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SMART CLASSROOM CONTENT DELIVERY USING UBIQUITOUS DEVICES FOR KENYAN LEARNING INSTITUTIONS

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Citation: Gogo, K. (2016). Smart Classroom Content Delivery Using Ubiquitous Devices for Kenyan Learning Institutions. In: Isutsa, D. K. and Githae, E. W. *Proceedings of the Second Chuka University International Research Conference held in Chuka University, Chuka, Kenya from 28th to 30th October, 2015. 513-522 pp.*

ABSTRACT

Due to integration of ICT in educational and the evolution of e-learning, there has been a tremendous growth of big data in education. The data have left students with no precise relevant data with regard to their professional content requirements, making students sometimes take a lot of time accessing non-relevant data to their educational/professional needs. This study introduces a platform through which big educational data can be classified, and students' professional requirements documented. The platform should be able to learn the students' profession and then avail only relevant data to the profession. The student profession details should be kept within their mobile (ubiquitous) devices that they use to access educational data. This will in turn make learning enjoyable and not time wasting in accessing irrelevant data. The platform should also make it possible for the students' devices to be located, giving a clear understanding on which classroom the student is based. In designing this system we used the standard system development life cycle, where we design intelligent database, which collects the students' profession and then searches for the relevant data at the big educational data banks kept in the learning institutions. The education data and the professions were coded for easy matching. The prototype system resulted in 70% relevance during the searches.

Keywords: *Smart Classroom, Ubiquitous Devices, Big Data, personalized learning, Mobile learning, Smart educational platforms, E-learning*

INTRODUCTION

There is increasing more and more educational data that is being generated and stored within the educational databases. This data if not taken care of in time, then there could be a tendency of this data growing to a level of big data and hence overwhelming the learners in selection of relevant data for them. It is in this regard that we develop a smart classroom content delivery to enable the ever growing education data to be stored and accessed in a way that it could be smartly provided to relevant persons, with regard to their educational needs. Williams, A., and Pence, H., (2011), point out that mobile devices are becoming very

proactive in propagating learning, and cannot be left out in e-learning, as this is the way forward for e-learning. Our contribution in this paper is to develop a model Smart e-learning environment for ubiquitous devices in Kenya, using wireless peer to peer networks and smart board approach.

Background to the problem

Hervás et al (2007), argues that of late learning is going digital in most learning institutions, calling for serious integration of ICT in learning. The integration of ICT in education has brought tremendous growth of education data, calling for ways of selecting relevant data that the learners really wants, as opposed to manually going through big data to find their relevant reading materials; thus this delivery of relevant learning materials to the different learners is what we refer to as smart e-learning environment. Hossain et al (2014), explains that on our day's today operations there is need to engage information communication technology in performing some of our educational and technological duties. In achieving some of our educational goals, there is need to automate the process of selecting the content that the learner needs to receive from the big heaps of educational data. Hence in this study we are introducing, wireless peer to peer networks and smart board approach for offering smart e-learning environment.

Problem statement

Zhiwen Y. and Xingshe Z. and Lei S. (2010), points out that there is a strong integration between ICT and e-learning. Due to integration of ICT in educational and the evolution of E-learning, there has been a tremendous growth of big data in educational. These big data in education has subjected students to manually dig through this big data in order to find relevant data with regard to their professional content requirements. Hence this study proposes a smart classroom content delivery which will avail relevant educational content to the learners' ubiquitous devices with regard to their area of profession.

Justification of the study

Due to the advancement in technology and to embrace e-learning in developments there has been a mass increase of educational data, resulting to the growth of big data education. It then becomes difficult for students to quickly access relevant data to their professional needs. This study therefore brings forward a an environment through which big educational data can be classified, and then students professional requirements documented. Hence this environment should be able to learn the students profession and then avail to them only relevant data to their professional requirements. The environment will then ease the students from the burden of manually searching for the relevant content with his profession. This then translates to the smart classroom which should be able to offer smart learning environment as suggested by Cook, D., and Das, K.,(2012).

Objectives

Broad objective

To develop a smart classroom content delivery platform for ubiquitous devices, through which learners could access and share relevant education data with regard to their profession through their ubiquitous devices.

Specific objectives

The objectives of this study are as follows:-

- i. To develop smart classroom content delivery model which will avail relevant learning materials to students with regard to their professional requirements, and network students with their professional colleagues.
- ii. Implement and test the model system

LITERATURE REVIEW AND RELATED TECHNOLOGIES

Smart boards

Uskov, V., (2015) and Wikipedia (2015), explains that Smart Board are interactive boards that uses touch detection for user input in the same way as normal PC input devices, and have features more similar to a touch screen tablet. They usually have digital inks for writing as opposed to markers.

Smart classrooms

Meyer, A., and Rose, D.H., (2005), suggests that smart classrooms are key to the strategy of offering student-centric learning; recognizing the demand, from both students and their parents, for seamless movement between learning at school, home, work and play. Smart Classrooms provides direction for harnessing the learning potential of ICT now and into the future and provides open doors to extraordinary learning. Uskov, V., L. Howlett, J and Jain, C. (2015) also views that these classrooms offer a traditional lecture style teaching space that has available technological equipment that can be used to aid and enhance instruction of a course.

Features of a smart classroom

Niemeyer, D. C, (2003) also clarifies that these classrooms have the following features:

- Enhanced lighting controls
- A gyro wireless mouse to control the computer and projector from anywhere in the classroom
- Switching controls to easily change projector output between the PC, laptop, document camera, and DVD/VCR
- Projectors
- Laptop plugs so you can bring your own computer and hook it up instantly
- A document camera to show transparencies, papers, or small objects on the projector and even take snapshots of them
- A SMART Sympodium that allows you to make electronic notes and images appear
- The Classroom Performance System (CPS) to get real-time answers from your students in class by means of wireless multiple choice response devices

Fig 1: show image of smart classrooms with a smart board in front.



Figure 1: Image of smart classroom with a smart board in front.

Wi-Fi networks

Michiardi, P. and Molva, R. (2003) suggests that Wi-Fi is a communication technology that uses the 'Direct-sequence spread spectrum radio technology' and the 'Orthogonal Frequency Division Multiplexing radio technology', Wi-Fi is the trademark used by a trade group known as Wi-Fi Alliance. The essence of the Wi-Fi technology is that, it acts as a bridge between wireless devices that operate on different technologies. Wi-Fi networks are mostly being protected using the WPA to secure it from unauthorized access. If the computer is not Wi-Fi enabled, you can use a wireless network interface card to connect to a wireless network. Wi-Fi network is shown in Figure 2.

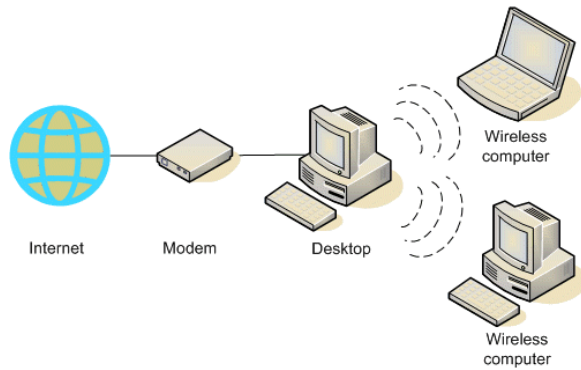


Figure 2: Wi-Fi network

Ubiquitous devices,

Aztiria et al (2010), explains that Ubiquitous Computing was a term introduced by Mark Weiser in 1991, which refers to a paradigm where a new type of relation between users and technology is established such that technology is widespread and transparent to the users. Poslad, S., (2009), suggests that is the trend towards embedding microprocessors in everyday objects so they can communicate information. The words **pervasive** and **ubiquitous** could be used exchangeable to mean "existing everywhere." The ubiquitous computing are been used in several functions in the globe, some being for content delivery. Fig 3 shows ubiquitous computing phenomenon for purchasing scenario.

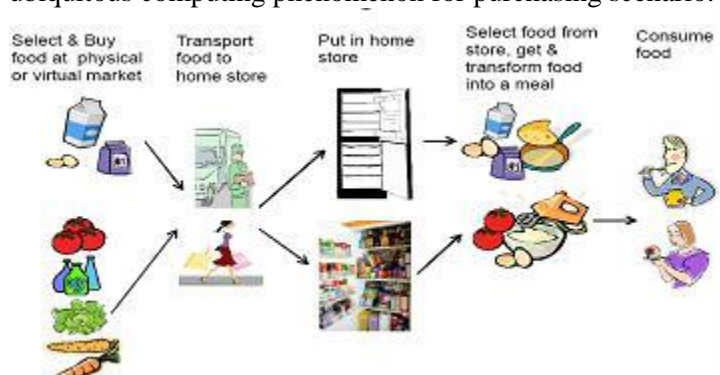


Figure 3: Ubiquitous computing phenomenon for purchasing scenario

Characteristics of ubiquitous computing

Meyer, A., and Rose, D.H., (2005), inform us that it offers a vision for computing to:

- Enable computer-based services to be made available everywhere (Ubiquitous)
- Support intuitive human usage
- But yet, appear to be invisible to the user.

Radio Frequency Identification (RFID)

Hossain, M. et al (2014), points out that Radio frequency identification is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal, or person. Angham, A., et al (2013) further emphasizes that this is the technology that the smart boards will use to identify the various ubiquitous devices within the smart classrooms, in order to offer the smart e-learning environments.

Chen, C., et al (2013), explains that RFID, are applied for the recognition, collection, and delivery of user contexts. The collected contexts from sensors, integrated mining and analysis techniques are usually used for instant decision making and personal information to users. Hence from the collected data from the user

(learner), the system could then be able to identify the learner, and hence deliver to the learner the content that the learner is in need of.

Below is a simple phenomenon on how RFID functions

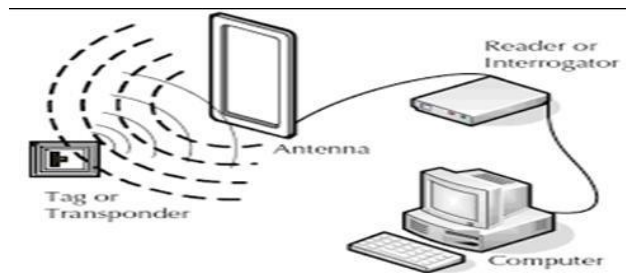


Figure 4: RFID operation gadget

RELATED TECHNOLOGIES

Identification using RFID

Hossain, M. et al (2014), argues that businesses have developed means through which items could be located if they are leaving the perimeters of the business, especially if they have not been cleared, then turn off an alarm. The RFID has then been even used in libraries, security checks and several other areas, but mainly to monitor if a device containing an RFID tag is crossing particular perimeters, then it triggers an alarm.

Identification using wireless networks

Chia-Chen C., et al (2015) and Hossain, M. et al (2014), explain that there have been several identification mechanisms that have been implemented using Wi-Fi networks. Such identifications have included issues such as monitoring the MAC addresses, IMEI of devices, among other network details.

Smart classrooms

Cook, D, and Das, S. K. (2012), and Nakashima, H., et al (2009) elaborates that there are a number of smart environments that are existing, they range from smart healthcare, smart E-learning, smart devices etc. There has been a number of smart classrooms that have been put to place, but these classrooms have been implemented using other approaches that include: intelligent websites, artificial intelligence, among other approaches

METHODOLOGY

Collect, digitize and code some educational data

Educational data which were used in testing the model were collected from various learning institutions. We collected digitized and coded educational data which we used to test if the model smart classroom content delivery could be able to deliver to the various learners their relevant educational data.

System model design

We will design a model smart e-learning system using flow charts, use cases, and data flow diagrams.

Code and implement

We coded a model system, stored the coded education data in the server, developed a Wi-Fi, and installed an RFID system. The RFID system will detect the mobile gadgets which will be fixed with RFID tags containing the student professionalism details. These details will be combined with the MAC address of the ubiquitous devices collected from the login details on the Wi-Fi network and then channeled to a particular data.

Testing: We run the model system and tested for the results, and document the results as they appeared.

SYSTEM DESIGN AND IMPLEMENTATION

Wi-Fi design

In two different geographic locations, we developed a Wi-Fi around each of the e-learning centre. The Wi-Fi was protected using a WPA security in order to restrict offer unauthorized access to the Wi-Fi. The Wi-Fi was installed in two different geographical locations to expand the smart classroom content delivery in order to demonstrate the ability of the system to access same materials but from two different locations. The Wi-Fi was expected to collect the MAC address of the ubiquitous devices that were successfully logged into the network. The smart board and the server that contained education data were permanently connected to the Wi-Fi network.

Education data digitizing and coding

Sample educational data were collected, digitized and coded such that first 2 digits represented main subject area, and the last 2 digits represented the specific subject area, as indicated below:

RFID design

Every smart classroom content delivery was connected to its RFID system, of which all the RFID systems were linked and centrally operated. The RFID was designed such that only those ubiquitous devices that were supposed to be located within a specific smart learning environment were fixed with a tag that could be detected with the RFID system. Those ubiquitous devices that were not registered to be tracked were not fitted with the tag, and thus they could not be located.

Subject	code
<i>Education</i>	<i>01</i>
Early childhood	01AA
Adult learning	01AB
Child psychology	01AC etc
<i>Computing</i>	<i>02</i>
Networking	02AA
Mobile computing	02AB
Smart environment	02AC etc
<i>Agriculture</i>	<i>03</i>
Animal husbandry	03AA
Crop diseases	03AB
Artificial insemination	03AC etc

Database server design

A database server was designed primarily to store the coded educational data. These educational data was stored in such a way that the storage locations for the respective educational data coincided with the subject code. I.e. Early childhood stored in location 01AA, Mobile computing stored in location 02AB etc. in the case of big educational data linked servers could be used for data storage.

Learner registration

All the learners were registered on the database server. The registration was in a way that the learner's unique number, surname, ubiquitous device MAC address, and the learners profession was take, i.e. 00140 Mathew 00.12.79.CE.CA.9E 01(Education). For a person who is accessing specific subject in education we instead give the specific code for that subject i.e. 01AA, while a person with more than one area i.e. education and computing you code 0102.

Components integration

Smart boards were connected to the Database server, such that the smart boards could directly connect to the database servers to fetch education data from them and forward to the ubiquitous devices. On the other hand the smart boards were able to create a Wi-Fi hotspot within the smart classroom. This hotspot is the one that ubiquitous devices are supposed to connect to in order to share with the smart board. The smart board would then collect the learner's registration details, and direct each ubiquitous device to the relevant education data location on the database server. If the project is to be rolled across a larger geographical area, several smart boards in different smart classroom content delivery across the larger geographical area, could be connected together through either satellite, leased lines, Virtual private network, etc so that they can share information and link to a centralized database. On completion the components integration will be as shown in Figure 1.

Testing

The model smart classroom content delivery system was tested and the results were as follows: -

Connecting a learner to the network:

When a learner connects to the education network it displayed the learners details as shown in Table 1

Table 1

SMART E-LEARNING ENVIRONMENT		
USER NUMBER: 00140	NAME : MATHEW	SMART BOARD NO : 0001
ACCESS LOCATION: 01 EDUCATION	MAC ADDRESS: 00.12.79.CE.CA.9E	

When a different learner connects to a different network:

When another learner connects to another education network it also displayed the learners details as shown in table 2

Table 2

SMART E-LEARNING ENVIRONMENT		
USER NUMBER: 00121	NAME : PETER	SMART BOARD NO : 0005
ACCESS LOCATION: 02 COMPUTING	MAC ADDRESS: 02.34.69.CF.CB.9C	

Accessing education data using the main subject area

When accessing education data using the main subject area as education. The system gave the learner access to the whole education files as shown in Figure 6.

SMART E-LEARNING ENVIRONMENT

USER NUMBER: **00140** NAME : **MATHEW** SMART BOARD NO : **0001**

ACCESS LOCATION: **01 EDUCATION** MAC ADDRESS: **00.12.79.CE.CA.9E**




	01AA	Date modified: 9/3/2015 11:36 AM
	01AB	Date modified: 9/3/2015 11:37 AM
	01AC	Date modified: 9/3/2015 11:37 AM

Figure 5

Accessing education data using the specific subject area

When accessing education data using the specific subject as early childhood. The system gave the learner access to the whole education files as shown in Figure 6.

SMART E-LEARNING ENVIRONMENT

USER NUMBER: **00140** NAME : **MATHEW** SMART BOARD NO : **0001**

ACCESS LOCATION: **01AA EARLY CHILDHOOD** MAC ADDRESS: **00.12.79.CE.CA.9E**





Name	Date modified	Type	Size
 01AA001.pdf	8/2/2015 2:24 PM	Adobe Acrobat D...	1,473 KB
 01AA002.pdf	8/1/2015 4:45 PM	Adobe Acrobat D...	3,289 KB
 01AA003.pdf	8/2/2015 2:24 PM	Adobe Acrobat D...	1,439 KB
 01AA004.pdf	8/2/2015 12:30 PM	Adobe Acrobat D...	1,236 KB

Figure 6

3.1 Accessing a specific document

When accessing the specific document. The system gave the learner access to the document as shown in Figure 7

SMART E-LEARNING ENVIRONMENT

USER NUMBER: **00140** NAME : **MATHEW** SMART BOARD NO : **0001**

ACCESS LOCATION: **01AA001** MAC ADDRESS: **00.12.79.CE.CA.9E**

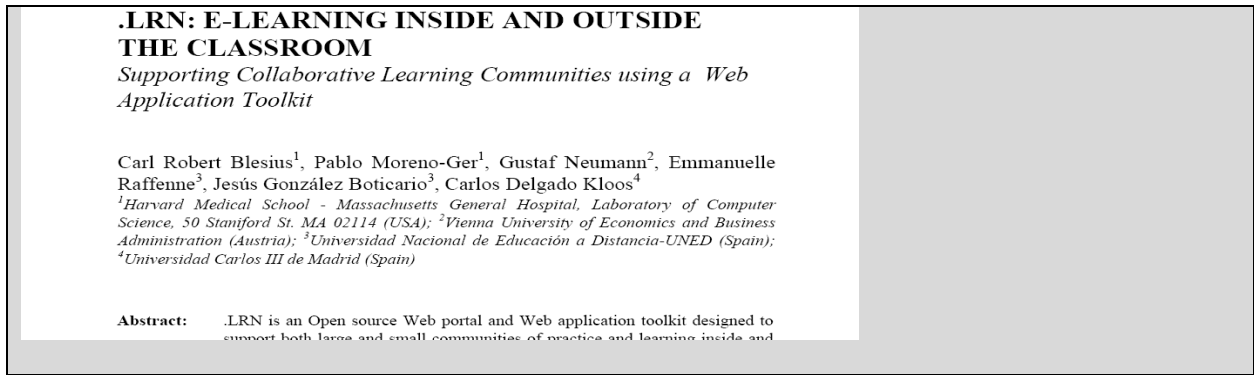


Figure 7

Identifying the location of the registered e learning ubiquitous device

Due to the network and the linking of all the smart boards which should share information. The details of all the smartboards and the users connected to them could be accessed. These locational details are enhanced more by the RFID detection system within each smart e-learning environment. The location details are provided as shown in table 3.

Table 3

SMART E-LEARNING ENVIRONMENT				
User number	Surname	Smart board no.	Mac address	Physical location
00140	Mathew	0001	00.12.79.CE.CA.9E	Nairobi CBD
00121	Peter	0005	02.34.69.CF.CB.9C	Mombasa

CONCLUSION AND RECOMMENDATIONS

We developed a model, and having not been able to access the services of a smart board, we used a table as our smart boards. The model smart classroom content delivery that we implemented and used for the testing, was able to link learners automatically to their relevant educational content. It managed to link the learners with great precision, based on their registration details that is kept with the smart e-learning central database. Though we anticipate the growth of learners and educational data, hence in preparation of the same we recommend the following: -

Link servers to offer big storage and accessibility services, use faster network facilities, develop standard code for the education data across Kenya, and get the correct and standard student registration details within the region.

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