사용자 중심 시나리오에 따른 U-스쿨 프레임워크 설계

Design of U-School Framework Based on User-Centric Scenario

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요약

유비쿼터스 컴퓨팅의 시대로 접어들면서, 컴퓨터 시스템은 언제 어디서나 우리의 일상생활에서 필요로 하는 적절한 서비스와 정보를 제공할 수 있게 되었다. 이러한 유비쿼터스 컴퓨팅은 언제 어디서나 학습을 할 수 있는 유비쿼터스 학습의 개념으로 발전시켰다.

본 논문에서는 기존의 ERSS(Korea's Educational Resources Sharing System)를 발전시켜, 유비쿼터스 컴퓨팅 기술이 적용된 U-스쿨을 위한 프레임워크를 제안한다. 제안된 프레임워크는 기존의 ERSS를 기반으로 하여 모바일 기술, 센서 단말 기술과 상황 인식 기술을 적용하였고 사용자 중심의 시나리오를 사용하여 사용자 중심의 러닝 환경을 제공한다. 특히 유비쿼터스 교육 환경에서의 상황인식 서비스는 학생, 교사, 객체 및 환경의 동적인 상황 정보를 기반으로 즉시 학습 및 개인별 맞춤 학습에 적용될 수 있다.

■ 중심어 : | 유비쿼터스 | e-러닝 | 상황인식 | U-스쿨 |

Abstract

In the age of ubiquitous computing, computer systems will be seamlessly integrated into our everyday life, providing services and information to us in an anywhere, anytime fashion. This ubiquitous computing can be used for developing a ubiquitous learning (U-learning).

In this paper, we present a framework for U-school in which ubiquitous computing technologies are applied to advance the existing ERSS (Korea's Educational Resources Sharing System). Our framework applies mobile, sensor, and context-aware technologies to the existing ERSS. This framework presents a user-centric learning environment, using user-centric scenario. The U-school with context-aware services therefore can lead to the just-in-time learning or learner-led learning based on dynamic contexts acquired from learners, teachers and computing entities.

■ keyword : | Ubiquitous | E-Learning | Context-Aware | U-School |

I. Introduction

With the help of ubiquitous computing, computer systems will be seamlessly integrated into our everyday life, providing services and information to us in an anywhere, anytime fashion[1]. Ubiquitous computing leads to ubiquitous learning (U-learning)

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allowing to embed individual learning activities in everyday life. Hence, the integration of education with ubiquitous computing is a new approach for advancing the traditional educational system such as a Korea's Educational Resources Sharing System (ERSS). Recently, the need of a mobile environment where the contents are accessed through various mobile devices has been increased in the ERSS. Especially, the moving from the internet environments to ubiquitous environments is to be a natural trend in the educational environments.

In the existing ERSS, each Teaching-Learning Assistant Center which is governed by the educational local offices holds the educational contents. This also deploys the corresponding metadata across the nation, so users access to the educational contents by searching the corresponding metadata[2]. The existing ERSS based on KEM (Korea Educational Metadata) provides and deploys educational contents generated by the offices of education as a web-based e-learning system. This means that the educational services may be location-centric or system-centric services rather than user-centric services. The existing ERSS also mainly focuses on registration of educational contents, management of quality and advancement of automatic process for contents sharing. The ERSS does not consider user's individual properties. Consequently, the analysis of the existing ERSS is progressing to advance it, so the moving toward the U-learning environment should be a new topic[3].

We believe that future ERSS has to introduce the ubiquitous computing and support user-centric learning services rather than system-centric learning services. In this paper, we present a framework for U-school in which ubiquitous computing technologies are applied to advance the existing ERSS. Our framework applies mobile, sensor and context-aware technologies to the existing ERSS. This framework can present a user-centric U-learning environment, using the existing educational contents and metadata.

The rest of this paper is organized as follows. Section 2 describes the ERSS, other educational contents sharing models and related ubiquitous technologies. Section 3 illustrates our U-school framework based on ERSS. Conclusions and future works are given in section 4.

II. Related Works

1. Educational Resources Sharing System

The ERSS called EDUNET is an online educational information system which is developed and managed by the KERIS(Korea Education and Research Information Service). By using the EDUNET, users can access to systematic educational resources anywhere and anytime instantly.

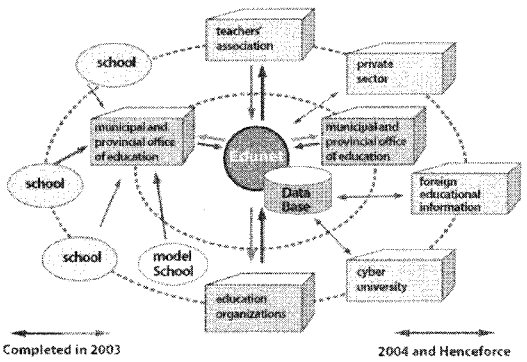

Fig. 1. A diagram of the nationwide Educational Resources Sharing System[2]

As shown in [Fig. 1], educational information is held by 16 municipal and provincial offices of education(educational & science research institutes) across the nation and EDUNET. This information includes teaching and learning materials, training

materials and education administration materials. A 'one stop' and 'any stop access' search can be possible through a comprehensive search service. A comprehensive search service can be easier by sharing a standardized metadata DB[2].

Production and distribution of the educational information will be facilitated by systemizing and standardizing educational contents as well as maximizing the share and usage of scattered educational information. And, for moving to the ubiquitous computing environments of EDUNET, KERIS has a plan ahead to design the architecture for ubiquitous environments, apply the context-aware technology for contents sharing, and introduce the ontology for Semantic Web based metadata[3].

2. Other educational information models

Each nation establishes its own educational information sharing model by applying information and communication technologies to its own educational conditions.

NICER(National Information Center for Educational Resources) in Japan is a central web site providing all kinds of information on educational resources[4]. GEM(the Gateway to Educational Materials) in USA allows users to quickly and easily search for educational resources, such as lesson plans and curriculum units[5]. EdNA(Education Network Australia) is Australia's leading online resource collection and collaborative network for the education and training community[6]. In European Union, EducaNext is a service supporting the creation and sharing of knowledge for Higher Education[7][8].

A comparison of the above educational information sharing models is shown in [Table 1]. These models are usually supporting the internet-based services. Each nation therefore is trying to advance the infrastructure and quality of services by applying the up-to-date technologies such as web services, semantic web, ubiquitous computing, etc.

Table 1. Comparison of other educational information models

Educational service	Operational range	Info. collection	user hierarchy	Quality management
GEM	local	no	no	yes
EducaNext	Global	yes	no	yes
EdNA	local	no	no	yes
NICER	local	no	yes	yes

3. Related Ubiquitous technologies

The purpose of ubiquitous computing is to provide computational services and information to us in an anytime anywhere fashion. By applying ubiquitous computing technologies to the ERSS, it can be a comprehensive U-learning system which allows all users to access to educational contents anytime and anywhere[9]. For designing our U-school framework, we consider mobile technologies based on wire/wireless network environments, diverse sensor-embedded technologies and context-aware adaptation technologies.

The current mobile technologies related U-learning are in a rudimentary stage of m-learning adopting the technologies of WLAN and PIMS. Therefore, m-learning can be a part of U-learning in a narrow sense. By using the mobile platforms and applications, m-learning is able to have the benefits of mobility, which can be summarized as being ubiquity, convenience, location and personalization [10]. In the Aura project at Carnegie Mellon University, they described an architectural framework for user mobility in ubiquitous computing[11]. A key feature of the architecture is that user tasks become first class entities. User tasks are represented as coalitions of abstract services. Environments are equipped to monitor and renegotiate task support in the presence

of run time variation of capabilities and resources.

In the U-learning environments, various embedded computational devices will be pervasive and interoperable across the network, so users may utilize these devices anytime anywhere. Smart Kindergarten aims to developmental problem-solving environments for early childhood education which is the application of sensor-based wireless networks[12]. This is a natural application as young children learning by exploring and interacting with objects such as toys in their environments. This system consists of a large number of sensors wirelessly connected to a background infrastructure that provides storage and computing services. While some of the sensors might be dumb, in general the sensors would also have associated processing capability to allow functions such as signal processing for feature extraction to be performed locally, which might be preferred to sending raw data over the wireless network.

Context is any information that can be used to characterize the situation of a person or a computing entity[13]. Context-aware technologies can provide intelligent services for users by examining the computing environment and reacting to the environment. Recent research work has focused on providing infrastructure support for context-aware systems. Ranganathan and Campbell developed a middleware for context-aware and semantic interoperability, in which they represented context ontology written in DAML+OIL[14]. In the CoBrA, they proposed an agent-oriented infrastructure for context representation, sharing knowledge and user's privacy control. Similarly, we believe that U-learning should also provide intelligent services for learner by using the context-aware technologies. The U-school with context-aware services therefore can lead to the just-in-time learning or learner-led learning based on dynamic contexts acquired from learners, teachers and computing entities.

III. A framework for supporting ubiquitous learning

Our U-school framework exploits mobile, sensor and context-aware technologies, connecting to the existing ERSS.

1. The ubiquitous technologies applied for U-school framework

1.1 Mobile technology

As the use of mobile devices is generalized, ERSS need to provide mobile services to users who are using the mobile devices. Generally, most of applications running on mobile devices involve the constraints of the mobile devices such as a slow communication, an intermittent connection, a high-cost connection, and so on. In this paper, to overcome these constraints we propose a new convergent web service technology based on proxy server. The proxy server in our framework plays role of a message level facilitator that transforms each of student's requests to SOAP message. A mobile device with mobile applications plays role of a client. Applications of mobile device are implemented by using Java and kSOAP. They also are implemented by using J2ME Wireless Toolkit(JWT) and IEEE 802.11b supporting Java wireless communication. If we use a PDA, mobile applications can be composed of the Java based client operational environment in [Fig. 2]. Mobile applications only communicate with the proxy server, so the constraints of the mobile devices can be decreased.

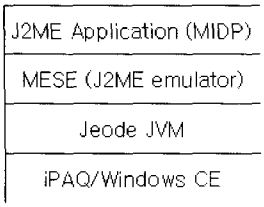

Fig. 2. Java based client environment

1.2 Sensor technology

Sensor-based technologies are to embed sensors or IC chips into diverse objects so that users are unaware of the usage of them. Our U-school framework in terms of sensor-based technologies includes acquiring a current context, delivering it to proxy server, and exchanging information, like as sensor-based networking in [12]. The objects in our framework need to be equipped the capabilities for sensing computing, and wirelessly communicating. We assume that our framework is equipped the above capabilities.

1.3 Context-aware technology

Context-aware services are computer services that can provide relevant services and information to users by exploiting context. For example, Contexts may include learners and teachers(name, role, etc.), location contexts(coordinate, temperature, etc.), computational entity contexts(device, application, etc.), and activity contexts(lesson, presentation, etc.). These contexts related U-learning may include the important situational information (e.g., where and when a learner is, what resources are nearby to a learner, and whether a learner communicates with his/her teacher or with a co-worker). Context-aware services therefore are adapted according to the dynamic changes over time, and can support a user-centric learning service. We can introduce the context-aware service similar to CoBrA. The context-aware service maintains and manages the shared contexts on the behalf of device agents and user agents. It has the following four responsibility: (1) to acquire situational information (2) to manage and share contextual knowledge (3) to reason about the context by interpreting acquired situational information (4) to coordinate user agents, device agents, contents and learning services.

2. U-school framework

The proposed U-school framework consists of the existing ERSS, Proxy Application Server, User Agents, and Device Agents [Fig. 3]. In our U-school framework, the ubiquitous computing technologies can be seamlessly integrated into the existing ERSS.

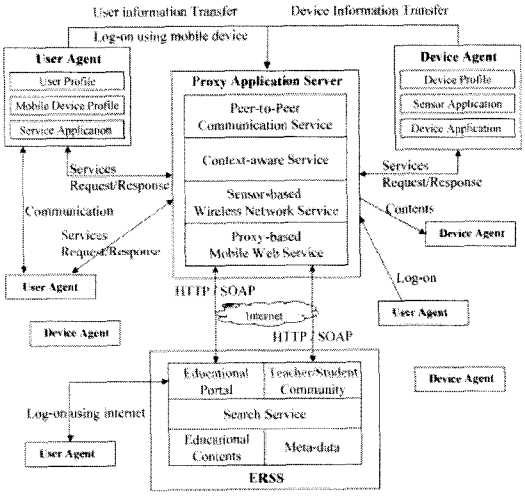

Fig. 3. The proposed U-school framework

2.1 The Proxy Application Server

As a learning server, the Proxy Application Server provides proxy-based mobile web service, peer-to-peer communication service, context-aware service and sensor-based wire and wireless network service.

The proxy-based mobile web service performs the proxy functionality on the behalf of User Agents and transfers a SOAP-based XML data. In order to

process SOAP messages, User Agents use the SOAP message processor for supporting the HTTP-based message processing. With this service, User Agents interoperate with existing ERSS, so users can utilize the search service same as the existing ERSS in a mobile environment.

The peer-to-peer communication service connects two users enable to communicate. The context-aware service provides services using the contexts according to the dynamic changes. For example, when a learner wants to communicate with an expert (e.g., a teacher), the context-aware service searches possible experts, inferring the contexts of a learner and experts (i.e., who are logging on the ERSS and suitable to theme of a learner's concern), and the peer-to-peer communication service connects a learner to an expert. Other example of the context-aware service which is related to the context of a user's mobile device is given in [Fig. 5].

The sensor-based wire and wireless network service supports the information exchange and sensor networks. The location tracking facilities in this service build into mobile phones and stationary sensors. Mobile phones and stationary sensors are hooked up to the network like environmental sensors. This service allows User Agents and Device Agents to be connected and share information each other.

2.2 User Agent

A User Agent is an application running on a learner's or a teacher's mobile device in which user ID is embedded. This also manages the owner's personal profile and mobile device profile. When a user logs on the Proxy Application Server, User Agent transfers the user's profiles together with user's ID. User Agent may be interoperated with Proxy Application Server, so that a User Agent can use the search service or the communication service.

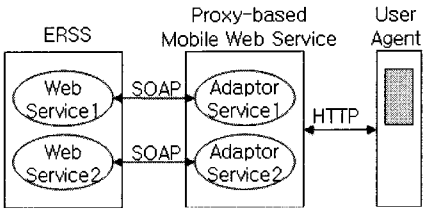

Fig. 4. Proxy-based mobile web service

As an example, figure 4 shows the processing of a web service[15]. A User Agent requests the service in the form of HTTP message. The proxy-based mobile web service in Proxy Application Server performs the proxy functionality and transforms the HTTP to SOAP message. This proxy service communicate with ERSS via Adaptor Services. Therefore a User Agent interoperates with existing ERSS in a mobile environment.

2.3 Device Agent

A Device Agent is an application running on each of objects or devices (e.g., stationary devices such as a desk, a PC, an audio/video displayer, or a speaker) in which a sensor is attached. Device Agents recognize a user's ID (a user's identity tag value) when a user's mobile device comes close to them. They also transfer the user's information to the Proxy Application Server. Device Agents in computational devices operate a device's inherent capability (e.g., play a music, display a film, etc.).

3. A Scenario in the U-school framework

In our U-school framework, a user can utilize the ERSS services with his mobile device on moving, and interact with his colleague or an expert. Let us consider a following scenario.

Scenario: A student calls to mind a quiz which is wrong at a fine-art course. He sits at the desk in classroom and logs on the learning server by using

his mobile device. He searches information related to wrong quiz, but he cannot understand resulting information. Hence, he asks for a communication with an expert who can correct the wrong quiz. After that he can communicate with a teacher. He takes a look at a moving picture which is recommended by that expert through a TV monitor in classroom.

The figure 5 shows the operations of the U-school framework according to above scenario. We divide the scenario into four parts and describe how our U-school framework operates in each part.

[Part 1] A student logs on the learning server through his mobile device.

(1) A student's User Agent transfers the personal profile, the mobile device profile, and the user ID stored in his mobile device to Proxy Application Server.

(2) Desk's Device Agent transfers this student's user ID which is acquired from the sensor embedded in the desk to the Proxy Application Server.

(3) Context-aware service in the Proxy Application Server compares the user IDs which are received from this student's User Agent, Desk's Device Agent, and other Agents. As a result, this student's location information and other Device Agents near to this student are detected.

[Part 2] He requests a search.

(4) This student's User Agent requests a search, using the SOAP message processor.

(5) The proxy-based mobile web service executes for search through the ERSS.

(6) Context-aware service infers whether this student's mobile device can be accommodated a searched result by considering contexts (e.g., mobile device's memory amount, screen size, and file format etc.), and proxy-based mobile web service transfers the result to this student.

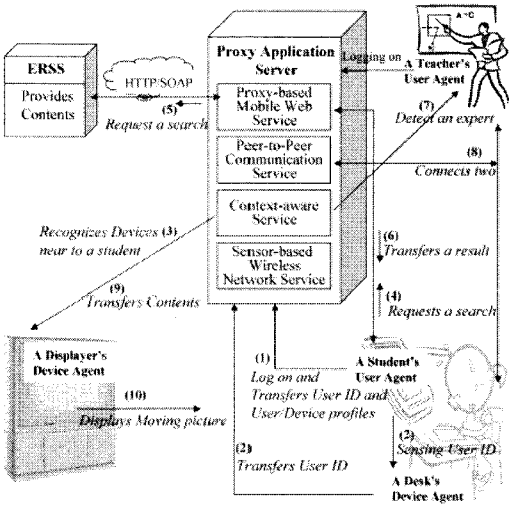

Fig. 5. The operations of U-school framework according to a scenario

[Part 3] He wants to communicate with an export.

(7) Context-aware service detects the experts who are logging on Proxy Application Server and are suitable to this student's request, and gets an acceptance from a selected expert (e.g., a teacher).

(8) Peer-to-peer communication service connects this student with an expert.

[Part 4] He takes a look at a recommended moving picture.

(9) If a recommended moving picture is a large one as compared with this student's mobile device capability, Context-aware service informs this student of that detail and transfers the moving picture to the Displayer's Device Agent which is near to him (this agent was detected in (3)).

(10) Displayer's Device Agent displays the moving picture which was received from the Proxy Application Server.

IV. Conclusion

In this paper, we introduced a U-school framework which adapts ubiquitous computing technologies to the existing ERSS. The U-school framework allows users to utilize the existing services from ERSS on moving. Also it can be used for construction of the user-centric U-learning environment. The ERSS should be considered the reorganization of educational contents and metadata suitable to a ubiquitous environment and the introduction of Semantic web for sharing the ubiquitous educational contents.

Especially in the U-School environments, diverse mobile and computing devices, i.e. heterogeneous computing objects will be used. Therefore, in order to support the inter operation among these objects and the context-aware service inferring diverse contexts, we will introduce the semantic web and ontology technologies in the U-learning ERSS.

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