

INTEGRATION OF INTERNET-OF-THINGS FACILITIES AND UBIQUITOUS LEARNING FOR STILL SMARTER LEARNING ENVIRONMENT

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Abstract: Ubiquitous Learning (u-learning) has been becoming an extension of smart learning environment due to the arrival of enormous mobile based smart devices. It supports learning activities through anywhere, anytime manner. The ubiquitous learning should have characteristics such as context aware, active, adaptive and seamless. Thus, pervasive education is its main feature. The smartness level of such Learning Environment can be measured through self-adaptation, sensing, inferring, learning, anticipation and self-organization. Literature study reports that u-learning environments need to be blended with emerging technologies to offer still additional smarter services. Thus, the current u-learning research focuses on integrating current ubiquitous learning technologies with emerging advanced technologies like Internet-of-Things (IoT), Ambient Intelligence (AmI), Ontology Engineering and Cloud Computing. Its main objective is to ensure additional smartness levels in existing ubiquitous learning environments. The list of such additional levels include, self-optimization, self-protection, self-healing, self-description, self-discovery, energy efficiency, compatibility, context awareness, dimension-ability, Multi model HCI, usability and connectivity. Hence, this article proposes a framework of integrating IoT with u-learning environment and reports various required IoT technology components for the same. It also presents the different activities that could be carried out in u-learning environment with IoT facility.

Keyword(s): u-learning, IoT, Cloud Computing, Ontology Engineering, Smart Learning Environment

Introduction: The main focus of this paper will explore how Internet-of-Things (IoT) can contribute towards smarter still more sustainable learning and teaching environments. *U-learning* environment, an emerging area, makes people to access computers without any limit to time and place, and provides customized learning services for the individual situation. This paper aims to make aware of the development of truly effective human-centric ambient intelligence systems for both engineering and computing models. The outcome of this paper will make a step forward towards a common understanding of how interdisciplinary fields can contribute to the IoT and do research with it.

Ubiquitous Learning Environment: In learning environment, *Ubiquitous Computing* offers teachers

and student having access to technology (computing devices, the Internet, services) whenever and wherever they need it. The technology is always accessible and is not the focus of learning [1]. Rather, faculty and students are active partners in the learning process, and they decide not only what technology is needed but also so what to learn and how best to create new knowledge. An *ubiquitous learning* environment (See figure 1) is any setting in which students can be completely immersed in the learning process. i.e.,

Ubiquitous Learning Environment : pervasive, everpresent, everywhere
 : educational, instructive, pedagogical
 : surroundings, setting, situation, atmosphere

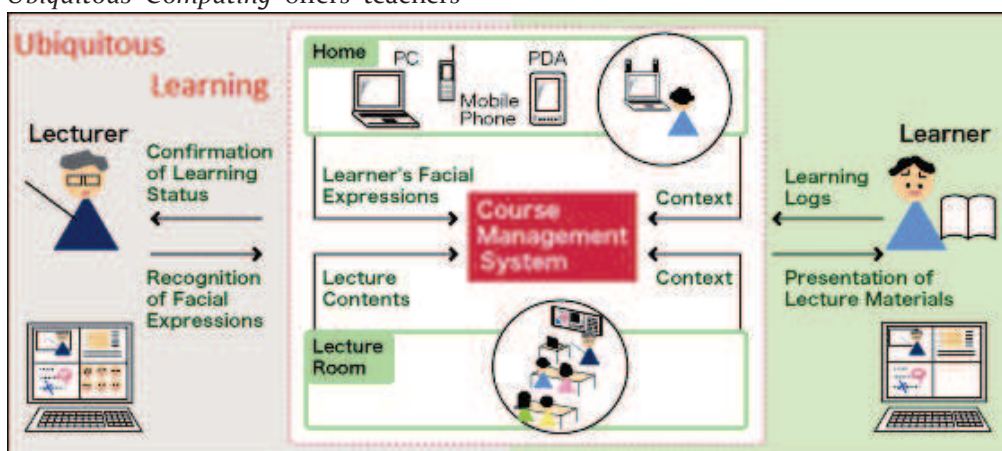


Figure 1. Ubiquitous Learning Environment

Characteristics of U-Learning : *Permanency*-The information remain unless the learners purposely remove it. *Accessibility*- Information is always available whenever the learners need to use it. *Immediacy* - The information can be retrieved immediately by the learners. *Interactivity* - The learner can interact with peers,

teachers, and experts efficiently and effectively through different media. *Context-awareness* - The environment can adapt to the learners' real situation to provide adequate information for learners. See table 1.

Criteria	u-learning
Concept	Learn the right thing at the right place and time in the right way.
Permanency	Learners can never lose their work.
Accessibility	System access via ubiquitous computing technologies.
Immediacy	Learners get information immediately.
Interactivity	Learners' interaction with peers, teachers, and experts effectively through the interfaces of u-learning systems.
Context-awareness	The system can understand the learner's environment via database and sensing the learner's location, personal and environmental situations.

Table 1.Characteristics of ULE

Ambient Intelligence (AmI): Ambient Intelligence refers to an exciting new paradigm in information technology, in which people are empowered through a digital environment that is aware of their presence and context and is sensitive, adaptive and responsive to their needs, habits, gestures and emotions. **Key Technologies of AmI:** *Ubiquitous computing* means existing or being everywhere at the same time: constantly and counteracted: widespread. *Ubiquitous Communications* should enable these objects to communicate with each other and with the user. *Intelligent User Interface* enables the people to control and interact with the environment in anatural (voice, gestures) and personalized way (preferences, context).

Ambient intelligence Characteristics: *Embedded:* many networked devices are integrated into the environment. *Context aware:* these devices can recognize users and their situational context. *Personalized:* they can be tailored to user's needs. *Adaptive:* they can change in response to user. *Anticipatory:* they can anticipate user's desires without conscious mediation.

Integration of IoT in ULE: According to ubiquitous learning, the IOT might also serve as backbone for

ubiquitous learning environment, and enable smart environments to recognize and identify objects, and retrieve information from the internet to facilitate their adaptive functionality[2]. A learner may gain the knowledge not only by connecting to the learning contents via networks by using desktop computers or wireless handheld devices such as PDAs (Personal Digital Assistant) and mobile phones, but also by communicating to the microprocessors (e.g. RFID – Radio Frequency Identification) embedded in devices[3]. The IoT based ULE is shown in figure 2. Thus a framework of social interacting for ubiquitous learning is formed.

Key factors for IoT facilities in Ubiquitous Learning Environment: *Interactivity* - The Ambient Learning excel in getting potential users involved. It provides multiple opportunities for collecting information and interactivity. *Convenience*-The Ambient Learning context technology can be conveniently used to organize and automate learning and educational processes. *Accessibility*-Both time and location limitations become irrelevant. Use greater accessibility to extend access and availability[4],[5]. IoT Devices in Ubiquitous Learning Environment is listed in the table 2.

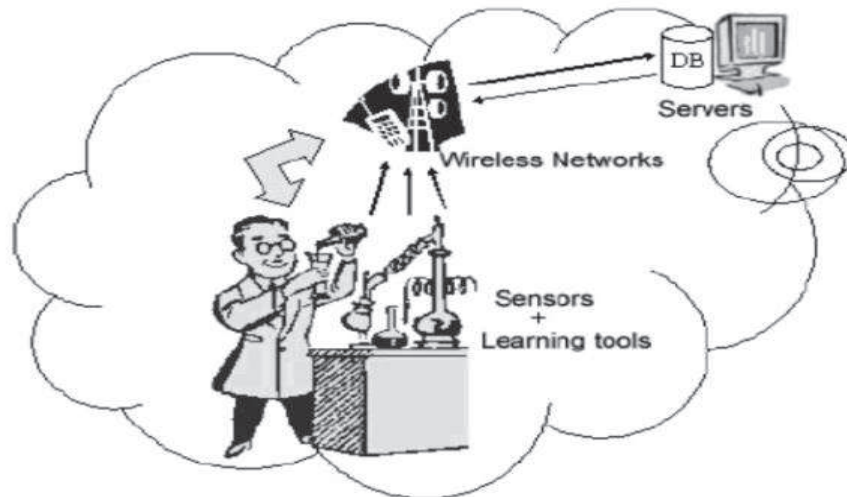


Figure 2. IoT Based ULE

Kinetic Sensor	RFID Devices	Tablets
		
Smart Watches	Pico Projector	Sensor Switches
		
Fingerprint and Password door lock	Wi-Fi headphone	Motion sensor for indoor and outdoor
		

Table 2. IoT Devices in Ubiquitous Learning Environment

Conclusion: IOT play an important role in ubiquitous learning. We presented Technical framework based-on IOT in ubiquitous learning. Other implement of key technology in ubiquitous learning base-on IOT works important role. Realization of ubiquitous learning has still a long way to go. A ubiquitous learning environment enables

seamless learning anywhere and anytime. Someday, maybe we find other useful method or technology that makes ubiquitous learning reality. Where, the learner is allowed to learn without being interrupted while moving from place to place. IOT in ubiquitous learning environment is the most challenging research directions.

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