LotG: A Design of Adaptive u-learning System

Yvette E. Gelogo1, Hyejin Kim2

Abstract

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. Wearable computers and embedded microchips are not as unbelievable or mind boggling. These innovations may have appeared strange and futuristic at first but, over time they 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. Ubiquitous technology and u-learning may be the new hope for the future of education. We want that learning doesn’t only happen in four corners of classroom, house or inside the building but learning should be anytime and anywhere with the help of technologies. In this paper, we proposed a concept of LotG (Learning on the Go), a design of adaptive u-learning system.

Keywords: U-Learning Privacy, Security Requirements, U-Learning security

1. Introduction

Ubiquitous learning (u-learning) is equivalent to some form of simple mobile learning that learning environments can be accessed in various contexts and situations. But, u-learning environment may detect more context data than e-learning. U-Learning Materials is defined as learning materials that may be transferred to mobile devices via cable or wirelessly and be operated in these mobile devices.

Ubiquitous learning is the next step in performing e-learning and by some groups it is expected to lead to an educational paradigm shift, or at least, to new ways of learning. The potential of ubiquitous learning results from the enhanced possibilities of accessing learning content and computer-supported collaborative learning environments at the right time, at the right place, and in the right form. Furthermore, it enables seamless combination of virtual environments and physical spaces [1]. The location-based optimal grouping service is to group geographically nearby students to together to create ad hoc online learning groups. In this service, the
positioning accuracy is not critical [2].

One challenge of mobile distributed computing is to exploit the changing environment with a new class of applications that are aware of the context in which they are run. Such context-aware software adapts according to the location of use, the collection of nearby people, hosts, and accessible devices, as well as to changes to such things over time. A system with these capabilities can examine the computing environment and react to changes to the environment [3].

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 unbelievable or mind boggling as they were when first depicted in early science fiction novels and movies. Many technologies have become integrated into our lives over the years, for example: the telephone; television; PCs; the Internet and mobile phones. These innovations may have appeared strange and futuristic at first but, over time they 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. Ubiquitous technology and u-learning may be the new hope for the future of education.

In this paper, we proposed a concept of LotG (Learning on the Go), a design of adaptive u-learning system.

2. Background of the Study

Ubiquitous computing can be considered as the new hype in the information and communication world. It is normally associated with a large number of small electronic devices (small computers) which have computation and communication capabilities such as smart mobile phones, contactless smart cards, handheld terminals, sensor network nodes, Radio Frequency IDentification (RFIDs) etc. which are being used in our daily life. These small computers are equipped with sensors and actuators, thus allowing them to interact with the living environment. In addition to that, the availability of communication functions enables data exchange within environment and devices. In the advent of this new technology, learning styles has progressed from electronic-learning to mobile-learning and from mobile-learning to ubiquitous-learning (u-learning).

We envisage a world in which the mobile devices that everybody currently uses (cellular phones, smart phones, PDAs, and so on) constantly and frequently change their functioning mode, automatically adapting their features to the surrounding environment and to the current context of use. For instance, when the user enters a shopping mall, the mobile phone can provide him/her with applications suitable for shopping, i.e., article locator, savings advertiser, etc; when entering in a train station, the same device becomes a train timetable able
to give information on the right platform, delays, etc. Even if it is well known that current mobile devices can be used as computers, since they have computational and communication capabilities similar to computers of a decade ago, how to achieve this goal is not clear. One approach might be to have an operating system continuously monitoring sensors on the mobile device, thus adapting backlight, volume, orientation, temperature, and so on, to the changing environment. Another approach is to have a Web browser showing to the user context-aware data selected by means of information filtering techniques. In our opinion both these alternatives suffer from a lack of flexibility and a waste of computational power [5].

To summarized, we have these learning systems that are existing nowadays.

• E-Learning: In a broad sense, the computer and network enabled transfer of knowledge
• M-Learning: mobile technology based learning
• S-Learning: smart-device based learning
• U (Ubiquitous)-Learning: wherever and whenever learning possible using array of digital devices

2.1 Context-aware Adaptation

Context awareness is defined complementary to location awareness. Whereas location may serve as a determinant for resident processes, context may be applied more flexibly with mobile computing with any moving entities, especially with bearers of smart communicators. Context awareness originated as a term from ubiquitous computing or as so-called pervasive computing which sought to deal with linking changes in the environment with computer systems, which are otherwise static. Although it originated as a computer science term, it has also been applied to business theory in relation to business process management issues.

Context awareness is defined complementary to location awareness. Whereas location may serve as a determinant for resident processes, context may be applied more flexibly with mobile computing with any moving entities, especially with bearers of smart communicators. Context awareness originated as a term from ubiquitous computing or as so-called pervasive computing which sought to deal with linking changes in the environment with computer systems, which are otherwise static. Although it originated as a computer science term, it has also been applied to business theory in relation to business process management issues [4].

Context-aware computing, and describe four categories of context-aware applications: proximate selection, automatic contextual reconfiguration, contextual information and commands, and context-triggered actions. [3]

One significant aspect of this emerging mode of computing is the constantly changing execution environment. The processors available for a task, the devices accessible for user input and display, the network capacity, connectivity, and costs may all change over time and place. In short, the hardware configuration is continually changing. Similarly, the computer user may move from one location to another, joining and leaving groups of people, and frequently interacting with computers while in changing social situations [3].
To address the context-aware u-learning activities in more detail, a learning environment with several illustrative examples, Figure 2 shows the context-aware u-learning environment with RFID sensors and wireless networks. Each target plant has an RFID tag attached to it which records the identification data of the plant and each student is equipped with a PDA with an RFID reader which can read the data from the tag if the student is close enough. Once the u-learning system identifies the plant and animals, relevant information can be read from the database in the server via wireless communications [12]. While the learner is on his/her way walking technology such shown in the figure above is working and transmitting data to the server via mobile devices and the learner response to the questions or direction given via mobile device. The context information is the main component of the LBS ubiquitous learning and it is something that will contribute for the success of the LBS.

3. Consideration in Designing a U-learning System

To design a u-learning system, there are things to consider.

3.1 Points to consider

N-Screen Technology

- Consider mobile location, in home, office, work, school, outside.
- Saving progress point of contents without download

Though technically there are differences, N-Screen (or nScreen) Services and Multi-Device Services (or Connected Devices or Device Proliferation) are often used to express the same technology. N-Screen is described as a unified entertainment experience across several devices, meaning that one can flit between watching the same program on one's TV, tablet or smartphone, with the software adapting the programming to the various formats automatically.
One Source Multi-platform & Browser
The adaptive u-learning system should run in any Browser (Explorer, Chrome, Firefox, and Safari) and in any Device, PC, smartphone, pad, Notebook. In computing, cross-platform, or multi-platform, is an attribute conferred to computer software or computing methods and concepts that are implemented and inter-operate on multiple computer platforms. The software and methods are also said to be platform independent. Cross-platform software may be divided into two types; one requires individual building or compilation for each platform that it supports, and the other one can be directly run on any platform without special preparation.

Mobile Push: Checking Progress User
- SMS cost down
- Real time message

Hybrid Mobile App: HTML5, CSS3 and Java scripts
It is an advantage to develop a u-learning system with hybrid mobile app with HTML, CSS3 and JavaScript for low cost maintenance and rapid rebuild service.

3.2 Hardware, software and human requirements
In designing a u-learning system, it is very important to consider the hardware and software requirements.
- H/W : Server, O/S
- Network : Internet, WiFi, LTE, 3G
- S/W
- Learning Management System
- Content Making Tool(Camera, relational S/W)
- Contents : Developed, purchased, leased
- Human : The most critical requirement

4. LotG: A Design of Adaptive u-learning System

4.1. Development Process

Figure 2 shows the LotG (Learning on the Go) adaptive u-learning system development process. Just like other software application development, LotG have stages.
4.2 Proposed Design

In this study we design an adaptive ubiquitous learning environment in a way that when the learner approaches the next object, that object is ‘aware’ of what the learner already knows. Throughout this procedure the adaptive u-learning server module is only accessed as required by the objects. A learner’s interaction with objects during the session can also be tracked and stored on the server. On the learner’s next visit, the adaptive u-learning system is ‘aware’ of the learner’s accumulated knowledge and can assist learning constructively by building on this knowledge. In this way the learner’s learning experience can be enhanced and a deeper understanding may be attained.

In LotG, the learning environment like park, museums, malls, exhibition center, home have a u-learning microprocessors and sensors implanted. Though at present this technology is not yet realized, but it is not impossible to happen. Nowadays, in advance countries, libraries, parks, museum and tourist attractions have an installed information system or QR codes to automatically search the place or read the information. But this type of application is not adaptive. What we want to design is that the learning is adaptive in a way that the discovery of learning information in surroundings is automatically detected by mobile devices with the use of sensors, microprocessors and wireless technology.

The type of content suitable to be taught within the adaptive u-learning system includes knowledge based disciplines such as History, Geography and the Sciences, which require knowledge transfer, reflection and active (physical or mental) participation. This may also be referred to as museum, or gallery, style learning which
caters for the primary learning styles of visual, aural, and kinesthetic/tactile learning. Learners are encouraged to create their own knowledge from their surroundings as they move around in u-space and interact with various objects and devices.

![Adaptive U-Learning environment](image)

**4.3. LotG: Adaptive u-learning System components**

1. **Sensors**

   Almost all mobile devices are equipped with some form of wireless network technologies (GSM, GPRS, UMTS, Bluetooth, Wi-Fi, Radio Frequency, IrDA, etc.), and can therefore sense if there is a network connection around them (and the strength of the corresponding electromagnetic field). Moreover, the device might be equipped with sensors capable of sensing data about the physical world surrounding the mobile device (e.g., noise, light level, temperature, etc.); also, the device might be able to receive data. Sensors that are able to detect any changes in surroundings. Placed on adjacent to the object that will be used to recognize the presence of the learner; detect movement, light and etc. to relay context information. It is clearly identified through the above discussion that u-learning is not equal to “learning with u-computing technology”, which emphasizes not only the usage of wireless communications, but also the sensor technology. More precisely speaking, “learning with u-computing technology” is a special case of mobile learning. In the following discussion, we shall focus on such a special definition of u-learning that employs mobile devices, wireless communications and sensor technologies in learning activities, called “context-aware u-learning”, to distinguish it from the broad-sense definition of u-learning, and the concept of mobile learning.

2. **Microprocessors** A microprocessor which has a memory which contains all the information about the
object. When the learner pass through the object the sensor can detect the presence of the microprocessor and send the information to the mobile carrying by the learner.

3. **Wireless technology** - this will be in the form of Bluetooth and WiFi:

Bluetooth has weak signal strength, uses little power and covers a relatively short distance. Its low power consumption and ability to communicate with many devices is extremely beneficial when using handheld devices. WiFi, based on the IEEE 802.11 specification, has a range and speed which surpasses that of Bluetooth. It is compatible with any brand of Access Point and client hardware built to the WiFi standard.

4. **Adaptive u-learning module server** includes the database and the learning modules. This is where the information is being stored and access.

![Adaptive u-learning System Components](image)

[Fig. 4]. Adaptive U-Learning System Components

The figure above shows the adaptive u-learning system components. There are four major components, the learner’s monitoring, object monitoring, microprocessor monitoring, and u-learning module server. The learner’s monitoring detects the learner’s presence in the learning environment. It manages the learners while it is connected to the network. It also monitors the collaboration between the learners. The object monitoring monitors the object embedded in the learning environment. It is where the sensors and microprocessors are embedded. The microprocessor monitoring is capable of connecting the objects and learners’ device.

The expected outcomes of LotG are the following:

- Enhance statistical business skills by offering training to anyone, anytime, and anywhere + any
device

- Maximize just-in-time learning effects by providing basis for developing training curriculum that is best for U-learning
- Increase statistical awareness by expanding training opportunities to the general public

4.4 Case Study

Here we present scenario that LotG adaptive u-learning is applied. This is based on the concept that our mobile devices are capable of sending and receiving context aware information. Context-Triggered Actions is something that acts according to what is the current state. The simple representation of this is the IF-THEN ELSE statement that the execution is depend on the result of the previous processes. Figure 5 shows the flow chart of learning module. The choice is only Yes or No, if true execute the statement under the true statement else follow the no statement. Context-Triggered response to the decision of the learner, that is the simple representation but context-awareness require a broader scope which is the behavior of surroundings like temperature, humidity and etc. that can be detected by sensor devices.

Feedback from the learner via the mobile learning device: includes the observed or sensed data of the target items (such as environmental temperature and acid value of water, air pollution, shape and color of a tree, machine status after performing an operation), acquired photos or interactions with the learning system (e.g., the answers to the test items or the log for operating the system). Personal data retrieved from databases: includes the learner’s profile and learning portfolio, such as the predefined schedule of the learner, expected starting time of a learning activity, the longest and shortest acceptable time period of a learning activity, the learning place, the learning paths or sequences of a course, the constraints or prohibitions of a course of learning activity, etc.
LotG: A Design of Adaptive u-learning System

[Fig 5]. Flowchart of adaptive u-learning module

The above figure shows the sample flow chart in which the learner ask a series of questions until he/she can identify the plant using his/her mobile phone. The context-aware intelligent system response to the learners answer and present questions related to the learners current status. This is how context awareness very helpful in Location Based Service ubiquitous Learning. The learners learn through answering the series of questions until they can reach to the next phase of. Learners have an option either to continue or not. If he/she chose to stop then his/her level will be recorded according to what they have finished or end up to. The next time around if they want to continue then they will start to where they had stopped.

Context-triggered actions are simple IF-THEN rules used to specify how context-aware systems should adapt. Information about context-of-use in a condition clause triggers consequent commands; something like living in a rule-based expert system. A number of applications can be organized in this way. The category of context-aware software is similar to contextual information and commands, except that context triggered action commands are invoked automatically according to previously specified rules. In addition to generating the normal functions of reminders at certain dates and times, Contextual Reminders permit a fuller description of the situation for when a reminder should occur. A message pops up according to when, where, who and what is with you. The problems of building context-triggered actions include how to balance the requirement of timely execution with the need for predictable behavior, when systems transition between a numbers of states it may not be desirable to have all the intermediary actions triggered, but delaying too long will make the system seem sluggish. Two problems to be addressed are the expressiveness of the predicate language, and the accuracy and timeliness of the underlying context information. [8].

5. Conclusion

Ubiquitous learning is supported by ubiquitous computing and represents the next step in the field of e-learning. The goal is that learning environments will be accessed increasingly in various contexts and situations. From this challenge, new questions arise concerning the adaptation of learning spaces to different contexts of use, so that they continue to enable and support learning processes. We want that learning doesn’t only happen in four corners of classroom, house or inside the building but learning should be anytime and anywhere with the help of technologies. In this paper, we proposed a concept of LotG (Learning on the Go), a design of adaptive u-learning system.

References

Education”, University of Hagen, Information Systems and Databases, 58084 Hagen, Germany


