choice questions etc. The **Google+** platform also provides free SMS to mobile phones of any network, multiple video phone calls between one faculty and another faculty, from faculty to students, or between students etc. Lecturers could also hold conference lectures from their offices online and in real time with a group or groups of students in their halls of residence, student centers, etc.

Other special features worthy of note here are the "**Hangout**" application. This application simply allows students and their friends or their lecturers to hold limited or unlimited but real time video conferencing, on any subject of their own with fellow colleagues, students, friends or from people of all races, all over the world. Such lectures or discussions can be placed on U-tube for further use or reference where the need arises. The "**#**" tag application also allows students to see, follow and also make direct contributions to specific comments, assignments, debates, arguments, projects, discussions, etc. which their lecturer may have raised during class session. Here, individuals making contributions are able to see the comments that have been made by other persons on the subject. This way, they are better informed to make meaningful contributions and arguments on the subject being discussed. The "**You-Tube**" applications, also by Google, is another application that have been tested and known to be used by lecturers and professors around the world to capture, via online video, a live coverage of classroom events and activities for students in class and those who for some reasons or the other, are unable to make the class or lecture in question. Such lectures can be recorded and stored online to be played back on a

later date by the student via a link which is made available to them by the lecturer.

Outside these mentioned applications, the Google+ apps also allows each participator to own a profile on Google+ that offers a whole lot of other applications that make studying, researching more fun than ever before. By this, I am talking about facilities such as a private e-mail service that synchronizes all your records, documents etc on a **Special Drive** from your computer. This way you can have access to them from any part of the world. You no longer really need to carry you laptops around anymore. Questions, objective test, and all manner of test and data can easily be administered, collected and recorded online via this platform, to mention but a few. Teachers therefore need no longer go through the stress of printing out questioners or question for examinations as this can be done online with results and data graded and analyzed easily.

12. TESTS, RESULTS AND ANALYSIS FROM THE PILOT STUDY.

Two groups of students were understudied during the period in question: March – June 2012. (Four Months). HMD 121 Students were **161** in number while & HMD 321 Students where **158** in number.

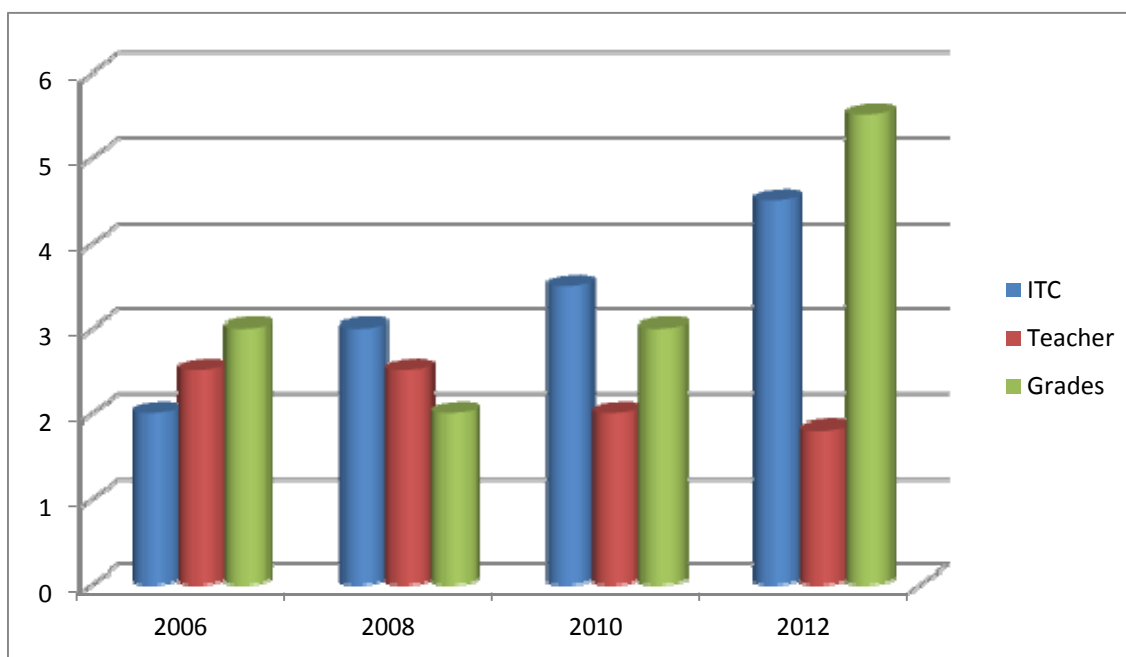
The combined strength of both classes when summed up together is **319 Students**.

The questionnaires distributed among both classes were designed to capture:

1. The degree of simplicity and effectiveness of the use of Google+ apps as a tool of study and learning among faculty and students in CU.
2. The influence on class participation in assignments, projects etc, both in and outside the class room period.
3. The influence and general effectiveness of the use of Google+ app to the field of e-learning education in general.
4. The influence of the use of the Google+ apps and e-learning on student's general test, examination and class performance.

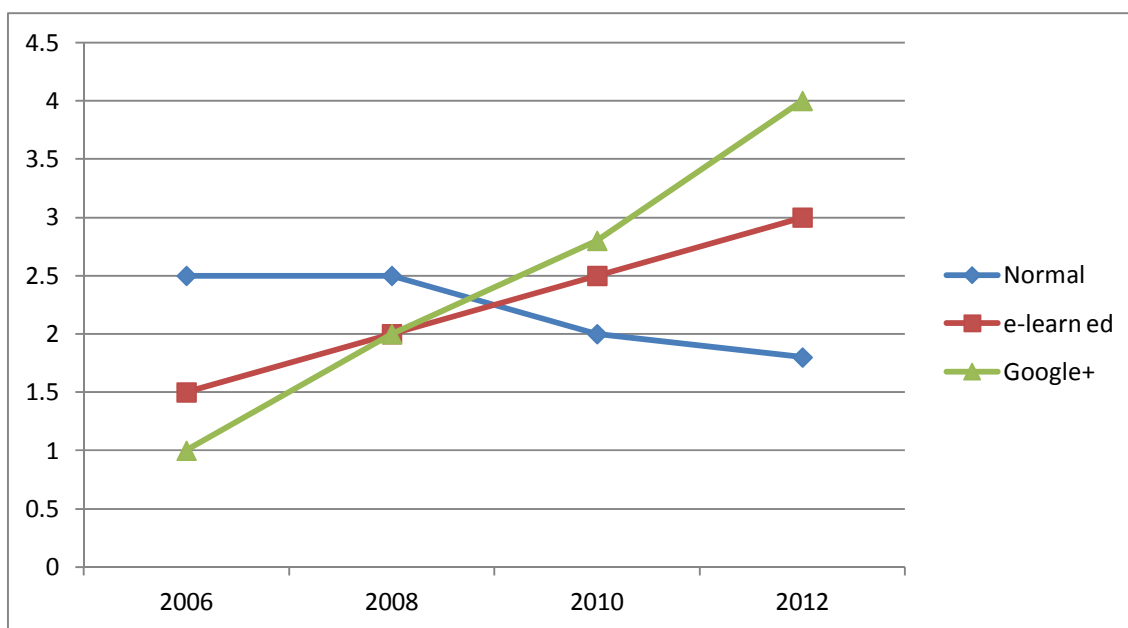
Below are graphical representations of the pilot study conducted on the use of Google+ and the impact on students' performance and general education over a specific period.

1. Graphical Representation of The Dilemma of The Teacher in The Phase of Distraction in the 21st Century And The Impact of E-learn & Google+ on Education on Student's General Performance ^[11]



S/N	YEARS	ITC IMPACT	TEACHER'S INPUT	STUDENTS GRADES
1	2006	2	2.5	3
2	2008	3	2.5	2
3	2010	3.5	2	3
4	2012	4.5	1.8	5

2. The Influence of e-learning & Google+ in the 21 century Education & The Learning Process ^[12]



S/N	YEAR	NORMAL TEACHING	E-LEARN METHODS	GOOGLE+ METHODS
1	2006	2.5	1.5	1
2	2008	2.5	2	2
3	2010	2.0	2.5	2.8
4	2012	1.8	3	4

13. GOOGLE+, A BOOST TO E-LEARNING EDUCATION

We have planned a much big test on the thesis we are proposing here about the impact of Google+ latter in the new academic session were we hope to gather more empiric data and come to more scientific resolutions about the aims and objectives proposed for the study so far. However, going by the tentative results we have been able to achieve with the pilot study conducted with the groups of students mentioned above, we are optimistic that the Google+ app could really be that boost that teachers, lectures

and professors have been seeking for in the field of e-learning education and education generally. I are therefore optimistic about the boost that the Google+ apps package can be to the entire learning process for students in higher institution of learning. We are therefore hoping that one of the communiqués that will proceed from this conference to the NUC and to all Nigeria universities is that the use of e-learn and perhaps Google+ be adopted as one of the modes of education in all the tertiary institutions of learning in Nigeria.

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9. See *The Mission Statement* of Covenant University as recorded in the Order of Proceedings of the 7th Convocation Ceremony of Covenant University, Ota, tagged *The Release of Eagles 2012*, which held on 29th June 2012. P. 2
10. See *The Mandate Statement* of Covenant University as recorded in the Order of Proceedings of the 7th Convocation Ceremony of Covenant University, Ota, tagged *The Release of Eagles 2012*, which held on 29th June 2012. P. 2
11. The graphical representation made here on the dilemma of teachers and the influence of ITC and e-learning on students performance at CU was gotten from the pilot study done with the HMD 321 and HMD 121 students of Covenant University between the months of March and June 2012.
12. The graphical representation made here on the Influence of e-learning & Google+ in the 21 century Education and learning process is a result generated from a pilot study conducted between the months of March and June 2012.

Security in Inter-Cloud Communication

Sudhir Dhage and Akassh A Mishra

Dept of Computer Engineering
Sardar Patel Institute of Technology, Andheri
Mumbai, India

e-mail: sudhirdhage@gmail.com, akassh.mishra@gmail.com

Abstract—Cloud Computing is an upcoming technology which has various advantages over the current existing system. Since, it's a new technology there are various areas which needs to be improved such as security issues, virtualization, Intrusion detection, etc... The Present paper proposes an Application which makes a difficult task of Inter Cloud Communication secure and automated. The cloud which is implemented by various companies has different architecture and they contain tremendous amount of data. If two companies which have different cloud architecture want to share resources and data the application which the present paper proposes will help those companies to share their data as well as their resources keeping in Mind the security issues for data and resources. The Main idea for this implementation will be based on XML which can help in exchanging the data between the clouds and for handling the security issues the protocol SSL will be used. The future scope of this technology is tremendous, since one cloud can use the resources of other cloud and this could help some weak cloud architectures to process a very strong request in terms of resources by taking resources for some other external clouds.

Index Terms—PubSub Hubhub protocol; Diffie-Hellman; public cloud; private cloud; infrastructure; SSL.

I. INTRODUCTION

The Inter cloud is an interconnected global "cloud of clouds" and an extension of the Internet "network of networks" on which it is based. Inter cloud will have the dimensions of one machine comprising all servers and attendant cloud books on the planet.

The Inter cloud scenario is based on the key concept that each single cloud does not have infinite physical resources. If a cloud saturates the computational and storage resources of its virtualization infrastructure, it could not be able to satisfy further requests for service allocations sent from its clients. The Inter cloud scenario aims to address such situation, and in theory, each cloud can use the computational and storage resources of the virtualization infrastructures of other clouds. Such form of pay-for-use may introduce new business opportunities among cloud providers if they manage to go beyond theoretical framework. Nevertheless, the Inter cloud raises many more challenges than solutions concerning cloud federation, security, interoperability, Quality of Service, vendor's lock-ins, trust, legal issues, monitoring and billing.

II. RELATED WORK

Cloud Security Alliance is playing a role is securing the cloud. Security, which is one of the major concerns about cloud computing that, is delaying its adoption. One of the biggest security concerns about cloud computing is that when you move your information into the cloud, you lose control of it. The cloud gives you access to the data, but you have no way of ensuring no one else has access to the data. Therefore, Cloud Security Alliance provides "Guidance for Identity & Access Management".

III. PROBLEMS IN INTER-CLOUD COMMUNICATION

A. Security

The relative security of cloud computing services is a contentious issue which may be delaying its adoption. Issues barring the adoption of cloud computing is due in large part to the private and public sectors unease surrounding the external management of security based services. It is the very nature of cloud computing based services, private or public, that promote external management of provided services. This delivers great incentive amongst cloud computing service providers in producing a priority in building and maintaining strong management of secure services. Organizations have been formed in order to provide standards for a better future in cloud computing services. One organization in particular, the Cloud Security Alliance is a non-profit organization formed to promote the use of best practices for providing security assurance within Cloud Computing.

B. Open standards

Most cloud providers expose APIs which are typically well-documented but also unique to their implementation and thus not interoperable. Some vendors have adopted others' APIs and there are a number of open standards under development, including the OGF's Open Cloud Computing Interface. The Open Cloud Consortium is working to develop consensus on early cloud computing standards and practices.

IV. SOLUTION TO PROBLEMS IN INTER-CLOUD COMMUNICATION

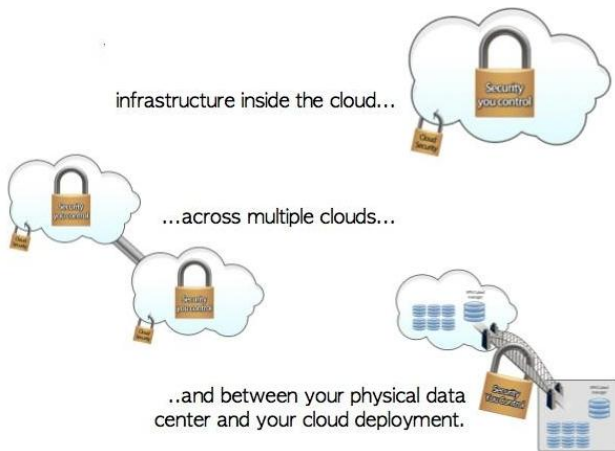


Fig. 1. Security Perimeter for Cloud Computing

As shown in figure 1 we can see the various security perimeters which describe where the security needs to be implemented.

A. Security in Infra structure inside the cloud

The Main issue with cloud computing is that when we move our information into the cloud, we lose control over it. The cloud gives us access to the data, but we have no way of ensuring no one else has access to the data. How can we protect ourselves from a security breach somewhere else in the cloud, Is the main question that needs to be tackled?

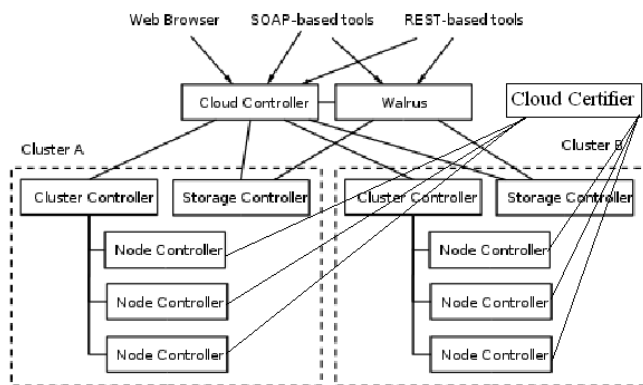


Figure 2 Secure Cloud Architecture

SSL protocol is the basis of all that protocol that implements security. For handling security Cloud will contain one more component known as “Cloud Certifier” is installed. Cloud Certifiers assigns and contains all the public key of node controller. Whenever a request is allocated to a particular node corresponding public key is sent to user as an http response or can also be sent using pub sub hub bub protocol which can make this process instantaneous. Cloud Certifier is responsible for assigning maintaining reviewing node controller key within the cloud infrastructure so that there is no external intrusion that takes place in cloud.

B. Security across multiple clouds

In this Security aspect also cloud certifier plays an important role. Cloud Certifier not only manages node controllers but also maintains a unique key for the whole cloud architecture which helps in inter-cloud communication. Unique key will only come in picture when a Particular cloud approaches another cloud for resources or data sharing. This unique key will be exchanges between the clouds using “Diffie-Hellman Algorithm”. After that what ever request and response any cloud wants to send to other cloud is secure.

C. Security in Data centers and clouds deployment

This security aspect is the makes use of above two algorithms for data interaction. When the data is sent from data centers to cloud it is encrypted with cloud’s unique key. No role is played by public and private key of Node controller in this aspect of security.

- 1) *Open Standards:* Open standard issues can also be solved to some extent by use of XML as the backbone of request response. A request about the resource can be standardized in a particular format which could help in communication irrespective of different standard and architecture and correspondingly a particular response will be generated which will also be in XML format. Open Standards issue can be handled by standardizing request response process.

V. CONCLUSION

The present paper proposes a solution to overcome the problem of security in inter-cloud communication by use of basic security protocol SSL and pubsubhubbub protocol for instantaneous sending of request. It also proposes to uses Diffie-Hellman Key exchange algorithm which helps in transferring symmetric key across the cloud. The present paper also introduces a change in architecture of cloud but introducing a new component called “Cloud Certifier”, which will maintain the private and public keys for all the node controllers and also contains a Unique Cloud key which is used in Diffie-Hellman algorithm.

The problem of Open Standards is solved to some extent by using a universal structured data formatter, XML which can be used for sending request and response across the different standards and architecture. In short standardizing a request and response process leads to solution of open standards issue.

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Proposed Interference Temperature Model for Improved Spectrum Efficiency in Cognitive Radios

B. S. Olanrewaju and O. Osunade

Department of Computer Science, University of Ibadan, Ibadan

E-mail: bs.olanrewaju@gmail.com, seyiosunade@gmail.com

Abstract

Spectrum management has become an important aspect of telecommunication due to the need to manage the limited radio spectrum resources caused by the widespread use of wireless devices. Cognitive Radio (CR) technology has been a key approach for dynamic spectrum access for maximizing the usage of scarce radio spectrum. However, the potentials of cognitive radio are not maximized based on the two broad divisions of dynamic spectrum access. In the overlay approach, cognitive radios referred to as secondary users (SUs) are able to opportunistically use spectrum whenever licenced users referred to as primary users (PUs) are absent. In the case when a PU signal reappears, cognitive radios must vacate the spectrum to avoid causing interference. The disadvantage of this approach is that it does not allow SUs to coexist with the PUs. In the underlay approach used by interference temperature model, an upper interference limit is set up for a given frequency band in a specific geographic location such that the cognitive radio users are not allowed to transmit above the set limit in order not to cause any harmful interference to the PU while using the specific band in the specific area. The disadvantage of this approach is that even when licenced users are absent, CR users cannot transmit above the set interference limit even though doing otherwise would not cause any harmful interference. Thus, this work seeks to develop other implementations of dynamic spectrum access and management for cognitive radios. In this paper an optimised interference temperature model that improves spectrum usage, access and management is presented. Experiments and simulations will be done to verify the proposed model.

Keywords: telecommunication, spectrum management, cognitive radio, frequency

Introduction

From the period of smoke signals method of communication, telecommunication technology has been continually experiencing steady improvement and growth. In the present time, wireless communication which is the major means of communication is growing by leaps and bounds. Wireless technology depends on the limited radio frequency which is a part of the electromagnetic spectrum. Radio frequency spectrum is in the middle of the electromagnetic spectrum and it covers a

et al, 2007). The usage of radio spectrum and the regulation of radio emissions are coordinated by both national and international regulatory bodies but each country is at liberty to manage spectrum as it wishes so far it portends no interference risks to other countries (Cave et al, 2007). Spectrum among many other things is used for Broadcast systems, Personal Communications Systems, Point to Point directional systems, Non-communication transmitter/receivers such as Radar systems for air traffic control, weather forecast, and other national security purpose use, Satellite Systems, Passive listeners:(primarily astronomical- space surveillance and remote sensing, and weather uses), and Short range uses (E.g. Bluetooth and WiFi) (CSMAC, 2008).

A large and growing part of the world's output relies upon use of spectrum for large varieties of things. According to Steenkiste et al (2009), wireless technology is proliferating rapidly with over 3 billion wireless devices, most of which are cell phones and mobile computers, and the number is expected to increase to approximately 100 billion by the year 2025. This rapid proliferation of wireless systems that demands for more spectrum bands is a problem that must be addressed through viable technology for significant improvements in spectrum efficiency and increased robustness and performance of wireless devices (Steenkiste et al, 2009). Dirk-Oliver (2009), describes radio spectrum as a scarce, finite natural resource which can neither be created nor destroyed and also as a competitive public good.

The key purpose of spectrum management is to maximize the value that society gains from the radio spectrum by allowing as many efficient users as possible while ensuring that the interference between different users remains manageable (Cave et al, 2007). Spectrum management as stated by Taylor (2003), entails delivering many information communications technology (ICT) services that requires the scarce and finite resource on a competitive basis, complex planning to ensure efficient use of it, and frequency allocation,

operations. Spectrum management provides each user with the right to transmit on a particular frequency over a particular area, typically in the form of a licence. In a licenced spectrum, only the licensee has the right to use the spectrum in that particular area. A few bands designated as unlicensed spectrum, allow users to share spectrum but with restriction to limit the consequences of interference (Cave et al, 2007; Peha, 2008).

Researchers have however, shown that most allocated spectrum sits idle at any given time (Norton, 2007; Peha, 2008; Danda & Gonjun, 2011). Spectrum allocation is necessary in order to ensure interference free operation for each radio service. However, when exclusive right (licenced spectrum) is given to a particular user to operate in a particular frequency, some sort of inefficient usage of the spectrum is inevitable. This is because the spectrum lies idle when the licensee is not using the spectrum and this limit the introduction of new technologies by supposedly shortage of spectrum which in much of the time sits idle (Cave et al, 2007). Unlicensed spectrum opens up the possibilities of better usage of spectrum by allowing sharing among different users (Steenkiste et al, 2009). But this sharing of the unlicensed spectrum also known as open spectrum sharing, must be properly coordinated to ensure that there is no reduction in the quality of service due to interference of multiple users.

Prevention of interference between systems by giving each system exclusive access to a block of spectrum leads to spectrum idleness whenever such a system is not transmitting because no other systems can make use of it (Peha, 2008). In order to improve the efficiency of spectrum, radio systems are allowed to coexist in the same spectrum through dynamic

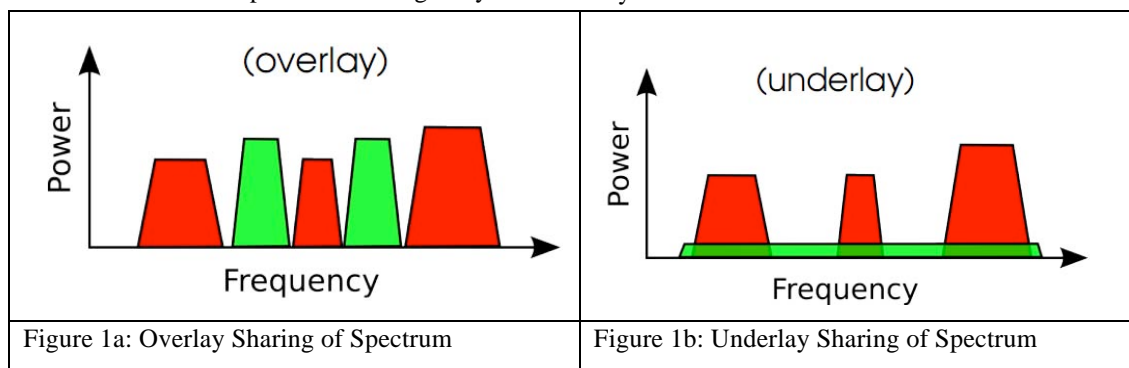
spectrum access (DSA). Effective spectrum utilization is achieved when one device transmits while others are idle. Dynamic spectrum access sharing could be between Primary and Secondary users (i.e. licenced and unlicensed users) or among different secondary users in open spectrum band.

One important aspect of DSA is spectrum sensing for opportunistic usage. There are several sensing techniques with their advantages and disadvantages.

Statement of the Problem

The increasing demand for spectrum in recent years due to the introduction of new wireless technology has put pressure on spectrum manager to evaluate spectrum utilization for the purpose of identifying idle channel for re-use (Kimmo, 2004; Mark, 2007; CRFS, 2010; ACMA, 2011). The observation is that most of the licenced spectrum at some time in a particular location lies fallow when the primary user is not transmitting while the unlicensed spectrum band is increasingly being overcrowded (Mark, 2007; Patrick, 2008; Pasi & Aleks, 2009;). In order to meet the demand for spectrum, new technologies to efficiently utilize the limited resource are being developed. One of these technologies is cognitive radio which is designed to opportunistically use licenced spectrum when licenced users are inactive (Patrick, 2008; Steenkiste et al., 2009).

The current spectrum sensing techniques in cognitive radio are not maximizing the opportunistic usage of the spectrum. In the overlay approach shown in Figure 1a, CR uses the spectrum only when licenced users are not present. Even when primary users' usage of the spectrum is low, CR cannot use it at all when usage at restricted transmission would not have cause any harmful interference.



Legend

	Secondary User
	Primary User

In the underlay approach shown in Figure 1b, CRs are allowed to share and coexist with primary users in the spectrum but with the constraint that CRs users cannot transmit above a set limit, so as not to cause harmful interference to primary users. The shortcomings of this approach is that when primary users are not even present, CRs users still cannot transmit above the set limit even though doing so will not affect primary users as they are inactive during the period.

The need to opportunistically and maximally use the under utilized licenced spectrum band, is the aim of this paper; that is to correct the disadvantages of the two approaches being used in cognitive radio. This paper addresses how to ensure that cognitive radios, through interference temperature model spectrum sensing technique, use vacant spectrum optimally when licence users are not transmitting. To solve this question, other issue that has to be addressed is how to develop an algorithm under the interference temperature model for cognitive radios, to know to transmit within the interference temperature limit when primary user is present, and to transmit optimally when primary user is absent?

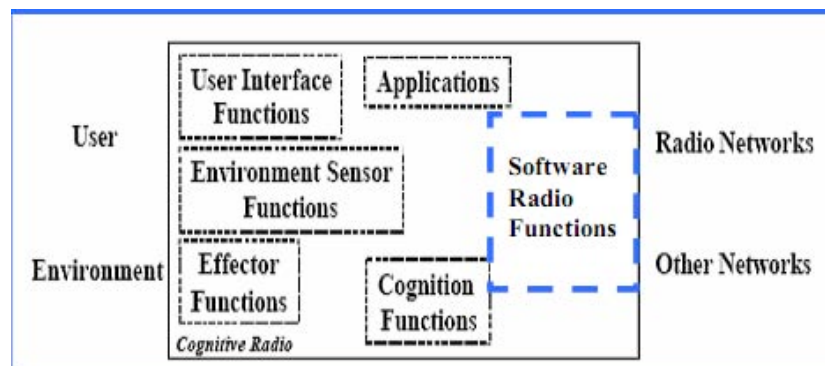
According to James (2006), because the current approach to spectrum access has not kept up with spectrum demand, there appears to be scarcity of electromagnetic spectrum. However, the introduction of cognitive radios has significantly affected spectrum management policy which has led to the idea of opportunistic spectrum utilization for finding available spectrum to improve coverage and capacity (James, 2006; Yuguchi, 2008). Finding available spectrum requires the ability to sense the absence or presence of licenced users and this is a major

challenge for cognitive radios (Yonghong et al., 2009). Different sensing techniques classified as overlay and underlay approaches have been developed but with identified shortcomings. The overlay approaches make use of available spectrum only when licence users are absent and completely vacate the spectrum when the presence of licenced users is felt. The underlay approaches make use of available spectrum by coexisting with licenced users but cannot transmit above a set limit even when the licenced users' presence could not be felt.

This work addresses the shortcomings identified by optimising the interference temperature underlay approach. This approach is preferred to the overlay because it allows cognitive radio users to coexist and transmit simultaneously with licenced users. In the optimised model, cognitive radio users will be able to use the available spectrum optimally when the licenced users' absence is noted unlike in the existing model where cognitive radio users are restricted to the set fixed transmitting parameters.

Literature Review

The term cognitive radio defines the behaviour of wireless devices and the related networks to be sufficiently, computationally intelligent about radio resources and related computer-to-computer communications to detect user communications needs and to provide radio resources and wireless services most appropriate to those needs (Norton, 2007). A cognitive radio is a software radio equipped with sensors and software that allow it to perceive the operating environment and learn from experience. Figure 2 shows the components of a cognitive radio as adapted by Kimmo (2004).



Cognitive radios by design are capable of sensing their environment and thereby make necessary changes in their transmission parameters to use the spectrum when primary users are inactive and to leave when licence users reappears (Clancy, 2006; James, 2006; Narayan, 2008; Yuguchi, 2008; Steenkiste et al., 2009). From software defined radio (SDR) which was conceived by Joe Mitola in 1991, comes the idea of cognitive radio as an option to the problems inherent in SDR (James, 2006). Cognitive radio is a technology for spectrum sharing that recognizes vacant bands of spectrum and adjusts autonomously its transmission to one of the bands by using SDR technology (Yuguchi, 2008).

Cognitive radio technology is expected to improve spectrum access through: increased spectrum efficiency of licenced spectrum users; secondary markets by allowing licensees to lease their spectrum access e.g. by machine-controlled negotiation between systems; automated frequency coordination between licensees; opportunistic spectrum use by unlicensed devices while protecting incumbents from harmful interference (Kimmo, 2004).

Radio functionalities are major challenges in cognitive radio as it requires a considerable amount of intelligence from the transmitting device. Cognitive radio need to detect the presence of primary users in a licenced spectrum and quit the frequency band as quickly as possible if the corresponding primary radio emerges in order to avoid interference to primary users (Kimmo, 2004). From the definition of cognitive radio, Akyildiz et al (2008) highlighted two main characteristics of cognitive radio to be cognitive capabilities and re-configurative capacities. This means that a cognitive radio will be able to detect multiple idle frequency bands and decides which frequency band to use since it is in most cases unrealistic that the user will be able to pick the right band (Steenkiste et al., 2009). In other word, cognitive radio systems require the four major management functions of spectrum sensing, spectrum decision, spectrum sharing and spectrum handoff or mobility (Wang & Wang, 2010).

The spectrum sensing techniques in cognitive radio is discussed under five main categories namely, Transmitter detection, Primary receiver detection, Cooperative Sensing, Interference Temperature Management, and Other Approaches.

- A. Transmitter detection:
 - i. Matched Filter (MF): This sensing technique performs optimally if transmitted primary signal is known at secondary receiver. It requires perfect knowledge of primary user signaling features and this makes implementation complexity to be very high because it needs to identify different signal types (Danda & Gonjun, 2011). MF is the most complex in terms of implementation but also, has the highest accuracy among the sensing techniques (Mansi & Gajanan, 2011).
 - ii. Covariance based detection: Exploit the covariance of signal and noise and detect signals by covariance matrix of received signals (Danda & Gonjun, 2011).
 - iii. Waveform-based detection: Best when a known pattern of signal is present and requires short measurement time but it is susceptible to synchronization errors (Danda & Gonjun, 2011).
 - iv. Energy detection: It is a widely used technique because of its low computational and implementation complexities and its detection without prior knowledge of primary users' signal (Vinod, 2009; Mansi & Gajanan, 2011).
 - v. Cyclostationarity feature detection: Uses cyclostationarity properties of the received signals to detect primary user transmission and can detect signal under very low signal-to-noise (SNR) (Vinod, 2009; Mansi & Gajanan, 2011).
 - vi. Random Hough Transform based detection: Borrowed from image processing files and used for pattern detection (Danda & Gonjun, 2011).
 - vii. Radio Identification based detection: This technique is used in European Transparent Ubiquitous Terminal (TRUST) project for feature extraction which is then used by CRs to choose suitable transmission parameters (Danda & Gonjun, 2011; Mansi & Gajanan, 2011).
- B. Primary Receiver detection: Signal detection is based on primary signal identified on PU receiver's Local oscillator (LO) leakage power of RF by a SU (Lakshmi & Aravind, 2008; Danda & Gonjun, 2011). CRs must be close enough to PU receiver LO power leakage for detection (Danda & Gonjun, 2011).

- C. Cooperative Sensing: To reduce the challenges in accurate and reliable sensing of wireless environment, CRs can cooperate to perform channel sensing, this is done in a number of ways (Lakshmi & Aravind, 2008; Danda & Gonjun, 2011; Mansi & Gajanan, 2011):
- i. Centralized server based detection: A central unit collects all the sensed information from cognitive radio devices, process it and then broadcast it to all CRs.
 - ii. External detection: External agent performs the sensing on behalf of CR users
 - iii. Distributed detection: Each CR users has sensing ability and collaborates with other CR users
- D. Interference Temperature Management: Works as an ultra wide band (UWB) technology where the secondary users are allowed to transmit simultaneously with primary users using low transmit power and are restricted by the interference temperature level (Mansi & Gajanan, 2011).

In 2003, the Federal Communications Commission (FCC) introduced the concept of interference temperature (IT) for quantifying and managing interference. The idea is to regulate received power rather than transmitted power. Using this model, cognitive radios (CRs) operating in licenced frequency bands would be capable of measuring the current interference environment, and adjusting their transmission characteristics in such a way that their transmissions avoid raising the interference temperature over a regulatory limit (Clancy and Abaugh, 2007).

The model was proposed as a way to dynamically manage and allocate spectrum resources. It would allow unlicensed radios to sense their current RF environment and transmit in licenced bands, provided their transmission does not raise the interference temperature for that frequency band over the interference temperature limit (Clancy, 2007).

Interference management is one of the most important topics in cognitive radio networks since secondary user (SU) is allowed to reuse the spectrum of the primary user (PU) only if

SU do not cause interference and resulting degradation in the PU transmission (SENDORA, 2010).

Interference temperature model has been widely used for quantifying and managing the interference (Clancy, 2009). The idea is to regulate the received power rather than transmitted power since interference actually takes place at the receivers. Using this model, cognitive radios can measure the interference environment and adjust their transmission characteristics such that the interference to PU is not above the regulatory limits. However, one drawback of the interference temperature model is that it only regulates the average interference and not the absolute interference (SENDORA, 2010). The concept of interference temperature is identical to that of noise temperature. It is a measure of the power and bandwidth occupied by interference. Interference temperature T_I is specified in Kelvin and is defined as

$$T_I(f_c, B) = P_I \frac{(f_c, B)}{KB}$$

(1)

Where $P_I(f_c; B)$ is the average interference power in Watts centred at f_c , covering bandwidth B measured in Hertz. Boltzmann's constant k is 1.38×10^{-23} Joules per Kelvin degree (Clancy, 2007). There are two approaches in the interference temperature management, one of them is when the parameters of the primary system are known (ideal model), and the second one is when these parameters are unknown (generalized model) (Garcia, 2010).

According to Garcia (2010), some multiple access technique is needed in order to ensure that:

- i. Cognitive radios are using the bandwidth and the proper frequency range
- ii. Cognitive radios can communicate with one another effectively
- iii. There is a way to handle the management of lost connections and
- iv. There is proper performance in the cognitive radio users while all the regulatory

A multiple access technique called interference temperature multiple access (ITMA) uses interference temperature and CDMA to unify the concepts of dynamic spectrum allocation, medium access control (MAC) and power control (Garcia, 2010).

The ITMA protocol incorporates the ITMA Physical layer which manages the radio frequency properties of the cognitive link, and it configures parameters such as power and bandwidth; ITMA MAC layer computes the interference temperature limit and calculates the radio parameters then decides on transmission procedures; and higher MAC functions which is concerned with the selection of a proper centre frequency (Garcia, 2010).

The disadvantage of this approach is that CR users will not be able to transmit beyond the set interference temperature limit even with the absence of PUs in the spectrum band (Danda & Gonjun, 2011).

- E. Other Approaches: Danda & Gonjun (2011) and Mansi & Gajanan (2011) classify the following techniques which do not fit into the above classification as other approaches.
- i. Wavelet-based detection: Signal spectrum is decomposed into smaller non-overlapping sub-bands for detecting edges which are the boundary between the spectrum hole and occupied channel in the power spectral density (PSD) of a channel.
 - ii. Multi-Tapper Spectrum Sensing/Estimation (MTSE): Samples of received signal are

collected in a vector form and represented as a set of slepian base vectors to identify the spectrum opportunities in the targeted spectrum band.

- iii. Filter Bank based Spectrum Sensing (FBSE): This is a simplified version of MTSE which is better for large number of sampled received signals whereas MTSE is better for small samples of receive signals (Mansi & Gajanan, 2011).

Proposed Interference Temperature Model

The model described above limits transmission to T_1 at every instant of transmission even when the primary user is absent. The proposed model in this paper incorporates sensing capabilities in the ITMA protocol to detect the absence of primary users and thereby utilizing the spectrum maximally by transmitting above the temperature limit as shown in Figure 3. This will be done by designing an algorithm that will be implemented in the ITMA.

From the figure T_1 is the interference limit, B is the bandwidth required for the data to be sent, C is the capacity in bits per second, and L is the range of transmission. If the bandwidth is below a maximum value B_{max} , the data will be sent; otherwise there should be a back-off and wait for a lower T_1 . If it is necessary for the data to be sent, then it will be necessary to either reduce the capacity or the range of transmission is increased. At some point, if some time out period has expired while the value of C is smaller than C_{min} and the value L is higher than L_{max} , the system should change the centre frequency (Garcia, 2010).

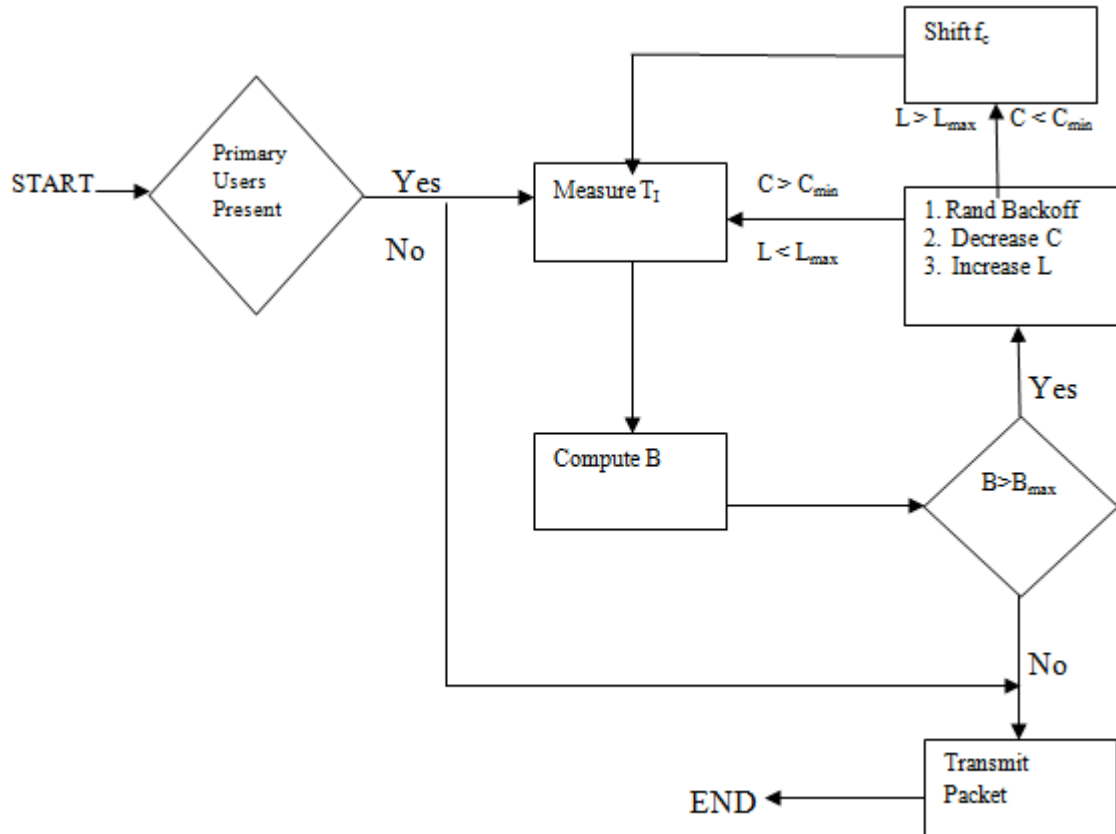


Figure 3: Medium Access Control layer (MAC) in the ITMA protocol of Proposed Model

Conclusion

When this model is implemented, it is expected to contribute to improved spectrum utilization in the underlay approach because cognitive radios will be able to exploit fully the inherent opportunities in dynamic spectrum access. If at any point in time or location there is an idle spectrum, instead of restricting the secondary users to the set temperature limit, cognitive radio will be able to utilize the spectrum maximally without any restriction to the temperature interference limit. Also when the primary user is present, with this model, cognitive radio will operate within the temperature interference limit to avoid harmful interference to the primary user. Therefore specifically, this model is expected to further open up the spectrum to allow more prospective users.

Future Work

The proposed model is to be compared with the existing model through experiments and simulations to verify the expected improved performance of the proposed model.

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SCrisis Terminator: A Computer Game Based Learning Approach for Reducing the Scourge of Sickle Cell Anaemia

Yetunde Folajimi¹, Howell Istance² and Vivien Rolfe³

¹Department of Computer Science University of Ibadan, Nigeria,

²Center for Computational Intelligence, De Montfort University UK

³School of Health and Life Sciences, De Montfort University UK

yetunde_folajimi@yahoo.com, y.folajimi@ui.edu.ng, hoi@dmu.ac.uk, VRolfe@dmu.ac.uk

Abstract

Computer game based learning approach has been described as an established means of educating players in an engaging and fun environment. One of the most important and challenging areas in this regard is how to design games to raise awareness of health issues in groups of younger children. It is expected that the game must be fun and engaging, and at the same time deliver the messages about the illness in a way that the children can understand, relate to and remember. As a result, this paper seeks to promote sickle cell health awareness among children between 6 to 12 years old. This includes children who have the condition as well as those who do not. Thus, by developing a computer game coined "Sickle cell terminator", we use game based learning approach to achieve our objective. Consequently, this paper presents a discussion of the game design its impact on the targeted audience in Nigeria and United Kingdom. The game design went through 3 different revisions as a result of evaluating it with groups of children. Preliminary tests of the designed game took place in the United Kingdom while additional tests were conducted in Nigeria. We found that the younger children (6 -8 years old) liked the game but didn't understand the idea of the blood disease and the health messages. The older children generally got the messages, but thought the game was too easy and not engaging. Lesson learnt include the fact that one game is not likely to meet all of the needs we have set as objectives.

Keywords: Sickle cell anemia, SCrisis Terminator, digital game based learning, videogame

Introduction

Technology is changing the way we think and the way we handle various situations including health interventions. Computer games or videogames are not left out of these radical changes in technology. A lot of people see video games as a means of entertainment while a number of attention have been drawn to the negative effects of playing videogames. However, there has been increasing interests in the concept of using digital games a means of education and entertainment, thereby leading to substantial research interests in serious games in recent years.(Durkin 2010).A serious game is defined by Annetta (2010) as videogame that is specifically designed for educational

patients with certain diseases or disabilities (Krichevets et al 1994; Szer, 1983). The use of videogames in health education is a groundbreaking example of how digital games can be applied constructively in an innovative manner.

In the face of existing medical interventions, technologies and personnel involved in healthcare delivery, a lot still have to be done by the patients in order to complement these efforts (Partridge, Kato, &DeMichele, 2009). Human beings, especially children do not naturally get used to the treatment and disease management rules easily. Kato (2010) suggests that the solutions to these problems are clearly complex, yet psychological and behavioral factors play an important role. As a result, digital games are groundbreaking tools that are increasingly being used deal with the psychological and behavioral roadblocks to the most favourable health care delivery. In the case of a disease like sickle cell anemia, there is need for the patient to be consciously aware of the do's and don'ts of managing the disease. Managing sickle cell disease becomes easier by children when they get used to the necessary preventive and maintenance strategies. As a result, we capitalize on the ability of computer games to engage players for a long time, while learning in a fun environment and utilize the opportunity to educate children about sickle cell disease

The essence of this paper is thus to explore the use of digital games in healthcare, especially in self-management of diseases by children. The rate at which digital games catch the attention of children and engage them while delivering the needed health information to them is an important novelty in this research.

This paper explores the use of digital games in healthcare, especially in self- management of disease by children. The rate at which digital games catch the attention of children and engage them while delivering the needed health information to them is an important innovation in this research. Consequently, the essence of this paper is to take advantage of the powers of digital games as an established innovative means of educating children in an interesting manner and leverage the benefits in educating children about the nature of sickle cell disease, and what can be done to promote good health in those who have the disease

tool named **SCrisis Terminator** meaning, **Sickle-cell Crisis Terminator**, game that helps children of ages 6-12 years to understand the nature of sickle cell disease and how best a patient can manage the disease.

Background Statement

Sickle cell anaemia is a genetically inherited disease that result in a disorder of the hemoglobin molecule, thereby hindering red blood cells from transporting oxygen to meet the body's requirements effectively. The disease is a genetic blood disorder, characterized by red blood cells that assume an abnormal, rigid, sickle shape. Sickling decreases the cell's flexibility and results in a risk of various complications commonly associated with the term "sickle cell crisis". The term "sickle cell crisis" is used to describe several independent acute conditions occurring in patients with sickle cell disease. In the UK, sickle cell is the most common single gene condition affecting 1 in every 2,300 births. On a global scale, 300,000 infants are born each year with these hemoglobin disorders, mainly in Africa. Most children die in infancy, but with new screening programmes and better health care surveillance being introduced, the survival rates will increase. In the Nigerian context, research relating to sickle cell anemia has consistently emphasized the need for more education about sickle cell disease among students (Bazuaye and Olayemi, 2009, Moronkola and Fadairo 2006). In these studies, only 32% of Senior Secondary School students knew their genotype, 12.9% claimed ABO blood group for their Hb genotype, while 55.1% did not know their Hb genotype. Also only 18% of the students had some/correct idea about sickle cell disease, 36% of the students knew the importance of premarital Hb genotype and only 15.1% believes that the disease is curable. The implications of their study were that majority of Senior Secondary School students do not know their Hb genotype, have a poor understanding of the disease and some will stigmatize patients with sickle cell disease. This is a major public health issue, and the impact of an early intervention among children has the potential to change this situation dramatically.

Consequently, researchers, as well as governmental and non-governmental organisations have continuously recommended intense campaigns against the disease thereby making various moves towards achieving this; including the sickle cell club and sickle cell foundation which have judiciously enhanced the awareness of the disease. Nevertheless, the majority of the awareness programs have been done through the media of newspaper, television and radio; journalists and other related professionals have mutually institutionalized one campaign or the other. However, none of these approaches are focusing on the use of latest technological advances, which bring the promise of new skills and greater youth participation in the society. Computer games are thus established means of

People who have sickle cell disease can control its effects if they understand the things that triggers sickle cell crisis and take steps to prevent this. A computer game is seen as a promising way to giving children this information. This paper is thus directed towards understanding how best computer games can be used to educate young people in particular about the nature of sickle cell disease, and what can be done to promote good health in those who have the diseases. **SCrisis Terminator** is a digital game based learning application directed at helping children within the age range 6-12 years to understand the nature of sickle cell disease and self-management techniques for children that have the disease. The game, which was recently publicized by the Lancet magazine (The Lancet, 2012), was created as part of the SCOOTER education resource project (<http://www.sicklecellanaemia.org/sickle-cell-anaemia/sickle-cell-anaemia-news-from-de-montfort-university>)

Digital Games and health education

Research has revealed that many students still fail to realize the concept of learning as it applies to games but there is a concession by teachers and education stakeholders that digital game based learning is an ideal tool for knowledge delivery if the needed interventions are readily available (Folajimi and Istance 2012). Games that are specifically designed for health education generally lay emphasis on ways by which we can promote healthy living among children by creating necessary health awareness and changing unhealthful attitudes. They could be utilized in diverse health domains including diet and nutrition, sexual health, non-terminal diseases and terminal diseases. *Squire's Quest* is a nutrition game to teach children the need to eat diets that can help prevent cancer and other serious ailments (Baranowski et al 2003). Studies with the game, which was developed by researchers at the Children's Nutrition Research Center in Houston, Texas, revealed that electronic game can promote healthier diet among children as compared to other school-based interventions. Another health education game is *Life Challenge*, a game aimed at preventing HIV/AIDS. It was developed by the New York State Department of Health to enhance adolescents' skill and self-efficacy regarding safer sex negotiation (Thomas, Cahill, & Santilli, 1997) describes an online game named *Hearth sense* was implemented to create awareness about hearth attack and increase speed of medical intervention. Sivlerman et al (2001) confirmed that the game gave a better knowledge of symptoms of heart attack disease and improved the thoughts of players about seeking emergency help without delay.

SCrisis Terminator

The game, **SCrisis Terminator** evolved with an initial conception from the Center for Computational Intelligence, De Montfort University. The game named **SCrisis** (meaning Sickle cell crisis), was aimed at educating young children about sickle cell disease

engage them on the subject. Developed with Adobe flash Actionscript Cs5, the game allows players to guide a red blood cell through the blood vessels of a human body depending on the temperature (Okai, 2012). The games mechanics were initially conceived to be similar to that of the popular flash 'Helicopter Game', where players guide a helicopter using just the left button on the mouse while avoiding stationary

obstacles. In the course of gameplay, the player avoids the red orbs and picks the blue orbs while the temperature is hot and avoids the blue orbs and picks the red orbs during hot temperature. The red blood cell turns it into a sickle shape when the player remains in the hot state or cold state for too long; this eventually terminates the game. Figure 1 is a screenshot of Scrisis

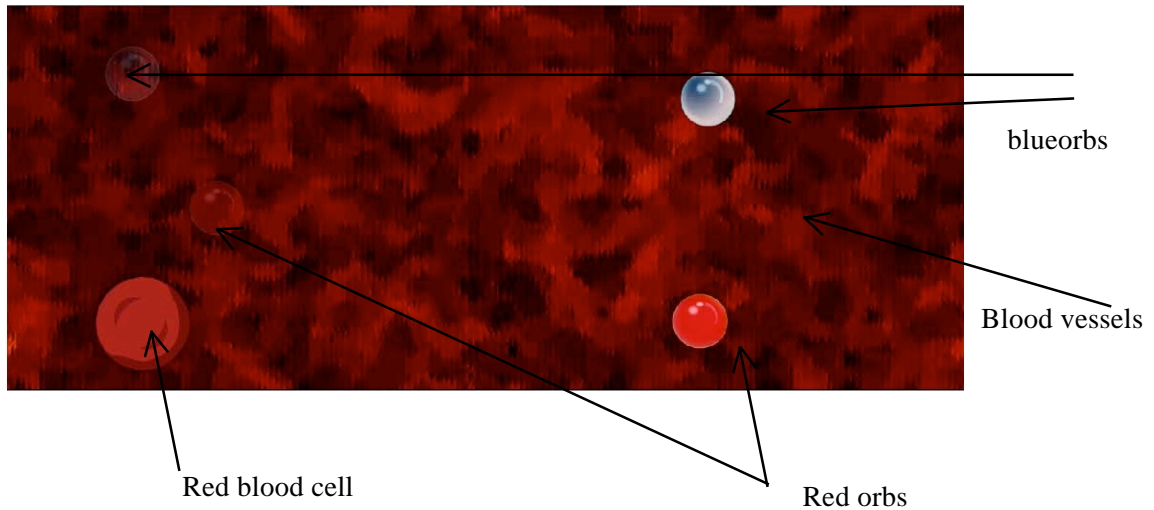


Figure 1: Screenshot of Scrisis

It was discovered that for the game to achieve the main objective of creating fun or entertainment while educating the players, we needed to fine-tune and add a number of functionalities and components to the game. These include:

- Scoring mechanism
- Improvement in the graphical user interface

- Faster red blood cell movement
- Improved collision detection
- Introduction, voice over and animation
- Introduction of smiley faces to express emotions

Figures 2 and 3 show the upgraded version of Scrisis

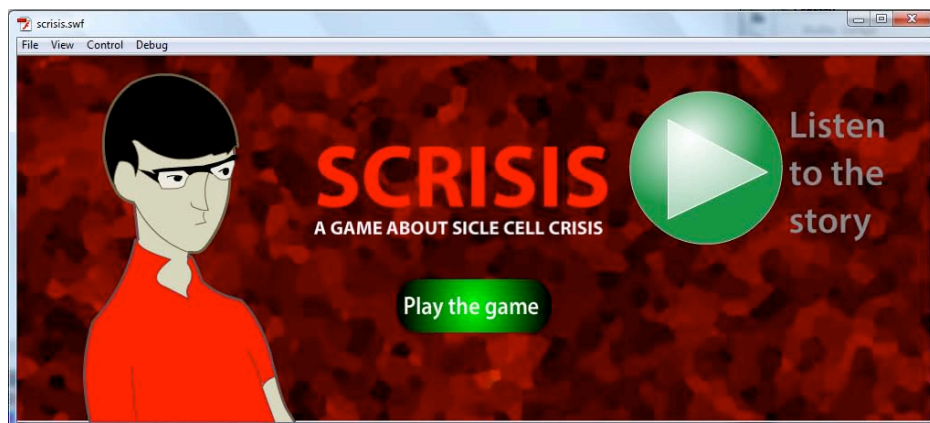


Figure 2: Upgraded version of Scrisis

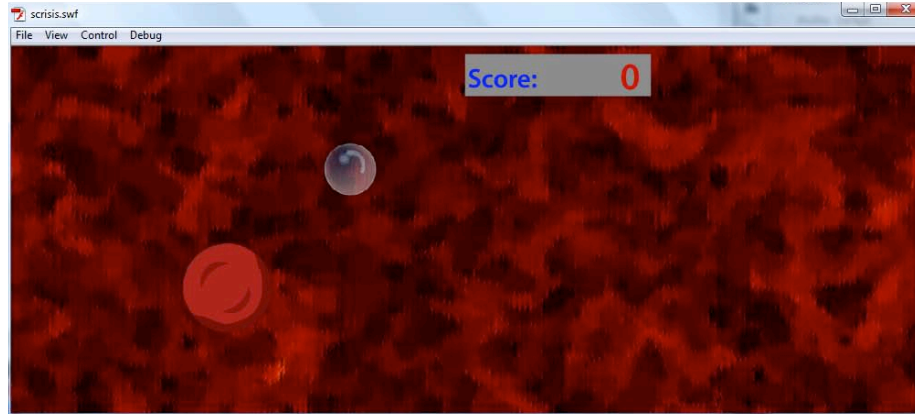


Figure 3: Scrisis newer version at play

Upon upgrading, we initially evaluated SCRISIS with some British-Nigerian children. The results suggested that more work have to be done for the game to really catch the attention of children. To achieve this, we did

a complete re-design and developed a new game named SCris Terminator meaning sickle-cell Crisis Terminator. Figure 4 presents screenshots of the newer game, Scrisis Terminator.



Figure 4: screenshots of SCrisis Terminator

The idea of the game is to keep the character ST healthy for as long as possible. To do this, ST has to watch out for the temperature condition. A bright (red) sunny background implies hot temperature while a blue (snowy) background implies cold temperature. When the temperature is hot, ST needs to gather as much blue orbs as possible in order to cool and as much red orbs as possible to keep warm in cold weather. ST also has to avoid the mosquitoes that appear intermittently on stage because they are capable of dropping ST's life at every bite. There is provision of medications in form of capsules, to be taken by ST to increase the lives but these capsules have to be carefully managed in order not to run out of them too soon.

Evaluating SCrisis Terminator with Case Studies:

Designing games to raise awareness of health issues in groups of younger children is challenging. The game must be fun and engaging, and at the same time deliver the messages about the illness in a way that the children can understand, relate to and remember. The target audience is children between 6 and 12, and includes children who have the condition as well as those who do not. It's important that children in the

understand something of the health risks that people with the condition face.

Preliminary testing of the game had taken place in the UK. The evaluation study has several different dimensions: younger and older groups within the age range 6 to 12, Nigerian or British cultural background, whether the game player has the condition or not (in the latter case then no previous knowledge of the disease can be assumed). The study has assessed how much the children enjoy playing the game as well as how much of the health directed content they can recall and understand afterwards.

The design of the game has gone through 3 different revisions as a result of evaluating it with groups of children. This is a process of iterative user-centred design, well known in the field of human-computer interaction. The first tests were to see whether the game was enjoyable to play. The second tests were to see whether older and younger members of the target group liked the game and understood the health messages. This resulted in a major change to how the background information about the disease and its relation to the game was presented to the person playing the game. The third set of tests with a larger group of children (6) was aiming at seeing how

entertaining and informing. We found that the younger children (6 -8 years old) liked the game but didn't understand the idea of the blood disease and the health messages. The older children generally got the messages, but thought the game was too easy and not engaging. Experiment with a larger set of children in Nigerian schools reveal that despite the limited infrastructure and access to technology, Nigerian children learn quickly, easily get used to playing the game and easily understand the knowledge delivered. As justified in Chiemeke and Folajimi (2010), computer games can shape the future of Nigerian children despite the limited infrastructure. In any case, the younger children feel more entertained with the game while the older children are looking for more challenging activities. This confirms the requirement for additional and diversified games to meet all the earlier set objectives.

Conclusion

This paper has discussed the role of games in promoting health awareness among children, with particular emphasis on sickle cell anemia. Lessons learnt include the fact that one game is not likely to meet all of the needs we have set as objectives. We are currently undergoing a larger set of tests in Nigerian schools and we are also exploring other types of games.

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Using Statistical Machine Translation (SMT) as a Language Translation Tool for Understanding Yoruba Language

Yetunde O. Folajimi¹ and Omonayin Isaac²
 Department of Computer Science University of Ibadan
¹y.folajimi@ui.edu.ng, yetunde_folajimi@yahoo.com

ABSTRACT

Machine Translation (MT) is the task of automatically translating a text from one language to another. Though SMT systems are trained using large parallel corpora, they can never hope to have a complete coverage of unrestricted text. Machine Translation (MT) has been a focus of investigations by linguists, psychologists, philosophers, computer scientists and engineers. It will not be an exaggeration to state that early work on MT contributed very significantly to the development of such fields as computational linguistics, artificial intelligence (AI) and application-oriented natural language processing. This paper evolves as a part of the efforts geared at finding solution to the problems of language barrier in the world. Consequently, the paper describes Statistical Machine Translation (SMT) system that translates English sentences to Yoruba sentences. The resulting software provides tools to tackle the problem of language translation between Yoruba (Nigeria language) and English language. The main challenge with the Yoruba language is that there is no English - Yoruba parallel corpus, hence we need to create English - Yoruba parallel corpus. The software employs a machine translation paradigm where translations are generated on the basis of statistical models whose parameters are derived from the analysis of bilingual text corpora. Design architecture and experimental results revealed that statistical machine translation is indeed a veritable tool for translating between English and Yoruba languages due to the fact that there is no parallel corpus between the English and Yoruba languages.

INTRODUCTION

Machine Translation (MT) can be defined as the use of computers to automate some or all of the process of translating from one language to another. MT is an area of applied research that draws ideas and techniques from linguistics, computer science, Artificial Intelligence (AI), translation theory, and statistics.

It has come to be understood as an economic necessity, considering that the growth of international communication keeps intensifying both at government (European Union EU, United Nations Organization UN) and business and commerce levels (exporters need product documentation in the languages of the countries where their products are marketed). The demand for faster and cheaper translations is strong indeed. The world is becoming a global village and

the growth of the economy, technology and other sectors of a country are dependent on the relation she has with other countries. The need for translation from English language to a local language is becoming paramount. Machine translations have helped a big deal in combating these language barriers. Due to these developments, the need for a proper communication channel between people of different languages and countries is very eminent. Overcoming the problem of language barrier in the world is the main reason for this research. Thus, we provides tools for tackling the problem of language translation between Yoruba (Nigeria language) and English language. Yoruba language is one of the mostly spoken languages in Nigeria with over 20 million speakers in the south-western part of the country. After a thorough research, it has been discovered that there is no parallel English – Yoruba corpus and hence no English – Yoruba statistical machine translator.

This paper thus provides a discussion of the software tool (statistical machine translator) that performs translation from the Nigeria indigenous language of Yoruba into English language and vice-versa based on the statistical approach of machine translation. The software employs a machine translation paradigm where translations are generated on the basis of statistical models whose parameters are derived from the analysis of bilingual text corpora.

BACKGROUND STATEMENT

Like translation done by humans, MT does not simply involve substituting words in one language for another, but the application of complex linguistic knowledge: morphology (how words are built from smaller units of meaning), syntax (grammar), semantics (meaning), and understanding of concepts such as ambiguity. The translation process may be stated as:

1. Decoding the meaning of the source text and
2. Re-encoding this meaning in the target language.

To decode the meaning of the source text in its entirety, the translator must interpret and analyze all the features of the text. This process requires in-depth knowledge of the grammar, semantics, syntax etc of the source language and the same in-depth knowledge is required for re-encoding the meaning in the target language. In general, a machine translation system

source language parser, translator, a target language morphological analyzer, a target language parser, and several lexical dictionaries. The source language morphological analyzer analyzes a source language word and provides morphological information. The source language parser is a syntax analyzer that analyzes the source language sentences. A translator is used to translate a source language word into the target language. The target language morphological analyzer works as a generator and generates appropriate target language words for given grammatical information. Also the target language parser works as a composer and composes suitable target language sentences. A machine translation system needs a minimum of three dictionaries such as the source language dictionary, the bilingual dictionary and the target language dictionary. The source language morphological analyzer needs a source language dictionary for morphological analysis. A bilingual dictionary is used by the translator to translate the source language into the target language; and the target language Morphological generator uses the target language dictionary to generate target language words.

RELATED WORK

Research has revealed that sentences are ill-suited for probability estimations, thereby necessitating a more refined approach. As a matter of fact, the first successful SMT systems worked on word level translation (Brown et al. 1990). However, some important developments have evolved and have found their way into machine translation. Kohen et al (2007) describes Moses as an open source toolkit that contains all required mechanisms for developing a phrase-based SMT system, and merely depends only relying on peripheral tools for implementing the language model and word alignment. Some key tools relevant in our SMT are described below.

MERT: MERT is a tool for minimum error rate training, which is included in Moses. This tool is the minimum error rate training in (Och, 2003, Venugopal and Vogel, 2005). this tool has been extended to randomized initial conditions, permuted the model order to deal with the greedy nature of the algorithm, and tune the dynamic parameter range to increase their potential relative impact. This tool is used to optimize decoding performance.

BLEU: Wikipedia defines BLEU (Bilingual Evaluation Understudy) is an algorithm for evaluating the quality of text which has been machine-translated from one natural language to another. Quality is considered to be the correspondence between a machine's output and that of a human: "the closer a machine translation is to a professional human translation, the better it

individual translated segments—generally sentences—by comparing them with a set of good quality reference translations. BLEU is designed to approximate human judgment at a corpus level, and performs badly if used to evaluate the quality of individual sentences. BLEU has frequently been reported as correlating well with human judgment,(Papineni2002b, Coughlin2003) and remains a benchmark for the assessment of any new evaluation metric. There are however a number of criticisms that have been voiced.

NIST: NIST is a method for evaluating the quality of text which has been translated using machine translation.

([http://en.wikipedia.org/wiki/NIST_\(metric\)](http://en.wikipedia.org/wiki/NIST_(metric))).It is based on the BLEU metric, but with some alterations. Where BLEU simply calculates n-gram precision adding equal weight to each one, NIST also calculates how informative a particular n-gram is. That is to say when a correct n-gram is found, the rarer that n-gram is, and the more weight it will be given.

TER: Translation Error Rate (TER) is an error metric for machine translation that measures the amount of edits required to change a systems output into one of the references. This technique is a more intuitive measure of “goodness” of machine translation output – specifically, the number of edits needed to fix the output so that it semantically matches a correct translation [Snover et al., 2006]. Human-targeted TER yields higher correlations with human judgment than BLEU

HunAlign: HunAlign aligns bilingual text on the sentence level (Varga et al., 2005). Its input is tokenized and sentence-segmented text in two languages. In the simplest case, its output is a sequence of bilingual sentence pairs (bisentences).

WordNet: WordNet is an electronic database for the English lexicon. It works by arranging words in English Language into sets of synonyms referred to as synsets and supplies concise definitions, and as well documents records in little words the various semantic relations between these synonym sets. The essence is to provide is to combine the dictionary and thesaurus in a more twofold: to produce a combination of dictionary and thesaurus that is more automatically operational, and to support automatic text analysis and artificial intelligence applications (<http://en.wikipedia.org/wiki/WordNet>).

METHODOLOGY

Desk Research is a major approach used in this study. It involved extensive surfing of the internet to acquire useful information and papers on the machine translation majorly on the statistical machine translation approach. So far many papers have being

linguistics and computer science. The reviewed papers have provided useful information which aided in the development of the software. Also the research involved testing of already existing translation machines to locate problems encountered during process and the problems encountered in each case were recorded and used in the development of the software. Due to the unavailability of English – Yoruba parallel corpus, some linguists were consulted to help with some word translations.

The programming languages used for implementation are Java and C++. The software was implemented using the following software components:

Parallel corpus

Parallel corpus is used for comparative language study, tradition of corpus linguistics statistical analysis used to discover patterns between languages, with little or no linguistic information. Parallel corpus offers a rich source of additional knowledge about language. The larger the corpora, the better the results.

“Bitexts are one of the richest sources of linguistic knowledge because the translation of a text into another language can be viewed as a detailed annotation of what that text means. One might think that if that other language is also a natural language, then a computer is no further ahead, because it cannot understand the original text. However, just the knowledge that the two data streams are semantically equivalent leads to a kind of understanding that enables computers to perform an important class of “intelligent” functions” (Dan Melamed, 2001)

Word alignment software

Word alignment software has the natural language processing task of identifying translation relationships among the words (or more rarely multiword units) in a bitext, resulting in a bipartite graph between the two

sides of the bitext, with an arc between two words if and only if they are translations of one another. Word alignment is typically done after sentence alignment has already identified pairs of sentences that are translations of one another.

Bitext word alignment is an important supporting task for most methods of statistical machine translation; the parameters of statistical machine translation models are typically estimated by observing word-aligned bitext, and conversely automatic word alignment is typically done by choosing that alignment which best fits a statistical machine translation model. Circular application of these two ideas results in an instance of the expectation-maximization algorithm.

Decoder

The task of the decoder is to use its knowledge and a density function to find the best sequence of transformations that can be applied to an initial target sentence to translate a given source sentence. This problem can be reformulated as a classic AI problem: searching for the shortest path in an implicit graph.

If you supply a translation model and a language model, the decoder translates text from one language (say, Yoruba) into another (say, English). These models are typically built from parallel corpora.

System Architecture

An external module was integrated within the baseline system; this was done because we believe that this module will improve the translation quality and accuracy of the system. Our module is the transliteration module. The module is responsible for identifying out of vocabulary words (OOV) and transliterating those words to reduce the presence of English words in the target Yoruba translation.

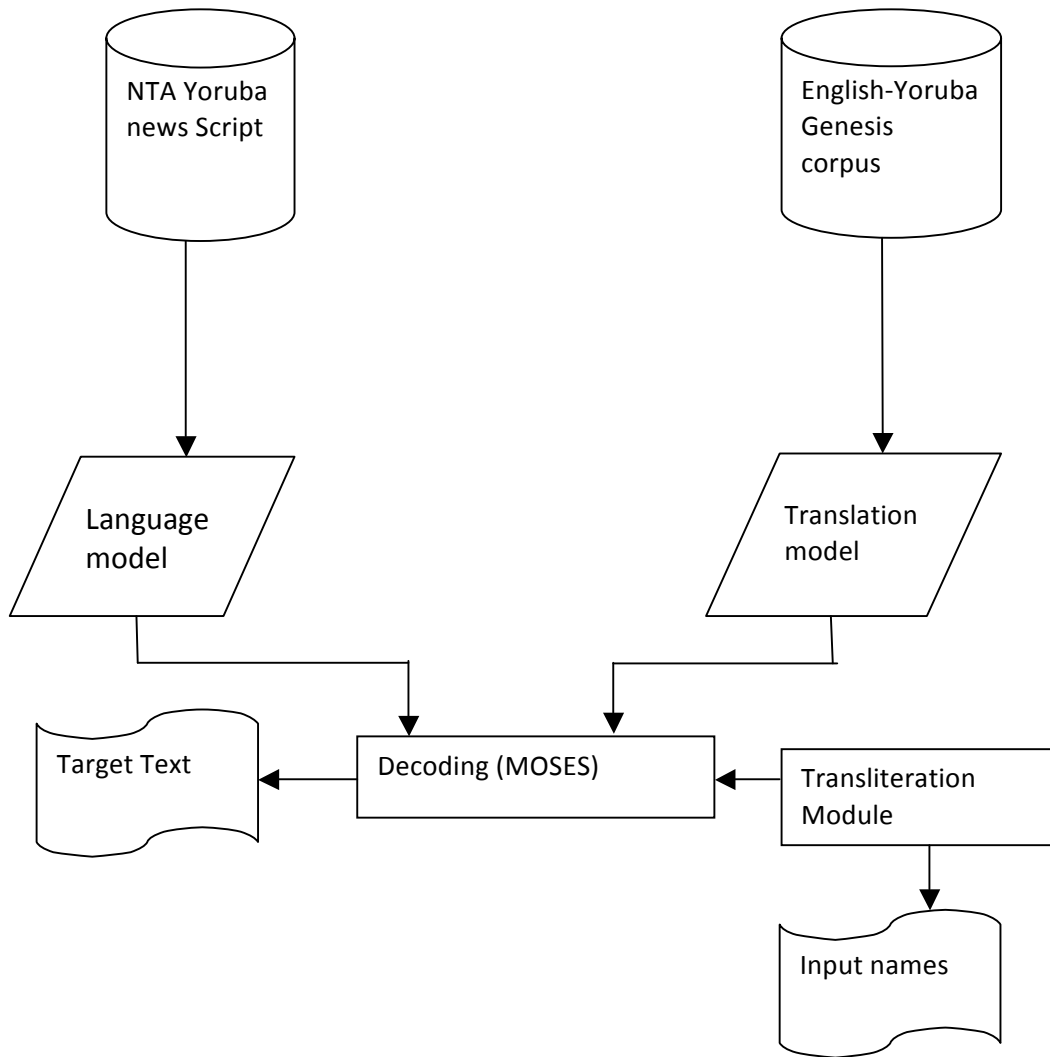


Figure 1: Combined System Architecture

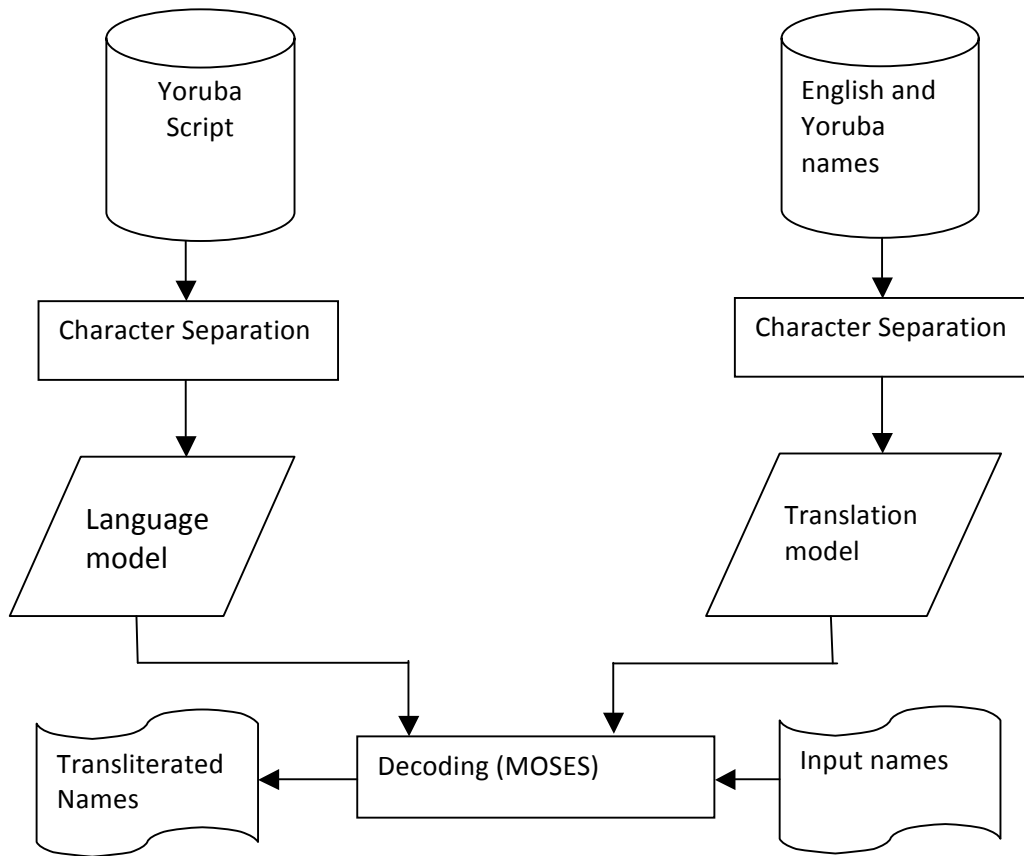
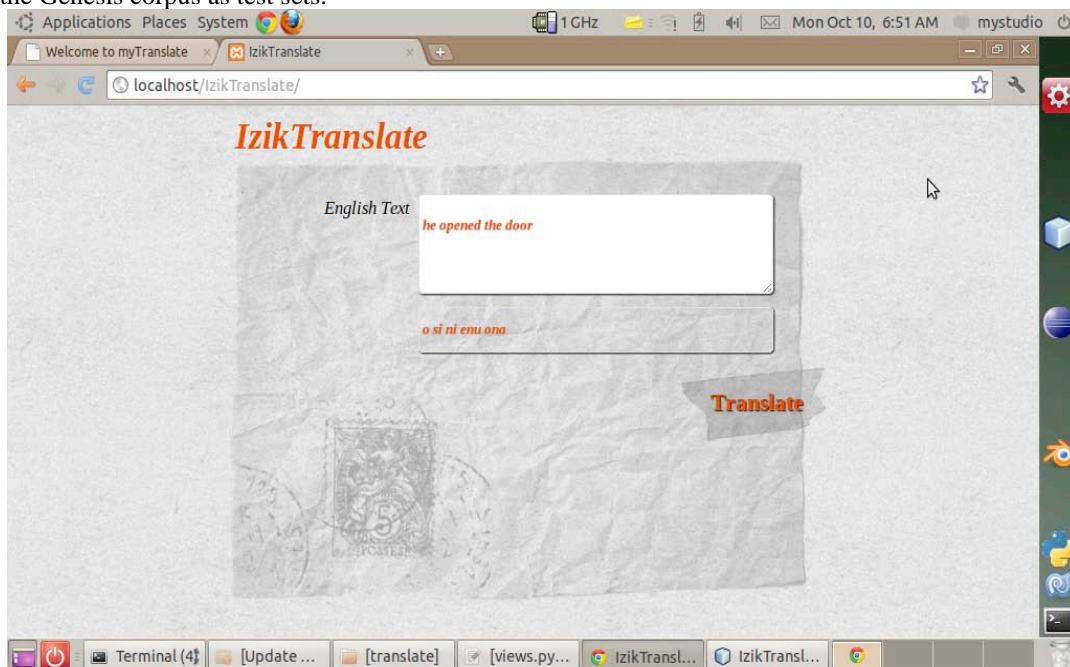


Figure 2:Transliteration Model Architecture

RESULTS AND DISCUSSIONS

The user interface of the system is shown in figure 3. We used the English and Yoruba bibles for our corpus. The translation system used the 2 sentence pairs from the John3 corpus, 2 sentence pairs from simple phrase corpus, 20 sentence pairs from the JT corpus, 2 sentence pairs from the omniglot corpus and 50 sentence pairs from the Genesis corpus as test sets.



Baseline Translation System

The Genesis English corpus contains 3935 sentences, while the Genesis Yoruba corpus has 1237 sentences. After some pre-processing, we got 914 sentences on both side of the corpus using bilingual sentence aligner. The processed English corpus contains 24777 words while the processed genesis Yoruba corpus contains 24203 words. The omniglot corpus contains 13 sentences on both sides. The omniglot Yoruba corpus contains 262 words while the omniglot English corpus contains 215 words. We have decided to separate 50 sentence pair from the genesis corpus and 2 sentence pair from the omniglot corpus for the development sets. We also separated the same number from both corpus for the test set. We used a 5-gram language model which is built from the omniglot corpus and the genesis Yoruba corpus. They contain a total of 27,626 words. Table 1 shows sample output of our baseline system.

English	Yoruba
and he commanded them	o si commanded them
then they speedily	then nwoyara
and i will make thee	Emi o si mu thee
if the woman	Biobinrinnaa
come sit down	wa sit down
go eat rice	Lo eat rice

Table 1: sample output of a baseline system

CONCLUSION

A human translator willing to use a state-of-the-art Statistical Machine Translation (SMT) system has two main options nowadays: to use an on-line translation system (e.g. Google Translate1) or to train his or her own MT system from scratch (e.g. Moses (Koehn et al., 2007)) using any available parallel corpus (e.g. Europarl2). Both options, however, present some important drawbacks. On one hand, the on-line systems are not customisable and might be inadequate if the user wants to translate sensitive data. On the other hand, installing an MT system with all its dependencies and training it requires technical expertise which is usually beyond the competences of an average translator. We have presented the framework for building SMT systems where each component is deployed on line. This way the user does not have to deal with technical issues regarding the tools, such as their installation, configuration or maintenance.

SMT systems require a significant amount of

There are not enough parallel corpora available between English and Yoruba to achieve quality translation using only a statistical MT system. Our system works reasonably well under the circumstances. It should be noted that though a lot of research has been on machine translation but little or no attention has been paid to Local languages of developing countries such as Nigeria. Also the few ones that have been do not follow the SMT approach which is the most reliable approach to machine translation. It is therefore recommended that more attention and research on SMT should be done to help translations of local languages of developing countries.

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Theoretical Comparison of Undersampling Techniques Against Their Underlying Data Reduction Techniques

¹Folorunso, Sakinat Oluwabukonla
Mathematical Sciences Department,
Olabisi Onabanjo University (OOU)
Ago – Iwoye, Ogun State, Nigeria

Adeyemo, Adesesan Bernabas
Computer Science Department
University of Ibadan (UI)
Ibadan, Oyo State, Nigeria

Abstract— The Class imbalance problem occurs when there are many more instances of some class than others. i.e. skewed class distribution. In cases like this, standard classifier tends to be overwhelmed by the majority class and ignores the minority class. This degrades the performance of the classifier as accuracy is tendered towards the majority class. Several techniques have been proposed to solve this problem. This paper is aimed at taking a survey of various undersampling techniques and makes a theoretical comparison with the properties of their underlying data reduction technique.

Keyword: Class Imbalance Learning, Data Reduction Technique, Nearest Neighbour (NN), Under Sampling technique, Prototype Selection.

1. INTRODUCTION

The class imbalance problem corresponds to the domain for which one class is represented by a large number of examples while the other is represented by few [1]. In such cases, standard classifier tends to be overwhelmed by the large classes and ignores the small ones. This imbalance causes suboptimal classification performance or even worse [2], [3]. It is one of the 10 challenging problems of Data Mining Research [4] and pattern recognition [5]. When the prediction model is trained on such an imbalance dataset, it tends to show a strong bias towards the majority class, since typical learning algorithms intend to maximize the overall prediction accuracy. In a problem with imbalance level of 99%, a learning algorithm that minimizes error rate could decide to classify all examples as the majority class in order to achieve a low error rate of 1%. However, all minority examples will be wrongly classified in this case [6]. The misclassification cost for the minority class, however is usually much higher than that of majority class and should not be ignored [7], [8]. Various techniques have been reported in the literature to alleviate the problem of class imbalance at both data and algorithm level [9]. Almost all the solutions developed were designed for a two-class problem, so a multi-class

problem have to be decomposed into several two-class problem or classify them directly for solution [5], [9], [10]. At the data level, the objective is to re-balance the class distribution by re-sampling the data space (e.g. sampling techniques). The main advantage here is that they are independent of the underlying classifier [11], [3]. Re-sampling technique balances the class distribution in the training data by either adding examples to the minority class (oversampling) e. g. SMOTE [12], [13] or by removing examples from the majority class (under sampling) [14], [11] and examples are Condensed Nearest Neighbour (CNN) [16], One-Sided Selectio (OSS) [17], Neighbour Cleaning Rule (NCL) [18], Tomek Link [19] and CNN+Tomek Link [20] or combination of both oversampling and undersampling technique [9], [21], [11]. Though majority class is undersampled, the decision based on the reduced dataset performs as well or nearly as well as the decision based on the original data set [51]. At the algorithm level, the solution is to adapt existing classifier learning algorithm to strengthen learning with regards to the minor class solutions. This is achieved either by: Adjusting the threshold or prior probability of the algorithm [13], [16], Cost Sensitive Learning (CSL) [22], [23], [24], [25], One Class Learning (recognition-based) [26], [2], [21] and Ensemble Techniques which combine the power of multiple (usually weak) classifiers trained on similar datasets to provide accurate predictions for future instances [27]. They can average prediction errors, reduce bias and variance errors [26], [10]. The basic idea of ensemble classification is to combine the strengths of several individual classifiers (weak) to achieve higher performance [10]. Performance of ensemble models is decided by the accuracy of individual classifiers and diversity among all classifiers. [26], [28]. Diversity allows voted accuracy to be greater than that of single classifier. Examples of ensemble techniques are RUSBoost [14], SMOTEBoost [30], RareBoost, AdaBoost[15], SMOTEBagging, UnderOverBagging etc. The basic ensemble techniques are Bagging, Boosting [29], [38], [10] and Random Subspaces [29], [27].

¹Corresponding author: Folorunso, Sakinat Oluwabukonla

The contributions of this paper are

1. To propose from a theoretical point of view the relationship between undersampling technique in class imbalance learning and prototype selection techniques.
2. To highlight the advantages and disadvantages of these techniques against their properties
3. To compare the various undersampling techniques in terms of their algorithm complexity, issues associated with their their underlying reduction techniques.

This aim of this paper is to surveys various Prototype Selection/ undersampling technique which aims at undersampling the majority class leaving the minority class sample intact as they are the class of interest. This is achieved by reducing the majority class dataset by means of selecting relevant prototypes (majority class sample). Most of the undersampling techniques reported in the literature are modifications of classic prototype selection methods to remove from the majority class [49]. Then, and compares these techniques with properties from their underlying reduction techniques. Section 2 discusses the various undersampling technique, briefly discusses Nearest Neighbour (NN) and properties associated with their underlying reduction technique as shown in Table 1. Finally, the last draws the conclusion and suggests some future direction.

2. RELATED WORK

Class imbalance problem has received much attention over the years. There have been researches and many algorithms have been developed to alleviate the class imbalance problem.

A. Background Knowledge

This section gives a brief review and background knowledge of various undersampling techniques reported in the literature. These techniques are success for simultaneously facing the computational complexity, storage requirement and low noise tolerance using data reduction/undersampling [14], [11], [16], [17], [18], [19], [20], PrototypeSelection [31], [32], [38], [39], [40],[49].

i. Reduced Nearest Neighbour (RNN) [44]: This algorithm starts with $S = T$ and removes each instance from S if such removal does not cause any other instances in T to be misclassified. It is

able to remove noisy and internal instances while retaining border points.

ii. Selective Nearest Neighbour (SNN) [38]: This method extends CNN such that every member of T must be closer to a member of S of the same class rather than to a member of T (instead of S) of a different class. Though, this algorithm is still sensitive to noise, there is great reduction in training set as well as a higher accuracy than CNN.

iii. Condensed Nearest Neighbour Rule (CNN) [16]:. This technique is used to find a consistent subset of examples and also to identify borderline examples. A subset E_i of E is consistent with E if using a 1- Nearest Neighbour, E_i correctly classifies the example E . Let E be the original training set. Let E_i contains all positive examples from S and one randomly selected negative example. Then classify E with the 1- NN rule using the examples in E_i . Move the entire misclassified example from E to E_i .

iv. One- Sided Selection (OSS) [17]:. This is combination of Tomek link followed by the application of CNN. Tomek Link is used to remove noisy and border line majority class examples. Then, CNN will remove example from the majority class that are distant from decision border. Then a consistent subset of the majority class is formed. The learner always keeps all positive examples (they are too rare to be wasted), noisy and prunes out only negative ones.

v. CNN + Tomek Link [20]: Here, the learner will first select a consistent subset of the negative examples using CNN and then use Tomek link to remove them. The training set becomes more balanced. The objective is to evaluate with OSS as finding Tomek link is computationally demanding, it would be computationally cheaper if it was performed on a reduced data set.

vi. Wilson's Edited Nearest Neighbour Rule (ENN) [16]: Wilson proposed an edited k- NN rule to improve the 1- NN rule. In his rule, editing the reference set is first performed: Each sample in the reference set is classified using the 3- NN rule and the set formed by eliminating it from the reference set. All the samples misclassified are then deleted from the reference set. Afterward, any input sample is classified using the 1- NN rule and the edited reference set.

vii. Neighbourhood Cleaning Rule (NCL) [18]: ENN rule is used to identify and remove majority class. The algorithm first finds the three nearest neighbours for each of E_i examples in the training set. If E_i belong to the majority class and it is misclassified by its three Nearest Neighbour (3-

¹Corresponding author: Folorunso, Sakinat Oluwabukonla

NN), then E_i is removed. If E_i belongs to the minority class and it is misclassified by its 3-NN to be the majority class, then removes the three nearest neighbour.

viii. Tomek Links [19]: This technique removes both noise and borderline example. Let E_i, E_j , belong to different classes, $d(E_i, E_j)$ is the distance between them. A (E_i, E_j) pair is called a Tomek link if there is no example E_1 , such that $d(E_i, E_1) < d(E_i, E_j)$ or $d(E_j, E_1) < d(E_i, E_j)$. Examples participating in Tomek link are either borderline or noisy.

B. Nearest Neighbours (NN)

Distance is evaluated from all training points to sample point and the point with lowest distance is called NN [45]. Given a set of previously labeled training set (TS), NN rule assigns a sample to the same class as the closest neighbour in the set, according to a similarity in the feature space [33], [34]. The basic NN algorithm retains all of the training instances, hence, requires relatively large storage, computational complexity and low noise tolerant [49]. It learns very quickly ($O(n)$ time) for it only needs to read in the training set without further processing [35] and generalises accurately for most applications [31]. Also, noisy instance are stored as NN stores all instances in the training set (TS) which degrades generalisation accuracy. Two broad groups techniques of undersampling reported in the literature were when the algorithm tries to remove erroneously labeled dataset and also "clean" the possible overlapping between regions of different classes referred to Editing [33]. The second group, which is aimed at selecting the minimal subset of training set (TS) but also lead to the same performance as the NN rule using the whole training set (TS) referred to as Condensing [34], [36]. These techniques include: Reduced Nearest Neighbour (RNN) [44], Selective Nearest Neighbour (SNN) [38], Condensed Nearest Neighbour (CNN) [16], One-Sided Selection (OSS) [17], Neighbour Cleaning Rule (NCL) [18], Tomek Link [19]

iv.

C. Properties/ Issues In Undersampling Techniques as adapted from [31], [32], [49].

- i. Representation: Instances (collection of training examples) could be represented using hyperrectangles, rules or prototypes [34]. Choices to be made when designing a TS undersampling algorithm are whether to undersample the original TS into a subset or to modify using a new representation.
- ii. Direction of Search: When searching to form a subset or modify training set (TS) to keep from the TS,

various direction of search reported in the literature were Incremental, Decremental and Batch.

- a. Incremental search: This begins with an empty subset S , and adds each instance of T to S if it meets some criteria. The advantage here is that instances can be added to S continuously with the same criteria after training is complete. Another advantage is that they are faster and uses less storage during learning. However, they are prone to errors: initial criteria are based on limited information, thus sensitive to order of presentation. e. g. EACH [47].
 - b. Decremental Search: Here, all examples are available for examination, so a decision can be made on which instance is best to be removed during learning. This search begins with $S = T$; then searches for instances to remove from S . Examples of algorithm belonging to this algorithm are RNN, SNN, ENN, SHRINK [40] and RISE [41]. Though, it can result in greater storage reduction but is often more computationally expensive.
 - c. Batch: All examples in the TS are available for examination. The examples that meet the removal criteria are removed from the TS at once. The algorithm is relieved from having to constantly update the list of nearest neighbours when instances are removed individually, but it suffers from increased time complexity.
- Border points Vs Central points: The decision to retain border point, central or some other point distinguishes one undersampling technique from another. Border points forms decision boundaries between classes so, removing them leaves smooth decision boundary behind. Noisy points are point that does not agree with their neighbours. 'Internal' or centre points do not affect decision boundaries so much and thus their removal will have relatively little effect on classification.
- Similarity (Distance) function: This is the distance between neighbours. It is used to decide which neighbours are closest to an input vector and can have a drastic effect on learning algorithm. The training points are assigned weights according to their distance from sample data point [45].
- a. Linear Distance function: Examples are Euclidean distance function, Mahalanobis e.t.c
 - b. Value Difference Metric for Nominal Attributes [42]: examples are Value Difference Metric (VDM).

¹Corresponding author: Folorunso, Sakinat Oluwabukonla

- c. Interpolated Value Difference Metric [31]: This function is appropriate for linear (discrete, but ordered), continuous (real valued) and nominal (discrete, unordered) attributes. e.g. Interpolate Value Difference Metric (IVDM).
- d. Heterogeneous Distance function [48]: This handles application with both continuous and nominal attributes e.g. Heterogeneous Euclidean-Overlap Metric (HOEM) and Heterogeneous Value Difference Metric (HVDM).
- v. Voting: k is the number of neighbours used to decide the output of a class of an input vector. The undersampling algorithm has to decide on value of k which is typically a small, odd integer (1, 3, or 5). Reference [43] propose a k -NN rule in which NN is calculated on the basis of value of k , that specifies how many NN are to be considered to define class of a sample data point.
- vi. Evaluation Strategies: Relative strength and weaknesses of each undersampling algorithm should be compared based on a number of characteristics namely storage reduction, speed increase, generalization accuracy, noise tolerance, learning speed [31], [32], Type of selection (Editing or Condensing) [49] and algorithm complexity [50].
- All the aforementioned undersampling techniques with issues against them are compared in Table 1 below. They all share similar advantages (Reduction in the size of the training data, Improves query time and memory requirement and reduces the recognition rate) and disadvantages (Computational complexity, high cost and time consuming) [45].

Table 1 Comparison of various undersampling technique against issues associated with the technique

Properties	RNN	SNN	ENN	CNN	ALL NN	K-NN	OSS	NCL
Presentation	Modified	Modified	Modified	Subset	Subset	Subset	Subset	Modified
Direction of search	Decremental	Decremental	Decremental	Incremental	Batch	Batch	Batch	Decremental
Border versus Point	Noisy & Internal point	Internal point	Noisy & Border point	Internal point	Noisy & border point	Noisy & border point	Noisy & border point	Internal and border point
Distance function		Euclidean	HVDM	Euclidean	Euclidean	Euclidean	Euclidean	HVDM
Voting			3-NN	1-NN	1-NN	1-NN	1-NN	3-NN
Author & Year	Gates (1972)	Ritters <i>et al.</i> , (1975)	Wilson, (1972)	Hart (1968)	Tomek (1976)	Kubat & Matwin (1997)	Kubat & Matwin (1997)	Laurikala, (2001)
Algorithm Complexity	$O(n^3)$	$O(n^2)$	$O(n^2)$	$O(n^3)$	$O(n^2)$			
Editing/ Condensing	Condensing	Condensing	Editing	Condensing	Editing	Editing & condensing	Editing & condensing	Editing

CONCLUSION

This paper exhaustively surveys different undersampling techniques reported in the literature and compared them against properties/issues associated with them. We have proposed a taxonomy based on the main characteristics studied in the literature. In future, we suggest the design of an undersampling technique that will have a good storage requirement, an investigation into the combine use of condensing and editing methods (mixed) is needed to consider applying the technique to real world applications, an extensive investigation into the use generalization accuracy, high execution

and reduced undersampling technique is also needed, and also the use of Proximity Graphs to provide various definitions of “neighbour”.

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Nigerian Computer Science Education and Open Source Software

O. Osunade

Dept of Computer Science, University of Ibadan, Ibadan, Nigeria.

Abstract. The exponential adoption of technology by literate and illiterate Nigerians is a threat to Computer Science education. The funding and support often provided to assist computer science departments are drying up with no new sources. Faced with limited resources and an increasing computer-literate student population Computer Science Educators are being pressured to modify or change the curriculum. The attractiveness of Open Source Software as a tool to prepare students and meet their needs has paved way for their use as tools for teaching, demonstration and practical sessions. This work examined the adoption of Open Source Software for teaching and practice in Computer Science Departments in Nigeria. The results show that open source software is yet to gain widespread use for teaching while students used Open Source Software to deliver successful final-year projects.

Keywords: Open Source Software, Education, Computer Science, Nigeria, Curriculum

1. Introduction

The Open Source Initiative's definition of Open Source Software (OSS) is: "software that must be distributed under a license that guarantees the right to read, redistribute, modify, and use the software freely [1]." The software goes through a type of natural evolution resulting in rapid development, increased reliability, and decreased cost. Open source software can be released under a variety of licenses. As of February 2010, the Open Source Initiative has approved 30 open source software Licenses [2]. Four licenses common to educational applications are the GNU Public License (GPL), the Lesser GNU Public License (LGPL), the Berkeley Software Distribution License (BSD), and the Mozilla Public License (MPL). Regardless of the license, releasing the code under an open source license allows others to find bugs, improve the algorithms, write documentation, or port the software to other hardware and software configurations.

Computer Science education started in Nigeria with the establishment of three Computer Science departments in 1973. The philosophy of the curriculum was to develop manpower to operate computing machines. This philosophy is still entrenched in the curriculum of most universities offering Computer Science at the undergraduate level. The infrastructure needed by computer science departments for the programs are no longer exclusive and funding is now a competitive process. The dwindling resources to train computer science students have led to the adoption of Open Source Software by many departments of computer science in Nigeria. Nigeria is the fastest growing market for telecommunication services in Africa. The telecommunication industry requires skilled manpower that can create products and services from computer codes. The current skilled manpower can only operate and not create, thus the telecommunication industry employs computer literate graduates who are then trained or retrained to meet the industry requirement. This reflects on the need to modify the computer science curriculum so as to develop skills and talents that can be applied to the contemporary world.

2. Literature Review

2.1. Open Source Software and Computer Science Education

Open source software offers tremendous benefits to the computer science education community. By using OSS, computer science educators and students can develop (or further the development of existing) software that can be used and improved upon by an international community. This not only provides the

student with a world-size laboratory and support staff, but also gives them experience in large-scale software collaboration and development. Distributed software collaboration has proven itself effective in the educational setting through the use of Internet-driven collaboration tools such as web pages and email lists [3]. These Internet-driven collaboration tools are the same as those that power open source development. Thus, the open source community can expose students to large-scale distributed software development. By using and developing OSS, not only is the student participating in a large distributed software community, but is also interacting with large, *real*, software code-bases.

GNU/Linux, an open source operating system, has also been presented as an educational technology to teach networking, databases, and system administration at the university level [4]. Students who are encouraged to build projects on top of OSS bases can build more interesting and exciting systems than they might have developed from scratch. Further, in order to succeed, they must work with a large code-base and associated documentation. If the code is well written and well documented, students learn how much can be accomplished with careful preparation. If it is not, students may take more care with their own work in the future. The best of these systems can be contributed back to the open source community.

Finally, due to the open and freely available source code, a high degree of verifiability can be attained [5]. By taking advantage of the open source development model, the methodology by which we learn, apply, and teach computer science will include peer-review.

2.2. The case for Open Source Software

Some advantages in using open source software in Computer Science education as discussed and experienced in [6, 7, 8, 9, 10] are:

- The cost for the university and the cost for students may be lower.
- Open source projects are advantageous for research as the user can get the source and is free to implement new ideas. They are great for teaching as students have the opportunity to make a difference in a project used by many people.
- Open source software allows the developer to port an application to another operating system. Proprietary software, is usually shipped on specific platforms.
- In many cases, an open source project is the de facto standard for that particular type of application. So, the user is working with the best application possible. Some examples are Apache Web Server, Linux Operating System, sendmail Mail Server.
- Open source encourages entrepreneurship, as students can directly use open source tools in order to develop a business idea without the up-front costs of proprietary programs.

The main disadvantage in using open source software is the fact that Linux usability on laptops is seriously affected by the lack hardware drivers especially for wireless, graphic cards and suspend/sleep functionality in laptops.

Adopting open source software for your courses is a challenge. Here are a few misconceptions and challenges that have to be overcome:

- Open source software is a niche market used only by a small group of hobbyists. In fact the opposite is true. There is wide adoption in the computer industry for open source software.
- There is no space on the lab computers to install this piece of open-source software. Decisions at the department level to use a certain open source software instead of a proprietary product helps in this case.

- Proprietary software is better and students learn more by using better software. Some open source projects are leaders in their market segment and many got great reviews from publications in the field. So it can be argued that there is no significant difference in what can be taught using open source software or proprietary software.

It is believed that both open source software and proprietary software have an important role to play in the computer industry of the future. It is not advocated to use only open source software for education but exposure to open source software is essential for students success.

3. Methodology

This work is exploratory in nature. It seeks to determine if open source software is used in teaching computer science curriculum at universities in Nigeria. Data was collected through interviews with undergraduate students and teachers in computer science departments. The interviews were carried out at some selected government and private universities in Nigeria. The collected data was used with secondary data such as Departmental prospectus for the initial analysis.

4. Results and Discussion

The results from the analysis are presented below.

Table 1: Categorization of Computer Science courses

Categorization	Number of Courses
General Courses	5
Software	19
Programming	7
Engineering	7
Management	4

A review of courses available on the curriculum of computer science courses for a four-year programme shows the distribution above. Table 1 indicates that teaching emphasis is on understanding software not in developing new software. The software courses include systems analysis and computer operating systems. Programming courses listed in the curriculum are Scientific Programming (Fortran) and Assembly Language.

Table 2: Computer Science Staff strength and Student population in some Nigerian Universities

University	Staff Strength	Student Population
University of Ibadan	21	350
University of Agriculture, Abeokuta	15	300
Ladoke Akintola University of Technology, Ogbomoso	20	420
Federal University of Technology, Akure	18	336
Obafemi Awolowo University, Ile-Ife	25	575

Table 2 implies that the staff to student ratio is adequate and sufficient for teaching and learning to be effective. Table 2 however does not reflect the teaching load of teachers especially as it relates to general courses offered by students from other departments.

Table 3: Student Enrollment over 4 years in a university

Departments	2011/2012	2010/2011	2009/2010	2008/2009
Chemistry	90	106	117	75
Computer Science	81	94	98	62
Physics	44	57	56	34
Mathematics	59	77	78	35
Statistics	55	63	55	25
Electrical Electronics Engineering	28			

The trend in Table 3 shows that the demand for enrollment in Computer Science at the university is high. The Information Technology sector is the major destination for employment seekers in Nigeria, thus this trend is likely to continue.

Teacher, do you use Open Source Software as learning material in your class?

This question when asked was answered in the negative by all the teachers. The reasons given include, it is not approved; it has no documentation; it requires a lot of programming; it needs the Linux operating system to work; i do not like anything free; it would require me to rewrite my lecture notes; and the software are always unpredictable.

All the teachers use the windows operating system on their personal and official computer systems. Some of the teachers also informed me that the Windows operating system was natural to them since they were introduced to computing on the windows platform. There are resources [11, 12, 13, 14] available for teaching and using Open Source Software in the classroom. If teachers are willing they can use the resources to teach concepts in a practical manner to students.

Student, do you use Open Source Software for school work?

The responses received varied with each student. The students were more adventurous than the teachers. The students used both Windows and Linux operating on their personal systems in several configurations such as dual booting and virtual machines. The students stated that they had to stick to what was taught by the teachers for success but when it comes to final-year projects they are free to use any type of programming language or software.

The students informed me that their knowledge of Open Source Software came from their participation in the Industrial Training. The Industrial Training allows students spend six months in training capacity at an organization offering information technology services or products.

Should Open Source Software be used for teaching and learning in Computer Science?

The students are in support of using Open Source Software for teaching and learning. The teachers are not agitated because they believe that proprietary and open software are manifestation of the concepts taught in the classroom. Students should be free to choose their interests in proprietary or open software provided unbiased information is given. Teachers were not informed about the successful use [8, 9] of Open Source Software in teaching several of the courses listed in the computer science prospectus.

It was found out during discussion that several open source software had been deployed on the campus to offer various services. Such deployments include e-learning services based on Moodle, websites using Joomla or Drupal, journal websites using open journal system and web servers using Apache web servers.

5. Conclusion

This initial work concludes that Open Source Software is used by students and teachers in Nigerian universities for personal or school projects but not in teaching Computer Science. Teaching of computer science courses adheres to the old philosophy of developing skilled operators and users. The curriculum of computer science needs to be modified to create professionals who are able to meet the challenges of the workplace and the country. The advantages of Open Source Software would be of great benefit to a developing nation like Nigeria. A structured and scientific approach will be adopted to examine the findings of this work.

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POWER QUALITY ASSESSMENT IN NIGERIAN DISTRIBUTION NETWORK

Ogunyemi, J.¹, Fakolujo, A.(PhD)² & Adejumobi, I.A.(PhD)³

¹Department of Electrical Engineering, Federal Polytechnic Ilaro

²Department of Electrical Engineering, University of Ibadan;

³Department of Electrical Engineering, Federal University of Agriculture Abeokuta

joelgunyemi@gmail.com, ao.fakolujo@ui.edu.ng, engradejumobi@yahoo.com

Abstract

The use of electronics devices as energy saving devices among others is on the increase globally due to factors such as environmental and economy. However, their application has constituted another problem in power system which must be addressed. As non-linear devices, they are not only sensitive to poor power quality but also contribute to poor power quality problems. Implications of poor power quality problems range from shut down of equipment to outright damage which leads to loss of money and labour. In Nigeria, data on power quality is almost completely lacking, and although data on the larger issue of electricity reliability are daily collected by the supply authority, the power quality data are not consistently defined and captured vividly in the distribution system. As Nigeria entered the deregulation market coupled with the promotion of energy saving device, there is need to address this problem. This paper identifies the existing gap on present state of power quality in Nigerian's electricity distribution system and proffers appropriate solutions to address the problem.

Keywords: Power Quality, Non-linear devices, Standards.

1.0 INTRODUCTION

Presently, Nigerian electrical power system is facing a lot of challenges as a whole. From generation to distribution, the reliability of the system is far below expectation (Popoola et al 2011). Recently, the Nigerian government announced the decision to embark

on measures to promote the use of energy saving lamps as part of solution to the energy crisis. Providing sustainable, adequate, reliable and efficient electricity supply to residential, commercial and industrial consumers is germane to national development.

The use of energy saving devices is on increase globally due to factors such as environmental and economy. Technological advancement and breakthrough are expanding the horizon of power delivery and applications, new devices are being designed to be efficient, energy saving and environmentally friendly. These electronic devices are often sensitive to power supply. As such, they place stringent requirement on clean energy for their effective and optimum performance. However, the application of these devices has constituted another problem in power systems which must be addressed. As non-linear devices; they are not only sensitive to poor PQ but also contribute to poor PQ problems. International standards concerning electrical PQ impose that electrical equipment and facilities should not produce harmonic contents greater than specified values, and also specify distortion limits to the supply voltage.

PQ problems have contributed immensely to power problems over the years. It is a well-known fact that higher or lower than normal voltage or current can lead to malfunctioning or damage of certain types of equipment. The PQ problems have

been world-wide phenomena. Some of the factors responsible for this include deregulation of power supply system and ever-increasing “high-tech” sophisticated electronics devices to meet energy saving requirements. The economical importance of PQ can be quantified. The cost of poor PQ in the distribution network is enormous. While there is no data to quantify the cost implication of PQ problems in Nigeria, the study carried out by Electric Power Research Institute (EPRI) in the United State of America (USA) shows that PQ problems and electrical energy outages in the United States cost more than US\$119 billion per year (Santos, 2007). It is also estimated that losses caused by poor PQ cost EU industry and commerce about €10 billion per annum (Markiewicz & Klajn, 2004). Table 1 shows a typical cost implication of poor PQ in business environments as released by the Department of Energy (DOE) USA. Hence, concerted effort is being made globally to address the problems as the cost of poor PQ usually exceeds the cost of measures required for improvement. Data are gathered from different utilities in the world to study and analyze the problems. The compliance with international standard on PQ of countries such as South Africa, Columbia, Norway and China has been reported (Herath, 2008). The need for a closer look at PQ monitoring and regulation in the face of globalization and deregulation has been emphasized (Gul, 2008; Abdel-Galil et al, 2002).

In Nigeria, the reliability of the power supply is not only low, but also of poor quality. No data is available on PQ status of Nigerian power system. According to Eto (2004), *“the absence of consistent and geographically comprehensive information about the prevalence and impact of power-quality problems on the nation’s economy presents challenges for consumers and policy makers/regulators”*. As Nigeria entered deregulation market in addition to the influx of electronic devices

often used as energy saving products in the market, there is need to properly address the PQ issues associated within the power system so as to reduce long-term economic impact of PQ (Dugan et al, 2004).

2.0 PQ INDICATORS

Various PQ problems identified in the literatures and classified by international standard are: Transient–impulse or oscillatory; variation–sag, swell or interruption; imbalance (unbalance); waveform distortion (voltage or current); harmonics, inter-harmonics; notching, noise; voltage fluctuation (flicker); intermittent frequency variation <10s and DC off-set. Their details characteristics are shown in the Table 1.

2.1 STANDARDS ON PQ

Globally, there are many standards on PQ. Different countries and regions of the world normally have their national or regional standards which regulates electricity from generation to distribution. However, the international standards have greater acceptance in many countries. In Nigeria, the relevant body is the Nigerian Electricity Regulatory Commission (NERC). NERC has developed codes on many areas. Examples are Distribution Code, Grid Code and Metering Code. Three most popular standards in PQ applications are briefly discussed below.

2.1.1 IEC STANDARDS

The International Electro-technical Commission (IEC) is a global body for standardization with the objective of promoting international co-operation on all questions concerning standardization in the electrical and electronic fields. IEC publishes International Standards among others which are popularly accepted worldwide. Examples on PQ are: IEC 61000-4-7, IEC 61000-3-2, IEC 61000-4-15 and

the new IEC 61000-4-30 which provides general requirement for testing and measurement.

2.1.2 IEEE Standard

The Institution of Electrical & Electronic Engineer IEEE Standards is also international standard commonly applied in PQ. IEEE 1159 Standard classifies various PQ problems as shown in Table 1. IEEE Std C57.110-1998 gives the recommended practice for establishing transformer capability when supplying non-sinusoidal load currents. IEEE Standard 1547 is for interconnecting distributed resources with electric power systems.

2.1.3 EN 50160 standards

The European Norm (EN) 50160 standard is for low and medium voltage usually experienced in distribution system. It specifies the voltage parameter at the point of common coupling. For instance, the standard on "voltage characteristics of electricity supplied by the public distribution systems" is given by EN 50160:2000.

3.0 EFFECTS OF NON-LINEAR DEVICES ON PQ IN A DISTRIBUTION NETWORK

The electronic devices that draw distorted current rather than pure sinusoidal wave from the supply system are referred to as non-linear devices. The proliferation of non-linear devices has brought the issue of PQ to limelight. The non-linear devices are: high efficiency energy saving lamp; adjustable speed drive (ASD) or variable frequency drive (VFD); switch mode power supply (SPMS); microprocessor controlled devices; industrial equipment (welding machines, arc furnaces, induction furnaces); UPSs, rectifiers; office equipment (computers, photocopy machines, fax machines, etc.); home appliances (television sets, micro-wave ovens, fluorescent lighting) and certain devices involving magnetic saturation (transformers). The effect of these

electronic devices is that they pollute the system by introducing distortion in the system. Harmonic currents produced by nonlinear loads are injected back into the supply systems thereby downgrading the quality of electrical power.

The presence of harmonics in the system can cause: overheating of transformer, motor failure, capacitor fuse blowing, excessive neutral current, error in power metering (watt-hour meter reading fluctuation), transformer secondary voltage distortion, increased power system losses, increase in energy costs, premature aging of equipment, disturbances in communication networks and on telephone lines, protective relay may not sense rms value leading to nuisance trip or fail to trip, digital clocks may run fast and production losses.

4.0 PQ MEASUREMENT & CONTROL

PQ studies have been carried out extensively using simulation and techniques such as Fourier, Walsh, Hartley and Wavelet transforms. The evaluation of PQ involves analytical study of the power system such as capturing and processing of voltage and current signals at various points of the system. Various works have been carried out on PQ measurement at a single substation site (PQ View, 1995); PQ improvement at specific site (Monem and Mahfouz, 2010) using various techniques such as harmonic filter in places like textile industry (Pradhan et al, 2008) and metro highway and distribution system. In Nigeria, no major work has been reported.

Some of the common tools for PQ measurement and analysis include: digital multimeter; wiring & grounding survey equipment; oscilloscope; PQ analyzer; field strength meter; spectrum analyzer; harmonic analyzer and transient network analyzer. With advanced in modern communication, many of these devices can now communicate the data from remote location, store and

process the data. They can now be used with such devices as supervisory control and data acquisition (SCADA), GPRS and phasor measurement unit (PMU) devices.

Various measures are been used to solve PQ problems depending on the applications, cost and technology. The commonly used method is filtering which can be passive, active or hybrid. Recently the use of VAR compensation to mitigate PQ as a result of Flexible AC Transmission (FACT) devices is on increase.

5.0 ADDRESSING PQ PROBLEMS IN NIGERIA

In order to reduce the effects of PQ due to non-linear devices, the following measures should be adopted:

1) Re-Design and Retrofit Measures

There is need for re-evaluation of design method for system supplying large number of non-linear devices such as computer centers, information and communication technology centers and cyber-café. The loads in these environments which are mainly single phase computers, servers and networking equipment are powered by switch mode power supply (SPMS). SPMS by nature are rich in third harmonic which will cause current to flow in the neutral conductor. In a balanced system therefore, the sum of all phase currents results in mostly third-harmonic current in the neutral conductor. This phenomenon has been responsible for neutral overloading (Botezan, 2010). Since there is possibility of overloading the neutral conductor; there is need therefore to estimate the neutral conductor and possible retrofit for the existing installation. New design should incorporate PQ impact at early stage of the design.

The transformer supplying non-linear loads must be derated because of harmonics problem associated with distribution transformer. It has been noted that as a general rule, a transformer in which

the current distortion exceeds 5 percent is a candidate for derating for harmonics (Schneider Electric, 2010). For a transformer supplying large quantities of non-linear loads, the graph in Figure2 shows derating required for a transformer supplying electronic loads.

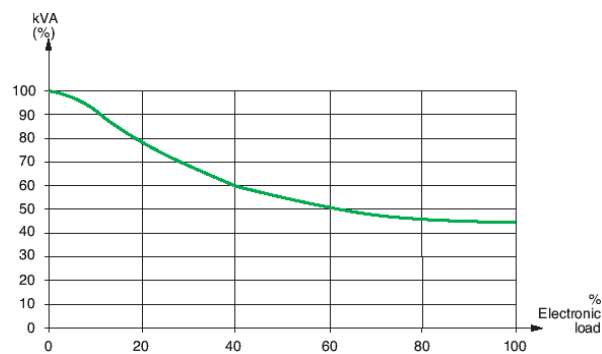


Fig 2: Derating required for a transformer supplying electronics loads (Schneider Electric, 2010)

Another alternative is the use of a K-rated transformer specially designed to cope with harmonic loads. Its choice over transformer derating because it is designed to have lower eddy current losses has been suggested (Keulenaer, 2002).

2) Research and Development

There is need for survey and research study to characterize the PQ. This is current trend globally. More studies are required on the impact of PQ in terms of engineering, economy and environmental impacts. In Nigeria data on PQ is almost completely lacking and, although data on the larger issue of electricity reliability are collected by utility, the PQ data cannot be said to be consistently defined and captured vividly in the distribution system. The PQ issues were addressed in section 4 of the Nigerian Electricity Regulation Code (NERC)'s distribution code. Table 1 shows the harmonic limit specified by NERC.

The study and design of a PQ system can be carried out using empirical methods as well as analytical methods. The analytical study may consist of modeling and design. In order to develop a suitable model, a thorough understanding of the electrical

power system and its operations is essential. The model can then be subjected to quantitative and/or qualitative analysis. Quantitative analysis entails knowing the systems' response to different signals. Qualitative analysis involves determination of systems' stability and controllability. For instance, the impact of Distributed Generation on (DG) on the power system can be studied through simulation.

Moreover, field measurements are needed to validate the model. Monitoring and surveying will generate a pool of data for national data on PQ. The data obtained from these studies can serve as part of data base for global information on PQ. Some of the countries in which PQ survey was carried out internationally are given in the Table3 (Herath, 2008).The information from PQ evaluation can help improve the efficiency of operating the electric power system and the reliability of customer operations.

3) Development of National Code on PQ and Regulations Standard.

With the new energy-saving drive and deregulation in the power sector, the existing codes by NERC should be properly developed. There is need for comprehensive standard on PQ in general most especially as the nation enters deregulation market. For instance South African PQ Standards NRS developed by the South African Electricity regulator (NER) has been reported (Herath, 2008). The results

and information obtained from research studies can guide in developing national code capable of addressing PQ issues in addition to the international codes. The importation of electronics products should be well regulated to ensure compliant. There is need also to educate the end-users on PQ as they are unaware of expected quality of power from the supply and their contribution to the problems. Ignorance and lack of awareness in PQ issues are major factors contributing to power crisis from the end users.

6.0 CONCLUSION

This paper has examined the issues of PQ in Nigerian distribution network. This is important as a result of influx of electronics devices some of which aim at reducing energy consumption. With deregulation and privatization of power sector, PQ study will help to know the state of the power system which can serve as basis for comparison in the future. It has revealed the existing gap in PQ evaluation and appropriate measure to address the problems. Such measures will be useful to electricity consumers, utilities, policy makers, manufacturers & importers of electrical/electronic products and minimize power crisis with greater benefit in the long-time.

Table1. The economic cost of electricity reliability and power quality in USA

Business Type	Event Description	Economic Cost (\$)
Manufacturer of silicon-chip fabrication equipment	Voltage sags and short-duration voltage interruptions	\$350,000 per event
Silicon-chip fabrication	Even an outage of a few minutes can lead to 1-1.5 days of downtime	Up to \$500,000 per day in lost revenue
Automotive manufacturing	From a few seconds to one half-hour of downtime	Less than \$1,000,000
	More than 1 hour of downtime	In the millions
Financial clearinghouse	30 minutes of downtime because of a lightning strike	\$12,000,000

Source: DOE (USA)

Table 2: IEEE 519 Classification of PQ

No.	Categories	Typical spectral content	Typical duration	Typical voltage magnitude
1.0	Transients			
1.1	Impulsive			
1.1.1	Nanosecond	5-ns rise	< 50 ns	
1.1.2	Microsecond	1- μ s rise	50 ns - 1 ms	
1.1.3	Millisecond	0.1-ms rise	> 1 ms	
1.2	Oscillatory			
1.2.1	Low Frequency	< 5 kHz	0.3 - 50 ms	0 - 4 pu (per unit)
1.2.2	Medium Frequency	5 - 500 kHz	20 μ s	0 - 8 pu
1.2.3	High Frequency	0.5 - 5 MHz	5 μ s	0 - 4 pu
2.0	Short-duration variations			
2.1	Instantaneous			
2.1.1	Interruption		0.5 - 30 cyc	< 0.1 pu
2.1.2	Sag (Dip)		0.5 - 30 cyc	0.1 - 0.9 pu
2.1.3	Swell		0.5 - 30 cyc	1.1 - 1.8 pu
2.2	Momentary			
2.2.1	Interruption		30 cy - 3 s	< 0.1 pu
2.2.2	Sag (Dip)		30 cy - 3 s	0.1 - 0.9 pu
2.2.3	Swell		30 cy - 3 s	1.1 - 1.4 pu
2.3	Temporary			
2.3.1	Interruption		3 sec - 1 min	< 0.1 pu
2.3.2	Sag (Dip)		3 sec - 1 min	0.1 - 0.9 pu
2.3.3	Swell		3 sec - 1 min	1.1 - 1.2 pu

SOURCE: IEEE 1159-92

Table 3: PQ Survey in some countries/regions of the world with the organization involved.

s/n	Country/Region	Organization
1	USA	Electric Power Research Institute (EPRI)
2	USA/Canada	National Power Laboratory (NPL)
3	Canada	Canadian Electricity Association (CEA)
4	Europe	Leonard PQ Survey
5	France	EDF
6	Tasmania	Hydro Electric Corporation
7	Australia	PQ Australia

Table 4: Harmonic limit specified by NERC

Harmonic Order (n)	Low Voltage Contracted Power less than 10 kW	Low Voltage Contracted Power greater than 10 kW	Medium Voltage
	A	%	%
(odds no multiples of 3)			
5	2,28	12	12
7	1,54	8.5	8.5
11	0,66	4.3	4.3
13	0,42	3,0	3,0
17	0,26	2.7	2.7
19	0,24	1.9	1.9
23	0,20	1.6	1.6
25	0,18	1.6	1.6
> 25	4,5/n	$0.8 + 0.8 \cdot 25/n$	$0.8 + 0.8 \cdot 25/n$
(odds multiples of 3)			
3	4,6	16.6	16.6
9	0,8	2.2	2.2
15	0,3	0.6	0.6
21	0,21	0.4	0.4
> 21	4,5/n	0.3	0.3
(even)			
2	2,16	10.0	10.0
4	0,86	2.5	2.5
6	0,60	1.0	1.0
8	0,46	0.8	0.8
10	0,37	0.8	0.8
12	0,31	0.4	0.4
> 12	3,68/n	0.3	0.3
Total	240 V Users: 5 A 400 V Users: 14 A	20.0%	20.0%

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COMPUTER SYSTEM CONFIGURATION MANAGEMENT

Engr Dimoji D.O, Oju Onuoha, Olawuyi J.O, Benson–Emenike M.E. (Mrs)

Department of Computer Science,

School of Science and Industrial Technology (SSIT)

Abia State Polytechnic, Aba. Nigeria

dimojonyiidd@yahoo.com, ojuonuoha@yahoo.com, olawuyijo@yahoo.co.uk, bensonemenikem@yahoo.com

Abstract

Computer System configuration management (CSCM) is a field of management that focuses on establishing and maintaining consistency of a system's or product's performance and its functional and physical attributes with its requirements, design, and operational information throughout its life. For information assurance, CSCM can be defined as the management of security features and assurances through control of changes made to hardware, software, firmware, documentation, test, test fixtures, and test documentation throughout the life cycle of an information system. CSCM for information assurance, is sometimes referred to as Secure Configuration Management, relies upon performance, functional, and physical attributes of IT platforms and products and their environments to determine the appropriate security features and assurances that are used to measure a system configuration state. For example, system configuration requirements may be different for a network firewall that functions as part of an organization's Internet boundary versus one that functions as an internal local network firewall.

Keywords: Secure Configuration Management, systematic control, original equipment manufacturers (OEMs), configuration identification, information technology (IT), and preventive maintenance.

1.0 Introduction

1.1 Advent of Configuration management

Configuration management was first developed by the United States Air Force for the Department of Defense in the 1950s as a technical management discipline of hardware. The concepts of this discipline have been widely adopted by numerous technical management functions, including systems engineering (SE), integrated logistics support (ILS), Capability Maturity Model Integration (CMMI), ISO 9000, Prince2 project management methodology, COBIT, Information Technology Infrastructure

Library (ITIL), product lifecycle management, and application lifecycle management. Many of these functions and models have redefined configuration management from its traditional holistic approach to technical management. Some treat configuration management as being similar to a librarian activity, and break out change control or change management as a separate or stand alone discipline. However the bottom-line is and always shall be Traceability.

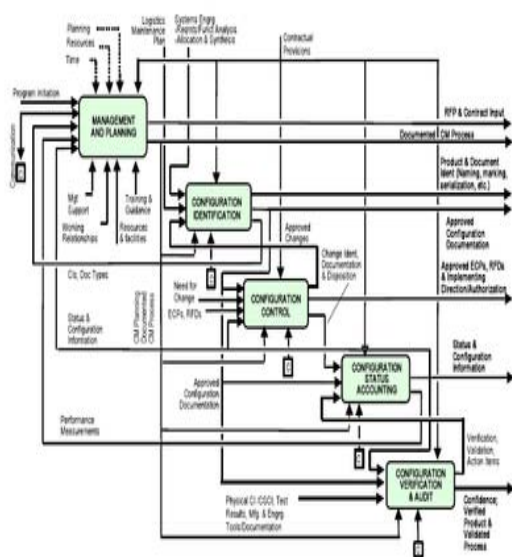


Figure showing Top level Configuration Management Activity model

2.0 Software configuration management

The traditional software configuration management (CSCM) process is looked upon by practitioners as the best solution to handling changes in software projects. It identifies the functional and physical attributes of software at various points in time, and performs systematic control of changes to the identified attributes for the purpose of maintaining software integrity and traceability throughout the software development life cycle.

The CSCM process further defines the need to trace changes, and the ability to verify that the final delivered software has all of the planned enhancements that are supposed to be included in the release. It identifies four procedures that must be defined for each software project to ensure that a sound CSCM process is implemented. They are:

1. Configuration identification
2. Configuration control
3. Configuration status accounting

4. Configuration audits

These terms and definitions change from standard to standard, but are essentially the same.

2.1 Configuration identification:

Configuration identification is the process of identifying the attributes that define every aspect of a configuration item. A configuration item is a product (hardware and/or software) that has an end-user purpose. These attributes are recorded in configuration documentation and baseline. Baseline an attribute forces formal configuration change control processes to be effected in the event that these attributes are changed.

2.2 Configuration change control:

Configuration change control is a set of processes and approval stages required to change a configuration item's attributes and to re-baseline them.

2.3 Configuration status accounting:

Configuration status accounting is the ability to record and report on the configuration baselines associated with each configuration item at any moment of time.

2.4 Configuration audits:

Configuration audits are broken into functional and physical configuration audits. They occur either at delivery or at the moment of effecting the change. A functional configuration audit ensures that functional and performance attributes of a configuration item are achieved, while a physical configuration audit ensures that a configuration item is installed in accordance with the requirements of its detailed design documentation.

Configuration management is widely used by many military organizations to manage the technical aspects of any complex systems, such as weapon systems, vehicles, and information systems. The discipline combines the capability aspects that these systems provide an organization with the issues of management of change to these systems over time.

National Consensus Standard for Computer System Configuration Management of U.S submitted that, outside of the military, CSCM is appropriate to a wide range of fields and industry and commercial sectors.

3.0 Computer hardware configuration management

Computer hardware configuration management is the process of creating and maintaining an up-to-date record of all the components of the infrastructure, including related documentation. Its purpose is to show what makes up the infrastructure and illustrate the physical locations and links between each item, which are known as configuration items.

Computer hardware configuration goes beyond the recording of computer hardware for the purpose of asset management, although it can be used to maintain asset information. The extra value provided is the rich source of support information that it provides to all interested parties. This information is typically stored together in a configuration management database (CMDB). This concept was introduced by ITIL.

The scope of configuration management is assumed to include, at a minimum, all configuration items used in the provision of live, operational services.

Computer hardware configuration management provides direct control over information technology

(IT) assets and improves the ability of the service provider to deliver quality IT services in an economical and effective manner. Configuration management should work closely with change management.

3.1 components

All components of the IT infrastructure should be registered in the configuration management database. The responsibilities of configuration management with regard to the configuration management database are:

- identification
- control
- status accounting
- verification

3.2 The scope

The scope of system configuration management is assumed to include:

- physical client and server hardware products and versions
- operating system software products and versions
- application development software products and versions
- technical architecture product sets and versions as they are defined and introduced
- live documentation
- networking products and versions
- live application products and versions
- definitions of packages of software releases
- definitions of hardware base configurations
- configuration item standards and definitions

3.3 The benefits

The benefits of computer hardware configuration management are:

- helps to minimize the impact of changes
- provides accurate information on CIs
- improves security by controlling the versions of CIs in use
- facilitates adherence to legal obligations
- helps in financial and expenditure planning

4.0 Maintenance systems

System configuration management is used to maintain an understanding of the status of complex assets with a view to maintaining the highest level of serviceability for the lowest cost. Specifically, it aims to ensure that operations are not disrupted due to the asset (or parts of the asset) overrunning limits of planned lifespan or below quality levels.

In the military, this type of activity is often classed as "mission readiness", and seeks to define which assets are available and for which type of mission; a classic example is whether aircraft on-board an aircraft carrier are equipped with bombs for ground support or missiles for defense.

A theory of system configuration maintenance on immunity for human-computer systems was worked out by Mark Burgess, with a practical implementation on present day computer systems in the software configured to perform real time repair as well as preventive maintenance.

4.1 Preventive maintenance

Understanding the "as is" state of an asset and its major components is an essential element in preventive maintenance as used in maintenance,

repair, and overhaul and enterprise asset management systems.

Complex assets such as aircraft, ships, industrial machinery etc. depend on many different components being serviceable. This serviceability is often defined in terms of the amount of usage the component has had since it was new, since fitted, since repaired, the amount of use it has had over its life and several other limiting factors. Understanding how near the end of their life each of these components is has been a major undertaking involving labor intensive record keeping until recent developments in software.

4.2 Predictive maintenance

Many types of component use electronic sensors to capture data which provides live condition monitoring. This data is analyzed on board or at a remote location by computer to evaluate its current serviceability and increasingly its likely future state using algorithms which predict potential future failures based on previous examples of failure through field experience and modeling. This is the basis for "predictive maintenance".

Availability of accurate and timely data is essential in order for CM to provide operational value and a lack of this can often be a limiting factor. Capturing and disseminating the operating data to the various support organizations is becoming an industry in itself.

The consumers of this data have grown more numerous and complex with the growth of programs offered by original equipment manufacturers (OEMs). These are designed to offer operators guaranteed availability and make the picture more complex with the operator managing the asset but the OEM taking on the liability to ensure its serviceability. In such a situation, individual

components within an asset may communicate directly to an analysis center provided by the OEM or an independent analyst.

4.3 Standards

- ANSI/EIA-649-1998 National Consensus Standard for Configuration Management
- EIA-649-A 2004 National Consensus Standard for Configuration Management
- ISO 10007:2003 Quality management systems - Guidelines for configuration management
- Federal Standard 1037C
- GEIA Standard 836-2002 Configuration Management Data Exchange and Interoperability
- IEEE Std. 828-1998 IEEE Standard for Software Configuration Management Plans
- MIL-STD-973 Configuration Management (cancelled on September 20, 2000)
- STANAG 4159 NATO Material Configuration Management Policy and Procedures for Multinational Joint Projects
- STANAG 4427 Introduction of Allied Configuration Management Publications (ACMPs)
- CMMI for Development, Version 1.2 CONFIGURATION MANAGEMENT

5.0 Case study: Construction Industry

More recently configuration management has been applied to large construction projects which can often be very complex and have a huge amount of details and changes that need to be documented. Construction agencies such as the Federal Highway Administration have used system configuration management for their infrastructure projects in the U.S. There have been several construction based configuration management software developed that

aims to document change orders and RFIs in order to ensure a project stays on schedule and on budget. These programs can also store information to aid in the maintenance and modification of the infrastructure when it is completed. One such application called ccsNet, was tested in a case study funded by the Federal Transportation Administration (FTA) in which the efficacy of configuration management was measured through comparing the approximately 80% complete construction of the Los Angeles County Metropolitan Transit Agency (LACMTA) 1st and 2nd segments of the Red Line, a \$5.3 billion rail construction project. This case study yielded results indicating a benefit to using system configuration management on projects of this nature.

6.0 Summary and Conclusion

While system configuration management may not be the easiest or the first function you implement in controlling your IT environment, it can be a very powerful step in ensuring proper control of your IT resources. System configuration management allows you to understand the IT resources you have and how they relate to one another. This information allows you to make informed decisions on maintaining and upgrading your IT environment. Implementation of a system configuration management program is a critical step to take in optimizing the management of your IT world. More recently system configuration management has been applied to large construction projects which can often be very complex and have a huge amount of details and changes that need to be documented. Construction agencies such as the Federal Highway Administration have used configuration management for their infrastructure projects. There have been several construction based configuration management software developed¹ that aim to document change orders and RFIs in order to ensure a project stays on schedule and on budget. These programs can also store information to aid in

the maintenance and modification of the infrastructure when it is completed.

7.0 Acknowledgements

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An Overview of Broadband communication over Power Lines

Adekunle, Oluwadara Victoria

Electrical and Information Engineering Department, Covenant University, Ota.

Abstract

Broadband over power lines are Systems for carrying data on conductors used for electric power transmission. Power line communication technologies can be used for different applications ranging from home automation to internet access.

With the spread of broadband technologies in the last few years, there are yet significant areas in the world that do not have access to high speed internet, as compared with the few internet service providers in existence, the additive expenditures of laying cables and building necessary infrastructure to provide DSL in many areas most especially rural areas is too great. But if broadband is served through power lines considering the fact that it exist all over the country, there will be no need to build new infrastructure. Therefore, anywhere there is electricity, there could also be broadband.

Broadband over Power line is designed to offer an alternative means to provide high speed internet access, voice over Internet protocol (VOIP) and other broadband services, using medium and low voltage lines to reach customers and businesses by combining the principle of wireless networking, modems and Radio. Researchers and developers have created ways to transmit data over power lines into homes at speeds between 500kilobits and 3 megabits per second which is equivalent to the cable DSL (Digital Subscriber Line) and this is achieved by modifying the present power grids with specialized equipments.

With this knowledge, the broadband power line developers could partner with power companies and

Internet service providers to bring broadband to everyone with access to electricity.

INTRODUCTION

The main aim of power line communication is to use the power supply system for communication purposes. Broadband over Power Line (BPL) can provide a vast coverage for broadband services. They have the potential to provide simplified in-house interconnection of computers and peripherals, and cost effective last-mile delivery of broadband data services. The power line communication systems consist of terminal devices that are plugged into to the electrical power supply network and allow data to be transmitted via the network to other terminal devices plugged into or attached to the network. The use of the existing electrical power supply network wiring reduces costs and provides convenient access to broadband interconnection between devices. This technology can however achieve 14 Mbps raw data rate and it has the potential for up to 200 Mbps. which makes it competitive with cable and DSL technology.

Historically, power line communications systems are known to be limited to low data rates typically less than 500 Kbit/s. These low data rate systems are used in applications such as the remote control of switches in domestic installations and by power supply authorities.

BPL ARCHITECTURE

The International Organization for Standardization (ISO) 7-layer Open Systems Interconnection (OSI) Communications Reference Model is defined in ISO-

7498. In this model the first layer is defined to be the Physical layer. For BPL, layer 1 is inclusive of all the in-place, power line distribution systems, the electrical power line distribution system, and the in-home electrical wiring down to the wall sockets. In some configurations, however, the power line transformers are bypassed, which excludes them from being part of the communications system architecture. A BPL Access network is usually comprised of a base station and a number of users connected via BPL modems. The modems can provide various standardized user interfaces into the BPL network. For example, a BPL modem can provide the user with a standard IEEE 802.3 (Ethernet) interface for connecting a personal computer to the network. The BPL modem connects to the power line transmission medium by means of a BPL specific (e.g., vendor proprietary) interface. Typically, BPL user interface modems provide the Medium Access Control (MAC) lower sub layer and the Logical Link Control (LLC) upper sub layer functions of the Layer 2 of the OSI model in addition to the physical layer. The modems also provide the Network Layer functionality of Layer 3 by supporting Internet Protocol (IP) routing. The manufacturers of existing BPL systems developed proprietary solutions for the MAC layer that are incompatible. The basic BPL components of injectors, repeaters, and couplers have been implemented in a variety of systems architectures, which feature different modulation techniques and designs at the Physical layer, MAC, and LLC.

The Physical layer channel impairments in BPL systems include: noise, multipath, strong channel Selectivity, and non-linear channel characteristics. To combat these impairments a number of different technologies have been employed that range from spread spectrum to Orthogonal Frequency Division Multiplexing (OFDM). BPL channel impairments reduce the available bandwidth to users, which is of

most concern, because BPL access networks operate in a shared transmission medium where subscribers compete to use the same transmission resources.

BPL TECHNOLOGY

The general technical idea of Power Line Communication is to modulate a radio signal with data and send it through power lines in a band of frequencies which are not used for supplying electricity. The used frequencies and the modulation scheme have a significant influence on the efficiency and the speed of the BPL service. The modulation scheme which is used in BPL is orthogonal frequency division multiplexing (OFDM). This is a multi-carrier transmission technique which has been recently recognized as an excellent method for high speed data communication.

Orthogonal Frequency Division Multiplexing (OFDM) was first used on military high frequency radio links starting in the 1960s. It performs services at the physical layer of the OSI model.

OFDM is based on the idea of frequency division multiplexing (FDM), which is a technology that uses multiple frequencies to transmit multiple signals in parallel at the same time. However, In FDM, about fifty percent of the total spectrum is wasted due to guard bands which are needed between sub-carriers to ensure that they do not overlap.

OFDM is much more spectrally efficient than FDM. It reduces the required bandwidth by squeezing sub-carriers tightly together until they actually overlap with each other. This is accomplished by keeping the sub-carriers orthogonal in the complex domain so that they do not interfere with each other. Cyclic Prefix (CP) and variants of Phase Shift Keying (PSK) modulation techniques such as Binary PSK (BPSK), DBPSK, and DQPSK are used to eliminate the need for equalization. Forward error correction (FEC)

with data interleaving are used to reduce the effects of impulsive noise events.

OFDM has been adopted for numerous technologies including: Asymmetric Digital Subscriber Line (ADSL) services, IEEE 802.11a/g, IEEE 802.16a, Digital Audio Broadcast (DAB), Digital Terrestrial Television Broadcast, DVD in Europe, 4G, IEEE 802.11n, IEEE 802.16, and IEEE 802.20. There is no single OFDM standard that has been universally adopted. Instead, there are similar but different

versions of OFDM and several proprietary implementations as various companies attempt to acquire better market penetration through improved efficiency and features.

The concept of OFDM is shown in figure below. The generation of orthogonal signals is done by using an IFFT (inverse fast Fourier transform) block. Using OFDM modulation the data is injected onto power lines.

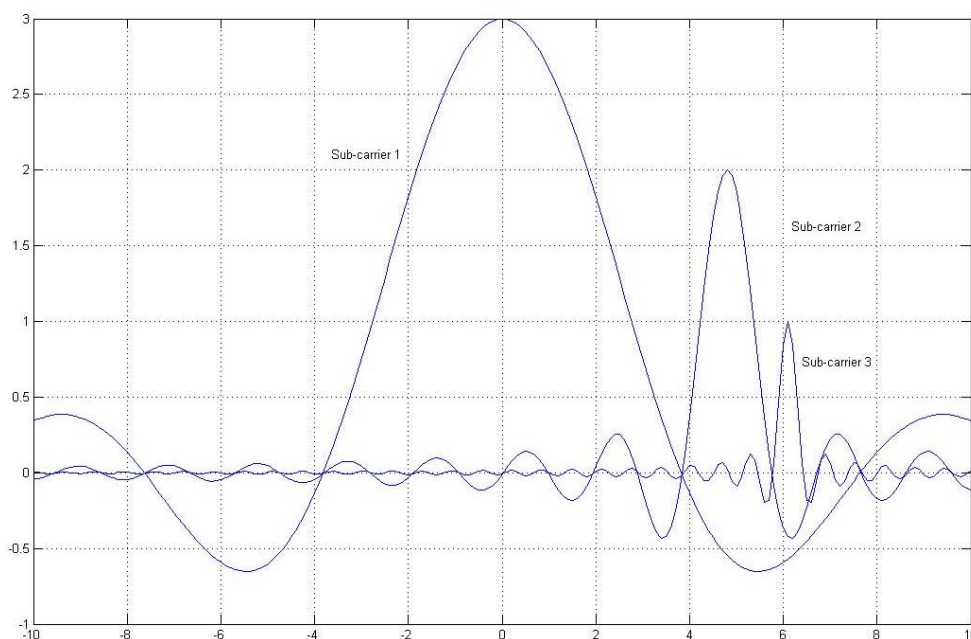


Figure1: Frequency rate of Multi-Rate OFDM

TYPES OF BPL

There are two main types of BPL, The Access BPL and the In-Home BPL.

Access BPL provides internet and other broadband services like voice (IP Telephony), Video, surveillance systems and entertainment (gaming) for homes and offices, utilities metering (electricity/water/gas) services. It is comprised of injectors which serve as the interface between internet backbone and medium voltage power lines and are also used to inject high frequency signals unto medium or low voltage power lines, Extractors used to retrieve the signals and provide the interface

between end-users and medium-voltage power lines. Extractors are placed at each distribution transformer which provides low voltage electric power for a group of homes in that area. BPL signals can propagate for 1000 to 3000 feet before they become too distorted and weak. Repeaters are then used to regenerate and amplify the signals to prevent loss due to attenuation.

The Federal communication commission has defined Access BPL as: "A carrier current system installed and operated on an electric utility service as an unintentional radiator that sends radio frequency energy on frequencies between 1.705 MHz and 80 MHz over medium voltage lines or low voltage lines

to provide broadband communications and is located on the supply side of the utility service's points of interconnection with customer premises."

On the other hand, in hybrid systems a combination of power lines and wireless transmission is used. In this scenario the injected BPL signal onto medium

voltage lines is extracted and delivered to the end user by using a wireless channel such as WIFI. Another scenario came up which is based on capturing a wireless signal and injecting it to low-power lines to be delivered to the end users. The Figure below shows an example of an end-to end Access BPL system while and a hybrid BPL system.

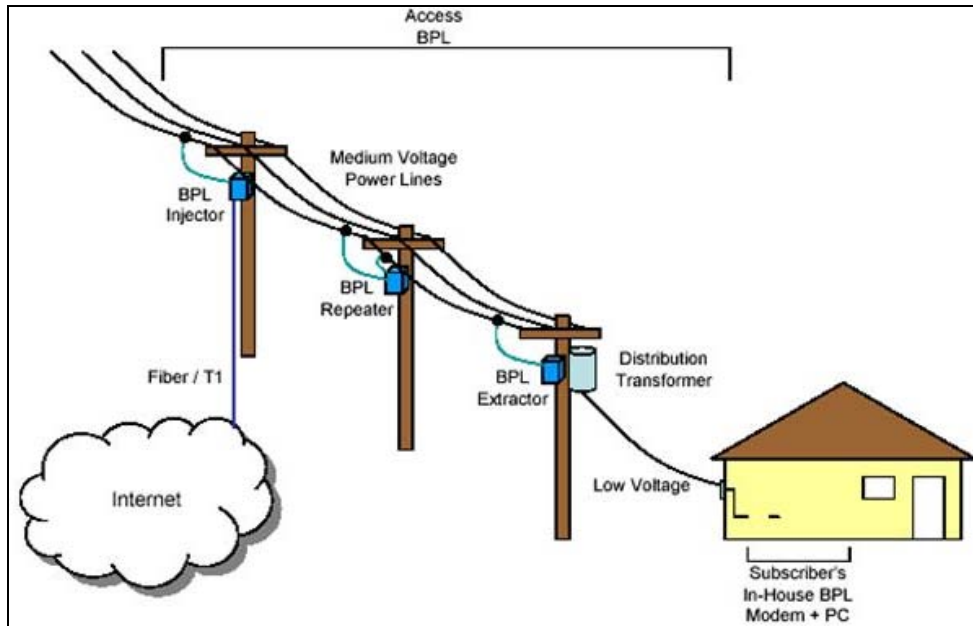


Figure 2 Showing Access BPL

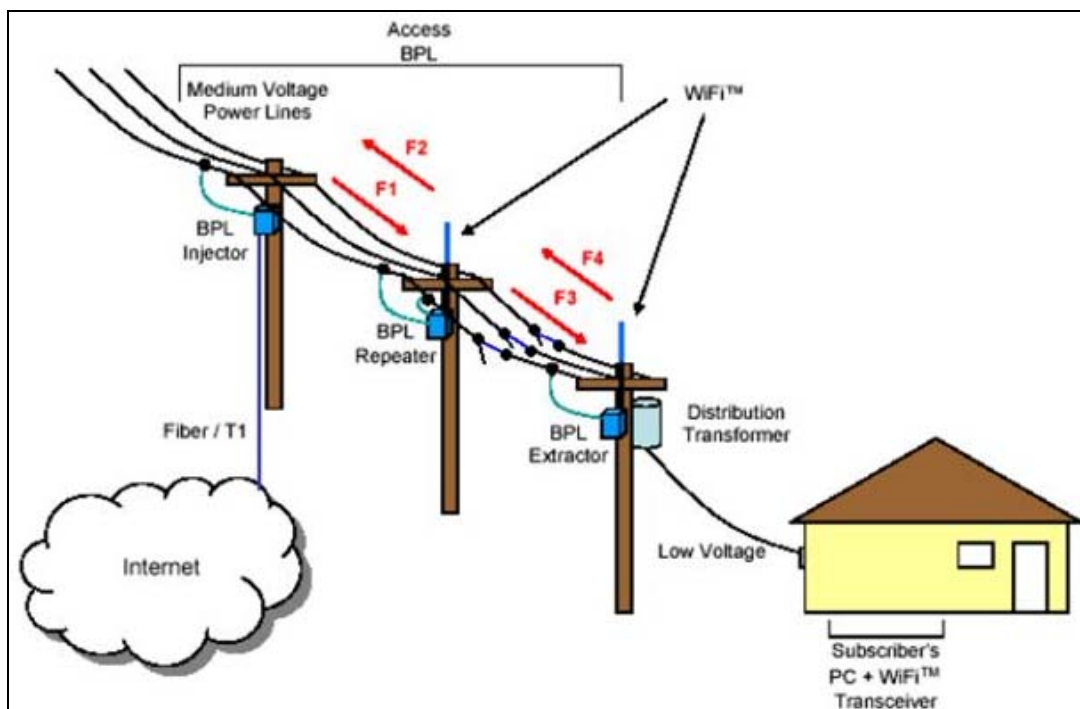


Figure 3 Showing Hybrid BPL

In-Home BPL modems utilize the existing house wiring to provide local area network (LAN) that can be used throughout the home. These applications occur within a single building with both ends of the communications link within the same building. The building might be a house, an apartment block or an office building. The path over which the transfer of data occurs within these buildings is relatively short - typically it is less than 100 m between devices.

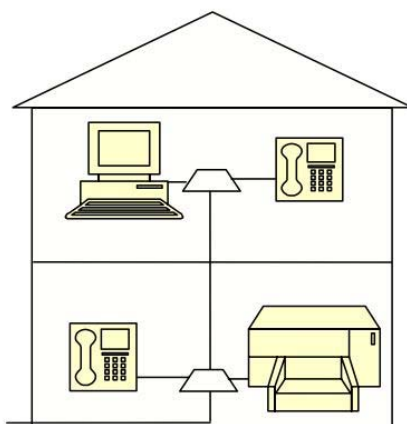


Figure 4 showing In-House Application

There are, however, some cities in overseas countries where the building density, the configuration of the AC power line network (e.g. underground) and the existing broadband data network infrastructure have been such that it has only been necessary to use outdoor power line communications systems over distances of a few hundred meters. This has allowed the use of devices with signal levels similar to in-house systems.

ADVANTAGES OF BPL

BPL has the ability to provide internet service by means of transmission line control protocol/ Internet protocol (TCP/IP) which can support voice, Data and video services the advantages therefore are;

Wide Coverage: BPL can provide wide coverage, since the power lines are already installed almost everywhere. This is advantageous especially for

substations in rural areas where there is usually no communication infrastructure.

Cost: The communication network can be established quickly and cost-effectively because it utilizes the existing wires to carry the communication signals. Thus, PLC can offer substations new cost-saving methods for remotely monitoring power uses and outages.

DISADVANTAGES:

High noise sources over power lines: The power lines are noisy environments for data communications due to several noise sources such as electrical motors, power supplies, fluorescent lights and radio signal interferences. These noise sources over the power lines can result in high bit error rates during communication which severely reduces the performance of BPL.

Capacity: Power line is a shared medium and therefore, the average data rate per end user will be lower than the total capacity depending on coincident utilization, i.e., the number of users on the network at the same time and the applications they are using. Thus, possible technical problems should be comprehensively addressed with various field tests before the BPL technology is widely deployed.

Open circuit problem: Communication over the power lines is lost with devices on the side of an open circuit. This fact severely restricts the usefulness of PLC for applications especially involving switches.

Signal attenuation and distortion: In power lines, the attenuation and distortion of signals are immense due to the reasons such as physical topology of the power network and load impedance fluctuation over the power lines. In addition, there is significant signal attenuation at specific frequency bands due to wave reflection at the terminal points. Therefore, there is loss in signal due to high signal attenuation and distortion.

Security: There are some security concerns for BPL arising from the nature of power lines. Power cables are not twisted and use no shielding which means

power lines produce a fair amount of Electro Magnetic Interference (EMI). Such EMI can be received via radio receivers easily. Therefore, the proper encryption techniques must be used to prevent the interception of critical data by an unauthorized person.

Lack of regulations for Broadband Power line communication: In addition to technical challenges, fundamental regulation issues of BPL should be addressed for substantial progress to be made. The limits of transmitted energy and frequencies employed for PLC should be determined in order to both provide broadband PLC and prevent the interference with already established radio signals such as mobile communications, broadcasting channels and military communications. In this respect, the Institute of Electrical and Electronics Engineers (IEEE) has developed a standard to support broadband communications over power lines.

BPL can be compared with other HFC cable and DSL technology as it is shown in table1.

Comparison	DSL	HFC Cable	BPL
Channel Media	Twisted Pair	Coaxial Cable	Electrical power lines
Availability of the physical media	More availability than cable	Limited availability	The most potentially available media
Speed	1mbps	1mbps to 6 mbps	5mbps and higher
Connection type	Not-shared	Shared	Shared
Security	More secure because of having a dedicated connection	Uses Encryption	Can use encryption
Estimated Prices per month	\$27 to \$49	\$39 to \$60	\$28 to \$ 39

CONCLUSION

BPL is one of the most exciting areas of innovation. It is a technology which needs further research and developments to be completely practical in a wide range. The major advantage of this technology is the already existing infrastructure for BPL even in rural areas which makes its deployment economically justified and also increases the potential coverage of the technology. On the other hand, the main issue with this technology is its interference with other radio systems. This issue has limited the deployment of BPL and to some extent has increased the cost of its deployment. However some companies claim that they have overcome the problem. The future still holds the widespread deployment of BPL.

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Survey of Recent Routing Techniques in Wireless Sensor Networks

Victor Govindaswamy*, Josue Lopez*, G. Balasekaran**

*Texas A&M University-Texarkana, **Nanyang Technology University
Email: lovebat814@yahoo.com

Abstract - The study of routing protocols in wireless sensor networks has increased. Routing protocols in wireless sensor networks are being addressed to improve the usage of limited network resources. Routing protocols are used to extend the life of the wireless sensor networks without compromising data delivery. Joint Sink Mobility, Routing Metric, and Beacon Vector protocols have been designed by inheriting features from Flat Based Routing, Hierarchical Routing, and Location Based Routing protocols. In this article, we survey and briefly discuss each routing protocol mentioned.

I. INTRODUCTION

Wireless sensor networks (WSN) consist of small sensor nodes that wirelessly sense, gather, compute and transmit data. A node is a device that is connected to a network that has a unique address and is capable of transmitting data. Wireless sensor networks can be composed from few sensor nodes to an unlimited number of sensor nodes. Sensor nodes are most of the time deployed in large number of nodes. As of now it is not possible to build a global addressing scheme for the deployment of large number of nodes as the overhead of ID maintenance. These small sensor nodes are used to gather raw data about their surrounding environment. Raw data gathered by these sensors have to be routed to be processed into usable information. There are sensors that are able to process raw data within themselves. Either way, sensors have to route their findings to other sensor nodes, a sink node, or a base station (BS) for further processing. Traditional IP based protocols used by most networks may not be applied to route data in WSNs. IP based protocols are not practical because of the environment that WSN work in.

Routing in wireless sensor networks pose many challenges that affect and limit the network. Many different routing protocols have been designed and are still being developed for WSNs. Depending on the networks topology and protocols used, energy

usage is very crucial in WSNs. The lack of energy affects the network performance. WSNs are limited to power supply because most sensors use small inefficient batteries. Data redundancy, limited communication bandwidth, addressing schemes, limited computing power, and limited memory make routing in wireless sensor networks a challenge. In WSNs, protocols are used to minimize energy consumption. Routing protocols, depending on their network structure, are used to make WSNs more efficient with limited network resources.

II. FLAT BASED ROUTING

In Flat Based Routing, protocols sensor nodes are equally assigned roles and functionality to gather data. All sensor nodes have the same information about the state of the network [3]. Sensors distribute information through out the network without organizing it. Flat routing uses a family of adaptive protocols called Sensor Protocols for Information via Negotiation (SPIN) [3]. SPIN offers energy saving, halves redundant data, but does not guarantee delivery of data packets. Flat routing allows data packets to be transmitted in a vertical or horizontal form. This gives flat routing energy efficient savings because less energy is used by transmitting data this way than diagonally [3]. Flat routing allows sensor nodes to approximate their locations using radio waves with regard to the distance between known points such as other nodes. In flat routing, being able to approximate their position helps eliminate non-working nodes.

III. HIERARCHICAL ROUTING

Hierarchical Routing uses the nodes with higher energy levels to process and send data. Nodes with lower energy levels are used only to sense the environment, prolonging the networks scalability, lifetime, and energy. Hierarchical Routing is able to

do this by making clusters. Low Energy Adaptive Clustering Hierarchy (LEACH) protocol, creates clusters and assigns special task to selected nodes (cluster heads) that have higher energy levels [1]. This allows Hierarchical Routing to evenly distribute available energy by reducing work load on weaker nodes; making the network more energy efficient. The job of the cluster heads is to collect all the data from other nodes in their cluster. Having selected cluster heads, Hierarchical Routing is able to perform data aggregation and fusion to decrease network traffic that enhances the networks life time.

IV. LOCATION BASED ROUTING

Location Based Routing also known as geographic routing, directional geometric, or position based routing is where sensor nodes are identified by their location on the network [1]. Many nodes are able to identify their location using GPS technology. If a node is not equipped with GPS, location can also be identified by incoming signals from other nodes. By receiving signals from other nodes they are able to identify their relative location from the sending node. In Location Based Routing, energy is saved by turning off unnecessary nodes in the network without affecting the coverage of the network. Rotating nodes, one at a time, stay awake to monitor the network while the others remain in sleep mode. Nodes are awakened when there is movement within their designated or relative location. This is how Location Based Routing is able to save energy.

Overall, routing protocols in WSN are classified into three basic techniques: Flat Based Routing, hierarchical based routing, and Location Based Routing. These three routing techniques are identified depending on their network's topology. Even using these three techniques, routing data is still a challenge due to the limited network resources. To help solve these challenges other routing protocols have been introduced.

We are now going to survey three state of the art routing protocols used in WSNs. Joint Sink Mobility, Routing Metric, and Beacon Vector protocols have the common goal to extend the life of the WSN without compromising data delivery. These protocols have been designed by inheriting features from Flat Based Routing, Hierarchical Routing, and Location Based Routing protocols. These protocols elaborate data communication and prolong the lifetime of WSNs.

V. JOINT SINK MOBILITY ROUTING

Joint Sink Mobility has developed an efficient algorithm that is able to prolong energy in WSNs by using a single mobile sink node instead of focusing on communication protocols for energy savings [4]. A sink node is the base station (BS) node that gathers all the findings of other nodes in the network for further data processing. The sink node is also the node that connects the WSN to the Internet to give users access to the reported data. Joint Sink Mobility takes advantage of the mobility of the sink node, the moving speed of the sink node, and the tolerable delay of the data delivery to improve network lifetime. Joint Sink Mobility has two approaches, high speed and slow speed mobility. The high speed mobility produces data delivery delay that spare nodes from the traffic- forwarding load [4]. The slow speed mobility improves the many to one traffic pattern in WSNs. Joint Sink Mobility uses dual algorithms to save energy by distributing the role of bottleneck nodes over time and balancing out the load [4].

VI. ROUTING METRIC

Routing Metric protocols propose energy control savings by measuring the end to end packet loss rate [5]. This gives Routing Metric protocols its energy performance indicators. Routing Metric protocols are similar to routers by connecting network segments and directing data based on information contained in the data packet. Routing Metric protocols estimate the number of hops using Routing Metric tables [5]. Routing Metric protocols are then able to select the best path with the smallest total number of hops to transmit data. Selecting the path with fewer hops instead of the path with a better quality link, Routing Metric protocols enhance the effectiveness of transmitting data using less energy [5]. This is how Routing Metric protocols are able to improve the life of WSNs.

VII. BEACON VECTOR ROUTING

The Beacon Vector Routing (BVR) protocol is a point to point self organizing ad hoc routing protocol [6]. BVR is based on the fundamental physics of the links available to transmit data within the WSN. The BVR protocol determines the location of nodes to better route packets saving power. BVR is able to

determine the location of uniquely identified nodes using the beacon vector and the Internet Protocol or MAC address [6]. Beacon vector, are the uniquely assigned coordinates that identify the location of nodes [6]. Knowing the location of nodes gives the hop distance to a number of uniquely identified nodes called the bacons [6]. Bacons assign coordinates to nodes based on the vector of hop count distance to a small set of beacons and then defines a distance metric on these coordinates [6]. Beacon nodes then send a beacon message to announce itself as a beacon that gives the relative location of this node to other nodes in the network. In BVR all nodes have to learn their hop distance from their beacon vector. The BVR protocol is then able to route packets greedily, forwarding to the next hop that is the closest to the destination. The BVR protocol includes algorithms that help it elect the beacon nodes dynamically and reassign beacon nodes when one fails [6]. BVR limits the usable distance to the maximum range that allows for bidirectional traffic [6]. This makes BVR protocols able to route data faster using less energy.

VIII. CONCLUSION

Most wireless sensors run off batteries. This means that the life of the entire network is depending on small inefficient batteries. Joint Sink Mobility, Routing Metric, and Beacon Vector protocols have been designed by inheriting features from Flat Based Routing, Hierarchical Routing, and Location Based Routing protocols. These protocols described have been discussed briefly in this article. Protocols are use to extend the life of the wireless sensor networks without compromising data delivery.

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Voltage Collapse and the Nigerian National Grid

Isaac Samuel*, James Katende** and Frank Ibikunle*
 *Department of Electrical and Information Engineering,
 Covenant University, Nigeria
 **Faculty of Science and Technology,
 Botswana University of Science and Technology, Botswana

Abstract — A modern electric power system network (PSN) is typically a large and complex engineering system whose healthy existence is crucial to industrial and socio-economic development of Nations. Voltage instability and collapse contribute to large extent to system collapse or blackouts and it is one of the major concerns for today's electric power system operations. The Nigerian National grid (NNG) experiences on an average of thirty-five (35) system collapse every year over the past ten (10) years. This paper presents an overview and classification of system collapse on the NNG.

Keywords — **Voltage collapse, Voltage instability, and Nigerian National Grid (NNG)**

I. INTRODUCTION

THE function of a power system network (PSN) is to generate and transmit power to load centres at specified voltage and frequency levels and statutory limits exist for the variation about base levels. The nominal frequency shall be $50\text{Hz} \pm 0.5\%$. Under system stress the frequency on the power system could experience variations within the limits of $50\text{Hz} \pm 2.5\%$ (i.e. $48.75 - 51.25$ Hz and the nominal voltage shall be $330, 132, 33, 11 - \text{kV} \pm 0.5\%$ while Under system stress or following system faults, voltages can be expected to deviate outside the limits by a further $\pm 5\%$ (excluding transient and sub-transient disturbances) [1]. As the system load changes, the resulting change in real and reactive power demands causes variation in the system voltage and frequency levels. The power system is equipped with controllers that reduce these variations to acceptable levels well within the statutory limits. In the operation and control of a power system network (PSN), voltage stability is a major concern to the power system engineer as the PSN nowadays operates very close to its stability limits [2]. This is due to increasing load demand, industrialization, environmental and economic factor which hampers the construction of new transmission lines and

generating stations. This has caused most PSNs to be weak, heavily loaded and prone to voltage instability ([2] [3] [4].)

Voltage stability can be defined as the ability of a power system to maintain steady and acceptable voltage at all buses in the system at normal operating conditions, after being subjected to a disturbance ([5] [6].) It is desired that the power system remains in the equilibrium state under normal conditions, and reacts to restore the status of the system to acceptable conditions after a disturbance, i.e. the voltage after a disturbance is restored to a value close to the pre-disturbance situation.

A PSN is said to enter a state of voltage instability when a disturbance causes a gradual and uncontrollable decline in voltage. The causes of voltage instability are contingencies (line or generator outage due to faults), increasing load, external factors, or improper operation of voltage control devices and load variations. More importantly, where there is a mismatch between supply and demand of reactive power, that is inability of the system to meet the reactive power requirement.

Voltage collapse can therefore be defined as instability of a heavily loaded PSN that leads to declining voltage and eventually blackout. This has severe consequence on the system security and negates the essential service of delivering uninterrupted reliable power to the customers. Figure 1 shows the progress of a voltage collapse phenomenon. The system voltage decreases slowly as the demand increases until a critical point is reached. At this point, any slight increase in demand will give rise to a large decrease in voltage, until the demand could no longer be satisfied which eventually leads to voltage collapse.

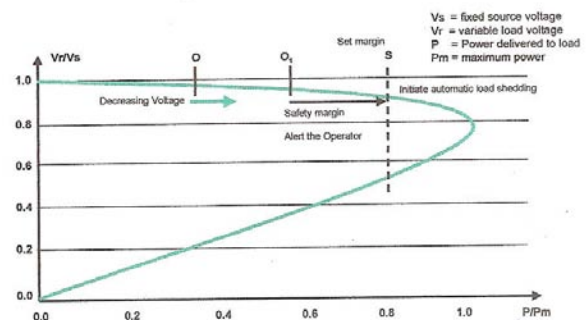


Figure 1: Progress of a voltage collapse case.

Isaac Samuel is with the School of Engineering and Technology, Covenant University, PMB 1023 Ota, Nigeria. (phone: +234.703.519.4939, iasamuel@covenantuniversity.com).

James Katende, is with the Botswana International University of Science and Technology, Gaborone, Botswana; (phone: +267.7.606.6430, e-mail: simpaa@gmail.com).

Ibikunle Frank is with the School of Engineering and Technology, Covenant University, PMB 1023 Ota, Nigeria. (phone: +234.809.535.9989; e-mail: faibikunle2@yahoo.com).

The paper is organised as follows. Section II presents power system stability while section III discusses the Nigerian national grid (NNG). Section IV deals with classification of system collapse on the NNG and section V presents the conclusion.

II. POWER SYSTEM STABILITY

Power system stability has been recognized as an important problem for secure system operation since the 1920s. Many major blackouts caused by power system instability have illustrated the importance of this phenomenon [7]. The world has witnessed several voltage collapse incidences in the last decades, prominent incidents that attracted much attention happened at Belgium (Aug 1982), Sweden (Dec. 1983), Tokyo (July 1987), Tennessee (Aug. 1987), Hydro Quebec (March 1989) and the recent major blackout incidence that happened in 2003 in North America and some parts of Europe [8]. The NNG witness several collapses as recorded in PHCN records. A comprehensive list comprising the time frame is summarized in ([5], [6], [8] and [9].)

According to the IEEE/CIGRE joint task force, "Power system stability is the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact." [10]. Figure 2 Shows the classification of power system stability according to IEEE/CIGRE joint task force.

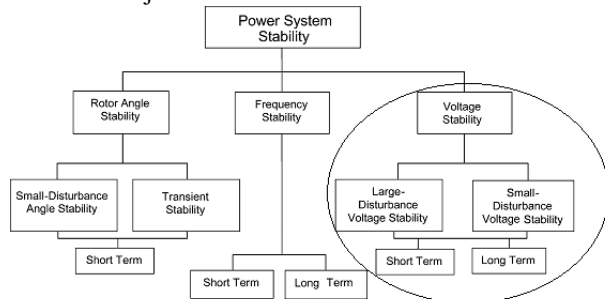


Figure 2. Classification of power system stability [10].

Based on the size of the disturbance, voltage stability can be further classified into the following two subcategories:

- i. Large-disturbance voltage stability refers to the system's ability to maintain steady voltages following large disturbances such as system faults, loss of generation, or circuit contingencies.
- ii. Small-disturbance voltage stability refers to the system's ability to maintain steady voltages when subjected to small perturbations such as incremental changes in system load.
- iii. Voltage stability may be either a short-term or a long-term phenomenon.
- iv. Short-term voltage stability involves dynamics of fast acting load components such as induction motors, electronically controlled loads, and HVDC converters. The study period of interest is in the order of several seconds.
- v. Long-term voltage stability involves slower acting equipment such as tapchanging transformers, thermostatically

controlled loads, and generator current limiters. The study period of interest may extend to several or many minutes, and long-term simulations are required for analysis of system dynamic performance ([11], [12].)

III. THE NIGERIAN NATIONAL GRID

The present installed capacity of the Nigerian National Grid (NNG) is about 6000MW, of which about 67 percent is thermal and the balance is hydro-based. By 2005, the transmission network consisted of 5000km of 330-kV lines, and 6000km of 132-kV lines. The 330-kV lines fed 23 substations employing transformer with voltage rating of 330/132-kV with a combined capacity of 6,000 MVA or 4,800 MVA at a utilization factor of 80%. On the other hand, the 132-kV lines fed 91 substations employing transformer with voltage rating of 132/33-kV with a combined capacity of 7,800 MVA or 5,850 MVA at a utilization factor of 75%. The system frequency is 50 Hz. The transmission network is overloaded with a wheeling capacity less than 4,000 MW. The NNG is characterized by poor voltage profile in most parts of the network, especially in the North, inadequate dispatch and control infrastructure, radial and fragile grid network, frequent system collapse, exceedingly high transmission losses [1]. The NNG is highly stressed and weak, this makes it prone to voltage instability and eventually voltage collapse [13]. The NNG diagram is as shown in figure 3.

CIRCUIT DIAGRAM OF POWER HOLDING COMPANY OF NIGERIAN plc GRID NETWORK PROPOSED AND EXISTING GENERATING STATIONS AND 330KV TRANSMISSION LINE

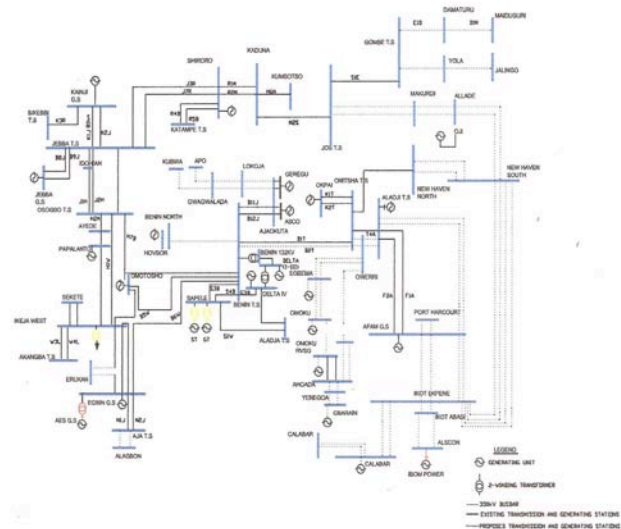


Figure 3: Nigerian National Grid 330kV Transmission Line.

The unreliability of the Nigerian PSN has impacted on the nation's socio-economic development and industrialization hence, the recent launch of the roadmap of the power sector reform by the Federal government [14].

Voltage collapse in PSN is an undesired phenomenon that occurs due to voltage instability and is generally associated with weak or stressed system (heavily loaded lines), long lines, radial networks, faults and /or reactive power shortages. Its occurrence is not frequent in developed countries despite their large and complex networks but its frequency is high in

Nigeria. Voltage collapses are highly catastrophic anytime they occur.

On the Nigerian national grid, the system collapse phenomenon is frequently experienced and often leads to either partial or total system collapse (black out), which greatly impairs the nation's socio-economic development and industrialization. This high rate is due to the fact that the NNG is weak, highly stressed, long and radial in nature hence lacking flexibility ([15], [16], [17].)

Statistics shows that system collapse on the NNG is very high. Table 1 shows the statistical data of both partial (p/c) and total (t/c) collapse on the Nigerian National grid from January 2000 to December 2009 [17].

Table 1: System Collapses for the period of 2000-2009 on the NNG [18].

Year	09	08	07	06	05	04	03	02	01	00
P/Collapse	20	16	8	10	15	30	39	32	5	6
T/Collapse	19	26	18	20	21	22	14	9	14	5
Total	39	42	27	30	36	52	53	41	19	11

This problem of system collapse is on the increase resulting in insecurity and unreliability of the entire PSN. This shows that we have an average of 35 collapses in a year. The inconvenience and economic cost it inflicts on both domestic and industrial customers is high and unbearable. The resultant power outages cost the nation an estimated \$1 billion per year (2.5% of GDP) [19]. Lack of adequate electric power has caused the closure of many industries that rely heavily on adequate power supply. Small businesses and heavy machine manufacturers are severely affected by the abysmal performance of the Power Holding Company of Nigeria (PHCN). Generally, the citizens are also affected socially, psychologically and physically due to inadequate and unstable power supply. On the overall PHCN has contributed in no small way to the stagnation of Nigeria economy. Poor services have forced most industrial customers and individuals to install their own power generators, at high costs to themselves and the Nigerian economy.

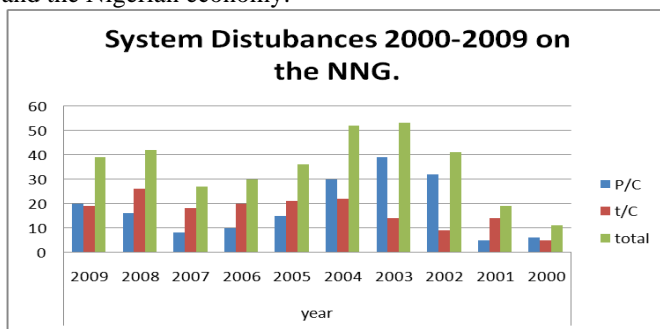


Figure 11: Bar chart showing the PHCN system disturbances form 2000 to 2009

When various components of power utility supply system experience complete seasure of energy flow, the system can be said to have total collapsed resulting in total blackout while partial collapse is when the network is islanded into two and one island is in blackout while on the other energy is flowing [14].

IV. CLASSIFICATION OF SYSTEM COLLAPSE ON THE NNG

The essence of classifying the system collapse on the NNG is to be able to know the system disturbances that are responsible for the high system collapse on the NNG and then proffer focused solutions to reduce the system collapse on the NNG. The summary of major system disturbances for three years i.e. 2008, 2009 and 2010 that gave rise to system collapse are classified as shown below:

Table 2: Classification System Collapses for the period of 2008-2010 on the NNG

Nature of Disturbances	2008	2009	2010
Faults	36	33	118
Gas (low pressure or lack)	2	5	0
Overload	1	2	3
Frequency	2	0	2
No reason	1	0	0

From table 2 above it can be deduced that fault induced collapse are predominant which reveal the nature of the NNG- as weak, stressed system (heavily loaded lines), long lines and radial networks. NNG is highly venerable to voltage instability.

It could be seen that the high rate of system collapse is largely due to technical challenges of the network. The state of the power system equipment and the entire network operation shows that there are also political challenges.

Technical Challenges are:

- I. Old and obsolete power system equipment.
- II. Inadequate compensation equipment on the system.
- III. Faulty and weak protection system
- IV. Weak network leading to indiscriminate tripping of the lines.
- V. Generation shortage due to increasing consumers demand.
- VI. Wheeling power is weak.
- VII. Poor maintenance culture.

Political challenges are:

- I. Neglect from Government over long period.
- II. The National leaders pay lip service to the development of the power sector. It has been seen as an avenue to loot.
- III. The sector has been fully politicized.
- IV. Corruption like cankerworms has eaten deep into the sector hampering its growth and development.

If the power sector will develop and consumers will reliable power supply then the technical and the political problems must be adequately handled. The government and the operator of the PHCN must be strong willed in handling the challenges. Investing more finance into the sector so that up-grading could be carried out to solve all the technical challenges and to install state of the art facilities.

The government must be willing to fight corruption and contract inflation to a standstill because it is a drain pipe that must be block otherwise steady power supply is not insight.

V. CONCLUSION

The classification of system collapse on the NNG is to help know the system disturbances that are responsible for the high system collapse on the NNG. The technical and political challenges must of necessity be tackled squarely by both government and the management of PHCN.

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