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A CLOUD-BASED VMmodel TO ENHANCE TRAFFIC MANAGEMENT ON NIGERIAN ROADS

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ABSTRACT

Attempts made by Nigeria governments to ensure that the congestions were managed through the various traffic management techniques have not yielded the desired results. The transport infrastructures and traffic management put in place in the city have not been able to ameliorate traffic congestion in the city. This paper introduces a cloud computing provision for the Vehicular Mobility Model (VMmodel) that provides additional traffic management techniques to the existing traditional method. The proposed VMmodel is based on an intelligent method of storing and tracking the licensed holding drivers that violate the traffic rules for road safety authority to take legal actions on them. The study proposes a conceptual framework and possible benefits for deploying a cloud-based VMmodel.

Keywords: *cloud computing, road safety, traffic rules, VMmodel.*

1. INTRODUCTION

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services (Software as a Service - SaaS). The datacenter hardware and software is what is called a Cloud. When a Cloud is made available in a pay-as-you-go manner to the public, it is called a Public Cloud; the service being sold is Utility Computing" (Armbrust *et al*, 2009). The idea of cloud computing started from the realization of the fact that businesses may find it useful to rent the infrastructures and sometimes the needed software to run their applications instead of investing on them. One major advantage of cloud computing is its scalable access to computing resources. With cloud computing, developers do not need large capital outlays in hardware to deploy their service for Internet applications and services. Keeping the noble benefit of cloud computing, the idea of Vehicular Cloud (V-Cloud) comes into light (http:// abhi-carmaniacs.blogspot. com/2012/02/ vehicular-ad-hoc-network.html).

A recent study by Vashitz *et.al*, (2008) suggests that in-vehicle visual display may increase mental workload causing distractions while driving. On the other hand, in-vehicle notification of safety information can add substantial value to increase driving attention. In Nigeria, the Federal Road Safety Corps (FRSC) has a legislation set for ensuring appropriate driving behavior that helps to qualify the drivers from their provisional license period to fully professional license holders. Traffic congestion occurs when a city's road network is unable to accommodate the volume of traffic that uses it. Attempts made by governments to ensure that the congestions were managed through the various traffic managements' techniques have not yielded the desired results (Onasanya and Akanmu, 2002). The transport infrastructures and traffic management put in place in the city have not been able to ameliorate traffic congestion. This inadequacy called for additional traffic management techniques to the existing traditional method, which could be found in cloud computing. So far, the conventional approaches to traffic management have not been able to make the desired impact, judging from the traffic congestion patterns in Nigerian cities.

Modern cars are equipped with permanent Internet presence, featuring substantial on-board computational, storage, and sensing capabilities and rather than keeping these huge resources idle, this paper proposed to use them in the co-operation with various authorities to solve problems which takes longer time to solve due to lack of additional resources.

The remainder of the paper is organized as follows: a relevant related works of different researchers are reviewed in the next section, while the proposed VMmodel concepts on cloud are discussed in section 3. The vehicular cloud architecture and case study of the design of VMmodel are outline in the section. Finally discussions and conclusion of the research are given in section 4.

2.0 RELATED WORKS

The work of Le-Tien and Phung (2010) was based on both Short Message Services (SMS) and General Package Radio Service (GPRS) technology to locating the vehicle. The work collects positions of the vehicle via Global Positioning System (GPS) receiver and then sends the data of positions to specialized server by the SMS or GPRS service. The specialized server is composed of a development kit that supports GSM techniques-WMP100 of the Wavecom Company. After processing data, the positions of the mobile vehicle are displayed on Google Map. The work of Jin-Cyuan *et al*.(2013) mainly consists of three steps including vehicle region extraction, vehicle tracking, and classification. The background subtraction method is firstly utilized to extract the foreground regions from the highway scene. Some geometric properties are applied to remove the false regions and shadow removal algorithm is used for obtaining more accurate segmentation results. After vehicle detection, a graph-based vehicle tracking method is used for building the correspondence between vehicles detected.

In the work of Aravind *et al*.(2009), Vehicle tracking system is one of such applications possible by embedding wireless sensor devices on the vehicles. Most of the state-of the-art technology uses GPS for tracking vehicles which is very expensive. The focus of this work is vehicle tracking system which is to track the desired vehicle with low-cost, effective implementation as in contrast to the existing high-cost tracking systems. Miah *et al*, (2011) proposed decision support systems based on an intelligent method in which decision/policy makers of the Australian road safety authorities can obtain on-demand monitoring records regarding the behavior of license holding drivers. The studies outline a conceptual framework that can automatically detect when a driver is using a hand-held device, generating an alert message through an onboard device. In order to minimize the risk, if the use of the device continues, they also proposed that relevant information should be automatically wirelessly sent to the legal authority. If the use of a hand-held device continues after the warning, the processing unit will automatically start communicating with a designated server or a legal authority through the cloud server by sending urgent messages. The communication includes vehicle details with its current location (automatically obtainable from the on-board GPS navigation system) and the type of driver activity.

Fernandez-Caballero *et al.* (2008) present an image-analysis approach for monitoring road traffic to ensure safer behavior. However, this approach is unable to identify driver behavior as the image is taken from outside the vehicle. However, Delen and Pratt (2006) demonstrated the limitation of simulation or model-based Decision Support System as it is found lacking when addressing real needs for manufacturing manager's decision making. As such, an intelligent Decision Support System was proposed to solve the problems of the manufacturing systems by introducing a new Decision Support System approach that is capable of helping decision makers to identify decision making life-cycle (Delen and Pratt, 2006). Considering the benefits of cloud computing and information demanded from various service delivery locations, research is required for empirical solution design, particularly for user-specific services. The new approach should also promote rapid decision making through the utilization of cloud computing.

2.1 State-of-the-Art Review on Traffic Mobility Model

The current state-of-the-art reviewed are the two urban road mobility models which are Manhattan mobility model and City Section mobility model. On the same note, rural road traffic simulation which include the Traffic on Rural Roads (TRARR) model developed by the Australian Road Research Board (Hoban *et al.*, 1991), the Two-Lane Passing (TWOPAS) model originally developed by the Midwest Research Institute (McLean, 1989) and the Swedish National Road and Transport Research Institute model that is Versatile Traffic micro-simulation model (VTISim) (Brodin and Carlsson, 1986) were reviewed. The development of the named model is briefly discussed as follows:

TRARR model utilized the theory of car-following model. Within TRARR model, each vehicle is assigned a desired following distance. This distance is composed of a time component and a distance

component. Vehicles that are constrained by a vehicle in front strive to follow their leader at the following distance. The follower adopts a speed that will allow it to achieve its desired following distance smoothly if the leader maintains a constant speed. Free vehicles strive to travel at its desired speed. Each vehicle is assigned a basic desired speed for ideal road conditions. A vehicle will always commence an overtaking if the time available for the overtaking is at least a safety factor times the estimated overtaking time. The desired speed and available power of the overtaking vehicle are increased during overtaking. A Vehicle which is being overtaken may however not commence an overtaking. A vehicle in the slow lane will move to the fast lane to overtake a slower vehicle if it has a sufficiently high aggression index and is not being overtaken. The model has been used by Australia, the US and Canada for evalua-tion of road alignment and passing lane alternatives (Botha *et al*., 1993). Available output of the TRARR model includes derived macroscopic traffic measures such as travel times, journey speeds, percent of time spent following and overtaking rates.

TWOPAS includes an empirically based overtaking model. The model is stochastic and includes overtaking gap-acceptance functions that determine the overtaking probability given the speed of the leader and the distance available for the overtaking (McLean, 1989). The distance available for the overtaking is given by the clear sight distance or the distance to the closest oncoming vehicle. The latest version of TWOPAS also includes an automatic procedure for sight distance calculation with respect to the road alignment and a user defined offset to roadside objects. The overtaking statistics include both overtaking rates and safety margins, i.e. time margins, at the end of overtaking. TWOPAS also provide travel times at zero traffic, i.e. free vehicle speeds, and the geometrical delay. VTISim is a microscopic rural road traffic simulation model. In this model, vehicles are classified as free or constrained depending on the headway to the vehicle in front. Constrained vehicles will strive to follow the vehicle in front at a given time headway. This time headway is a property of the leader rather than the follower, all followers will consequently follow at the same distance behind a given leader. If the leader decelerates then the follower will decelerate to obtain the speed of the leader after a certain distance given by the road geometry and restrictions on the follower's decelera-tion rate.

The Manhattan mobility model was proposed to model movement in an urban area (Zhou *et al*, 2004) where the streets are in an organized manner. The model focuses on nodes moving along horizontal or vertical streets, which is not enough to model nodes moving along non-horizontal and non-vertical streets. The City Section mobility model (Boudec and Vojnovic, 2006) limits the movement of nodes on a grid road topology. They proposed that, the node will at most make one horizontal and one vertical movement. The speed that the vehicle will travel at depends on the road it chooses to travel on. There are two road classes, high-speed, and low speed roads to choose from. Since all adjacent vehicles travel at the same speed, Car-to-car interactions will all be overlooked. All the models from the state-of-the-art reviewed either makes the design capable of modeling variations in the traffic flow over time and as a continuous flow called macroscopic models or tend to model individual vehicles, but describe their behaviour in a simplified manner, (Mesos-copic models).

This research captures the behaviour of vehicles and drivers in more detail, which makes them appropriate for evaluation of Intelligent Transportation Systems (ITS) at the operational level. For instance, the model will look at the drivers violating the rules of the traffic authority, free flow movement of vehicles and other better control traffic strategies using Cloud technology.

3.0 PROPOSED VMModel CONCEPT ON CLOUD

This section describes cloud archi-tectural considerations for the proposed VMModel solution model. Technical detail of a conceptual VMModel was also presented.

3.1 Vehicular-Cloud Architecture

Vehicular cloud architecture includes Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS) and Storage as a service (STaaS) to operate the cloud environment. In IaaS, the wireless sensor network through General Packet Radio Service (GPRS) connected to the cars collect the information, traffic and road information about the vehicle. More so, as every car has Internet connections, the wireless sensors connected to the cars for measuring Global Position System (GPS) information use the approved minimum gap

acceptance by the road safety authority as the communication range, hence, informa-tion is automatically sent to a cloud controlled by the traffic police. This information is then passed to either STaaS or SaaS through PaaS. This kind of system will communicate with the users within the cloud, process all information and give useful services such as velocity, positioning, time of occurrence and security gap between the vehicle and the front vehicle, inform of feedback.

Finally, all the information within the cloud are stored and retrieved from the STaaS (figure 1). The cloud architectural model has been classified into three types: a) private cloud, in which resources are shared across the local network, b) public cloud, in which resources are shared from the public network, and c) hybrid cloud, in which a combination of both provisions is presented.

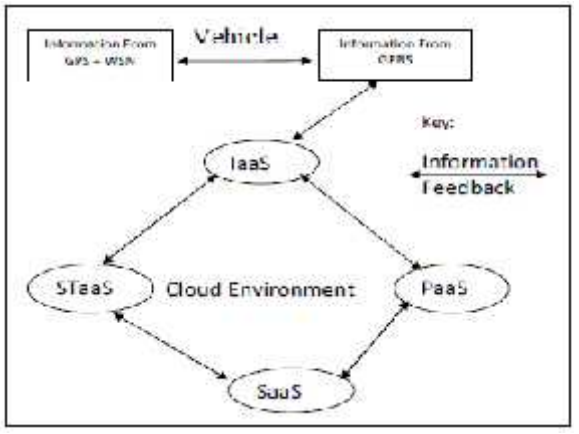

Figure 1: Schematic diagram of cloud architecture which included VANET as IaaS

The combined cloud has the potential to accommodate VMmodel applications because most of the target decision makers require access through private and public networks (e.g., road safety authorities work from their LAN).

Studies identify some considerations that must comply for cloud application design Whitepaper (2010). Design consider-ations are: the simplest application design, splitting functions of the applications into clusters, realizing network communication, and testability. With these guidelines, VMmodel can be composed into three clusters: the user interface, received vehicle detail and activities, and the preservation of databases. This helps improve application performance in clusters and monitors its integration points from the network environment. Figure 2 below illustrates the architectural consideration of the proposed VMmodel design on cloud.

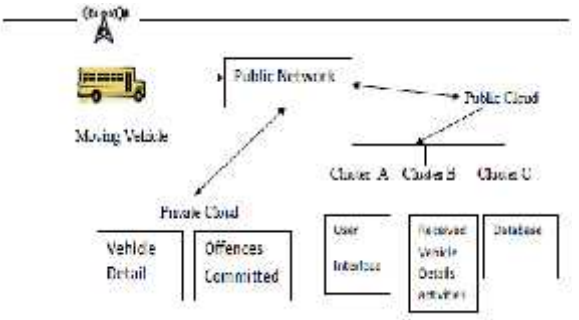

Figure 2: Proposed VMmodel design clusters on cloud computing (adapted from Miah *et.al*, 2011)

3.2 Concept and Modeling of VMmodel

The objective of the study is to outline a conceptual framework that can automatically detect a license holding driver violating the rules and regulation of the proposed traffic control strategies such as entering or moving within the minimum gap acceptance between two vehicles, moving above the speed limit, doing wrong overtaken and unnecessary lane changing, generating an alert message through an onboard device. To minimize risk, if the driver violates any of these rules, relevant information will be automatically wirelessly sent to the legal authority. At the same time, in terms of keeping continuous records in a dynamic database and providing facilities for user-behavior analysis for recommendation systems, the potential of a cluster-based approach are examined. Two important goals has been identified, the first one is the design/deployment of an automatic system that would detect the presence of the vehicle at the recommended front and backward space of another vehicle and it is assumed that all vehicles are using an onboard processing device containing a video sensor, GPS navigator, and/or in-built speedometer reading and wireless communication device. Secondly, the system facilitates the automatic generation of an alert message for a certain period of time and at a particular distance so that the driver could be warned against violation of the rules of the road. To minimize the risk, wireless transmission of relevant information is processed to notify the legal authority for necessary

action. The following four processes have also been identified to meet the goals defined in this section:

a) Determining vehicle motion

The main purpose here is to prevent drivers from violating the rules and regulation of the traffic authority so as to maintain free flow movement of vehicles on the road, reducing accident rate or vehicle collision and make tracking of violator of the rules easy to detect. The first processing step is to determine whether the vehicle is moving. The processing unit can determine this either from the odometer reading or using an onboard GPS navigation system. The optimal gap acceptance (G(s)) for any given vehicle speed (*G*(*s*)) is calculated as follows provided the two vehicles start at the same time:

$$G(S) = \begin{cases} G_o + R_n S & 0 \le S \le S_{limit} \quad n = 1,2 \ldots \\ G_{min} + R_n(S_{limit} - S) & S_{limit} \ge S \quad n = 2,3 \end{cases}$$

G_o- value of the gap acceptance for vehicles at rest (distance)

R_n- rate of increase of gap acceptance when vehicle speed is between o, S and S_{limit} (distance/speed)

S_{limit} - speed limit

S – speed of the vehicle

G_{min}– minimum gap acceptance (distance)

l_n – length of Vehicle n

b) Detecting the vehicle's details

The smart processing unit of each vehicle would have contained the vehicle plate number, chasses numbers and vehicle type for vehicle to vehicle communications.

c) Transmitting and generating warning message

The car-following model utilized in this VMmodel works as follows. Within the ad hoc network, each vehicle is assigned a desired following Minimum Gap Accept-ance (G_{min}) of the length of the vehicle. This G_{min} is composed of a time component and a distance component. Vehicles that are constrained by a vehicle in front strive to follow their leader at this following G_{min} . The follower adopts a speed that will allow it to achieve its desired following G_{min} smoothly if the leader maintains a constant speed.

The smart processing unit will start generating warning message as soon as the following vehicle enters into the optimal gap acceptance but the alert will be different from the one to be issued when the vehicle enters the minimum gap acceptance. The Optimal Gap Acceptance (G(s)) is modeled as a piecewise, linear, monotonously increasing function of the vehicle's speed. addition of the minimum gap acceptance and the length of the vehicle. The basic assumption of these models is that vehicle should have minimum gap acceptance (G_{min}) of at least the length of a car between lead vehicle and the following vehicle.

Figure 3: Diagram of the followed vehicle and lead vehicle on a free flow way

$$f(x) = \begin{cases} \\ \\ \\ \end{cases}$$

Where V_n and V_{n+1} are the speed of the follower and the leader, respectively, it shows that the optimal gap acceptance is greater than the minimum gap acceptance and it is not the same for every vehicle type so that driver will not always fall into violation of the traffic rules.

If $V_n > S_{limit}$ then R^{rv} otherwise R^{ff}

Where: n is the number of vehicles in the ad hoc network.

R^{ff}- report "free_ flow" to the cloud

R^{rv} – report "rule_ violated" to the cloud

The smart processing unit will be able to transmit records of the car and drivers to a database located at cloud server. The processing unit will have the ability to generate a warning relevant to each vehicle.

The model describes a vehicle which can either be in the free flow, or rule violation. The different areas are defined by minimum gap acceptance (G_{min}). The G(S) is

defined by a minimum gap acceptance that depends on the speed of both the follower and the leader. It consists of an estimation of the distance needed for acceleration from the follower's speed up to the leader's speed with a normal acceleration rate. The Optimal Gap Acceptance (G(s)) can be calculated while the vehicle is accelerating. From the Newton's second law of motion,

$v^2 = u^2 + 2ax$

$a = (v^2 - u^2)/2x$

hence,

$x = (v_{n+1}^2 - v_n^2)/2a$

where a = acceleration of the vehicle.

$$G(S)_{(v_n, v_{n+1})} = \begin{cases} v_n T + l_n + x & if\ v_{n+1} \geq v_n \quad n = 0,1 \ldots \\ v_n T + l_n + x & if\ v_n > v_{n+1} \quad n = 0,1 \ldots \end{cases}$$

where V_n and V_{n+1} are the speed of the follower and the leader, respectively, T is the length of a time interval which is equal to the reaction time of the driver, L_n is the length of the follower vehicle, x is the displacement and a_n is the normal accele-ration rate. The last term, G_{min} is the minimum distance between stationary vehicles, which is depending on the length considered by the traffic safety authority.

When travelling in the free flow, the followed vehicle is not allowed to accelerate more than the speed limit. If the vehicle travels faster than the speed limit and enters the minimum gap acceptance, the sensor in the lead vehicle will upload the information about the position, velocity, time of occurrence about the vehicle, gap distance and the plate number as the vehicle's identification for detection to the cloud. Then the road safety authority is notified from the cloud system, traces the vehicle, captures it and takes action against the car. Hence, from the cloud, the vehicle can be monitored and find irregularities when necessary. This method of monitoring the vehicle on the road will reduce the necessity of too many base stations around the city, reduce the density of vehicles on the urban area as well as creating better opportunities for the drivers in the urban area to be a part of the Internet access when required. It will create a new dimension to the traffic control system.

If the speed of the lead vehicle is zero, the following vehicle decelerates its speed so that it can stop before a collision occurs.

$V_{n,t+1} = V_{n,t} - a_{n,d}\, T \quad for\ V_{n-1,t}=0\ \&\ V_{n,t} \neq 0$

The distance that the following vehicle can move before collision is equaled to the spacing minus minimum gap acceptance. If the lead vehicle is moving and the following vehicle is stopped, the follower will not start to move immediately. The follower usually remains stopped, and only moves once the spacing is greater than a specific spacing (i.e. the start spacing). The follower then moves at the next time step, with its acceleration equaling its desired start

$V_{n,t+1} = a_{n,d} T \quad for\ V_{n-1,t} \neq 0\ \&\ V_{n,t}=0\ Pos_{n,t} \geq G_{min}\ otherwise\ then\ R^{rv}$

Finally, if the following vehicle stops and the spacing is less than the start spacing, the follower remains stopped at the next time step

$V_{n,t+1} = 0, \quad for\ V_{n,t} = 0\ \&\ Pos_{n,t} < G_{min}$

d) *Communicating automatically with a designated server and/or legal authority*

If the following vehicle (FV) enters into the minimum gap acceptance, the lead vehicle (LV) gives warning message and record the information on the FV (time, distance and speed) on its processing unit. The smart processing unit of the LV will automatically start communicating with a designated server or a legal authority through the cloud server by sending urgent messages. The communication includes vehicle details with its current location (automatically obtainable from the on-board GPS navigation system), time and vehicle's speed.

4.0 DISCUSSIONS AND CONCLUSION

This article is a potential research avenue for developing a VMmodel that will take care of Nigerian road traffic control system and how road safety authority could track the drivers that violate the road driving rule and regulation. The conceptual study outlined a research requirement for develop-ing a novel cloud-based VMmodel in the bedrock of an intelligent traffic control system. This initiative would enhance VMmodel scholarship within new provision-ing cloud technology. The successful imple-mentation of the design VMmodel would potentially provide invaluable services to the road transport authority and drivers by enhancing road safety features, and thus

help prevent risky driving practices. For instance, traditional intelligent VMmodel is designed particularly for monitoring purpo-ses and the model can be extended to capture other rules and regulation as it may be spell out by the road authority. Further study is required for evaluating the conceptual framework and extension of the model to capture other rules through outdoor experiment or simulation to reduce the cost.

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A MODEL FOR MAINTAINING DATA SECURITY AND AUTHENTICITY IN VOICE-DRIVEN SYSTEM

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ABSTRACT

There were cases of lost or stolen or counterfeited password, thus we present a model for real-time voice recognition in access control. Voice-driven involves identification and verification of the speaker. At each stage, the voiceprint is compared with model voices of all speakers in the database. The comparison is a measure of the similarity (score) from which rejection or acceptance of the verified speaker is chosen. The Dynamic Time Warping (DTW) and Vector Quantization (VQ) models were employed to investigate processing time and memory requirements. The Linear Predictive Coding (LPC) and Cepstral analysis for feature extraction techniques were used for damping. The system was trained and tested using a population of ten users, with additional ten impostors. The average call success of a true speaker was 96.5%. The impostor's success rate was statistically computed to be 0.0036%.. The DTW was found to be more suitable for real-time application with the real-time average speaker recognition time of 7.80 seconds. The system was able to make access decision in an average of 2.80 seconds after the voice sampling was completed. In general, our model compares favourably with what obtained in literature with better recognition and access decision times.

Key words: Voice-driven, Real-time, Dynamic Time Warping, Vector Quantization, Linear Predictive Coding

1.0 INTRODUCTION

Accessing protected resources is always carried out through the use of personal tokens like a key or badge, knowledge of certain information like a password or combination of numbers Aladesanmi *et al*. (2012). A password is a string of characters used to login to a computer and other systems for files access, program access, and other resources. They are used to ensure that people do not access any system unless they are authourized to do so (Aborisade *et al*., 2013). It is however observed that these passwords (or keys or badges) can be lost, stolen or counterfeited, thereby posing a threat to information or data security. Thus, in order to reduce this security threat, this paper focuses on real-time voice-driven access to the restricted resources, since voice is unique to each person and cannot be lost or stolen. Voice-driven based solutions are able to provide for confidential financial transactions and personal data privacy.

The remaining section is organized as follows: section 2 reviews a number of relevant literatures on speaker recognition system; section 3 describes the metho-dology for the proposed system while 4 and 5 describe the results and concludes the work respectively.

2.0 RELATED WORK

There have been numerous researches in the application of techniques and models used in extracting voice feature or matching feature in order to identify and verify speaker in speaker recognition system. A number of such relevant researches were reviewed in this paper. David (2004) found that Verification system authenticates a person's identity by comparing the captured biometric charac-terristic with its own biometric template(s) pre-stored in the system which conducts one-to-one comparison to determine whether the identity claimed by the individual was true. A verification system either rejects or accepts the submitted claim of identity and that the identification

system recognizes an individual by searching the entire template database for a match which conducts one-to-many comparisons to establish the identity of the individual. The delimitations of (David, 2000) were that the rate of fingerprint capture and feature extraction were not considered, although in a real-time world scenario, this is an important factor.

In (Julius *et al*., 2005), a stochastic model was developed to solve the problem of speech processing in speaker recognition. The research was able to develop a high-quality, multivariate and Hidden Markov Model (HMM) by means of Hidden Markov Toolkit (HTK) tool software to determine the speaker but provision for grammar testing enlargement as the new models are needed for the new words training. However, the limitations of the research were the direct counting of the probability that was very complicated; and that the current state depends on the previous state. A new feature selection method for speaker recognition was proposed by Hanwu *et al*. (2008) to keep the high quality speech frames for speaker modelling and to remove noisy and corrupted speech frames. The research adopted spectral subtraction algorithm to estimate the frame power. An energy based frame selection algorithm was then applied to indicate the speech activity at the frame level. The research was able to use the eigenchannel based GMM-UBM speaker recognition system to evaluate the proposed method. However, the research required long-term spectral analysis and computation found to be complex. Sara (1998) concentrated on optimized speech processing in the DSP56001 hardware platform, especially in the application of noise reduction and speech enhancement. Kwek (2000) worked on a hardware based speech recognition system. Both work by Kwek (2000) and Sara (1998) were hardware based but were not concentrated in the area of speaker recognition, which is the focus of this paper, based on the observation that the size of the speaker database grows when the number of speakers in a system is increased. This poses two problems in terms of memory requirement for voice database storage, and processing time required by the system and these problems are being analyzed in this paper using a comparative analysis on Dynamic Time Warping and Vector Quantization based models to determine a suitable model with better response time in real-time application for voice-driven recognition system.

3.0 METHODOLOGY

A voice-driven system involves two phases. In the first phase, a user enrols by providing voice samples to the system. The system extracts speaker-specific information from the voice samples to build a voice model of the enrolling speaker, Figure 1.

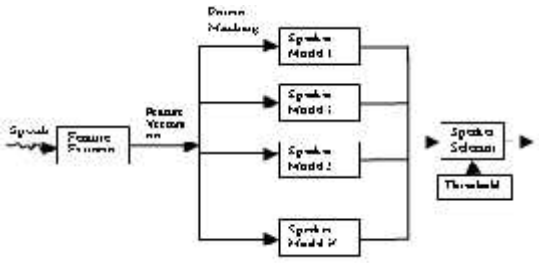
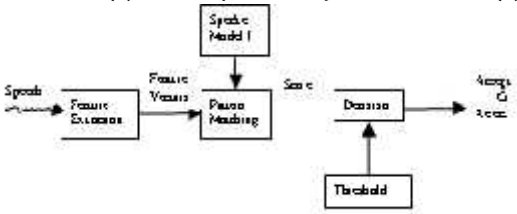


Figure 1: Model of a Voice Identification System

In the second phase, a user provides a voice sample (also referred to as test sample) that is used by the system to measure the similarity of the user's voice to the model(s) of the previously enrolled user(s) and,



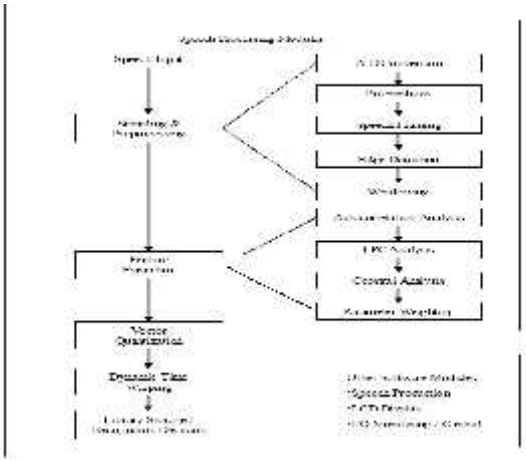
subsequently, to make a decision. In a speaker identification task, the system measures the similarity of the test sample to all stored voice models. In speaker verification task, Figure 2, the similarity is measured only to the model of the claimed identity.

Figure 2: Model of a Voice Verification System

Several conversational telephone calls in English and Yoruba languages were conducted and recorded. The collected voices were processed through the use of notebook computer with an external microphone attached, where all the voices were recorded digitally into the computer via the microphone. Voice sampling was required to convert an analogue signal into a discrete signal, to be digitally processed by a digital computer. Further pre-processing such as speech framing, edge detection and

windowing were performed to improve the raw digitized signal to be used in the feature extraction process, further steps taken is as shown in Figure 3.

A digital signal processor running at 50MHz was used to execute the voice recognition algorithm. The Linear Predictive Coding (LPC) Cepstral technique was used for feature extraction of speech signal as the speech sample $s(t)$ at time t was approximated as a linear combination of the past p samples



$$s(t) \approx a_1 s(t-1) + a_2 s(t-2) + \ldots + a_p s(t-p) \quad (1)$$

Figure 3: Block diagram of software modules developed for the voice recognition system

where the coefficients $a_1, a_2, \ldots, a_p$ were assumed constant over a single speech frame. The autocorrelation method with function

$$r_l(m) = \sum_{t=1}^{t} x_l(t)x(t+m), \quad m = 0,1,2,\ldots,p \quad (2)$$

was used for estimating the coefficients which provided the energy of the speech frame, and was used for discarding silent frames. The LPC coefficients $a_i(t)$, $0 \le t \ge T\text{-}1$ were computed from the autocorrelation vector using a recursion method known as Durbin's method where the equations were solved +recursively for $i = 1,2,\ldots,p$. On completion of the algorithm, the final solution was given as:

$$a_m = LPC\ coefficients = a_m^{(p)}, \quad 1 \le m \le p \quad (3)$$

Vector quantization (VQ) codebook was used for feature matching, to efficiently represent speaker specific characteristics. One codebook was created for each i speaker during the training stage. During recognition, the total distance for the i-th speaker was computed by:

$$D^i = \sum_{i=1}^{L} \min_{1 \le j \le N} d(y_i, C_j^i) \quad (4)$$

where C_j^i is the j-th code vector of the i-th speaker's codebook, N_c is the codebook size, $y_1, y_2, \ldots, y_L$ represent the feature vector of the test utterance, D^i is the matching score and $d(yi, C_j^i)$ the distance between the feature vector and the codebook vector, where the speaker identification decision was based on the matching score. The speaker model with the smallest matching score, D^i was accepted as the producer of the voice sample, otherwise, rejected.

Speaker identification using Dynamic Time Warping (DTW) was implemented using a training or reference template for each speaker. During identification stage, a DTW score of the test utterance was made against each training template. Speaker identification was carried in favour of the speaker whose training template produced the lowest score, provided the score is within the threshold value. For speaker verification application, the test utterance was compared against the training template of the speaker who was being verified. The obtained DTW score was compared against a threshold value and the user was only verified if the score was lower than the threshold value set for the speaker. The verification threshold T was computed using equation 5:

$$T = \frac{\mu_{spk}\,\mu_{imp} + \mu_{imp}\,\sigma_{spk}}{\sigma_{spk} + \sigma_{imp}} \quad (5)$$

Where (i) The mean, μ_{spk}, and standard deviation, σ_{spk}, is computed from the DTW score from each digit; and (ii) The mean, μ_{imp}, and standard deviation, σ_{imp}, is computed from the DTW score against this users template and speech samples of impostors.

For the real-time experiment, the memory requirements for VQ and DTW were computed when implemented on a voice recognition system. The classifiers compared were the VQ and DTW. The memory required for the types of classifier implementations were noted along with the execution time. The execution time was only given for the classifier training and recognition routine. The memory and processing time results were recorded. Voice access was only granted if both identification and verification were successful. An application software was developed using C programming language with Code Composer Studio (CCS) to generate the source codes for autocorrelation analysis, LPC Cepstrum and DTW. The DSP Starter Kit (DSK) Debugger was used to download source code to the speaker recognition system, which executes decoding and monitoring. The average identification success rate and average verification success rate for both original speakers and impostors were given in percentage. The system performance was evaluated using Equal Error Rate.

4.0 DISCUSSION OF RESULTS

The speaker identification and verification result of a true speaker is given in Table 1.

Table 1: The voice identification and veri-fication success count

SPk	Successful Identification (True Acceptance)	Unsuccessful Identification (False Rejection)	Successful Verification (True Acceptance)	Unsuccessful Verification (False Rejection)
S 1	47	3	47	3
S 2	50	0	50	0
S 3	45	5	50	0
S 4	50	0	49	1
S 5	47	3	48	2
S 6	47	3	50	0
S 7	49	1	44	6
S 8	48	2	50	0
S 9	49	1	47	3
S10	48	2	50	0

The average identification success rate was 96%, and average verification success rate was 97%. The overall call success result of a true speaker is given in Table 2. The average call success rate for a true speaker was 96.5%. The total Storage/memory and processing time is summarized in Table 3.

The training time listed is for each enrolment session. The speaker identifi-cation time was calculated on assumption that there were 100 enrolled users. From Table 3, the storage requirement needed for the VQ implementation was the least, with the DTW implementation required larger storage area.

Table 2: True Voice call attempts success count

Speaker	Successful Entry (True Acceptance)	Unsuccessful Entry (False Rejection)
S 1	45	5
S 2	50	0
S 3	45	5
S 4	49	1
S 5	45	5
S 6	47	3
S 7	44	6
S 8	48	2
S 9	46	4
S10	48	2

Table 3: Storage and processing time for VQ and DTW classifiers

	Storage Location	Training Time	Speaker Identifi-cation Time	Speaker Verification Time	Total Proces-sing Time
VQ	1.2Mb	8.50s	15.82s	0.26s	16.08s
DTW	4.2Mb	0.50s	0.90s	0.06s	0.96s

The VQ implement-tation requires a comparatively moderate amount of memory. The VQ consumes less memory than the DTW, which was expected due to the lousy compression nature of the VQ implementation. All the classifiers evalua-ted required memory location which was easily made possible in current design.

The time needed to enrol a user varies drastically between the classifiers. The DTW

implementation required 0.50 second for training and found to be acceptable, and may be used for online training. A person can be made to wait during an enrolment session, and thereafter the trained database may be verified. If the verification is unsuccessful, speech samples may be prompted again from the user to retrain the user database. The training time of VQ was well beyond the waiting time for a user who was enrolling. The training may be carried out offline, during the idle processing time of the voice recognition system.

The speaker identification time for DTW classifier was within acceptable limit. The identification time of the VQ was quite long and may not be suitable in certain applications like telephone banking and telephone credit cards. The training time can be reduced by using a more powerful DSP.

The time needed for all 10 speakers who enrolled in the speaker recognition system were recorded. Prior to training, all speakers were briefed of the training procedure. Average training time was noted at 50.0 seconds. This included the voice sampling time of a minimum of 16.72 seconds. Sampling time increased due to verification of digit and login name sample. Speakers were requested by the system three times, if verification failed.

The average speaker recognition time was noted at 7.80 seconds. This timing included the prompt and sample time of 5 seconds. The system was able to make access decision in an average of 2.80 seconds after the voice sampling was completed.

5.0 CONCLUSION

As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent. Therefore, in order to aid forensics in criminal identification, authentication in civilian applications and for preventing un-authorized access, there is a need to develop a voice recognition system that would be able to provide solutions for confidential financial transactions and personal data privacy that reduces the high-tech computer theft or fraud in terms of access control, telephone banking and telephone credit cards.

This paper presents a model for maintaining data security and authenticity in voice-driven system whereby a system designed consists of memories and data acquisition modules that were well suited for a voice recognition system. Voice as a special characteristic of an individual, a form of biometric feature, could be used as a form of personal system identification and verification, and is recommended to be part of feature to be captured in the on-going government's activities like the acquisition of National Identification Number, Drivers Licence, International Passport, Integrated Payroll and Personnel Information System (IPPIS), etc.

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DEVELOPMENT OF A DIGITAL YORUBA PHRASEBOOK ON A MOBILE PLATFORM

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ABSTRACT

Yoruba phrasebook is a book of useful words and phrases in a Yoruba language with translations, for the use of visitors to places where the language is spoken; it can be likened to bilingual dictionary of Yoruba-English.

Digital Yoruba phrasebook was developed in this research using the latest technologies such as PHP, Mysql, .net, Mssql 2005, 2008, Ajax techies, C# and lots of cloud computing services all on both Windows and Linux platform.

Mobile application for the design of phrasebook brings the usefulness of Information Technology to the doorstep of non Yoruba tourists who wishes to converse, make friends with Yoruba people that are not literate or transact business with Yoruba indigenes.

KEYWORDS: BILINGUAL, YORUBA-ENGLISH, PHP, LINUX PLATFORM, INFORMATION TECHNOLOGY.

1. INTRODUCTION

In the 21st century, it is reasonable to expect that some of the most important development in science and engineering will come about through interdisciplinary research. Mobile application of Digital Yoruba Phrasebook cut across information theory, computer science, statistics and lingual. The design of phrasebook for foreign language users has been one of the challenges of modern applied linguistics under translation since it became an autonomous field of study. Of emphatic mention was the one designed for the United States army during the second world war – a phrasebook of common Chinese (Rabina, 1999). Its aim is to understand how certain Yoruba words and phrases can be understood by visitors through electronic media. It must identify the inquisitiveness of a typical learner or tourist, promote its ethical values to potential students, accept the enquiry of the readers of Yoruba language, deliver the readers' or learners' request and support learners' use for non Yoruba tourists that wish to converse with Yoruba speakers. Digital phrasebook can be CD-ROM based, network based, intranet or internet based or mobile application which provides new channel for communication between travellers (tourist) and their guide (tutor) in their respective destinations.

Yoruba is a dialect of West Africa with over 50 million speakers (Wikipedia, 2010). It is a member of Niger-Congo family of language and it is spoken among other language in Nigeria, Togo, Benin and partly in some communities in Brazil, Ghana, Sierra Leone (where it is called Oku) and Cuba (where it is called Nago) (Bamgbose, 1965). Yoruba is one of the three major languages in Nigeria and language is the principal means used by human beings to communicate with one another (Encarta, 2009); it is spoken and considered as the third most spoken native African language. Yoruba language has ancestral speakers who according to their oral traditions is Oduduwa (son of Olúdùmarè), the supreme god of the Yoruba (Biobaku, 1973). Yoruba first appeared in writing during the 19th century and the first publications were a number of teaching booklets produced by John Raban in 1830 – 1832 and another major contributor to orthography of Yoruba was Bishop Samuel Ajayi Crowther (1806 – 1891) who studied many of the languages of Nigeria (Oyenuga, 2007), he wrote and translated some of the Yoruba phrases and words. Yoruba orthography appeared in about 1850 although with many inherent changes since then. In the 17th century Yoruba was written in the Ajami script and major development in the documentation of Yoruba words and phrases

were done by Anglican (CMS) missionaries that were working in places like Sierra Leone, Brazil, Cuba and they assembled the grammatical units in Yoruba together which were published as short notes (Adetugbo, 1982), in 1875 Anglican communion organized a conference on Yoruba orthography.

Digital phrasebook is done with an easy to read and pronunciation guide for all the phrases and words that readers (learners) need to communicate effectively and efficiently so as to solve visitors-dwellers predicament while visitors are abroad (Howe and Henriksson, 2007). It would cover all must–know vocabulary and phrases for typical situations from making reservations and getting around to shopping and obtaining all forms of help. In the time past, the quality of communication and fluency was linked to your mother's tongue language while in the future; the quality of communication will be linked with digital phrasebooks (Geere, 2009) and with the advent of internet which is becoming the most important source of information, tourist or prospective learners of any language can obtain all necessary words and phrases to communicate in Yoruba. Internet brings people together from any country in the world and reduces the distance between people in many ways (Schneider and Perry, 2001). Prospective tourist or learner of Yoruba language can use digital phrasebook to learn a language that are geographically separated from a typical learner. The web as a virtual environment helps learners and teachers of Yoruba language to share a common interest by reducing the cost and increase the communication skills of intended tourists or learners. Today a web is frequently the first place teachers, learners or researchers go to conduct any research or find out any information and also any tourist to a Yoruba nation would consult the web for a guide to have an enjoyable moment abroad and the availability of Yoruba phrasebook on the web would be an added value to Yoruba nations and enhance better relationship between the visitors (learners) and dwellers. It would also portray and rebrand the images of Yoruba nations. Digital phrasebook increases the opportunities of conversing in other languages apart from one's mother tongue, web enhancement feature of the digital phrasebook would increase the speed and accuracy with which learners and teachers can exchange information and cost of learning are drastically reduced. It would provide wide range of phrases and words in Yoruba language for any interested learner to read or study 24hours a day. If distance education is making it possible for people to learn skills and earn degrees no matter where they live or which hours they are available for study, so also is digital phrasebook in teaching spoken Yoruba language.

The first kind of phrasebook is Chinese military phrase book that was printed in China in 1945 and was used by American Soldier during World War; phrasebooks are guiding manual that offers a collection of phrases you are likely to use during your travel in another country, ranging from simple introductions to asking for directions to casual conversa-tions (Howe and Henriksson, 2007).

1.1 Motivation

Translation is inevitable because communication is the lifeblood of business or transaction and hence need for large-scale translation of Yoruba to English and vice versa for non indigenes of Yoruba that intend to deal with Yoruba natives. The efforts to develop digital Yoruba phrasebook have one source of motivation which is to solve associated problems with communication and language barriers. There are numerous predicaments that manual Yoruba phrasebook cannot solve, language as we are aware is primarily spoken and there are many languages in the world today that have not been committed to writing whereas all languages in the world are spoken. This means that, the spoken language takes precedence over written languages. The necessity of spoken language over written has been the focal point for the development of digital Yoruba phrasebooks with their pronunciation for non indigenes to be familiar with Yoruba nation, cultural values and creed.

Considering a tourist and language student from the United States, Clara who landed in Osogbo, Nigeria. For four years she had been nursing the ambition to witness the UNESCO recognized Osun Osogbo Festival. She cannot wait to experience the charm that arrested Adunni (Suzzaire Wenger). Of course, she is prepared; she had earlier read publications about Nigeria as a whole, the Yoruba people and culture, as well as Osogbo specifically. She is a post graduate student, someone who knows the power of language at negotiating and navigating, its effect on native speakers and

foreigner who even if crumbly, could use some phrases in such language.

You see, Africans (and indeed Nigerians) are fond of you when you can say something in their native languages – it does not matter how well. Oh, she loves that bead (necklace) and must buy, Clara will like to own one too. So she called on the seller, "Mama, e lo ni?", touching the beads. Instead of saying the price, the bead seller laughed, danced round her colleagues in both amusement and surprise "Oyibo n so Yoruba!". Clara smiled at her, it was the beginning of a good bargain and she was sure. And when the bead seller said her price, Clara slashed it by half, again surprisingly in Yoruba "Ko gba igba naira ni?" she won the seller and bargained well. Above all, she has sown the seed of bond between herself and not just the seller but also her colleagues. In the later days, there was not anything that Clara needed that was not provided by those women. What worked for Clara in those illustrations was the advent of electronic phrasebook compiled on the internet. The phrasebook contained important expressions for situational communication between a foreigner and native Yoruba speakers in the areas of bargaining, greetings, descriptions, numbers, colours, etc. Without doubt, Clara will enjoy her stay than someone else who could not lay his hands on such facility, which is exactly what this present research work aims to achieve.

All human beings have natural propensity to speak language but not all human beings can write or read in a particular language and with advances in computer technology Yoruba would be spoken amidst all people who may intend to visit or transact business with the indigenes of Yoruba nations, spoken language saves time and digital Yoruba phrasebook will provide the ability to learn the language in the shortest time possible unlike the written that takes a lot of time for preparation. Once the web enabled Yoruba phrases and words are learnt on the internet feedback would be immediate and other paralinguistic features combined would give more meaning to the spoken Yoruba language. Computer has been an indispensable tool in lexicography for decades which prompt the development of phrasebook for Yoruba language electronically. The need to store, sort and retrieve large amounts of linguistic information drew the attention to work on this research work. Without pretending to teach you a new language, this phrasebook will hopefully prove to be a helpful tool in your communication arsenal, it will offer an essential guide in all areas because translation is inescapable. Other research works including Microsoft (Kinect and Treelet), Systran, Marclator, Pangloss, Cunei, Yeminli Sozluk, Gaijin, EUROTRA, OPENMaTrEx, Susy, Meteo, Ariane(GETA), METAL, Rosetta, Babel-Fish, ALEPH and so on have motivated this research work.

1.2 Objectives

The objectives of the research are to:

(a) design electronic Yoruba phrasebook that will carry out its basic operations
(b) design and implement a mathema-tical model for (a).
(c) determine its efficiency and usage with interface to beautify various tourist centres in Yoruba speaking countries.

2.0 LITERATURE REVIEW

The ability to process human langu-age by computers is as old as computers themselves, so it became imperative to perform useful tasks involving human language like enabling human-machine communication, improving human-human communication or simply doing useful processing of text or speech. There are several research works in this domain and key insight of last 50 years of research in language processing are captured through the use of models or theories.

Descartes and Leibniz first suggested mechanical dictionary in 17th century (Wikipedia, 2008) and French-Armenian (George Artsrouni) designed a storage device on paper tape which can find equivalent of any word in another language (Cohen, 1986) and Russian Petr Smirnov-Troyanskii supported the proto-type. IBM and Leon Dostert collaborated to translate sample of Russian words to English in January 1954. Other major contributors are Warren Weaver, Andrew Booth, Richard H. Richens who produce crude word-for-word translations of scientific abstracts on punched cards. IBM, MIT, University of Texas, US Air Force, University of Washington (Seattle), CLRU, ALPAC is one of the organizations with immense contributions. ALPAC report of 1966 inhibits the prospect of computers for translation. Here are few of examples of related works in this domain and there are numerous researches both ongoing research works (research in motion) and

concluded works by Microsoft Research Translation System but to mention few, Kinect translation and Treelet translation system. Others that are done outside Microsoft Research Translation System which includes Semantic Translation System, Rule Based Machine Translation (RBMT), Distributed Machine Translation, Example Based Machine Translation (EBMT). Various approaches to translation are represented in Figure 1.

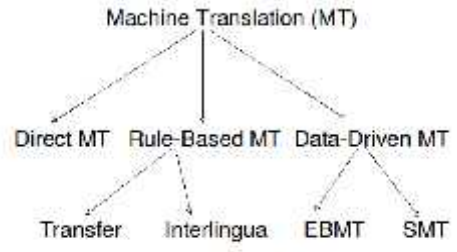

Fig 1: Machine Translation approaches

3.0 RESEARCH METHODOLOGY

A comprehensive review of manually composed phrasebooks such as French, German, Spanish, Italian and other languages would be appraised, funda-mental features of web and internet would be applied in this research work which will enhance the development of digital Yoruba phrasebook. This Digital Yoruba phrase-book is developed using the latest technologies such as PHP, Mysql, Mssql 2005, 2008, Ajax techies, .net C# and lots of cloud computing services all on both windows and linux platform. All these aforementioned technologies were integ-rated together in such a way that the front-end processor of the software will allow the user to enter or make a selection of one or more phrases or word as desire, determine in which language will the pronunciation be made and translate too. After these, the back-end processor will then analyse all the choices made by the user using the front-end processor to produce the desire output in the alternative language specified by the user and then give the user choice to click and listen to the pronunciation of the output produced.

The basic mathematical object of this research work is the joint probability distribution with statistical decision theory that revolve round set theory, probability and mapping to depict the iterative idea of translating English word or phrase into its Yoruba equivalent and vice versa. The approach is to take a particular phrase or word and examine it against the database to see if it is available or not, sets are collections, the objects "in" the collection are its members and set theory. Set theory is a theory about what sets are like- bunch of principles which are important foundational tools in mathematics, linguis-tics and philosophy. All mathematical structure can be regarded as sets and phrases and words are naturally considered as members of a set, by articulating some assumptions about sets and rigorous theory of infinite collections using axiomatic method of Zermelo-Franenkel set theory we have Axiom of extension in which two sets of both source and target languages are equal if and only if they have the same elements

$$\forall E \forall Y((E=Y) \leftrightarrow \forall x((x \quad E) \leftrightarrow (x \quad Y))) \quad (1.0)$$

where **E** is a set of all English words and phrases and **Y** is a set of all Yoruba words and phrases. All the remaining axioms are valid for the design of web-enabled Yoruba phrasebook. Let **E** and **Y** be any two non-empty sets.

Let **E = {p, q, r}** and **Y = {a, b, c, d}**.

Suppose by some rule or other, we assign to each element of **E** a 'unique' element of **Y**. Let **p** be associated to **a, q** be associated to **b, r** be associated to **c** etc. The set **{(p, a), (q, b), (r, c)}** is called a function from set **E** to set **Y**.

If we denote this set by 'f' then we write **f : E** ▶ which is read as "f " is a function of **E** to **Y** or 'f' is a mapping from English words or phrases **E** to Yoruba words or phrases **Y**.

The probability distribution of the translation **P(e/y)** that a string **e** in the target language (for example, English) is the translation of a string **y** in the source language(for example, Yoruba). Modelling the probability distribution function for translation **P(e/y)** would be approached by intuitive and iterative Bayes' Theorem that is **P(e/y)** can be calculated from a knowledge of **P(y/e)** and gives the relationship between the probabilities of **E** and **Y**, **P(E)** and **P(Y)**, the conditional probabilities of **E** given **Y** and **Y** given **E**, **P(E/Y)** and **P(Y/E)**, here is the general form:

$$P(E/Y) = \frac{P(Y/E)P(E)}{P(Y)} \quad .....(1.1)$$

where the translation model **P(Y/E)** is the probability that the source string is the

translation of the target string, language model **P(E)** is the probability of seeing the target language string and **P(Y)** is the probability of source language. Baye's theorem help to keep the number of wrong translations as minimal as possible and corresponding result is provided by Statistical Decision Theory (SDT). The general framework for this research is based on SDT and problem specific modelling, the prototypical area where this approach has been used is speech recognition. The approach is expressed by this equation:

Machine Translation (MT) = Linguistic Modelling + Statistical Decision Theory (SDT)

It translates Yoruba to English language using SDT

$$\hat{e} = \arg_e \max P(e/y) = \arg_e \max(P(e).P(y/e) \ldots \quad (1.2)$$

(search process)

Hidden Markov Model (HMM) would be applied and the idea is to build a multi layer model to translate from Yoruba words to English and vice versa. HMM is a powerful statistical tool for modeling generative sequence.

Digital Yoruba phrasebook is like business activities conducted using electronic data transmission via internet and wide world web (www). There are three main elements of the web enabled digital Yoruba phrasebook. The elements include:

- Learners shopping on the web called Teacher to Learner (T2L).
- Learning conducted between Teachers on the web called Teacher to Teacher (T2T).
- The learning procedures that support human communication and symbiotic relationship between language and communication on the web.

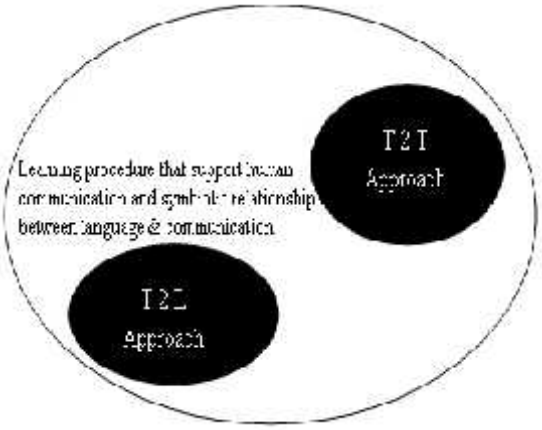

Fig 2: Typical elements of Yoruba phrasebook

3.0 SYSTEM OVERVIEW

The framework of digital Yoruba phrasebook employed online support with synchronous training, it is a bilingual system for translating a single pair of languages (English and Yoruba) which is capable of translating from both languages because of the difficulties in practice and theoretically, the design employed two similar unidirectional systems running on the same system that is method of analysis and generation for either languages were design independently. Transfer method is the indirect approach used in the framework design of the digital Yoruba phrasebook without language-independent that convert source texts into target texts with interpose bilingual modules that link separate modules (interface representation).

A simple 3-states Markov model for Yoruba phrasebook are employed in this research work, the assumptions that once a word or phrase is checked for, translation was made, the word or phrase is observed as being in one of the following states

State 1: found
State 2: not found
State 3: Add/Create

It is in a discrete state from among a finite number of possible states at each "step" and Markov property states that the probability of being in any particular state only depends on the previous state it was before. If a set of states Q = q1, q2… qN; the state at time t is q_t

Transition probabilities: a set of probabilities A = $a_{01}a_{02}\ldots a_{n1}\ldots a_{nn}$. Each a_{ij} represents the probability of transitioning from state i to state j and the set of these is the transition probability matrix A

$$a_{ij} = P(q_t = j \mid q_{t-1} = i) \quad 1 \le i, j \le N$$

$$\sum_{j=1}^{N} a_{ij} = 1; \quad 1 \le i \le N$$

Various HMM elements, basic Viterbi algorithm and Forward and Backward algorithms were employed in its design as the mathematical techniques before decoding process builds translation from left to right, by picking source language to translate into target language. It could be done with explosion of search space or pruning. Decoding can be likened to parsing in which source language e.g. Yoruba words or phrases are translated into tree stumps and more entries can be added, entries can be

combined, etc. which aids synthesis of target text(s) from source text(s).

Fig 3: Deployed interface for mobile application

3.2 Benefits of Mobile Platform for Yoruba Phrasebook

The following would be the bene-fits of this research work in its entirety:

(a) A web enabled Yoruba phrasebook that gives orderly and clear cut definitions of Yoruba words and simple expressions in English langu-age was designed.

(b) Provide solution to problems associa-ted with the language barrier among visitors and the native in the intonation and sound that are closer to English language.

(c) Teaching spoken Yoruba language and tutoring would be made avail-able to non indigenous learners with high reliability at anytime.

(d) Yoruba as mother tongue which is gradually going into extinction can become relevant in virtues with the advent of mobile application for Yoruba phrases and words.

(e) Flexibility of the phrasebook would proffer the ability to add more words or phrases in either English or Yoruba language.

4.0 CONCLUSION

This paper has described, developed and implement Yoruba translator on mobile devices and enhance the rate at which Yoruba language is learned, spoken and used as means of communication for indigenes and non indigenes. With mobile platform for Yoruba words (phrases) at all time of the day, Yoruba language can not go into extinction and Yoruba creed, culture and virtue would be extol.

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HH-CLOUD: A NETWORK BASED KNOWLEDGE MANAGEMENT FRAMEWORK FOR R&D ORGANIZATIONS IN NIGERIA

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ABSTRACT

This paper proposes a framework for Knowledge Management (KM) using a derivative of cloud computing offering. This is referred to as Software as a Service (SaaS) intended to be deployed on a Mini Private Cloud DataCenter using Electronic Development Institute, Awka as a deployment context. From the simulated network model, the throughput and utilization values (100kb and 0.0289) were obtained from the simulation results showing over 85% efficiency for non mission critical applications. We observed that the absence of an effective knowledge sharing, and poor documentation practices for R&D works, could mainly arise partly from network design considerations. From our survey, following the ongoing debate and discussions as to whether the proposed Smart Virtual Knowledge Management (SVKM) paradigm will facilitate research activities in Nigeria, we argue that the proposed SVKM proposal will securely deliver the future of effective research undertakings and enforce research discipline among researchers in research organizations.

KEYWORDS: KNOWLEDGE MANAGEMENT, COLLABORATION, SAAS, VIRTUAL, PROJECT MANAGEMENT, HOTSPOT

1.0 INTRODUCTION

More recently, with the advent of the cloud computing, the concept of knowledge management has evolved towards a vision based on people partici-pation through virtual collaboration, in depth project management and document-tation as well as paperless office emergence. This line of evolution is termed Smart Virtual Knowledge Manage-ment (SVKM) which we seek to deploy on a hotspot hybrid cloud (HH-CLOUD).

On-going discussions on the need for effectiveness and archiving of R&D works have brought two concepts into limelight in this research. In this regard, Knowledge Management (www.enwiki-pedia.org/knowledge management) and cloud computing (Okezie, *et al*., 2012) are two concepts that have attracted a lot of attention to researchers, professionals and other stake holders in the IT industry. For KM, a wide range of thoughts on the KM discipline is found in literature, though the approaches vary by authors and schools (Bray and David, 2013, and Robbins, 2006). As the discipline keeps evolving, research debates have kept on increasing in both theory and practice. These perspectives are segmented into three major dimensions viz:

- Techno-Centric Dimension with a focus on technologies that enhances knowledge sharing and creation (Alavi, *et al*., 1999 and Rosner *et al*., 1998).
- Organizational Dimension with a focus on how an organization can be designed to facilitate knowledge processes best (Rachael *et al*., 2006) as well as engineering and technical discipline on research in carrying out documentation activities.
- Ecological Dimension with a focus on the interaction of people, identity, knowledge, and environmental factors as a complex adaptive system which is similar to a natural ecosystem (Bray and David, 2013, and

Okurowsk, 2013). Regardless of the school of thought, core components of KM include people, processes, technology (or) culture, structure, technology, depending on the specific perspective (www.enwikipedia.org/knowledge management). Also, irrespective of the evolving schools of thoughts and various paradigms, this work leverages the first two dimensions to propose solutions to intelligent research docu-mentation, collaboration and resource sharing among researchers in isolated and distributed environments.

The proposed framework will serve as a generic template for every R&D intensive environments, but for deploy-ment purposes, our adopted testbed is Electronic Development Institute, Awka in the south eastern part of Nigeria. Furthermore, the practical relevance of the SVKM in R&D organizations will be discussed in the later section of this work.

2.0 CLOUD COMPUTING TAXONOMY

In this section, this paper will discuss various key concepts found in cloud computing field and then carried out a review discussion of the Knowledge Management ideologies as well as the limitations of existing KM paradigms.

2.1 Definition of Cloud Computing

Cloud computing is a collection of applications and technologies which can be accessed and manipulated by a large number of users in real time (Mainkar *et al*., 2013). Cloud computing is a style of computing where dynamically scalable and virtualized resources are provided as a service over the Internet. The cloud refers to the datacenter hardware and software that supports a client's needs, often in the form of datastores and remotely hosted applications (Goyal and Dadizadeh, 2009).

Several definitions have been studied in literature, but the work defines Cloud computing as the use of computing resources (hardware and software) that are delivered as a service, platform or infrastructure over a network (typically the Internet).

In cloud taxonomy, the following are the deployment models (Silky, 2012).

(a) Private Cloud

The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

(b) Community Cloud

The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g. mission, security require-ments, policy, and compliance considera-tions). It may be managed by the organizations or a third party and may exist on premise or off premise.

(c) Public Cloud

The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

(d) Hybrid Cloud

The cloud infrastructure is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) . The main difference between cloud computing and traditional enterprise internal IT services is that the owner and the user of cloud IT infrastructures are separated in cloud (Li *et al*., 2010). The three major cloud computing offering includes (Hughes, 2009):

- **Software as a Service (SaaS)**: These are the applications, such as e-mail, social media, office software, and online games enrich the family of SaaS-based services. For instance, web Mail, Google Docs, Microsoft online, NetSuit, MMOG Games, Facebook, etc. Figure 1 shows the SaaS Multilayer model (Hughes *et al*., 2009), that people use every day. Firstly, Software as a Service is a multilayer model, existing on top of an infrastructure as a service (IaaS) and platform as a service (PaaS), complemented by the applications developed and owned by the service provider as shown in Figure 1.

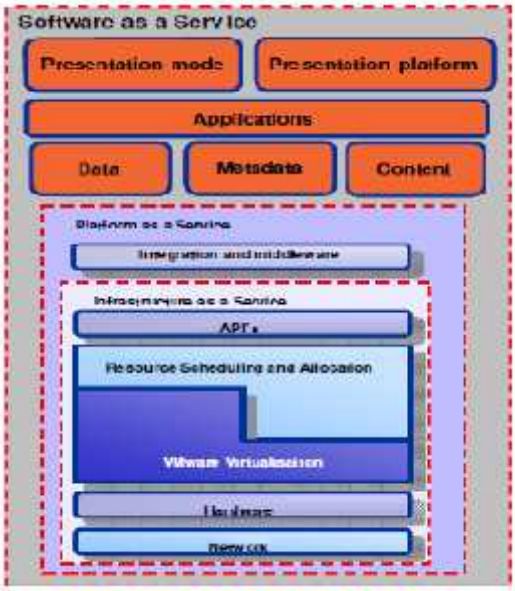

Figure 1: SaaS Multilayer Model (Hughes, 2009)

- Platform as a Service (PaaS): The operating environment in which applications run. PaaS cloud computing delivery mode offers a high-level integrated environment to build, test, deploy and host customer-created or acquired applications. Typical examples of PaaS are Google App Engine, Windows Azure, Engine Yard, Force.com, Heroku, MTurk. (Figure 1).
- Infrastructure as a Service (IaaS): Infrastructure as a Service (IaaS) provides processing, storage, networks, and other fundamental computing resources to users on-demand. IaaS users can deploy arbitrary application, software, operating systems on the infrastructure, which is capable of scaling up and down dynamically. IaaS user sends programs and related data, while the vendor's computer does the computation processing and returns the result.

The infrastructure is virtualized, flexible, scalable and manageable to meet user requirements. Examples of IaaS include Amazon EC2, VPC, IBM Blue Cloud, Eucalyptus, FlexiScale, Joyent, Rack space Cloud, etc.

2.2 Cloud Computing Platform Resource Requirements/ Characteristics

Typical cloud platforms such as Google App Engine, Google drive, drop box, exo-cloud, etc. share similar characteristics. The next section discussed the key resources requirements of a typical cloud platform.

2.2.1 The dynamic DataCenter (DC)

A Data Centre run the applications that
er business processes, services that provide
al information and rich, differentiated
nt for users. In DC, users can leverage on
gile, and responsive infrastructure that
des exactly the access that they need. This
e 24x7x365 for services that must be always
d accessible from anywhere, or a series of
luled updates set to meet user needs for
based information (hourly, daily, weekly,
hly, or quarterly). Basically, the composition
tacenter includes (Figure 2):

Figure 2: Sun Microsystem MD 200 (Randy, 2009)

- Network Infrastructure which provides connectivity and transport for applications and services between users and the data center, within the data center and across multiple data centers. The Network infrastructure has three main sub components, namely the access network, the core network and the edge network.
- Compute and Storage which represents the compute and storage infrastructure appropriate for applications (rack-mount and chassis-based, cost-effec-tive and multi-core, with unstructured content and highly structured transact-tion databases). The compute and storage functional area hosts all business applications such as Enterprise

Resource Planning (ERP), SaaS, SOA and Web 2.0 applications (among others).

- Services which supports applications with security, user verification, and entitlement, and application support, including application acceleration, deep packet inspection (DPI), and load balancing.
- Management and Orchestration which ties together all of the elements of the cloud-computing infrastructure, enab-ling efficient and responsive monito-ring, management, and planning The datacenter model for the cloud application must support dynamic infrastructure that unifies the strengths of the Web-centric cloud computing model and the conventional enterprise data center (Whitepaper, 2009).

Usually DCs are virtualized for efficiency while employing the tools and techniques adopted by SaaS cloud offering to enhance and support secure transac-tional workloads. With this highly efficient and shared infrastructure, it becomes possible for cooperate entities to respond rapidly to new business needs, to interpret large amounts of information in real time and to make sound business decisions based on moment-in-time insights. The data center that supports a dynamic infrastructure is an evolutionary new model that provides an innovative, efficient and flexible approach in helping to align IT with business goals.

2.2.2 Cloud virtualization

A key characteristic of a cloud DC is virtualization. This refers to the abstraction of logical resources away from their underlying physical resources in order to improve agility and flexibility, reduce costs and thus enhance business value. In a virtualized environment, computing environments can be dynamic-ally created, expanded, shrunk or moved as demand varies. There can be network virtualization, and server virtualization.

Our discussion in this paper is mainly in the context of our proposed HH-Cloud setup.

In any Cloud DC, virtualization is well suited to a dynamic cloud infra-structure. Ideally, a common interpretation of server virtualization is the mapping of a single physical resource to multiple logical representations or partitions which are basically accomplished a Hypervisor Interface (HI). A hypervisor logically assigns and separate physical resources on the server. It also allows a guest operating system, running on the virtual machine, to function independently. In this case, it acts as if it were solely in control of the hardware, unaware that other guests are sharing it. Each guest operating system is shielded from the others via its virtual instance and is thus unaffected by any instability or configuration issues of the others. Applications can run concurrently in multiple virtual instances on the server centric DC.

Today, hypervisors are the core virtualization layer on client and server systems in a DC. There are two major types of hypervisors visible in DC servers viz:

- Bare-Metal Hypervisors (BMH): A BMH runs directly on server hardware to provide virtual machines with fine-grained timesharing of resources. Virtualization implemented at the server hardware level can provide the highest efficiency and performance.
- Hosted Hypervisors (HH): A hosted hypervisor runs on a host operating system and uses operating system services to provide timesharing of resources to virtual machines. Examples of software-based hosted hypervisors include VMware Server and Microsoft Virtual Server.

In summary, the benefits of virtua-lization in server centric cloud designs are:

Firstly, it provides important advantages in sharing, manageability and isolation as multiple users and applications can share physical resources without affecting one another.

Secondly, it allows a set of underutilized physical servers to be consolidated into a smaller number of more fully utilized physical servers, contributing to significant cost savings.

2.2.3 Infrastructure Management

In Cloud DCs, some identified cloud infrastructural requirements/charac-teristics include:

- **Virtualization Automation:** It is known that infrastructure adminis-tration is a key challenge in a cloud computing environments. Simply building a virtualization environment without the proper approach to administration can increase complexity and thus generate added expenditures (CAPEX and OPEX). These costs could be high enough to reduce

the cost savings derived from virtualiza-tion which is unacceptable.

- **Automated Provisioning**: Automation is very essential in any dynamic process. In cloud paradigm, this scheme could be directly applied dynamic DCs operations of onboarding and off-boarding of applications and services. Basically, Onboarding is the process of installing and configuring the operating system and additional software on servers so that they can be made available to do useful work. On the other hand, off boarding refers to the steps necessary to automatically reclaim a server so that it is available for other purposes. DC Servers for cloud computing must be enabled for application Onboarding so as to optimize time- and labor in computing environments. It will eradicate time consuming process such as installation of the operating system and software and configuration of the network and storage.
- **Automated Reservations and Sche-duling**: This makes for the ability to understand the current and future capacity requirements for user's requests. Essentially, a cloud should be able to communicate the provisioning status and availability of resources, provide the capability to schedule the provisioning and re-provisioning of resources and reserve resources for future use.
- **Self-Service Portal/Convergence:** A self-service portal provides systematic request handling and change manage-ment capabilities. This is needed to allow end users to request computing resources through a SaaS offering. A cloud data center must be able to flexibly handle and execute change requests rapidly to align with fast-changing business needs. In cloud convergence, provisioning of compu-ting resources, operating systems etc, should be logical and automatically stored by the system.
- **Monitoring:** Monitoring resources and application performance is an impor-tant element of any environment. The task of monitoring becomes harder, yet more critical in a cloud virtualized environment. The benefits provided by monitoring include:
  - Collecting historic data to assist with planning future data center resource needs and to optimize virtualized resource placement;
  - Capturing real-time data to quickly react to unexpected resource needs;
  - Measuring adherence to perfor-mance service level agreements (SLAs);
  - Proactively generating alerts and detail data to quickly detect and solve application problems; and
  - Reporting resource usage data by application, necessary for alloca-ting costs appropriately.

All these requirements are adapted in the proposed private cloud datacenter that will consequently host the SaaS based on SVKM developed in this work. Figure 2 shows a typical Sun Microsystem Modular Datacenter 200 with 280 blade Servers, Monitoring and Control Equipment, using a total of 185KW (Randy, 2009).

2.3 Review on Knowledge Management

Using cloud computing to harness KM is a novel research area as frameworks and standards are still evolving. Sample studies showed that different frameworks for distinguishing between different types of' knowledge exist (Sanchez, 1996). Figure 3 shows the spiral KM.

Figure 3: The Spiral Knowledge Management (www.enwikipedia.org/knowledge management)

The various strategies on KM are studied in sample works (Bontis *et al*., 2002; Benbasat and Robert, 1999; and Whitepaper, 2013). Knowledge may be accessed at three stages: before, during, or

after KM-related activities (Bontis *et al*., 2002]. Different organizations have tried various knowledge capture incentives, including making content submission mandatory and incorporating rewards into performance measurement plans (Benbasat. and Robert, 1999).

One strategy to KM involves actively managing knowledge (push strategy) (White-paper, 2013). In such an instance, individuals strive to explicitly encode their knowledge into a shared knowledge repository, such as a database, as well as retrieving knowledge they need that other individuals have provided to the repository (Whitepaper, 2013). This is also commonly known as the Codification approach to KM (Whitepaper, 2013). Other knowledge management strategies and instru-ments for companies as studied in (www.en-wikipedia.org/knowledge management) include:

- Rewards (as a means of motivating for knowledge sharing)
- Storytelling (as a means of transferring tacit knowledge)
- Cross-project learning
- After action reviews
- Knowledge mapping (a map of knowledge repositories within a company accessible by all)
- Communities of practice
- Expert directories (to enable know-ledge seeker to reach to the experts)
- Best practice transfer
- Knowledge fairs
- Competence management (systematic evaluation and planning of compe-tences of individual organization members)
- Proximity and architecture (the phy-sical situation of employees can be either conducive or obstructive to knowledge sharing)
- Master-Apprentice relationship
- Collaborative technologies (group-ware, etc.)
- Knowledge repositories (databases, bookmarking engines, etc.)
- Measuring and reporting intellectual capital (a way of making explicit knowledge for companies)
- Knowledge brokers (some organiza-tional members take on responsibility for a specific "field" and act as first reference on whom to talk about a specific subject)
- Social software (wikis, social book-making, blogs, etc.)
- Inter-project knowledge transfer.

In this work, our study shows that a number of claims exist as to the motivations leading organizations to undertake a KM effort. Typical conside-rations driving a KM effort as found in (www.enwikipedia.org/knowledge management), include:

- Making available increased knowledge content in the development and provision of products and services.
- Achieving shorter new product development cycles
- Facilitating and managing innovation and organizational learning
- Leveraging the expertise of people across the organization
- Increasing network connectivity between internal and external individuals
- Managing business environments and allowing employees to obtain relevant insights and ideas appropriate to their work
- Solving intractable or wicked problems
- Managing intellectual capital and intellectual assets in the workforce (such as the expertise and know-how possessed by key individuals).

Documentation and Knowledge sharing remains a challenging issue for knowledge management. While there is no clear agreement, barriers may include time issues for knowledge works, the level of trust, lack of effective support tech-nologies and culture. Again, from literature survey, existing Knowledge management systems can thus be categorized as falling into one or more of the following groups: Groupware, document management systems, expert systems, semantic networks, relational and object oriented databases, simulation tools, and artificial intelligence (Gupta and Sashil, 2004).

This work observes that existing KM systems such as social computing tools (bookmarks, blogs, and wikis) have allowed more unstructured, self-governing or ecosystem approaches to the transfer, capture and creation of knowledge. This however includes the development of new forms of communities, networks, or matrixes organizations. In addition, there is the lack of intranet functionality for private cloud operations.

3.0 METHODOLOGY

An investigative research design was used. Firstly. A sampling study at ELDI was carried out to ascertain the level of awareness

and usage of SVKM using a survey approach. Analysis of the survey led to a postulation on the integration of SVKM on large scale network for performance evaluations.

3.1 Smart Virtual Knowledge Mana-gement on Hotspot Hybrid Cloud (HH-CLOUDD)

Figure 4 shows the proposed Virtual R&D scenario which will engender optimal R&D performance in related organizations. Using the benefits of cloud computing SaaS, our SVKM framework is a collection of native technologies to provision project documentation and knowledge sharing in a Hybrid Hotspot Cloud Computing infrastructure. We opine that the use of IT in ELDI considering SVKM will facilitate R&D decision making with optimal results while spending less on strategies required to solve any R&D peculiar challenges.

In our framework shown in figure 4, R&D activities from various departments, real-time collaboration, research resources in form of materials, etc can be provided through the private DC domiciled in an organization as well as from a cloud provider. The application framework for the HH-Cloud is shown in figure 5 while figure 6 shows the HH-CLOUDD Network layer Framework. Using ELDI scenario as a case study, we propose four major modules for the SaaS, viz: A project management module, a collaboration module, Library management System module and R&D resources module. Other features such as file conversion, backups, downloads, etc are inclusive in our proposed SaaS integration. Figure 4 formed the simulation basis where the throughput and utilization responses will be ascertained.

Furthermore, our proposed private mini DC will literally migrate computing and storage from the user's desktops/laptop to remote locations where huge collection on of servers, storage systems and network

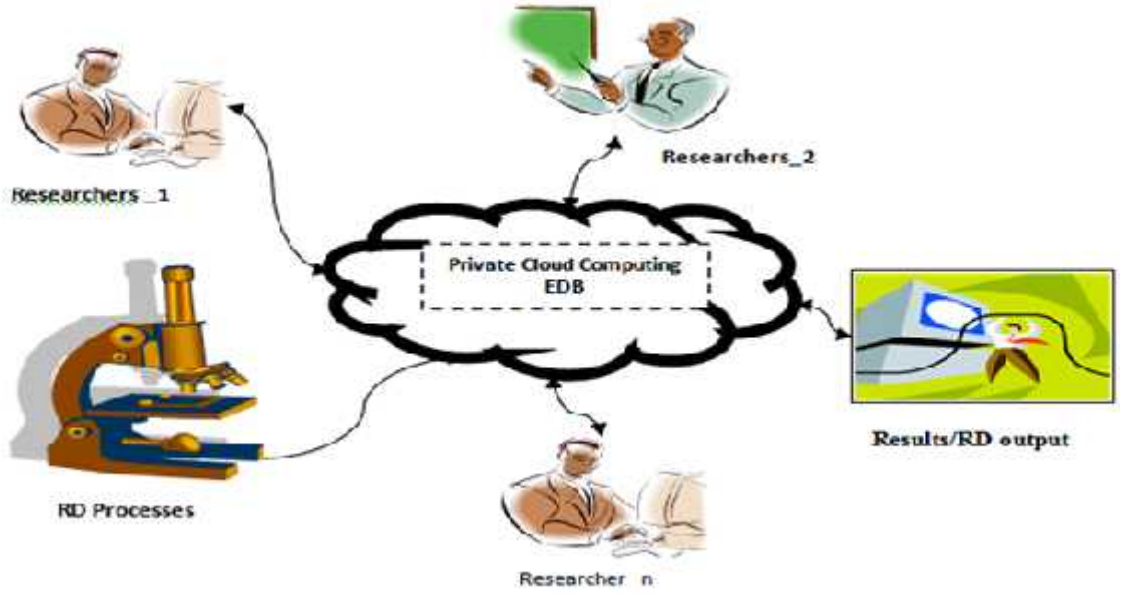

Figure 4: A Conceptual Framework for SVKM

equipment can form a seamless infrastru-cture for applications and storage.

All these will help researchers to demonstrate efficiency and productivity in their research undertakings while encour-aging documentation and experience sharing from remote locations.

In the proposed SVKM model, (Figure 5) is the SaaS framework which runs on HH-CLOUDD (Figure 6). In our present research, the use of commercial off the Shelf (COTS) equipment with following configurations and settings is leveraged viz:

1. Switching Datacenter System: The entire user within the network map can connect to the application by associating the Service Set Identifiers (SSIDs) with the minipop APs. For our testbed, the Minipops Access Points terminates at the datacenter switch. Virtualization at the network switches and server OS characterizes the setup of figure 6.
2. Minipop Tranzeo-Wavion Antenna: In this work, the tranzeo TR-5800 Series which is a broadband wireless backhaul radios can provide high data throughput over long distances. This will be configured to drive data rates up to 54 Mbps at Half-Duplex speeds while operating in the license-free 5 GHz frequencies. The TR-5800 Series will be used for Point-to-Point wireless links (minipops). This can also be used in Line-of-Sight (LoS) running at 5.3 to 5.8 GHz backhaul point-to-point solution.

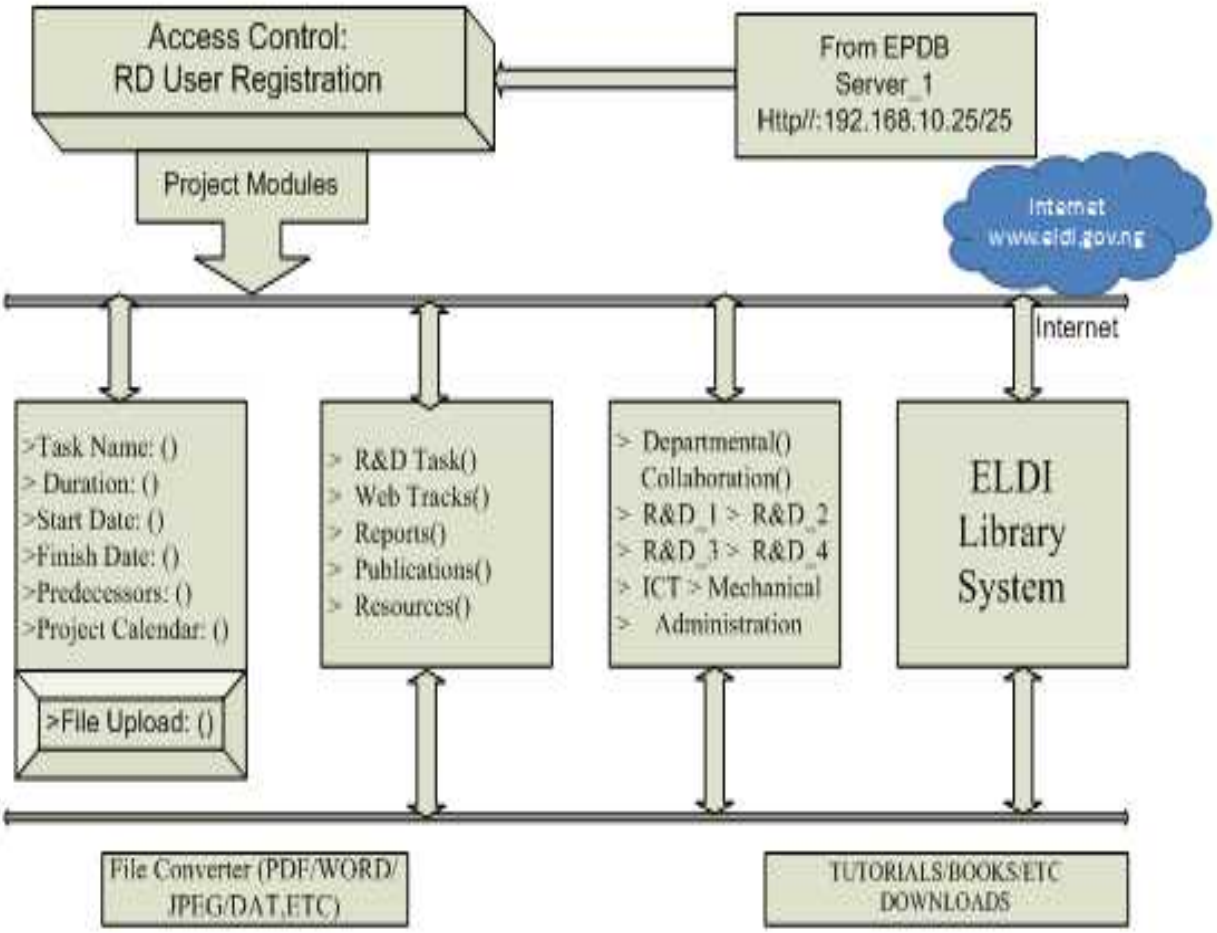

Figure 5: H-CLOUD Application layer Framework

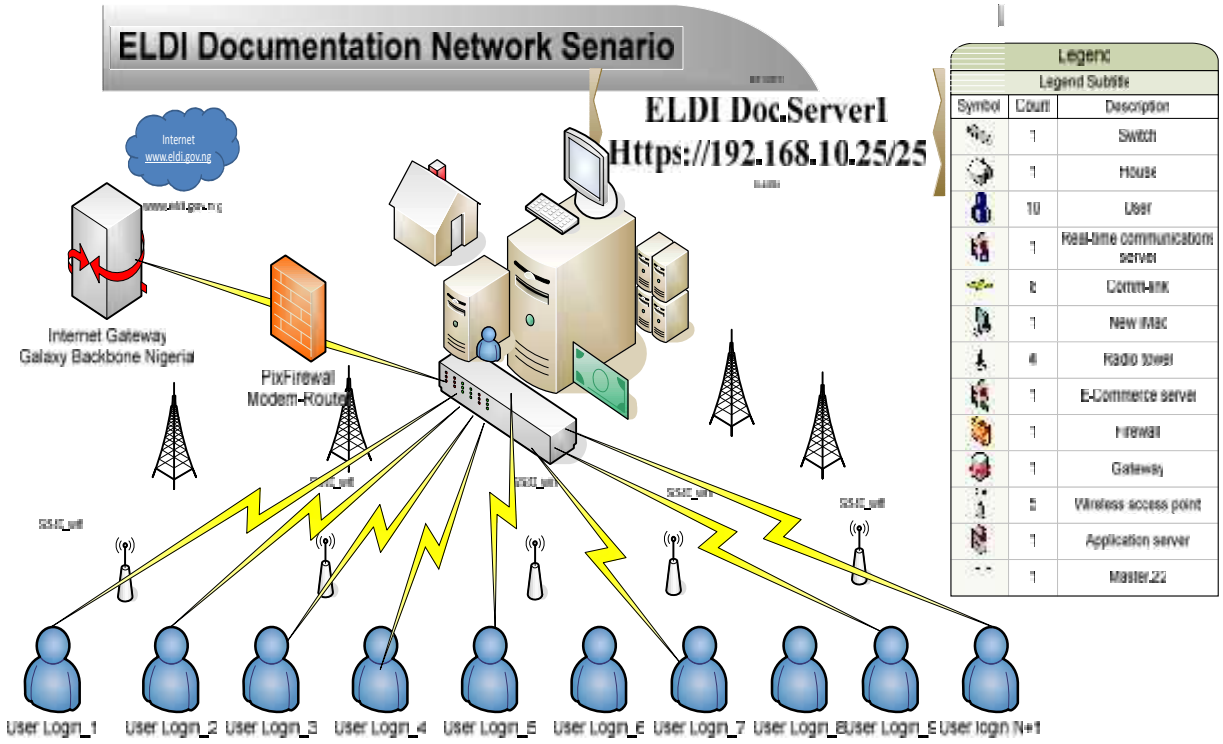

Figure 6: HH-CLOUDD Network layer Framework

The Wavion's 5800 beamforming technology adopted is based on Wavion's Beam forming Wi-Fi chip. Figure 7a and figure 7b depicts the RF radios for our deployment shown in figure 6.

Figure 7a:Wavion Nanostations

Figure7b: Antenna mast with Tranzeo and Wavion Radios

3.2 Implementation Strategy

As discussed earlier, the project (HH-CLOUD) leads to the development of a software platform that supports energy-efficient management and allocation of Cloud data center resources. In order to reduce the cost of software engineering, we will extensively reuse existing Cloud middleware and associated technologies. We will leverage third party Cloud technologies and services offerings including (a) VM technologies such as open source Xen and commercial one from VMWare fro server virtualization. We will also leverage Google App Engine, which is a platform for building enterprise Clouds. In the simulation environment, we will implement a generic connection resource manager in the SaaS to allow interaction with any Cloud management system.

(a) System Requirements: The work is still ongoing, but in the initial phase, the following are the requirements for the HH-CLOUD, viz:

- Reliable Internet/Intranet backbone
- A 1000 capacity Hotspot Infrastructure with APs, Access Points/Minipops (Tranzeo TR-5800 and Wavion's 5800)
- Router/firewall
- File Converters
- Chat RMI modules
- Licensed Microsoft Server 2008-
- Dedicated Server Machine- Itanium X64 with Virtualization (On a customized Server rack) with 4G RAM, 1Tb HDD, 2G Swap disk
- The EDB Application based Php, MySQL/
- Oracle 11g)
- Ventilation Air conditioning Systems

(b) Simulation Results: Figure 5 was characterized as http service while figure 6 was simulated with OPNET IT guru for subnetted nodes. The simulation paramters used by an ealier work (Udeze *et al*., 2012) was also used for our intial evaluations. Figure 8a and figure 8b shows simulation results in a run mode. It shows the average traffic throughput response and the resource utilization response of the proposed HH-CLOUD. Figure 8a depicts the traffic throughput response. In the network model, the topological properties of the network and statistical properties of the traffic is maximized as the routing algorithm tries to minimize the packet delivery time. At this critical load, we consider that the network is congested.

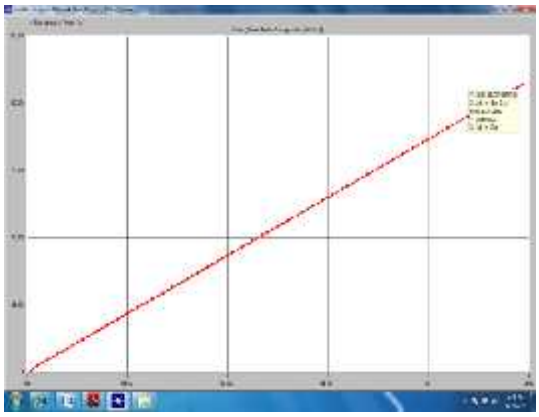

Figure 8a: Traffic Throughput Response

No critical behavior is noticed in the network throughput which is defined as the number of packets reaching their destination per unit time per host. Starting from a low load, the throughput increases proportionally as the increase of the load, until congestion is reached. At this point the network has its maximum throughput (Over 100kb). Figure 8b showing Resource Utilization at Traffic peaks depicts symmetry at the traffic conditions on the network. This yields about 0.0289 which is very considerable for high density networks. The conceptual frame-work for SVKM as depicted in figure 4 showed a great potential for stable peer to peer interactions under increasingly realistic load conditions.

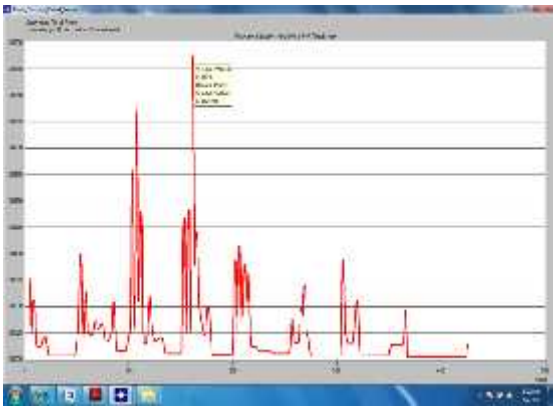

Figure 8b: Resource Utilization at Traffic peaks.

The realistic specification for end users significantly impacts the network performance considering file sharing scenarios.

Finally, much work remains to be done in peer-to-peer information retrieval, especially in investigating the properties that hold in large-scale simulations. We conclude that by maintaining a mini private DataCenter network, large scale SVKM platform will continue to serve today's computing requirements regardless of constraints of the collaboration application. SVKM is believed to address the challenges of security, QoS, stability and flexibility in campus layer domain.

4.0 OUR CONTRIBUTIONS

ELDI private cloud is a pre-requisite for the functionality of SVKM framework. However, for the public Cloud, the Cloud providers have to ensure that their DataCenter network is flexible in their service delivery to meet with service delivery requirements of the researchers and for the file backups on demand while keeping the consumers isolated from the underlying infrastructure. It is however necessary to note that to support the Cloud computing infrastructure, green energy infrastructures is recommended to minimise the energy consumption of Cloud infrastructure, while enforcing service delivery.

The main objective of this work is to initiate research and development of a flexible document and collaboration platform that will run on hotspot facilities in an energy-aware and secured data centre. This is intended to make our HH-CLOUD more sustainable, with eco-friendly technologies that will drive scientific and technological advancement for R&D organizations in Nigeria.

Specifically, our work aims to define an architectural framework of the documentation and collaboration platform intended for an energy-efficient Hotspot Cloud computing Infrastructure. The rest of the work is organized as follows: Section II: presents Cloud Computing taxonomies, Section III: Presents related works on KM ideologies and its limitations. Section IV: discussed the Smart Virtual Knowledge Management Model and outlined the merits of the framework. Section V: Shows the implementation Strategy and the Bill of Measurement and Evaluation While the conclusion and future work is detailed in Section VI

5.0 CONCLUSION AND FUTURE WORKS

This research work advances Knowledge Management using cloud computing SaaS to show the feasibility of developing a SVKM model that will fit into R&D organizations in Nigeria. We explored on the characteristics of cloud paradigm, but identified the need for discipline and productivity in R&D organizations through project document-tation and collaboration initiatives. These consequently lead to conceptual frame-works while outlining the implementation strategy and the initial system require-ments. We argue that as Nigerian government plans to join the League of Nations in driving the economy through technology, the R&D sector will face enormous challenges resulting from poor R&D documentation practices as well as having poor research outputs as a result of alienation from R&D collaborations of various forms. To develop a strong, competitive R&D industry especially in Nigeria, it is of great need that researchers understand the importance of document-tation using platforms that will facilitate such processes. This work is still ongoing but will help to facilitate and drive research interests via collaboration and knowledge sharing at large. Therefore, we expect researchers world-wide to put in a strong thrust on open challenges in R&D context identified and or unidentified in this paper in order enhance research documentation and project

management using cloud computing SaaS and energy-efficient private cloud computing infra-structure.

Future works will focus on the following:

(i) An investigate on energy-aware resource provisioning and alloca-tion scheme that provision data-center resources to client R&D applications in a way that improves the efficiency of the datacenter, without violating the negotiated Service Level Agreements (SLA)

(a) Development of autonomic and traffic mechanisms that self-manage changes in the state of resources effectively and efficiently to satisfy service obligations and achieve performance efficiency;

(b) Investigate heterogeneous workloads of various other types of R&D Cloud applications and develop algorithms for resource-efficient mixing and mapping of Virtual machines (VMs) to suitable Cloud resources in addition to dynamic consolidation of VM resource partitions.

(c) To implement a prototype system – incorporating security, application SaaS and resource management mechanisms, and consequently deploy it within the state-of-the-art operational Hotspot Cloud infrastructures with real world demonstrator applications. Finally, we will also, validate different aspects of our implementations as outlined in this work.

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MODELING MOBILE CELLULAR SIGNAL LOSS PREDICTION IN SUBURBAN PROPAGATION ENVIRONMENT IN NIGERIA

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ABSTRACT
In this work, the log-normal shadowing method was used to model mobile cellular signal propagation loss. The data used for this analysis were gathered between November 2012 and March 2013 in a suburban town cellular link in Niger-delta Nigeria. The measured data were applied to some propagation loss model equation and analyzed using linear regression method to obtain the link parameters such as the propagation loss exponent n = 3.38, the standard deviation $\pm$ = 9.2dB, to formulate the model equation $PL\ (dB)$ = 75.16 + 33.8logd for the design of a mobile radio link in the test bed areas. This will assist system engineers determine signal strength in error and as efficient propagation loss prediction tool thus improve the quality of GSM signal.

KEYWORDS: AVERAGE SIGNAL LEVEL, LINEAR REGRESSION, LOG-NORMAL SHADOWING, PROPAGATION LOSS, MODELS, RADIO LINK

1.0 INTRODUCTION

Cellular radio communication technology has been undergoing rapid evolution over the past couple of decades and is still growing rapidly. Recently wireless network provide users with a wide range of network services, but poor quality of services such as frequent call drop, echo during radio conversion, cross talk, poor inter and intra connectivity, network congestion and many other network problems, may be attributed to poor quality of signal strength deliver to the end user of the GSM Mobile Unit (MU).

The mechanisms behind electro-magnetic wave propagation are diverse, but they are characterized by reflection, refraction, path loss, fading, scattering and shadowing. Hence, the need for efficient planning in mobile radio systems is extremely important because imprecise propagation loss prediction models always lead to networks with high co-channel inter- ference and waste of power (Rappaport, 2002). An accurate estimation of path loss is useful for predicting coverage areas of base stations, frequency assignments, and proper determination of electric field strength, interference analysis, handover optimiza-tion, and power level adjustments.

Importantly, the knowledge of the propagation characteristics of a mobile radio channel is essential for designing any wireless (mobile) communication system in a given region (Hess, 1993). In terrestrial cellular radio systems, radio signals generally propagate by means of any or a combination of these three basic propagation mechanisms; reflection, diffraction, and scattering (Stuber, 2001, Sharma, 2007). One of the most important features of the propagation environment is path (propagation) loss. The accurate qualitative understanding of the radio propagation using path loss model as a function of distance from where the signal level could be predicted is essential for reliable mobile wireless system design. Hence, in this paper, we present a practical seasonal measurement of signal strength over a GSM network in a suburban town of Amukpe-Sapele in Niger-Delta of Nigeria and determination of the signal attenuation by statistical analysis of measured data, using these parameters to develop a model that appropriates for certain geographical areas, that would assist

system engineers determine signal strength in error and efficient path loss prediction thus enhances proper network design to improve the quality of GSM signal strength for transformation.

1.1 Background

Communication System engineers are generally concern with the application of two main radio channel links. These channel links are the mobile radio link parameters and time dispersion nature of the channel. The mobile radio link parameters consist of the path loss exponent (*n*) and the standard deviation (σ). The Path loss exponent indicates the rate at which a signal depreciates with increase in distance while the standard deviation accounts for the random shadowing effects which occur over a large number of measurement locations which have the same transmitter-receiver separation, but have different levels of clutter on the propagation path. This paper also aimed at determination of these mobile link parameters in a given seasonal propagation environment.

Performing on site calculations and considering link loss in the practical environment and their result may be applied to existing models for correction (Moinuddin and Singh, 2007). Both theoretical measurement based propagation models indicate that average received signal power decreases logarithmically with distance, whether in outdoor or indoor radio channels. The average large-scale path loss for an arbitrary T-R separation is expressed as a function of distance by using a path loss exponent n

$$\overline{PL}(dB) = \overline{PL}(d_0) + 10n\log\left(\frac{d}{d_0}\right) \quad (1)$$

Where n is the path loss exponent, which indicates the rate at which the path loss increases with distance, d_o is reference distance and d is the T-R separation distance (Faruque, 1996). n depends on specific propagation environment for free space $n = 2$ and when obstructions are present n will have a larger value. The reference distance should always be in the far field of the antenna so that near field effects do not alter the reference path loss. Its typical value is 1 Km in macro cell system, 100m in micro cell systems and 1 m in Pico cell systems.

Usually, the calculation of path loss is called path loss prediction. On the basis of the mobile radio environment, path loss prediction models are classified into two main categories: outdoor and indoor prediction models (Rappaport, 2002).

Furthermore, with respect to the size of the coverage areas the outdoor path loss prediction models are subdivided into megacellular, macrocellular, and micro-cellular, whereas the indoor prediction models are subdivided into two classes: Picocellular and femtocellular (Sharma, 2007). Megacell areas are extremely large cells spanning hundreds of kilometers. Megacells are served mostly by low-earth orbiting mobile satellites".

Macrocellular areas span a few kilometers to tens of kilometers, depending on the location (Neskovic, 2002). These are the traditional cells corresponding to the coverage area of a base station associated with traditional cellular telephony base stations. Macrocells can be classified into different channel types: urban, suburban, and rural propagation environments (Hogue et.al, 2006). Microcells are cells that span hundreds of metres to a kilometre. The span of picocells is between 30m and 100m, while femtocells span from a few metres to few tens of metres.

2.0 PATH-LOSS MODELS

The most important aspect of any radio propagation is how field strength varies as a function of distance and location. This property is usually captured in the concept of path loss. Pathloss tends to increase linearly with the logarithm of the carrier frequency (Hata, 1980). This is also known as large scale fading, which account for the attenuation of the signal level. Other forms of fading are; the small scale fading which causes signal distortion, dissipation and are, relatively insensitive to the carrier frequency, but effects can depend on the service bandwidth. Multipath could arise from diffraction, scattering and reflection of related objects such as building and cars in the physical environments. The existing path-loss models can be classified into: theoretical and empirical models. Theoretical models predict transmission losses by mathematical analysis of the path geometry of the terrain between the transmitter and the receiver and the refractivity of

the troposphere (Adeseko, 2012). Empirical models on the other hand add environmental-dependent loss variables to the free-space loss to computes the net path loss in the corresponding environment. This method requires that measurements be made and so considered more accurate in view of its environmental compatibility. Path-loss models are needed for effective wireless design. These models help via simulation to predict signal level and coverage. Path-loss along with the transmitter power and the gain at each end of the radio path, the analyst/designer can determine how much power is received from particular transmitter. In this work, we consider only the empirical models which use measurement data to model a propagation loss equation.

2.1 Link Budget Design using Loss Model

Most radio propagation models are derived using a combination of analytical and empirical methods. The empirical approach is based on curve fittings whereas analytical is based on a set of measured data. However, the validity of an empirical model at transmission frequencies or environment other than those used to derive the model can only be established by additional measured data in the new environment at the required frequency. The two practical mobile radio link design estimation techniques are: The log-distance path loss model and the log-normal shadowing model (Seidel , 1991).

- The Log-distance path loss model:- This model indicated that the average receive signal power decreases logarithmically with distance; the average large-scale path loss for an arbitrary Transmitter-Receiver (T-R) separation is expressed as a function of distance(d) by using a path loss exponent(n) as in equation (1).
- The log-normal shadowing model: - The log-distance path loss model does not consider the fact that the surrounding environmental clutter may be vastly different at two difference locations having the same T-R separation. This leads to measured signals, which are vastly different from the average value predicted by equation (1).

The log-normal distribution des-cribe the random shadowing effects which occur over a large number of measurement locations which have the same T-R separation, but have different levels of clutter on the propagation path. This phenomenon is referred to as log-normal shadowing. Log-normal shadowing implies that measured signal levels at a specific T-R separation have a Gaussian (normal) distribution about the distance-dependent mean of equation (1); where the measured signal levels have values in dB units. The standard deviation of the Gaussian distribution that describes the shadowing also has units in decibel dB.

Measurement have shown that at any value of d , the path loss $Pl(d)$ at a particular location is random and distributed log-normally (normal in dB) about the mean distance dependent value, that is:

$$PI(d)[dB] = \overline{PI}(d) + X_{\pm} = \overline{PI}(d_0) + 10n\log\left(\frac{d}{d_0}\right) + X_{\pm} \quad (2)$$

Where Xσ is a zero-mean Gaussian distributed variable (in dB) with standard deviation σ also in dB. The close-in reference distance d_o , the path loss exponent (n), and the standard deviation (σ) statistically describe the path loss model for an arbitrary location having a specific T-R separation and this model may be used in computer simulation to provide received power levels for random locations in communication system design and analysis (Seidel , 1991).

3.0 MATERIALS AND METHOD

Pavlos *et al*. (2007) provides that measurement reports over the GSM network are transmitted periodically (480ms) from the Mobile Terminal (MT) to the Base Transceiver Station (BTS) on the Stand Alone Common Channel (SACCH) assigned to each communica-tion, according to which the measured received signal Level (RXLEVs) from the serving BTS and from a neighbor BTS (in situations requiring handover) are submitted. In this work, RXLEV data or signal strength data measurement was done with data acquisition software. The losses in signal strength that do occur during transmission from the Transmitting antenna TX to the Receiving antenna RX are given by the path loss, while the receive power is the result of the path loss phenomenon.

The Field test measurement in the environment explicitly, has the advantage of taking into account all the environmental effects. Using the NOKIA 1265 test phone systems operated in

the active mode which was provided by the GSM network service provider, to measure received signal from the serving BTS, accompanied with an HP portable laptop and a GAMINI GPS (Global positioning system) receiver for accurate location, measurement survey was conducted on received signal strength propagation level, transmitting in 13000MHz. The system links compromises of five BTS site cells the links characteristics is shown in Table 1 and schematic diagram of measurement setup in Figure 1.

Table 1: System Link Characteristics

System Parameters	***Stations***
Latitude and Longitude	05° 53.961'/ 005° 41.139'
Antenna Type	Sectoral
BS Antenna Height	30m
Transmitting Frequency	13Ghz
Tx Pwr	15.0 (dBm)
Path Length	1km – 10km

The cells in the environment investigated have sectoral antenna placed at 30 meters above ground level.

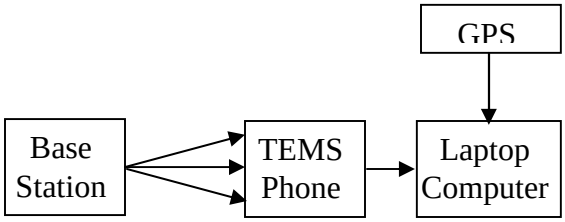

Figure 1: A schematic diagram of measurement setup

3.1 Methods

The measurement setup is shown in Figure1. A NOKIA handset equipped with net-monitor software (Transmission Eva-luation Monitoring System TEMS) was used to measure the received signal strength level (power received) at a distance (d) from the base station. The software comprises of a scale, which represent the power received in dBm. For every cell in the environment investigated, power received at a distance 1000 meters from the base station was measured. Power received at a distance interval of 1000 m from the initial test point up till the distance of 10km was measured. The global positioning system GPS was used to determine the geographic coordinate and distance. The field test was done between November 2012 and March 2013 at Amukpe-Sapele suburban area in Niger-Delta Nigeria using existing GSM network and five BS cell sites selected in the locations of study. With the aid of testing tool (i.e. NOKIA mobile handset) running on the software mode, calls were initiated at each test point until it is established and the signal strength information sent over the air interface between the base and the mobile station were read and recorded with the laptop computer. For every site, received signal strength was measured at a reference distance of 1000m from the base station and at subsequent interval of 1000m up to 10000m. All measurements were taken in the mobile active mode and in three sectors of each base station. This was to ensure that the mobile phone was in constant touch with the base station. Averaging is done to compensate for variation in signal strength at a given location over time.

Table 2: Mean Received Power (Pr) at Different Months Nov 12 – March 13.

Cells	T-R Separation (m)	Months Nov 2012 – March 2013				
		Nov (dBm)	Dec (dBm)	Jan (dBm)	Feb (dBm)	Mar (dBm)
Cell1	1000	-51.3	-51.9	-51.5	-50.0	-50.1
Cell2	2000	-54.7	-54.9	-54.7	-49.5	-53.2
Cell3	3000	-58.6	-58.8	-58.7	-53.5	-57.2
Cell4	5000	-66.7	-66.4	-66.5	-61.5	-65.6
Cell5	10000	-98.5	-98.3	-98.8	-98.2	-97.5

ts points from the reference point of the base station were recorded using the global positioning system (GPS). The GPS showed the T-R separation distances. The GPS was first switched on at the foot of the BTS tower; before the ENTER button was pressed. We moved away from the reference BTS, and when the radial distance on the GPS becomes equal to the desired close-in reference distance, the radio propagation simulator was switched on to take the readings. Table 2 showcases the results obtained.

4.0 DATA PRESENTATION

Following the measurement procedures above the average of power received signal level at different months cum sites was computed and presented in Table 2.

Table 2 show case the average power received during the dry season between

November, 2012 and March, 2013. On determination of the propagation loss given that:

$$Pl = Pt - Pr$$

Where

Pl is Path loss, Pt is Power Transmitted and Pr is Power Received. The signal loss is shown in Table 3.

Table 3: Propagation Loss at Different Months Nov 12 – March 13 (Pl = Pt - Pr)

Cells	T-R Separa-tion (m)	(Pl = Pt - Pr)				
		Nov (dB)	Dec (dB)	Jan (dB)	Feb (dB)	Mar (dB)
Cell1	1000	66.3	66.9	66.5	65	65.1
Cell2	2000	69.7	69.9	69.7	64.5	68.2
Cell3	3000	73.6	73.8	73.7	68.5	72.2
Cell4	5000	81.7	81.4	81.5	76.5	80.6
Cell5	10000	113.5	113.3	113.8	113.2	112.5

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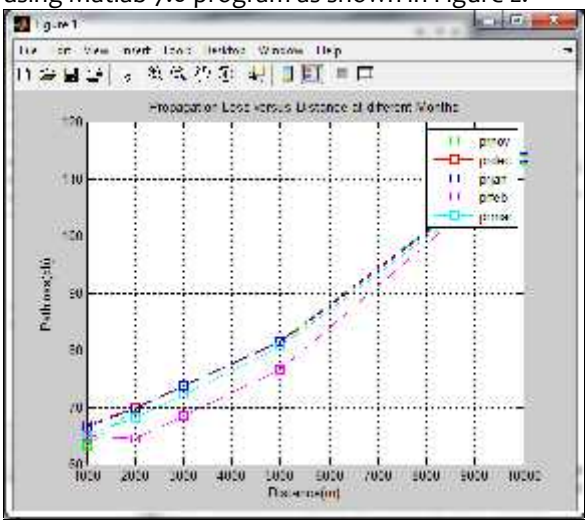
using Matlab 7.0 program as shown in Figure 2.



Distance (m)	$Pl(dB)$	$\overline{Pl}(dB)$	$Pl - \overline{Pl}$	$\left(Pl - \overline{Pl}\right)^2$

Fig 2, Plot of Propagation loss vs. Distance for the Months

The variation of signal strength loss in the months as showcase in the plot of Fig 2 showed a trend of signal degradation in the environment generally increasing with distance

4.1 Data Analysis and Result

Knowing that the close-in reference distance (d_o), the path loss exponent(n), and the standard deviation (σ) statistically describe the propagation loss model of an arbitrary location; to truly characterize propagation path loss for the environment (location), values should be establish for these parameters Pl, n, d_o, and $\pm$. The path loss exponent *n*, which characterizes propagation environment of Amukpe-Sapele suburban, is obtained from the measured data by the method of linear regression (LR) analysis (Moinuddin and Singh, 2007). In the LR analysis the difference between the measured and predicted pathloss values are usually minimized in a mean-square sense. The sum of the squared errors is given by (Moinuddin and Singh, 2007):

$$e(n) = \sum_{i=1}^{K} \left\{ P_L(d_i) - \hat{P}_L(d_i) \right\}^2 \qquad (3)$$

where $P_L(d_i)$ is the measured path loss at distance d_i and $\hat{P}_L(d_i)$ is the estimated path loss obtained using equation (1). The value of *n* which minimizes the mean square error $e(n)$ is obtained by equating the derivative of equation (3) to zero and solving for *n.*

Table 4.0 Measured Path loss at various distance

T-R Distance (m)	Average Received Power (Pr) dBm	Power Transmitted (Pt) dBm	Path loss Pl (dB) = Pt - Pr
1000	-50.96	15	65.96
2000	-53.4	15	68.4
3000	-57.36	15	72.36
5000	-65.34	15	80.34
10000	-98.26	15	113.26

Table 5.0 Mean Square Error

1000	65.96	65.96	0	0
2000	68.4	65.96 + 3.01n	.44 – 3.01n	9.0601n² – 14.689n + 5.9536
3000	72.36	65.96 + 4.77n	6.4 – 4.77n	22.7529n² – 61.056n + 40.96
5000	80.34	65.96 + 6.98n	14.38 – 6.98n	48.7204n² – 200.7448n + 206.7844
10000	113.26	65.96 + 10.0n	47.3 + 10.0n	100.0n² – 946n + 2237.29

Evaluating the value of the mean square error from the table gives:

$$\sum_{i=1}^{k}\left(PL-\hat{PL}\right)^2 = 180.533+n22.48+9490.9 \quad (4)$$

Differentiating equation (4) and equating it to zero gives the value of n in equation (5):

$$d\,e/d = d\frac{(180.533+n22.48+9490.9)}{dn} = 0 \quad (5)$$

$$n = 3.38$$

Having derived the parameter of the propagation loss exponent n, therefore the standard deviation σ (dB) of random shadowing effect is computed using the relationship in equation (6):

$$¢(dB) = \sqrt{\sum_{i=1}^{K}[P_L(d_i) - P_L(d_i)]^2 / k} \quad (6)$$

Recalling that n=3.38 and k = 5 i.e. the number of sites cell investigated, therefore substituting these values in equation (6) gives the computed to be $\pm[dB]$ = 9.2.dB

Substituting the above calculated propagation path loss exponent n and the standard deviation ± into the log-normal shadowing model in equation (2) gives the model that describes the design parameters the mobile link in that location.

$$PL(dB) = 65.96 + 10(3.38)\log(d) + 9.2$$
$$PL(dB) = 75.16 + 33.8\log d \quad (7)$$

The equation (7) models the radio propagation channel/link for the mobile system in the location the research was carried out. This model can also be used in computer simulation to provide received power levels for random locations in mobile communication system design and analysis.

5.0 RECOMMENDATION

The telecommunication companies in Nigeria whether based on GSM or CDMA technologies operating at radio frequency bands, should apply the knowledge presented in this paper in radio link budget design and analysis so as to further improve their services, thereby serving high quality signals to their teeming subscribers in sub/urban areas.

Researchers who are motivated to perform propagation surveys for the purpose of radio system development and deployment should use this model to predict signal strength loss in environment with similar characteristics and use as validation propagation prediction tool.

6.0 CONCLUSION

The objective of the paper was to develop a model that appropriates for certain geographical areas, that would assist system engineers determine signal strength in error and efficient path loss prediction tool that would enhances proper network design to improve the quality of GSM signal strength for transformation. Measurement of received signal level was conducted in the test-bed area of Niger-Delta in Nigeria with the use NOKIA handset equipped with net-monitor soft-ware Transmission Evaluation Monitoring System TEMS. The measured data were analyzed by the method of linear regression (LR) analysis to formulate this model the mobile radio link parameters that Communication System engineers are generally concern with were determined. The mobile radio link parameters consist of the path loss exponent (*n*) = 3.38 and the standard deviation (σ) = 9.2dB that characterized the propagation environ-ment.

Conclusively, it is essential that for reliable mobile wireless system design the accurate qualitative understanding of the propagation using propagation loss model as a function of distance from where the signal level could be predicted.

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MEASURING INFORMATION SECURITY AWARENESS EFFORTS IN SOCIAL NETWORKING SITES – A PROACTIVE APPROACH

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ABSTRACT

For Social Network Sites to determine the effectiveness of their Information Security Awareness (ISA) techniques, many measurement and evaluation techniques are now in place to ensure controls are working as intended. While these techniques are inexpensive, they are all incident-driven as they are based on the occurrence of incident(s). Additionally, they do not present a true reflection of ISA since cyber-incidents are hardly reported. They are therefore adjudged to be post-mortem and risk permissive, the limitations that are inacceptable in industries where incident tolerance level is low. This paper aims at employing a non-incident statistic approach to measure ISA efforts. Using an object-oriented programming approach, PhP is employed as the coding language with MySQL database engine at the back-end to develop sOcialistOnline – a Social Network Sites (SNS) fully secured with multiple ISA techniques. Rather than evaluating the effectiveness of ISA efforts by success of attacks or occurrence of an event, password scanning is implemented to proactively measure the effects of ISA techniques in sOcialistOnline. Thus, measurement of ISA efforts is shifted from detective and corrective to preventive and anticipatory paradigms which are the best forms of information security approach.

Key words: Incident-driven, information security awareness, non-incident statistics approach, quiz templates, sOcialistOnline

1.0 INTRODUCTION

Many experts agree that ISA is effective while some others are of a different opinion (Veseli, 2011). Okesola (2014) in particular, criticises the effectiveness of Information Security Awareness (ISA) arguing that ISA has been promoted for many years as being fundamental to IS practices. His statements clarifies that only very few studies have been done regarding the effectiveness and efficiency of ISA.

The importance of security awareness is actually being discussed by many authors and organisations but very few empirical studies are done, and none of these offers a technique that is effective in measuring users' behaviour in Social Network Sites (SNSs) (Veseli, 2011). Similarly, very few experiments are done in the *measurement* of the effectiveness of the changes in human behaviour or attitude (Spice, 2007; Williams, 2007). Although recent research works (Albrechsten & Hovden 2010; Wolf, 2010) are already looking into the effects of ISA efforts on SNSs, they have always been focusing on phishing threats, and are known for showing the effectiveness of phishing tests, class-room based training, e-mail based training and web-based awareness material (Johnson, 2012).

Research has been exhausted in the realm of ISA, but literature still lacks proof of the effectiveness of ISA methods from psychological theories and they are still silent on the fundamental assumptions of these methods. However, Khan et al., (2011) evaluated the effectiveness of different ISA tools and techniques on the basis of psychological models and theories. They eventually succeeded in describing processes needed to measure ISA in an organisation.

The recent report of ABC, (2013) work submitted in November 2012 classified all these methods as *incident statistics approaches* to

Johnson (2012), in his doctoral measure ISA. They are adjudged to be incident statistics, since the measurement of their effectiveness is based on the occurrence of an event or success of an attack. Therefore, putting in mind the goal of password scanners as a non-incident statistics technique, this author chooses to develop a strong password scanner capable of cracking SNS passwords that is hashed with a more complex system.

People generally do not see legitimate reasons behind the creation of password scanner/cracker. However, the problem is not the existence of password crackers, but their frequent illegal use by fraudulent people for bad goals and objectives. When employed with good intentions, password scanners offer a valuable service to system and data administrators by alerting them of system or users' weak passwords (Taber, 2011).

2.0 RELATED WORK

A wide form of completely different strategies is being adopted to measure ISA efforts. However; organisations seem to find it difficult to implement effective quantitative metrics (ENISA, 2007). They tend to adopt different methods, both quantitative and qualitative approaches, to measure the effectiveness of their ISA activities. Nyabando, (2008) agrees that more extensive qualitative and quantitative studies are needed to understand the disparities between awareness and practice.

In 2005, a prototype model was invented by Kruger and Kearney, (2005) to measure ISA effectiveness in an international gold mining company, based on knowledge, attitude and behaviour (KAB). However, their work failed to study the basic theory behind the model. Similarly, Hagen, Albrechtsen and Hovden, (2008) analysed responses to research questions from 87 IS managers in Norwegian organisations. Furthermore, in a research study concluded in September 2010, Albrechsten and Hovden (2010) identified IS related discussion as a tool effective enough to raise users' awareness.

research work conducted at the University of Lagos in May 2012, argues that too much is expected from the audience, undermining a fact that security processes can only be effective when audience have a good security support and appreciate security requirements. On this basis and by applying background training, Jagatic, Johnson, Jakobsson and Menczer, (2007) were able to prove that it is very easy (through SNS in particular) to capture huge amount of data for effective phishing attacks. However, they attempted (with no success) to measure the influence of social context information on phishing attacks. What makes their work different was that e-mails were spoofed to deceive users as if it was from friends in the Social Networks (SNs), and at the end the total number of victims to this phishing attack outweighed the expectation (Jagatic, 2008).

Wolf, (2010) reported that there were some unconventional methods used to study and measure users' SA. One of the notable methods was employed by Dodge, Carver, and Ferguson, (2007), who used phishing e-mails to detect users that clicked on potentially malicious links in e-mails. Briggs, (2009), who described how software was implemented to examine network traffic for Personally Identifiable Information (PII) that was being transmitted unencrypted over a campus network, made another attempt. Meister and Biermann, (2008), using similar methods, detailed the use of a worm that was created to test the users' ability to detect phishing attempts in their research. Nagy and Pecho, (2009) tested Facebook users' ability to detect and measure phishing attacks by attempting to friend as many unknown people as possible.

Research conducted by Briggs (2007) highlighted 12 different metrics as effective in measuring the success of ISA activities, all of which are *incident statistics* driven. The most popular overall is the measure of internal protection, where policy breaches from audit report are being used as a measure.

This is followed by the effectiveness and efficiency measure, where experience of the respondents on security incidents count a lot. The common metrics include the quantity of incidents resulted from human unsecured deeds and root cause analysis of the most terrible incidents.

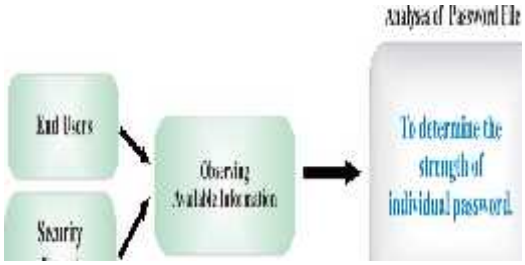

Figure 1: Data Gathering (own compilation)

Surveys and questionnaires are adjudged to be the most popular measurement instrument as evident by the large number of studies that used them, Bulgurcu, Cavusoglu and Benbasat, (2009)are the only authors who use author observation as part of the measurement. They combined surveys, interviews, case studies and observations to form their analysis (Wolf, 2010).

While considering a *non-incident statistic approach* to measure ISA on SNSs, Okesola, (2014) in his doctoral research work, identified several applications and utility software presently available to scan SNS's password file, but with a limitation to only the files that are hashed with less complex system such as MD5. These password scanners/crackers include but are not limited to Facebook Password Sniffer, John the Ripper, Password Decryptor, Google Password Decryptor, Password Security Scanner, PasswordFox, Sniffer, OperalPassView, Access PassView, Web PassView, and AsterWin IE. This limitation calls for the need for a stronger password scanner to crack SNS passwords hashed with a more complex system.

3.0 METHODOLOGY

In this study, quantitative research strategy is deployed where data-gathering is primarily focused on collection of existing data already gathered by sOcialistOnline – a newly developed Social Network Site – SNS (figure 1). These existing data are relevant data from management information systems such as users' personal and confidential data including photographs and password files. To ensure data collected from the study is treated as private and confidential, and to comply with the ethics policy (http:// www.unisa.edu.au/policies/codes/ethics/ethics.asp) on research, the scanner is designed to display *only* the security information about passwords without actually showing the password itself (see figure 2).

3.1 Developing the Scanner

This author consulted some existing algorithm and expert knowledge to come up with a new scanner suitable enough for this research purposes only. Based on an exploratory approach using an object oriented programming (OOP) methodology, the utility software is structured to scan and display security information of the passwords (and not the password itself) stored on Microsoft Outlook, Mozilla Firefox, and Internet Explorer and display password security information, such as password strength.

This information is later used to determine the strength of the passwords of the SNS's users without necessarily seeing the passwords themselves.

Some of the features of this newly developed password scanner are described as follows.

- System requirements: This scanner works on Windows 2000 version and up to Windows 7.
- Applications supported: It was incident-ally tested and found suitable to scan the passwords of Internet Explorer 7.0 - 9.0, Internet Explorer 4.0 - 6.0, and Micro-soft Outlook as well.
- Known limitations: Only two limitations were noticed: (1) once protected by a master password, this scanner cannot scan the Firefox passwords; and (2) Windows passwords can only be uncovered if the scanner is run with administrator's privileges.
- Columns description: The scanner output has 9 columns as displayed in figure 2 and described as follows:

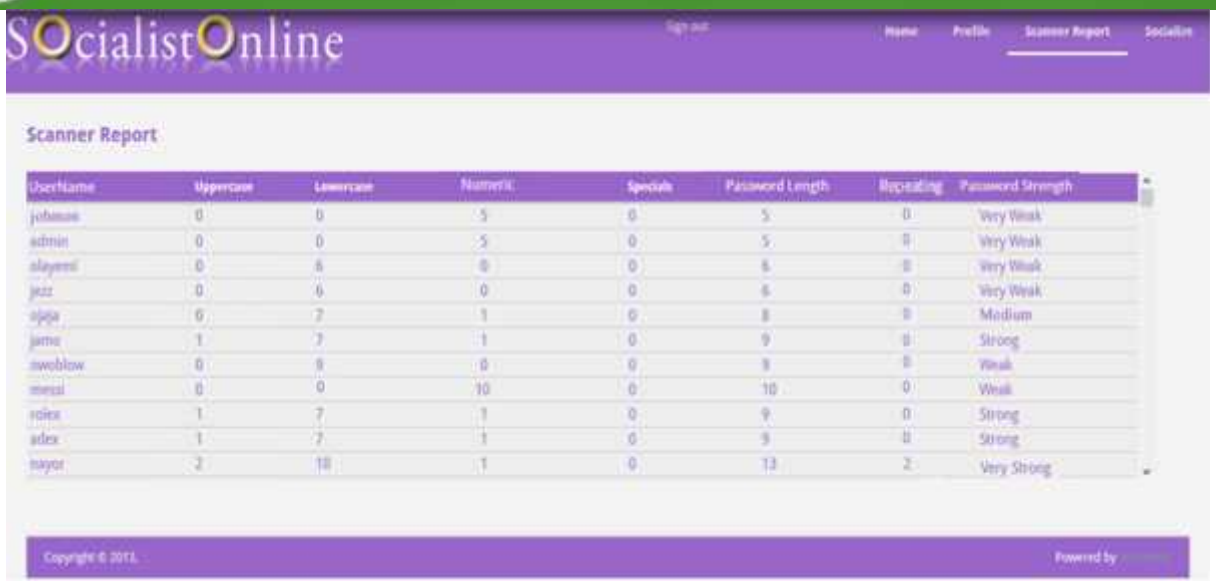

Figure 2: The Screen-print of the Password Scanner (own compilation)

User Name: The user name or UserID of the particular password item.
Uppercase: The total number of characters with uppercase (A - Z) in a password.
Lowercase: The total number of characters with lowercase (a - z) in a password.
Numeric: The total number of numerals (0 - 9) in a password.
Special: The total number of characters that are non-alphanumeric in a password.
Password Length: The total number of letters or characters in a password.
Repeating: The total number of characters repeated in the password. For instance, if the password is cnbnckc, the *repeating value* will be *two* since only c and n characters appear more than once.
Password Strength: This may be calculated based on the total number of parameters including the character type, the presence and the total number of characters and repeating characters used in the passwords. Each value appearing in this column denotes the strength of the password, in line with the classifications in table 1.

Table 1: Password Classification Table

Security classes	Sub-classes	Class interval	Character composition
BAD	Very weak	1 – 5	Less than 8 characters length, only alphabets or numbers.
	Weak	6 – 15	Only alphabets or numbers but longer than 7 characters.
GOOD	Medium	16 – 29	Alphabets (lowercase or uppercase) plus numbers and longer than 7 characters.
	Strong	30 – 49	Uppercase, lowercase plus numbers and longer than 7 characters.
	Very strong	50 and above	Uppercase, lowercase, numbers, plus special characters (#, $) and longer than 7 characters.

3.2 Password Classification

For this research exercise, a password is classified as good or bad (table 1). In which case, a password is said to be:

- *Bad* and *guessable* if its character combination is *weak* or *very weak*; and
- *Good* if its character combination is *medium, strong,* or *very strong*.

Following this classification, data related to the biographic details were captured and analysed to generate a survey report. These data include Group, age, gender, tribe, country, qualifications, profession, and technological advancement based on the user level of computer literacy and proficiency.

3.3 Conducting the Scanning

sOcialistOnline was developed and system-tested in September 2011, but it was not migrated to production stage until November 2011 due to some Users Accep-tance Test (UAT) and security challenges. The SNS was planned to run for only 12 months (December 2011 – November 2012) but because of low patronage owing to being new to SNSs users, it was left on production stage until July 2013. Meanwhile, the password scanner has been developed and tested okay for use since November 2012.

The sOcialistOnline password file was decrypted, downloaded and scanned into a flat data file. All the users on the SNS were captured but bearing in mind that most people who join will not remain active for privacy, social, and other factors (Okesola, 2014), the file was automatically reviewed to eliminate the non-active users. The scanner statistically analyse the composi-tions of the *active* passwords to determine their strengths and weaknesses as *very weak, weak, medium, strong,* and *very strong*.

4.0 FINDINGS AND DISCUSSION

The result from the password scanning exercise is summarised in table 2, where the numbers of good and bad passwords are almost at ratio 5:1 with bad password taking less than 20% of the total population size. As indicated in table 2 and figure 3 as well, only 364 passwords (representing 19%) of the population size of 1,903 are bad passwords.

Table 2: Output from the Password Scanner

Password Classes	Good	Bad	Population Size
Very Weak		135	135
Weak		229	229
Medium	384		384
Strong	397		397
Very strong	858		758
TOTAL	1,539	364	1,903

Figure 3: Good vs Bad Password Combinations

This is an improvement on some past related works of Briggs, (2009), Carnegie Mellon University (Spice, (2007), CISO (a large finance service) German organisation (Williams, 2007), and Khan et al., (2011) where ISA efforts were evaluated on the basis of post-mortem metrics. The latter in particular evaluated the effectiveness of various ISA tools and techniques on the basis of psychological models and theories, and succeeded in describing processes needed to measure ISA in an organisation.

Despite the fact that the statistics generated from this method are always of great interest to senior management, the approach may still not be the most effective because it cannot give a true reflection of ISA (Briggs, (2009). This is because security awareness is not the sole determinant factor of incidents occurrence but also the extent of the occurrence of attacks.

5.0 CONCLUSION AND RECOMMENDATION

The major achievement here, which remains the main focus of this research work, is that the effectiveness of ISA efforts implemented on the SNS were successfully measured using a non-incident statistics technique. The implication is that guessable password combinations could be discovered before the occurrence of an event or success of an attack.

Of recent, there have been several sites such as OnlineHashCrack.com (2013), Pendriveapps (2013), Stock and Barto (2013) offering to scan Facebook accounts, even at no cost. Some claim to scan using the *expertise* they gained in last few years, while others based their claims on their full awareness of the existing loopholes of Facebook and some other popular SNSs. The same claims go for Facebook *password crackers* and *stealers.* This author disagrees with these claims because they are all based on the false assumption that Facebook has a MD5 password that is indecipherable. Facebook do not use MD5 for password hashing; it uses more complex system (OnlineHashCrack.com 2013) just as it is in sOcialistOnline.

The goal of the password scanning is to provide a useful direct quantitative measure of the attitude and behaviour of SNSs' users. Following the successful scan-ning of users' password files, the proposed solution in this study analyses the strength of individual passwords, using an automated statistical approach. The number of users using easily guessable passwords is a key indicator of effective ISA.

The stronger password scanner developed in this research is thereby recommended for use to measure the effectiveness of ISA efforts on the SNSs, as it is capable of cracking SNS passwords that is hashed with a more complex system than MD5. However, it must not be used with a clean objective and not for bad goals and fraudulent intentions.

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NIGERIA YOUTHS: MAJOR CONTRIBUTOR TO ICT TOOLS OR MAJOR CONSUMERS OF ICT?

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ABSTRACT

Information and Communication Technology (ICT) tools have been widely adopted by Nigeria youths; various tools have been integrated into their daily life, either for communication, research, networking, social activities or any other purpose including academics. As much as these tools are embraced by the youths, interest in inventing or contributing to the existing technology is not high among them. This research takes a look at the rate of youth's interest in contributing to the existing ICT tools. The study was conducted in one of the Nigerian private universities and employed the survey form of research where copies of questionnaire were used as the research tool. A stratified sampling technique was used across all the levels of their computer science department with a total population of 1030 and a sample size of 3/5 was considered. The analysis of the research was carried out using Statistical Package for Social Science (SPSS). SPSS was used to analyse the gathered data. The result showed that despite the exposure of our youth to ICT at early age, their passion for ICT and desire to be known for an invention, they still fall majorly under the class of consumers of ICT rather than creators. This is a situation that needs to be addressed by government of Nigeria, educational institutions, ICT based organisations as the youths are the future of any nation.

Keywords: Communication, Information Communication Technology, ICT tools, Nigeria Youth.

1.0 INTRODUCTION

Computer Science is about solving problems using computer techniques. One of its resultant effects on the environment is the marriage of Information and Communication Technology (ICT). Infor-mation and Communication Technology (ICT) is greatly transforming the world, making the world a global village. This is possible through the Internet and several internet-based applications such as social media, news and information, entertain-ment, email services etc. These applica-tions are now more popular in Africa, especially in Nigeria through the wide spread of mobile devices. Also, these applications have enhanced the flow of information, and youth transition across the globe.

According to 2013 news report by minister of communication, thirty two million, five hundred and thirteen thousand, two hundred and sixty-one (32,513,261) Nigerians are accessing the Internet through telecommunications net-works, larger percentage of whom are youth. Various applications or devices that are populating the ICT world make youth interact more with ICT. Thus, Nigeria Youth should begin to think about how to develop ICT tools that can solve problem in their immediate environment. In Nigeria, a Youth is someone between the age of 18 to 40 and majority are university students.

Normally, as users interact with ICT, they consume, modify, design, reconfigure, and can bring technological development. The result of interactions with ICT can be seen in some Youth from developed world. For example, Mark Zuckerberg was 19 when he and his three roommates in Harvard University designed Facebook. The software, originally called Facemash, was written by Mark Zuckerberg. His interest in Computer Science was built up by his father, who taught him basic programming. His father later hired a software tutor for him. One of his passions is to use this medium to make Harvard

University Student more open. Through the site his classmates met to study a course and the teacher reported of recording the best grades that session (Wikipedia, 2014).

Drew Houston invented Dropbox as a personal solution to USB flash drive which he often forgets at home. He was then an undergraduate student in MIT (Massuchest Institute of Technology). Dropbox as a cloud-based storage system, can help to share files and pdf that are too large for email attachment.

Google was created as a result of collaboration to write a program for a search engine (initially called BackRub) by Larry Page, and Sergey Brin who were graduate students of Computer Science in Stanford University. The Common things among these inventors are; they were driven by the desire to solve problem in their immediate environment using ICT, and they were Youth, and they were Computer Science students (Wikipedia, 2014).

Nick D'Aloisio, a 17 year old London teenager, has recently become one of Britian's youngest millionaires due to his invention of the app 'Summly', an app that summaries news articles for the small screen, and was swiftly purchased by Yahoo after initially being downloaded one million times on Apple's App store before Yahoo's purchase. Yahoo bought the app for £30 million, a staggering figure that serves to highlight the increasing value that the youth of today represents in the technological field. Thomas Goodenough, 12 year old, holds the title of the youngest app inventor in his creation of Air Ambulance, an app that allows virtual tours on air ambulances (Lucy, 2012).

There is a clear gap in the market for innovative youngsters who run their lives through technology to prosper by using their creativity and experience in technology. (Lucy, 2012). Hence, Africa youth, especially Nigerians should not only be consumers of ICT products but must start to be innovators. For a country to improve her Global Competitive Index (GCI), innovation is one of the major areas of improvement. Nigeria Youth needs to move from the level of consumption into levels that can bring innovations to ICT. The adoption of this rule will transform them to be more innovative technologically thus leading them to be more of contributors rather than consumers.

This research takes a look at students' interest towards becoming contributors to ICT, their involvement, and their first contact with ICT. The research provided answer to the question of whether Nigeria youth are major contributors or consumers of ICT. This helped to predict the trend of ICT in Nigeria and gave us insight towards the possible solutions. The research employed the use of copies of questionnaire in order to ascertain students' level of interest in using ICT to solve problems in their immediate environment. The data gathered were analysed using SPSS (Statistical Package for Social Science).

1.2 Aim and Objectives

The aim of the research is to determine the extent to which Nigerian youths have been engrossed with IT in terms of creating and building ICT tools (both hardware and software).

Specific objective of the research are to:

- find out the level of ICT tool usage among Nigerian youths
- examine the basis of youths interest in ICT and
- find out the percentage of youths who have contributed to the development of ICT tools

1.3 Research Question

The following are the questions answered by this research:

- To what extent do Nigerian youths regard ICT courses or ICT related courses?
- What is the level of ICT tools usage among Nigerian youths?
- What was the basis of youths' interest in ICT?
- What is the percentage of youth's contribution to the development of ICT tools?

2.0 RELATED RESEARCH WORKS

In Carroll *et al*. (2002), this research work tried to find out what young people want from Information and Communication Technology? Why some technologies were adopted and others rejected? What roles do mobile technologies play in their lives as they move from childhood toward adult world?

The objective of the paper is to examine the young people's adoption of infor-mation and communication technologies in order to envision the design of innovative technologies.

The research employed a structured-case methodological frame-work, where a combination

of methods was used to build understanding of young people's use of mobile technologies. All these were drawn from research methods from various other disciplines; focus groups, questionnaires, participant observation, on-line diaries and scrapbooks were all used to collect data and triangulate young people's opinions and recollections.

It was concluded in this research that young people are adopting a lifestyle rather than a technology perspective: they want technology to add value to their lifestyles, satisfy their social and leisure needs and reinforce their group identity.

In Thulin (2005), this study explores how urban youth fit the use of information and communication technologies (ICT) into their everyday lives.

The study is based on an in depth, two-wave panel study of young people living in Gothenburg, Sweden, supplemen-ted by national ICT-use survey data.

Results show that young people use computers for one and a half hours per day, and half of this time is spent online. Time spent on ICT use is increasing, and ICT now encompasses a broader range of activities. The Internet is mainly used to communicate with people already known in 'real life'. Contacts are both geo-graphically far-flung and very local. ICT use is found to generate additional contacts and communication rather than replace telephone calls and travel.

In Johnson (2012), Federal Ministry of Communication Technology (2012) opined that 70% of Nigeria's 167 million population is occupied by youths from ages 18-35(in accordance to National youth policy) and globally they are recognised that they are greatest consumers of ICT content and creators of ICT tools. The research suggested the following to government in order to promote ICT:

- increased availability of broadband,
- institutional support of youth entrepreneurship in ICT
- skills and capacity development.

In Cole (2008), the researcher opined that most of the social software technologies only create room for student to be more of the web content consumers rather than web content publishers. Hence, the uniqueness of wiki technology.

The aim of the study was to present to the educational community the negative impact encountered when the integration of wiki into existing teaching format is poorly designed and supported.

The specific objectives were:

- to take a review on the features of wiki and suitable models of learning presented,
- to examine the cause of failed action research experiment to integrate wiki into existing system.

The researcher employed a descriptive form of research where an overview of a failed action research was examined along with review of learning theories and features/ characteristics of wiki technology. Also case studies were presented on the effect of integrating wiki into existing system.

The study showed that wiki has little impact on student engagement simply because participating students chose not to pose to the wiki.

3.0 RESEARCH METHODOLOGY

To achieve the above objectives, the research examines the rate at which youth get involved with ICT tools for their different activities, their first contact with ICT, also examines the level of students' interest in being a contributor to ICT and how far the students have gone in using ICT to solve problems in their immediate environment.

The research adopted an exploratory survey approach to examine issues discussed above and report the investigated opinions of the youth. An initial conceptual framework was carried out, which informed the starting point, the scope, area of interest, participant, planning, collecting and analysing of data, and also reflection on the findings. The process started with the selection of a target case study of students of Science and Technology in a University in South West Nigeria for the survey. Questionnaires were administered to the target participants, feedback gathered from the case study were collated and then analysed. The statistical tool employed for the analysis of the gathered data is SPSS. From the analysis, reflections were made on the implications of the gathered data.

3.1 The Scope

The research focused mainly on ICT tools which could be hardware or software, the target participants were the students of computer science

department of the University, where the following courses were taken: Computer Science, Computer Information System and Computer Technology. The total population of the department is 1030 where a sampling size of 3/5 was considered. The student from second year (200 level) to the fourth year (400 level) were recruited on the basis that they are getting grounded in the reality of their course of study unlike the freshmen.

3.2 Questionnaire

The survey was first reviewed by experts in ICT before a final version was now administered to the participant. A total number of 620 questionnaires were produced and administered The survey contains four sections:

Section A: The demographic Information of the participants

Section B: The section measuring passion and interest in ICT

Section C: he section measuring the desire to continue with ICT

Section D: The section examining how far the participant has gone in building ICT tool.

4.0 FINDINGS

The collected data were analysed, this enabled us to examine all the issue discussed. Out of the 620 questionnaire sent out 550 were returned and the findings were drawn from that returned questionnaires. The findings were expressed below in form of a frequency table.

Section A: Course of Study

There are three different courses of study in the Computer Science department of the University. They are Computer Science, Computer Information System and Computer Technology. Table 1 shows the percentages of students in each option

Table 1: The three arms in computer science of the selected institution.

		Frequency	Percent	Valid Percent
Valid	CS	204	37.1	37.2
	CT	159	28.9	29.0
	CIS	185	33.6	33.8
	Total	548	99.6	100.0
Missing	System	2	.4	
	Total	550	100.0	

(ii) Age Range

The majority age range of the participants ranges between ages 15 and 25 the table 2 shows various percentages of the participant age ranges

Table 2: The age range of youths in the computer science department

		Frequ-ency	**Percent**	**Valid Percent**
Valid	15-25	526	95.6	96.5
	26-35	16	2.9	3.0
	36-45	3	.5	.6
	Total	545	99.1	100.0
	Missing System	5	.9	
	Total	**550**	**100.0**	

(iii) Sex

The department consists of both male and female students, but from the survey it was discovered that there are more male students than female. Table 3 shows the frequency and percentages of each sex.

Table 3: This table showed the percentage of gender selected at random

		Frequ-ency	**Percent**	**Valid Percent**
Valid	Male	354	64.4	64.7
	Female	193	35.1	35.3
	Total	547	99.5	100.0
Missing	System	3	.5	
	Total	550	100.0	

Section B

This section consists of various questions that are used to measure interest and passion that the youth have in ICT and ICT tools. The section revealed that, based on the fact that majority of the youth were exposed to ICT tools at tender age, many resources are made available for their usage via the ICT tools, their interest in ICT usage had been developed. Hence, the positive influence on their self choice of ICT course. This is further shown and discussed in tables below:

(i) Do you have passion for tech-nology/ICT related courses?

Table 4 shows that a greater percentage of our youth currently in an institution have passion for the technology/ICT related courses they are taking presently.

Tabe 4: Showing the percentage of youths having passion for technology/ ICT related courses

		Freq-uency	Percen	Valid Percent	Cumulative Percent
Valid	Yes	416	58.3	76.1	76.1
	Not Really	113	15.8	20.7	96.7
	No	18	2.5	3.3	100.0
	Total	547	76.6	100.0	
Missing	System	167	23.4		
	Total	714	100.0		

(ii) **Was your passion for technology/ ICT a childhood desire?**

Table 5 showed that though we have greater percentage of respondents that had a childhood desire for Information Technology, there are also greater percent-age that did not considered ICT courses as an option in their infancy.

Table 5: the percentage who had childhood desire for ICT

		Frequ-ency	Percent	Valid Percent	Cumula-tive Percent
Valid	Yes	250	35.0	45.8	45.8
	Not Really	191	26.8	35.0	80.8
	No	105	14.7	19.2	100.0
	Total	546	76.5	100.0	
Missing	System	168	23.5		
	Total	714	100.0		

(ii) At what academic level were you exposed to ICT tools?

Table 6 showed that most of the exposure for ICT tools started from primary school, but the exposure was not enough to inspire or challenge the youths to be ICT tools creators rather than consumers.

Table 6: Showing level of exposure of the youth

		Frequ-ency	Percent	Valid Percent
Valid	Primary	243	44.2	44.8
	Secondary	228	41.5	42.0
	Tertiary	64	11.6	11.8
	Others	8	1.5	1.5
	Total	543	98.7	100.0
Missing	System	7	1.3	
	Total	550	100.0	

(iii) Your Choice of ICT course was made by?

From table 7, it is important to allow the youths to make decision of courses or carrier selection on their own without imposing courses or carrier selection on them.

		Freq u-ency	Per-cent	Valid Per-cent	Cumul a-tive Percen t
Valid	Self	410	57.4	76.2	76.2
	Parent	67	9.4	12.5	88.7
	Guardians	61	8.5	11.3	100.0
	Total	538	75.4	100.0	
Missing	System	176	24.6		
	Total	714	100.0		

Table 7: Showing who influenced the choice of ICT courses

(iv) Are you finding your technology/ ICT related courses interesting?

Table 8 showed that some youths currently involved in technology/ ICT courses are not really finding it interesting. This could be as a result of so many factors like choice of selection or the direction of exposure the instructor(s) are embarking on.

Table 8: Showing level of interest of the youth in ICT

		Frequ-ency	Percen t	Valid Percen t	Cumula-tive Percent
Valid	Yes	268	37.5	49.5	49.5
	Not Really	234	32.8	43.3	92.8
	No	39	5.5	7.2	100.0
	Total	541	75.8	100.0	
Missing	System	173	24.2		
	Total	714	100.0		

(v) Are you regularly exposed to technology/ICT and its tools in your institution?

Table 9 showed that the level of exposure gotten by our youths to ICT tools is quite poor, most important devices or tools that are relevant and useful are either kept away from their usage or

there are no adequate hands in terms of facilitators or instructors to handle them.

Table 9: Shows level of exposure of students to ICT tools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	198	27.7	36.1	36.1
	Not Reall	217	30.4	39.6	75.7
	No	133	18.6	24.3	100.0
	Total	548	76.8	100.0	
Missing	System	166	23.2		
	Total	714	100.0		

(vi) Do you enjoy working with ICT tools?

Question 7 analysed in Table 10 showed that the level of interest exhibited by our youth on ICT tool usage is quite encouraging.

Table 10: Showing the level of satisfac-tion of the youth with ICT tools

		Frequency	Percent	Valid Percent
Valid	Yes	414	75.3	76.0
	Not Really	117	21.3	21.5
	No	14	2.5	2.6
	Total	545	99.1	100.0
Missing	System	5	.9	
	Total	550	100.0	

(vii) If yes, how often do you work with ICT tools?

Question 8 analysed on table 11, proved that our youths are serious consumers of ICT tools. Majority of then depends so much on the usage of this tools for their daily activity especially in relation to their study.

Table 11: Showing how often the ICT tools were used by the youth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Seldom	235	32.9	45.9	45.9
	Often	277	38.8	54.1	100.0
	Total	512	71.7	100.0	
Missing	System	202	28.3		
	Total	714	100.0		

Section C

This section consists of questions to measure that based on the level of interest and number of years a youth has spent in the field, is the youth still willing to continue and get rooted in this field and to what extent does the youth want to be involved with the ICT tools, is the youth interested in inventing a tool for ICT or does the youth prefer to be a consumer, all this were answered and reviewed in this section. The categories of questions asked in this section were answered based on levels of agreement, options of Strongly Agreed, Agreed, indifferent, Disagree and strongly disagreed were available for choice on each question. They are further explained below in tables.

(i) I enjoy reading books that are technology/ICT related

From the question, it was realized that 207 of the youth which is 38 per cent of the entire population have interest in reading book on ICT while 201 forming 36 per cent were indifferent about ICT books.

Table 12: This table showed the rate of youth's interest in reading technology/ICT related books.

		Frequency	Percent	Valid Percent
Valid	SA	93	16.9	17.1
	A	207	37.6	38.0
	N	201	36.5	36.9
	D	30	5.5	5.5
	SD	14	2.5	2.6
	Total	545	99.1	100.0
Missing	System	5	.9	
	Total	550	100.0	

(ii) Do you browse the internet for topics/articles that are related to technology/ICT

From question 2, the rate at which our youths browse the internet for technology /ICT related topics in order to keep track of updates was derived. It was observed that a higher percentage browse the internet rather than study book for ICT related topics.

Table 13: This table showed the rate at which our youths browse the internet for technology/ICT related topics

		Frequency	Percent	Valid Percent
Valid	SA	163	29.6	30.1
	A	218	39.6	40.2
	N	121	22.0	22.3
	D	30	5.5	5.5
	SD	10	1.8	1.8
	Total	542	98.5	100.0
Missing	System	8	1.5	
	Total	550	100.0	

(iii) I wish to design or invent an ICT tool (software or hardware) of my own

From the table, it showed that Nigerian youths have the passion to design or invent ICT tools of their own, as 52 per cent strongly wish or desire to invent a tool of their own, 23 per cent agreed, 14 per cent were indifferent, only 9 per cent appear to be not interested in personal invention of ICT tools.

Table 14: Showing the desire to invent ICT tools

		Frequ-ency	Per-cent	Valid Percent	Cumula-tive Percent
Valid	SA	287	40.2	52.7	52.7
	A	128	17.9	23.5	76.1
	N	79	11.1	14.5	90.6
	D	23	3.2	4.2	94.9
	SD	28	3.9	5.1	100.0
	Total	545	76.3	100.0	
Missing	System	169	23.7		
	Total	714	100.0		

Section D

This section looks at how ready the youths are to invent an ICT tool, also what they have done or what they are working on in order to meet a need or solve a problem in their environment. This is further discussed below.

(i) I want to be known for my own design/invention?

The first question in this section analysed on table 15 showed that, Nigerian youths wish to be known for their own design rather than dwelling more on ICT tools that have been invented by others.

Table 15: Percentage of those who wants to be known for their design

		Frequ-ency	Per-cent	Valid Percent	Cumula-tive Percent
Valid	To a great extent	317	44.4	59.8	59.8
	To an extent	133	18.6	25.1	84.9
	To a minimal extent	57	8.0	10.8	95.7
	Not at all	23	3.2	4.3	100.0
	Total	530	74.2	100.0	
Missing	System	184	25.8		
	Total	714	100.0		

(ii) Have you discovered a problem in your neighbourhood that you think you can solve using IT?

Table 16 showed that our youths in their constant interaction with the environment do not really focus on discovering problems that could be solved with their ICT knowledge and skills. As larger percentage responded to not really, though a close range affirmed that they have discovered a problem to solve.

Table 16: Those who have discovered a problem

		Frequ-ency	Percent	Valid Percent
Valid	Yes	214	30.0	39.4
	Not Really	256	35.9	47.1
	No	73	10.2	13.5
	Total	543	76.1	100.0
Missing	System	171	23.9	
	Total	714	100.0	

(iii) Have you designed any ICT tool (hardware/software) that has been used to solve problem within your environment?

This last question analysed in Ttable 17 showed that greater percentage of Nigerian youths are major consumers of ICT tools rather than creators. As only a few percentage, 16 percent have designed or invented a tool for ICT.

Table 17: Showing how many have designed or invented an ICT tool.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	88	12.3	16.0	16.0
	Not Really	111	15.5	20.2	36.2
	No	351	49.2	63.8	100.0
	Total	550	77.0	100.0	
Missing	System	164	23.0		
	Total	714	100.0		

5.0 REFLECTIONS ON THE FINDINGS

The study found out that:

- Most of Nigerian youths undertaking technologic/ICT related course are being mandated by their parent or guardian to take such as a carrier. Hence, the youths show less interest in these courses.
- Also those that have interest in this courses lack sufficient encouragement in terms of exposure to this tools.
- The extent of exposure being gotten by the youths was not enough to drive them towards discovering problems and building/inventing tools that could be used to solve such problems.
- Nigerian youths are major consumers of ICT tools. This is because focus is more on learning how to use rather than re-creating the created.

6.0 CONCLUSION/RECOM-MENDATION

In conclusion, it is noted that despite the exposure of youth and their involvement in the usage of ICT and its tools at an early age, their passion is driven towards exploring more of the developed tools and becoming experts in the usage. They prefer to be users rather than going the extra mile of recreating the created or adding more to the tools that are in existence. This is due to the fact that most of them still find it difficult to identify problem in their environment that can be solved via a tool they can invent. Also for those who have ideas or who have identified a problem that they can solve, the major challenge is the lack of adequate resources and indebt understanding of how to take giant stride of inventing or designing a tool that can solve the identified problem. It is therefore conclu-ded that Nigeria youths of this day are major consumers of ICT tools and not creators of ICT tools.

In view of this, it is therefore recommended that there should be re-design of educational curriculum where youths should be exposed to ICT tool usage from their primary learning, so that any time spent with ICT tools after then should tend towards creating rather than solely depending on existing ICT tools. Also subjects that treats elementary parts of electronics, programming, software design and hardware architecture should be introduce into elementary schools with practical included. Also it is important that Nigerian Universities should change their method of teaching to problem-driven approach. This will aid and encourage the students to discover unique problems and how to go about solving them.

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Phishing E-mail Detection Mechanism Based on Middleware Technology

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ABSTRACT

In view of the widespread adoption of phishing email in deceiving unsuspected users to part with their authentication credentials , current countermeasures have proved less efficient. In this work, a Middleware-Based Anti-Phishing E-Mail Scheme is presented. The proposed scheme involves three processes: Registration process, Scanning process and Decision process. The registration process involves a user choosing a user name, a graphical based security question and the e-mail address (unique key) on which the middleware anti-phishing scheme will operate. The scanning process is activated when a registered account receives an e-mail message. The results of scanning process inform the action of the decision process, which classifies message as phish or otherwise. The proposed solution ensure the anti-phishing service remains efficient as administration is under the control of service provider and it does not require client-side scripts, plug-ins or external devices.

KEYWORDS: ANTI-PHISHING, E-MAIL, MIDDLEWARE, PASSWORDS, WEB SECURITY

1.0 INTRODUCTION

The rate of internet acceptability continues to grow considering the widespread adoption of electronic option for both formal and informal communication. However, this scenario has presented some security challenges to the online community. These challenges reached all-time high with the advent of phishing attacks. Phishing is a serious security threat whereby a phisher tries to trick unsuspecting internet users into providing confidential information (Dhamija et al. 2006). To achieve this malicious goal, an attacker first sets up a fake website that looks almost the same as the benign target website. The URL of the fake website is then sent to a large number of users at random via e-mails, social networking sites or instant messages. Unsuspecting users who click on the link are directed to the fake website, where their personal information is unknowingly leaked to the phishers. The success of this malicious action has grave effect on both the unsuspecting users and online company's brand reputation. It is interesting to note that the success of phishing attacks depend largely on its source of disseminating phishing messages. Phishers employ e-mail in most cases because a large number of e-mail addresses could be easily harvested from some online sources.

To respond to the phishing email threat, a large number of countermeasures have been developed and deployed. Although, a number of current methods mitigate these threats from growing, their effectiveness is still a subject of further research. For instance, the server/client-side approaches employed in most works studied, had been recently criticized as inadequate. Ofuonye and Miller (2013) identified the challenges of client-side method (e.g. browser plug-in, toolbars etc) to include the use of specific browser (e.g. spoofGuard on Mozilla), user intensive administration (configuration, installation and upgrade) and high browser exploits and vulnerabilities of over 79% (Turner, 2008). The server filters is another popular alternative in most anti-phishing schemes which suffers from the challenges of trust and third parties involvement (e.g. SSL certificate, etc.).

The only viable alternative to challenges of client/server filter is the use of Middleware Technology (MT), which has not been extensively applied in anti-phishing design. The primary advantage of MT is that it leverages on the benefits of software as a service model. That is, software solution or design remains external to their system and is accessible and executable by a large numbers of individuals. In this work, a

Middleware-Based Anti-Phishing E-Mail Scheme (MBAPES) is presented. The proposed scheme involves three processes: Registra-tion process, Scanning process and Decision process. The registration process involves a user choosing a user name, a graphical based security question and the e-mail address (unique key) on which the middleware anti-phishing scheme will operate. The scanning process is activated when a registered account receives an e-mail message. The results of the scanning process inform the action of the decision process, which classifies message as phish or otherwise.

The remainder of this paper is organized as follows. In the next section, the motivation for this work is discussed. In Section 3, relevant related works are discussed in detail. Section 4 contains the methodology of the proposed anti-phishing solution and Section 5 summarizes our conclusions.

1.1 Motivation

Phishing scams have been receiving extensive attention because such attacks have been growing in numbers and sophistications (Kirda and Kruegel. 2006). Phishing has become a crippling problem for many of today's internet users. Despite innovations in preventative measures, phishing has evolved to become very hard to detect. Determining whether a particular site is a phishing site or not is difficult, causing many inexperienced users to fall victim (Ferguson et al. 2012). Moreover, browser vulnerability, poor understanding of internet security, poor password culture and server side vulnerability (e.g. injection attacks, URL obfuscations, XSS attacks) have left phishers with wider freedoms to ravage the cyber community. Neverthe-less, anti-phishing detection, defence and offence remain an area of research owning to the following reasons:

- Phishing is a significant security threat to the cyber community, a plague that causes tremendous loss every year to both experienced and unwary internet users.
- The popularity of social networking sites such as Facebook, Twitters etc. where instant electronic communica-tion presents phishers the opportunity of embedding malicious links in e-chat (Aggarwal et al. 2012).
- The open source model of web pages makes it easy for attackers to create an exact replica of a legitimate site (Han et al. 2012). Because such a replica can easily be created with little cost and looks very convincing to user, many such fraudulent web sites continuously appear.
- Phishing is a pervasive problem that will not disappear in the near future, but will most likely become even more sophisticated (Baker et al., 2006).

The rationale behind the proposed MBAPES solution is simple. Humans have been identified as the weakest link in the electronic communication chain because of negligent, ignorance and poor understanding of security complexity of the cyber environment. Most phishing attacks exploit these vulnerabilities in electronic communication. In the light of this, a middleware scheme is proposed to block some of these vulnerabilities through an efficient scanning process that identifies security loopholes in electronic communication. The position of MBAPES between the E-Mail Web Server and the client's machine ensures automatic detection of phishing e-mail and deployment of necessary corrective mechanism. This service "disarms" the threat of the phishing email before their arrival at the client's machine.

2.0 RELATED WORKS

Some of the related works that aimed to detect phishing e-mails was presented in this section.

Olivo *et al*. (2011) proposed a technique that yielded the minimum set of relevant features providing reliability, good performance and flexibility to the phishing detection engine. The experiment-tal results reported in their work showed that the proposed technique could be used to optimize the detection engine of the anti-phishing scheme.

Chen and Guo (2006) created a client approach based on five main features. The proposed technique reached 96% of detection rate. One advantage of their approach is that the learning phase for the classifier is not necessary. However, if the phishing features change, the formula used in detection can fail. Another negative aspect of their work is the lack of a test database with legitimate messages; therefore it is not possible to measure the false positive rates. Besides, the features are considered isolated and no combination of them was studied.

Basnet *et al*. (2008) reported in their work that using 16 features. The authors' proposal, although using SVM, depends on many features and the identification of keywords in

the body of the e-mail message, which can make the approach very slow during the detection phase in real detection systems. The chosen keywords are searched considering the financial sector. Although e-mail phishing historically had been associated with such a sector, statistics showed that this kind of behavior is changing recently, leading to targets as trading, government, etc.

Fette *et al*. (2007) used a technique that involves machine learning with 10 features. In this approach the detection rate achieved 99.5%, when used in cooperation with an anti-Spam tool. Despite of the high classification rate, this technique needs 10 features, anti-Spam tool and querying external sources (the WHOIS service) to discover the "age of a domain" of the e-mail sender or some URL in the e-mail body. Such an approach may increase considerably the time to evaluate each message, derailing the proposal in a real SMTP gateway that receives a great number of messages.

3.0 METHODOLOGY

In this section, the underlying techniques, framework and algorithms of the proposed MBAPES are discussed in details. In the design of the proposed scheme, the following are incorporated targeting both efficient and accurate Anti-Phishing system:

- Accurate reports/decisions: The APS is designed to have the capability to emphasize low false positives in order to minimize mistaking non-phishing URL as malicious
- Fine-grained classification: The pro-posed APS is able to differentiate between phishing hosted on public services alongside non-phishing con-tent (e.g. injection of malicious code into benign websites)
- Adaptable to feature evolution: The arms-race nature of phishing leads to everyday innovation on the part of phishers' efforts to evade detection. Thus, the APS requires the ability to easily retrain to adapt to new features to prevent Zero-Day Attack (ZDA).
- Real-time Upgrade: The APS is designed to operate as near-interactive real-time detection service whose upgrade and decision results should be incorporated into the design without significant delays.

Toward the goal of the design considerations, a robust multi-stage midd-leware driven methodology is developed which can be implemented as an anti-phishing protective security layer on email server and web servers to automatically detect phishing messages and deploy necessary corrective mechanism depending on the severity of the attack.

3.1 Architecture of Middleware based Anti-Phishing e-Mail Scheme

The architecture of MBAPES is presented in Figure 1. The architecture combines the merits of middleware technology as transparent service model, browser rendering applications, large database processing using Map Reduce, the power of natural language processing, search engines and WHOIS to build efficient phishing email detector. The superior efficiency and accuracy of MBAPES stem from the following key features:

- Browser independent anti-phishing techniques with support for HTTP and HTTPS
- Operating system independent approach
- Generic middleware architectural solu-tion with stronger guarantees than browser plugins (can catch phish even if the browser is closed or not part of the communication)
- Richer configurability and re-configur-ability of anti-phishing services with no changes to Web based Data Services (WDS)
- Quality of security service manage-ment with high support for customiz-able deployment options.

The core components of the MBAPES architecture which captures the design goals and key features highlighted in the opening section of the design methodology consists of:

- Registration process
- Scanning process
- Decision process

(a) Registration Process: Usually, the registration process for the proposed middleware service involves the following steps. A user must choose a user name, select a graphical-based security question and provide a unique email address. The weakness of text-based security question informed our decision of using the graphical based security question. Such graphical-based security question makes the registration more secure. Once the user completes this simple registration process, the Monitor Engine of the proposed MBAPES enlists the email address on its

"whitelist". The whitelist contains the credential of registered MBAPES users.

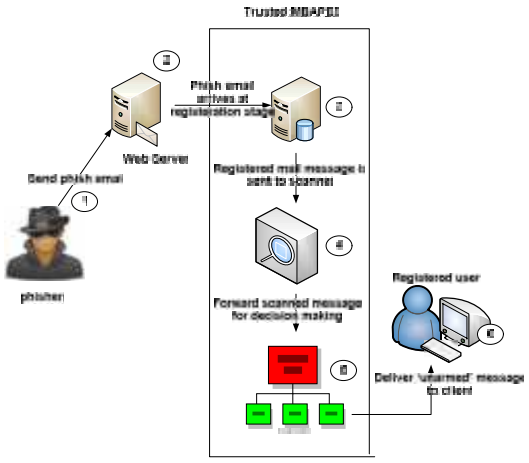

Figure 1: MBAPES Architecture and Work flow

In step (1) a phisher crafts a phishing email and sent it to some harvested email addresses; in step (2) the routes the phishing email through a Mail server; in step (3) if the email address is registered on MBAPES, the monitor engine tracks the detail of the message; in step (4) the content of the email is scanned and in step (5) decision is made based on the result of the scanning process; in step (6) a safe message arrives the client's machine.

(b) **Scanning Process**: This is the core activity in the whole detection process. In this stage, the scanning process scans all registered electronic-mail address for new mail by cooping through the "whitelist". The scanning process invokes the parser which tokenizes the message using the algorithm 1. The parser scans for the most indicative features that reveal the intention of phishers' action (e.g. embedment malicious URL, violation of binding relationship etc.).

Algorithm 1: New Email Parsing Algorithm

***Input**: New E-mail message*

Output*: Parsed E-mail message*

Algorithm:

1. *Extract e-mail from mail web server*
2. *Text preprocessing*
   a. *Tokenize text sentences into Named Entity Recognition*
   b. *Use FeatureNet to removes proper nouns and stop features*
   c. *Construct tf-idf of each term*
   d. *Generate features // Corresponding to Feature Generator//*
   e. *Return the tf-idf terms as the term identity*
3. *If has a text input keyfeature indicator, invoke Scanner*
   a. *Check violation of binding relationship if login form is found on preapproved site*
   b. *Else Test login field with bogus data*
   c. *Label the transaction*
   d. *exit*
4. *ElseIF is a URL* ∈ *{preapproved sites, popular sites etc}*
   a. *Invoke URL checker using WHOIS*
   b. *Compare term identity retrieved with page under investigation*
   c. *If WHOIS.URL≠Page.URL then Label the transaction*
   d. *exit*
5. *Return* Parsed Email messc

Expectedly, the presence of login form on a webpage is characterized by the presence of three properties i.e. Form tags, INPUT fields and login keyfeatures such as passfeature, PIN, ID etc. The INPUT fields usually hold user input and login keyfeatures distinguish a login form from other types of forms. The scanner uses Latent Dirichlet Allocation due to its sensitivity to changes in feature usage which make it good at handling synonyms. For instance, phishers can use different feature patterns such as passcode, customer number etc. to hide from common login key features. In addition, it can discover threatening theme in a message and intentionally misspelled features and conjoined features. The scanner consists of a customized filter that detect the presence of login form on the original homepage, a user profile which establish a binding relationship between a user and a page, if a user has visited the page before and a PhishTester which identify the destination website and test with bogus credentials. The algorithm for the scanning process is presented in algorithm 2.

Algorithm 2: Algorithm for scanning process

Parse page p

$r \leftarrow DOM$

$FilterByWhiteDomain(n, Dw)$

```
LF ← DetectLoginForm(r)
if n ∈ Dw and n(LF) = ∅
  return
   else
     if p == user profile
     Collect user.id
   update user profile if neccesary
 check any violation of binding relationships
  else
collect user.id in monitored mode
 check p.status with bogus data
go to 11
    else if r contains URL ti
 call URL checker ()
k ← Get(p.status)
Return k
URL checker ()
      Input URL(s)
        For int i=0; i<url(s).length;i++;
        if (url(i).contain in url database){
         return url ok
          else {
  if (url(i).contain something closely similar)
       return url not ok }}
   End URL checker ()
```

The scanning interface of a typical email message in MBAPES is shown in Figure 2.

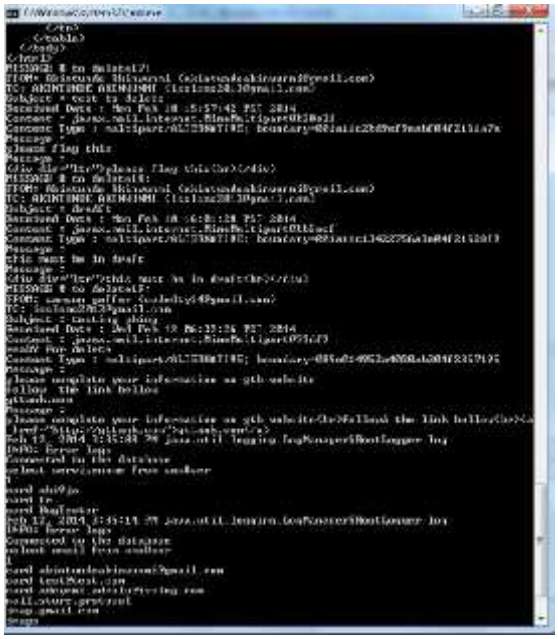

Figure 2: E-mail scanning interface

(c) Decision Process: The decision process receives the results of the scanning process and deploys necessary corrective action based on the severity of the attacks. The decision process is a rule-based system that ranks attacks into three classes namely High Impact Attack, Medium Impact Attack and Low Impact Attack. The response of the decision process is based on the category of attack. For instance, consider a decision algorithm that assign a threat score, $0 \leq t_i$;, to the *i*th email upon the occurrence of the *j*th events in the scanning phase. The threat scores may qualitatively identify the threat level upon classification as compromised if t_i = threatened if $0 < t_i$, and unthreatened if t_i . The complete algorithm for decision process is presented in algorithm 3.

Algorithm 3: Algorithm for Decision process

Input: = scanned e-mail

Output: *ts* = threat score, *rs* = response type

Begin

If (t_i =) then stop

Elseif ($t_i = 1 .and. 0 < t_i <$) then

Replay (t.history and t.features)

Compute t.impact = information Gain (IG)

If IG = 1 // high level phish

Deploy HIR // high impact response

IF IG >0 .4 // middle level phish

Deploy MIR // middle impact response

If IG < 0.4 // low level phish

Deploy LIR // low impact response

End if

End if

End

4.0 CONCLUSION

The goal of email phishing is to steal user's personal authenticating credentials, such as account names, PIN, social security number and passwords. Although there exists a number of methods for detecting phishing scams and protecting users from attacks, the trend of phishing attacks continue to climb further. Most phishing attacks exploit the vulnerabilities of human element in the electronic communication

chain. In this paper, a middleware based scheme is presented to reduce the exploitation of human vulnerabilities in electronic communication. The proposed system offers a layer of security service that "disarms" phishing messages and deploys necessary corrective mechanisms before arriving at the user's machine. We acknowledge that user's privacy concerns may constitute some challenges to widespread adoption of this approach. However, recent trends in mobile applications usage indicate that users place higher premium on tools that ensures their security while offering efficient service.

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SECURE FACE AUTHENTICATION USING VISUAL CRYPTOGRAPHY

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ABSTRACT

The main concern of this paper is to apply visual cryptography technique onto the area of biometrics authentication using human face. By using biometrics, authentication is directly linked to the person, rather than his / her token or password. However, biometric is susceptible to certain vulnerabilities such as circumvention, covert acquisition, collusion, coercion, etc. Visual cryptography is a kind of secret sharing scheme where a secret image is encrypted into shares which independently disclose no information about the original secret image. The goal of this paper is to combine biometrics with visual cryptography in order to overcome the vulnerabilities in biometric systems. This can be achieved as follows. We divide an input face image into two shares with the help of visual cryptographic technique keeping one in the database in the form of a cipher-text (share) while the other is kept with the participant in the form of an ID card, this serves as a key (share) to revealing the original image when these shadows are superimposed together. This combination of biometrics and visual cryptography is a promising technique for information security, as it offers a more secure way to authenticate and protect personal identity.

KEYWORDS: BIOMETRICS, AUTHENTICATION, FACE, SECURITY, VISUAL CRYPTOGRAPHY

1.0 INTRODUCTION

Identity theft is a growing concern in the digital world. Traditional authentication methods such as passwords and identity documents are not sufficient to combat identity theft or ensure security. Such surrogate representations of identities can be easily forgotten, lost, guessed, stolen, or shared (Asakpa, 2010). Similarly, in traditional cryptosystems where user authentication is based on possession of secret keys, which could falls apart if the keys are not kept secret (for instance, keys shared with non-legitimate users). It follows that, in traditional cryptosystems, keys can be forgotten, lost, or stolen and, thus, cannot provide non-repudiation, a very important goal of cryptography (Meneze, 2006). As a result, reliably secure mechanisms are required to protect data and information against vulnerabilities like spoofing and unauthorized access to computer resources. Biometric authentication is a possible alternative. Biometric authenti-cation systems are an example of technologies which are widely accepted in various applications such as in identification based systems and access control, ID cards verification, banking operation, etc (Rahna, 2011; Rao, 2008).

Biometrics is a science that uses unique physiological characteristics (such as fingerprints, iris, retina, face and hand geometry) or behavioural characteristics (such as voice, signatures, and keystrokes) for the purpose of identification and authentication (Rahna, 2011). Using biometric methods have significant adven-tages over traditional password authentication systems. As against pass-words based or traditional cryptosystem authentications, biometrics cannot be forgotten, stolen or shared. A biometric system is however vulnerable to two types of failures namely, denial

of service and intrusion. A denial of service occurs when the system does not recognize a legitimate user (i.e. false rejection), while an intrusion refers to the scenario in which the system incorrectly identifies an impostor as an authorized user, (i.e. false acceptance) (Asakpa, 2010; Ross, 2011).

A possible solution to these problems is a two level security measure that harnesses the strengths of cryptography using a visual secret sharing scheme (VSSS) referred to as visual cryptography and biometrics together (Russ, 2008).

This paper proposes the application of visual secret sharing scheme as a technique for achieving biometric authentication with emphasis on human face. The proposed system can be applied in various applications like banking services, examination identity, airport verification, etc.

The rest of this paper is organized as follows: sections 2.1, 2.2 and 2.3 consider secret sharing scheme, overview of visual cryptography, and application of visual cryptography to biometrics respectively. Section 3 is a discussion of the proposed method. The experimental results and conclusions are presented in sections 4 and 5.

2.0 LITERATURE REVIEW

2.1 Secret Sharing Scheme

In modern cryptography, the security of data is fully dependent on the security of the keys used. Most ciphers are public knowledge, what is not known is the key, once the key is revealed we can easily encrypt and decrypt any message. The most secure key management scheme keeps the key in a single, well guarded location (e.g. a computer, a human brain, or a safe). This approach is highly unreliable since a single misfortune (e.g. a computer breakdown, sudden death, or sabotage) can make the information inaccessible (Shamir, 1979; Sonali, Kapil and Janhavi, 2013). An obvious solution is to keep a multiple copies of the key at different locations, but this increases the danger of security breaches. A possible solution is to distribute the key among a group of people so that no single individual has the key. This is known as secret sharing scheme (Russ, 2008).

Therefore, a secret sharing scheme is a method of distributing a secret, usually a key, among a group of users, requiring a cooperative effort to determine the key, so the plaintext (message) can subsequently be decrypted.

It was discovered independently by George Blakley and Adi Shamir in 1979 (Stinson, 2006).

The general ideas behind "secret sharing scheme" are:

- Distribute a secret to **n** different participants;
- Any group of **t** participants can reconstruct the secret;
- Any **t-1** or fewer participants cannot reveal anything about the secret.

This is otherwise referred to as a **(t, n) threshold scheme**, meaning that the secret is dispersed into **n** overall pieces, with any **t** pieces being able to recreate the original secret.

Therefore, in a secret sharing scheme, any share by itself does not provide any information, but together they reveal the secret.

- An example:

One-time pad: the secret binary string

$\mathbf{k} = k_1 k_2 k_3 \ldots k_n$ can be shared as

$\{\mathbf{x} = x_1 x_2 \ldots x_n$; $\mathbf{y} = y_1 y_2 \ldots y_n\}$, where x_i is random and $y_i = k_i$ XOR x_i

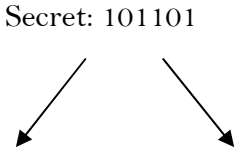

Figure 1: S_1:011011 S_2:110110

No information about the secret will be gained by looking at either the first share (S_1) or the second share (S_2). We need to combine the two shares S_1 and S_2 in order reveal the secret: Secret = S_1 XOR S_2.

2.2 Visual Cryptography

Visual cryptography is a special kind of secret sharing scheme for hiding a secret image into a set of binary transparencies which seem like random noise. Visual cryptography was introduced by Naor and Shamir (1995) at *EUROCRYPT '94*. It is used to encrypt written material (printed text, handwritten notes, pictures, etc) in a perfectly secure way. The decoding can be done by the human visual system directly.

Visual cryptography uses a visual secret sharing scheme based on a **(t, n)** threshold

framework, where **n** means a secret image will be hidden in **n** transparencies, and **t** is that we stack **t** or more than **t** transparencies to reconstruct the secret image. It is basically a secret sharing scheme extended for images.

For a set **p** of **n** participants, a secret image **s** is encoded into **n** shadow images called shares, where each participant in **p** receives one share. Certain qualified subset (**t**) of participants can visually recover the secret image, but other forbidden (**t-1**) set of participants have no information about the secret **s**.

A visual recovery for a set **q** of participants consists of copying the shares onto transparencies, then stacking them on a projector.

Visual cryptography has some characteristics that serve as advantages:

- Complete security;
- Robust method against the loss of compression and distortion because of the property of binary;
- Does not need computer for decryption.

2.2.1 Threshold scheme share distribution

Given a secret message, the goal is to generate *n* transparencies so that the original message is visible if any *k* or more of them are stacked together, but totally invisible if fewer than *k* transparencies are stacked together. Assuming that the message consists of a collection of black and white pixels and each pixel is handled separately.

Each original pixel appears in *n* modified version (shares), one for each transparency. Each share is a collection of *m* black and white sub-pixels, which are printed in close proximity to each other so that the human visual system averages their individual black/white contributions.

The resultant structure can be described by an *n* x *m* Boolean matrix $S = [S_{ij}]$ where $S_{ij} = 1$ iff the $_j$th sub-pixel in the $_i$th transparency is black and $S_{ij} =$ 0 iff the $_j$th sub-pixel in the $_i$th transparency is white (Hugo, 1993; Russ, 2008; Sreekumar, 2009). It therefore follows that, a *k* out of *n* visual secret sharing scheme consists of two collections of *n* x *m* Boolean matrices C_0 and C_1, as shown in figure 2.

$$C_0 = \begin{bmatrix} 100 & \cdots & 0 \\ 100 & \cdots & 0 \\ \vdots & \cdots & \vdots \\ 100 & \cdots & 0 \end{bmatrix} \text{ (White)}$$

and

$$C_1 = \begin{bmatrix} 100 & \cdots & 0 \\ 010 & \cdots & 0 \\ \vdots & \cdots & \vdots \\ 000 & \cdots & 1 \end{bmatrix} \text{ (Black)}$$

Figure 2: Matrices obtained by permuting the white and black columns of a pixel.

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as follows in figure 3:

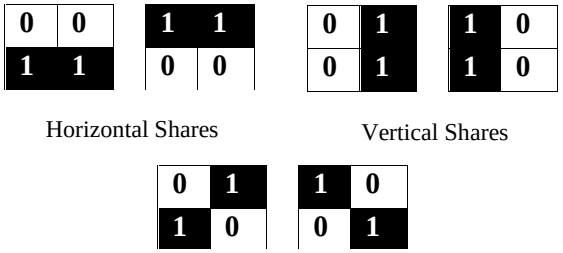


Figure 3: (2,2) VSSS various shares

Any single share is a random choice of two black and two white sub-pixels, which looks medium grey (Hugo, 1993; Russ, 2008; Sreekumar, 2009).

When two shares are stacked together, the result is either medium grey (which represents white) or completely black (which represents black). Figure 4 shows the shares combinations.

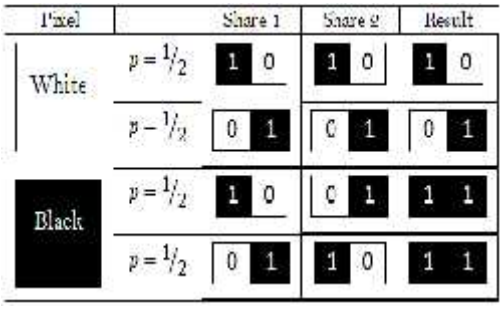


Figure 4: Shares combinations and results

It is therefore important to note that a threshold scheme could either be a *k* out of *k* or *k* out of *n*.

In general, a typical visual cryptographic scheme (VCS) takes a secret image as input and outputs shares that satisfy two conditions:

1) any qualified subset of shares can recover the secret image;
2) any forbidden subset of shares cannot obtain any information of the secret image other than the size of the secret image. Figure 5 shows a typical example of a (2, 2) VCS.

a b c

Figure 5: (2, 2) VCS

In this scheme, shares (a) and (b) are distributed to two participants secretly, and each participant cannot get any information about the secret image, but after stacking their shares (a) and (b) together, the secret image (c) can be recovered visually by the participants.

2.3 Applications of Visual Crypto-graphy to Biometrics

The combination of biometrics and visual cryptography is a promising information security technique which offers a two layer security platform for data and information. There are various applications of visual cryptography to bio-metrics with various degrees of successes.

Neha, Anuja, and Nikhita (2013) and Revenker, Anjum and Gandhare (2010) considered the application of visual cryptography to biometric templates of iris in a database. They provided a two-fold security to the iris template using visual cryptography. Divya and Surya (2012) explored the possibility of using visual cryptography for imparting privacy of biometric templates. Their contributions included a methodology to protect the privacy of palm print images by decomposing an input image into two independent sheet images, such that the private palm print image can be reconstructed only when both sheets are simultaneously available. Askari, Moloney and Heys (2011) proposed the application of visual cryptography to fingerprint templates. The system works by comparing and matching the participant's fingerprints with secret fingerprint images that are derived from visual cryptography algorithm. Facial images are the most common biometric characteristic used by humans to make a personal recognition, hence the idea to use this biometric in visual cryptography. This is a nonintrusive method and is suitable for covert recognition applications. Unlike the other biometric methods, the face is the only biometric feature that could be used by human being without the help of a machine, in order to recognize and authenticate a person. Face verification involves extracting a feature set from a two-dimensional image of the user's face and matching it with the template stored in a database. The most popular approaches to face recognition are based on either: 1) the location and shape of facial attributes such as eyes, eyebrows, nose, lips and chin, and their spatial relationships, or 2) the overall (global) analysis of the face image that represents a face as a weighted combination of a number of canonical faces. It is questionable if a face itself is a sufficient basis for recognizing a person from a large number of identities with an extremely high level of confidence. Facial recognition system should be able to automatically detect a face in an image, extract its features and then recognize it from a general viewpoint (i.e., from any pose) which is a rather difficult task.

3.0 THE PROPOSED SYSTEM

This section presents the methodology for the proposed system. To authenticate the identity of a participant of the system, the system administrator will take the image of face of the participant. Then by applying suitable visual cryptography scheme for the image, two encrypted shares of the image are generated. One of these shares is kept in the system's database while the other share is given to the participant in the form of an ID card. When the user authentication is required, the shares are superimposed for decryption and the decrypted image is compared with the actual image of the participant. If there is a match, then the participant is authenticated. Therefore, it is important to note that there are two important modules for this system namely, enrollment and authentication (Rahna, 2011; Rao 2008).

(a) **Enrolment Module:** The system administrator will collect the face image of the eligible participants who are considered qualify to use the system. The enrolled face image is required to be processed so as to extract the essential features. This involves three major steps namely; acquisition, pre-

processing and feature extraction as highlighted below:

- Acquisition is the phase at which the face image is captured for processing.
- Pre-processing is the phase during which common operations such as enhancement, normalization, filtering and background removal, etc are performed on the face image for easy processing.
- Feature extraction is the stage during which principal components are extracted for processing. In order to provide accurate authentication of participants, the most discriminating information present in the face image is extracted.

The resultant face image is subjected to visual cryptographic algorithm that will generate two shares that will be divided between the system's database (stored) and the participant (ID card), as earlier stated (Askari et al, 2011; Neha et al, 2013).

(b) Authentication Module: For authen-tication, participant will provide share in the form of ID card. System queries for the corresponding share from the system's database. By stacking the two shares, the face image is reconstructed. This represents the face template, A. Next, the participant face image is captured and subjected to the basic tasks in the enrolment module, the resultant face image form the face template, B (Askari et al, 2011; Neha et al, 2013). Then these two feature templates, A and B are matched using Euclidean distance. Euclidean distance is the straight line distance between two pixels. Given an arbitrary instance *x* described by the feature vector:

$$x = [a_1(x), a_2(x), \ldots, a_n(x)]$$

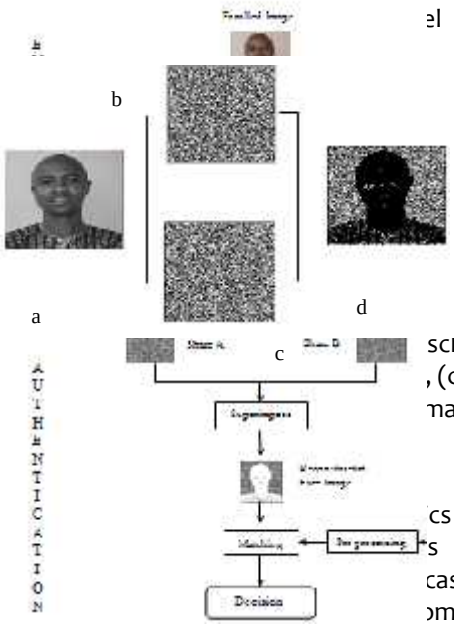
Where $a_r(x)$ denotes the value of the *r*th attribute of instance *x*. Then the distance between two instances and is defined to be the Euclidean distance, *d*(,):

$$d(x_i, x_j) = \sqrt{\sum_{r=1}^{n} (a_r(x_i) - a_r(x_j))^2}$$

If features, A and B match access is granted otherwise the verification fails (Asakpa, 2010). These two modules can be presented in a diagram form as shown in figure 6.

4.0 EXPERIMENT AND RESULT

The result of the proposed experiment is implemented in MATLAB 7.10 running on Windows 8 computer. Codes were written in MATLAB using the image processing toolbox. The size of each secret face image used is 256 x 256 pixels. Shares A and B were generated. Share A is stored in the database while share B is kept with the subject. The two shares are required to retrieve the information, in this case, the face image. As it is shown in Figure 7, the face image is encrypted into two shares. For decryption, shares A and B are stacked together to reconstruct the secret image. There is a loss of resolution in the reconstructed image. There are several research works on how to restore the loss of resolution (Jin, 2003 and Young-Chang, 2003). The enrollment and authentication for a face image is illustrated in figure 6.



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characteristics of an individual are difficult to steal, lose or forge. Even though biometrics come with its own challenges as highlighted in the paper, to address such challenges, a two-level security is proposed in this paper. That is, the combination of biometrics and visual cryptography to ensure higher level of security.

In this paper, we discuss secret sharing scheme, a precursor to visual cryptography. A method is proposed based on the (2, 2) threshold scheme to produce two shares that are distributed between the participant and the system database. Authentication is achieved by

comparing and matching the probe with the reconstructed face image.

It is recommended that future researchers may consider a (t, n) threshold scheme such as (2, 3) at least. In such a situation, there are three shares, two of which can conveniently recover the stored information. Though this may expose the system to compromise but would have solved the problem of a loss of share.

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MOBILE TECHNOLOGIES: ADOPTING APPLICATION MODEL FOR ECONOMIC PRODUCTIVITY IN NIGERIA

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ABSTRACT

Employees in Nigeria are faced with the demand for higher productivity; this is compounded with the inability to access information on demand. Challenged with this scenario, it is the views in this paper that the country needs to embrace mobile applications for a way out. The first part of the paper reviewed mobile applications in the context of information society, define their scope and limitations. In the second part classical mobile application model and context-aware mobile application model are introduced. In order to show the potential of information support in the state of mobility the paper discusses types of mobile applications and emphasises the significance of workflow concept for mobile applications. In the final part, the paper establishes that development opportunities abound in mobile technologies and proposed a context-aware mobile application model that will support economic productivity in Nigeria, stating the implications for it to come on board, as well as its impacts on national development. Furthermore, it outlines some factors that are vital to enable the country kick-start the process for its economic growth.

Keywords: context-awareness, entrepreneurship, mobile applications, mobile business, social cohesion

1.0 INTRODUCTION

The information society is the world of ongoing progress and tech-nological innovations. It is enabled by the technological development and progress achieved in the areas of information and communication technology. The informa-tion society is enabled by technology, but it is far more than just a technology-driven society. It is a complex and multi-disciplinary society driven by knowledge, innovations and development (Rupnik and Krisper, 2003). The information society is a service-oriented society in which the effectiveness of the individual and the organisation as such depend on the ability to acquire the accurate information at the right time and react according to the information acquired. The convergence between several technology sectors offers the opportunity for the emergence of new services. One of the most representative characteristics of the information society is the convergence between information and communication technologies. The development in mobile computing and telecommunication led to the proliferation of mobile phones, tablet computers, smartphones, and notebooks. Some of these consumer electronic products, like notebooks are often priced lower as compared to laptops and desktop computers, since the target market for these products are those living in the emerging markets. This made the Internet and computing more accessible to people, especially in emerging markets and developing countries where most of the world's poor reside. Mobile applications are the consequence and the result of this development (Müller-Veerse, 2000). Mobile applications also represent demand of the information society. There are some laws determining characteristics which endorse the importance of mobile applications for the information society. Some of them are (Rupnik and Krisper, 2003):

- Metcalfe's law, which defines the value of the network proportional to the square of the number of nodes connected to the network. Mobile applications represent a high potential for services in the information society, due to the fact that there are significantly more mobile devices than the

number of computers connected to the Internet;

- Information society requires access to the qualitative information for successful management. Mobile applications will also enable the access to the information in the state of mobility, and will therefore make a significant contribution to the information access;
- Employees are faced with the demand for higher productivity. The ability to access information and use applications in the state of mobility will without doubt make a contribution to this area;
- With ongoing emergence of jobs with direct or indirect demand for application use and information access mobile applications will represent a contribution in this area as well.

Mobile applications, therefore, represent the consequence and demand of the information society. They are un-disputedly worth the full attention of infor-mation system scientists and information system managers.

The paper discusses mobile appli-cations with the emphasis on mobile application as a new context-aware application model. This paper introduces the scope of mobile applications, classical and context-aware mobile application models, and overview of types of mobile applications and emphasises the signi-ficance of workflow concept for mobile applications.

2.0 MOBILE APPLICATIONS

Mobile application is a computer program running on a mobile device. Native architecture for mobile applications is three-tier (multi-tier in general) architecture and the execution of mobile application is distributed over multiple layers: presentation layer, application layer and database layer. For the purpose of this paper, a mobile device is any device connected to the Internet using any standard wireless communication protocol; Palm or WAP-enabled mobile phones are mobile devices, while a notebook connected to the Internet via wireless connection is, for the purpose of this paper, not considered as a mobile device (Tarasewich, Nickerson and Warenikin, 2002). The reason for the elimination of the notebook as a mobile device is because it does not reflect the distinct characteristics and limitations of mobile devices. Mobile phones manufacturers are coming closer to the PDA manufacturers; they offer communicators with combined functionality of PDA and mobile phone (Müller-Veerse, 2000).

According to (Varshney *et al*., 2000) the size and some other characte-ristics of mobile devices imply their limitations. They have relatively little memory available for running of applications, their processors are not of the highest performance, displays are relatively small and the using of keypad is uncomfortable. The growth in storage and processing capabilities and improvement of manipulation are important objectives of the development of mobile devices (Rupnik and Krisper, 2003). The limitations of mobile devices are essential, because they determine the limitations of mobile applications. The limitations of mobile applications and mobility itself make the mobile application model distinct from other application models (Rupnik and Krisper, 2003).

2.1 The Scope of Mobile Applications

Applications perform five different elementary functions within an infor-mation system: capturing, storing, retrieving, transforming and displaying (Alter, 1999). Due to the limitations of mobile devices, mobile application cannot reach the same level of efficiency at capturing and displaying as other applications. Nevertheless, lower levels of efficiency at performing elementary functions does not make mobile applications handicapped, because to reach the same level of efficiency as other applications is beyond the scope of their purpose.

The scope of mobile applications is to enable the use of applications and access to the important information and basic level of services in the state of mobility. Their scope is not to enable the same level of functionality as classical applications on notebooks or desktops. The services they offer and the functionality they enable should be appropriate for mobility and the needs of a mobile user. It must be emphasised that the mission of mobile applications is to offer mobility-suitable, mobility-aware and mobility-adapted mobile services. Mobile applications must provide a basic level of functionality, access to the important information and the possibility to be informed about exceptional, unexpected and other unusual situations happening within an organisation that one belongs. Mobile applications signify the connection of a mobile user with his organisation and its information system (Rupnik and Krisper, 2003).

Mobile applications will cause and demand business process reengineering. On the one hand, business processes will demand mobility, and on the other hand, mobility will enable different and also new business processes. It is estimated that a larger percentage of employees are going to be mobile in the future and that mobile application will represent a considerable contribution to the efficiency of information systems at supporting business processes (Rupnik and Krisper, 2003).

The comparison of mobile applications with classical ICT applica-tions is unjustified and inappropriate (Spritersbach, 2001). The limitations of mobile applications, which are implied by limitations of mobile devices and mobility itself, justify the research of mobile applications as distinct application model (Rupnik, 2002) and offer a motivation for this paper.

2.2 Classical and Context-Aware Application Model

Mobile applications must be developed with mobility in mind (Hampe *et al*., 2000). Mobility is the main purpose of mobile applications and demands a new functionality, a new philosophy and a new application model. Merely developing mobile applications as simplification of applications already available would not be of significant benefit to the information system and its mobile users.

2.2.1 Classical application model

There are two mobile application models. The first is a classical mobile application model, where a mobile application is started by the users' demand. The fact that the mobile user has run a mobile application indicates his current informational needs. The classical mobile application model does not bring the highest possible added value to the mobile user, because it assumes the perception of the mobile user: what information is essential at a particular moment, and accordingly, which mobile application they should run in order to acquire that information. It must not be under-estimated, because users will still need on-demand applications (Rupnik, and Krisper, 2003; and Hampe *et al*., 2000).

The introduction of a classical mobile application model has pointed to its disadvantage, implicitly revealed in the characteristics required from a new mobile application model. The new mobile application model should move the focal point from an application being run by a mobile user on demand to an application being triggered by an application server and passed on to a mobile user based on the condition that depends on current circumstances within the business system and its information environment. The main idea of new application model is context-awareness (Dey, 2000). Context is defined as implicit information on:

- The situation a mobile user is currently involved in. That is, a context of situation which is defined by the user's location, social situation and physical environment;
- Informational needs of a mobile user which is determined by information systems' informational needs. This is defined as a context of informational needs

Technical descriptions, which carry the information about the places where the user is usually present, the information about the technical characteristics of the users' mobile device and the information on the current state of the wireless network. This is defined as the context of technical descriptions.

All these components are required in order to determine the context of a mobile user. Information on the current state of the wireless network, for example, determines the form in which an application can be passed on to the user. In cases of wireless network overload, the system can pass on to the user an application with ASCII interface instead of graphical user interface (GUI). The context determines the information given to the user and the moment at which application is triggered and passed on to a mobile device.

2.2.2 Context-aware application model

Context-aware mobile application model is the second model. Mobile application is context-aware if it uses the context for determination of the triggering moment and the forming of contents. That means it uses the context to provide information to the user. The information is relevant to the user due to the context of informational needs, limited by the context of situation and affected by the context of technical descriptions (Rupnik and Krisper, 2003).

A context-aware mobile application model is based on the aforementioned definition of context-aware mobile applications. It eliminates the disadvantage of a classical mobile application model, because it enables the triggering moment

of application to be determined by the context of informational needs and not only on the user's demand. Context-aware mobile applications will enable the following new functions:

- ***Confirming***. The main idea of confir-ming is to minimise the need for entering data, while using mobile application. Our assumption is that, in many cases, data can be pre-generated based on context, stored into a database and then offered to a user as an option. Pre-generation is the creation of appropriate set of data and can be implemented using lists of values, or can be physically pre-inserted into a database. The first type of confirming is approving; users must either approve the only option or disapprove it; while the second type of confirming is selecting, in which case, users must select one among multiple options (Hampe, Swatman and Swatman, 2000);
- ***Messaging***. Messaging will enable the broadcasting of important information, mostly, to managers, and also, to other individuals within the information system, and in general as well (Müller-Veerse, 2000). There are at least two levels of messaging. Operational level messaging broadcasts information of the operational, non-strategic level. On the other hand, management level messaging broadcasts tactical and strategic level information, which enables decision support. At any level, messages can be triggered either by time, or event based on condition.

Confirming and messaging are new non-elementary functions typical for context-aware mobile applications. Confir-ming is, for example, only a special case of storing. Those functions are not implemented only by mobile applications; they can be implemented in any other environment. But they bring a substantial benefit and meaning, especially to a mobile user. Their main purpose is to enable the mobile user to do as much as possible with as few clicks as possible.

The implementation of context-aware mobile applications covering all of context components is a rather difficult task, which demands complex technolo-gical infrastructure, especially for the determination of the context of situation. Sensors in buildings and localisation software, for example, are needed for the implementation of the context of situation (Dey, 2000). On the other side, there are also complex and uncertain algorithms needed for the implementation and determination of the context of situation. For that reason the focal point should be on the context of informational needs, at the present stage. The first phase in the evolution of context-aware mobile applications will be based on the context of informational needs and the context of technological descriptions.

3.0 MOBILE APPLICATIONS AS ADDED APPLICATION CHANNEL

Mobile applications represent a niche application model appropriate for specific roles within specific business processes. They will not prevail over other types of applications, i.e. web applications and client/server applications. Mobile applications as primary application channel would not bring substantial added value to every user.

Application models presented in this paper indicate that mobile applications are simple applications with rather limited functionality. They can, therefore, better serve as additional application channels offering mobility-adapted and mobility-suitable services within portals or information systems (Figure 1). Portals represent primary application channels for users where they can personalise and customise mobile applications, i.e. the level of information support while being mobile. Within personalisation, users can set up different things: events and situations they want to be informed about, transitions of business processes they want to confirm or they want to be informed about and classical applications they want to use within their mobile portal.

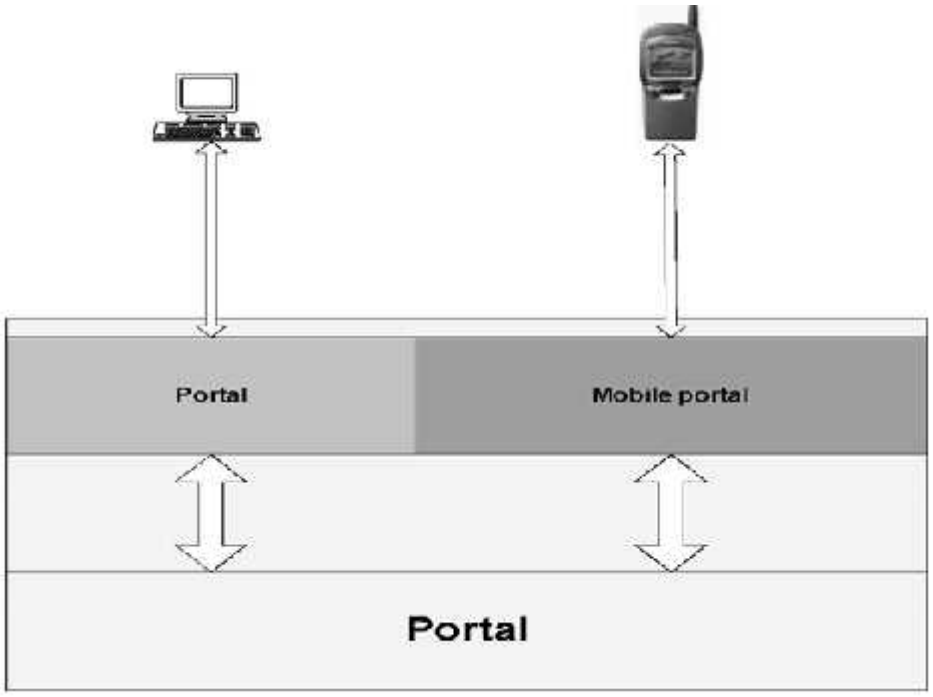

Figure 1:

Mobile Portal within a Portal as Additional Application Channel

The just introduced concept of mobile portal within a portal represents a platform for enabling the information support in traditional working environments and in the state of mobility. This platform enables the broadcasting of information to the entire information system environment: transaction processing support and decision support. The area of decision support will be the one who will benefit a lot, because the decision makers are often not present in their traditional working environment and the ability to view information and confirm decisions in the state of mobility will be very important for some companies.

3.1 Types of Mobile Applications Functionality

The new application models just introduced offer the first criterion to make a classification of types of mobile applications. Therefore, in this dimension, the two models distinguish mobile applica-tions: classical mobile applications model and context-aware mobile applications model.

There are several types of traditional, non-mobile applications (Alter, 1999). For the discussion about mobile applications, the following are relevant: communication systems, transaction pro-cessing systems, management application systems and decision support systems. SMS is part of the traditional mobile applications side. It could also part of the new model, and implicitly it is, because in the context-aware model any messaging is conceptually similar to SMS. Mobile e-mail is another traditional mobile application type. It can be

3.1.1 Mobile application functionality

The second dimension is funct-ionality of the application system. Application systems perform three major types of functions within information system: information broadcasting support, transaction is based on an application implemented in different ways, even though SMS service, according to estimations, will be one of the most used and popular mobile applica-tions. Both of applications mentioned so far belong to the information broadcasting support category.

Mobile transaction processing applications are probably the most wanted mobile applications, because transaction support is demanded in every area. Some simple and even sophisticated applications of this kind are already offered. One of the conditions for their

real era to come is the solution of the security problem, which is conceptually already solved, but not implemented in all mobile devices. The most significant areas for a mobile user are banking, shopping, broking reservations and education. Mobile applications for the areas mentioned are already offered (Müller-Veerse, 2000), but very little for education.

Decision support area will probably gain the most of all areas of functionality with the emergence of mobile applications. Managers and executives will have the opportunity to see essential parameters of running business and make decisions based on those parameters while being mobile. Mobile management applications and mobile decision support systems of traditional application model enable query-on-demand without combination with messaging.

Transaction support is in the heart of all functionalities for the classical application model. This is not surprising, as it is in accordance with the fact that to record facts was one of the most important missions of application systems. With the new application model things are different, because the demand for mobility determines information broadcasting as the core functionality. Mobile decision support systems will mostly be based on messaging and confirming as well. They will also keep query-on-demand capability, but their main potential is in context-aware messaging capability. Mobile decision support systems will be mostly messaging oriented; there will also be some confirming in cases when managers will have to confirm some draft decisions made by their subordinates, and these will be triggered by the context.

Various messaging systems designed for various purposes will play an important role in the future. In order to satisfy user's needs and in order to prosper, they will have to be location dependent and personal profile dependent. Among other things, this will make mobile advertising possible; that actually means one-to-one, location dependant and fully personalised marke-ting.

Furthermore, emerging 3G net-works are the important prerequisite for the emergence of mobile applications (Economist, 2003). Always-on is the precondition for the emergence and the success of mobile applications and it can be achieved through connection to GSM (2.5G or 3G) networks.

3.1.2 Mobile commerce

The most important type of mobile applications of the future is mobile commerce applications. They will rep-resent a considerable part of the mobile application market. The general name, mobile commerce applications, covers an extensive area of various mobile applications sub-types which all have evident commercial component. There are three groups of mobile application sub-types within mobile commerce applica-tions.

In the first group, there are mobile applications that are mostly transaction-support oriented, but with noticeable information broadcast support as well. They enable messaging and confirming with emphasis on transaction support. With only transaction support, mobile applications of this group would, in fact, be mobile transaction processing applications. Their contribution and the new value that they provide are in messaging, which adds a dynamic component to transaction processing. The most typical mobile applications of this group are applications that support mobile auctions, mobile broking and mobile advertising.

The second group has strong emphasis on transaction support with messaging and confirming functions required. Mobile banking, mobile reservations and mobile shopping are representatives of mobile applications of this group. The main difference between the first and the second group is in information broadcasting support. For the first group, the information broadcasting, with messaging function as its implementation, is the primary functionality. Transaction can only be a consequence of a message delivered to the user. For the second group, the transaction support is the primary functionality, with messaging only as its supportive function.

3.2 Workflow and Mobile Applications

Workflow concept is very important for mobile applications. It is concerned with the automation of procedures, steps of business processes, where data, documents, information or tasks are passed between participants according to a defined set of rules to achieve, or to contribute to, an overall business goal (Workflow Management Coalition, 1995). Workflow is defined as computerised facilitation or automation of a business process, in whole or part. The ability to distribute tasks and invoke mobile application at the right moment is paramount for implementing concepts of

messaging, confirming and accepting. In the workflow framework, workflow engine is responsible for invoking applications.

Between the areas of mobile applications and workflow, there is a kind of coherence; for success of mobile applications in a way depends on workflow technology and workflow technology will become more important through expansion of mobile applications.

3.3 Mobile Technology and Develop-ment Opportunities

The advent of mobile technology as part of ICT in development initiatives has proven to be a success as the rapid distribution of mobile telephony has made it possible for poor people to have easy access to useful and interactive infor-mation (Silvia Masiero, 2013). For instance, in India, the total number of mobile phone subscriptions reached 851.70 million in June 2011, among which 289.57 million came from rural areas, with a higher percentage of increase than that in urban areas. The unexpected growth of affordability and coverage of mobile telephony services has increased its importance not just as a means of two way communication but that of ease-of-access to information as well.

Mobile phones are capable of much more than the exchange of information between two people through calling or text messaging. Advanced models of mobile phones can take affordable. For example, a study in Kenya identified innovation in mobile technologies for development in particular the success of M-PESA mobile banking (Silvia Masiero, 2013). M-PESA (M for mobile, PESA is Swahili for money) is a mobile-phone based money transfer and microfinancing service for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania (Communications Commis-sion of Kenya, 2012). The study also looked at sectors like m-agriculture and m-health where best practice is still to be achieved and have high demand from Kenyan people.

The main lesson they learnt was exemplified by M-PESA where they found the presence of three factors required if mobile technology innovation is to be fostered in developing countries (Silvia Masiero, 2013):

- A creative private sector;
- A process coordinated by a govern-ment;
- Committed international donors.

They found demand for mobile technologies in Kenya present for health and agriculture and found case studies of best practice in these fields (Silvia Masiero, 2013). They learnt that best practice in m-health seems to depend on demand and on the government facilitating innovation. Alternatively, they found m-agriculture leaving more room for entrepreneurship in the private sector (Silvia Masiero, 2013).

photos, record video, receive local AM/FM stations radio frequencies, share and receive multimedia and even connect to the Internet. These features make an even better device to aid in ICT for development projects.

According to International Tele-communication Union (ITU), mobile communications and technology has emerged as the primary technology that will bridge in the least developed countries. This trend can be further supported by the rosy sales reports of technology companies selling these electronic devices in emerging markets which includes some of the least developed countries.

Moreover, data from the ITU's *Measuring the Information Society 2011 Report* shows that mobile phones and other mobile devices are replacing computers and laptops in accessing the Internet. Countries in Africa have also recorded growth in using mobile phones to access the Internet. In Nigeria, for example, 77% of individuals aged 16 and above use their mobile phones to access the Internet as compared to a mere 13% who use computers to go online (ITU, 2011).

These developments and growth in mobile communication and its penetration in developing countries are expected to bridge the digital divide between least-developed countries and developed countries, although there are still challenges in making these services, the

3.4 Impact of Mobile Technologies in Economic Development

According to a study conducted in Tanzania (Bhavni, Chiu, Janakiram, Silarszky, Bhatia, 2008) the use of mobile phones has impacted rural living in many ways. According to the latest study conducted on mobile commerce, up to 78 percent of smartphone users are applying their devices to the shopping decision process for choosing the products that they will buy. The study was conducted with participation of 400 users of both smartphones and social media users in India, from among 4,000 total

participants. The study indicated that among smartphone using consumers 65 percent use their devices for buying from a retail store. Moreover, 81 percent of them often used social media over those devices to obtain purchasing advice before they actually buy the item being considered. The mobile commerce study was conducted in 10 different countries (Lambert, 2013).

4.0 ADOPTING APPLICATION MODEL FOR ECONOMIC PRODUCTIVITY IN NIGERIA

Several authors have done research on mobile application model for economic productivity The research pointed out that consumers in the mobile commerce environment are creating a fundamental shift in shopping as they begin using that channel as their primary choice on an increasing basis. It also indicated that even though there are some security concerns that continue to exist, online banking is also on the rise and this will only help to boost the popularity of shopping and transactions as a whole.

Employees in Nigeria are faced with the demand for higher productivity; this is compounded with the inability to access information on demand. Challenged with this scenario, it is the views in this paper that the country needs to embrace mobile applications for a way out. It must be emphasised that the mission of mobile applications is to offer mobility-suitable, mobility-aware and mobility-adapted mobile services. The ability to access information and use applications in the state of mobility will without doubt make a contribution to this area.

A context-aware mobile applica-tion model that will provide the func-tionality for economic productivity in Nigeria is hereby proposed. The model will have functionalities for messaging, accepting and confirming with features for information broadcasting support, transact-tion support and decision support.

In comparison with the context-aware model, the classical model is disadvantaged, because it lacks the potential context-sensitivity inherent in the new model selected, the basis of which is that the new mobile application model will move the focal point from an application being run by a mobile user on demand alone to an application being triggered as well by an application server and passed on to a mobile user based on the condition that depends on current circumstances within the business system and its information environment.

As Nigeria is predominantly made up of rural dwelling communities, this paper expects that deployment of mobile application will impact on the nation's economic productivity in many ways:

- **Easy Access to Information:** Mobile phones will enables users to access valuable information such as prices, arbitrage and market or trade opportunities which could better prepare them for business transactions.

- **Transport Substitution:** The improvement in the information flows between the buyers and sellers make for a more effective bartering of information without traveling. This is particularly significant in rural areas where traders need to travel to urban areas simply to check for demand and negotiate prices. Mobile phones eliminate the need for middlemen and journeys as traders could ensure that demand for their products exists before leaving their rural homes;

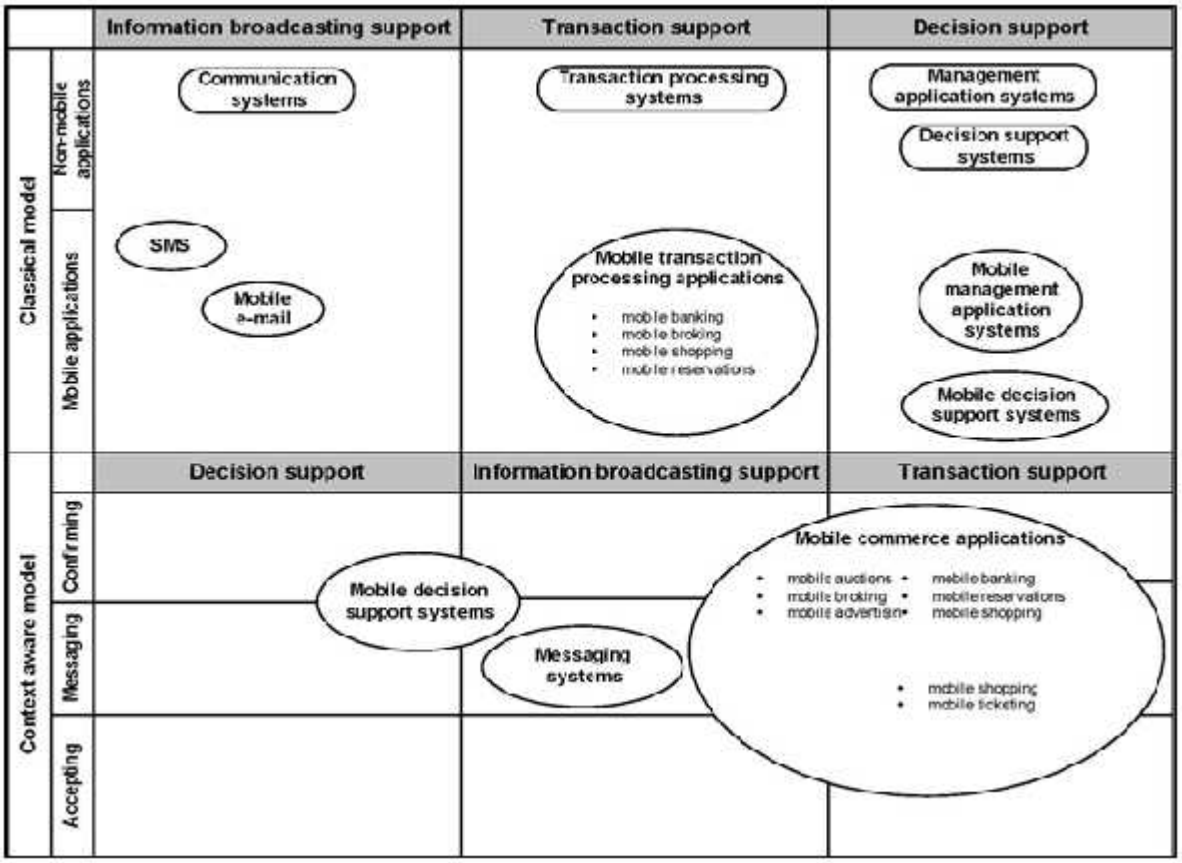

Figure 2: Proposed Context-Aware Mobile Application Model
Courtesy: Academia.edu

- **Market Inefficiencies:** The use of mobile phones can correct market inefficiencies, therefore regaining the balance in the supply market;
- **Disaster Relief:** In cases of severe drought, floods, wars or weak economies, mobile phones can be used to keep in touch with one's home community. Mobile operators have proven to be incredibly helpful in disaster relief efforts by providing emergency-related communications infrastructure;
- **Education and Health:** Mobile services can be used to spread locally generated and locally relevant educa-tional and health information;
- **Social Capital and Social Cohesion:** Mobile services will enable partici-pants to act together and pursue shared objectives by promoting cooperation among social networks;
- **Entrepreneurship and Job Search:** Use of mobile phones will reduce the cost of running a business and, in some cases, the technology could even enable a user to start one.

4.1 The Implication of the Mobile Application Model

The adoption of the proposed mobile application model for economic productivity, fundamentally, will entail:

- **Infrastructure**: especially for deter-mination of the context of situation; that will include
  - *sensors in buildings,*
  - *localisation software*;
- **Mobile portal within a portal:** this presents a platform for enabling information support in traditional ICT environment and in the state of mobility. This platform will enable broadcasting of information to the entire information system environ-ment, transaction processing and decision support;
- **Connectivity with GSM:** especially 2.5G or 3G broadband network;
- **Business process reengineering:** mobility will entail different and also new business processes, as a larger percentage of employees are going to be mobile in the future; mobile application will then represent a considerable contribution to the efficiency of information systems at supporting business processes.

As mobility is the main idea of mobile applications it demands a new functionality, a new philosophy and a new application model. This paper views that developing mobile applications as simplification of applications already available would not be of significant benefit to the information system and its mobile users.

5.0 RECOMMENDATIONS AND CONCLUSION

5.1 Effective Adoption of Mobile Application

The country will have to embrace the innovations brought about by use of mobile technologies in the various sectors of the economy. In view of the implications of the mobile application and in order to kick-start this process effectively in Nigeria, the following enabling environments should be put in place:

- A creative private sector seizing the initiative and acting upon a specific and wide demand for innovation;
- A process coordinated by a govern-ment that is supportive;
- Committed international donors sup-porting the innovation across all phases.

5.2 Conclusion

Mobile applications are a novelty introduced and enabled by the techno-logical progress in the information society. They represent the foundation for m-commerce, which is probably one of the most demanded services by mobile users, and the widespread acceptance of e-commerce. Mobile applications are accompanied by a new context-aware application model, which represents higher value added to the mobile user, because the content and the triggering moment are based on context.

The paper highlighted that 3G networks are the important prerequisite for the emergence of mobile applications, and the success of mobile applications can be achieved through connection to GSM (2.5G and 3G) networks. It is, therefore, evident that the future success and the widespread use of mobile applications depend on possibility for mobile devices to connect to these networks.

Context-aware mobile applications introduced in the paper represent one of the core challenges to the research area of information systems development. There is a great need and opportunity for a research area of information systems development to take advantage of mobile applications

This paper has established that development opportunities abound in mobile technologies and proposed a context-aware mobile application model that will support economic productivity in Nigeria, stating the implications for it to be put in place. It also has highlighted significant impact the application will have on national productivity and outlined some factors that are important to enable the country kick-start the process for its economic growth.

In today's world, the speed of changes and emergence of novelties in the area of technology often overtake the science and development of methodologies to support changes. Mobile applications are example of such overtaking. Infor-mation systems development methodo-logies will have to adopt new approaches, methods and techniques for development of context-aware mobile applications with advanced functionality.

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ANALYSIS OF SMART VIDEO SURVEILLANCE SYSTEMS

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ABSTRACT

This paper presents a review of current developments in smart video surveillance systems. We look at the existing surveillance systems in line with their domains of application, their architectural design, their support for multi-sensors, multi-cameral, video analysis, and quality of service. Their support for 3D visualization, data fusion, and mobility were also looked into. The Computer Vision techniques applied to surveillance technologies are also given. The current research issues supported by these systems were also analyzed as well. The objective of this paper is to present the state of the art of visual systems for surveillance in the past and present with a view to understanding the current research focus areas of these technologies and the challenges ahead.

Keywords: smart, multi-sensor, multi-camera surveillance

1.0 INTRODUCTION

1.1 Smart Systems

Smart systems are systems that use a feedback loop of data, which provides evidence for informed decision-making. The system can monitor, measure, analyze, communicate and act, based on inform-ation captured from sensors (Martyn *et al.,* 2012).

1.2 Smart Video Systems

Surveillance involves object detection, classification and monitoring within the scene while activity recognition involves the process of recognizing the actions performed by a person, such as walking, running, jumping, bending and so on. Also identity recognition involves the process of recognizing a person using some unique features such as face, fingerprint, gait, and so on. Video surveil-lance is a technology that has been applied in many public and private places such as banks, airports, highways, crowded areas for the purpose of security (Yigithan, 2004). In the beginning, video outputs are processed in real time by human operators and are usually stored for later for post-crime investigations. However, it has been recognized that humans are inefficient at doing this especially now that we have a large number of areas to be monitored simultaneously (Hampapur et al., 2005). In order to detect important events automatically from such an array of cameras, assisting the human operators with identification of important events in video by use of "smart" video surveillance systems is a critical requirement. Figure 1 presents a typical video surveillance system.

Figure 1: A typical visual surveillance system

The terms Smart visual surveil-lance, intelligent video surveillance, video analytics, intelligent video and intelligent analytics are

typical names used to describe the concept of applying automated signal analysis and pattern recognition to video cameras and sensors, with the goal of automatically extracting "usable information" from video and sensor streams (Russo, 2008)

Detection, tracking, and understanding of moving objects of interest in dynamic scenes have been active research areas in computer vision over the past decades. Intelligent visual surveillance (IVS) refers to an automated visual monitoring process that involves analysis and interpretation of object behaviors, as well as object detection and tracking, to understand the visual events of the scene (Kim *et al*. 2010).

2.0 COMPUTER VISION TECHNI-QUES IN SMART VISUAL SYSTEMS

2.1 Video Analysis

In general, the tasks of video analysis can be divided into that of fore-ground detection, classification, tracking, identity recognition, and activity recognition. Surveillance involves the detection, tracking and classification of foreground objects in video scenes, while Human identity recognition involves the process of recognizing a person using some unique features such as face, fingerprint, gait, and so on. Activity Recognition involves the process of recognizing the actions performed by a person, such as walking, running, jumping, and bending and so on. The foreground detection subsystem detects the moving regions in the scene, foreground classification attempts to classify the moving object into the various classes they belong. Foreground tracking is concerned with locating the position of the moving object from frame to frame within the scene. Foreground Identification tries to recognize the identity of the moving objects. Activity recognition attempts to recognize the action taking by the moving objects in the scene or detect if an action is normal or abnormal.

2.2 Object Detection in Smart Visual Systems

Accurate human segmentation in videos is a necessary requirement for any surveillance system. The first task of a video analytics is to detect moving objects in the scene. This detection is used in the later stages of the video analytics. There are many moving object detection mechanisms in the literature. Due to the nature of different backgrounds- i.e. static, dynamic, and a quasi-stationary, motion detection poses a difficult problem, and different algorithms have been proposed in the literature to work in different environments. Frequently used techniques for moving object detection are back-round subtraction, background statistical modeling, temporal differencing, optical flow and Hair like features.

Surveillance system needs objects to be identified in the scene. In general video analytics foreground detection can be classified by the methods used to detect the motion. Those that use models of the background and those that make use of temporal difference and finally those that make use of the flow vectors of motion to estimate regions of motion. In the case of background subtraction, a model of the background is obtained by using the first background frame or by building statistical model of the background using few first frames of the background. Motion is then detected by taking the difference between the current frame and the background reference frame in a pixel-by pixel fashion. Temporal differencing makes use of the pixel wise differences between two or three consecutive frames in an image sequence to detect moving regions. This method is very adaptive to dynamic science, but does a poor job of extracting all the relevant pixels.

Optical flow based method uses flow vectors of moving objects over time to detect moving regions in an image sequence. The flow computation is computationally intensive and sensitive to noise and cannot be applied to real time video without specialized hardware (Yigit-an., 2004).

2.3 Object Tracking in Smart Visual Systems

Object tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. In other words, a tracker assigns consistent labels to the tracked objects in different frames of a video. Additionally, depending on the tracking domain, a tracker can also provide object-centric information, such as orientation, area, or shape of an object (Yilmaz *et al*., 2006). Object Tracking is an important task in many computer vision applications including surveillance (Yang et al., 2005). The tracking of real world objects is a challenging task due to the presence of noise,

occlusion, clutter of objects of interest. A variety of algorithms have been proposed in the literature to tackle these problems.

According to Yang., (2005), trac-king algorithms can broadly be classified into two categories Deterministic methods and stochastic methods. Deterministic methods typically track by performing an iterative search for the local maxima of a similarity cost function between the template image and the current image. The cost function widely used is the sum of squared difference (SSD) between the template and the current image. In this regards, more robust similarity measures have been applied and the mean-shift algorithm or other optimization techniques have been utilized to find the optimal solution (Yang *et al*., 2005).

Model based tracking algorithms incorporate a priori information about the objects to develop representations such as skin color, body blobs, silhouettes, kine-matic skeleton, while appearance based approaches apply recognition algorithms to learn the objects either in some basis such as the eigenspace, or in kernel space (Yang et al., 2005).

The second category which is the stochastic methods, use the state space to model the underlying dynamics of the tracking system.

2.4 Human Identity Recognition in Smart Visual Systems

Automatic recognition of people is a challenging problem which has received much attention during the recent years due to its many applications in different fields such as law enforcement, security applications or video indexing. Identifying human beings from distance in a surveil-lance scenario require non-cooperative subjects; hence the physiological and behavioral traits that can be used for this purpose are face and gait of the individual.

Face has always been one of the biometrics uses for human identification. Although other methods of identification such as fingerprints, iris scan can be used, but they cannot be suitable in a situation where non-copeartion is needed. Face recognition has always remain a major focus of research mainly because of its non-invasive nature and because it is people's primary method of person's identification (Chellappa *et al*., 2003). Humans often use faces to recognize individuals and advancements in computing capability over the past few decades now enable similar recognitions automatically (Chellappa *et al*., 2003).

Human face localization or detection is often the first step in video surveillance application. Locating and tracking human faces is a prerequisite for face recognition and/or facial expression analysis. In order to locate a human face, the system needs to capture an image using a camera and a frame grabber to process the image, extract important features and then use these features to locate the region of human face in videos. Face recognition is a very challenging problem and up to date, there is no technique that provides a robust solution to all situations and different applications that face recognition may encounter (Chellappa *et al*., 2003).

Gait is a spatio-temporal pheno-menon that typifies the motion charact-eristics of an individual (Kale *et al*., 2002). Gait recognition is aimed to recognize human beings from distance using the way they walk (Bouchrika *et al*., 2008). Human gait recognition works from the observation that an individual walking style is unique and can be used for identification. It is observed that natural biometric systems fails in two ways 1) failure to match in low resolution images 2) user co-operation to obtain accurate results. These shortcomings might be a plus for using gait for biometric purposes (Rani and Arumugam 2010).

Many studies have shown that it is possible to recognize people by the way they walk (Imed *et al*., 2008). In kinesiology (human kinetics) the goal has been to understand human motion with applications in sports, medicine, elderly care and early detecting of movement disorders (Harris *et al*., 2010). Analyzing human gait has found considerable interest in recent computer vision research (Katiyar *et al*., 2010).

Various Gait algorithms have been proposed in literature to achieve better recognition results. They can be broadly classified as model-based and modeless algorithms. The model-based approaches use a bio-mechanical motivated approach, and input/output modeling approaches while the modeless approaches use shape and motion information for gait analysis (Ding, 2008).

2.5 Activity Recognition in Videos

This section reviews the state-of-the-art methods of action recognition in realistic, uncontrolled video data. The existing works is structured into three categories: (a) Human model based met-hods, which employ a full 3D (or 2D) model of human body parts, and action recognition is done using information on body part positioning as well as move-ments. (b) Holistic methods which use the knowledge about the localization of humans in video and consequently learn an action model that captures characteristic global body movements without any notion of body parts. (c) Local feature met-hods which are based on descriptors of local regions in a video, no prior knowledge about human positioning nor of any of its limbs is given. A model-based approach employs a kinematics model to represent the poses of body parts in each snapshot of body action. The recognition algorithm first aligns the kinematic model to the observed body appearance in each video frame and then codes the motion of the body parts with the model transfor-mations (Chen et al 2008). Appearance-Based: An Appearance based method use the appearance properties of each action frames without explicitly representing the kinematics of the human body. A good example is template matching, which is widely used as an appearance-based action recognition algorithm e.g. (Bobick *et al*., 2001). In part-based method, the appear-ance of an actor is decomposed into a set of small, local spatio-temporal compo-nents, and statistical models are applied to map the local components to actions.

3.0 REVIEW OF SMART VISUAL SURVEILLANCE SYSTEMS

There have been several smart surveillance systems reported in the literature. Many of such systems are depicted in Table 2.1. Haritaoglu (1998) presents a Real Time system for Detecting and Tracking people is presented. W4 is designed as real time visual surveillance system for detecting and tracking people and monitoring their activities in an outdoor environment both day and night. It operates on a monocular grayscale video imagery or video imagery from an infrared camera. W4 is motivated by the desire to develop a people tracking oriented system that can locate and track people especially during the night time. The objectives of developing the system are:

- To construct a system to answer ques-tions about who is the there?, what is he doing?, people are doing and where is he? and when was the action?.
- To track multiple people and their parts using shape analysis.

The system can perform the following:

- Background modeling using frame dif-ferencing.
- Object detection
- Object tracking
- Occlusion handling using region Mer-ging and splitting
- Parts tracking using cardboard Algo-rithm.

The limitation of the system is that the model used for body pose prediction is restricted to upright position only and hence cannot detect people in other body poses. Also the system cannot detect complex events. The W4 actually extends the first generation of surveillance systems by providing for automatic detection of objects and actions in the system. This type of systems can be categorized as second generation systems.

In Collins *et al*. (2001), the Archi-tecture of the Video Surveillance and Monitoring (VSAM) is presented. The Objective of the system is to develop a single user monitoring system. The architecture of VSAM consists of an operator control unit, several sensor pro-cessing units, a graphical user interface (GUI), and several visualization nodes. VSAM allows multiple (Operator Control Unit) OCU to be networked together each controlling multiple (SPUS) Sensor Processing Units. Each OCU supports exactly one GUI through which all users' related command and control information is passed. Data dissemination is not limited to a single user interface, however but is also accessible through a series of visualization modes (VIS). Object detec-tion is performed by the sensor processing units using adaptive background sub-traction and three-frame differencing. This information is sent to the operator central unit. That is, the operator control unit receives the processed data from the entire sensor processing units distributed over the area of interest. Once the operator control unit acquires results from the sensor-processing units, this information is integrated with a site model and a database of known objects to infer information of interest to the user (Collins *et al*., 2001).

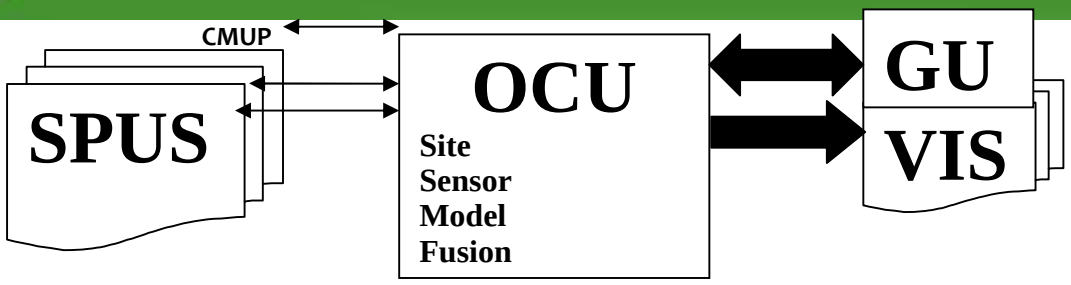


Figure 2: Schematic overview of the VSAM testbed system (Collims *et al*., 2001)

The system schematic overview is presented in figure 2 and consists of the following:

- **Sensor processing units (SPUS):** The SPU acts as an intelligent filter between a camera and the VSAM network. Its function is to analyze video imagery for the presence of significant entitles or events and to transmit that information symbolically to the OCU. The advantage of this arrangement allows for many different sensor modalities to be seamlessly integrated into the system. Also performing as much video processing as possible on the SPU reduces the bandwidth requirements of the VSAM network. Full video signals are not required for transmission, only sym-bolic data extracted from video signals.
- **Operator Control Unit (OCU**): The OCU accepts video processing results from each of the SPUs and integrates the information with a site model and a database of known objects to infer activities that are of interest to the user. This data is then sent to the GUI and other visualization nodes as output from the system.
- **GUI:** The GUI currently consists of a map of the area, over laid with all object locations, sensor platform loca-tions, and sensor field of view. In addition a low bandwidth and the compressed video stream from one of the sensors can be selected for real-time display. The GUI is also used for sensor suite testing. Through the interface, the operator can test individual sensor units, as well as the entire testbed sensor suite.
- **Visualization nodes** are used for viewing the 3D scene of the surveillance area. This also supports data fusion. Every observed object is positioned in a 3D geodetic coordinate system using relocation.

The system is one of the pioneered works in third generation surveillance systems. The systems allow many different sensors to co-operate and work together. Also there is efficient usage of bandwidth since only symbolic information is sent across the network. But complex activity recognition is not supported by the system.

In Georis *et al*. (2003) an IP-distributed computer-aided video-surveil-lance system is presented. It is a surveil-lance architecture that basically consists of three components: Computers connected together through a typical fast Ethernet network (100 Mbls). The various cameras are plugged either in an acquisition card in a PC or directly on the local network hub for IP cameras. It also consists of Human Computer Interface (GUI) and storage space plugged into the system. The overall advantage of the architecture is the flexibility offered and robustness in the presence of errors, transmission interrupt-tion.

In this work, a generic, flexible and robust intelligent real-time video surveil-lance system is presented. The proposed system is a multi-camera platform that is able to handle different standards of video inputs (composite, IP, IEEE1394). The system implementation is distributed over a scalable computer cluster based on Linux and IP network. Data flows are transmitted between the different modules using multicast technology. Video flows are compressed with the MPEG4 standard and the flow control is realized through a TCP-based command network (e.g. for bandwidth occupation control). The design of the architecture is optimized to display, compress, store and playback data and video flows in an efficient way. This platform also integrates advanced video analysis tools, such as motion detection, segmentation, tracking and neural networks modules. The goal of these advanced tools is to provide help to operators by detecting events of interest in visual scenes and store them with appropriate descriptions. This indexation

process allows one to rapidly browse through huge amounts of stored surveil-lance data and play back only interesting sequences.

The major components of the physical architecture are presented in Figure 1. Basically, the system is compos-ed of computers connected together through a typical fast Ethernet network (100/Mb/s). The various cameras are plug-ged either on an acquisition card on a PC or directly on the local network hub for IP cameras. A human computer interface and a storage space are also plugged on this system. The main advantage of such architecture is the flexibility. The robust-ness of the overall system is provided by the logical architecture. It manages the various problems that can arise such as a network packet loss and network transmis-sion interruption.

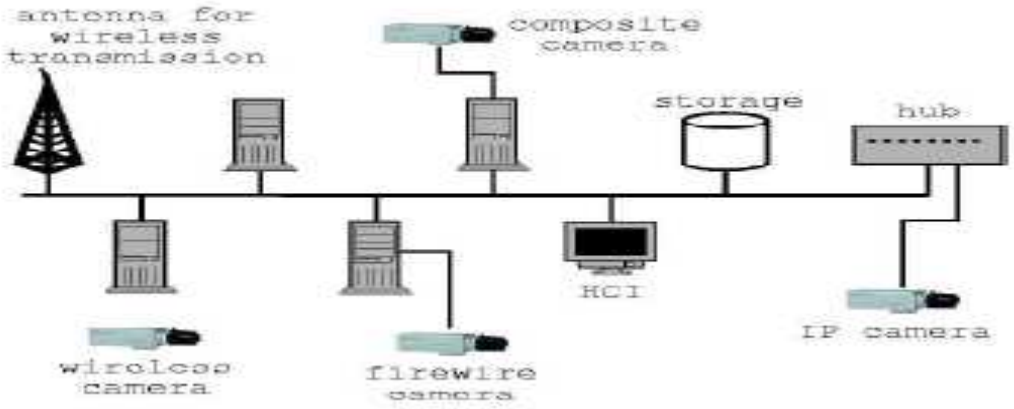


Figure 2.10 Architecture of the Georis *et al*. (2003)

In Luca *et al*., (2003), a co-operative multi-sensor system for face detection in video surveillance applica-tions is presented. This work presents an innovative architecture for multi-sensor video surveillance cameras. The use of static and other active sensors both co-operating to capture human faces and track it in a scene in real-time is presented. The motivation is to develop a system with enhanced capabilities on the monitored environment and on activities which take place in that environment. The system aims to locate, detect and track human faces in complex outdoor scenes and capture facial video shots. To achieve this aim, the system involves the use of video camera for image acquisition. Features provided by the lower levels enable it to estimate 3-D position dimensions of the detected objects tracked in the scene. The system has the following layers of information processing:

- **Sensor Layer**: Calibration of sensors, positioning of cameras, collection of video data.
- **Image processing Layer:** This is used for video processing and manipulation.
- **Data fusion layer:** Interaction strate-gies, Multi-camera calibration, and networking is achieved in this level.
- The face tracker follows the face through the scene. The system performs well but the model used for skin detection needs improvement.

In Ko *et al*. (2004) Secure Internet examination system based on video monitoring is presented. It is recognized that the use of the Internet for web-based teaching and learning is fast becoming a reality, however, since it is difficult to verify the identity of the student through a simple user ID and password on the client side, the performance evaluation of students through test and examination through Internet is still a problem. To overcome this hurdle, a system using face biometric is adopted. The authors assert that as web-based learning takes root, the use of the Internet for formal test and examination becomes an interesting challenge. Since such test and examination can be carried out anywhere, anytime, the problem of security is the main concern that needs to be overcome. For example, the student taking the test may have correct ID and password, but may

be aided in the Web-test since they are far from the examiners. To solve this problem this problem, a camera installed on the client computer captures the student's face and posture at random intervals during the test. These captured images are stored in the server for the examiner to verify the identity of the student when there is doubt on his or her identity or the circumstances under which the test is taken. The problem with this system is that it cannot provide real time alert to the examiners during the test. It can only be used for later after examination investigation.

In Hampapur *et al*. (2005), Smart Video Surveillance: Exploring the concept of multi-scale spatio-temporal tracking is presented. This project attempts to develop a surveillance system that spans multiple scales of space and time. It is recognized that in the existing surveillance systems, the component technologies are evolving in isolation. To provide comprehensive non intrusive situation awareness, it is imperative to address the challenges of multi-scale, spatio-temporal tracking. The work addresses these problems by the use of active cameras, multiple object models, and long-term pattern analysis to provide comprehensive situation awareness. According to the authors, the objectives of developing the system are to solve some of the challenges of surveillance systems such as:

- **The Multi-scale challenge:** This involves acquisition of information at multiple scales. A security analyst who is monitoring a place needs to observe who the people are; what they are doing and expression on people's faces.
- **The contextual event detection chal-lenges:** While detecting and tracking objects is a critical capability for smart surveillance, the most critical chal-lenge in video-based surveillance is interpreting the automatic analysis data to detect events of interests and identify trends.
- **The Large System development challenge:** The challenge here deals with how to build large-scale deployable systems. The identified challenges of deployment include minimizing the cost of wiring, meeting the need for automatic calibration of cameras and automatic fault detection, and developing system management tools.

To solve these challenges a multi-scale solution is proposed. The system has a static camera which is used to capture a global view of the scene. Another camera, the pan-tilt-zoom (PTZ) camera is meant to obtain detailed or fine-scale information about objects of interest in the scene. The video from one static camera is used to detect and track multiple objects in either two or three dimensions. Additionally, the fixed camera images can be used to extract additional information about the objects at a coarse level; like object class (person, car, truck) or object attributes (position of a person's head, velocity of the car etc). The coarse-scale information is used as a basis to "focus the attention of the PTZ cameras". The information from the PTZ cameras is then used to perform fine-scale analysis. The system performs object detect, then background subtraction and salient motion detection. A two-dimen-sional object tracking is also performed to develop object trajectories over time by using a combination of the object's appearance and movement characteristics. The system in addition is also able to perform face cataloguing, object structure analysis and movement pattern analysis. The pattern of movement and video index is generated which are stored in relational database for querying purposes. As the system monitors the scene, it generates the viewable video index which is stored in relational database against which queries may be implemented. The limitation of this system is that complex activity recognition is not supported by the system.

Bramberger *et al*. (2006) presents a Smart Camera for Traffic Surveillance. Smart cameras are obtained by incorporating advanced CMOS image sensors with high-performance processors into an embedded system. A smart camera combines video sensing, video processing and commu-nication within a single device. The work reports on the prototype implementation of a smart camera for traffic surveillance. It captures a video stream, computes traffic information and transfers the compressed video stream and the traffic information to a network node. The entire smart camera is packed into a single cabinet which is typically mounted in tunnels and high-ways. The electrical power is either supplied by a power socket or by solar panels.

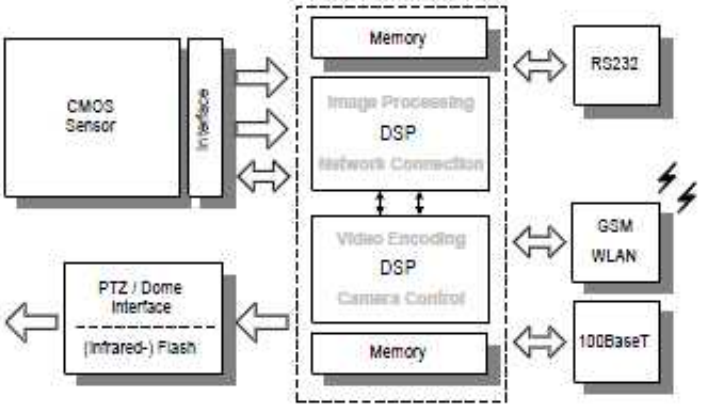


Figure 1: System architecture of the smart camera.

The video sensor represents the first stage in the smart camera's overall data flow. The sensor captures incoming light and transforms it into electrical signals that can be transferred to the processing unit. A CMOS sensor best fulfills the requirements for sensing in the smart camera Bramberger etal.(2006). These sensors feature a high dynamics due to their logarithmic characteristics and provide on-chip ADCs and amplifiers. The first prototype of the smart camera is equipped with the LM-9618 CMOS sensor from National Semiconductor.

The second stage in the overall data flow is the processing unit. Due to the high-performance on-board image and video processing the requirements on the computing performance are very high. A rough estimation of 10 GIPS computing performance. These performance requirements together with the various constraints of the embedded system solution are fulfilled with digital signal processors (DSP). The smart camera is equipped with two TMS320DM642 DSPs from Texas Instruments running at 600 MHz. Both DSPs are loosely coupled via the Multichannel Buffered Serial Ports (McBSP), and each processor is connected to its own local memory. The video sensor is connected via a FIFO memory with one DSP to relax the timing between sensor and DSP Bramberger etal. (2006). The image is then transferred into the DSP's external memory with a capacity between 8 MB and 256 MB.

The final stage of the smart camera represents the communication unit. The processing unit transfers the data to the output unit via a generic interface. This interface eases the implementation of the different network connections such as Ethernet, wireless LAN and GSM/GPRS. For the Ethernet network interface only the physical-layer has to be added because the media-access control layer is already implemented on the DSP.

A second class of interfaces is also managed by the communication unit. Flashes, pantilt-zoom heads (PTZ), and domes are controlled using the communication unit. The moving parts (PTZ, dome) are typically controlled using serial interfaces like RS232 and RS422. Additional in/outputs are also provided, e.g. to trigger flashes or snapshots.

Figure 5: Prototype architecture of the smart camera including the CMOS image sensor.

Figure 5 depicts the prototype architecture of the smart camera including the CMOS image sensor, the DSP-based processing unit and the Ethernet network connection. The system has been applied in vehicle detection and

tracking and found very effective. However, the development of smart cameras is still at its infancy.

In Fleck (2006), A Distributed Network of smart cameras for Real –Time Tracking and its visualization in 3D is presented. In this project a multi-object tracking system is developed. The live visualization of tracking result is embedded in a 3D model of the environment. The project is motivated by the desire to develop a multi tracking system that can be visualized in an embedded 3D model environment.

The system consists of multiple, networking enabled camera nodes, a server node and a 3D visualization node. Each camera node is implemented either by a smart camera or by a combination of one or multiple non-smart cameras. The server node acts as server for all the camera nodes and concurrently as client for the visualization node. It manages configu-ration and initialization of all camera nodes, collects the resulting tracking data and takes care of person handover. The visualization node acts as a server receiving position, size and texture of each object currently tracked by any camera from the server node. It embeds the ROI of each object. The system however does not support identity recognition, complex activity recognition.

In Rangaswami *et al*., (2004), The Sfinx Video Surveillance System is presented. The system is motivated by the desire to design a surveillance system that not only supports real-time monitoring and storage of the video streams, but also performs video analysis and answers semantic database queries. The objective of the system is to develop a system with several core components to process, transmit, and fuse video signals from multiple cameras. Also to mine unusual activities from the collected trajectories and to index and store video information for effective viewing.

Cameras are mounted at the edges of a sensor network to collect signals. When activities are detected, signals are compressed and transfused to a server. The server fuses muti-sensor data and constructs spatio-temporal descriptors to depict the captured activities. The server indexes and stores video signals with their meta-data on RAID storage. Users of the system are alerted to unusual events and they can perform online queries and inspect video clips of interest. The Limitation of the system is that the Architecture is designed but was not implemented.

Reulke1 *et al*. (2007) presents Traffic Surveillance using Multi-Camera Detection and Multi-Target Tracking**.** It is recognized that non-intrusive video-detection for traffic flow observation and surveillance is the primary alternative to conventional inductive loop detectors. Video Image Detection Systems (VIDS) can derive traffic parameters by means of image processing and pattern recognition methods. Existing VIDS emulate the inductive loops. The project uses a trajectory based recognition algorithm to expand the common approach and to obtain new types of information (e.g. queue length or erratic movements). Different views of the same area by more than one camera sensor is necessary, because of the typical limitations of single camera systems, resulting from the occlusion effect of other cars, trees and traffic signs. The trajectories are derived from multi-target tracking. The fusion of object data from different cameras is done using a tracking method.

The cameras are being used to monitor overlapping or adjacent obser-vation areas. With it the same road user can be observed using different cameras from different positions and angles. The objects of interest are identified from that image data by means of automatic image processing methods. These image coordi-nates are then converted into a common world coordinate system in order to enable the object tracking and data fusion. The tracking of a single object is realized using a Kalman-filter. It estimates the state of an object for the time stamp of the following picture, thus allowing to compare the estimated state and the observed object data. They can be associated to the same object, if both are within a certain distance. In order to derivate the initial object state, directly observable features like position, colour and size of objects are compared in two successive frames without any estimation process. Constraints like maxi-mum velocity or size change are defined in order to limit the number of incorrect associations. The trajectory is finalized when the object is leaving the observed area. The trajectory is also finalized after a particular number of misses. A distributed cooperative multi-camera system enables a significant enlargement of the observation area

Jang *et al*. (2007) presents a wireless network-based tracking and monitoring of construction materials on project sites. This work presents a new prototype framework of automated trac-king and monitoring system for construction materials. It is based on a ZigBee-based system architecture using combination techniques of Radio Frequency (RF) and ultrasound to improve positioning accuracy and cost benefit. It is recognized that computing and sensor network technologies provide potential for data acquisition and communication for automation and improvement in process performance. A new prototype framework of automated tracking and monitoring system that will address the needed shift from the time-and labor-intensive legacy systems into sensor- and network-based tracking and monitoring systems for construction materials is presented. The research presents the design of tracking and monitoring system architecture based on ZigBee™ networks, named as Auto-mated Material TRACKing (AMTRACK). To implement the ZigBee™-based tracking and monitoring system, the combination techniques of radio frequency signal and ultrasound to improve positioning accuracy and cost benefits was proposed. In addition, feasibility analysis and application scenario was examined to present the possible deployment frame-work in construction. Jang *et al*. (2007).

ZigBee is emerging network tech-nology and a wireless communication standard capable of realizing the ubi-quitous environment to satisfy such requirements. ZigBee specification takes advantage of the IEEE 802.15.4 wireless protocols as communications method, and expands on this with a flexible mesh network, wide range of applications, and interoperability. This work envisions the possible scenario utilizing the ZigBee protocol in construction. ZigBee routers are placed at the location that can cover the entire laydown yard within their trigger ranges to detect the events associated with the movement of distributed smart tags. In this network topology, sensing data collected to each of the routers is transmitted to the base station, i.e. field office, along with the ad hoc path. Different smart tags are categorized, identified, and attached to the construction materials according to the characteristics of material property and measurement type within the geometry of construction site. For example, humidity sensor can be attached to the bulk of a cement bag or a steel beam to sense the level of humidity in order to avoid the hardening or corrosion caused by water in the humid environment.

Kousia *et al*., (2008) presents an automated visual traffic monitoring and surveillance through a network of distributed units. It is recognized that robust and accurate detection and tracking of moving objects has always been a complex problem especially in the case of outdoor video surveillance systems. The visual tracking problem is particularly challenging due to illumination or background changes, occlusions problems etc. The aim of the TRAVIS project was to determine whether the recent changes in the field of Computer Vision can help overcome these problems and develop a robust traffic surveillance application Kousia *et al*., (2008). The research presents two prototypes:

- Traffic control of aircraft parking areas (APRON). This application focuses more on the graphical display of the ground situation at the APRON. The system calculates the position, velocity and direction of the targets and it classifies them according to their type (car, man, long vehicle etc). Alerts are displayed for dangerous situations, such as speeding. This information can be accessible by the respective employees, even if they are situated in a distant area, with no direct eye-contact to the APRON. Kousia etal., (2008)
- Traffic control of tunnels at highways. The focus of this application is on the collection of traffic statistics, such as speed and traffic loads per lane. It can also identify dangerous situations, such as objects falling, animals or traffic jams. These results can be sent to traffic surveillance centres or used to activate road signs/warning lights. Kousia *et al*., (2008).

The proposed system consists of a scalable network of autonomous tracking units (ATUs) that use cameras to capture images, detect moving objects and provide results to a central sensor data fusion server (SDF). The SDF server is responsible for tracking and visualizing moving objects in the scene as well as collecting statistics and providing alerts for dangerous situations. The system uses two modes of operation each supporting a different data fusion technique. Grid mode separates the

ground plane into cells and fuses neighboring observations while map fusion mode warps grayscale images of foreground objects in order to fuse them. Kousia *et al*. (2008).

The network architecture is based on a wired or wireless TCP/IP connection as illustrated in Figure 2.9. These topologies can be combined to produce a hybrid network of ATUs. Depending on the available network bandwidth, images captured from specific video sensors may also be coded and transmitted to the SDF server, to allow inspection by a human observer (e.g. traffic controller) Kousia *et al*. (2008).

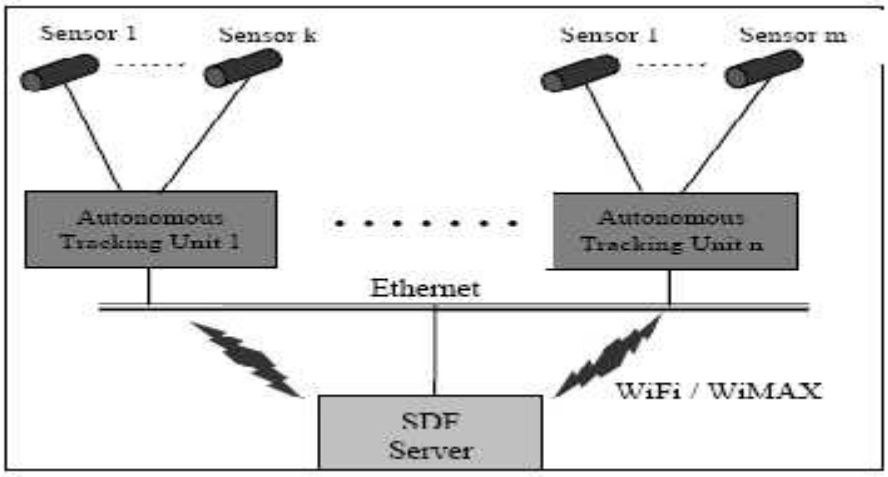


Figure 2.8: Architecture of the proposed system. source Kousia *et al*., (2008).

Each ATU is a powerful processing unit (PC or embedded PC), which periodically obtains frames from one or more video sensors. The video sensors are standard CCTV cameras. They are also static (fixed field of view) and pre-calibrated. Each ATU consists of the following modules:

- **Calibration module** (off-line unit to calibrate each video sensor). To obtain the exact position of the targets in the real world, the calibration of each camera is required, so that any point can be converted from image coordi-nates (measured in pixels from the top left corner of the image) to ground coordinates and vice versa. A calib-ration technique, which is based on a 3x3 homographic transformation and uses both points and lines correspond-dences, was used.
- **Background extraction and update module**. Each ATU of the system supports several robust background extraction algorithms. It consists of foreground segmentation module,
- Blob tracking module, Blob classifica-tion moduleand finally a 3-D observa-tion extraction module. It uses the available camera calibration informa-tion to estimate the accurate position of targets in the scene. Since the camera calibration is based on homographies, an estimate for the position of a target in the world coordinates can be directly determined from the centre of each blob. The limitation of the system however is that it does not support human identity and complex activity recognition.

Russo (2008) presents IBM Smart Surveillance Solution (SSS). According to the Author, the system was motivated by the desire to design a surveillance system that provides capability for real-time decision making and post-event correlation of people and activities. The objectives of developing the system are to create a system with real-time alerts and ability to perform user-driven queries. SSS provides the unique capability to carry out efficient data analysis of video sequences, either in real-time or recorded video.

The integral software component of SSS is IBM Smart Surveillance Analytics (SSA). All SSA functionality is Web-based, allowing virtually "anytime, any-where" access to both real-time and historical event data from the system. The SSA framework is comprised of two core components:

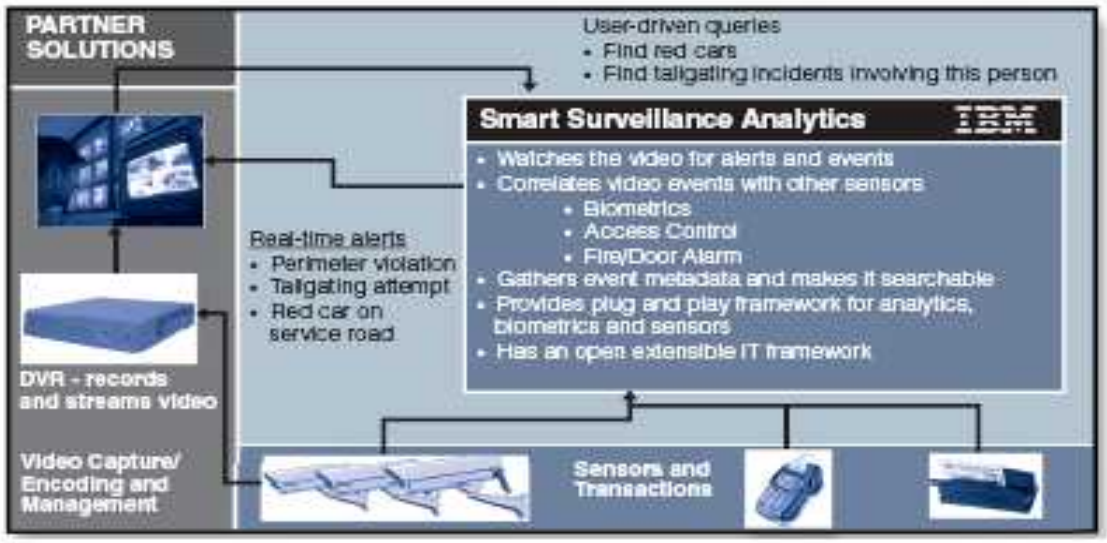
- Smart Surveillance Engine (SSE).

- Middleware for Large Scale Surveil-lance (MILS).

- **The Smart Surveillance Engine (SSE):** Video Analysis Performed by the SSE in the first item in the data flow of the architecture of the SSS, The smart Surveillance Engine (SSE) processes the sensor data (typically form a camera) to generate real time alerts and generic event meta-data. The Smart Surveillance Engine (SSE) is designed to process one stream of video in real-time, extracting object meta-data and evaluating user defined alerts. The SSE uploads messages in XML format to the central data repository while the Middleware for Large Scale Surveillance is used for data management.

  Object detection is achieved by background subtraction methodology. The detected objects are tracked throughout the field of view of the camera. After, tracking, object classi-fication is used to determine if object belong to people or vehicles. Shape and motion of the object are used to classify the object. Tracked object are also classified using their colour properties. Eight types of alerts can currently be detected in the system. Motion detection, Directional motion , Standard object, Object removal, Trip move, Region alert, Camera moved, Camera motion stopped. Compound event detection such as a person leaving a building is also included in the system.
- **Middleware for Large Scale Surveil-lance (MILS):** The MILLS provide data management services needed to build a large scale smart surveillance application and to enable extensive search capabilities. (MILS) provides the algorithm needed to take the event meta-data and map it into tables in a relational database. It also provides event search activities, meta-data man-agement, and user management and application development services. MILLS provides analytical engine with the following support functionalities via standard web services interfaces using XML documents.
  - Meta-data ingestion services; there are web services calls which allow the engine to ingest events into the MILLS system. There are two categories of ingestion services
    - Index ingestion services
    - Event ingestion services
  - Schemata Management Services: There are web services which allow a developer to manage their own meta-data schemata. A developer can create a new schema or extend the base MILLS schema to accommodate the meta data produced by the analytical engine.
  - System Management Services: These services provide a number of facilities needed to manage a surveillance system including:
    - Camera management services
    - Engine management services
    - User management services
    - Content-based search services

Figure 2.6: IBM Smart Surveillance Systems Architecture



The Limitation of the system is that complex human actions and Identity recognition are not included in the system. Lo *et al*. (2003) presents an intelligent distributed surveillance system for public transport. It is recognized that security and safety are major concerns to the stake-holders of public transport systems (i.e. passengers, staff, operating, companies, regulation, local authorities, and govern-ment). Some of these concerns are based on actual situations that threaten personal security. Lack of risk to personal security can affect the patronage of public transport system because people may prefer not to make a trip at all depending on personal factors and the way in which environment factors affect each person. Lo *et al*. (2003).

The motivation for the work is to develop a transport security system were safely and securities are safeguarded. Also to develop Automation that deals with large distributed environment. The object-ives of the system are: (a) to determine where pedestrians are in close proximity with vehicles (e.g. in platforms) or in situation that could lead to dangerous condition e.g. (overcrowding), and gener-ate alarms. (b) To detect,and prevent anomalous anti-social or criminal behaviours e.g. intrusion to forbidden areas, pick pocketing, aggression, willful damage to equipment, rowdy behavior, unattended packages. To cope with different, security and safety issues in public transport, the system incorporates different intelligent detection devices. The PRISMATICA is designed as a distributed system built upon a CORBA (common object request broker Architectures) Network, where each devices is a stand alone Sub-system. The system consists of:

- Local camera network
- Wireless data/video/audio transmission system
- Intelligent camera system
- Audio surveillance system
- Contactless passcard system
- MIPSA (modular integrated pedestrian surveillance Architecture

The limitation of the system is that no identity recognition system is incorpo-rated. However, a true multi camera and distributed surveillance system has been developed.

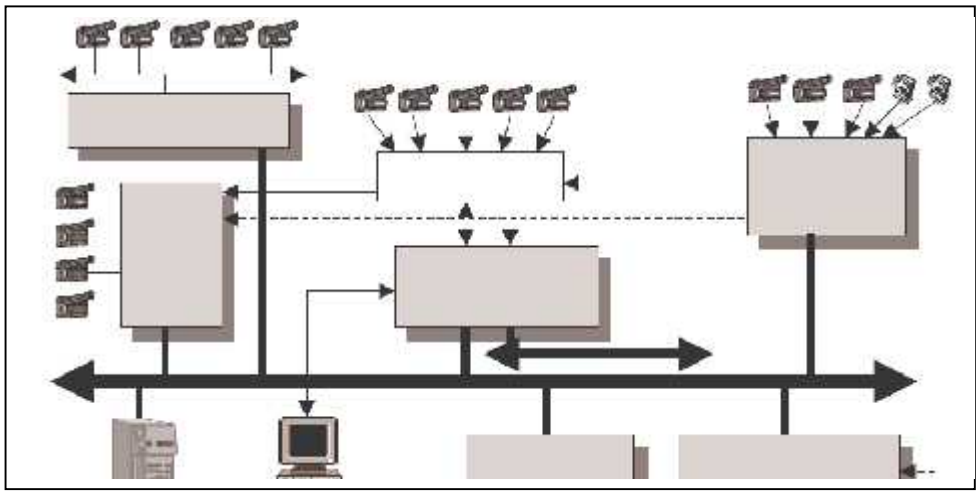


Figure 2.9 Architecture of GeNERIC surveillance system source: Benny *et al*. (2008).

Survonvorn (2008) presents a generic software platform for real-time video surveillance system to support ongoing research in motion detection, tracking and abnormal event recognition. The proposed system is a multi camera platform that is able to connect with different standard of video inputs from many manufacturers. The system supports video display, storage, searching and playing back.

The motivation for the system is to develop a visual surveillance system that can work independently with cameras devices and network infrastructure from many manufacturers. The aim and objective of the project is to design a surveillance system that support multi-cameras, and multi devices that can co-operate and work together in the same platform. It is also aimed to design systems that support alert, video Storage,

video searching playback, object recognition and tracking.

Video acquisition is done using IP-cameras. A graphic user interface for viewing different cameras from different manufacturers at a time is also presented. The system is able to perform motion detection, object tracking and recognition.

Video encoding and storage, stores image sequence when only having motions on the scene. Encoders starts encoding images after capturing a motion event and stop when new event is raised. A window media encoder (WME) is used to encode the video data. The system has the limitation that complex action recognition and identity recognition are not incorporated.

Ratty (2008) presents a high level architecture for a single point surveillance systems. It is based on distributed multi-sensor surveillance system. It comprises of an arbitrary amount of sensors that collects readings from a single location, which is the surveillance point. Each sensor transmits its data to a session sensor which handles the connections among the components. The session sensor routes the crude sensor information to the logical decision making sensor. The logical decision making sensor automatically deducts the situation at the surveillance point based on the received sensor information. The logical decision making sensor informs the security manager sensor of the situation at the surveillance point.

WU† *et al*. (2011) presents a Clustering-based motion understanding method for traffic vehicles. It is recognized by the authors that motion understanding is the classification process for time-varying data and vehicle motion understanding under road traffic scene is a systematic research work. The work presents a clustering-based motion under-standing framework for traffic vehicle. The work first preprocesses the obtained trajectory, and then uses Fuzzy C Mean clustering to cluster the preprocessed collection of trajectories and uses the Hausdorff distance measure to classify the vehicle trajectory. On the basis of the correct classification, understanding the behavior of the vehicle combined with the vehicle's context information is achieved. To verify the effectiveness of this method, this work uses violation-oriented traffic incident behaviors in the experiment. Experimental results show that this method has good feasibility and robustness.

Summary of the existing smart systems reviewed

Author and year	Domain	Multisensor	3D visualization	Multicamera	Video	Architecture and Communication	Video Analysis	QoS	Mobility	Data Fusion
Haritaoglu (1998)	Pedestrian				√		√			
Collins et al. (2001)	Genericl	√	√	√	√	√	√	√	√	√
Lo Benny et al. (2003)	Transport			√	√	√	√	√		
Luca et al. (2003)	Face Recognition	√			√	√	√			√
Georis et al. (2008)	Generic				√	√	√			
Ko et al (2004)	Examination Monitoring				√		√			
Hampapur et al. (2005)	Generic	√		√	√	√	√			
Bramberger et al. (2006)	Traffic			√	√	√	√			
Fleck (2006)			√	√	√	√	√			√
Rangaswani et al. (2004)	Generic			√	√	√	√			√
Reulke et al. (2007)	Traffic flow observation			√	√	√	√			√
Jang etal (2007)	Building				√	√	√			
Kousia et al. (2008)	Aircraft packing areas				√	√	√	√		
Suvonvorn (2008)	Generic			√	√		√			
Raty 2008)	**Generic**	√			√	√	√	√		
Wu et al. (2011)	**Traffic**				√		√			

Table 2.1: A survey of some existing surveillance systems

4.0 CONCLUSION

In this paper, efforts have been made to review the existing smart visual systems for surveillance. We have discussed the smart visual systems and computer vision techniques used in such systems. Several systems developed in smart visual systems were also reviewed. We learnt that no single generic system has been able to function in all areas of human needs. It was also observed that identity recognition and complex human activity recognition were not incorporated into many of the existing systems. It is hoped that future technologies will incorporate these aspects into their developmental efforts.

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TEXT TO SPEECH BASED APPLICATION FOR ENHANCED LEARNING IN COMPUTER ASSISTED ENVIRONMENT

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ABSTRACT

The integration of information technology to life needs has been globally accepted; education is however not an exception. The attainment of states' educational aspirations taking into cognizance the limitation of time and available resources have made information technology a viable tool to create virtual platform for teaching and learning. In light of the growing need for technology in learning, this work developed a text to speech application that can aid the learning process by augmenting the traditional class method with an application that reads out lecture note on students system anywhere. The application development was in two phases, the web and window desktop application. The web application takes care of the student profile, display of course registration and selection of course outline of choice. while the windows application reads out the selected course outline. The application is developed using .NET framework. It was finally recommended that equivalent implementation designed to work on mobile device should be developed and further analyze the critical factor that could affects the deployments of such application in tertiary institutions.

KEYWORDS: TEXT TO SPEECH, APPLICATION, LEARNING, COMPUTER ASSISTED ENVIRONMENT.

1.0 INTRODUCTION

This The introduction of computer (ICT) into learning has become a Global phenomenon; its effect on education cannot be over emphasized. As technology evolves so does our way of life evolve including the way learning is dispersed. In traditional learning environment, the ratio of teachers to students is not directly proportional and not evenly distributed; students taught on a one-on-one basis tend to perform better than when taught as a group. It is however expensive and not feasible considering local economic state of the country to have one teacher to one student scenario. Hence, the need for computer assisted learning.

It is equally important to note that, a computer is nothing more than a tool, an aid to be used or not, as the teacher thinks fit "(Farrington, 2010). The computer provides a means of enhancing the effectiveness of human natural talents and capabilities, it is useless without the human input and control but when "used properly they can be very effective indeed; enabling the individual to carry out task optimally (Kenning and Kenning, 2008). The role of computers in learning is however to compliment the traditional mode of teaching i.e. the chalk and blackboard, by providing virtual means of impacting knowledge into students effectively.

Computer assisted learning is not a new field, as it is already been exploited and its application varies from language learning to complimenting classroom efforts. Computer shouldn't be seen as an outside instrument rather as a part of the ecology of learning because it's an integral aspect of education delivery in the 21st century (Kern, 2006). The use of Computer assisted learning has moved from the input – control – feedback sequence to management of communi-cation in a learning environment which include various contexts such as text, audio, forums and video (Jane & Willis, 2008). All of us have at one point or the other used a Computer Aided Learning system (CAL) system

unconsciously, a DVD player when used to play video tutorials or listen to audio as simple as it sounds, serves the purpose of CAL. The focus of this research work is to develop a Text-To-Speech (TTS) based application to read out lecturer's uploaded lecture note on students' system without the institution incurring the expense of a speech server. The developed platform made it possible for students to have their lectures' notes in an audible form even outside the four walls of their classes; which enhanced their understanding of the course and learning at large. The application developed was deployed for testing at Yaba college of Technology, Center for Information Technology and Management (CITM) and students opinions were sampled after interacting with the new system developed.

The remaining part of this paper is organized as follow; Section 2 earns out a literature of various existing platforms. Section 3 explains the design methodo-logy. Section 4 earns out the implement-tation and testing feedback while Section 5 concludes the paper.

2.0 LITERATURE REVIEW

Text-To-Speech (TTS) technology in CAL already exists but not commonly used. The traditional CAL system outputs information on screen and user interact using keyboard and mouse to pass in inputs. TTS is just one of the many different technologies that can be implemented in CAL, some of which are web tutorials, multimedia and chat. It is believed that it's not the technology that makes CAL effective or ineffective but ways in which the technology is used. It's expedient to know the set of technology to merge, when to use them and the right learner to use the technology with, to achieve the effectiveness desired (Zhao, 2003). TTS technology is also referred to as speech synthesis and there are quite a few applications already in use, some of which are: the reading pen, the screen reader, mobile Polaris office and some mobile phone applications. The reading pen can make printed text audible by moving it line by line across the printed text, while the screen reader is a program designed to read the text on the computer screen. Some mobile phone applications such as SMemo and TMemo have the ability to convert pictures to text using optical character recognition (OCR) technology and speech synthesis converts the text to speech.

It is necessary to know that in order to achieve optimal efficiency in learning using computerized environment, there is need for the appropriate mix of technology for the right set of student. Text to speech is already in use in some CAL programs. However, the usage is limited due to high cost of implementation and resources required to have such application up and running. Benchmarking is a suggested way out of the limitation, has it's believed that once it can be proven that TTS based application can provide the necessary result consistently, the resources can be invested in it (Necto, Batista and Klautau, 2012).

TTS are often deployed for the use by people with reading problems, such as visually disabled or dyslexic people (Otaiba & Fuchs, 2006). Since educational bodies do not provide special curriculum for disabled students; they are required to have access to the same curriculum as their peers without disabilities, the incorpo-ration of TTS into learning will serve as a bridge to the gap created by their dis-ability. It is however of great importance to make text available beyond the pages of books and on chalk in other to supplement the learning process for both people with and without disability because words heard are better understood than words read.

Figure 1: Existing TTS implementations

Students with reading disability can use any of these devices shown in figure 1 to read and acquire knowledge in the process (Zhao, 2003).

3.0 DESIGN METHODOLOGY

This paper presents the develop-ment of a learning platform that imple-ments various classes of the TTS library of .NET framework to read out lectures notes made available by the lecturers. The system has two segments, the web applica-tion and windows application which were developed using asp.net and vb.net respectively. The windows application was designed to read out the lecture note selected by the student after login in the courseware portal. The

courseware portal is the web application which the student logs into to view available materials for the registered courses in the current semester. Microsoft SQL Server (Ms SQL SERVER) was used as database back end. The database housed the data uploaded by the lecturers and students registration information (which include the courses registered and student profile). The database also housed the parameters that describe the currently selected course outline to be read and earned it to the windows application (windows read out). This is achieved by storing the specific system address and system name of the requesting client's system (the system where the course outline was selected) and corresponding material requested. This is picked up by the windows read out to read aloud the materials corresponding to the resident system.

3.1 Data Collection

Students' record, departments and courses used to populate the developed application database was acquired from the Centre for information technology and management (CITM) of Yaba College of technology. While the lecture notes were sourced from the internet. All the data collated were manually fed into the database using the Microsoft SQL server management studio. It should be noted that only computer science ND 1 and HND 1 courses were uploaded into the courseware for testing.

3.2 Database Documentation

The database back end for this project used Microsoft SQL Server (MSSQLSERVER) and it has seven (7) users' tables namely; student password table (named as "Studpass"), Course outline table (named as "CosOutline"), various course table (named as CosTable), the current outlined table (named as Curoutline), Department table (named as Depts), Student profile view (named as StdproView) and the published registration table (named as PubReg). Figure 2 and Figure 3 show the database diagram for the implemented tables and various relation-ships. Figure 2 shows '*StdproView*' 1-N relationship which indicates that each matric number in '*StdproView*' table have many associated records in the '*PubReg*' table. The relationship that exist between '*StdproView*' table and the '*StudPass*' is a 1-1 relationship which indicates that each record in '*StdproView*' table has an equivalent record in '*StudPass*'. Figure 3 shows the relationship between '*CosOutline*' and '*CurOutline*'. The tables are connected using the topic outline ('*TopOutline*') field in a 1-N relationship. This indicates that the '*CurOutline*' could have several '*TopOutline*' in the '*CosOutline*' table.

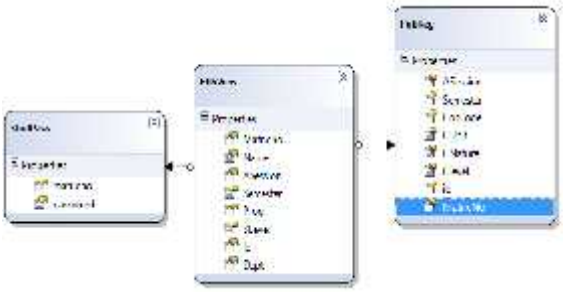

Figure 2: Database diagram of Studpass, StdproView and PubReg

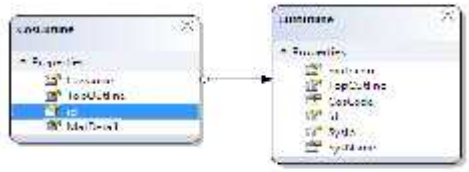

Figure 3: Database Diagram for CosOut-line and Curoutline

3.3 System Design

The entire system is represented in a flow chart shown in figure 4. The students' access to the courseware portal is dependent on successful authentication against the student password table ('*Studpass*') in the database. The authentication is done using student Matriculation number and associated password; on successful attempt, the student is redirected to the home page where 'courseware' link can be selected. Thereafter, the students' registered courses for the current semester is displayed as in the published registration table ('*PubReg*'). Selecting any of these courses would display the associated course outline from the course outline table ('*CosOutline*'). Here the student can select an outline of choice to initiate the windows application and read-out lecture note. Figure 5 shows the various processes involved to read aloud a lecture note selected by the student (The read-out part of the work was done by the windows application).

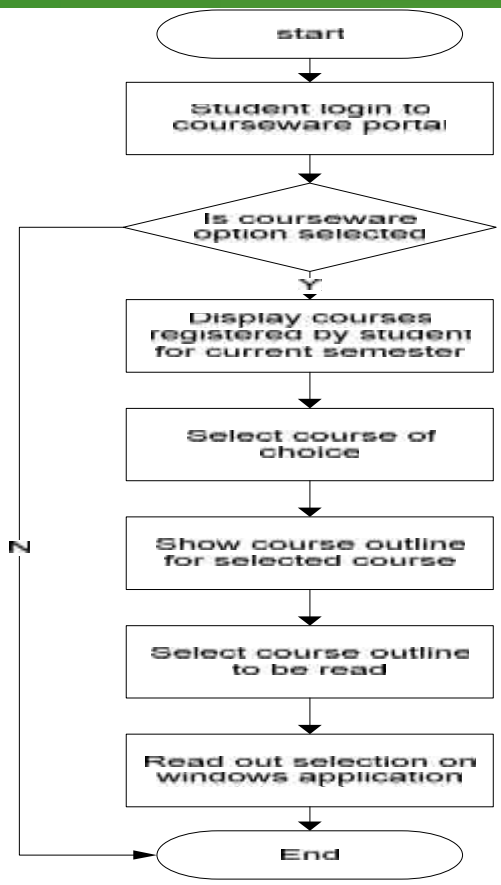

Figure 4: Application Flow Chart

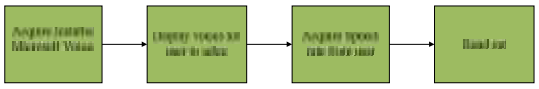

Figure 5: Block diagram for the read out part

4.0 SYSTEM IMPLEMENTATION

The application developed was written and compiled on Visual studio 2010 and deployed to be hosted on an online server running Internet Information Service version 6.0 (i.e. IIS 6.0 web server). The outputs shown in figure 6 to 9 were various outputs at different instances while testing the developed application. Figure 6 shows the homepage interface which is the students' dashboard that shows the student's full name, Matriculation number and a hyperlink to courseware; the homepage is shown after successful login.

Figure 6 : Student's dashboard

Figure 7 was the course display interface. This interface lists all the registered courses with respective course unit(s) of the student who is currently logged in. Figure 8 displayed course outline for a selected course ('COM113') and a dialogue box shown to initiate the windows application on selecting the course outline shown. Figure 9 showed the output form that finally reads the lecture note, highlighting the speakers installed on the local system, speech rate and different controls available on the form (the restart reading button, stop reading button and start reading button).

Figure 7 : Course display interface

Figure 8 : Course outline display interface.

Figure 9 : Lecture note read-out interface

4.1 System Testing and Feedback

The TTS application was tested in the computer laboratory of Yaba College of Technology under the supervision of selected Centre for Information Techno-logy and Management (C.I.T.M) staff. The students were exposed to using the developed application and in-turn rated the application based on its effectiveness.

A total of 105 students were used in the survey. The testing was done in two different days. The selection process was random and it was ensured that volunteers had basic knowledge of the functionalities and usage of a computer system. Each user was given a separate username and password and was given the liberty to choose any course material to read. Assessment was based on comprehension and their opinion of the application; if they would like it to be incorporated into their main course portal. The students' were told to rate the application on a scale 1-5 (ranging from poor to excellent). Table 1 and Table 2 showed the summary of students' responses based on their com-prehension and if they want it incorporated into the school's portal (acceptability) respectively.

Table 1: Summary Based on Comprehension

	Rating Scale for comprehension				
	1	2	3	4	5
Number of students	0	0	12	58	35
Percentage of students (%)	0	0	11.43	55.24	33.33

Table 2: Responses for Acceptability

	Options for the acceptability measure question		
	Yes	No	Indifferent
Number of students in each category	96	0	9
Percentage of students (%)	91.43	0	8.57

The feedback from the student showed that the entire students indicated that they easily comprehended any of the materials selected, as all of them rated the application 3 and above (60% comprehensive and above). This is shown in table 1.The survey also showed that more than 90% of the students were looking forward to the implementation of the new system as it will improve the process of learning. This is shown in table 2. After the survey some of the students were interviewed and these were their comments: I would love to use the TTS system because it helps eliminate boredom, it requires less stress because full consciousness is not needed to listen, and it is also easier to understand compared to the traditional method of reading. They however had challenges coping with the speech rate which was adjusted for them afterwards by selecting speech rate '-2' and '-3'. It is however fair to say that TTS system will add value to the learning community by aiding the assimilation rate of students and making learning more fun.

5.0 CONCLUSION

This research work has successfully developed and described a Text-to-Speech teaching aid which presents an audio version of loaded course material. The survey carried out after testing the application showed that the presented modality for teaching in this research work will stimulate student interest, reduce boredom and add glamour to classes as well as provide disabled with the necessary leverage to be at par with students without disability. This to a large extent demonstrate one of The potential benefits of utilizing computer based technologies for teaching and recommends that computer based teaching should be implemented simultaneously with the traditional method of teaching to maximize the process of learning in our environment.

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