Comparing Learning Experiences by Linking Physical Objects and Videos

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Abstract: The paper presents LORAMS personal learning assistant to support reuse of user's learning experiences. The system take into consideration the learning context (situation) of a user captured as movies linked with RFID tags. We think that these videos are very useful to learn various kinds of subjects. The system is evaluated in a study in the domain of cooking.

Keywords: Ubiquitous Learning, RFID tag, multimedia, richmedia, comparison

Introduction

Ubiquitous computing [1] will help organize and mediate social interactions whenever and wherever these situations might occur [6]. Its evolution has recently been accelerated by improved wireless telecommunications capabilities, open networks, continued increases in computing power, improved battery technology, and the emergence of flexible software architectures [11]. With those technologies, CSUL (Computer Supported Ubiquitous Learning) is realized, where an individual and collaborative learning in our daily life can be seamlessly included.

One of the most important ubiquitous computing technologies is RFID (radio frequency identification) tag, which is a rewritable IC memory with non-contact communication facility [4]. This cheap, tiny RFID tag will make it possible to tag almost everything, replace the barcode, helps computers to be aware of their surrounding objects by themselves, and detect the user's context [3].

We assume that almost all the products will be attached with RFID tags in the near future, where we will be able to learn at anytime at anyplace from every object by scanning its RFID tag.

The fundamental issues in CSUL are

(1) How to capture and share learning experiences that happen at anytime and anyplace.
(2) How to retrieve and reuse them for learning.

As for the first issue, video recording with handheld devices will allow us to capture learning experiences. Also consumer generated media (CGM) services such as YouTube [http://www.youtube.com/] help to share those videos. The second issue will be solved, by linking the objects in a video with RFID tags so that the system can recommend the videos in similar situations to the situation where the learner has a problem. In addition, the learning will be improved by comparing the video of the learner's experience with the video of a similar situation.

This paper proposes LORAMS (Linking of RFID and Movie System) for CSUL. There are two kinds of users in this system. One is a provider who records his/her experience into videos. The other is a user who has some problems and retrieves the videos.

As for related works, there are two kinds of educational applications using RFID tags. The first type is the applications that can identify the objects on a table and support face-to-face collaboration. For example, EDC (Envisionment and Discovery Collaboratory) [2] and Caretta [12] consist of a sensing board and objects with RFID tags such as house, school, etc. Detecting objects on the table enables the systems to show the simulation such as urban planning. Also TANGO (Tag Added learNinG Objects) system supports learning vocabularies [7][8][9][10]. The idea of this system is to stick RFID tags on real objects instead of sticky labels, annotate them (e.g., questions and answers), and share them among others. The tags bridge authentic objects and their information into the virtual world.

The second type is the applications that can detect the learner's location using RFID tags that allows the system to track the learner's positions and to send the right messages to the learner. eXspot [5] is an example of this type of application, which is designed for museum educators, it can capture the user's experiences at a museum for later reflection.

In this way, RFID is very useful for identifying objects precisely. LORAMS system utilizes the full advantage of RFID to capture, share and reuse personal experiences for ubiquitous learning.

1. LORAMS

1.1 Features

The characteristics of LORAMS are as follows:

(1) Learner's experience is recorded into a video and linked to RFID tags of physical objects. The video can be shared with other learners.
(2) Learners can find suitable videos by scanning RFID tags and/or entering keywords of physical objects around them.
(3) The learner can compare the video of a similar situation with the learner's video.
(4) All learners can freely add the annotation to videos.

There are three phases for LORAMS as follows:

(1) Video recording phase.
(2) Video search phase.
(3) Video replay phase.
    A) Normal Replay (NR)
    B) Comparing Multi Replay(CMR)

Video recording process needs PDA, RFID tag reader, video camera and wireless access to the Internet. First, the user has to start recording video at the beginning of the task. Before using the objects, the user scans RFID tags and the system automatically sends the object data to the server. This data recorded in the database with timestamp. The user scans RFID tags again when the user finishes using the object. The user repeats the previous procedure until finishing the task. After completing the task, the user uploads the video file to the server. Then, the server automatically starts encoding the video file. After encoding, the user inputs some personal information.

On the other hand, video search and replay processes need PDA, RFID tag reader, and Web browser. The learner scans RFID tags around him and/or enters some keywords, then the system sends them to the server and shows the list of the videos that match the objects and/or the keywords.

1.2 User Interface

In recording phase, the learner sets up the information for the RFID reader such as port number and code type. At the beginning of the task, the learner inputs the user name and pushes on “Send” button (1). Then, the learner pushes on “Start-Read” button at the same time that recording starts (2). When you read RFID tags, the data will be automatically stored in the server. As shown in the right side of figure 1, the RFIDs are linked to the video.

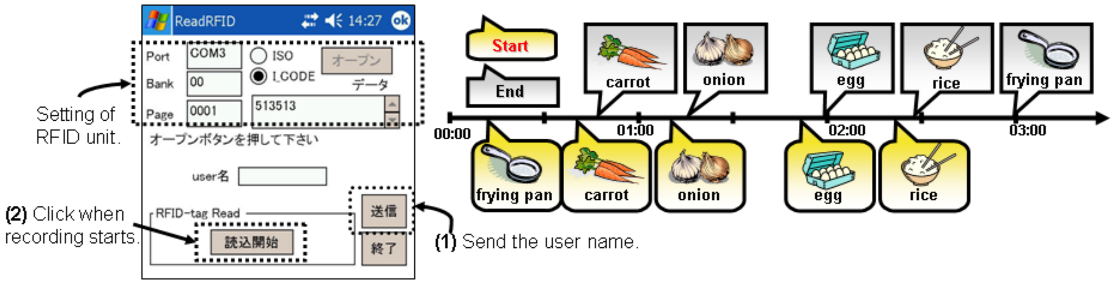

Figure 1: The interface of the recording phase (left) and video timeline (right).

In the search phase, as shown in figure 2, the user scans RFIDs and/or enters keywords in (B), then the images of the scanned objects will be automatically displayed at the top of the page as shown in (A). Also, the system will display the result in (C). It is easy to recognize the content of the video from its thumbnail. The video can be replayed using Flash

Figure 2: The interface of index page (left) and normal replay (right).

8 player. The list of the used objects in the video is displayed in (D). By drugging & dropping the icon shown in (E) on the screen, all learners can freely add the annotation to the video. LORAMS automatically retrieves similar situations to learner’s video in (F). In figure 3, two videos are replayed to make a comparison. In (G), a bar shows when and what objects the learner is using.

1.3 System configuration

Figure 3: The interface of CMR.

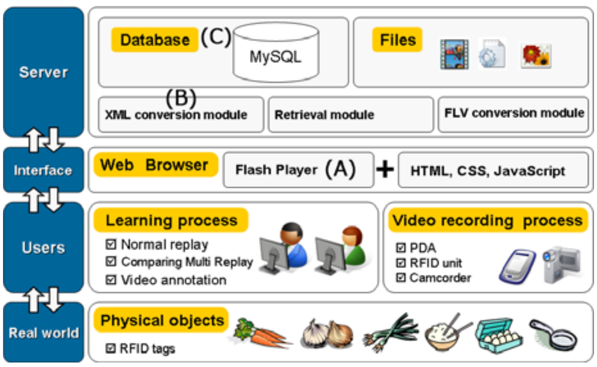

Figure 4: System configuration

We have developed LORAMS, which works on a Fujitsu Pocket Loox v70 with Windows Mobile 2003 2nd Edition, RFID tag reader/writer (OMRON V720S-HMF01), and WiFi (IEEE 802.11b) access. RFID tag reader/writer is attached on a CF (Compact Flash) card slot of PDA. The tag unit can read and write data into and from RFID tags within 5 cm distance, and it works with a wireless LAN at the same time. The LORAMS program has been implemented using Embedded Visual C++ 4.0, PHP 5.2.0, Perl 5.8.8 and Flash 8. Figure 4 shows the system configuration.

1.4 Recommend method of similar situation with the learner's video

The following algorithms are used in LORAMS to look for a video which contains a similar situation to the learner's video. There are two criteria. One is to consider the rate of the same objects, while the other is to calculate the similarity of the order of the objects, as follows:

1) The videos are listed according to the rates of the same objects in the different videos.
2) If the rates of 1) are the same, then the videos are listed according to the similarity of the order of the objects.

We use "Kendall's rank correlation coefficient" in the second algorithm. To apply this algorithm, we selected common objects of two videos. The common objects are re-numbered according to the order in which the objects were used. Then, the algorithm is applied to the set as shown in Table 1. And, the learner can visually confirm the similarity in the graph as shown in Figure 4.

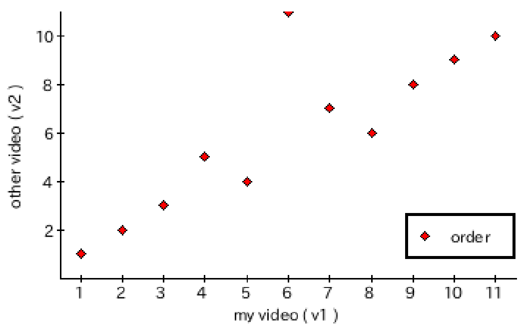

Figure 4: Graph of similarity

Table 1: Object table

Object ID	Object name	Order (v1 , v2)
E1000005	flying-pan	(1 , 1)
EC000002	cooking oil	(2 , 2)
E0000012	onion	(3 , 3)
E0000013	carrot	(4 , 5)
E1000002	ladle	(5 , 4)
…	…	…
EC000005	salt	(9 , 8)
EC000006	pepper	(10 , 9)
EC000010	soy sauce	(11 , 10)

2. Experimentation

We investigated the effect of using the video comparison. The task was cooking a fried rice. The cooking method, utensil and ingredient vary from person to person, therefore we think that cooking is a suitable task for the LORAMS.

2.1 Experimentation design

Twenty-one students from the department of computer science in the University of Tokushima were involved in the experiment.

We assume that learner is cooking at home and shoots a video by himself. Therefore, the camera is fixed and captures at hand activity. It is difficult for learners to cook fried rice while scanning RFID tags. So, in this evaluation, an operator was scanning RFID tags for the learner. In the future, if the RFID reader becomes smaller, it will be easy for the learner to read the RFID tags by himself. The left side of figure 5 shows an actual appearance.

The learner can freely cook and select various utensil and ingredients. We prepared 8 kinds of seasonings, 17 kinds of ingredients and 5 kinds of utensil. The right side of figure 5 shows a part of the ingredients.

2.2 Result

The learner watched and compared other learners' videos by using the system after cooking. And some learners cooked again later. Consequently, the learner who had made the same kind of fried rice had a tendency to become skillful. Some learners were stimulated to other learners' video, and challenged a different kind of fried rice.

Figure 5: Appearance of the experiment (left) and a part of the ingredients and tools (right)

4. Conclusion

This paper proposes a ubiquitous learning environment called LORAMS (Link of RFID and Movies System), which supports the learners with a system to share and reuse learning experience by linking movies and environmental objects.

In future work, we will enhance the user interface, improve the recommendation method, and allow the learner to add more annotation on the video. This experiment only examined whether the system was able to be applied to the cooking. So, we will be firmly evaluated on the study side in the future. Moreover, we will apply to other domains such as the personal computer assembling and car maintenance.

In addition, we will develop a desktop gadget that supports awareness in cooperation with LORAMS.

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