Mobile Application Outdoor Navigation Using Location-Based Augmented Reality (AR)

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Abstract. In order to formalize and co-create the Industrial Revolution 4.0. Augmented Reality is indispensable to facilitate human life. As a result, the difficulty is experienced by the user to know the exact location. As such, these developed applications can greatly assist mobile application users in making it easier to decide where to use their smartphones in specific location. Using Augmented Reality GPS location-based is well suited to a phone's ability to have GPS sensors. Therefore, the place the user is searching or choosing is at the end of the user's finger and it is in the form of virtual environment real-time.

1. Introduction

The ability to map computer graphics to real world is often called Augmented Reality (AR). Unlike deep Virtual Reality, AR interfaces allow users to see the real world at the same time as virtual images attached to real locations and objects. In the AR interface, users view the world through a handheld or headset display (HMD) that either views or crosses the graphics of surrounding environment videos. AR interfaces enhance the real-world experience, unlike other computer interfaces that draw users away from the real world and onto the screen [1].

The Location-based services (LBS) have gained high interest due to rapid advances in mobile technologies, wireless communication and ubiquitous computing that enables Augmented Reality. Mobile navigation is one of the most important applications within LBS. Augmented reality is a powerful technique to enable human interaction with virtual objects in their surrounding environment. Augmented reality differs from Virtual Reality as it supplements reality rather than immersing the user in a synthetic environment. It states that the main characteristics of augmented reality should include a combination of interactive virtual objects that are processed and displayed in real-time within the user’s environment. These characteristics differentiate augmented reality from Virtual Reality or simply a 2D display over a live video feed [2].

Augmented reality enables a rich and ubiquitous interaction for the user with the environment [3]. Indoor navigation is one of the interesting areas where augmented reality is being explored to give users an interactive navigation experience. Augmented reality indoor navigation will lessen the abstraction of conventional map navigation which requires the user to orientate using available landmarks, process pathways to desired location and memorizing the pathway. It has been show by May et al. that participants use landmarks more frequently as navigational cues in outdoor navigation.
than distance information and street names. People tend to lose direction a lot easier within a building than outdoors due to lack of landmarks. Navigation is described as a method of determining the direction of a familiar goal across unfamiliar terrain. Augmented reality as technique for a non-traditional indoor navigation system provides an alternative and more effective method to navigate across unfamiliar terrain than traditional indoor navigation systems. Research into human interaction with non-traditional indoor navigation systems is limited, prompting this research [4].

![Figure 1. The view of augmented reality](image)

2. Related works

Mobile computing capabilities have increased dramatically, to the point where additional reality has become feasible on mobile phones. The approach to internal localization and generate estimates to support additional reality applications on mobile phone platforms. Using the embedded camera, the application localizes the device to its normal environment and determines its orientation. Once 6 DOFs are destined to be determined, 3D virtual objects from the database can be projected into images and displayed for mobile users. Offline data acquisition consists of acquiring images in different locations in the environment. Determination of online pose is made by the feature-based matching between the cell phone image and the image selected from the previous database using the phone sensor (accelerometer and magnetometer). The app allows users to visualize virtual objects in camera images and localize them in normal environments. We describe in detail the process of building a database and estimating algorithms used on mobile phones. We evaluate the performance of the algorithm and its accuracy in terms of distortion of 3D virtual objects in a mobile phone image. [4].

Augmented virtual reality systems require head and object trackers that help create an effective illusion of virtual objects that coexist with the real world. The tracker must work at long ranges and know the approximate position of the user's head. Users can override any conflicting signals by using their visual sense. Augmented virtual reality consists of supplementing rather than supplanting the real world. Visual objects must be properly aligned for the proper registration of the virtual objects to the real world. There are no systems that presently have both sufficient range and accuracy to track at long ranges to the precise degree that is desired [5].

The technological capabilities of modern smart devices have increased our ability to run applications such as desktops by demanding resource requirements in the mobile environment. Throughout this stream, many concepts, techniques, and prototypes have been introduced, focusing on the basic implementation issues of mobile applications. However, only a small amount of work related to the design and implementation of (i.e., engineering) sophisticated smart mobile applications and reports on lessons learned in this context. In this paper, we provide an in-depth overview of the design and implementation of such mobile applications, which allow for location-based augmented reality on two different mobile operating systems (i.e., iOS and Android). In particular, this type of mobile application is characterized by high resource demands as multiple sensors need to be considered over
time and many virtual objects may need to be pulled in real-time on smart mobile device screens (that is, high number of frames per second). We focus on efficient deployment of robust mobile reality engines, which provide location-based functionality, as well as implementation of mobile business applications based on these engines. In the same context, we also discuss the lessons learned when implementing mobile business applications with our augmented reality engine [6]. Table 1 are the comparison of the previous project that related to Augmented Reality system.

| Index | Title                                                                 | Implemented               |
|-------|------------------------------------------------------------------------|---------------------------|
| [4]   | Location-based Augmented Reality On Mobile Phones                      | - Sensors                 |
|       |                                                                        | - Accelerometer           |
|       |                                                                        | - Magnetometer            |
| [5]   | Tracking Requirements for Augmented Reality                           | - Accelerometer           |
|       |                                                                        | - GPS                     |
| [6]   | Location-based Mobile Augmented Reality: Challenges, Examples, Lessons | - Sensors                 |
|       | Learned                                                               | - Accelerometer           |

### 3. The structural design of the AR location-based

In the development of AR, it goes through some of the processes commonly used by some AR developers. Figure 2 shows the structural design of the AR location-based in the project.

#### 3.1. System planning

The use of GPS, accelerometer, digital compass is one of the techniques used in the development of location-based or geo-based AR. Therefore, every mobile device use requires permissions to access the sensors that are already installed on the device. In the development of AR modeling is very important. Hence, the appropriate asset design is selected in the delivery the content. The development of the model needs to be consistent in the contact that it intends to convey in order not to conflict with the user's wishes. Figure 3 shows the modelling of the asset in Unity.
3.2. AR Tools

The use of game engine like Unity is very good in AR development as every AR development facility is built into it. Unity is a platform for incorporating 3D modeling, AR GPS-location and ease of exporting to mobile device formats. The selection of coordinate area should be accurate in order to avoid any error. Choosing a flat area or a road is best used in AR development. Then the selected coordinates must be divided into longitude and latitude to make it easier to understand the Unity AR GPS-location software. Figure 4 and Figure 5 shows the specific coordinate that had pick from user and the approximate coordinate from the maps.
3.3. AR Apps

To create an application, there are many ways and formats to export the application to a smartphone. Figure 6 shows some exportable formats such as iOS, Android OS, MacOS, Windows OS, Linux OS and so on. Furthermore, to create applications within smartphones, the iOS platform is used for AR GPS-location production. The iOS platform selection is more stable because the iPhone has the ARCore SDK and it is compatible with the Unity AR.

4. Project Result

Based on the final decision of the project, the techniques used in GPS-location can be implemented in a AR location-based. The result can be seen from Figure 7 below which shows the smooth pavement of the road is identified through the yellow square because the yellow square will scan the flat surface area. By using the coordinates that have selected, the object or asset that has designed will appear in virtual environment on user smartphone using a real-time view.
Integration is a process of combine close and smooth coordination between multiple departments, groups, organizations, systems, etc. Multimedia integration of animation, audio, graphics, text, and full motion video are made through computer hardware and software for education, entertainment, or training of a few groups.

5. Conclusions
Although Augmented Reality technology is not new, the potential for environmental education is just beginning to be explored. Unlike other computing technologies, the AR interface offers seamless interaction between real and virtual worlds, tangible interface metaphors and ways to switch between real and virtual worlds. Developers should work with researchers in the field to explore how these features can be applied effectively to the campus environment [7].

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