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Screen-less Display – The Emerging Technology

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Abstract— With the advancement of technology, the concept of development needs to be constantly evolving. It has to be a ceaseless process. The things looking impossible earlier have turned into the daily basic needs. Now the smart phones have become a crucial part of our life. The touch-screen display is the trending display technology for smart phones. The major problem faced by this display technology is that it needs a lot of space. The advanced screen-less display technology has emerged as a solution to replace the touch screen technology. Therefore, this paper is intended to give an overview about screen-less display technology that enables the transmission of data without using any display screen and also display image directly on the open space, human retina or in the human brain. It also introduces the classification of screen-less display and then analyses the basic working of all types of screen-less display technologies. The authors have tried to make an active research and exploration for this technology from the f aspects of classification, architecture, construction methods, advantages, disadvantages, applications and future enhancement about the screen-less display.

Keywords— Hologram, laser, optic nerve, raster –pattern, LCDs.

I. INTRODUCTION

Technologies have made our life easier and more comfortable day by day to solve various types of problems at higher level. The improvement of technology can be accomplished by enhancing the existing tools and machines. Now the Smart phone has become an indispensable part of our life. Today's touch screen technology is a latest display technology which is commonly used in android phones, smart phones and tablets. It is an electronic visual display capable of "locating" a touch over its display area. User can simply scroll things on the screen, move them, make them bigger and many more. Touch screen technology is accepted by almost all electronics gadgets. The major problem faced by display with screen is that it needs a lot of space. Screen-less display technology has emerged as a latest display technology. Screen-less display can be defined as a display which help to display and even transmit any information or image without the need of any screen. This display technology has emerged as a most interesting technology in IT field.. Using this display we can create image into the air. Using this technology images can be projected directly onto the retina of the human eye and even in the human brain. Next section discusses about various types of screen-less display technologies available.

II. TYPES OF SCREEN-LESS DISPLAY

There are three types of screen-less display, namely visual image, virtual retinal display and synaptic interface.

1. Visual Image

Visual image is one of the types of screen-less display where the eye or the retina can perceive any screen-less image. The principal working of this display is that light gets reflected by any intermediate object before reaching the human retina. Intermediate object can be holograms, windows or even LCDs. Some examples of visual image is Holographic display, Virtual reality goggles and Heads Up Display.

1.1. Holographic Display: Hologram is consisting of two Greek words holos (whole) and gramma (message). It is a three dimensional image created by photographic projection shown in fig. 1. Holography technique is used to create and generate hologram. Holograms were mostly used in telecommunication as an alternative to screens. Hologram can be transmitted directly or it could be stored in various storage devices. A hologram is first recorded and then reconstructed whenever it needed. This can be accomplished by capturing the reflected light from the intermediate object. Using this technology 3D image can be constructed or generated. Holographic messages become popular from the Star War movie. Latest fiction movies like "Avengers" and "Iron man" have shown technology in advanced form. The system focuses a beam of laser light which initially creates plasma medium in the environment using atmospheric Nitrogen and Oxygen must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified. [11]

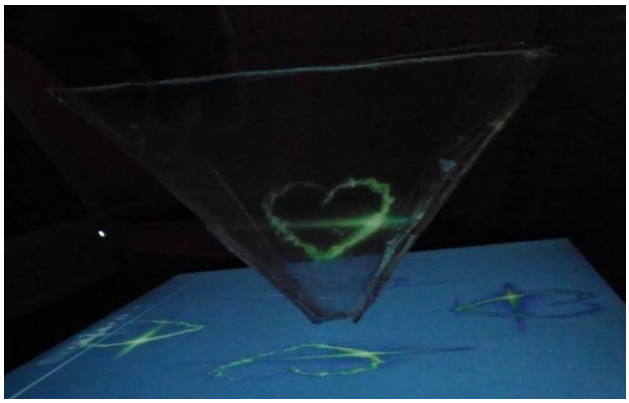

Fig. 1 Hologram

The fig. 2 shows the basic working principle of hologram. When a laser beam is passed through beam splitter, in which it is then divides the beam into two parts; one is illumination beam and another which is made to fall on mirror. When object is placed in front of beam, splitter is illuminated by the illumination beam and the reflected beam is captured on the recording medium (photographic plate). At the same time the reference beam, is made to fall on photographic plate. In fig. 2, the arrangement of mirrors is made so that it reflects entire light in every direction with equal consistency, and the photographic plate is placed in such a way to capture the entire light incident on it. Thus this interference pattern gets engraved on photographic plate.

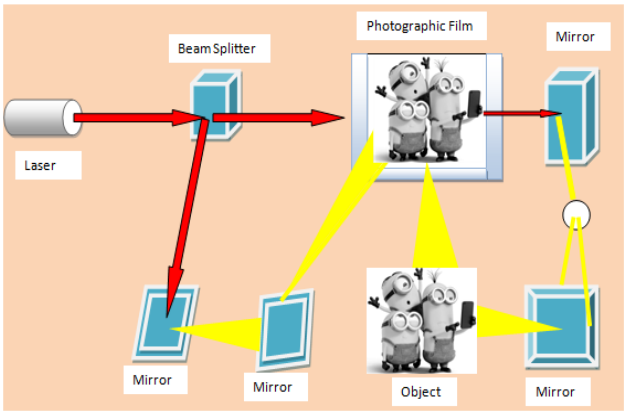

Fig. 2 Block diagram of Holographic display

In order to view recorded data, we need a key which is the original beam of laser light that is used while recording. At the time of reconstruction, the Photographic plate is illuminated by the original beam, which then forms the diffraction phenomenon. It scatters the light in the air and then the resultant images can be viewed. This image is known as virtual image.

1.2. Virtual Reality Goggles (VRG): A Virtual reality goggle is the one of the type of visual display. Virtual Reality Goggles is an eye wear display device. Wearer can interact with a series of computer generated images while viewing the same as shown in fig. 3.

Fig. 3 Virtual Reality goggles

The block diagram of the Virtual Reality Goggle is shown in fig. 4. It consists of two polarized lenses, 2 micro mirror array and LED. Image begin with the low power LED after passing through the first scatter optics, the light is reflected to the micro mirror array. 2 million mirrors arrays shakes the light and form the image that focus to a second polarized optics and projected directly to the eye of human retina.

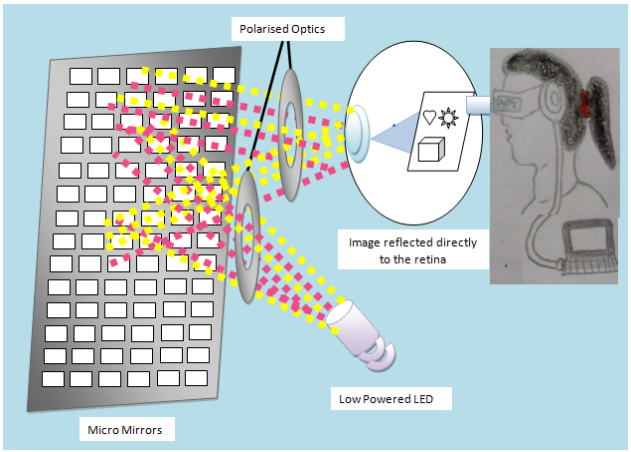

Fig. 4 Block diagram of Virtual Reality Goggles

The key feature of Virtual Reality Goggles is presence of polarized lenses. Polarized lenses will show two images, one per eye and the brain combines them to form a three dimensional image. These goggles show an illusion of depth. Many of these goggles have the head tracking systems that is connected to a computer, thereby manipulating the images seen by the wearer as they move around [5], [8].

1.3. Heads Up Display (HUD): Head up display is a transparent display that will project information on a windshield as shown in fig. 5. So the users do not need to look away from their field of view. A Standard HUD contains a projector unit, combiner and a computer as its components. This Projector Unit projects the image and the combiner redirects the projected image such that the field of view is visible as well as the projected image at the same time. Computer is an interface between projector unit and data to be displayed. They are used in airplanes, automobiles, computer games etc. [2]

Fig. 5 Heads up Display

2. Retinal Display or Virtual Retinal Display

In Virtual Retinal Display, the image is directly projected on to the retina of human eye without any intermediate object. Thus this makes retinal display different from visual image. This property of retinal display makes it highly secure, safe and private. The most suitable example of retinal display is Google Glass.

2.1. Google Glass: Google Glass is just like classical glass as shown in fig.6 [3]. It consists of block of glass on one eye that allows the user to see amplified reality. Text as well as the Images and information related to the objects and places are displayed in front of the user's eye. [1]

Fig. 6 Example of Retinal Display (Google Glass)

As shown in fig.7, Virtual retinal display consists of photon generation, intensity modulation, beam scanner, optical projection and drive electronics. Photon generation block generates the consistent beam of light; this photon source uses the laser diodes as coherent source with retinal display which results in diffraction onto the retina of the human eye. The light that is generated from the photon source is intensity modulated. This intensity gets modulated to match with the intensity of the image [7],[9].

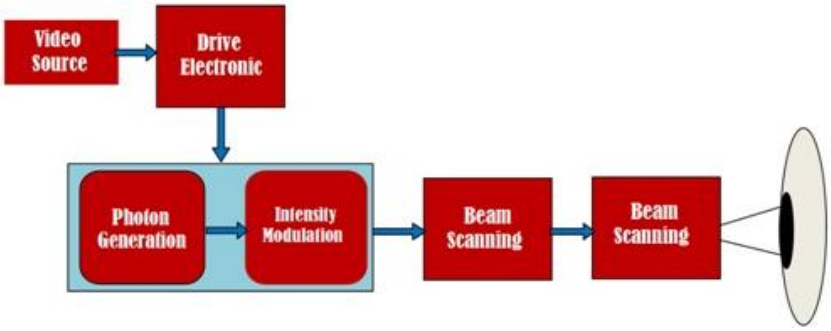

Fig.7. Block diagram of Retinal Display

The intensity of the image being rendered is matched to that of the beam of light, by modulating the light beam. The beam is first generated and then modulation can be achieved. The source can be modulated without delay if it has enough bandwidth, which can be often seen in case of a laser diode.

There are various patterns in the resulting modulation beam where each pixel is positioned on the retina. For instance, the scanner can be used in a raster mode like a calligraphic mode or a TV such that the lines forming the images are drawn directly. On using the raster method, standard video sources can drive the Virtual Retinal Display (VRD). This is achieved by shifting the beam to draw a row of pixels with the use of horizontal scanner. The vertical scanner moves the beam to the next line when another row of pixel is drawn. After scanning, there must be accurate projection of the optical beam in the eye. For the proper image formation on the eye, it is mandatory that the exit pupil of the VRD and the pupil of the eye must be on the same plane.

The angle of incidence to eye determines the position of the image. Scanners determine this angle, while brightness is controlled by the intensity modulation. The persistence of eye forms an un-interfering image which is continually rechecked by the modulations. Thus the drive electronics helps to synchronize the intensity of modulator and the scanners with incoming video signals such that a stable and well organized image is obtained.

3. Synaptic Interface or Direct Neural Interface

Synaptic display is a type of screen-less display that does not display an image in free media or onto the retina. It displays by transmitting the signals directly into the brain through the optic nerve. There is no light involved, basically electrical impulses are used as shown in fig. 8. [1][4]

While these systems have yet to be implemented in humans, success has been achieved on horseshoe crabs by recording nerve images. Sampling usable video signals from the biological eyes of a living horseshoe crab through their optic nerves, and sending video signals from electronic cameras into the creatures' brains by using the same method. Therefore, furthering the neural code transmitted to the brain by the optic nerve. This display offers the possibility of providing sight for the blind by using implanted electronics to bypass non-functional parts of the eye. Imagine a visually impaired person gaining the freedom to drive and self dependent. This will remove occupational limitations of the visually impaired. It can give users the benefit to view images in greater coordination and complexity than the eyes capable of producing. This is useful for security system for effective communication, in education sector, business planning and broadcast. However the method requires more research and development for further production of worldwide application and implementation. [2]

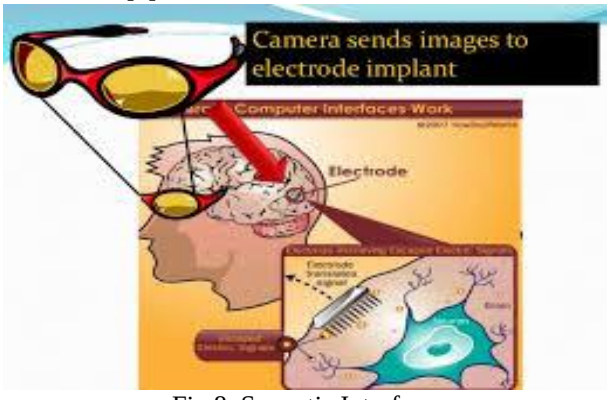

Fig.8. Synaptic Interface

3.1. Brain-computer Interfaces: This allows direct communication between the brain and the external device. They are also known by Brain Machine Interface, Mind Machine Interface, Direct Neural Interface and Synthetic Telepathy Interface.

A brain-computer interface is the technology in which computers can read and then interpret the signals directly from the brain. In medical we have already achieved clinical success in allowing quadriplegics, and those suffering from "locked-in syndrome". Recent research has focused on the possibility of using brain-computer interfaces which can connect different brains together directly. [5][6]

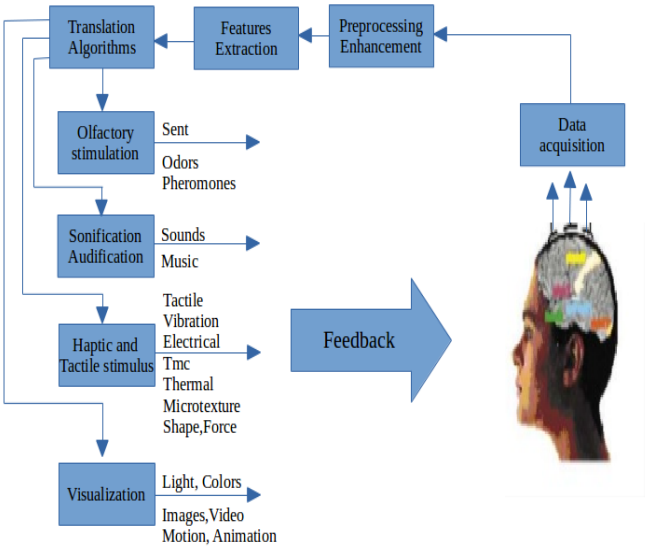

Fig.9. Synaptic interface

Recently Duke University reported that by connecting the brains of two mice over the Internet, the mice were able to cooperate and perform tasks. In 2013 Harvard University reported that they established a link between the brains of rat and human. In 2013, MIT reported that they have implanted false memory into the brain of a mouse [2].

III. ADVANTAGES OF SCREEN-LESS DISPLAY

The present section discusses various advantages of screen-less display technology. 3D images can be constructed and generated in Screen-less display technology. Images of any size can be creating and edited. It provides high quality and large angle of views. It requires light weight hardware and it provides greater portability. Power requirement is also reduced. Bright and better contrast images are formed. It has ability to present far point images. There is high colour accuracy and resolution. [1], [2],[9]

IV. DISADVANTAGES OF SCREEN-LESS DISPLAY

Everything has its own advantages and disadvantages. Screen-less display technology has also got some disadvantages. It's one of the major disadvantages is non-affordability due to high Cost per unit. Another disadvantage is its non- availability in significant number as it is still under progress. The VRD is still under progress and Development.

V. FUTURE ENHANCEMENT

For the future development of this emerging new technology, a lot of research is going on and the several renowned IT sector companies and labs present in the world are handling over the project of screen-less displays [10]. Some of them are given as follows:

- Smart Google is developing the compact video camera which films everything the wearer looks at and it directly sends the information to the glasses hence there is no need of any screen or projector
- Multi touch is a human computer interaction technique and the hard-wires devices which allow the users to compute without conventional input devices.
- Japanese scientists have discovered the pair of intelligent Glasses that remembers where people last saw their items like: - keys, Handbags, laptops, and cell phones.
- Several laboratories are working under progress on the electron beam lithography which includes the advanced enhancement of the futuristic screen less display.
- Adobe systems are also working on development and deployment cross platform of the several applications which are to be viewed without the actual screen.

VI. CONCLUSION

This paper presents an in-depth overview of screen-less Display technology which is one of the latest emerging technologies and has become the most interesting area for the upcoming future. This technology includes various benefits like, portability, lightweight and lower power requirement. Its uses confirm that it will be a new outlook to the virtual world, which includes-immense gaming, heads up displays and scientific research. Since this technology is constantly enhancing, it signifies the great advancements that humans are making every day in the field of technology. Screen-less displays look ready to start a generation in the lineage of projections, and that generation is the screen-less generation.

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