Mobile learning resources push system design based on RFID

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ABSTRACT: Mobile learning can satisfy learners' requirements to study anytime and anywhere, but there exists an outstanding problem: mobile learners can easily be affected by external interference, so they cannot stay focused for a long period of time. High-tech radio-frequency identification (RFID) can collect and process information fast, in real-time and accurately, is the most appropriate choice for the objects to be recognised and oriented in a certain area. RFID sends the learning resources to students' hand-held mobile devices and achieve the push notification function of learning resources. A mobile learning resources push system based on RFID integrate the conception of resources push into mobile learning, improves the easy-interferential state at present mobile learning's process and solves the problem of low efficiency of learning. Learners can, therefore, acquire resources service in time and satisfactorily, and it has a certain application value for improving and expanding learning patterns.

INTRODUCTION

Computer technology has already transited from isolated time to cyber time, and it can also allow for mobility (in contrast to the fixed model) by providing a technology environment for study, which can be launched at all times and in all places [1]. Mobile learning can satisfy learners' requirements to study anywhere and anytime, but an outstanding problem remains. The learning laboratory of Stanford University occupying an important position in the field of mobile learning indicates: people can be extremely distracted when they are in a *locomotive* state. When learners study in fragmentary bursts, the situational relevance is different from other learning methods, such as the fixed learning method, capacious learning methods, etc [2].

In view of the above, if it can provide learners with learning reminders at the proper time and place, and give an active push of learning resources to mobile learners, coherence and systematicness of the learning will be promoted and it will improve the effect of mobile learning. RFID is a high technology, which can collect and process information rapidly, in real-time and accurately; it is the most appropriate choice for the objects to be recognised and oriented in a certain area [3]. In this study, RFID has been applied to mobility learning and to mark learners' hand-held mobile devices. When a server finds there are users entering its regions, it will send the learning resources to students' hand-held mobile devices and achieve the push notification function of learning resources.

THE APPLICATION OF RFID IN RESOURCES PUSH SYSTEM IN MOBILE LEARNING

RFID Technology

Radio frequency identification (RFID) has been used widely; it is a non-contact automatic identification technology using radio frequency communication [4]. The basic RFID system is composed of two parts: the *tag* and the *reader antenna*. The unique function of RFID technology is to mark anybody or anything in the real world; it has two functions, which are *mark*, *address number* and *sense*. When objects with RFID tags pass by the places setting the reader, they will report to a related host, so long as the objects pass by some place, it can recognise the objects' locations. RFID is regarded as one of the most important techniques. It is widely used in the fields of logistics, library management and transportation, with the promotion of the conception of the Internet of Things, RFID as an advanced productivity has a great promotion to improve production efficiency and users' application experience [5].

Application of RFID Technology in Mobile Learning Resources Push Systems

Mobile learning is a learning method and technology that has distinctive technical characteristics. Its implementation and development need the support of technologies, especially advanced technologies. In order to make learners persist

with their studying in the process of *moving*, one can build a mobile learning resources push platform with the help of RFID: each piece of mobile learning equipment has a unique tag recognised in all regions that have an RFID reader installed. When learners enter the region, the system will recognise learners automatically and send resources according to the recognisable information. In this system, the advantages of RFID are mainly embodied in the following aspects:

- Non-contact recognition:

  Because RFID is based on non-contact wireless recognition, as long as learners' mobile devices have the RFID tags, it can invisibly handle learners' recognition, location and learning activities, which makes learners study in a real environment.

- Reading and writing functions of data are strong:

  An RFID reader has features of non-directional angular limitation and is interference-free, etc. It can recognise high speed moving objects and handle several tags at the same time, so it can recognise several learners efficiently and provide timely learning resources, and there is no delay.

- Tags can be used repeatedly:

  The data information stored in RFID tags can be amended and renewed repeatedly, which has the function of reusability. When learners leave school, they can get rid of the information stored in tags, the aim being to reduce the costs and save on school expenses.

- Environmental suitability is strong:

  An RFID tag has a strong resistance to water, oil and chemicals; for learners who need to access to experimental buildings, where there exit chemical reagents and medicines, tags on mobile devices will not be affected, and they also can deliver data.

- The security is steady:

  Though RFID can accurately locate and acquire learners' information, it not only has password protection, but also achieves safety management with the help of algorithms such as DES, RSA, DSA and MD5, which will remove learners' doubts sufficiently about privacy.

MOBILE LEARNING RESOURCES PUSHING SYSTEM DESIGN BASED ON RFID

National college students' innovative experimental programme is an essential part of undergraduate teaching quality and teaching reform project. The carrier is the programme, which is supposed to encourage students to participate in open and comprehensive practical activities. Students study in groups, research together, do their duty and cooperate, which will nurture students' spirit of cooperation and teamwork [6]. *Innovative Experimental Programme of Biology Subject*, a sub-programme of the National College Students' Innovative Experimental Programme, has been conducted for Year 2 and Year 3 students of the *Biology* major in the College of Life Science at Northern Beijing Vocational Education Institute, since 2010. This study takes the *Innovative Experimental Programme in Biology Subject* as an example, and presents designs and applications of a mobile learning resources push system in 2015. Sixty-five students were taking part in the programme and they used the system. The system mainly adopts a feature that RFID technology can recognise objects' locations, which makes the server sense learning devices and push learning resources. The scope of the system is defined for each region where learners will appear (including teaching building, laboratory, various venues, etc). Finally, the effect of the resource push service is analysed through the results of a questionnaire survey.

System Target and Constitution

In the process of experimental work, students need preliminary observations and spot investigations, and they can gain the direct data through a specimen museum, plant greenhouse, aquaculture garden, field observation and personal experience. Therefore, the aim of the system indicates that when learners are approaching or have entered some region mentioned above, the reader will locate each learner and, then, related severs will push learning resources about the region to users' mobile devices.

The system consists of the following parts:

- RFID tags and readers:

  To ensure the efficiency of induction, it adopts RFID products, the working frequency is 860-960 MHz, the distance of reading and writing is 3-10 metres.

- Mobile device:

  The client of a mobile device's installation system can be used to customise learning resources, and check information on the server (including location, resources' types); it embeds the RFID tag, and the tag's contents include learners' code, grade, major, etc.

- Home agent:

  Home agent is put in the network centre. Its main function is to provide code, location, and the IP of the server, which is corresponding to learning resources.

- Server:

  Putting a server in the specimen museum, plant greenhouse and aquaculture garden to store learning resources associated with the related regions. Each server is associated with the RFID reader, which depends on the reader to collect and recognise learners' location initiatively.

- Network environment:

  Using WLAN, GPRS and 3G to achieve the transmissions and exchanges.

The Architecture and Achievement of the System

The architecture of this system includes two routes (as shown in Figure 1), one is a real moving route; namely, learners' action band; in this case, it refers to the routes that learners go to three venues, respectively; the second is a virtual information flow: information flow 1 is mainly used to customise learning resources, information flow 2 is used to achieve the perception of mobile devices and push learning resources, information flow 3 is the feedback of mobile learning. These three information flows cooperate and complete the system target together. Learners' mobile devices first acquire the code of the server, which corresponds to learning resources at the home agent by wireless network. When learners enter the perceived regions of RFID readers, mobile devices will check if the code of the server matches with the code that had been acquired previously. If the match succeeds, the server will include resources that learners need, and learners will receive mobile learning resources automatically.

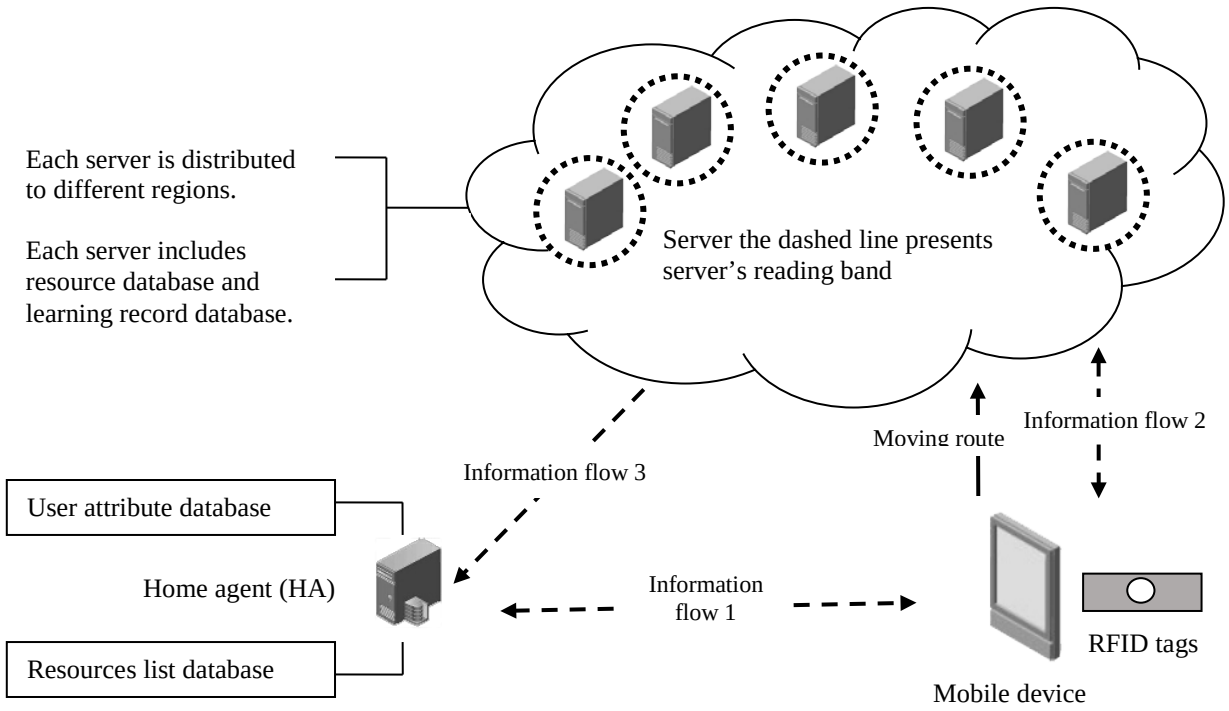

Figure 1: System architecture.

To accelerate read access time of data, the data are classified and stored according to types. The database of home agent includes a resource list database and a user attribute database, where the user attribute database is used to store all kinds of learners' information, including basic personal information and selective resource list information. The databases of the server include the resource database and the learning record database, with the latter being used to store learners' learning process in this region. The detailed description and types of system parameters are given in Table 1.

Table 1: List of system parameters.

Name	Parameters	Detailed description	Type
Server info	Server_Code	Server-code	String
	Server-Position	Server-position	String
	Server_IP	Server IP	String
	Server_Num	Server total numbers	Number
Resource info	Resour_Code	Resource code	String
	Resour_Content	Resource specific content	String
User info	User_ID	User ID defaulted to student ID	String
	User_Content	Resource ID of learners' recent learning content, which corresponds to resource code	String
Tag ID	TagID	RFID tag ID similar with user ID	String

The Work Flow of this System

In this system, the server codes of the specimen museum, plant greenhouse and aquaculture garden are S1, S2, S3, respectively. The resource codes of the three servers present according to their priority; for example, learning resources stored in the server at the specimen museum are animal S1_01, plant S1_02, fungi S1_03, human body S1_04 and fossil S1_05.

Here, the learning resources of *fossil* at the specimen museum and *fish* at the aquaculture garden have been used as examples to show the system's achieving process, as depicted in Figure 2. It consists of five steps:

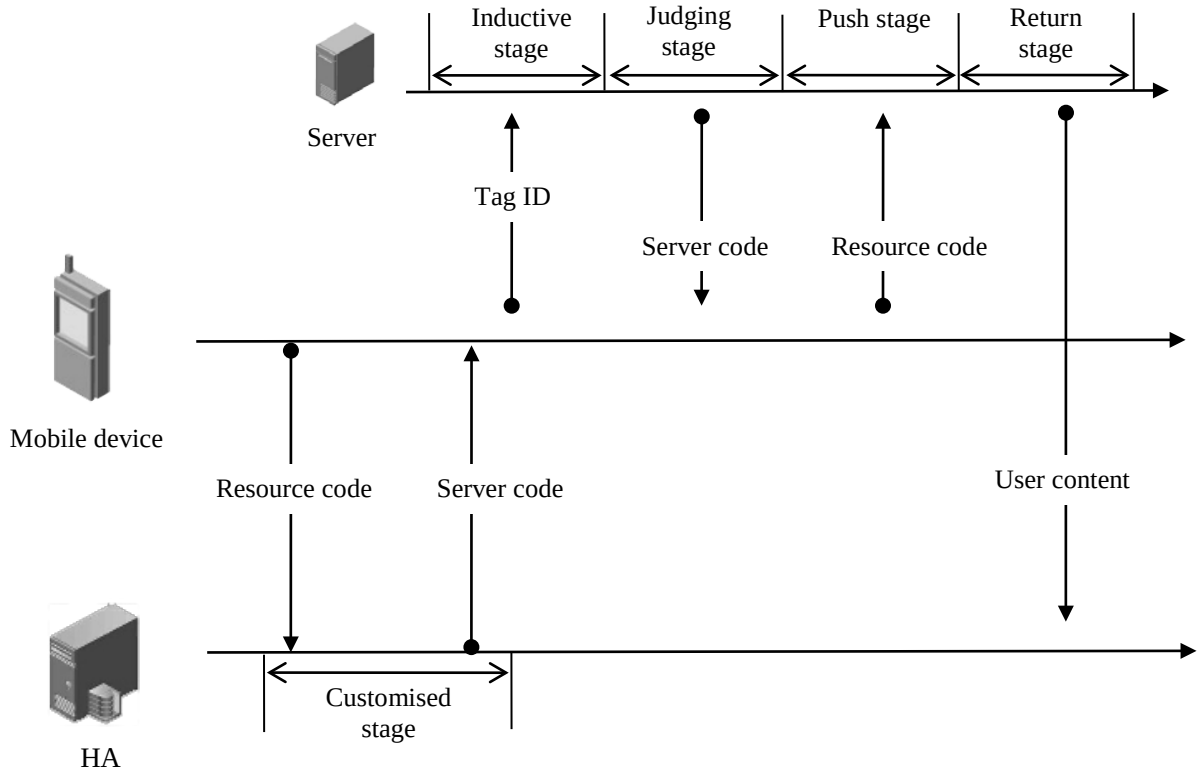

Figure 2: System running.

- Customised stage:

  In the initial stage of m-learning, learners' mobile devices build a relationship via the wireless network and home agent, and use the client to visit the resource list, choose what learning resources they will require and, then, the resource code (S1_05, S3_01) is sent to the home agent; the home agent passes these resources back, which correspond to the server code (S1 and S3).

- Inductive stage:

  When learners carrying a mobile device enter a server reading region, the RFID reader will detect TagID and pass back the server code to learners' mobile devices.

- Detecting stage:

  Learners' mobile devices will compare the server code received from the server with the specified server code received from the home agent in the customised stage to check if they match. Because S1 and S3 are the server codes, which are designated by the home agent, so when learners are in the specimen museum or the aquaculture garden, the mobile devices can match the server, and cannot match it in the plant greenhouse.

- Push stage:

  Through previous checking, if it can match the server code, the mobile devices will send selective resource codes to the server, and the server will push resource content in the resource database to learners; otherwise, the operation will be cancelled.

  When learners are in the specimen museum, the mobile devices will send *fossil* code S1_05 to S1 and acquire detailed resource contents. The process in the aquaculture garden is similar to it, but it cannot be operated in the plant greenhouse.

- Return stage:

  When learners have finished their mobile learning, the server will pass back learners' recent learning user content to the user attribute database of the home agent to give the learners a reference in the next customised resource stage. Thus, the activity of the learners' mobile learning has finished, completing the learning process as shown in Figure 3.

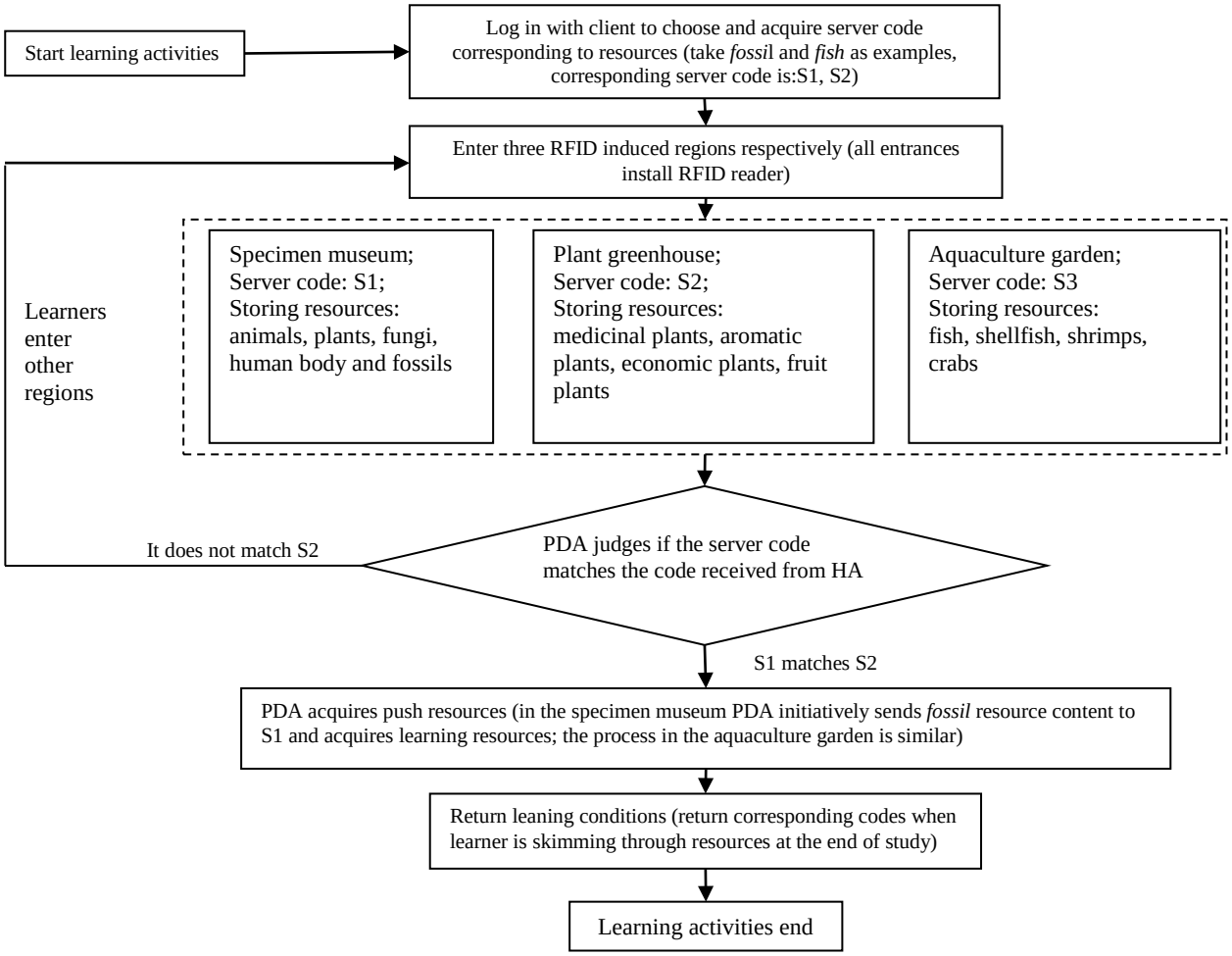

Figure 3: Learning flowchart.

Analysis on the Effect of the Resources Push System

In view of the number of students participating in the programme, 65 questionnaires were issued and 65 effective questionnaires were returned. The content of questionnaire and the statistical results are shown in Table 1. It can be seen from the results that the learning resources push service can meet the needs of the students' individualised learning and help them to focus their attention on their mobile learning.

Table 1: The content of questionnaire and the statistical results.

Item	Strongly agree percent (%)	Agree percent (%)	Neutral percent (%)	Disagree percent (%)	Strongly disagree percent (%)
Learning resources push service can meet the needs of students' individualised learning.	38.46%	53.85%	7.69%	0	0
Learning resources push service can help students to focus their attention on their mobile learning.	30.77%	49.23%	15.38%	4.62%	0

Based on the survey results, the following observations can be made:

- Meeting the needs of students' individualised learning:

  92.31% students strongly agree or agree that the learning resources push service can meet the needs of students' individualised learning. It can be seen that this system can push appropriate resources initiatively, combining with the learners' individual demands, and provide a mobile learning pattern oriented to learners.

- Help students to focus their attention on their mobile learning:

  80.00% students strongly agree or agree that the learning resources push service can help students to focus their attention on their mobile learning. It can be seen that giving learners' learning reminders at a proper time and place, and giving an active push of learning resources can solve the problem of attention that may be extremely distracted in mobile learning.

CONCLUSIONS

Practical application of the information educational pattern is realised in this case as the system mentioned above embodies several application characteristics:

1. Learners have different requirements about the kinds and types of resources, because their learning emphasis is different. This system can push appropriate resources initiatively, combining with learners' individual demands and providing mobile learning pattern oriented to learners.

2. The system mixes the learning environment and natural environment together, and pushes resources, which are close to present situations; therefore, when learners are studying, they maintain a close relationship with the external world, which improves learning's rapid transformation.

3. Mobile learning resources push system, based on RFID, integrates the conception of resources push into mobile learning, improves the easy-interferential state at the present mobile learning's process and solves the problem of low efficiency of learning, so that learners can acquire resources service in time and satisfactorily. It has a certain application value to improve and expand learning patterns.

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