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Augmented Reality Navigation

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Abstract - **With the introduction of the Android system, smart phones are growing faster and more easily with internet access to smart phones, user location information can be quoted anywhere at any time with ease. With this growth, many new technologies are introduced and to be very beneficial to the Users as they can be used with the existing technologies/applications in various fields. One of the major technologies introduced is Augmented Reality, this can be used to interact with the real world using virtual objects and videos. Augmented Reality based Technology enables the provision of a variety of information such as photos and placement of buildings in the travel field. This field can also be used in the Navigation as discussed in this paper. Most of the unconventional virtual programming used for the Visual Trace Way (Marker and Marker less method). For visual tracking, digital tagging and digital information should be provided while the Non- visual Trace Way requires the use of Hardware (G.P.S, sensors etc.). Most navigation requests can only show the path from the user's current location to its destination. In this paper, the design and implementation of augmented reality system are discussed. It will use a well-designed smart phone camera and GPS to display user-centric information in real time on a smart phone. The proposed app will combine G.P.S location technology with tracking technology to provide the user with basic information about the building they want or one they are close to.**

KEYWORDS: Augmented Reality, Navigation Systems, Indoor Tracking, Campus Navigation, Android Navigation.

1. INTRODUCTION

For centuries, people have been trying to find ways to improve navigation. Historically our use of maps and compasses in the time of exploitation or, in modern times, the use of Google Maps to find the fastest way to access their destination. Navigation systems play a major role in our daily lives. Today's systems use satellite navigation technology to position and show the path to users. They usually provide turn-by-turn navigation instructions and occasional 3D rendering of the path. However, they run on a special device (usually a smartphone or laptop) and require the user to divert their attention to interact with the software. This often causes occasional dissatisfaction with users and accidents.

Augmented reality (AR) is a technology that "infuses" physical objects into the real world. AR strives to mix the real world with the physical world in such a way that both physical and abstract objects are visible to the user in the same space. R. Azuma describes AR as systems - "combine real and virtual information, interact at real time, and are registered in three dimensions". An augmented reality navigation system is a system that uses augmented reality technology to navigate the to the users. In essence, the system combines explicit navigation information with real-world objects. Such systems can be used in a variety of contexts such as motorized navigation, pedestrian navigation, indoor navigation, etc. In all of these cases, the goal is to help the user reach their destination successfully by adding real-world information to navigation. For example, displaying navigation marks on a car line or navigating a video camera from a smartphone with a navigation system, etc.

1.1 Goals

The main purpose of this application is to provide a mobile-based, controlled-to-visitor solution as they move around any buildings such as College, Supermarket, Hospital, etc., and, the purpose is to reduce time-consumption, split-group and gain efficiency, accuracy, application friendliness, as well as the speed, of the application for a small area of the building.

1.2 Objectives

Provide an easy-to-use, mobile-based solution system, which will contain all the necessary information, to ensure convenience, accurate navigation and identification of various buildings, doors and to help guests reach their desired location without difficulty.

1.3 Scope

The scope of the application is determined by the time allocation, resources and customer demand. The scope of the program is limited and can grow the way it is done. Users can navigate the building with the advice provided by the AR browser. They can view construction, locations etc. Or they are searching for places.

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1.4 Overview

In this modern era, successful navigation has become increasingly important as cities develop and are set to grow with skyscrapers and large buildings built continuously. Due to this need, for technologies such as the Global Positioning System, GPS was developed to help navigate. However, door-to-door is still a problem because there is no such accurate, efficient and risk-free technology to find the need.

The project aims to use augmented reality to develop the type of advertising that facilitates circulation within the home. An augmented reality is the idea of a real world transmitted by some kind of sensory input to a production such as sound or graphic. This app is designed for smartphones as almost all smartphones today are equipped with the camera and the processing power of the graphics that provide access to other graphics. This program is developed using the Android SDK and the Vuforia Augme nted Reality SDK.

2. RELATED WORK AND PROBLEMS

In this chapter, the existing applications and the problems associated with these applications and the problems with the present Navigation applications will be discussed.

2.1 Similar Applications

2.1.1 Arizona Mobile [8]

Arizona Mobile [8] is the first official app and one-touch experience for all things for University of Arizona including a navigation system. Not only does Arizona Mobile make life easier for current students, but past/ present students around the world can stay up to date with features like event calendars and video tours that make every user feel like they’re on campus – no matter where they are.

Features:

Some of the main features included in this system are Maps, Phonebook and campus directory, Course listings, U-Access Student, UA-news, Event listings, Social Media, Videos, Library, Tours, Photos, Alumni, Emergency contacts.

Review and Comparison:

There are few unique features residing with this mobile application. For example, the users’ social interaction function is a new addiction. Pupils could be in updated with college news and headlines via this application. But the map is not well working with upper versions of Android mobiles because there are less utility and information given. Would suggest integrating University Access into the app rather than directing to a browser for the mobile site.

2.1.2 Oregon State University Mobile [9]

The application comes in both iPhone version and Android supportive platforms. The description for the application system developed by the University of Oregon is as described below.

Features:

- Offers an optimized experience for a variety of web phones and devices.
- Can access this site from any mobile web browser, with real-time data.
- Can find buildings on campus or track down phone numbers just using your thumb: the auto-populating people finder will even complete user typing, saving time in a crunch.

Review and Comparison:

It is more of iOS rather than Android. Still uses outdated iOS UI elements. Quick functionality of finding buildings and phone numbers. Could work on the add contacts. Would add the email to the wrong contact on user phone. If could link towards the online services, this app would be phenomenal.

2.2 Problems

Currently, the most popular navigation systems used in the market are smartphone applications or stand-alone systems that use distance-based writing and home-satellite navigation. The navigation system usually displays a map where the navigation method is displayed and the user's current configuration. As well as this, the app works and inspires the user by providing instruction, either vision or audio, to follow the intended path. Although existing navigation applications solve the problem of navigation, they are not in the best interests of users. Typical navigation systems show navigation information in a restricted form that usually shows arrows pointing in the direction or by providing a "bird's eye view" of the map and the intended route. Look for a car navigation system that usually has a screen on the dashboard showing navigation information. The driver should look in the mirror for details. This actually gets the driver's attention out of the way and such distortion is a major problem because it puts the driver's safety at risk. In fact, research shows that distraction from drivers as a result of traffic congestion has led to several accidents. This type of distraction can be prevented by using augmented reality in navigation procedures while convincing the driver to focus on the road.

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3. AUGMENTED REALITY NAVIGATION

In general, augmented reality navigation can work as follows:

1. Get real-world views from the user's perspective.

2. Get user tracking location information. This information typically links GPS.

3. Generate visual world information based on real-world views and geographical location.

4. Register the physical information generated by the real world view and display the user information, thus creating augmented reality.

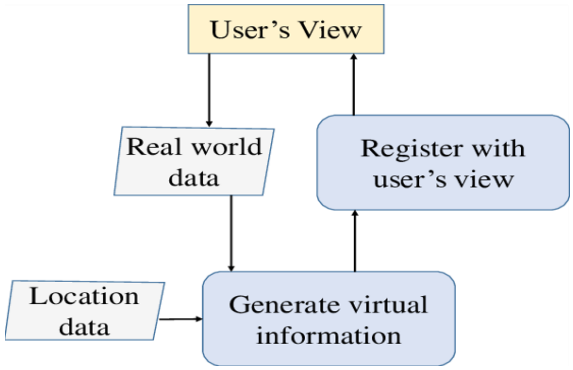

Fig. 1: Flow Chart for AR Navigation

In the following subsections, we describe the technology considerations for AR navigation systems. Thereafter we introduce different types of state-of-art systems and then list the opportunities and challenges for such systems.

3.1 Design Considerations

The main challenges lie in combining virtual and real worlds, and designing navigation interfaces. There are plenty of display technologies that enable unmatched augmented reality listed in the next section. There are also numerous navigation interfaces that are proposed to get the best user experience.

3.1.1 Augmented reality Display

How to display augmented information to a user is a constant problem in AR. There are many display options ranging from full-featured display to standard display. In the AR navigation system, the display should not be compatible with the user's navigation. Display technologies that are genuinely augmented like:

Video display: A complete video display puts a digital screen between the real world and the user. The user sees the real world with augmented details to be added to this screen. The real-world view is captured using a camera that is integrated with augmented information and displayed on the screen, which can be in front of the user's eyes to provide a realistic view or can serve as a separate monitor. An example of that kind of display is a head mounted display with cameras.

Optical display: The optical display uses a transparent and a reflective screen, also called a connector(integrator), in front of the user's eyes. Details are projected on this connector by the projector. The end result is that the user is able to see the visual information and actual views augmented to the same plane (screen). Note that only the virtual information is projected at the integrator, while the actual view looks exactly like it is since the connector is transparent. Thus, the illusion of an interconnected virtual and real world is created. An example of this is the type of fighter plane of a plane in which the virtual information is projected.

Projective: In a projective AR demonstration, virtual information is shown directly to the actual object instead of being digitally displayed or seen on the screen. This type of AR display can cover large areas of the world. However, the quality of the coverage provided may vary depending on the type of range in which the information is projected.

For navigation purposes, selecting an AR display can be difficult because all of the visual(virtual) references discussed above are possible. Considering the car's navigation, the user's need should be for free movement and minimal adoption. However, it is recommended to see where the Windshield of the car works as an integrator. In the case of pedestrian or indoor navigation, a watch video displayed on a smartphone is a great way to use it.

3.1.2 Navigation Interface

Navigation information can be displayed to the user in many ways. A few examples include, pointing the arrows towards the intended direction or painting the road in bold color.

It is suggested that the interface should be designed from the perspective of the driver (of the user) i.e. the route to be delivered should be painted in bold color. This establishes a clear path from the driver's perspective. In addition, the curvature and exit that are hidden due to obstructions to view should also be visible by placing the overlaying road in an obstacle course. The same points they hold for the pedestrian-friendly plan.

However, the highlighted path can create a confusion when displayed through an object blocking view. To eliminate this, it is proposed to draw a path highlighted in the sky so as not to disturb the intended direction of the user.

The starting point to be talked about is expanding the navigation interface for audio commands. Therefore, the system should provide means of moving and assisting using sound.

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A global overview of the route on the map is also helpful along with the latest misleading information. This is similar in what is shown in car racing video games like the need for speed. In this case, the driver is more detailed and can decide to drive in advance.

3.2 Different kinds of AR Navigation

This section describes various scenarios in which augmented reality can be exploited for navigation. Traditional navigation systems are commonly used for traffic and pedestrian navigation. Real-life experiences can dramatically increase user experience of these streaming services. Indoor navigation is also a great tool for using AR.

3.2.1 Car Navigation

The main goal of making practical use of the augmented reality inthe navigation system is to keep the driver on the road and solve problems related to traditional navigation as discussed in section 2.2 above. AR Navigation is proposed for car navigation that allows the user to be free from additional AR resources. This is achieved by embedding the operating equipment into the user's environment, that is, the vehicle. This should be followed in order to fulfill the above recommendation: A car windscreen on the screen, tracking locations using GPS and other sensors.

Another Hardware features a video camera to detect the driver's viewing behavior. Location information is obtained not only by the GPS sensors in the rear but also by means of a vehicle tracking system that uses wheel sensors when GPS is not available. Therefore, the broadcasting of the camera and location data is provided by the software. The software then uses the camera input, compares it to stored maps and dynamic road data (construction, accidents, etc.), and creates a 3D image of the road. Based on the navigation system selected by the driver, the 3D image is annotated by road lighting. This 3D image is transmitted to an AR provider that registers virtual information in real-world view and displays it to the driver's windshield.

Fig. 2: AR Navigation for Vehicles

3.2.2 Pedestrian Navigation

The navigation system is not just a vehicular navigation system but it should be sufficient for pedestrians as well. There are a number of smartphone applications that work both as a pedestrian and a vehicular navigation system. The basic goal of AR navigation for pedestrians is similar to vehicular navigation systems.

A program like the one in Section 3.2.1 was sent to the smartphone as smartphones are the ubiquitous today. The software uses orientation sensors to display AR information as efficiently as a smartphone can be accessed in any way. Location information is collected through GPS sensors. If GPS is temporarily unavailable, the location can be detected by looking at the dead reckoning using the orientation and the accelerometer sensor of the smartphone. A real-world view is available on an existing camera on a smartphone. After that, the navigation details/information created are integrated with real world camera streaming and displayed on a smartphone screen. Broad functions such as rendering graphics, route calculations, etc. transferred to a different server. Nowadays, these functions can be deployed on a separate cloud computer while the smartphone acts as a small client.

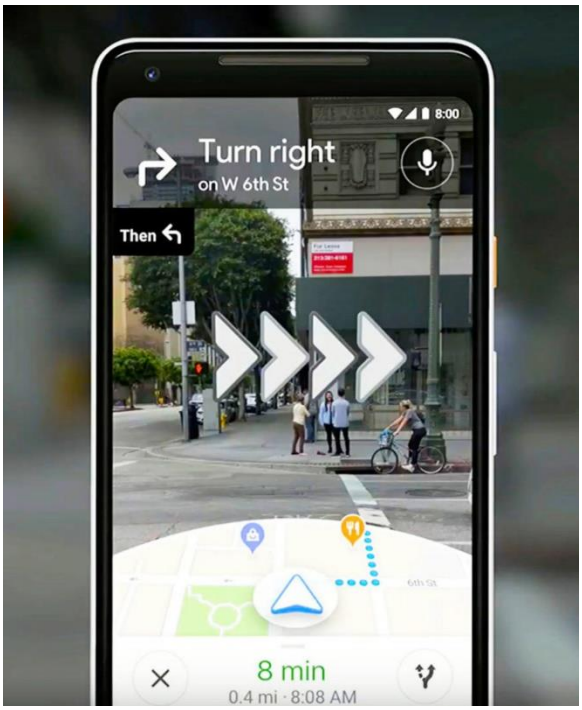

Fig. 3: Google Maps AR Navigation

In this system, images of landmarks can be used to perform pedestrian navigation commands. When the user selects a path, the system collects images of landmarks along the way. Subsequently, the images are enhanced with orientation in-

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formation using arrows pointing correctly. Finally, the user is presented with the details as an image sequencing.

3.2.3 Indoor Navigation

Augmented reality can also be applied to internal(indoor) navigation. It is different from other navigation applications in that it detects the user's location. It is known to build structures attenuate GPS Signals. In the absence of GPS-enabled locations, localization can use other techniques such as Wi-Fi, Bluetooth, or fingerprinting. In addition, indoor paths must first be mapped and stored in the database and used as a reference for the user's location adjustment. There are a couple of promising technologies for indoor use: two upgraded ones are iBeacon, from Apple and Indoor-Atlas from a company with the same name. Some technologies use physical references such as QR codes to detect non-progressive locations. Once the location is rediscovered, it can be used along with the camera installation to create the augmented reality information in the navigation system.

Fig. 4: Indoor AR Navigation

The supported indoor navigation system that does not monitor the user's location continuously, instead uses information points (interest points) printed on the floor to find the user's location. When the user has chosen a route, the system creates a task that specifies the number of steps and time to be taken. The details of the navigation are registered in 3D on the smartphone by enabling camera streaming. For example, the user first selects the start point by scanning the QR code on the floor/wall and at its destination. After that, the system produces activities. The user's real-time location is calculated by the dead estimate, that is, by counting the number of steps the user has taken from the last location-point. The system shows points of interest round the user when the camera is moved. The points of interest are obtained based on user's location and recorded in the camera stream using data from the compass, gyroscope, and accelerometer sensors. Since dead reckoning suffers a reduced accuracy over time, the user needs to update its location by scanning another way-point when moving.

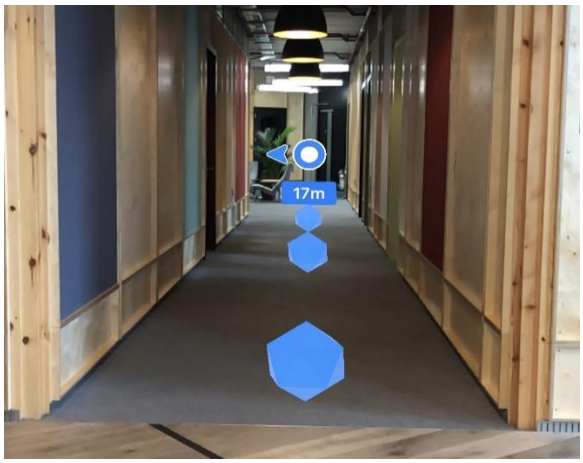

Fig. 5: Indoor AR Navigation

3.3 Opportunities and Challenges

Here are a few of the opportunities for augmented reality navigation systems over traditional navigation systems, including driver safety in which the driver is notified of details such as hazard zones, crash warnings, route alerts, speed limits, zebra crossings, etc. The paper also discusses details of contact issues such as nearby operators, and specific status information, or key locations.

It is found that an augmented reality system, despite the necessary improvements, is better than most current navigation devices. AR navigation significantly reduced navigation errors and problems associated with fragmented/divided attention. Augmented reality applications for vehicular, pedestrian or indoor navigation are very interactive and realistic. In addition, combining navigation with some contextual information enhances men's user experience. Increasingly, consider traveling to the mall using the AR navigation system on your smartphone that shows all the discounts available in the store you pass by.

There is difficulty using the AR navigation system too. The user experience depends on the amount of virtual information augmented with the real world. The details of the navigation should not hide the user's real-world views. This could also lead to security issues where the user's AR view is too intrusive to allow user to focus on the road. Therefore, the design of the AR navigation display connector is very important. AR navigation can lead to privacy concerns as well. Since applications capture real-world camera input, some users may find that they are surrounded by multiple cameras.

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4. CONCLUSION AND FUTURE WORK

This paper presented a rigorous literature review of AR navigation techniques including design considerations and various navigation types. It also presents a variety of opportunities and challenges for using AR in navigation.

Augmented reality is a very powerful way to improve user experience in navigation applications. Apart from the user experience, it extends far beyond driver safety. Examination of research literature suggests that AR significantly increases driver's attention. Although the current technologies are far from a full-fledged AR experience, research is moving fast and several institutions and companies such as BMW, Pioneer, and Toyota are working on development in navigation. It is important to note that the use of AR in navigation is highly dependent on advances in the field of augmented reality. Also, the acceptance for AR navigation will depend on the better user experience. It will be interesting to see how this technology develops in the future.

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