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Advance Technology in Augmented Reality

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Abstract: This paper examine the new technology which is more advance of Augmented Reality known as Holographic Projection (Microsoft Hololens). The Competency to relate in the real world by using holograms will give us new way to raise the ideas in the world. A new idea comes where it's not any screen to touch or mouse to click, this technology provide a gestures to create and modify the holograms. Microsoft Hololens understands the users activities, vision, voice and enable us to interact with the world in more natural way. This paper discuss the Virtual Reality (VR), Augmented Reality (AR) and the most amazing technology of Microsoft i.e. HOLOLENS and their application and future which change the world digitally.

Keywords: Augmented Reality, Virtual Reality, Hololens, New Technology, Holograms.

I. INTRODUCTION

A. Augmented Reality

The previous technology i.e Virtual reality, next come the augmented reality which is more leading and it takes real environment to flourish our ideas in new way. Augmented reality (AR) is a vital direct or indirect view of a physical, real-world environment (or we can say that it generates the live vision of real world environment) whose elements are augmented /enhanced by computer-generated sensory input such as sound, video, graphics or GPS data.

In 1990, the former Boeing researcher THOMAS P. CAUDELL gives the concept of 'Augmented Reality' then more researches are going on this technology such as in 2013, Google takes an open test for Google Glass augmented reality. The technology is growing fast in every sector over the world. The basic goal of system is to enhance the user's perception of and interaction with the real world and build up the real world with 3D virtual objects that appear to coincide in the same space as the real world. Augmented Reality aims at simplifying the user's life by bringing virtual information not only in the existing environment, but also to any indirect view of the real-world environment, such as live-video stream. Examples of AR such as: Google Glasses, Head Mounted Display (HMD), Hololens.



Fig. 1 Reality – Virtuality Continuum

B. Virtual Reality

Now in present days, the Virtual Reality (VR) technology developed significantly. It is a computer-generated scenario i.e computer graphics and other technologies that simulates realistic experience in which users interact. The term 'Virtual' has been used in computer sense of 'not physically existing but made to appear by software'. It tricks user's brain to believe that she/he is in this virtual world and blocks the real world around the user. In short, Virtual Reality substitutes the real senses of the users like Sight or Hearing with the virtual world so that the brain starts believing that virtual world itself is the real world.

The first concept of Virtual Reality is used in Goggle Cardboard. Virtual reality shares some elements with 'augmented reality' that blends what the user sees in their real surroundings with digital contents which are generated by computer software. The exact origin of virtual reality is conflict but the elements of VR are appeared as early as the 1860s. The Sensorama was give this concept in the 1950s. At present, lots of companies made virtual devices and products which has amazing experience.

Examples of VR: VR headsets, Oculus Rift, HTC Vive, Sony PlayStation VR, Samsung Gear VR.

C. Microsoft Hololens

Microsoft Hololens goes above augmented reality and virtual reality by enabling user to interact with 3D holograms blended with world. High quality holograms integrated with your real world will unlock all new ways to create, communicate, work and play. Microsoft Hololens intelligently maps the room you are in, blending holograms around you. With Microsoft Hololens, you can interact with holograms and everyday object together. It puts you at the center of world that blends holograms with reality. With the ability to design and shape hologram, you will have a new medium to express your creativity, a more efficient way to teach and learn, and more effective way to visualize your work and ideas. Microsoft Hololens, together with Windows 10 introduce a powerful new holographic platform.

II. LITERATURE REVIEW

This paper [1] authors has given the concept, Augmented Reality technology can add auxiliary information about the objects in the scene and place the virtual objects arbitrarily into reality to achieve the fusion of virtual objects and the real scene then they produce the 3D visual effect which is able to be observed by human eyes, and achieve virtual reality effect by the headset device. Also the author, Julie Carmigniani and Borko Furht[2] explained Augmented Reality (AR) is a live-time direct or indirect view of a physical real-world environment that has been augmented by a importing virtual computer-generated information to it. He also explained the AR applications which change the future of world digitally.

Augmented reality in the form of Google Glass, or Microsoft HoloLens, may appear to solve that problem. These devices present contextual information transparently or in a way that unclear little, clearly allow you to navigate the world safely, in the same way head-up displays gives fighter pilots to maintain situational awareness. AR is a key technology for personalized, situated in information delivery, navigation, on-demand instruction and games. The huge availability and fast evolution of Smartphones and new devices such as Hololens uses software-only solutions for AR, where it was previously necessary to make custom hardware solutions. However, technical limitations of existing devices make this a challenging endeavor.[5]

Through a series of scenarios, HoloLens overlaid virtual scenes on real space, allowing wearers to safely and efficiently use of rooms while engaging with 3D imagery using voice, gesture etc[8]. The recent appearance of augmented reality headsets, such as the Microsoft HoloLens, is a unique to move from traditional 2D screen to 3D hologram-like interfaces.

III. WORKING OF AR

This concept of AR was first used for military purposes. A jet pilot can see a beautiful sunrise from his cockpit which is in terms of navigation not so helpful. If there is poor visibility the landscape relief is projected directly into a special helmet, or other navigation intel. Soldiers also use special device which are able to display tactical data. The biggest advantage of augmented reality is makes low cost because it uses common devices used in many cases (only the see-through glasses can be costly).

There are 2 ways to experience Augmented Reality – with Marker-based or Marker-less



Fig. 2 Marker Based versus Marker Less AR

Using a mobile application, a mobile phone's camera determine marker, also it detect a black and white barcode image. The software analyses the marker and creates a virtual image is superimpose on the mobile phone's screen, fixed to the position of the camera. This means the app works with the camera to clarify the angles and distance of the mobile phone is away from the marker. Due to the number of calculations a phone must exchange the image or model over the marker, often only Smartphone's are capable of supporting augmented reality with any success. Phones need a camera, and if the data for the AR is not stored within the app, a good high speed Internet.

Let us describe how it is possible to add brand new digital elements into a scene:



Fig. 3 Augmented Reality Display Principle

A. Capturing the Scene

Scene is captured in real-time (but it is possible to utilize a pre-captured record for the next phases). In fact a conventional web camera is sufficient (more high quality auto focus camera is recommended).

B. Scene Recognition

Characteristic markers are set in the scene, pictures or scene can be 3D scanned (3D markerless tracking). A marker is recognized and upon its transformation the position of a 3D model is established.

C. Scene Proccession

On the basis of the previous step 3D objects, 2D pictures, video, etc. are transformed and displayed.

D. Scene Display

The complete scene, supplemented by the new object, is displayed on a monitor, projector, tablet, see-through glasses, etc.

E. Enabling Technologies in AR

- 1) See –Through Displays
- 2) Projection Displays
- 3) New Tracking Sensors and Approches
- 4) Calibration and Autocalibration

F. The applications of AR in real world are

- 1) *Navigation:* Enhanced GPS systems are using augmented reality to make it easier to get from source to destination.
- 2) *Sightseeing:* We have many augmented reality applications in the sightseeing and tourism industries. The ability to amplify a live view of displays in a museum with facts and figures is a natural use of the technology.
- 3) *Military:* The Head-Mounted Display (HMD) is used by ground unit. Analytical data such as enemy location can be presented to the soldier within their line of sight. This technology is also used for mirroring for training purposes.
- 4) *Medical:* Augmented reality can reduce the risk of an operation by giving the surgeon improved sensory attention. This technology can be deal with MRI or X-ray systems and bring everything into a single view for the surgeon. Neurosurgery is at the beginning when it comes to surgical applications of augmented reality.

IV. MICROSOFT HOLOLENS

A. Overview

In 2016, the Microsoft has developed and manufactured the concept of 'HoloLens'. This is known under the Project Baraboo which is a pair of augmented and virtual reality. This HoloLens is smart technology of augmented reality which is beyond our imagination and it transform the complete world. Don't call holoLens as VR.....It's a AR and Hologram. Microsoft HoloLens goes

beyond augmented reality and virtual reality by enabling user to interact with 3D holograms blended with world. High quality holograms integrated with your real world will unlock all new ways to create, communicate, work and play.

Microsoft Hololens is a smart glass which is the first cordless device, self-contained holographic computer running Windows 10. The hololens similar to Google glass in that it uses AR (Augmented reality) technology. Most advanced holographic computer the world has ever seen its a self –contained computer. Price of this device \$3000. Wear hololens headsets and collaborate in augmented reality give by Windows 10. This Windows 10 is the first platform to support holographic computing. It is fully apart i.e no wires, phones or connection to PC is needed. Microsoft Hololens allow you to pin hologram in your physical environment and provide a new way to see your world. This hololens is equipped with advance sensors and a new Holographic Processing Unit (HPU) that estimate the world around the user and is able to run without any wires while preparing terabytes of data from the sensors in real time. Holograms are made entirely of light.



Fig. 4 Microsoft Hololens

B. Design

- 1) *Designed For Ease:* The headset is designed with high weight distribution for a proper fit. Weight occurs around the edges of your head, saving your ears or nose from pressure.
- 2) *Adjustable Fit :* The device can be aligned up and down, as well as adjusted forward and backward according to the headband. To use the HoloLens, the user uses an adjustment rotator wheel at the back of the headset
- 3) *Built-In Speakers :* At the bottom of side there are a pair of small red speakers. Unlike headphones, the speakers do not obstruct external sound, allowing the user to experience the virtual sounds together with the real-world sounds.
- 4) *Buttons :* On the top are two pairs of buttons: brightness and display buttons around the left ear, and volume buttons above the right ear. These buttons are shaped like— concave and convex respectively so that the user can distinguish them by touch. On the left side there is a power button and band of five tiny LEDs, which are used for giving the system status, as well as for power management, setting power/standby mode and indicating battery level.
- 5) *Advanced Optics :* New projection optical system is used in HoloLens to generate full color high definition multi-dimensional images with very low latency which helps to see holograms in your real world.
- 6) *Sensor Fusion :* There is a combination of an energy-efficient depth camera with a $120^\circ \times 120^\circ$ angle which is of a photographic video camera, and an inertial measurement unit (IMU) .

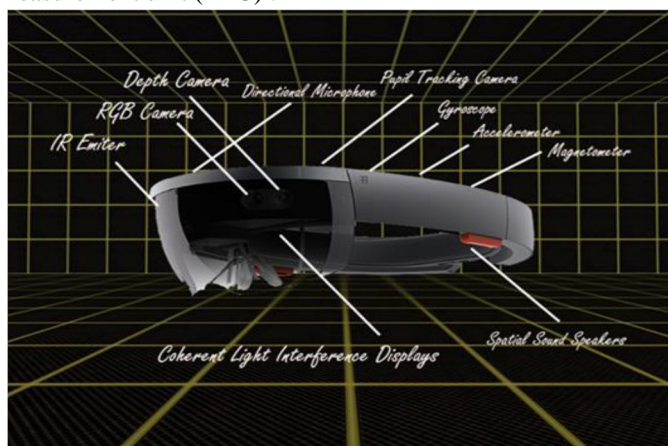


Fig. 5 Hololens Design

C. Specifications

1) Optics

- a) See through holographic lenses*
- b) 2 HD 16:9 light engines*
- c) Holographic Resolution*

2) Sensors

- a) 1 IMU*
- b) 4 environment understanding cameras*
- c) 1 depth camera*
- d) 1 2MP HD video camera*
- e) 4 microphones*

3) Human Understanding

- a) Spatial sound*
- b) Gesture input*
- c) Voice support*
- d) Gaze tracking*

4) I/O Connectivity

- a) Built-in-speakers*
- b) Volume up/down*
- c) Brightness up/down*
- d) Audio 3.5mm jack*
- e) Power button*
- f) Battery status LEDs*
- g) Wi-Fi 802.11 ac , Micro UAB 2.0*
- h) Bluetooth 4.1*

5) Processors

- a) Intel 32 bit architecture*
- b) Custom-built Microsoft Holographic Processing Unit(HPU 1.0)*

6) Weight and Memory

- a) 579g*
- b) 64GB flash*
- c) 2GB RAM*

V. ADVANTAGES

A. No connection, no phones, no wires.

Transparent lens and state of the art sensors that allow you to see your environment and move confidently in it . Weightless and adjustable to fit any head size. So that you do anything, comfortably.

In-built high quality sound lets you hear audio wherever they are in the room with pinpoint precision.

VI. DISADVANTAGES

Can be easily beat- up or broken. It may point to accident while driving. Privacy of people may be difficult due to new glasses. Radiation can occur health issues.

VII. APPLICATIONS

The possibilities given by the Microsoft Hololens see a wide array for developers, organizations, designers, creators and those who are seeking a whole new way of experience a thing in unique way that is nothing but Microsoft Hololens.

Microsoft hololens will be revolutionary tool for businesses. It will convert how companies, designers, and creators work with three-dimensional data to bring products and information to real life. Microsoft had given demo on few applications using the prototype:

Building a 3D model Exploring the surface of Mars

Minecraft-like Gaming



Fig. 6 Hololens Experience in real world

VIII. FUTURE SCOPE

Today's new technology Augmented Reality (AR) has wide spread used in world. As we all know Hololens is the device develop with lots of betterment. We can say that HoloLens is the future of Google glass and Oculus Rift. It is a new way to visualize our work, a new way to collaborate and explore in world like never before. If Microsoft implements the things with more new researches in it then HoloLens can be become unbeatable. There are many uses and scopes for hololens, some of them can be given below:

Pining holograms to real-life objects so user can relocate them in each angle and with gesture do all new creation. Visual diagrams would actually show up in space around the user showing exactly what needs to be done next.

IX. CONCLUSION

Considering the present technology's and their performance, the most challenging is the Augmented Reality which change the outline of the world to imagine the things in real world, the results of this technology are distinguished. Among that, Microsoft Hololens is far ahead than all the existing one. Hololens uses advance sensors, a high definition stereoscopic 3D optical head – mounted display and spatial sound to allow to AR applications, voice and hand gestures that gives you way to go beyond the screen, which mean that you can see your world as a canvas. With the help of AR it is possible for scientist to perceive the chemical reactions in a much better way. Architects can make an optimum use of VR and AR by visualizing a building and to experience a virtual tour of structure. Augmented Reality also used great in medical field such as surgeons while in surgery who can be comfort by other surgeons in other part of the world. With this amazing used of Hololens we experience a new augmented or virtual world over the real one.

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