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Personalization and Context-awareness Supporting Ubiquitous Learning Log System

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Abstract: This study primarily exploits a context-awareness and personalization model supporting ubiquitous learning log system. Learning log stands for the log of knowledge or learning experience acquired ubiquitously. The model has three main behaviors, which are to recommend learning objects in accordance with both learners' needs and contexts, to detect their learning styles using the context history and to prompt them to review what they have learned regarding their learning styles. What's more, by monitoring learners' reaction on the recommendation or prompting, the model can improve its prediction.

Keywords: personalized learning, learning log, context-aware learning, language learning

Introduction

In recent years, a great revolution is occurring in the mobile device world with the release of new generation smartphones represented by iPhone and Android. Since the new generation smartphones accommodate users with many advanced functions such as the multi-touch interface, GPS, millions of applications and so on, smartphones are becoming more and more popular. One key feature of smartphones is that they are equipped with a range of sensors such as the accelerometer, GPS, compass and so on. This paper primarily investigates the capabilities of the sensors of smartphones in context-aware and personalized mobile learning, because the sensors can play two important roles on learning. On one hand, it can monitor learners' current context including their activities involving whether they are running, walking or suffering on the Internet and so on, and the environmental information including the location, time and so on. Then, the system can support specified learner's learning taking into account both the context and his study needs. On the other hand, the model can track learners' contextual data as context history when they learn something using smartphones and catch individual's personal learning styles through analyzing the context history. With the two basic ideas, we build a context-awareness and personalization model. This paper will lay much emphasis on this model-building.

In addition, the model depends on a system called SCROLL (System for Capturing and Reminding of Learning Log) that allows learners to log learning experiences with photos, audios, and so on. The detailed introduction about SCROLL is given in Section 2. Section 3 mainly presents the model in terms of its three dimensions. At last, the conclusion is talked about.

1. SCROLL

With the evolution of the mobile devices, more and more people prefer to record notes with their cell phones. However, few systems are proposed to support formal notes like

vocabulary in language learning. SCROLL is a system designed to meet such needs. The aim of SCROLL is to aid users to simply capture the learning logs they have learned, review and reflect their old learning logs, reuse the knowledge when in need, be reminded at right time at right place and be recommended others' learning logs properly. Detailed introduction can be found in [1]. Next section mainly introduces its recall function.

1.1 Recall what we have learned

After learners recorded their learning logs, the aims of SCROLL are lying in helping them recall what they learned via the context, recommending other learners' learning experiences for them, finding out individuals' learning styles and supporting their learning in accordance with personal learning style. Quiz function is responsible for recalling what we have learned and it is based on two theories: the theory of encoding specificity and the theory of test-enhanced learning. Based on the former theory, a number of things such as the place where we learned or the picture we took can be encoded as retrieval cues initially and they are effective to activate a stored memory [2]. What's more, according to the basic research on human learning and memory, practicing retrieval of information (by testing the information) has powerful effects on learning and long-term retention. And compared with repeated reading, repeated testing enhances learning more [3]. This is called test-enhanced learning or test effect. Thereby, the quiz function taking advantages of the pictures and the metadata such as location is proposed. Three types of quizzes can be generated automatically by the system, which are yes/no quiz, text multiple-choice quiz and image multiple-choice quiz.

Usually, learners can examine themselves by practicing the quizzes. But two more ways provoked by the system are provided. One is that when a learner moves to the place where he took down knowledge, the system can show quizzes about the learned knowledge for him. The other one is that if a learner has his learning style, the system will prompt him to review what he learned in quizzes when the circumstance meets the learning style. In the rest part of this paper, we will talk about them in detail.

1.2 The Scenario of Using Learning Log System

Up to now, SCROLL mainly focuses on language learning field. One typical scenario of its use is to assist international students to study Japanese in Japan. In this case, learners, who face rich learning contexts every day, can gain abundant of knowledge from their daily lives in different kinds of situations, such as shopping in the market, seeing doctor in the hospital, having a haircut in a barbershop, visiting the museum and so on. They cannot only take down what they have learned in those situations, but also will receive support from the system to recall and review them after that. This paper is presented based on the case study under this scenario.

2. Personalization and Context-awareness model

To catch individual learner's learning styles and support his learning in accordance with current contexts, the model will monitor, analyze and dig his contexts, derive the learning styles from them and prepare proper learning objects for him. Figure 1 demonstrates the whole processing flow of the model. It follows the below steps:

(1) The model collects a learner's context information from three parts: his activity, the status of device and the environmental data.

(2) The model analyzes the context and checks status of the device: for example, how much battery is left and whether the Internet is connected. If the availability is low, the system will do nothing.
(3) If the device has a high availability, the system will check whether there is location-based knowledge near the learner. If existing, the system will provide location-dependent quizzes or recommend learning logs for him.
(4) If there is no location-based knowledge for the learner, the model will examine if the learner is in his preferred learning context. If so, the model will show messages to encourage him/her to study.
(5) All context data remains as context history to detect individual learners' learning styles. Finally the learner's response to the learning style based recommendation is used to improve the learning style detecting method.

The above processing flow reveals that the model consists of three dimensions, which are learners' current context, their learning styles or preferences and the learning objects. The following sections will introduce the three dimensions respectively in detail.

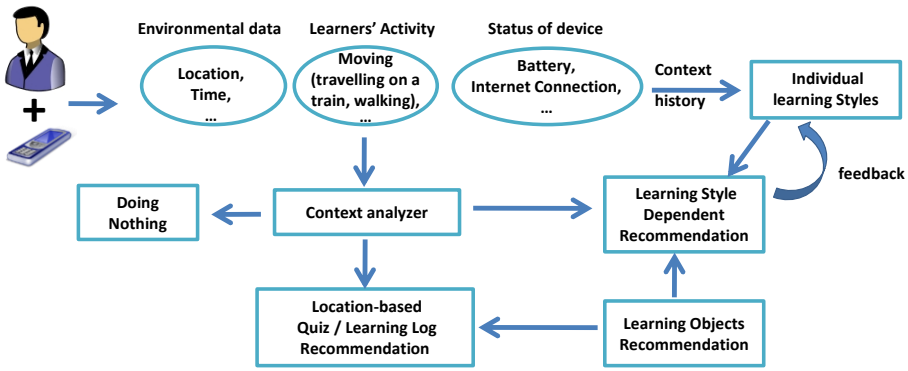

Figure 1: Workflow of the personalization and context-awareness model

2.1 Learners' context

A lot of study on context-aware computing can be found in the literature. In order to fully capture learners' context we propose a more complicated model. We divide the context into three parts: learner's activity, status of device and environmental data. Based on the contextual data, the system will behave as follows:

(1) Firstly, it will check the availability of the context, for example, whether the battery is enough (more than 20%), whether the Internet is connected, and so on.
(2) If these conditions are satisfied, the system then will ascertain whether there are learning objects near him (within 50 meters). The learning objects include two parts: those he learned and those that he may want to learn.
(3) If the learning objects he learned exist, the system will give a piece of message writing "Now you are near some learning logs you learned. Do you want to recall them in quizzes?" If he replied the message, he can finish quizzes considering the place as a retrieval cue.
(4) If the learning objects that meet his learning requirement, the system will show a piece of message saying "Some other learners' learning logs are found near here. Would you like to view them?" If they click the message, the system then shows a list of the learning logs and can navigate learners to the specified ones.
(5) Finally, the system will check whether the message is responded. If not responded, the system will recommend one more time when the user comes to the place again. But totally the number of times of recommendation in a same area cannot exceed 3 times.

Additionally, the contextual data will be recorded as context history and it will be reused for analyzing the learners' learning styles. We will introduce this part in the next section.

2.2 Learners' Personal Learning Styles and Preferences

In our model, some personal attributes, which are supported by many personalized learning systems such as appropriate learning objects and memory cycle, are exploited as well. The detailed description about this is touched upon in the section 2.3. In this section, we will talk about some more personal learning styles or learning habits that can only be detected by mobile sensors. These learning styles involve where a learner usually studies (such as home, school or fast-food restaurants), whether a learner has a habit of studying on the commuting train and when a learner prefers to study (e.g. after waking up in the morning or before sleeping at night) and so on. In our opinion, these kinds of learning styles play a very important role on our learning because usually they are related to learners' daily customs and habits. For example, for the learners who usually study on a commuting train it may motivate them to learn if they receive a prompt message. The context histories collected from SCROLL consist of the context data when the users take down learning logs and do quizzes. Three kinds of context history data covering location, time, and speed are utilized to detect whether a learner has any of the three learning styles mentioned above. The following parts introduce the concrete method to detect the learning styles.

For the learners' preferred learning time, because the time of learning every day is a discrete random value, we determine to repeat observing the regularity of the learning time in several periods to examine whether a learner has such learning style or not. Concretely speaking, we separate a day into 24 phases. Each phase stands for an hour. Then we count the number of times of learning collected from a two weeks period in different phase. The next two periods of four weeks will be observed as well. Finally, the frequency phase which occupies more than 25% of the all learning times in three periods will be thought as the learner's preferred learning time.

As for to find a learner's preferred learning place, we adopt a K-means algorithm. Firstly, we group a learner's learning locations into clusters. A cluster is a circle area whose radius is within 50 meters. Then, the scope that contains more than 30% of the learning location data is perceived as the learner' preferred learning location. Considering how to discover whether a learner has a habit of studying on a commuting train or bus, the speed and the time parameters are needed. Another experiential fact is that the speed and the time of commuting are relatively stable. Consequently, we firstly search the data with high speed (10~50 km/h is thought as the speed of the bus while above 50km/h is thought as the speed of the train [4]) and then group the data containing time and speed into clusters as well. The two data the difference of whose time is within 60 minutes and difference of whose speed is within 3km/h are considered in a cluster. Finally, if a cluster taking up 30% of the data exists, the system assumes this learner has that habit.

After achieved the learners' learning styles, the system can recommend messages when learners entered those environments. For example, when a learner stays in the place where he usually studies, a piece of message writing "The system guesses you are in a place where you usually do studies. Do you want to review what you have learned?" will be given. When it is his preferred learning time or when he is moving on a commuting train, he will receive a similar message as well. Finally, by checking the learners' response the system can modify its prediction: if the system shows messages for him more than three times based on the same learning style without any responses, this learning style will be disabled.

2.3 Learning Objects

In this study, a learner's learning objects can be separated into two types: the learning logs that he learned (the ones that he uploaded or glanced through) and the ones recommended by the system. In order to provide learners with appropriate learning objects, when to remind them of the learned learning logs and what to recommend for them are two important issues. The former one is about the timing to show learners their learned learning logs in quizzes. The system adopts the graduated-interval recall method proposed by Pimsleur [5]. The intervals are 5 hour, 1 day, 5 days, 25 days, 4 months, and 2 years and so on. That is to say, after a learner added a learning log, the quiz about it will be available after 5 hours and then after 1 day and so on. Learners will be reminded continually. As for what to recommend, the system takes into account the profile of the owner of to be recommended learning objects. It means that firstly the learning log whose owner has the same both study language and mother language will be recommended. Then, the specified learner should have the same ability level with the owner.

3. Conclusion

In this paper, we introduced a personalization and context-awareness model on the basis of SCROLL. This model aims to assist learners to review what they have learned and recommend others' learning experiences for them by utilizing the contexts. Also, it can detect learners' learning styles by analyzing their context history and prompt them to review past knowledge according to their learning styles. Finally, the attributes of the learning objects are also considered in the model. In the future, we would like to conduct an experiment to evaluate the model.

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