A DESIGN OF LEARNING MANAGEMENT SYSTEM USING ADAPTIVE RECOMMENDATION METHOD

Jinsuk Yang[1], Kyoungsu Oh[1], Sangjun Lee[2]

[1]Department of Media, Soongsil University, Sangdo 1-dong, Dongjak-gu, Seoul, Korea
[2]School of Computer Science and Engineering, Soongsil University, Sangdo 1-dong, Dongjak-gu, Seoul, Korea
E-mail : ispio@ssu.ac.kr, oks@ssu.ac.kr, sangjun@ssu.ac.kr

ABSTRACT

The sperad of smartphone, many system technologies grow rapidly in ergonomics fileds. Especially, various learning contens has been developed to satisfy the demand of various users. However, because most previous contents are simple and uniform, it is difficult to reflect the demand of various user. Also given feedback after learning includes serveral problems such as wrong infomation. To solve this problem, a system which interact with user and focus on adaptive learning is needed. In order to improve manageability for learning contents, we propose a learning management system using automaic and adaptive recommendation methods. To achieve this, we analyse a result of user's question-solving and difficulty level of each question. The results of analysis are reflect to new questions. We also design a quality management of questions and cheating prevention scheme to improve our system.

Key words: *Learning Management System, Smartphone Based Learning, Ergonomics*

1. INTRODUCTION

The efficiency and convenience of learning grow up rapidly in many different aspects and disciplines (Bevely, 2000). And the learning management systems have spread to goverment, public organization, educational institution and companies. However, because most previous learning management systems provide simple and uniform learning methods, it is difficult to reflect the demand of various user and provide a correct feedback after learning (Hye-Jin, 2009),(Seontae, 2005). For example, published various english vocabulary applications provide a fixed quantity questions. And user study vocabulary by repetition simply. Therefore, user's motivation to learn is discontinuous and we need more effective learning management system (Hye-Jin, 2009),(Jun-Hee, 2005).

In order to improve these problems, we propose a automated and adapting learning management system which can manage contents effectively for each user. Our proposed system analyzes situations of user and difficulty of question, and then provides learning contents which include adaptive question to each user. Also we design a quality management of questions and cheating prevention scheme to increase reliability of our system. Lastly, our set question scheme of system is base on the *Ebbinghaus Forgetting Curve theory* (Ebbinghaus, 1885) for effective repetition in learning and this system is used in smartphones which are portable: It can be accessed from anywhere, anytime.

This paper makes the following contributions, such as:

- In order to provide user-adaptive learning contents, four schemes such as user level, question level, question quality and cheating prevention are introduced into our system.
- Given questions to user are selected based on *Ebbinghaus Forgetting Curve theory*. So user can learn more effectively.

The rest of the paper is organised as follows. Section 2 gives an overview of the proposed system. Section 3 explains our main idea for learning management system using adaptive recommendation methods, while Section 4

provides a desiged system in more detail. Finally, Section 5 concludes the paper.

2. SYSTEM OVERVIEW

Figure 1 shows our proposed learning management system. It consist of an application on the smartphone for learning such as solving given questions and services at the server for contents management and evaluation. Contents providers such as educators and teachers will be connected to the central server and the learning contents are provided by the contents provider. In this paper, question words in English are provided for learning contents. Each learners use their smartphone to play learning contents. The results of playing learning contents are sended to central server, and then evaluation such as learner's level is progressed by our schemes. The eveluation results will reflect to select next questions and improve the question database. So our system can provide a high-quality questions and correct feedback to each learners. To show how the proposed system would work, an example scenario is given in Section 2.1.

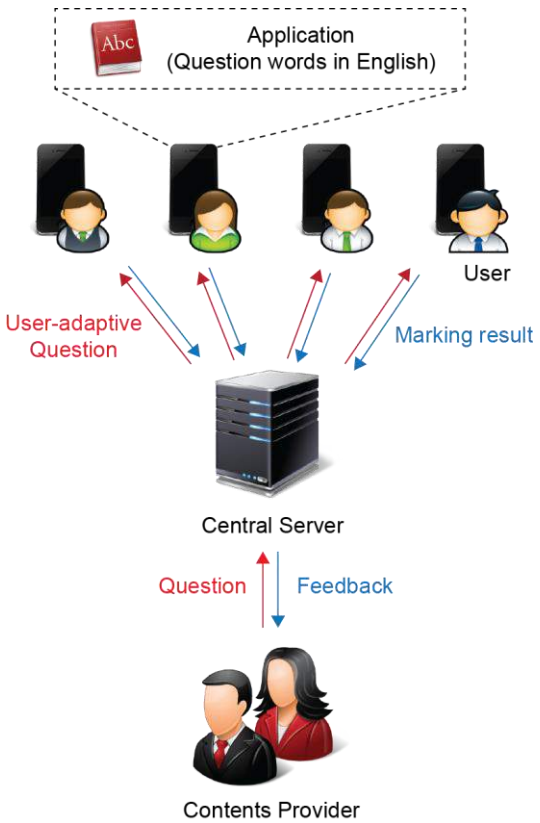
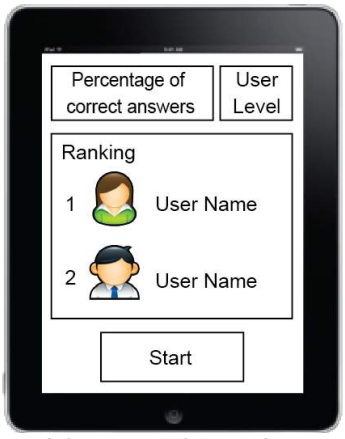


Figure 1. System Design

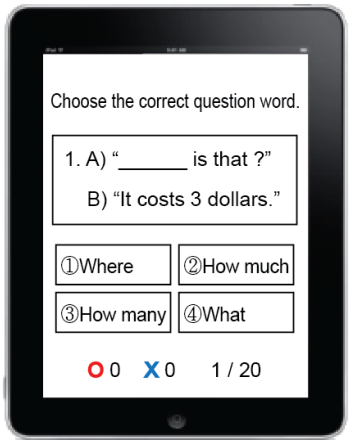
2.1. Example Scenario

Contents provider send questions to question database in central server. Central server selects user-adaptive questions, and then provides selected questions to each user. Each user will solve their given question on smartphone at anytime and marking result is sended to the central server. The central server updates some information such as learner's lelve, question level, question quality and probability of cheating. These information is used for selecting next question. These processes are repeated as often as user solve questions.

The preview of sample application is shown in Figure 2. Figure 2-(a) shows the user information such as a percentage of correct answers, user level, ranking and so on. Figure 2-(b) shows the question board that consist of question, answers list, the number of correct answer and so on.



(a) User Information



(b) Solving given questions

Figure 2. Preview of sample application

3. A LEARNING MANAGEMENT SYSTEM USING ADAPTIVE RECOMMENDATION METHODS

As education using learning management system is expanded, various learning contents has been developed to satisfy the demand of various users. However, most previous learning management system still lack user-adaptive learning contents, so that user simply lose interest in learning. Thus some studies wich improve these problems have been introducing.

In this chapter, we introduce a novel learning management system which can manage learning contents effectively for each user. Section 3.1 explains the effective repetition in learning method using *Ebbinghaus Forgetting Curve theory* and Section 3.2 explains four schemes to provide user-adaptive learning contents.

3.1. Effective repetition in learning

Herman Ebbinghaus, a German psychologist, carried out an experiment that led to the formulation of the famous *Ebbinghaus Forgetting Curve* (Charles, 2012),(Richard, 2002). This theory suggests adults will remember less than 50 percent of what they've learned within an hour of learning unless they have the opportunity to reinforce and practice it during or immediately afterwards. However, as well as providing an insight into the relative frailty of human memory *Ebbinghaus'* results can tell us a lot about how we might construct enviroments to improve both the effectiveness and the efficiency of learning.

Figure 3 shows the forgetting curve adapted from *Ebbinghaus*. The percentage of savings in relearning the list, defined as the number of trials needed to learn the list originally (OL, for original learning) minus the number of trials needed for relearning (RL) divided by OL and then multiplied by 100 (to get a percentage). Thus savings is as follows:

$$Savings = (OL - RL)/OL \times 100 \qquad (1)$$

We provide an efficive repetition in learning using *Ebbinghaus Forgetting Curve*. Questions that each user answered has been wrong in central server are reselected using the following criteria based on *Ebbinghaus Forgetting Curve*.

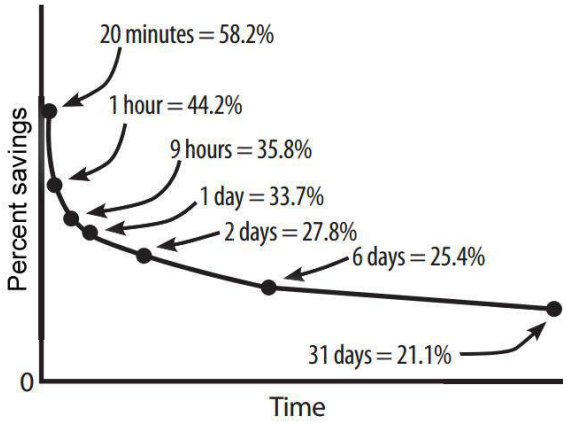


Figure 3. Forgetting curve adapted from *Ebbinghaus*

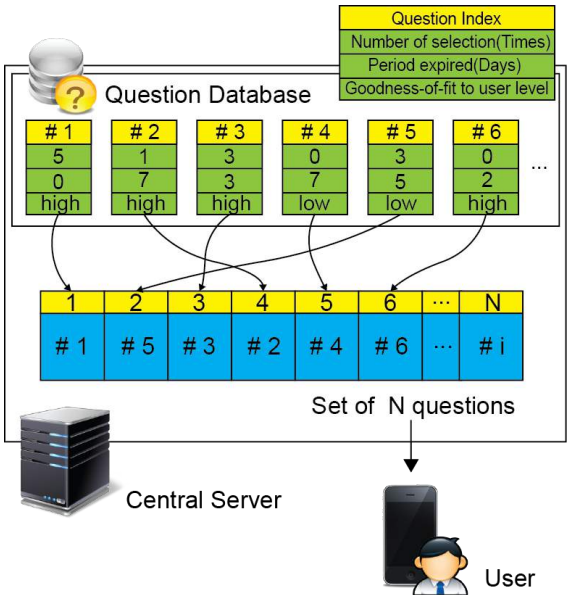


Figure 4. An example of question selection

Prioritizing to select question

Assuming we set N questions at a time, our system select N questions by using three criteria. Our criteria are described below.

(1) Select frequently asked question

Frequently asked question mean that user did not have learned perfectly yet. Therefore, we select this question first.

(2) Expired question

Accroding to Forgetting Curve, review cycle is important to learn. Therefore, expired question sholud to set second priority.

(3) Suitable questioin for user level
If there is no questions that correspond with (1) and (2), we select a suitable question for user level.

Figure 4 shows an example of question selection. Each question in question database in central server has some information such as question index, number of selection (times), period expired (days) and goodness-of-fit to user level. Question selector fill the question set using above criteria.

3.2. Four schemes for adaptive recommendation

In order to provide user-adaptive learning contents, our system finds suitable question using four schemes. Our four schemes are described below.

(1) User level
The User level is a excellence scale of user. So excellent user receive higher level than not excellent user. In practice, the user level is similar to percentage of correct answer. The only difference is, it consider the sum of weights of questions which answered correct. The user level $Level_{user}$ is computed as:

$$Level_{user} = \left(\sum_{i=1}^{N_q} QL_i \times w_i \right) / N_{sq} \quad (2)$$

Here, N_q is the number of questions which answered correct, QL_i is the level of i_{th} question, w_i is the weight of i_{th} question and N_{sq} is the number of solved questions.

(2) Question level
The question level is a difficulty scale of questions. Questions which will be sent to user, are selected by matching user level against question level. The question level $Level_{question}$ is computed as:

$$Level_{question} = \sum_{i=1}^{N_u} UL_i / N_{su} \quad (3)$$

Here, N_u is the number of users (answered wrong), UL_i is the level of i_{th} user and N_{su} is the number of users (answered).

(3) Question quality
In order to sort out faulty question, the question quality is used. If a question quality of arbitrary question is smaller than threshold, this question is removed from question database. The question qualty $Quality_{question}$ is computed as:

$$Quality_{question} = C(Level_{user}, Level_{question}) \quad (4)$$

Here, C is the correlation coefficient (Lawrence, 1989).

(4) Cheating level
In oreder to prevent cheating, the cheating level is used. If a cheating level of arbitrary user is greater than threshold, this user receive some penalty such as substract user level. The cheating level $Level_{Cheating}$ is computed as:

$$Level_{cheating} = N_{repetition} \quad (5)$$

Here, $N_{repetition}$ is the required repeat count for learning once.

The process of adaptive recommendation method using above four schemes is illustrated in Figure 5.

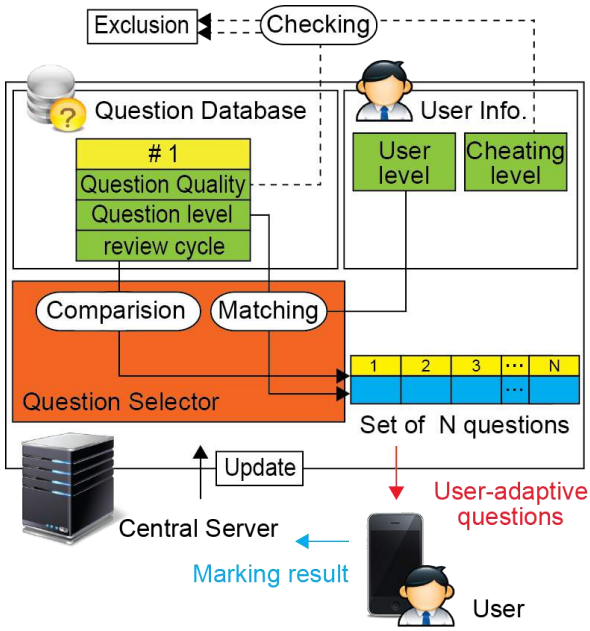


Figure 5. The process of adaptive recommendation method

4. CONCLUSION

This paper proposes a learning management system that allows for user-adaptive learning. In order to achieve user-adaptive learning, we uses *Ebbinghaus Forgetting Curve* and four schemes such as user level, question level, question quality, and cheating level for adaptive recommendation. Although our system have not been tested, the framework has been set up. We are hoping to be able to deploy our system.

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AUTHOR BIOGRAPHIES

Jinsuk Yang is a Ph.D. student at Soongsil University, Seoul, South Korea. He received his B.S degree in Department of Media at Soongsil University in 2009. Since 2009, he has been working in the fields of computer graphics. Currently, his primary research interest lies in level design for computer games. His address is <ispio@ssu.ac.kr>

Kyoungsu Oh is a professor of Global Media Department at Soongsil University, South Korea. He received B.S., M.S. and Ph.D. degrees in Computer Science from Seoul National University, South Korea in 1994, 1996, and 2001, respectively. Current research topics include global illumination, shadow, image based rendering and computer games. His email address is <oks@ssu.ac.kr>

Sangjun Lee is a professor of School of Computer Science and Engineering at Soongsil University, South Korea. He received B.S., M.S. and Ph.D. degrees in Computer Science from Seoul National University, South Korea. Current research topics include database, mobile data processing and P2P system. His email address is <sangjun@ssu.ac.kr>