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AUGMENTED REALITY: APPLICATIONS AND FUTURE ADVANCEMENTS

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ABSTRACT

This paper surveys the field of Augmented Reality, in which 3-D virtual objects are integrated into a 3-D real environment in real time. It describes various applications of Augmented Reality. This paper is meant to give a brief overview about Augmented Reality for those who are new to this field. Registration and sensing errors are two of the biggest problems in building effective Augmented Reality systems. We will also be discussing various types of Augmented Reality. This review provides a starting point for anyone interested in researching or using Augmented Reality.

General Terms

HMD, Virtual Reality.

KEYWORDS: Augmented Reality, Technologies, Applications, Limitations

1. INTRODUCTION

1.1 What is Augmented Reality?

Imagine bubbles floating before your eyes, filled with cool info about stuff you see on the street. It's augmented reality. And one day it won't be a luxury but a necessity. The virtual scene generated by the computer is designed to enhance the user's sensory perception of the virtual world they are seeing or interacting with. The goal of Augmented Reality is to create a system in which the user cannot tell the difference between the real world and the virtual augmentation of it.

1.2 Definition

Augmented Reality (AR) is a variation of Virtual Reality (VR) as it is more commonly called. VR technologies completely immerse a user inside a virtual environment wherein the user cannot see the real world around him. But, AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world. AR doesn't replace reality instead it supplements reality. Figure 1 shows an example of what this might look like. Without AR this would simply be viewed as a street view but AR makes it possible to add more information to the street view. It makes it more informative.

Figure 1: Application of AR

2. APPLICATIONS OF AUGMENTED REALITY (AR):

2.1 Mobile Based AR

Mobile Augmented Reality is one of the fastest growing research areas in AR. The reason for this is emergence of smart phones that provide powerful platforms for mobile AR [8].One reason for this is emergence of Smartphone’s that combine fast CPU’s with displays, cameras, graphics acceleration, compass, GPS sensors and even gyroscopes. Now, people have a powerful AR hardware platform in their pockets. Mobile learning research has long understood the importance of location context and the objects found in that location and over recent years the capabilities of location-aware technologies has increased. It is possible to locate someone holding the device by combining GPS and digital compass technologies and hence computing their orientation. Recent advancement in GPS and networks have now enabled location accuracy to within 5-10 meters for single-point receivers (Ordnance Survey, 2012), this can be improved to less than 1 centimeter. Larger, thinner and lighter touch-sensitive screens and advances in cameras and sensors also increase the potential for creating and viewing information anytime and anywhere.

Combining these technologies has led to the recent emergence of mobile applications that utilize location sensing to provide users with relevant geo-referenced information. Smartphone apps, such as Wikitude and Layar, orient users to information about their surrounding area.

2.1.1 AR in Mobile Learning: Present and Future

Studies have shown that using AR for educational purposes will develop a keen interest in students at a personal level to learn promoting motivation amongst them. A recent study where AR was used in a static environment, using desktop computers both at school and home, showed that AR supported particular learning activities, such as problem solving, in a highly interactive and memorable fashion (Luckin and Stanton Fraser, 2011). This last study also referred to other positive aspects of AR found within its research, such as its ease of use amongst young children, its enjoyment/“fun” factor, its flexibility (in terms of using it with a range of age groups or across different subject); the ease of use in reference to installation/mobility of hardware; and the immersive and engaging nature of three-dimensional AR visualizations (Luckin and Stanton Fraser, 2011)[10].In the last decade, augmented reality has progressed from a specialist, relatively expensive technology to one that is now commonly available to the general public, due to technological advances in mobile computing and sensor integration.

2.2 AR for Printing and Publishing

AR plays an important role in transition from paper to digital. There are various enabling factors for successful innovation in publishing. Following are some of the factors:

- Worldwide increase in latest generation Smartphone.
- Increasing adoption of Internet on mobile devices.
- Establishment of mobile commerce.
- Growing adoption of Tablet mobile devices.[6]

Figure 2: AR for Printing and Publishing

2.2.1 Application for Publishers

2.2.1.1 Augmented Advertising

Inside newspapers and magazines, it is possible to create special content areas targeted to advertisers. By a suitable AR tag these areas can trigger visualization of digital content such as video, audio, 3D animations just as we used to see in Harry Potter movies.[5] This scenario requires appropriate AR tags similar to QR codes or generic image recognition technology.

2.2.1.2 Geo-Located Contents

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2.2.1.3 AR Books

Figure 3: AR for Books

AR technology inside books can help to create a virtual story which will be easy to understand by the user and to create immersive reading experiences. Possible applications:

- Encyclopaedia for children.
- Text books.
- University Books.
- Tourist Guides.[7]

AR technology, thus, not only makes the book a new and more attractive product from a commercial point of view but also improves functional features from the printed books.

2.1.1.4 Collectibles

The category of collectibles includes all of the editorial products that can be collected and are typically offered in multiple issues during the year. Imagine many AR applications, from assembly manuals to card games up to innovative products that only imagination can conceive like poke balls too. Some topics include: archaeology, boats, geography, film, history, science and technology.

2.3 AR for Logistics

Having said that AR is in relatively early stages of adoption in logistics, it could offer significant benefits. This can be segmented in following categories:

2.3.1 Warehousing Operations

Figure 4: Warehousing Operations

AR has shown promise for logistics on warehousing operations. These are estimated to account for about 20% of all logistics cost and task of picking up accounts for 55% to 65% of total cost of warehousing operations[1]. Optimized picking include following points:

- Picking staff are equipped with wearable AR devices for picking process.
- Reducing training time by offering digital navigation to find right route and item more efficiently.

AR may also affect warehouse planning processes. Today's warehouses are used for various purposes such as storage, product assembly, product labeling, repacking and repair. Planners can test whether measurements of planned modifications will fit in place and model new workflows. In future this could allow real warehouse to be used as the test bed for warehouse operation planning.

2.3.2 Transportation Optimization

Over the last decade, efficiency, reliability and security of freight transportation has been improved with help of advanced information technologies by logistics providers.

COMPLETENESS CHECK

AR can achieve effective pick-upswing order to check whether the container consists of all required items we use handheld machines which is time consuming. In future, wearable AR devices could use combinations of scanners and 3D depth sensors to check the products which will also be less time consuming.AR device will also help to determine any faults or errors in the product.[2]

FREIGHT LOADING:

Freight transportation by air, water and road makes extensive use of digital data. Issues such as content, weight, size are taken into consideration for each item.AR devices could replace printed cargo lists. At a transfer station, the loader could obtain real time information on their AR devices [3]. The AR device could display loading instructions with arrow so as to where to place the container. The information can be generated in advance or on the spot by ad-hoc object recognition. This will eventually speed up the freight loading process.

2.3.3 Last-Mile Delivery

Last-mile delivery is another important field of application for AR. People are encouraged to buy things online which has led to increase in e-commerce. So optimization of last-mile delivery to drive down product cost and increase profit is promising field of application for AR devices.[4]

PARCEL LOADING AND DROP-OFF

In future at the distribution centre, each driver could receive accurate information about a specific product by looking at it with their AR device. This information could include the type of goods being transported, each parcel's weight, delivery address, and whether it is fragile or requires specific positioning to avoid damage. The device could then calculate the space requirements for each product in real time, scan for a suitable empty space in the vehicle, and then indicate where the parcel should be placed, taking into account the route.

AR SECURED DELIVERY

Figure 5

Providing staff AR devices could increase security. The person receiving the parcel could be unambiguously identified without having to show any ID with the help of facial recognition technology. The AR device can take a picture and match it with their database. This service may not be applicable for every-day deliveries but when parcel has extraordinary high value; users may appreciate this enhanced level of security as it safer than forged ID card.

2.4 Paper Based AR

The images of small patches of text contain enough information to make them as unique as a fingerprint. It is possible to distinguish a small rectangular region from among thousands of other text image patches. We used this characteristic to identify the electronic original for a given paper document. However, patches of text can be used as markers in an augmented reality system in which arbitrary x-y positions in printed text passages can be associated with electronic data. This paper proposes a new method of interacting with documents termed Paper-Based Augmented Reality that links patches of text to electronic data and uses a camera phone as the recognition device

ALGORITHM OUTLINE:

Paper Based Augmented Reality- enabled documents are created by scanning them and indexing for text patch recognition. Data is associated by choosing hotspots that are rectangular patches of text. The index information and hot spot data are stored in PBAR database. A simple example of data in hotspot is a URL that points to a web page. However, it could be a video file, an audio clip or even an electronic version of original documents itself. At the same time user captures an image of a part of page with camera and then system applies text patch algorithm and checks whether the database contains the page image. An identification for the page is returned along with its (x, y) location and location of hotspot image on the phone. The hotspot data is returned to the phone and appropriate rendering application is applied to it. If data is URL, a web browser could be invoked.

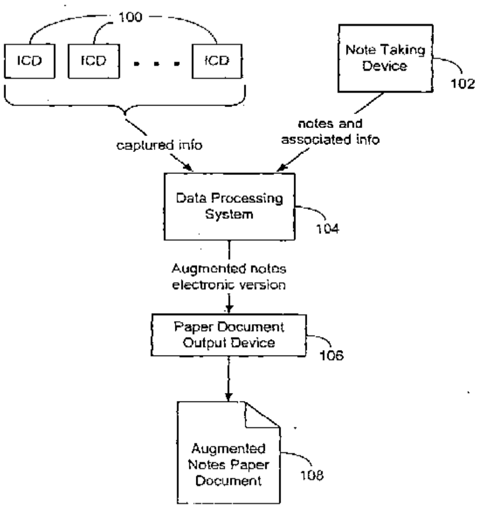

Figure 6: Flowchart for Paper Based AR

2.5 Marker based AR

Figure 7: Marker Based AR

AR markers are images detected by camera and which can be linked with software as the location for virtual assets. Colors can be used as long as the contrast between them is recognized by camera, mostly black and white are used. Simple AR markers can be of more than one shapes made up of black squares against white background[9]. A camera with AR software is used to detect AR markers for location. The image can be viewed on a screen and digital assets are placed into the scene at the place of markers. Limitations on types of AR markers that can be used are based on software that recognizes them. The simplest type of augmented reality markers are mostly black and white 2D barcodes.

2.6 Marker Less based AR

Figure 8: Marker Less Based AR

In marker less AR the image is gathered via internet and displayed on a specific location. This software doesn’t require a marker to display the content and hence is more interactive than marker based augmentation.

3. FUTURE ADVANCEMENTS

3.1 Hybrid Approaches

Future tracking systems may be hybrids, because combining approaches can cover weaknesses. The same may be true for other problems in AR. For example, current registration strategies generally focus on a single strategy. Future systems may be more robust if several techniques are combined. An example is combining vision-based techniques with prediction. If the fiducially are not available, the system switches to open-loop prediction to reduce the registration errors, rather than breaking down completely. The predicted viewpoints in turn produce a more accurate initial location estimate for the vision-based techniques.

3.2 Social and Political Issues

Technological issues are not the only ones that need to be considered. There are also social and political issues when getting new technologies into the hands of users. Sometimes, perception counts, even if the technological reality is different. For example, if workers perceive lasers to be a health risk, they may refuse to use a system with lasers in the display, even if those lasers are eye safe. Ergonomics and ease of use are paramount considerations. Whether AR is truly a cost-effective solution in its proposed applications has yet to be determined. Another important factor is whether or not the technology is perceived as a threat to jobs as a replacement for workers. AR may do well in this regard, because it is intended as a tool to make the user's job easier, rather than something that completely replaces the human worker. Although technology transfer is not normally a subject of academic papers, it is a real problem. Social and political concerns should not be ignored during attempts to move AR out of the research lab and into the hands of real users.

4. CONCLUSIONS

Augmented Reality is far behind Virtual Environments in maturity. Several commercial vendors sell complete, turnkey Virtual Environment systems. However, no commercial vendor currently sells an HMD-based Augmented Reality system. A few monitor-based "virtual set" systems are available, but today AR systems are primarily found in academic and industrial research laboratories. Note that integration of physical and virtual objects is not always easy. Augmented reality can create as well as solve problems for the user.

When designing augmented reality applications, it is important to consider how to make the integration of real and virtual as seamless as possible. Each application must choose the best combination of techniques for detecting information from the real world and presenting electronic information to the user.One area where a breakthrough is required is tracking an HMD outdoors at the accuracy required by AR. If this is accomplished, several interesting applications will become possible. The most innovative aspect of augmented reality is not the technology: it is the objective. Instead of replacing physical objects with a computer, we create systems that allow people to interact with the real world in natural ways and at the same time, benefit from enhanced capabilities from the computer. One area where a breakthrough is required is tracking an HMD outdoors at the accuracy required by AR. If this is accomplished, several interesting applications will become possible. Two examples are described here: navigation maps and visualization of past and future environments. It took about 25 years to progress from drawing stick figures on a screen to the photorealistic dinosaurs in "Jurassic Park."

Within another 25 years, we should be able to wear a pair of AR glasses outdoors to see and interact with photorealistic dinosaurs eating a tree in our backyard.

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