

Introduction to Augmented Reality: An overview, Development of AR in Android

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ABSTRACT

In simple terms augmented reality is nothing but digital information lying on top of live view of real world. The goal of augmented reality is to create a system wherein user should not be able to differentiate between the real world and virtual augmentation to it.

This paper helps readers to get a complete idea of what exactly augmented reality is, as it focuses on describing its working, components used for augmented reality, some of its application in android.

Categories and Subject Descriptors

Augmented reality and AR in Android

Keywords

Augmented Reality, AR Applications, Virtual Reality, Android.

1. INTRODUCTION

The term augmented reality was first coined by Tom Caudell and David Mizell, a former researcher at Boeing's Computer Services for understanding where in

the building process should the certain cable go, so that it can be ease at the time when actual work begins, However it is not that, before augmented reality was not around, it is just that nobody thought upon what exactly to call it

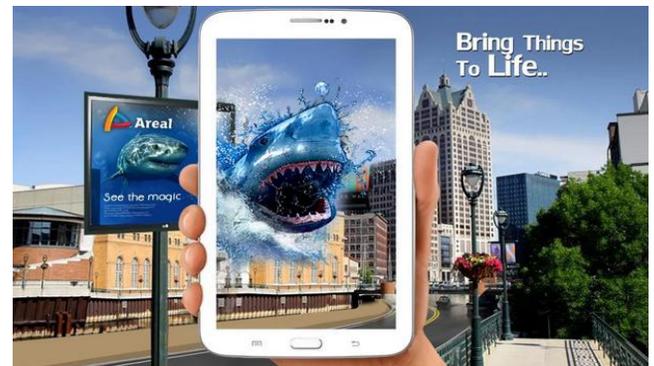


Figure 1.1 Augmenting shark on a real life object

After these many years after its introduction today it is one among the emerging trends in the market. It is emerging an innovative are of research and is being used in the field of advertisement, medical, smart phone apps, marketing etc. Talking of smart phone, augmented reality uses the device camera which is used to capture real world data to act as an input for the AR app which then overlays the digital information about the images that has been captured and is appearing on the screen.

Augmented Reality has two major forms:

- Marker-based AR.
- Marker-less AR.

Marker-based AR uses the concept of target recognition for its working, the target can be anything like an image, text, object, human-face, QR etc., the target in AR are called markers. Once the object is detected by the AR

engine the virtual information or object can be overlaid on it and displayed on the camera screen, whereas Marker-less AR uses the devices GPS to track its position first and then displays information of nearby location which are relative to that location on the camera screen.

This paper will be helpful for the people who have come across the word augmented reality for the first time. The paper emphasizes more on the theoretical view of augmented reality rather the implementation which is a drawback as no experiments have been carried out, so the reader of the paper will be able understand what exactly augmented reality which might help him/her to come up with his/her own new idea.

The paper is organized as follows: section [II] shows related work and methodology. Section [III] shows augmented reality vs. virtual reality. Section [IV] lists and describes the components used in augmented reality. Section [V] shows the working of augmented reality. Section [VI] specifies display techniques used by display devices. Section [VII] gives an overview of some of its applications. Section [VIII] Area of research use of AR in android. Section [IX] which is last section summarizes the conclusion.[X] Acknowledgement.

2. METHODOLOGY

The main method used in this research is going through the previously published research papers and other material related to it over the internet to understand the concept and for the reference purpose. Our study of the research was specifically guided by the following questions.

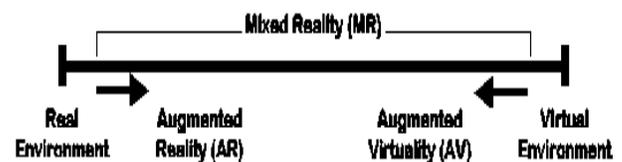
- 1) What is AR and how it is different from virtual reality.
- 2) How does it work? What is required for its working?
- 3) Which are the areas in which it has been explored and used?

After going through the research papers and other materials we understood or you can say at least got an overview of what exactly AR is and how it works, along with that we got to know that it has it applications in many domains like advertisements, medical, education, smart phone apps etc.

3. AUGMENTED REALITY V/S VIRTUAL REALITY

Augmented reality is nothing but digital information lying on top of the real world object where in the user is

able to interact with virtual content in the real world can differentiate between the real world and virtual. Whereas Virtual reality is all about creating a virtual world that user can interact with and it should in such a way that user should not be able to differentiate between real world and virtual world it requires head mounted display worn by the users , to be in a virtual world. So the major differences lies in the submersion of the user, in augmented reality user is submerged into the virtual world but is also in touch with the real world objects while interacting but in virtual reality the user is completely immersed into the virtual world and is isolated from the real environment.



Milgram's Reality-Virtuality Continuum

Milgram (Milgram and Kishino 1994; Milgram, Takemura et al. 1994) came up with a taxonomy which states how augmented reality and virtual reality is related. In it the real world and virtual world are two ends of the continuum and middle region is called mixed reality. Augmented reality which lies near the real environment is a type of mixed reality whereby the digital content is overlaid on top of real object as compared to augmented virtuality, whereby the content that is generated is conversion of the real world content.

4. AR COMPONENTS

4.1 Scene Generator:-

Scene generator is something that is responsible for rendering the scene. In Augmented reality real objects are not fully transplanted they are just supplemented so only few objects are to be drawn, and it is not necessarily required to be rendered to serve the purpose of the application.

4.2 Tracking System:-

Tracking in augmented reality means nothing but registration of the real world objects into the virtual world and this objects must be properly aligned while registration else the illusion that two worlds coexist will get compromised, this problem is called as registration problem which is the most basic of all problems restricting or limiting the augmented reality as many applications demand accurate registration.

Considering the case in medical systems if the object is not in the place where it is shown then that can be quite a problem

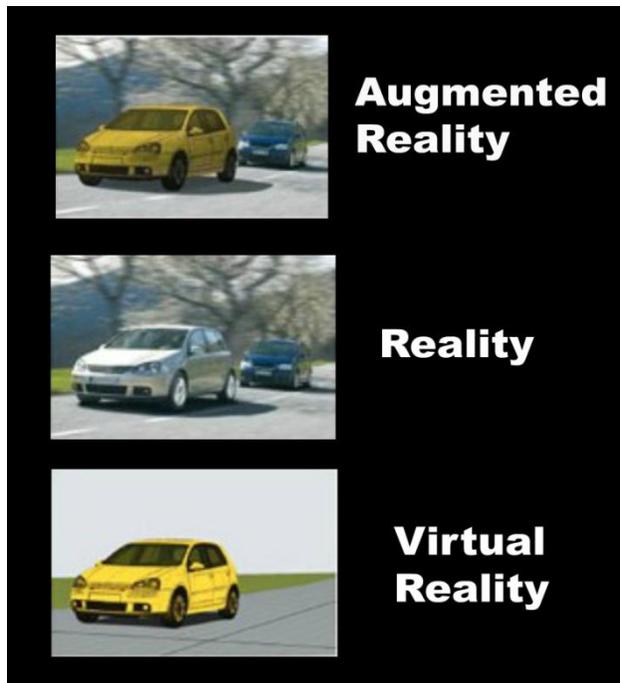


Figure 3.1: Augmented v/s Virtual Reality

4.3 Display device:-

The idea of augmented reality is to supply the information which is not visible to our naked senses and so for the display of it a certain device is required. Display device is the one responsible for the projection of augmented reality rendering. Various things can be used for that such as head-mounted, head-up display. Besides these there can be other possibilities which include the use of projector to superimpose directly on the surface which is desired, additionally monitor can also be used for the display purpose and as the computing power of today's handheld devices match some of the monitors they can also be used as a display device. Example includes use of Mobile camera to get the information about the area surrounding it with the help of AR app such as "iOnRoad Augmented Driving" which helps in navigation on our trips and keep us safe from the collisions on the road ahead.

5. AR WORKING

Augmented reality can be described as the ability to seamlessly and dynamically integrate graphics and other multimedia content with live camera views on pc's or smart phones. The scene is viewed by imaging devices which can be a mobile phone camera or video camera. The camera performs the projection of 3D objects onto a 2D plane. There are certain parameters which are used by the device to determine what exactly is projected on

its 2D plane i.e. the real world coordinates are derived by a process called image registration. The registration uses computer vision and is critical when it comes to augmented reality as compared to virtual reality as we are sensitive to misalignments. Now based on the data obtained virtual objects are modeled and rendered then an image of virtual object is generated using a standard graphics system. The image is then merged with the image of the real world to form the augmented reality image.

6. AR DISPLAY TECHNIQUES

Display techniques that are used by AR display devices falls among one of these: virtual retinal display, optical See Through, Video see through, virtual retinal display and projection based.

6.1 Optical See through HMD:

Optical see through technique uses a transparent head mounted display to overlay the virtual item on to the real world. Optical combiners are placed directly in front of the eye over which virtual images get displayed and through which real world becomes visible to the user.

The display of synthetic image on the display requires three things: 1) tracking, 2) rendering and then 3) display which takes quite a few time and this can be and is great disadvantage with optical see through HMD as user keeps continuously moving and while moving the objects in the real life changes which requires the device to perform that three thing and by the time image gets ready and displayed user might change its position again so there might be change that the image, that is displayed, is mis-registered which leads to confusion and misunderstanding besides these optical see through HMD can also be a disadvantage in case the image that is displayed is quite bright i.e. when the light intensity becomes too high.

6.2 Video See through HMD:

In Video see through display one or more video cameras are mounted on the display and their job is capture the video with the use of which synthetic imagery is generated and is then displayed on the HMD. To combine the video and imagery additional software is required i.e. is too add a video signal into the data stream, example chroma-keying.

Video see through HMD has suffers from lagging problem as in optical see through HMD, it also has depth problems and more , One major problem in video see through HMD is occlusion.

6.3 Virtual retinal display:

The invention of VRD is done in Human Interface Technology Lab at the University Of Washington in 1991. The main advantage of it is to produce a high resolution and high brightness imagery. In this a device called VRD uses scanned imagery and projects directly into our retina, at first only is small spot is focused which is then spread in raster pattern. One thing to be notice in this is that even though it uses low power it can be very bright.

6.4 Projection Based Display:

In projection based display a real life surface is used as a plane to project synthetic image.

7. AR APPLICATIONS

Augmented reality has its application in a wide range of area including Marketing, Education, medicine, Sightseeing, Entertainment etc. Some of its applications are:-

7.1 Sightseeing:-

Augmented reality plays a very important role in enhancement of tourism industries. There are number of application for augmented reality in the sightseeing industries which makes it possible for the user to have best of its experience. Having just a smart phone equipped with camera people can just walk around the places and see the data or information about famous sites. These application uses either image recognition or GPS technology in other uses marker-based or marker-less technology to fetch data from the database and display it on the screen.

7.2 Entertainment:-

Augmented reality is being used in entertainment area from quite a long time. A simple example of it would be whenever we see a cricket match we usually see advertisement being displayed on the cricket ground but actually what happens is that the add or logo is just superimposed on the live view of the field which is then displayed to us. Similarly in the media industry while seeing a weather report we see a person standing and explaining the weather report but in real what happens is that the person stands in front of the

screen which is augmented with the computer generated reports.

7.3 Military:-

In military the technology such as Head-up display or Head-mounted display is used for the augmentation. We have usually seen an image or in movies a transparent display in front of pilot showing some data which usually includes airspeed, altitude and other critical data. Which is augmented by head-up display and head-mounted display is usually used by ground troops.

7.4 Navigation:-

Navigation applications have also started the use of augmented reality. Enhanced GPS system are using augmented reality to make it easier to get from the point A to point B, information can also be displayed on the screen of automobile indicating the road conditions traffic information and alerts. There are some apps which are capable of augmenting what is front of the automobile using the smart phone's camera.

7.5 Medical:-

The use of augmented reality in the field of medical is advancing every year. Since 2005 a device has been made which uses augmented reality to project the image of the veins onto the skin making it easier to locate veins. The technology is generally used by the medical student to practice surgery. This technology reduces the risk during an operation by giving the doctor or the surgeon a 3D view of the part of the body making it bit easier for the surgeon to operate however complications still exist in case of movement of anything inside the body while the operation or surgery is still going on.

7.6 Education:-

Augmented reality in the field of education can be used quite extensively. Visual representation leads to clear understanding rather than by reading, augmented reality can be used to superimpose a video, graphics in the real time environment to show a complex structure like molecular structure which can help students to learn more and it might also keep them interested. This technology can also be used to explain the students more about the astronomy as they would see that in a 3D space along with that the reading material can contain embedded markers which when scanned will show additional information related to that.

Besides all these the use of augmented reality is increasing its area and is also used in the fields of art, archaeology, construction, and engineering.

8. AREA OF RESEARCH

Every time a technology is introduced, the main focus behind it is to reduce human efforts and save time. From the AR's background study and its applications in many areas, there are some fields where efforts and time can be minimized thereby enhancing visualization and better understanding of the process.

DEVELOPMENT OF AR IN ANDROID

Implementation of AR model contains two main sections: the "live" data we increase and Meta data "used to enlarge. For example, the overlay in the real world, the live data we increase is usually a combination of information in the viewfinder camera rear-facing, current location, facing the device. This information then cross references the list of Meta data.

For example, if we want to see the locations of gas stations in the view finder, AR data must be increased for each gas station, including latitude and longitude and. using this information, the device/camera, we can approach the location of each gas station and overlay window and view finder display little icon or click website.

Data source (i.n. fuel station locations list) can be anything, but more often it's a database or a Web service that can be classified to the point of near interest.

The remainder of the implementation of the AR consists of APIs to use the device camera, graphics APIs, APIs for sensor overlay data increase on live data and create an enjoyable experience.

Components:

1. View live camera robot is in augmented reality. Available for using the APIs available within a package android.hardware.Camera camera data.
2. Just having feed camera for augmented reality apps more than not enough. You will also need to specify the device location (and thus its user). To do this, you will need to access the information located fine or coarse, usually accessed via APIs available within the android.location package, with layer LocationManager.

3. Remote sensing data are often important AR applications. for example, knowing the direction of the phone is usually very helpful when trying to keep data synchronized with r camera.

To determine the orientation of the Android device, you will need to take advantage of the APIs available in the android.hardware.SensorManager package. Some of the sensors you are likely to benefit as follows:

- *Sensor.TYPE_MAGNETIC_FIELD*
- *Sensor.TYPE_ACCELEROMETER*
- *Sensor.TYPE_ROTATION_VECTOR*

9. CONCLUSION

Augmenting the reality is a powerful concept and is gaining its popularity year by year as it has the capability to enhance the user's environment. This technology has already been explored and is used in areas like military, education, navigation etc., Even though the technology adds as a great advantage in many areas its implementation is bit complex and is very much expensive. The disadvantage that display techniques have, there is still no solution for some of it.

As we have suggested the use of AR in the field of BI there are many more areas in which AR can be introduced and add to their advantage like use of AR in textbooks etc.

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