RECOMMENDATION OF THE VIDEO IN A UBIQUITOUS LEARNING ENVIRONMENT

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ABSTRACT

This paper proposes a personal learning assistant called LORAMS (Link of RFID and Movies System), which supports learners with a system to share and reuse learning experiences by linking movies to environmental objects. We assume that every object has RFID tags and mobile devices have a RFID reader and can record a video at anytime and anyplace. By scanning RFID tags of real objects, LORAMS can provide only video segments that include the objects. Also LORAMS recommends the similar videos to be compared. In LORAMS, the video recording and RFID tagging are used purposely to support further teaching or learning rather than “just record it and use it in some day”. We think that LORAMS can be applied to various kinds of domains that employ several kinds of real objects and vary the results depending on the combination of the objects; for example, cooking, checking upon cars such as oils, battery, and tires, surgery operations and chemical bioreactor experimentations.

KEYWORDS

Ubiquitous Learning, Life log, mobile learning, RFID tags.

1. INTRODUCTION

Ubiquitous computing (Abowd & Mynatt, 2000) will help organize and mediate social interactions wherever and whenever these situations might occur (Lyytinen & Yoo, 2002). 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 (Sakamura & Koshizuka, 2005). 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 the RFID (radio frequency identification) tag, which is a rewritable IC memory with non-contact communication facility. This cheap, tiny RFID tag makes it possible to tag almost everything, replaces the barcode, helps computers to be aware of their surrounding objects by themselves, and thereby detects some aspects of the user’s context (Borriello, 2005). The features of RFID tag are as follows:

(1) Non line-of-sight reading: unlike the bar code, RFID does not require line-of-sight reading. In addition, the distance range for RFID reader is longer than bar code scanning range.

(2) Multiple tag reading: Unlike a bar code reader, RFID unit can read multiple tags at the same time. This feature enables counting a number of objects in a second. This is one reason that one of the key applications of RFID is supply-chain management.

(3) Data rewritable: RFID has a memory chip that can be rewritten using an RFID unit, on the other hand, the data of bar code is not changeable.

(4) High durability: Tags are very sturdy from vibrations, contamination (dust and dirt), and abrasion (wear). Hence, tags can be permanently used.

(5) Ease of maintenance: There are two types of RFID tags. One is passive, which does not use any battery. The power comes from the reader unit. Therefore, passive tags can be used permanently. The other one is active, which contains batteries and has a longer range than passive ones.

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. Also we think that almost mobile devices will have a video camera and record a video (Ogata and Yano, 2004).

The fundamental issues of 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 social media services such as YouTube [http://www.youtube.com/] helps to share the user generated videos. The second issue will be solved, by identifying objects in a video with RFID so that the system can recommend the videos in similar situations to the situation where the learner has a problem.

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. In this system, a user uses his/her own PDA with RFID tag reader and digital camera, and links real objects and the corresponding objects in a movie and shares it among other learners. Scanning RFID tags around the learner enables us to bridge the real objects and their information into the virtual world. LORAMS detects the objects around the user using RFID tags, and provides the user with the right information in that context.

In the previous work, we developed LORAMS using RealPlayer and applied the systems for computer assembling (Ogata, Matsuka, El-Bishouty & Yano, 2007). From the evaluation, RFID is very useful for identifying objects precisely. However, we found that LORAMS system should support annotations for sharing knowledge and comparing videos. In this paper, LORAMS system has been improved in order to utilize the full advantage of RFID to share and compare personal experiences for ubiquitous learning.

2. LORAMS

2.1 Design

The characteristics of LORAMS are as follows:

(1) The learner's experience is recorded into a video and linked to RFID tags of real objects. The video can be shared with other learners. Therefore, it is not necessary to add keywords or annotations into a video and is easy to make an index of the video to be shared with other learners.

(2) Learners can find suitable videos by scanning RFID tags of real objects around them without entering any keyword.

(3) Based on ratings by learners and the system, the results are listed.

There are three phases for LORAMS as follows:

(4) Video recording phase

(5) Video search phase

(6) Video replay and compare phase

The video recording process requires a PDA, an RFID tag reader, a video camera, and wireless access to the Internet. First, a user has to start recording video at the beginning of the task. Before using objects, the user scans RFID tags and the system automatically sends the data and its time stamp to the server. After completing the task, the user uploads the video file to the server and the server automatically generates an SMIL (Synchronized Multimedia Integration Language) file to link the video and the RFID tags.

On the other hand, video search and reply processes need a PDA, an RFID tag reader, and a video player. The user scans RFID tags around him/her and/or enters keywords of the objects, and then the system sends them to the server and shows the list of the videos that match the objects and keywords. The system, moreover, extracts a part of the video that matches with these objects.

2.2 User Interface

In the recoding phase, the user sets up the information on the RFID reader such as port number and code type, and enters the user name. When the user uses an object, s/he pushes “start” button and scans the RFID of the object. Also, when the user finishes the work using the object, s/he pushes the “end” button and scans the RFID of the object. The RFIDs and the time stamps of the scans are sent to the server by pushing the “send” button. Using the absolute time, the RFIDs are linked to the video. Users can create their own user id and password before using LORAMS, and a video file can be uploaded through the web page.

By entering keywords and/or scanning RFID tags of physical objects in figure 1, video search starts. LORAMS starts to search videos and shows the video in order of a appropriateness. The list shows the videos that have been registered recently. By selecting a video from the list, the video playback window appears. The video title, the author’s name, and the recorded date are shown, and all the objects are listed in time order. By clicking an item in the list, the system jumps to the video segment that includes the selected item. By clicking one of the pictures, the system shows to the video segments that include the selected item. Playback (such as fast-forward) is controlled by the tool bar. Videos similar to the playing video are listed.

User can compare two different videos in the window as shown in figure 4. For example, the left is a video of an expert, and the right is a video of the user after the user watched the expert’s video. The tile of the video is shown in (A) and the video is replayed in (B). The timeline of the left video is shown in (D) and that of the right video is (E). In figure 4, the user can find that the timeline (E) took longer time than (D) and the work efficiency of the user is not good. On the timeline, a colored rectangle shows an object that the user used at the timing. If the mouse pointer is over the colored rectangle, the system shows the picture of the corresponding object in (F). Since the same object has the same color, the user can easily recognize when the object was used in the two videos.

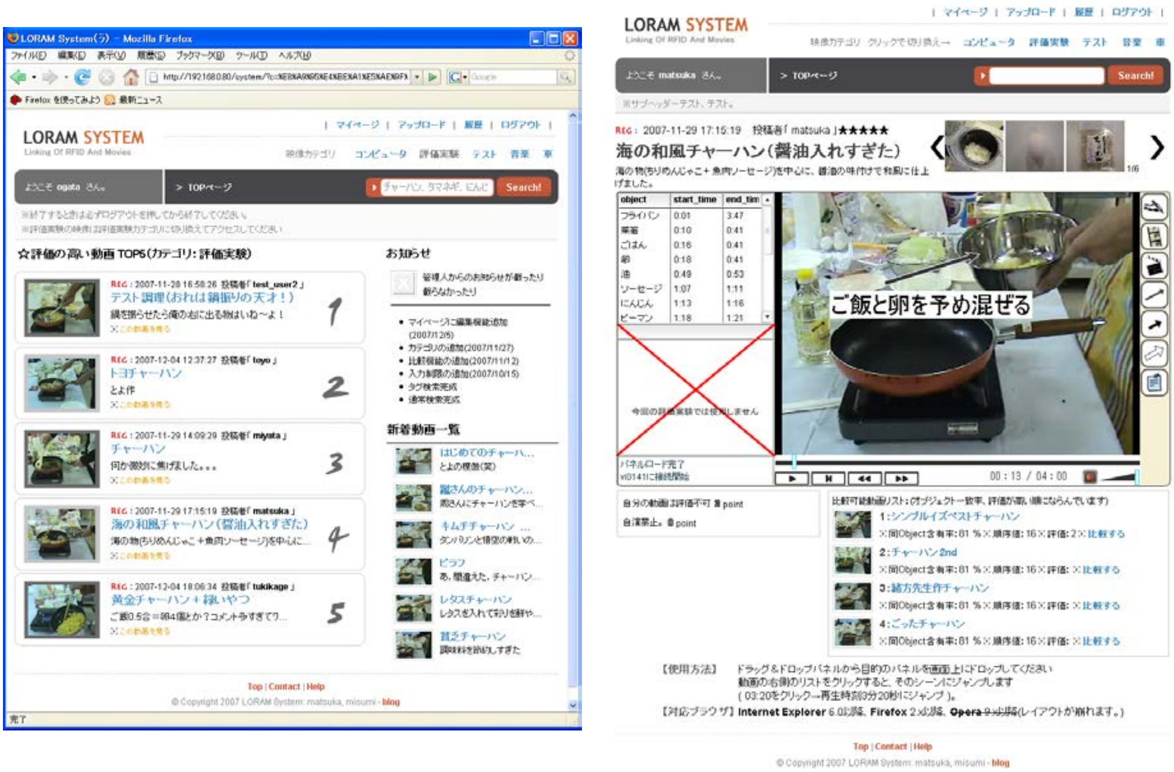

Figure 1: Video search interface (left) and video replay interface (right).

Figure 2 shows the video recommendation using LORAMS Gadget. The recommendation is based on the objects around the learner and his/her interests. If the learner clicks a video on the list, the video will be replayed in the web browser. We use TF*IDF method for the recommendation. The more the same objects included the video, the higher the score of the recommendation is.

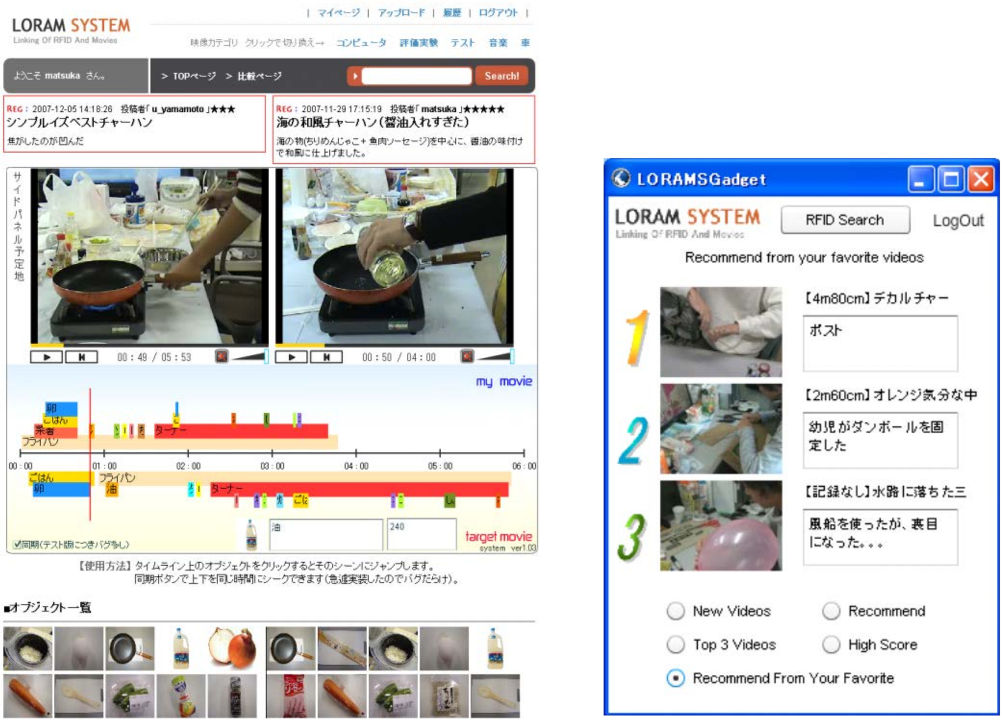

Figure 2: Video comparison interface (left) and gadgets user interface (right).

3. EXPERIMENT

This section describes the experiment on toy-making handicraft, which lasted for nine days. In this experiment, Experiment (2) functions plus the visual recommendation function under TF*IDF method and LORAMS Gadget (hereafter we call it Gadget) are implemented. We mainly examined these newly implemented functions.

The subjects are 15 students (3 seniors, 4 master course 1st years, 8 master course 2nd years). They were assigned to make two moving or flying toys out of daily materials such as disposable chopsticks, milk packages, cardboards (Figure 3). They competed the distance, how far they could make their toys run or fly. They learned the procedures through this system and Gadget. Fourteen kinds of tools and 17 kinds of materials were used for making toys.

Figure3: Environment fo the subjects (left) and the launching platform (right).

3.1. Methods and Purposes

We followed the steps as shown below:

(i) Pre-meeting of the participants

They received the briefing about the competition rules, the whole schedule, and guidance to the system.

(ii) Toy-Making (First Try) (cf. Figure 4)

Each subject made a toy only with the help from the written manual and let it run. They were supposed to make it within 10 minutes. All the procedures were video-recorded and shared by the participants. Tag was read by the examiner for the purpose of convenience.

(iii) Learning through the system and making improvements

After (ii) was done, each subject made use of the system and Gadget and learned through watching other participants' procedures. While watching, they were asked to write down the video files they thought were helpful. Meanwhile they were free to make an improvement on their own toys, video-record their improved ones and share the videos.

(iv) Toy-Making (Second Try)

After learning through watching videos, they gave it the second try to make toys. Every procedure was video-recorded and shared by the participants.

(v) Post-Questionnaires

Each subject was asked to pick out helpful video files and evaluate the systems including interface design.

In Step (iii), each subject’s number of times of access to the video files was counted and the usage rate was calculated. In Step (iv), it was examined whether or not they made any improvement on their moving/flying performance compared with their first toys. In Step (v) they picked out three helpful videos and it was examined whether helpful videos would be recommended by the recommendation system.

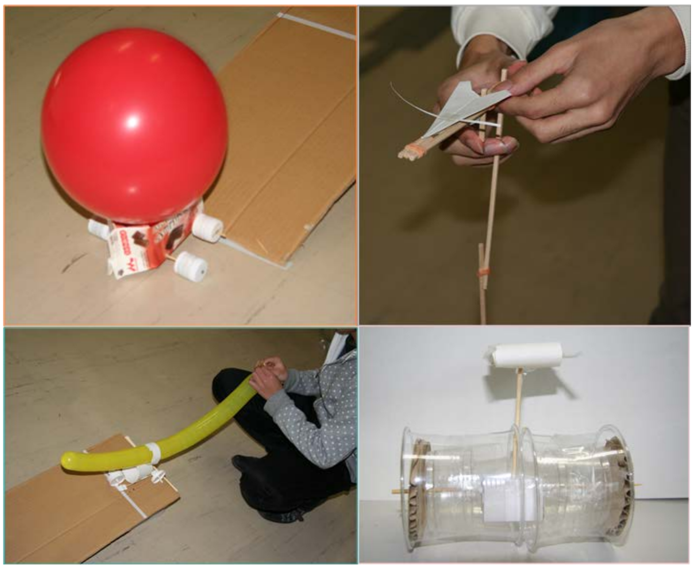

Figure 4: Toys made by the subjects.

3.2 Results and Discussions

Handicraft videos accumulated up to 37 including the ones made by the examiners. Totally 89 videos were uploaded and shared. During the experiment, the users visited and watch them 204 times in all.

Table 4.4 shows some of the handicraft toys made by the participants. The best record, 6.7m was made by the car powered by air-balloon. Table 1 shows the trial records and the results of the post-questionnaires are shown in Table 4.6.

Table 1: Records

Trial	Average Record	Best Record	Worst Record
1st trial	0.67m	4.80m	0.00m
2nd trial	2.59m	6.70m	0.05m
2nd trial - 1st trial	1.92m	1.90m	0.05m

Table 2: Post-questionnaire Results

	Questions	Avg	SD
Q1	Was the system supportive in making toys?	4.57	0.65
Q2	Did you get new knowledge through the system?	4.43	0.51
Q3	Did the system let you find your mistakes thus help improve your second trial?	4.07	1.00
Q4	Was the search result interface user-friendly?	4.12	1.19
Q5	Was the video-browsing and annotation input interfaces user-friendly?	3.15	1.34

As Table 1 shows, the net increase of the average record was 1.92m and that of the best record was 1.90m. Judging from these results and their replies to Q1, Q2, Q3 shown in Table 4.6, we can safely say that the participants made use of our system and it contributed to the progress of their record through watching and learning shared videos.

As for interface evaluation, Table 2 Q4 shows the search result interface obtained comparatively high score, while Q5 shows the video-browsing and annotation input interfaces were not user-friendly. Its inconvenience was pointed out by some who say it was hard to know how to input annotations. But since another said that annotation was convenient because the users were able to add some comments or hints. Therefore it seems to be worth keeping it as a function. Still it is necessary to reconsider and improve annotation interface.

Table 3: Results of Gadget questionnaires.

	Questions	Avg	SD
Q1	Was Gadget user-friendly?	3.93	1.27
Q2	Did Gadget help you notice newly uploaded videos?	3.86	1.17
Q3	Did Gadget disturb you?	3.14	1.03
Q4	Did you find Gadget necessary?	4.14	1.03
Q5	Did the recommendation function work well?	3.54	1.27

Their reply to Q 2 (Table 3) shows that we could provide the circumstance where the users could easily notice the newly uploaded video files. The users' comments included that Gadget pushed them to watch videos, that it was convenient to log in directly from Gadget, and that it was troublesome to make access to the web system. Its automatic log-in system, log-in by clicking the thumbnail picture received the most favorable comments from the users.

Among other comments, some say that the blinking light on the task bar drew their attention to notice new videos, while others say that it was annoying. So the same function works well to some, while not to others. It means that it might be necessary to make the system more adaptive to each user's needs.

Taking these things into account, with some problems to be solved, Gadget worked well enough as a tool to support LORAMS.

3.3 Discussions

Points at issues brought out by the experiment and their possible solutions are summarized as follows:

(1) It is hard to input annotation.

(2) Some found Gadget helpful, while others felt it annoying.

(3) Unstable recommendation function

(4) Unable to add important notes on the videos

And their possible solutions are :

(1) An improvement on this issue will be made and reexamined in the future experiment

(2) More adaptive user interface will be made.

(3) The new recommendation method (TF*IDF＋subjective observation) will be developed and examined to see if there will be any improvement.

(a) Similarities between the one shown in the video and the one that the other users produced

(b) Importance of choice and combination of materials

Above (a) tells the user that other users are facing the similar problems and it helps him to see his problems more objectively. Above (b) gives hints on which materials should be combined to produce high-performance toys

In order to realize these, we suggest the followings and will be working on them in the future.

* From video-recorded time information, we will identify important materials to be used.

*Among the videos which received high reputation, we will identify good combinations of the materials

*We will develop a new interface where the video producers themselves can set up important data items and register proper information.

It has been found out that the present recommendation system does not always work effectively. In spite that the video of the championship winner balloon powered toy-making procedures should have been more recommended to other subjects, in fact it wasn't, unless they registered it as a material for use. In order to solve this problem, we suggest that recommendation system should be based not only on TF*IDF but also on the users' evaluations or self-evaluations.

4. CONCLUSION

Ubiquitous computing will be integrated into everyday objects and activities and support not only to provide the right information at the right time at the right place but also to capture, share and reuse human's experiences.

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 videos and environmental objects. The system has the following features:

(1) Without any text annotation, the learner can find the suitable scenes that include the objects around the learner.

(2) The system recommends the learners the suitable videos for watching and comparing according to the numerical ranking methods that are proposed in this paper.

(3) The system allows the learners to share knowledge through making annotations into videos.

In future work, we will improve the user interface and ranking methods based on the students' comments. Also we believe LORAMS can be applied to many domains in which a person needs several kinds of objects and skills to do a task, and the result varies depending on the objects and the skills used in the task; for example, checking upon cars such as oils, battery, and tires, second language learning for the people who are living in a foreign country, or surgery operations and chemical bioreactor experimentations.

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