A Sensor -Based Framework for Ubiquitous Learning in Nigeria

Boyinbode O. K. and Akintola K.G.

Department of Computer Science, Federal University of Technology
Akure, Nigeria

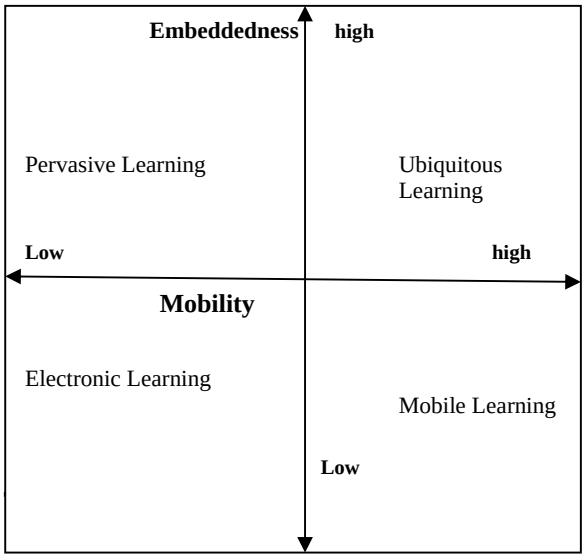
Abstract

Sensor based network is an enabling technology for Ubiquitous Learning, which in fact is one of the major features that distinguish U-learning from E-learning. The ability of a U-learning System to provide the right information at the right time or a personalized service depends on its ability to sense its environment through sensors deployed in the environment. This paper discusses the design of a Sensor-based framework for Ubiquitous Learning in Nigeria.

Keywords: Ubiquitous Learning, Sensors, Electronic Learning, Ubiquitous Computing

1.0 Introduction

Electronic learning offers methods, which decrease the limitations of traditional education but Ubiquitous Learning offers more. Ubiquitous Learning is a new Learner centered paradigm, which is seamlessly embedded into every fabric of our lives. Ubiquitous learning also called U-learning is based on ubiquitous technology. The most important and complete role of Ubiquitous computing technology in U-learning is to construct a ubiquitous learning environment, which means anyone is able to learn at anyplace at anytime. Due to rapid development of wireless technology, the learning form is gradually promoted from Electronic Learning (E-learning) to Ubiquitous Learning (U-learning). The U-learning services aims to achieve the right time and right place with right learning services. To understand Ubiquitous learning more clearly figure 1 (shows a comparison of u-learning, m-learning, e-learning and pervasive learning (p-learning) in terms of dimensions of mobility and embeddedness [2]. This figure illustrates that the "mobility" is about the level of easy- to- carry; the "embeddedness" focuses on large storages and memories that can be used. E-Learning exhibits the lowest mobility and lowest Embeddedness while U-learning exhibits the highest mobility and highest embeddedness, hence providing the most convenient service to learners among the four learning modes.



	NO OF USERS	NO OF COMPUTERS
E-LEARNING	1	1
U-LEARNING	1	N

Figure 1: Comparisons of Four Learning Modes

The relationship between users of E-learning and U-learning and computers is given in table 1 above.

2.0 What is E-learning?

Any learning that utilizes a network (LAN, WAN or Internet) for delivery, interaction, or facilitation. This would include distributed learning, distance learning (other than pure correspondence), Computer- based training (CBT) delivered over a network, and Web-based training (WBT). Can be synchronous, asynchronous, instructor-led or computer-based or a combination. E-Learning is the online delivery of information, communication, education, and training. It provides a new set of tools that can add value to all the traditional learning modes-classroom experiences, textbook study, CD-ROM, and traditional computer based training.

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2.1 Components of E-Learning

E-learning is comprised of three elements, each of which is described below.

1. Content Delivery Methods: Content consists of educational resources and learning activities. Conventional learning and educational resources are either texts or tests, or combination thereof. As is the case with e-learning content, texts may be accompanied by audio or video materials.
2. Authoring tools: Authoring tools are software products with editing functions to create content. There are three basic types of software.
    - Software to convert documents, images and charts created on word processors, spreadsheets and presentation software into e-learning content
    - Software that allows people without programming skills to create advanced content, such as simulations.
    - Software designed to synchronize audio and video materials with presentation content.
3. Learning Management Systems: Ever since the CAL era, the most important component of e-learning systems has been the Learning Management System (LMS). This system allows learners, managers and operators to check and assess individual performance and progress.

3.0 What is Ubiquitous Learning?

Ubiquitous learning is a learning style in which the learner can smoothly commence learning process anytime and anywhere. [9]
U- Learning stands on the learning platforms or an environment structured by Ubiquitous computing technology [8]. U-Learning environment is an integrated network of all kinds of physical or abstract resources, such as human beings, physical devices or place, information space and so on. In Other words, a U-learning environment is a learning environment that anyone can access anywhere, any time or any device.

U- Learning = {uenvironment, ucontents, ubehaviour, uinterface, uservice}
Here

- U environment is an environment surrounded with embedded and invisible computers and wearable devices.
- U contents include the knowledge, information pervading in or embedded in the u environment.
- U behaviour includes all forms of learners' actions occurring in the learning process, such as learners' gesture, speech and so on.
- U interface is an interactive interface between the learner and u environment.
- U service is a user support function considering pedagogical, psychological and social theories. The u service is supported by the cognitive technology and analyzing and reasoning methods. etc.

3.1 Characteristics of Ubiquitous Learning

The main characteristics of ubiquitous learning [1, 3] are shown below:

1. Permanency: Learners can never lose their work unless it is purposefully deleted. In addition, all learning processes are recorded continuously every day.
2. Accessibility: learners have access to their documents, data or videos from anywhere. The information is provided based on their requests. Therefore, learning involved is self-directed.
3. Immediacy: Wherever learners are, they can get any information immediately. Therefore learners can solve problems quickly. Otherwise, the learner may record the questions and look for answers later.
4. Interactivity: Learners can interact with experts, teachers, or peers in the form of synchronous or asynchronous communication. Hence the experts are more reachable and the knowledge is more available.
5. Situating of instructional activities: The learning could be embedded in our daily life. The problem encountered as well as the knowledge required are all presented in their natural and authentic forms. It helps learners to notice the features of problems situations that make particular actions relevant.
6. Adaptability: Learners can get the right information at the right place in the right way.

3.2 Context-Awareness (Sensing) is an Enabling Technology

In Ubiquitous Learning, interaction with computers is inevitably in context. Context-awareness becomes a fundamental enabling technology for Ubiquitous Learning and is a key issue when creating computers that are invisible and disappear in terms of the user's perception. In these terms context-awareness goes beyond providing context information, it also requires understanding context and ultimately understanding situations.

3.2.1 Acquiring Context using Sensors

Mechanisms to gain context information by the use of sensors are introduced. The reasoning behind this is that context-aware applications rely on the availability of information about the situation they are used in. The ultimate goal is to make available to the system, a representation of the world around that is close to the perception of the user. In this section it is assessed which steps are needed to provide basic perception for context-aware systems.

The following senses have been a point of inspiration when searching for sensing and perception technologies

- Vision
- Hearing
- Smell
- Taste
- Touch
- Temperature
- Gravity and acceleration
- Position and constellation of parts
- General magnetic fields and in particular the magnetic field of the earth
- Electric fields

3.2.2 Sensing Technologies and Systems for Data Capture

Sensors and sensing technologies are widely applied in robotics, automation, and process control. In the field of sensor technology major advances have taken place resulting in significant improvements with respect to physical size and weight, power consumption, processing requirements, interfacing options, reliability, robustness, and price, [4, 5]. These developments suggest that a variety of sensors are useful and deployable in Ubiquitous Computing environments to provide information about the real world. An overview of technologies is presented in Table 2. The range of sensors available is large, e.g. the nomenclature of the 'sensor 99' fair lists more than 130 categories of sensors [4].

Table 2: Technologies for Context Acquisition

Sensing Technologies
Light and Vision
Audio
Movement and Acceleration
Location and Position
Magnetic Field and Orientation
Proximity, Touch and User Interaction
Temperature, Humidity and Air Pressure
Weight
Motion Detection
Gas-Sensors and Electronic Noses
Bio-Sensors
Zero-Power Sensors

3.2.3 A Frame Work for Context-Aware Ubiquitous Learning

Based on the TEA architecture [6] we arrived at a framework for Context-Aware Ubiquitous Learning as depleted in figure 2 below. The context derived from the sensors becomes input for the ubiquitous learning applications.

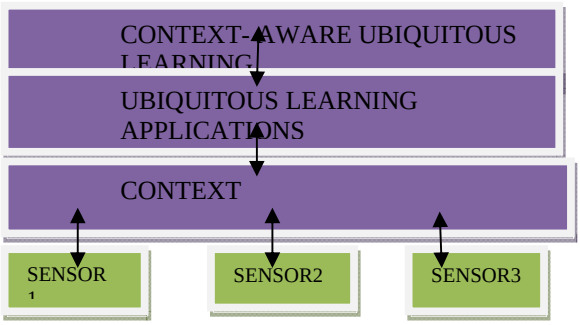

Figure 2: A Framework for Context-Aware Ubiquitous Learning

3.3 The Ubiquitous Learning Environment

A ubiquitous environment is any setting in which learners can become totally immersed in the learning process. To define [7]

Ubiquitous = Pervasive, omnipresent, ever present, everywhere

Learning = Educational, instructive, didactic, pedagogical

Environment = Surroundings, settings, situation, Atmosphere

So a ubiquitous learning environment (ULE) is a situation or setting of pervasive (or omnipresent) education (or learning). Source data can be embedded in objects and learners just have to be there to learn

3.3.1 The ULE Model

Case Study: Federal University of Technology Akure, Nigeria

Four Oldest Schools of FUTA Case Study

- SCHOOL OF SCIENCE (SOS)
- SCHOOL OF AGRICULTURE AND AGRICULTURAL TECHNOLOGY (SAAT)
- SCHOOL OF ENGINEERING (SET)
- SCHOOL OF ENVIRONMENTAL AND ENVIRONMENTAL TECHNOLOGY (SEET)

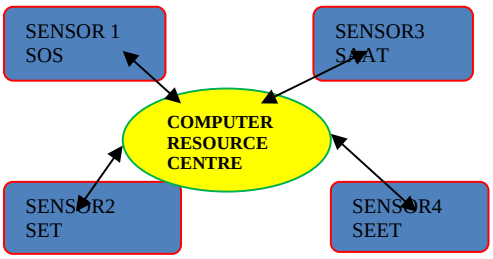

Figure3: Proposed Sensor Framework for FUTA

This ULE model [7] is designed for use in the education sector, which is implemented in the FUTA model. Components of the ULE include:

1. Microprocessors with memory will be embedded in every object/device. The information each processor will hold will be about the object. When a Learner approaches, the sensor detects his presence and will start relaying information to the learner's PDA.
2. ULE Server Module will include the server, the educational strategies unit and a database: The ULE server manages the network resources. This is located at Computer Resource Center(CRC)FUTA
3. Wireless Technology _ this will be in the form of Bluetooth and Wi-Fi.
4. Sensors (S1-S4) mounted in four oldest schools of FUTA will be used to detect any changes in the surroundings. These will be placed adjacent to the objects/devices and will be used to recognize students

3.3.1.1 Seamless interaction between Learner x and device.

Figure 4 illustrates the seamless interaction between Learner x and the system. Here the Learner approaches and observes the object. Adjacent sensors detect the Learner's presence and send data about the object to the learner's PDA (a1). This can be transferred to the Learner in the form of images, text, sound or other format (a2). At the same time, the object will access the ULE Server Module (b1) and request information about the Learner. However, being capable of both networked and independent operation, the object can function alone and transmit data. Information about the learner, such as whether the Learner has accessed the data previously and what format is most suitable for this particular learner is sent by the ULE Server Module. If the learner has responded well to verbal or visual information in the past, this information will be transmitted. The interaction is summarized as below

Object1 is approached by learner x

1. Information is sent to Learner x
2. object 1 analyses learner x' s responses
3. The information is relayed to all other objects in the u- space

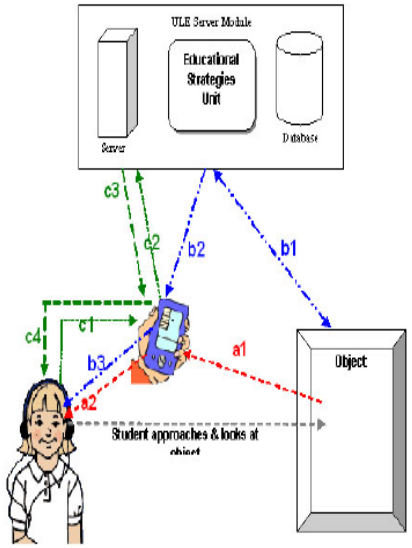

Figure 4: Learner x object interaction.

3.4 U-Learning Advantages

The above ULE model depicted several advantages of a u-learning environment:

1) The learning environment is context aware. The location of the learner and the environmental parameters of that location can be sensed by the learning system.
2) The interactions between the system and the learner are personalized. It can be seen that the system is able to provide personalized guidance for each learner during the learning process.
3) The learning process is seamless. While the learner moves from place to place, U-learning system can provide continuous guidance without being interrupted.

Based on those advantages, a comparison of U-learning system and E-learning system is given in the table 3 below:

Table 3: Comparison of U-Learning System with E-Learning System

U-Learning System	E-Learning System
The system can sense the learner's environment. It is context aware.	The system cannot sense the learner's environment. It is not context -aware
Learners can never lose their work. There is continuity	Learners can lose their work. There is no continuity.
Learners have access to their information from anywhere	Learners have access to their information in specific locations.
Learners get information immediately	Learners cannot get information immediately
Learners interact with experts and others.	Learners interaction is limited
Learners gets the right information at the right time	Learners get the available information

4.0 Conclusion

The concept of Ubiquitous Computing and U-Learning goes beyond portable computers. As new technologies evolve and more pervasive forms of technology emerge, computers will become invisible and will be embedded in all aspects of our life. They will be seamlessly integrated into our world in a phenomenon referred to as calm technology. Wearable computers and embedded microchips are not as they were first depicted in movies. Many technologies have become integrated into our lives over the years. For example: the telephone; television; PCs; internet and Mobile phones. These innovations may have appeared strange and futuristic at first but, over time they will be blended into our everyday lives. In this age of progress and great change, we tend to easily adapt to the technologies and pedagogies that emerge. Having seen the merits of U-learning over E-learning we can boldly say that Ubiquitous technology and U-learning may be the new hope for the future of education.

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Olutayo Kehinde BOYINBODE is currently a lecturer at the Department of Computer Science, the Federal University of Technology, Akure, Ondo-State, Nigeria. She received her B. Tech (Hons) from Federal University of Technology, Akure in 1995 and Master of Science from University of Lagos in 1998. Presently, She is a PhD student at the same school where she taught. Her research focus is on Ubiquitous Learning, Sensor networks, Grid computing, Mobile and wireless networking

My name is **Akintola Kolawole Gabriel**. I graduated from the Federal University of Technology, Akure where I studied Computer Science in 1995. I had my master's degree in the same Institution in 2004. Presently I am a Computer Science Lecturer in the University. I write computer programs using languages such as C, C++, JAVA, and .NET platform.