

Research of an Adaptive System in Mobile Learning Environment¹

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Abstract: In recent years, the number of mobile terminal type has been grown dramatically. So, developing adaptive learning resources according to the different terminals and users' preferences is the key research issue of mobile learning. In this paper, we mainly introduce an adaptive mobile learning framework, which considers four dimensions in process of adaptation. Meanwhile, we also introduce two different learning modes, whole course learning and knowledge point learning. In these two kinds of learning modes, we use cache mechanism and knowledge grade to improve the capability of the adaptive system.

Keywords: mobile learning, adaptability, whole course learning, knowledge point learning

Introduction

Mobile and wireless technologies constitute innovative infrastructures that support the access to the internet at any time from any place through diverse device. Mobile-learning has been defined as e-learning through mobile and handheld devices using wireless transmission [1]. There are many researches and projects about adaptive system in mobile learning. These researches and projects could be divided into three types.

- Adaptive learning content management systems. These systems usually are based on web. So they only adapted to the web content to various terminal devices [2][3]
- Adapting to context awareness in mobile learning. The task of the context-awareness is to sense the environment and react to the changing context during the learning process [4]. CALS [5] selects appropriate activities for learners based on their current learning context. CALM [6] puts forward six dimensions in context-awareness.
- Adapting to learners' learning styles and cognition. Learners' learning styles and cognitive levels affect their effect of learning activities. Therefore, many researches consider the learning styles and cognitive levels in adaptive process. Hyungsung Park [7] suggests building an adaptive mobile learning system, which is adaptive to students' learning style defined by Felder & Silverman. Hyosook Jung [8] consider the information that a learner is experiencing and learning contents are adaptively presented based on the cognitive and competency attributes of learners.

Although various research groups are exploring the potential of adaptation in mobile learning, lack of research on some issues still blocks progress. In our system, we concerned

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about the adaptability of multi-media resources, the user preference and the wireless connection and propose two different learning modes, whole course learning and knowledge point learning. The rest of the paper is organized as follows: section 1 presents an adaptive infrastructure of our system; section 2 introduces different adaptive strategies; section 3 shows the experimental results about two different learning modes on simulators.

1. Adaptive infrastructure

There are many factors affect the result of mobile learning, such as various terminal devices, unstable wireless connection, continual changed environment and learning styles. So we consider four dimensions: learner, device, connectedness and learning environment.

The infrastructure of adaptive system in mobile learning environment is shown in Figure 1. The system consists of two modules: information analysis module and adaptive controller.

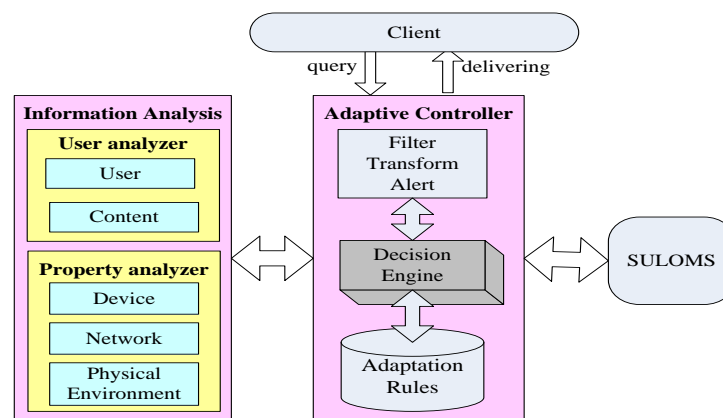


Figure 1. Infrastructure of adaptive system

1.1 Information analysis module

The module analyzes the user's basic information. User analyzer analyzes the content of user requirements and user preferences. Property analyzer analyzes the major information about the equipment, network condition and environmental information of learning activity happened. All these information obtained will be sent to adaptive controller as the necessary parameters in adaptive process.

1.2 Adaptive controller

Adaptive controller module chooses individual resources for user to meet the specific performance and user preferences obtained by information analysis module. This module consists of adaptive decision rules, decision engine and adaptive conversion module

Adaptive decision rules contains a set of rules to determine which kind of resources should be sent in certain circumstance. The rules contains conversion rules to define the conversion between multimedia formats, preference rules to define the corresponding relationship between the user preferences and multimedia formats, transmission rules to determine acceptable size of the resource allowed to sent to user.

Decision engine is the core of the adaptive system which assembles resources dynamically. In the process of assembling, it will match the parameters obtained by

information analysis with adaptive rules in order to select resource and decide whether to convert the resources. The decision process can be divided into three steps.

- First step: Format matching. System matches the original formats of resource with the client supported media formats, and decides whether to convert resources by the adaptive decision rules.
- Second step: Balancing the parameters. In this step, the system will balance the quality and time of resources which will be downloaded. It aims to make the time and resources quality can be acceptable for user.
- Last step: Step of identify priority. The system chooses the final available resources through priority of data. The development priorities of resources can be decided based on user preference or transmission time and so on.

Adaptive conversion module use the command from the adaptive engine, this module filters, chooses and converts resources. Eventually, it chooses a suitable learning resource for transmitting to the learners.

2. System implementation

In this part, we will introduce the process of adaptation in two kinds of learning modes, whole course learning and knowledge points learning. In whole course learning, learner can download all sections of a course once in order to have a comprehensive understanding about the whole course. In knowledge points learning, the learner can download resources of a chapter or a knowledge point about which we can have highly quality resource.

2.1 Cache

The purpose of using cache is to improve the efficiency of adaptation. In learning activities, system should choose adaptive resource for learner. In cache, the system store resources information and the parameters of adaptive dimensions used in process of adaptation.

When other learners applied for resources, the system first search the cache to find whether there are appropriate resources for learner's requirement. If there are available resources, and the parameters used in process of adaptive match with the learner's properties, the system will send them to learner. Otherwise the system will use adaptation engine to dynamically produce the resources. By using cache mechanism, the system will reduce the dynamic resources adaptive generating process and adaptive time. Thus the waiting time will reduce.

2.2 Knowledge grade

When describing courses, we set grade for knowledge points in order to ensure that the whole course of all the knowledge will be assigned the corresponding client storage space. For each chapter and knowledge point in course, we mark grades which show the importance and difficulty of a chapter or knowledge point. In our system, we define four grades. Grade four is the highest grade. It means the knowledge point is most important and difficult. The grade one means the knowledge point is least important and difficult.

In the adaptive computing, knowledge grade will be transformed to a percent. In adaptive process, system will user this percent to allocate the client storage space. This will guarantee different knowledge point will be distributed more suitable storage space. It will make important and difficult knowledge points distributed more storage space, while the

relatively simple and not difficulty knowledge points distributed less storage space. Under this mechanism, we can guarantee each knowledge point has corresponding resource to learn in the whole course learning.

2.3 Process of implementation

The process of adaptive system is shown in Figure 2.

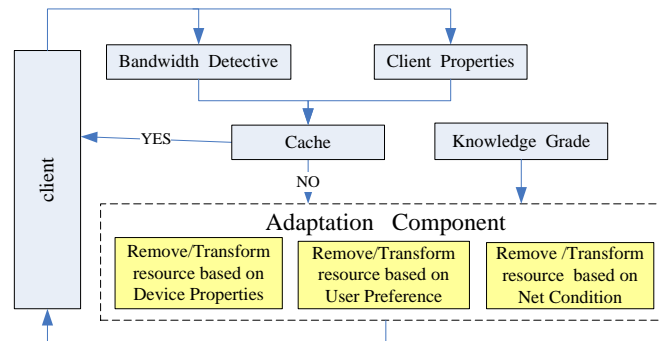


Figure 2. The process of adaptive

First, when client and server establishing connection, the network monitoring module checks the network condition while client property module gets learner preference, device property. Then, the system finds out whether existing resources in cache fit to these parameters. If there are available resources, send their list to the client. Otherwise, the adaptive engine will filter, convert and select resources according to these parameters and finally sending the resource list to client

Generally speaking, there are great deals of knowledge points and contents in a whole course. However, the capacity of mobile device, in storage, screen size, supported formats and so on, is limited. Therefore, the whole course learning resources will be much simpler in order to assure learners could get the intact course.

The adaptive engine analyzes the requirement firstly. If it is whole course learning, the system will dispose resources according to the parameters of device first, and then select them by learner's preferences. When distributing storage size for knowledge points, in order to let the learner gain complete course resources, the system adopts the weight method introduced above. In this way, the system converts weights to possessive storage percent and distribute storage size by this percent for every knowledge point. By this approach, each knowledge point has content sent to learner. However, in this situation, it is hard to assure the quality of resource we sent to learner is the best and the most appropriate for learner. For knowledge points learning, the system will filter resources according to learner's preferences first, and then select or convert them by the supported formats of device, the available memory space and network condition. In this mode, the user can get the high quality resource, which is totally fitting to learner's preferences to satisfy the learner's requirement of detailed study.

3. Scenario

We use JDK installation of "Java program language" as an example making an experiment on simulator in two different learning modes. The difference is shown in Figure 3. When the learner chooses to learn the whole course, the adaptive engine selects a text file for this knowledge, as shown in picture (a). Because there are too many resources in the whole course and this knowledge takes a very small proportion. When the learner choose to learn

