CHAPTER-1

INTRODUCTION

Over the years, display technology has been growing, from simple CRT to plasma screen. But now display technology has reached a stage where images can be displayed in thin air without the aid of a screen. A technology used for displaying images in thin air is called Heliodisplay. Heliodisplay is a technology developed by Chad Dyner, CEO for IO2 Technologies. In the Heliodisplay, a projector is focused onto a layer of mist in mid-air, resulting in a two-dimensional display that appears to float. This is similar in principle to the cinematic technique ofrear projection. As dark areas of the image may appear invisible, the image may be more realistic than on a projection screen, although it is still not volumetric. Looking directly at the display, one would also be looking into the projector's light source.

Heliodisplay can work as a free-space touchscreen when connected to a PC by a USB cable. A PC sees the Heliodisplay as a pointing device, like a mouse. With the supplied software installed, one can use a finger, pen, or another object as cursor control and navigate or interact with simple content. The mist is formed by a series of metal plates, and the original Heliodisplay could run for several hours on one liter of tap water.

CHAPTER-2

BASIC UNITS AND WORKING

2.1 BASIC UNITS

Heliodisplay projects images as shown in figure 2.1. The basic units of heliodisplay are base unit and projection source as shown in figure 2.2. The projection source unit projects images onto the mid-air. The base unit produces the water vapour screen necessary to display the image. The image can be viewed from behind the base unit. The Heliodisplay is designed to be hidden (into a pedestal, table etc), so that only its projected image is visible. The display connects to a standard video source (such as DVD player or PC) and projects any images that would be viewable on a computer screen or television. No specialized hardware or software is needed to view images. The Heliodisplay's projected image hovers just above the base unit. The display is less bold than a normal computer screen. The housing of the Heliodisplay is floor bound and water particles rise rather than descend.

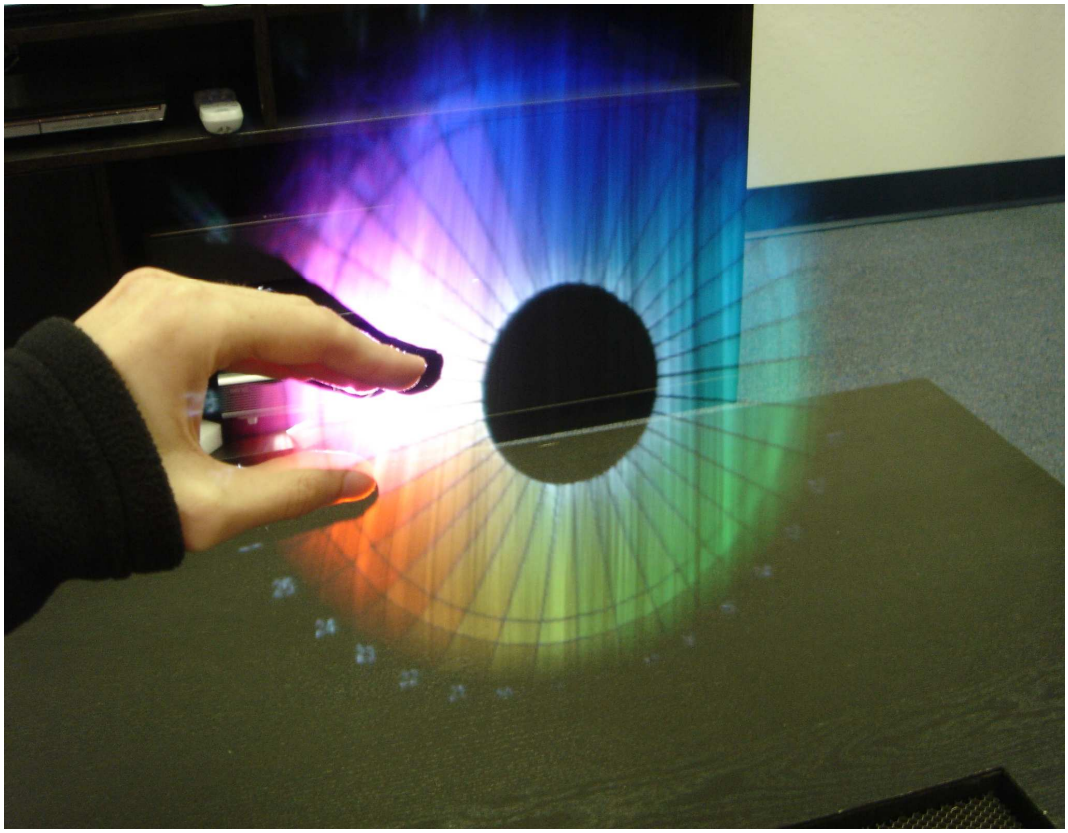

Figure 2.1. Heliodisplay projecting image

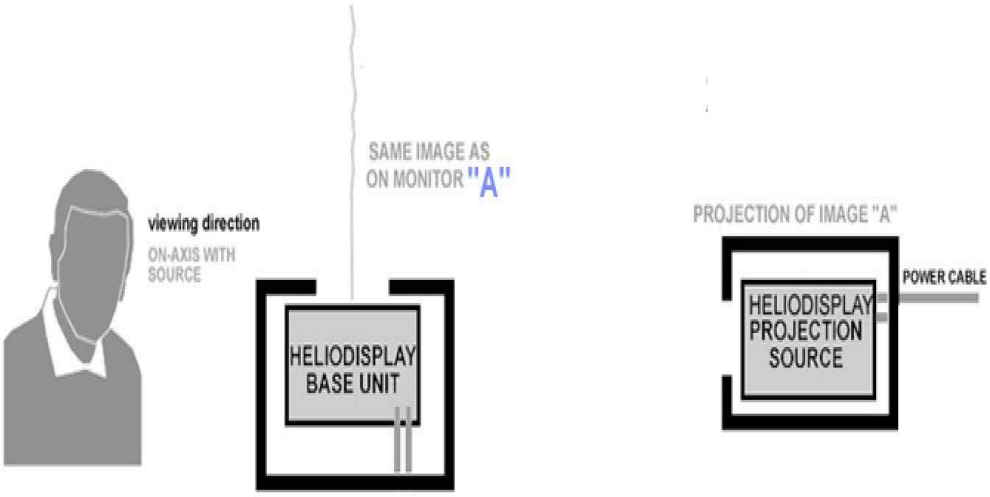

Figure 2.2. Basic units of heliodisplay

2.2 WORKING

Heliodisplay can receive input from a computer, television, or even from video game consoles, and project the image on a floating screen of air. The image can even give the appearance of a floating, holographic, 3-D image. Essentially, the device converts the imaging properties of the air so that the air is taken in, converted instantaneously, and then re-ejected out. Then projects onto that converted air. After air is drawn into the machine, it moves through a dozen metal plates and then comes out again. The system creates a dynamic, non-solid particle cloud by ejecting atomized condensate present in the surrounding air, in a controlled fashion, into an invisible particle cloud. It is electronic as well as thermodynamic. No moving parts are involved. The device works by creating a cloud of microscopic particles that make the air image-friendly. Light is forward transmitted to create visible images. Thus image is displayed as in figure 2.3.

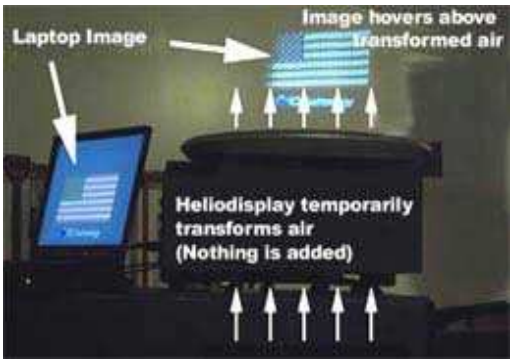

Figure 2.3. Working

The machine, uses no harmful gases or liquids. Nothing is added to the air so there isn`t any harmful gas or liquid emitted from the device, and nothing needs to be refilled. Operating the device will not change a room`s environment, air quality or other conditions. If a Heliodisplay were left running for a week in a hermetically sealed room, the only change to the room`s environment would be from the electricity used to run the device. The ambient air is bottom-projected and illuminated, generating the free-space image that floats in midair. It causes no odour in the air, and the area onto which the images were projected seems dry to the touch. Dark background emphasizes the contrast of the image and is highly encouraged when designing a location to view the display. Viewing in direct sunlight is almost impossible. Like any rear projection system, the images are best seen within 70 degrees to either side as shown figure 2.4. Viewing requires no special glasses.

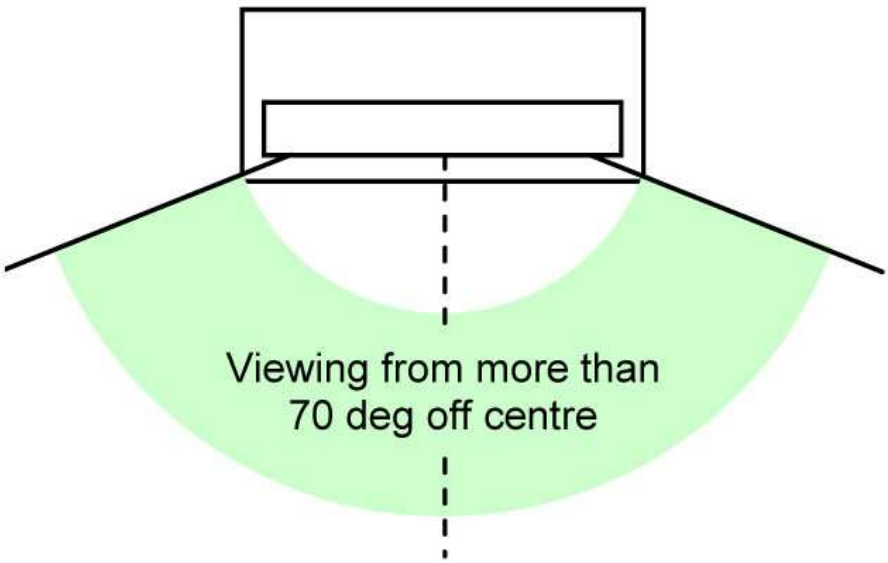

Figure 2.4. Angle of viewing

The image can also be manipulated by touch. A finger or some hand-held object can act as a mouse and seemingly drag images in midair. Hand movements are monitored by an optical tracking system, which is essentially a camera

in the unit that monitors and locates movements and changes in the location of our hand. This is shown in figure 2.5.

Figure 2.5. Heliodisplay as touchscreen

CHAPTER-3

DEVELOPMENTS IN HELIODISPLAY

3.1 MODEL M1

The original **M1** units produced by IO2 were advanced prototypes and proof-of-concept. These are the first heliodisplay developed by the IO2 technologies. They have all the above said properties. But they have less fidelity. These first generation heliodisplays support only a 22” image.

3.2 MODEL M2

The second-generation **M2** Heliodisplay supports a 30” image with 16.7 million colours and a 2000:1 contrast ratio. It is shown in figure 3.1. Heliodisplay images are unique and offer many advantages over existing displays. The M2 is about the size of a tower desktop computer case turned on its side. The interactive **M2i** version includes virtual touchscreen capability. It allows a finger placed on the floating image to act as a computer pointing device. The user can interact with floating images or video, and manipulate them as you could with a mouse, including clicking and dragging. The M2i comes with Heliocast software and PC drivers to enable this.

Figure 3.1. Model M2

3.3 MODEL M3 and M30

The third-generation **M3** version has the same basic specifications as the **M2** but is much quieter, with improved brightness and clarity and more stable operation with an improved tri-flow system. Parts of M3 and M30 are shown in figure 3.2. Apart from displaying at a standard ratio of 4:3 in addition it also displays 16:9 widescreen ratio. These improvements allow the display to begin to offer advantages in markets such as teleconferencing, board room displays, and as an access point for gathering information in hotel and corporate lobbies. The Heliodisplay M3 is available directly from IO2. There is also an interactive version called the **M3i.** M3i serves as a computer input device for cursor control in a desktop environment. The **M30** is the updated version of the M3, which fits into the current model numbering system, 30 designating the diagonal screen size.

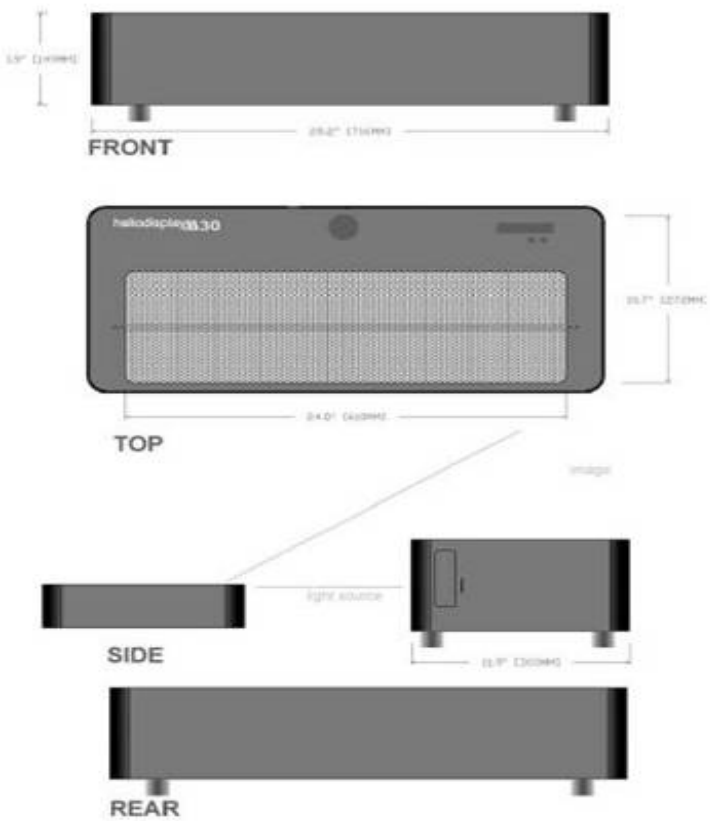

Figure 3.2. Model M3 and M30

3.4 MODEL M50 and M100

In late 2007, IO2 Technology introduced two larger Heliodisplays, the M50 and M100. They are shown in figure 3.3. The M50 has a 50” diagonal image, equivalent to displaying a life-size head-and-shoulders person. The M100 has a 100” diagonal image, equivalent to displaying a large full-body person (about 2 meters tall).

Figure 3.3. Model M50 and M100

3.5 MODEL L90

L90 is another model developed of heliodisplay by the IO2 Technologies. It has a model as shown in figure 3.4. This is also an updated version of previous models. It has an interactive version also, called L90i. L90 is backward compatible.

Figure 3.4. Model L90

3.6 P-SERIES

P-series Heliodisplay Projection systems are designed with simpler operation functionality and advanced controls for integrating and use. P-series incorporate an optical sync between components that they are in direct communication link so only one button or trigger is required to operate as they all turn on and shut down in sync. Communication ports allow for the helio projection and helio base to be controlled remotely in an installation via a remote controller or PC. Onboard diagnostic features support timing and other advanced independent controls via a controller or PC. Built in gesture control allows even simpler operation, such as hand waving to turn on the unit without actually touching the device. To project the images and videos, air should be touched. The PRX2 projection unit includes proprietary baffling to reduce the viewing of the light source and beam-steering optics shorten the throw distance by 10”(25cm) while simultaneously allowing for easy control of the projection angle without even moving the projection. In addition, and only available in the in the P92”, the base system can operate in any orientation from 0-180 degrees. It also has USB playback from projection unit. Various parts of the P-series are shown from figures 3.5 to 3.8.

Figure 3.5. Digital LCD interface of P-series

Figure 3.6. Media drive of P-series

Figure 3.7. External hook-up of P-series

Figure 3.8. Complete P-series

CHAPTER-4

ADVANTAGES AND DISADVANTAGES

4.1 ADVANTAGES

The main advantage of heliodisplay is that it needs no screen to project image. It changes the air and creates a dynamic non-solid particle of cloud on to which the image is projected. The device is also light weight and designed to conceal inside furniture. Therefore we can create an effect of displaying images in mid-air. Also nothing is added to the air; nothing affects air quality. Hence it does not cause any health problems. No special glasses or projection screens are required to see the images projected by heliodisplay. Heliodisplay does not create fog. So it does not cause any problems to the other electronic equipments in its vicinity. Projected images and video are two-dimensional, (i.e. Planar) but appear 3-D since there is no physical depth reference. Also heliodisplay can project images from all the normal sources like DVD player or PC. It can be used in any country since it works on 95-115 or 220-240V VAC. With Heliodisplay, imagery can be seen up to 75 degrees off aspect for a total viewing area of over 150 degrees. Translucency is controllable with the Heliodisplay.

4.2 DISADVANTAGES

Heliodisplay is very expensive. It starts from Rs. 700000/- onwards. Common people cannot afford it. Also it cannot be used outdoors since any disturbance in air would affect the quality of the image. wet and turbulence affecting seriously reduces the fidelity of imagery. The image is slightly unstable and can clearly be seen in a dark background.

CHAPTER-5

APPLICATIONS

Proposed applications for the real-world Heliodisplay include:

- Advertising and Promotion, e.g.: trade shows; in-store displays; museum, movie and casino displays; theme parks.
- Collaborative Decision Making, e.g.: board meetings and presentations; air-traffic control; military command and control; architectural and engineering design; teleconferencing.
- Simulation & Training, e.g.: virtual targets; pre-operative planning; virtual surgery.
- Consumer, e.g.: video games; home theatre.
- Heads-up displays in new fields, e.g.: a patient's vital signs could hover above the chest during open heart surgery.
- Build one into a door jamb and have a walk through image or virtual privacy screen.
- An in-store end cap advertising display and demonstration through which the customer can reach and grab shown product.
- Build the Heliodisplay into furniture, e.g. project from desk.

CHAPTER-6

RELATED TECHNOLOGY

6.1 FOGSCREEN

Senior researcher Ismo Rakkolainen and Professor Karri Palovuori of Finland's Tampere University of Technology have developed the FogScreen, a display surface made out of a cloud of water vapor diffused into the air as a very dry fog. A projector can display images on the FogScreen. It uses a technology very similar to heliodisplay. FogScreen is shown in figure 6.1.

Figure 6.1. FogScreen

Unlike heliodisplay, FogScreen creates fog to display images. The FogScreen uses fog as a projection surface, creating an image floating in thin air. If people walk through the FogScreen, the image will instantly reform behind them. It allows

projection of interactive content, such as images, videos or animations, to appear floating in free space. It also enables to create special effects like walking through a brick wall or writing fiery characters in thin air. The FogScreen employs an optimized, patented method for forming a physically penetrable 2D particle display. The basic principle is the use of a large non-turbulent airflow to protect a flow of, for example, dry fog particles inside it from turbulence. The outer airflow may get slightly turbulent, but the inner fog layer remains thin and crisp, enabling high-quality projections and the walk-through possibility. Ordinary tap water is broken into fine fog droplets and trapped inside this non-turbulent airflow. Even though the fog is made of water, it appears dry to the touch, just like air. The resulting thin, stable sheet of fog enables projections on a screen that is dry and feels like slightly cool air. The light from a standard projector is scattered through this sheet of fog, creating a rear-projection image.

6.2 LARGE TRANSLUCENT DISPLAYS

The dnp Holo Screen and the HoloClear displays make the screen practically transparent from the viewer's point of view, showing only projected objects. They are examples of screens that consist of an acrylic plate that is coated with a holographic film, such that it catches only light that is projected from a 30-35 degree angle. A bright and clear image can thus be obtained in daylight conditions, while the display is transparent from the opposite side. These types of transparent displays are single-sided and not penetrable. When a projection system is combined with user tracking and a large semitransparent display, the result is a projection-based optical see-through AR system. A serious limitation of such a setup, however, is its inherent single sidedness. Requiring the user to stand on one side of the semitransparent display limits the number of simultaneous collocated users and complicates eye contact. Large planar collaborative workspaces, such as digital whiteboards with computer-supported interaction, suffer from the same problem. Even if these display technologies could be amended to support dual-sided rendering, collaboration across the display would be hindered by the material screen separating users.

6.3 VOLUMETRIC DISPLAYS

While head-worn displays attempt to create the appearance of virtual objects within some work space, volumetric displays actually create the 3D image of a surface within a volume. The surface can be viewed from arbitrary viewpoints with proper eye accommodation since each point of light has a real origin in 3D. Tracking of the viewer is not necessary. Volumetric displays are based on a broad and diverse collection of various methods, technologies and ideas. Numerous techniques incorporating e.g., fibre optics, mirrors or oscillating screens, have been developed to achieve this effect. Traub's display creates a virtual image by varying the focal length of a mirror to produce a series of 2D images at different apparent depths. A real 3D image is generated by Actuality Systems' Perspecta display, which draws 2D images on a quickly rotating screen to fill the entire volume swept out by its path. A 3D display Actuality Systems' Perspecta is shown in figure 6.2. The DepthCube Z1024 display takes yet another approach, using 20 stacked LCD panels to light 3D points in space without any moving parts. Unfortunately, these displays all create their 3D imagery in a fairly small enclosed volume that the viewer cannot enter. They are more suited for computer graphics than video applications due to the difficulty in capturing suitable natural imagery in 3D. One drawback is typically image transparency where parts of an image that are normally occluded are seen through the foreground object. Yet another difficulty that could give an unrealistic appearance to natural images is that of the inability to display surfaces with a non-Lambertian intensity distribution.

Figure 6.2. Actuality Systems' Perspecta

CHAPTER-7

CONCLUSION

The heliodisplay is a relatively new technology and is still being developed. Heliodisplay works as a kind of floating display and touch screen, making it possible to manipulate images projected in air with our fingers. Though it has some flaws the attention that it brings is enormous. Its various applications such as in advertising, a board room etc suggests that its future scope is very large. Several other thin air-displays are available but heliodisplay out classes them and as a result it has more market value.Though it is currently expensive and unaffordable heliodisplay technology has a great potential. It is the future generation display where we can see images projected into mid-air without the help of a solid screen. It could be used for museum or trade-show displays or for advertisements, and would be ideal for collaborative work.

REFERENCES

1. Heliodisplay Floating Display; Tuesday, November 28, 2006 - Iddo Genuth
2. IO2 Technology intros floating M3 Heliodisplay screen by Darren Murphy Feb 28,2007
3. IEEE SPECTRUM August 2004,volume 37
4. DiVerdi, Rakkolainen, Hollerer, Olwal, A Novel Walk-through 3-D Display. Proceedings of SPIE 2006 Electronic Imaging, Vol.6055,428-437, January 2006.
5. Heliodisplay-Futuristic display technology by Bill Christensen, August,2005
6. Rakkolainen, K. Palovuori, Laser Scanning for the Interactive Walk-Through FogScreen. ACM Virtual Reality, Software and Technology (VRST 2005) Monterey, CA, USA, November 7-9, 2005
7. dnp Holo Screen. DNP, http://www.dnp.dk/. December 2005