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PROPOSED SYSTEM FOR MID-AIR HOLOGRAPHY PROJECTION USING CONVERSION OF 2D TO 3D VISUALIZATION

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ABSTRACT

Holographic Projections is one of the world's top trending technologies. As the technology has graphical interaction, it is quite intriguing. Due to the multifaceted nature, multinational corporations are using this technology to a wide extent for their various purposes. The primary advantage of the technology is that the computer vision is constantly evolving and it has made possible to view content in 3D. The technology has lot of scope to evolve such that it can be made feasible to the common people. The sole purpose of interaction with 3D holographic projection is to bring life to a virtual image in 3D world. We are proposing three systems which can be used by the common people to view photos and videos as mid-air holograms at home. The proposed system uses 2D to 3D photo and video conversion application and wireless interaction between the user and system. The interactivity can be used by the user to interact with the holograms for changing the holograms or to rotate them.

Key words: Mid–Air Display, 3D Display, Holography, Interactive Display

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1. INTRODUCTION

I. E. Sutherland quoted in his article "The Ultimate Display" in the year 1965 that "The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuff s displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked" [1].

Holograms are 3D image projected in such a way that a viewer gets a feeling of seeing a live object. This has been widely used to at presentations, seminars and places where a 3D objects are presented to an audience. Many methods have been developed for projecting holograms [11, 12]. Now that holograms are used for giving presentations, they have to interact well so as to get the best of the presentation. Thus making a dynamic projection for hologram enables interactivity to be added to it. For several decades, we are watching mid-air displays which projects floating images in free space in several science fiction movies. Promising technologies have emerged in home TV and digital signage which is attracting a lot of attention. Due to this, many holographic displays have been developed as well as proposed. It is worth noting that these few terms like 3D, mid-air display and holography are much obfuscated in media. The idea behind 3D displays is to artificially recreate the depth that we naturally perceive while viewing a real 3D object. Computer graphics [10] have been constantly evolving and hence it has made possible the rendering scenes for computers free from the limitation of real world and helping in visualizing various computer simulations. GUIs are still heavily relying on the screens and mouse since several decades. The proposed systems are a way to bring mid-air holography along with interactivity in their homes. The systems will help them to visualise photos and videos as three dimensional holography at homes and interact with them like changing the photos or rotate them.

2. RELATED WORK

2.1. Floating 3D Image in Mid-Air

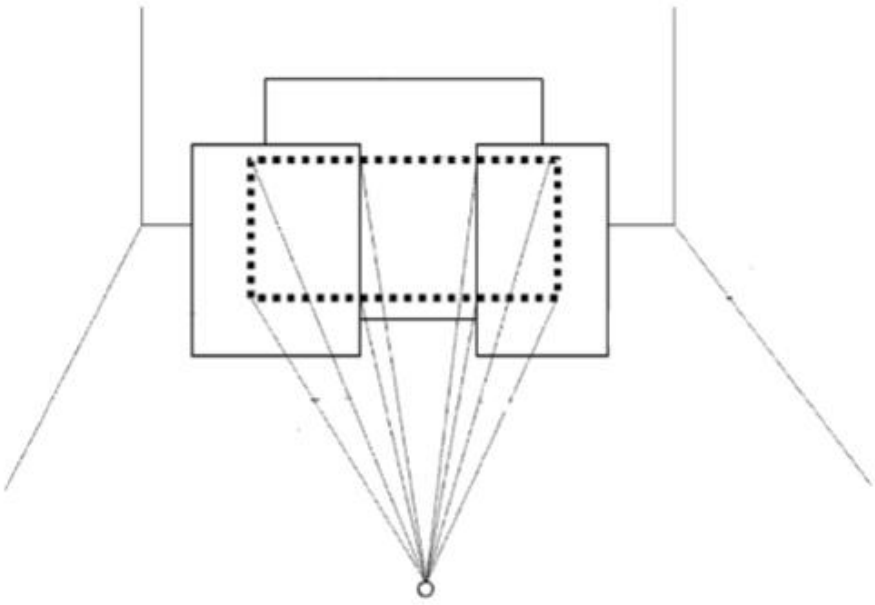

Figure 1 Floating 3D Image in Mid-Air [2]

The patent [2] as depicted in figure 1, introduces a method for projection of 3D images floating in the mid-air. User can see the 3D images always in front of their eyes even though they are in any position. It also features for the users to walk around and walk through the 3D images and do interact with the content. The reforming of the projected image according to data can be done using a database and the CPU is utilized. The figure illustrates the database being connected with the CPU and the rest of the components which are projector, image source and position tracker are utilized by it. Before reforming the image source according to the surface location, it contains the data of the image. The location and direction of the user's eye is tracked using the position tracker. The figure shows the replacement where the database is replaced with a 3D scanner along with an image source. In this setup there is no requirement for the position tracker.

2.2. Holographic Display Systems, Methods and Devices

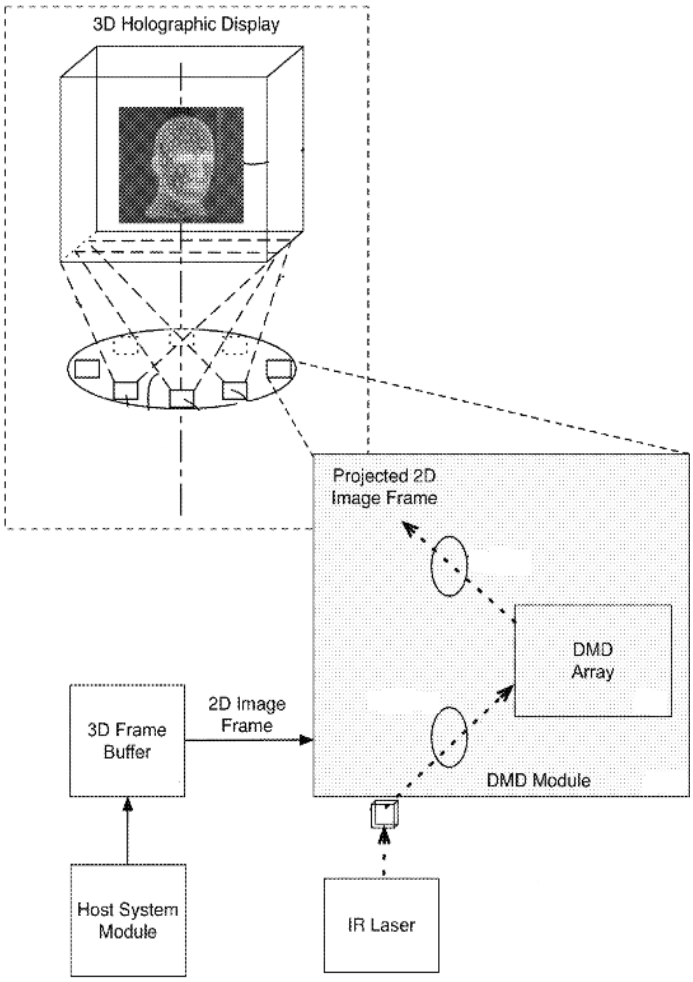

Figure 2 DMD based Holographic Projection [3]

The patent [3] as displayed in the figure 2 describes a method which includes an IR laser radiation to a DMD array also known as Digital Micromirror Device. The DMD is used to for modulating the IR radiation spatially. Any conventional 3D display would provide view a scene from single position which has to kept fixed. In these cases the 3D resolution changes as well as the viewing experience from one view to another. The diagram shows the 3D holographic projection display [6] assembly which includes the DMD modules. There are numerous DMD modules and

each module contains a DMD array, relay lens and projection lens. 3D frame buffer along with infrared laser, host system module and a beam splitter are part of the setup. The 2D frames are used to create holographic images in three dimensional. Each DMD module is configured to modulate the IR laser radiation spatially for the projection of the 2D frames. All 2D images are specified by the host system module and stored in 3D frame buffer. Once stored they are conveyed to the corresponding DMD modules. IR laser can be in two forms: 1) Pulsed 2) Continuous wave. The IR laser is split using the beam splitter into as many required individual laser beam for each DMD module. Relay lens will convey the corresponding IR beam to DMD and DMD array will use the projection lens to display the 3D holographic image [7].

2.3. Pepper's Ghost

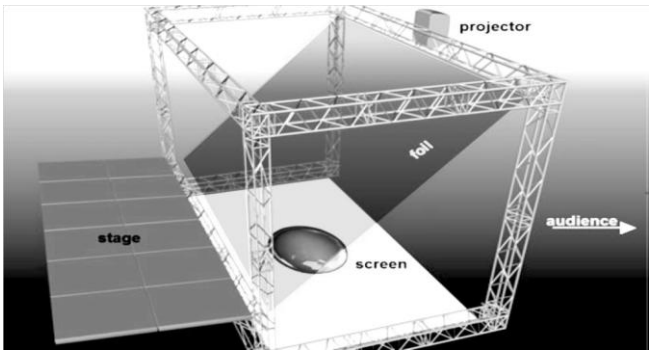

Figure 3 The pictorial representation of Pepper's Ghost type [12]

Hologram is a 3D image created using photographic projection and holography is a method that enables holograms to be made. There are mainly three types of hologram mainly reflection, transmission and hybrid of both. Pepper's ghost holographic system consists of transparent anti-glare acrylic sheet, Projector and a white projector screen. 3-D object is projected on the screen that will be reflected on the transparent anti-glare sheet which gives a 3D holographic effect to the audience.

3. PROPOSED HOLOGRAPHIC SYSTEM

3.1. Building Blocks

The holographic proposed system can be setup in two different ways. Both the holographic proposed setups are explained in detail. The various building blocks required for the proposed system are as follows:

- **Pyramid:** This component represents the space where the holographic image will be projected in three dimensional. It needs to be built from a sheet of extra clear glass sheets to have high clarity visualization.
- **Display Screen:** This component is optional as the proposed holographic system may easily work with a tablet or a mobile device. With a display screen, larger holographic projections in three dimensional will be visible.
- **Tablet or Mobile Device:** The following devices are the primary component of the proposed system. These devices will contain the images that we want to display as three dimensional holographic images.
- **Mobile Application:** The following component needs to be installed either on the mobile application or on the display screen supporting Android as the images needs to be converted to three dimensional images to display as holographic projections.

- **Webcam or Kinect:** These components provide interactivity with the holographic projections as well as it provides a facility to change the images with interactivity of hands.
- **Wi-Fi:** These component will be used to transfer the three dimensional images from the mobile device or tablet to the display screen without using any wired means of communication.

3.2. Proposed Holographic Projection Setup using Tablet or Mobile Equipped with 2D to 3D Conversion Application

The explanation for the holographic proposed system given in the figure 3 is presented here. The user will be holding the mobile device or tablet in the hands. The tablet or the mobile device is equipped with a mobile application which will convert the user's required images to three dimensional images so it can be projected in the holographic system. The images will be transferred wireless from the mobile to the display screen using Wi-Fi sharing. The webcam or Kinect are attached with the display screen to provide interactivity with the holographic projection. The type of interactivity it can provide is to rotate the holographic projection. The mobile device or the tablet should be equipped with the screen cast feature so that the projections can be made visible in the pyramid. The pyramid needs to be kept in the center of the display screen and it will be easily movable for the user's convenience.

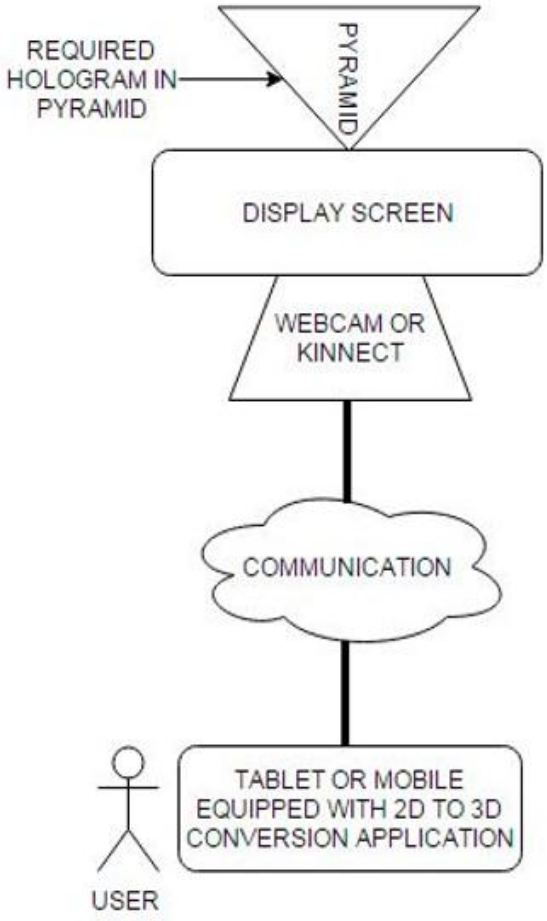

Figure 4 Proposed Holographic Projection Setup using Tablet or Mobile Equipped with 2D to 3D Conversion Application

3.3. Proposed Holographic Projection Setup using Tablet or Mobile directly attached to the Display Screen

The explanation for the holographic proposed system given in the figure 4 is presented here. The user needs to transfer all the converted images from the mobile application to a removable device and the removable device is to be attached to the display screen. The webcam or Kinect gets connected to the display screen to provide interactivity. Users can change the images directly by waving in front of the webcam or Kinect. Also, with the webcam and Kinect, users will be able to rotate the holographic projection just by sitting in front of the display screen.

3.4. Proposed Holographic Projection Setup using Tablet or Mobile Using an External Camera

The explanation for the holographic proposed system given in the figure 5 is presented here. In this proposed system, instead of using the display screen we are directly using the mobile device or tablet as display screen. The tablet or the mobile device is attached with an external USB web camera to provide interactivity for the users. Users can directly interact with the external camera by hand gestures to change the holographic projection to next projection or also to rotate the holographic projection. This proposed system has the least cost in implementing as there is neither Kinect required nor the display screen is required.

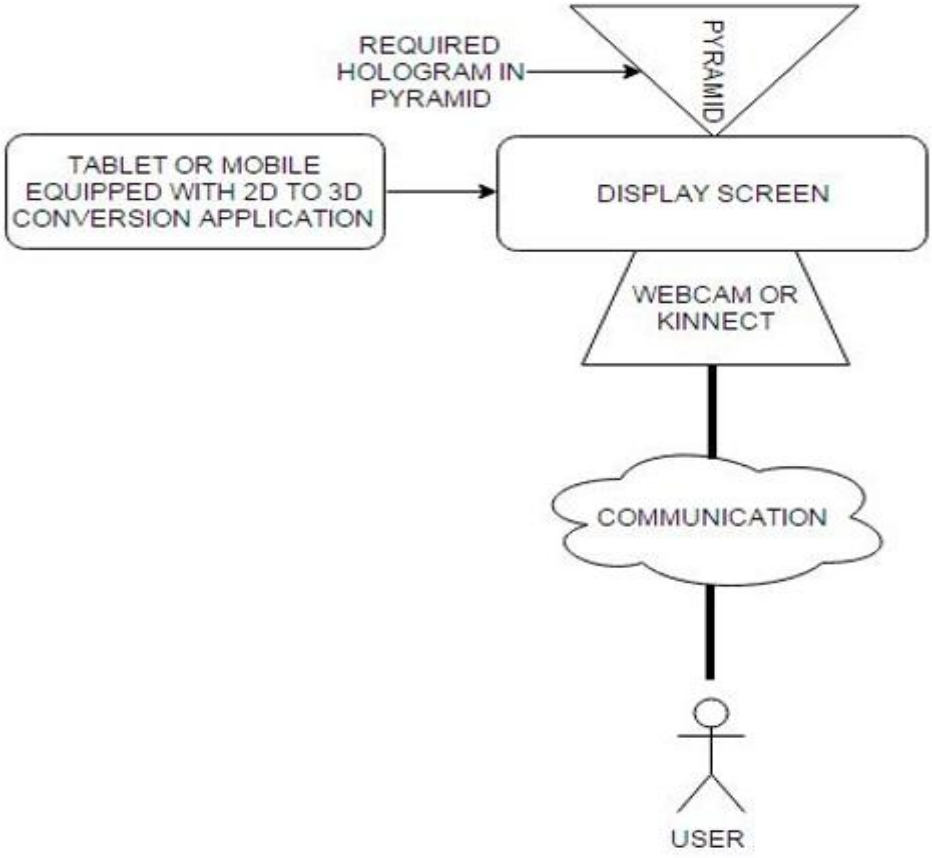

Figure 5 Proposed Holographic Projection Setup using Tablet or Mobile Directly Attached to the Display Screen

3.5. Feasibility Study for Holographic Proposed System

The feasibility study of each component and the application is analysed here. The pyramid construction can be done using the extra clear glass available in the market and the costing for the glass ranges between 650 INR to 1500 INR. The construction of pyramid doesn't take much time as it can be easily completed within a short duration of time once the sheets are available.

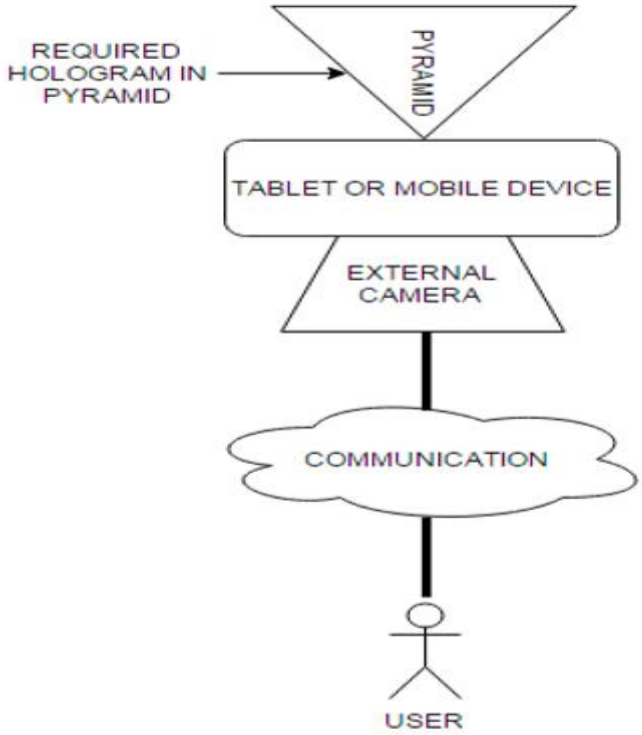

Figure 6 Proposed Holographic Projection Setup using Tablet or Mobile Using an External Camera

The display screen is an optional component for the proposed system as the proposed system also works with only mobile device or tablet. The display screen can be used for the high end users who are ready to buy the display screen as the costing of the display screen is high. The display screen can vary by size to size and also in pricing depending upon the company that we are buying. Costing of good display screen may vary from 25000 INR to 50000 INR. There is a size ration between the display screen and the pyramid. The larger the display screen, the larger pyramid we need to build and the larger holographic projection will be available to the users. For the proposed holographic projection setup using tablet or mobile equipped with 2d to 3d conversion application, the display screen should support the screen casting feature to enable wireless transmission of converted photos from the mobile device or tablet to the display screen.

One mobile application needs to be developed to convert the normal 2D photos or videos to be converted to 3D photos or videos so that they can be projected in the holographic system. The application can be developed in VUFORIA SDK [9] so that the application becomes platform independent and can be easily run on android devices as well as iOS devices. The application will take photos or videos as input depending upon the user's requirement and then convert the given input into the 3D form which can then be used for projection. For wireless transmission of images from the mobile device or tablet to the display screen in the proposed holographic

projection setup using tablet or mobile equipped with 2d to 3d conversion application, the mobile device or the tablet needs to be equipped with the screen casting feature.

Webcam or Kinect [8] has to be bought to provide interactivity to the holographic projections and also change the holographic projections in the proposed holographic projection setup using tablet or mobile directly attached to the display screen. Kinect is a motion sensing device by Microsoft for the Xbox 360 Video Game Console and Windows PC. Based around a Web-Cam style add-on peripheral, it enables users to control and interact with the Xbox 360 without any game controller through gestures and spoken commands. Kinect using its depth camera, it first collects all the depth of the points that are in its range. Then using the x, y and z co-ordinates it plots them and thus creating a point cloud. To provide motion detection in webcam, JavaScript along with jQuery can be used for motion detection. Kinect can be used for high end users to provide better gesture recognition and also faster gesture recognition. The costing of the webcam ranges from 600 INR to 2000 INR whereas the costing for Kinect ranges from 7500 INR to 20000 INR depending on the user's requirement. Kinect can be used for the users who are using the display screen for the projection and the users who are able to afford high costs.

4. FUTURE SCOPE

The implementation of the three proposed holographic systems will be carried out to provide user's watch holograms at home at minimal costing. The user's just need to setup by following the guidelines and can have holographic projections at home and interact with them using the various options available.

5. CONCLUSION

Till now, the aerial projections of three dimensional holography was extremely costly and hence the common people can't use it at home. The proposed systems are proposed keeping the common people in mind and they can have 3D aerial projections at home at minimal costing. The implementation of the proposed systems will give three options to the user to setup the projection at home. The user can make the choice according to the budget as first and second proposed systems are costlier than the third proposed system. Thus, users within a limited budget will be able to watch holograms at home.

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