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Visual Interactive and Location Activated Mobile Learning

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Abstract—**In this paper we proposed an application on smart phones for interactive mobile learning. Image recognition technology is used to link physical objects seen through the camera to relevant information. Through the built-in camera on the smart phone, visual interactive learning can be realized. With the GPS sensor, location activated learning is also possible. Combining both the camera and the GPS sensor on the phone, multimedia contents can either be activated by snapping a picture from a real world object or entering a predefined geographical area. This makes the learning process more interesting and intuitive. A web portal is developed for teachers to create the learning trails for different learning objectives. The mobile apps are also developed for iOS and Android platforms. A trial was conducted with school teachers and students and positive feedbacks are obtained.**

Keywords-mobile learning; interactive learning; location based learning

I. INTRODUCTION

As the smart phone penetration rate increases, mobile phone applications are becoming more and more popular. Many mobile apps bring convenience to mobile users in their daily life. Mobile learning is one of the application areas [1]. There are more and more companies developing mobile learning applications [2]. However, most of these mobile learning applications are used to deliver courses and exercises to students. These are more static and passive learning methods. Students' attention may not be attracted easily.

HP Labs developed a prototype technology called mscape [3]. mscape can be used by people to design and play location-based experiences with friends, family and others, anywhere in the world using Windows Mobile devices. The learning application generated by mscape is called mediascape. It is a location-based mobile application that incorporates digital media with the sights, sounds, and textures of the world around the user. Upon the user enters a predefined area based on the GPS information, digital images, video, audio and interactions with the physical landscape will be activated. Games, guided walks, tours, and destinations are among the mediascapes created to date. The sensors which mediascapes use to activate the multimedia information are GPS, RFID, Bluetooth. HP also tried to use 2D barcode to activate the interaction between a physical object and the students. However, pasting barcode to an object is intrusive and sometimes not possible. The interaction between the real world objects and the students is not intuitive. Furthermore, as barcode recognition requires a close capturing of the barcode image, students have to capture the image one by one standing closely in front of the barcode. It wouldn't be efficient if a large group of students are required to capture the barcode image.

The application we proposed here aims to enable the students to interact and experience with real world objects and environments. While looking at a physical object, with a button click, the student is led to the background information relevant to the object. Interactivity between the students and the physical world is provided. While immersing in the real world, students' attention can be led to the virtual world where histories, stories and interpretation are given in multimedia format. With interaction between real world objects and digital virtual representation, experiential and discovery learning can be realized.

The main technology to connect the physical world to digital world as mentioned above is through image recognition. The image recognition technology is used to link a physical object or scene which the student is looking at to a virtual world with rich multimedia information. While a student shows curiosity on something, he or she can take a picture of it, immediate explanation will be shown automatically for the student to learn. The mobile phone camera will be used to capture the student's attention by identifying what the student is looking at. Relevant knowledge is provided to the student via the mobile device in multimedia format. The learning contents displayed to the students can be customized by teachers according to different learning subjects. It can also be retrieved from internet via internet search technology.

II. SYSTEM ARCHITECTURE

In our system, the image recognition engine is running on the server and the learning contents can also be hosted on the server. Internet access and GPS sensor are required for the app to run on the mobile device. The system architecture is shown in Figure 1. Once the students find the object of interest and snap a picture of it, the picture will be sent to the server for image recognition. After the server identifies where the picture is taken from, it will return the content associating with the object of interest to the mobile client and display it to the students. Web services are used for the

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communication between the mobile clients and the server. The learning contents in the content database can be updated any time according to curriculum requirements without modifying the mobile apps.

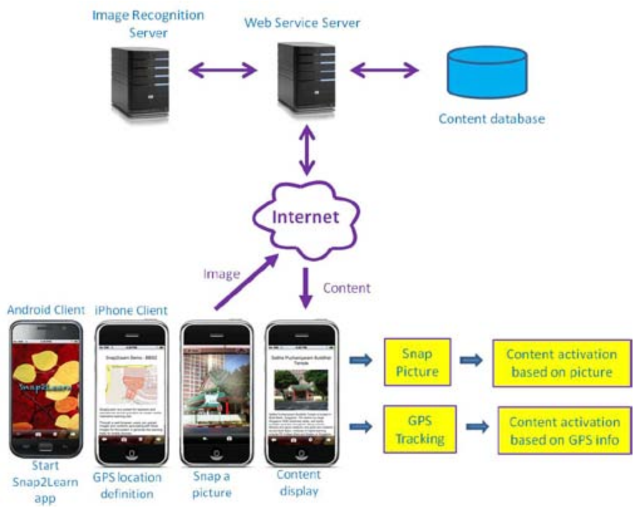

Figure 1. System architecture.

Two apps are developed on iPhone/iPad and Android phones respectively. Different learning contents can be customized at the server and displayed on the same mobile app. A web portal is developed for the teachers to create different learning trails and associate different learning contents to different objects of interest. The mobile apps are configurable to run different learning trails.

III. VISUAL INTERACTIVE LEARNING

Using our web portal, teachers can create any learning trails with their own teaching contents. The contents can be in the format of web pages, power point slides, PDF files, audio or video files etc. Teachers only need to associate the contents with the sample pictures taken from a set of objects of interest. With a button click, a learning trail can be created for the iPhone/iPad and Android phones. The iPhone/iPad app and Android phone app can be configured to run any one of the learning trails created by the authors. An outdoor learning trail can be designed as below. After the app started, instructions are given to the students on the learning objective and what to take note during the learning trail. First, students are given clues to look for an object of interest. When the object is found, a picture should be taken from the object. The picture will be sent to a server for image matching. Due to the page limitation of this paper, we will provide more details on the image matching methods in our future papers. Once the image is identified, the learning contents will be returned and displayed on the screen of the mobile device. Figure 2 shows the screenshots of our iPhone app on snapping a picture and the returned contents. The contents can be the information relevant to the object of interest. It may also be un-relevant to the picture. In this case, the returned contents can be another clue to find another object of interest, such as a treasure hunt game, until the final object is found. The returned contents can also be questions for the students to answer. The answer can be provided by the students directly or found from the returned contents by snapping another picture. Once the students submit the answers to the server, they can obtain scores. Then another clue is given for the next learning station. Bonus can be given for correct answers. With the bonus, the next learning station may be more attractive with more credits. During the learning trail, students need to understand the instructions and clues correctly the quickly. Thus the students' reading and comprehension capability can be trained. The answers to the questions can help students' learning on any subjects. For cultural heritage or history learning, the answers may be found on the objects of interest or by exploring the surrounding environments.

snap a picture teacher designed content internet content

Figure 2. Screenshots of the iPhone app.

IV. LOCATION ACTIVATED LEARNING

With the web portal, teachers can easily define the geographical areas and the contents to be activated. As shown in Figure 3, a user interface with geo-fencing tools is provided for teachers to draw the geographical areas on the map. Learning contents will be assigned to each area on the box pop up when the area is clicked. Teachers only need to fill in the source location of the video or audio, the URL of the webpage. The video, audio and webpage contents can either be located at a server connecting to internet or the smart phone locally. If they are located at the phone, no internet access is required when the contents are activated by entering the predefined geographical areas.

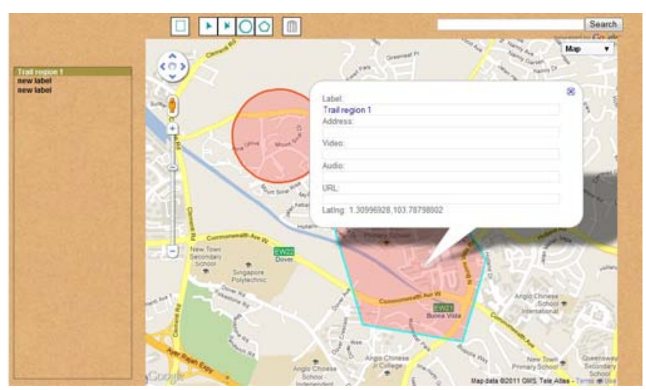

Figure 3. User interface with geo-fencing tools.

When students with the smart phone running the app enter any of the predefined geographical areas, an alert sound will be played and the text contents will be shown on the phone screen, or the audio, video will be played depending on the learning objective designed by the teachers. Different contents will be activated at different locations.

V. A TRIAL ON OUTDOOR HISTORY LEARNING

A trial was conducted for 13 teachers and 40 students on outdoor history learning at Boat Quay. Boat Quay is a historical quay in Singapore which is situated upstream from the mouth of the Singapore River on its southern bank. It was the busiest part of the old Port of Singapore, handling three quarters of all shipping business during the 1860s. A teacher created the learning trail using our web portal. 9 objects of interest were selected including a shop house, the Elgin Bridge, the Raffles statue etc. Learning contents were provided by the teacher for the students to learn about how people conducted shipping business there in the past. The learning contents include text description and pictures showing what the places looked like before. Students were given questions before the trail. During the trail, they were supposed to snap pictures from the objects of interest to get the answers.

A survey was conducted after the trial. Most of the teachers and students agreed that the smart phone app makes the overall learning trip more fun and enjoyable. The web portal for learning trail creation and the mobile app are easy to use. A few statistical results of the survey answers are shown in Figure 4.

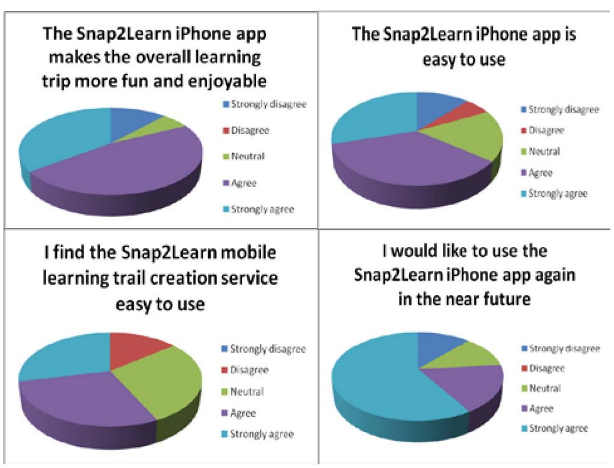

Figure 4. Results of survey answers.

During the trial, we found one of the problems that the students encountered is on the 3G connection. The 3G signal was not stable and at some of the locations the signal was very weak. Due to this problem, sometimes it took a long time for the students to get the returned contents after snapping a picture. And the app seemed hanging. This is because the picture is sent to the server via 3G network connection after it is taken. If the network connect is broken, the learning content will not be able to return to the smart phone even though the picture is identified. Some of the students were frustrated by this problem, which caused the disagreement on that the app is easy to use. For students holding a phone with better quality of 3G data plans, the connection problem didn't happen. A fun and smooth learning trip was experienced.

Due to the research challenge and limitation of the technology, the image recognition is not 100% accurate. A picture taken from an object of interest may not be recognized or it may be recognized wrongly. The correct recognition rate of our image recognition technology is about 93%. If a picture is not recognized, the app will tell the student to take another picture. In most of the cases, another picture taken from another angle will normally be recognized. In rare cases, if a picture is recognized wrongly, the wrong content will be returned. As the students roughly know about the objects of interest, they are able to identify whether the returned content is correct or not. If the wrong content is returned, the students will need to take another picture to get the correct content returned.

VI. CONCLUSIONS

We developed an interactive mobile learning application for iPhone/iPad and Android phones. Visual interactive learning is enabled by snapping a picture from a set of objects of interest. The content associating with the object of interest is returned once the picture is recognized in a computer server. A web portal is also developed for teachers to create learning trails easily. With the geo-fencing tools provided by the web portal, geographical areas are easily defined with associating GPS location activated contents. A trial was conducted for a group of teachers and students on outdoor history learning. A survey was conducted after the trial with positive feedbacks from both the teachers and students. In the future, we will continue to improve our application and the web portal for trail creation. We are planning for more trials with more teachers and students and to commercialize this technology.

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