안드로이드 웹 플랫폼 기반 U-Learning을 위한 M-Learning 애플리케이션

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M-Learning Application for Ubiquitous Learning Based on Android Web Platform

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요 약 본 연구는 U-Learning을 위한 안드로이드 플랫폼에서의 증강 현실 도입에 대한 것이다. 안드로이드는 모바일 컴퓨팅 및 개방형 기술의 새로운 기반이며, 안드로이드는 모바일 전화에만 국한되지 않고 다양한 장치에 적용이 가능하다. 또한 개발자의 기술을 활용할 수 있는 기회를 제공하며, 활동적이고 흥미로운 커뮤니티를 구축할 기회를 제공한다. 증강현실은 카메라, GPS 등 대부분 애플리케이션에 적용될 수 있으며, 점차 스마트 폰에서 일반화되고 있다. 증강현실은 웹 접속이 가능한 유비쿼터스 장비를 통해 개인들이 유연하게 정보들을 수신, 발신, 검토할 수 있는 교육 도구가 될 수 있다. 본 논문에서는 형식 정의에 증강 현실을 이용한 안드로이드 스마트 폰을 사용하여 형식 식별을 위한 증강 현실을 제안한다. 본 연구는 학생들의 외부 공간 실습 활동, 즉 동물원, 식물원 등이 방문 시에 유용할 것이다.

Abstract   In this paper we introduced Augmented Reality (AR) on Android platform for ubiquitous learning (u-learning). Android is breaking new ground for mobile computing and open technologies. Android is versatile as it is not limited only to mobile phones, but it can be installed on various devices. Android gives developers the opportunity to leverage their development skills, while also building an exciting and active community. Augmented Reality (AR) is going to be the future of most apps; all it takes is a decent processor, a camera, a compass and a GPS, all of which are becoming increasingly common on smart phones. Through AR we can have educational tools that provide individuals with total flexibility to receive, send, and review training and detailed product information through an increasingly ubiquitous web-enabled communication device. In this paper, we proposed Augmented Reality for Species Identification using Android Smartphone with augmented reality in species determination. This study is appropriate in the field of Biology. This is useful in outdoor experimental activities of the students. Like for example while they are visiting the zoo, botanical garden and etc.

Key Words : Augmented Reality(AR), Android platform, Ubiquitous learning, Species identification

1. Introduction

Augmented reality (AR) is a term for a live direct or an indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input, such as sound or graphics. It is related to a more general concept called mediated reality, in which a view of reality is modified(possibly even diminished rather than augmented), by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one.

Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable.

Augmented reality and computer vision is very hot topic now. Everybody is finding ways to utilize this emerging technology for education synthetic. It is one of the most disruptive applications for mobile learners. It is an example of location-based services, where information is provided to you based on your location, and even the direction that your phone camera is facing. With that information, your Smartphone can supply additional textual information about what you are looking at, or can blend computer generated objects with the video or still image on your screen.[4]

AR can also supply clues and problems to you through your Smartphone based on your location, allowing for both training applications and learning games while on the move. For example, there are AR applications that can add historical objects to the picture of your surroundings as you move through a town, giving you a richer sense of the historical significance of an area. Another AR application tells you the tenants of a building as you point your camera in its direction.[4]

2. Background

Augmented reality (AR) is an emerging form of experience in which the real world is enhanced by computer-generated content specific to a location and to an activity. Today, AR applications have become portable and available on mobile devices. AR is beginning to change news, entertainment, sports, e-commerce, travel, museums, architecture, and marketing in tangible, exciting ways. In education and training, AR has the potential to make ubiquitous learning a reality, allowing learners to gain immediate access to a wide range of location-specific information from various sources. The 2010 Horizon Report predicts that the use of simple AR in education will be widespread within 2 to 3 years on U.S. college campuses.[1]

Although AR is not new, it is still in infancy especially applying in education. As an educator, I think AR has great potentials in teaching and learning. We should examine the impact of AR on society, evaluate the implications of AR for education, and explore the integration of AR applications into teaching and learning environments.[1]

Media spaces can be thought of as the video counterpart of ubiquitous computing. The combination of the two is what we call Ubiquitous Media. Ubiquitous Media can also be understood in relation to Artificial Reality. Rather than turning inward into an artificial world, Ubiquitous Media, encourage us to look outward. It expands our perception and interaction in the physical world.[7]

While the capability to deliver augmented reality experiences has been around for decades, it is only very recently that those experiences have become easy and portable. Advances in mobile devices as well as in the different technologies that combine the real world with virtual information have led to augmented reality applications that are as near to hand as any other application on a laptop or a smart phone. New uses for augmented reality are being explored and new experiments undertaken now that it is easy to do so. Emerging augmented reality tools to date have been mainly designed for marketing, social purposes, amusement, or location-based information, but new ones continue to appear as the technology becomes more popular. Augmented reality has become simple, and is now poised to enter the mainstream in the consumer sector.[12]

3. Augmented Reality Requirements

Hardware: The main hardware components for augmented reality are: processor, display, sensors and input devices. These elements, specifically CPU, display, camera and MEMS sensors such as accelerometer, GPS, solid state compass are often present in modern smartphones, which make them prospective AR platforms.

Display: There are three major display techniques for Augmented Reality: head‑mounted displays, handheld displays and spatial displays.

Head‑mounted: A Head Mounted Display (HMD) places images of both the physical world and registered virtual graphical objects over the user's view of the world. The HMD's are either optical see‑through or video see‑through. Optical see-through employs half-silver mirrors to pass images through the lens and overlay information to be reflected into the user's eyes. The HMD must be tracked with

sensor that provides six degrees of freedom. This tracking allows the system to align virtual information to the physical world. The main advantage of HMD AR is the user's immersive experience. The graphical information is slaved to the view of the user.[8]

Handheld: Handheld displays employ a small display that fits in a user's hand. All handheld AR solutions to date opt for video see-through. Initially handheld AR employed fiduciary markers, and later GPS units and MEMS sensors such as digital compasses and six degrees of freedom accelerometer-gyroscope. Today SLAM marker less trackers such as PTAM are starting to come into use. Handheld display AR promises to be the first commercial success for AR technologies. The two main advantages of handheld AR is the portable nature of handheld devices and ubiquitous nature of camera phones. The disadvantages are the physical constraints of the user having to hold the handheld device out in front of them at all times as well as distorting effect of classically wide-angled mobile phone cameras when compared to the real world as viewed through the eye.[9]

Spatial: Instead of the user wearing or carrying the display such as with head mounted displays or handheld devices, Spatial Augmented Reality(SAR) [11] makes use of digital projectors to display graphical information onto physical objects. The key difference in SAR is that the display is separated from the users of the system. Because the displays are not associated with each user, SAR scales naturally up to groups of users, thus allowing for collocated collaboration between users. SAR has several advantages over traditional head mounted displays and handheld devices. The user is not required to carry equipment or wear the display over their eyes. This makes spatial AR a good candidate for collaborative work, as the users can see each other's faces. A system can be used by multiple people at the same time without each having to wear a head mounted display. Spatial AR does not suffer from the limited display resolution of current head mounted displays and portable devices. A projector based display system can simply incorporate more projectors to expand the display area. Where portable devices have a small window into the world for drawing, a SAR system can display on any number of surfaces of an indoor setting at once. The drawbacks, however, are that SAR systems of projectors do not work so well in sunlight and also require a surface on which to project the computer-generated graphics. Augmentations

cannot simply hang in the air as they do with handheld and HMD-based AR. The tangible nature of SAR, though, makes this an ideal technology to support design, as SAR supports both a graphical visualization and passive haptic sensation for the end users. People are able to touch physical objects, and it is this process that provides the passive haptic sensation.[10-12]

Tracking: Modern mobile augmented reality systems use one or more of the following tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, RFID and wireless sensors. These technologies offer varying levels of accuracy and precision. Most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.[13]

Input devices: Techniques include the pinch glove, [20] a wand with a button and a smartphone that signals its position and orientation from camera images.

Software and algorithms: A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent from the camera, from camera images. That process is called image registration and is part of Azuma's definition of Augmented Reality. Image registration uses different methods of computer vision, mostly related to video tracking. Many computer vision methods of augmented reality are inherited from visual odometry. Usually those methods consist of two parts. First detect interest points, or fiduciary markers, or optical flow in the camera images. First stage can use feature detection methods like corner detection, blob detection, edge detection or thresholding and/or other image processing methods.

4. Augmented reality Applications for Android Smartphone

Augmented Reality (AR) is going to be the future of most apps; all it takes is a decent processor, a camera, a compass and a GPS, all of which are becoming increasingly common on smart phones. This futuristic AR world for android is slowly growing. Though, the true experience of Augmented Reality Technology.

Layar is the world's first augmented reality app and it uses Android's GPS, camera, and compass features to display

real-time information on the things you see and explore. Once you point your phone camera to the places in front, details are displayed on the screen. Be it restaurant, school or hospital you will get the info quickly. Developers created many layers for diff services and many more are in pipeline.

Wikitude Drive is an Android navigation app that makes use of the Augmented Reality technology to overlay your route directly on top of what is coming through your Android phone camera's viewfinder. This app can truly replace your virtual tour guide and can be helpful for frequent vehicle users. Real time geographical data is spiced up with camera inputs to give you a visually rich experience.

TagWhat is basically a social networking app that make use augmented technology. It lets users to tag whatever they see in front of them using the apps tag feature. Once tagged your friends when visiting those tagged places will see the details while pointing their android phone to places in front.

Google Goggles is Google Inc's contribution to this emerging revolutionary technology. While the app is running just point your android phone's camera to an object in front and capture. The app then uploads it to SnapTell server and image recognition backend compares images with available ones to find an exact match. A very useful and worth using AR app available till date we say.

Space InvadAR is the latest addition to Android augmented reality space. It's actually a vision based game that makes use of AR. You point the camera towards a high resolution image and the app loads the right game based on the image. Here for demo purpose they have used an earth image and a fun game loads. Watch out this app is a paid app and is costly. All the requirements for augmented reality (AR) are met by android OS and technology like Smartphone. Fig. 1 illustrates the requirements of AR that are all present in android platform.

5. Augmented Reality for Ubiquitous Learning: Why?

As the economic realities of education change and today's student becomes ever more sophisticated, the platforms used for teaching students must evolve to remain effective.

[Fig. 1] Augmented reality on android platform

In addition to traditional classroom-based instruction and more recent e-learning methods, AR provides the ideal platform for busy, always-connected students to learn at a pace and through a medium that suits them. In addition to the flexibility (time and space) of a portable training solution, AR learning enables students to digest information and learn at their own pace, repeating lessons and practice exams as needed to gain a mastery of their subjects.Reality has many features that revolutionized ubiquitous learning. It can be deploy to Smartphone which can be used in ubiquitous learning. All the possible things that we can ever imagine in ubiquitous learning are available and can be possible with AR. Utilizing the current technology for AR will meet the desired ubiquitous learning. Augmented reality deployed in android Smartphone for ubiquitous learning is a great integration. Many AR applications are now deployed in android as what we have mentioned in previous sections. Currently, these applications have specific uses. But as we study it, each application can contribute for the success of AR for ubiquitous learning. The best way is to have android based augmented reality platform for ubiquitous learning. Take as example is the "'Books 'Pop' With New Augmented Reality Tech" which was designed to give real learning experience. It change the way we interact with our favorite games and books. Like the kids apparently found out on their first try, combining the real world with three-dimensional figures is an immersive experience with potential. But this technology is not really designed for ubiquitous learning because it does not support mobility. It is a classroom based learning technology. But it is pretty good and gives interactive and exciting learning experience. The new trend now is putting learning anytime and anywhere, and so putting augmented reality to mobile phones will every one of us to learn while in mobile. Put information everywhere, utilized that information to learn, help us gather information as fast as just a click. That is how ubiquitous learning should

be with augmented reality. While walking in the road, finding nearest restaurant or gasoline station, emergency help, location determination, searching for real time information we can use our Smartphone with augmented reality application. That is how augmented reality will revolutionized u-learning.

Discovery-learning is also a new term applied in ubiquitous learning. This section will focused on the augmented reality for ubiquitous learning in discovery approach learning.

6. Proposed Augmented Reality for Species Identification

We will be using Android Smartphone with augmented reality in species determination. This study is appropriate in the field of Biology. This is useful in outdoor experimental activities of the students. Like for example while they are visiting the zoo, botanical garden and etc.

The two applications that android have now like Google Goggles and TagWhat has features that can be applied to species identification. Google Goggles app is running just point your android phone's camera to an object in front and capture. The app then uploads it to SnapTell server and image recognition backend compares images with available ones to find an exact match. TagWhat is basically a social networking app that make use augmented technology. It lets users to tag whatever they see in front of them using the apps tag feature. After capturing the image then compare to the data in on the internet for the exact match of the capture image. It includes image description which help in identifying the species of the image, take for example the butterfly.
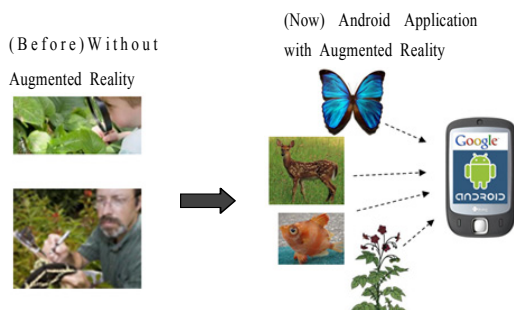
[Fig. 2] Species Identification with Augmented Reality

7. Conclusion

In this paper we introduced Augmented Reality (AR) on Android platform for ubiquitous learning (u-learning). Android is breaking new ground for mobile computing and open technologies. Android is versatile as it is not limited only to mobile phones, but it can be installed on various devices.

Augmented Reality (AR) is going to be the future of most apps; all it takes is a decent processor, a camera, a compass and a GPS, all of which are becoming increasingly common on smart phones. In this paper, we proposed Augmented Reality for Species Identification using Android Smartphone with augmented reality in species determination. This study is appropriate in the field of Biology.

[Fig. 3] Matching image after capturing

This is useful in outdoor experimental activities of the students. Like for example while they are visiting the zoo, botanical garden and etc. In our future works, we will try to develop application designed for Species Identification integrating the google goggles features and TagWhat applications.

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<Research Interests>
E-learning, U-learning, Security application for education system, privacy issues for teachers and students