Chapter 3.3
Ubiquitous Computing Technologies in Education

Gwo-Jen Hwang
National University of Tainan, Taiwan

Ting-Ting Wu
National University of Tainan, Taiwan

Yen-Jung Chen
National University of Tainan, Taiwan

ABSTRACT

The prosperous development of wireless communication and sensor technologies has attracted the attention of researchers from both computer and education fields. Various investigations have been made for applying the new technologies to education purposes, such that more active and adaptive learning activities can be conducted in the real world. Nowadays, ubiquitous learning (u-learning) has become a popular trend of education all over the world, and hence it is worth reviewing the potential issues concerning the use of u-computing technologies in education, which could be helpful to the researchers who are interested in the investigation of mobile and ubiquitous learning.

UBIQUITOUS LEARNING: THE NEW AGE FOR EDUCATION

In recent years, digitalization around the globe has been proceeding toward wireless communication and sensor technologies, which are able to detect the contexts of our daily lives, and provide personal supports accordingly. Such technology has been called ubiquitous computing (u-computing). The innovation and advance of those new technologies have led to a new research issue in education; that is, to develop an innovative learning environment so that the students can learn in any place at any time. Moreover, with the help of context-aware (sensor) technology, the learning system is able to detect the student learning behaviors in the real world, and hence more active and adaptive learning activities can be conducted. Such a learning scenario is called context-aware ubiquitous learning (context-aware u-learning), which has

gradually become a popular trend of education.

Researchers have demonstrated how a context-aware u-learning environment can be used to help the learners in increasing their ability for solving problems in the real world. For example, a group of researchers in Japan has employed u-computing technologies to conduct students to learn Japanese under real-world situations. The systems can provide learners with appropriate expressions according to different contexts (e.g., occasions or locations) via mobile devices (e.g., PDA, Personal Digital Assistant).

Ubiquitous Computing Technologies that Facilitate Education

U-computing technologies can be used to provide personalized services in the context-aware u-learning environment. For instance, when a student enters a lab or stands in front of an instrument, the context-aware devices are able to detect the location of the student and transfer the information to the server. Based on the decision of tutoring program in the server, relevant information, such as the operating procedure for each device, the need-to-know rules for working in the lab and emergency handling procedures, will be timely displayed to the student based on the personal and environmental contexts. Some ubiquitous computing technologies that might be useful in educational applications are given as follows:

- Sensors for Detecting Personal Contexts

Researchers have proposed several significant characteristics of u-learning, which make it different from conventional e-learning, including seamless services, context-aware services, and adaptive services. In an ideal context-aware u-learning environment, the computing, communication and sensor equipment will be embedded and integrated into the articles for daily use. In addition, researchers also indicated that "time" and "location" might be the most important parameters for describing a learner's context.

There are several ways to detect the timely location of a learner. GPS (Global Positioning System) is one of the popular technologies for continuously detecting an object's position by satellites, which trace air waves shot from the IC chips embedded in the objects. The object's location is described with longitude, latitude and elevation. Other sensors, such as RFID (Radio Frequency Identification), which is an automatic identification method relying on storing and remotely retrieving data using devices called RFID tags or transponders, can also be used to detect the location of a learner by reading the messages from the tags, and then calculating the learner's position based on the intensity of the signals.

- Advanced Technologies for Detecting Personal Contexts

Learners might feel distressed or confused while encountering problems in the u-learning environment. Under such circumstances, a u-learning system could actively provide timely hints or assistance if the contexts concerning human emotions or attitudes can be sensed. Recent studies have depicted the possibilities for detecting such advanced personal contexts. Sensing devices with affective aware ability can not only capture the expressions of human faces, but also tell apart their emotional conditions. For example, the Affective Computing Group in MIT Media Lab of America have presented significant progress in this field, which can be used to create more friendly interaction between human and computer by the detection of affective computing. Other studies concerning facial expression detection also demonstrated the ability of computers in recognizing emotional conditions of people via various sensors and algorithms.

Human voice is another context for describing the learner's status, which might be affected by personal emotion, health condition, or surrounding