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HOLOGRAM PROJECTOR WITH RASPBERRY PI

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This study has been accepted as an Undergraduate Graduation Project in the Department of Computer Engineering on 31/08/2021 by the following jury.

JURY

Member
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ABSTRACT

This project is mention about displaying image in raspberry pi. There is an interface for communication. User uploading an image in this interface and sending image to raspberry pi.

There is a two server on this project. First server on personal computer as local server. Server waiting to user upload image to server. When user upload image, php file saving image to new directory. Server checking directory. If image uploaded, then sending image to other server on same existing on same router.

In raspberry pi has another server. This server waiting image. When image came then running image and displaying it. If new image arrive then, it destroy window and displaying new image.

Keywords: rapberrypi, opencv, server, socket.

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1. HOLOGRAPHY

Holograms are virtual three-dimensional images created by the interference of light beams that reflect real physical objects. Holograms preserve the depth, parallax, and other properties of the original item. They are great for presenting complex technical concepts as well as showcasing visually appealing products.

Hologram was invented and developed by the Hungarian–British physicist Dennis Gabor. It is the effect of the light scattering off object resulting in the three dimensional image of the object. The concept which is the most widely used one is, creating the hologram image of the object from the reflection of four normal two dimensional images of the object on the special hologram screen. [1]

Using the Pepper's ghost principle one can create a 3-D illusion displaying symmetrically opposite images that seem to float in mid-air and which are visible from different angles, this by no means is a 3-D image of course but a projection of 2-D images producing a clever result.

1.1. Pepper's Ghost

Pepper's ghost is an illusion technique used in the theatre, cinema, amusement parks, museums, television, and concerts.It is named after the English scientist John Henry Pepper (1821–1900) who began popularising the effect with a theatre demonstration in 1862. [2]

By means of a sheet of glass, special lighting, and using the reflective properties of the glass, the impression or optical illusion is created that objects or persons appear and disappear. The technology at that time was, of course, rudimentary due to the weak light sources, such as oil lamps and candles, and the images that appeared were only faintly recognizable or very transparent. For that reason, mainly ghosts, phantoms, or other inexplicable phenomena were shown, which also led to the naming of Pepper's Ghost – after the inventor John Henry Pepper and his ghostly technology.[3] 1.1

Briefly Pepper's ghost is reflecting the image to the glass which placed at a special angle using special light environment.

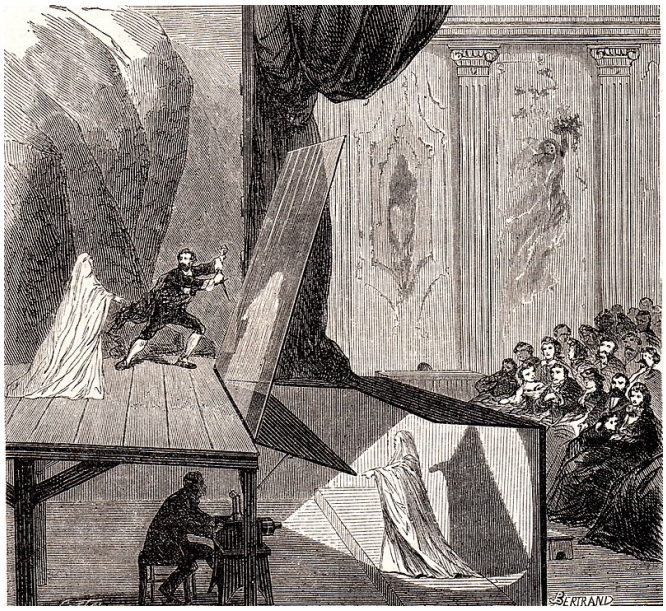


Figure 1.1: Stage setup for Pepper's Ghost. A brightly lit figure out of the audience's sight below the stage is reflected in a pane of glass placed between the performer and the audience. To the audience, it appears as if the ghost is on stage

1.2. The Aerial Burton Laser Plasma Holograph

A company known as Aerial Burton has created a holographic projector that uses a plasma laser to float a 3D image in mid-air. At the moment it's very rudimentary stuff but it shows that light can be viewed without the need to bounce it off a surface. The technology uses a 1kW infrared pulse laser which is focused on direct points in the air via a 3D scanner causing the molecules in the air to be ionized to create a plasma.

1.3. Light Field Display Holograms

It used to be that a round mirror could project the illusion of a 3D image from the right angle, but now researchers are using LCD screen advancements to create machines like the HoloPlayer One, which sends 32 views of a given scene towards their designated directions simultaneously. This creates a "field of light", which a scene that occupies the same physical volume would have given out. 1.2.

1.4. Physical Holograms

Researchers at MIT created a tangible informed dynamic shape display called inFORM that can render the shapes of people and objects on 2D surfaces. To do this it

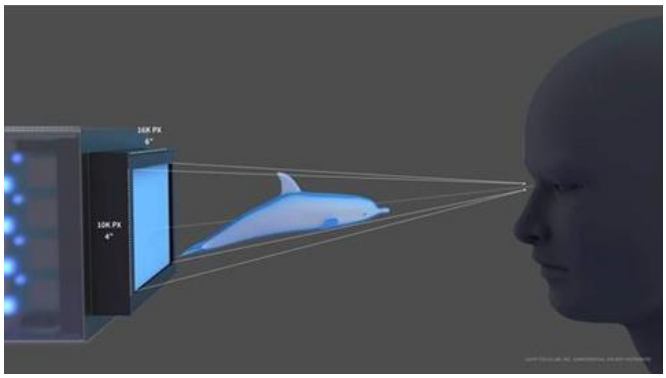


Figure 1.2: With the LFL monitor your eyes focuses at the point of light / holographic object

uses up to 900 motor driven columns in a tiny area that are capable of sculpting shapes in real time.

1.5. Table Holograms

Though not true 3D holograms like the Digital Holographic Tabletop above, there are a couple other holographic table products worth mentioning as they are available right now and very cool. The Euclideon Hologram Table is an immersive, multi-user system that coordinates atoms of light with an incredible algorithm that can handle 1000GB of graphics data, creating stunning visuals. Unfortunately, it does require special lenses to use. 1.3.

Figure 1.3: Table Holograms

2. LIST OF MATERIALS

The hardware of used in this projects:

- Raspberry Pi 3
- Plexiglass
- Wireless 11N USB ADAPTER

The software of used in this projects:

- HTML - CSS
- JavaScript
- PHP
- Python
- VNC Wiever
- OpenCV

2.1. Hardware

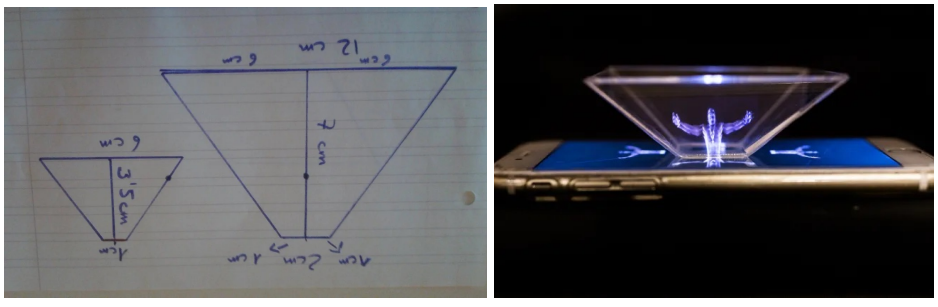
2.1.1. Raspberry Pi

The Raspberry Pi is a low cost, energy efficient , small computer with a processing power and ability comparable to a standard desktop computer. The platform was initially developed for people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. The current price (as of August 2022) of the Raspberry Pi 3 used in our work, price is 1.980TL. In term of energy consumption, the electricity consumption rate is less than 4W per hour, depends on peripherals connected. Moreover, it has the ability to browse the internet and play high-definition video. 2.1

2.1.2. Plexiglass

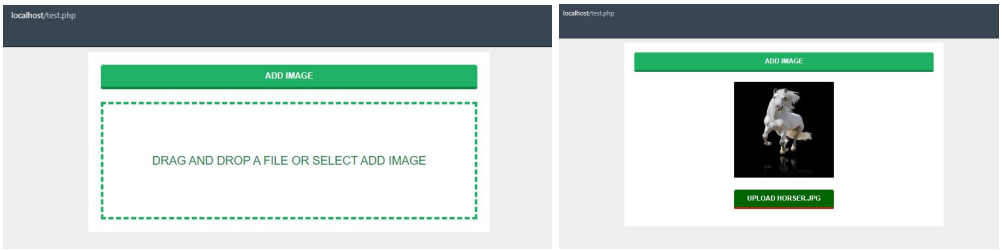
Cut plexiglass for making the prism. Prism has special dimensions. In the figure 2.2 there 2 different dimensions {1. Top 2cm, Height 7cm, Bottom 12cm and 2. Top 1cm, Height 3.5cm, Bottom 6cm }.

Figure 2.1: Raspberry Pi 3



(a) (b)

Figure 2.2: (a) Dimensions of Prism (b) Prism



(a) (b)

Figure 2.3: Interface

2.1.3. Wireless 11N USB ADAPTER

The model Raspberry pi 3 has not wireless. So I used wireless adapter for connect to network.

2.2. Software

2.2.1. Interface

In this project used make an interface using HTML-CSS-JavaScript. Connecting the interface using local address: http://localhost/test.php . User selecting image from computer after click the add image or can drag and drop. After selecting the image user uploading the image. 2.3

2.2.2. Upload Image to Directory

Using the php saving image to directory. When user upload the image then click the upload, interface loading uploading.php file and this file taking image and saving to new directory.

Algorithm 1 uploading.php

$target\ directory \leftarrow target$
if $check\ file\ exist$ **then**
    print $error$
end if
if $check\ file\ valid$ **then**
    $save$
else $file\ not\ valid$
    return $error$
end if

2.2.3. Sending Image

This is the second step when project start. User running the python code and the code start to waiting the image. File waiting until the image loading. After the load the code starting and sending.

$path \leftarrow ./temp/$
$dirList \leftarrow os.listdir(path)$
$port(path, dirList)$

Python code taking image path and calling the sending function.

Algorithm 2 port(path,dirList)

$address \leftarrow (serverNumber, portNumber)$
$connectToSocketWithAddress$
$openImage\ givingPath$
while image **do**
    $sendImage$
end while
$closeFile$
$closeSocket$
$removeImageInPath$

2.2.4. Taking Image

In raspberry pi, takingImage.py python code must be run. This code is the server code. Set up the server and creating new thread for waiting the image.

Algorithm 3 takingImage

$address \leftarrow (serverNumber, portNumber)$
$connectToSocketWithAddress$
$openImage\ givingPath$
$createThread$

Thread calling $taken()$ function and this function start to listening server. If anything came then press the "escape" for destroy the window ıf any image displaying. Removing image from directory and join the thread. Then create new image file and taking image in while. After finish the taking the image then creating new thread and calling the runningImage.py.

This server is endless.

Algorithm 4 takingImage

$server.listen()$
$keyboard.press(Key.esc)$
$remove(".images/image.jpg")$
$thread.join()$
$file \leftarrow open(".images/image.jpg","wb")$
while image **do**
    $takeImage$
end while
$closeFile$
$createThread$
$call\ runningImage.py$

2.2.5. Hologram Image Displayer

This is also python code that using OpenCV. Firstly taking image and resizing it. After that placing and rotating the images into screen was made black screen. When all calculation done then displaying it until the user press to any key.

Algorithm 5 runImages(path, dirList)

$getMonitors()$
$path \leftarrow path + dirList[0]$
$Resize\ the\ Images$
$Relocate\ the\ Images$
$Rotate\ the\ Images$
$Display\ Image$
$WaitKey$
$destroyAllWindows$

2.3. VNC Wiever

For displaying used the mobile phone screen. Between the connection with mobile phone and raspberry pi I used VNC Wiever. They are using same local network and we can see raspbery pi screen on phone and computer. But when raspberry pi start the run we need connect to any monitor, because of openCV we need monitor information or the runImages function giving error.

3. PROJECT

This project is a making a hologram project with using one image. User choosing and uploading image to server and displaying it as a 3D.

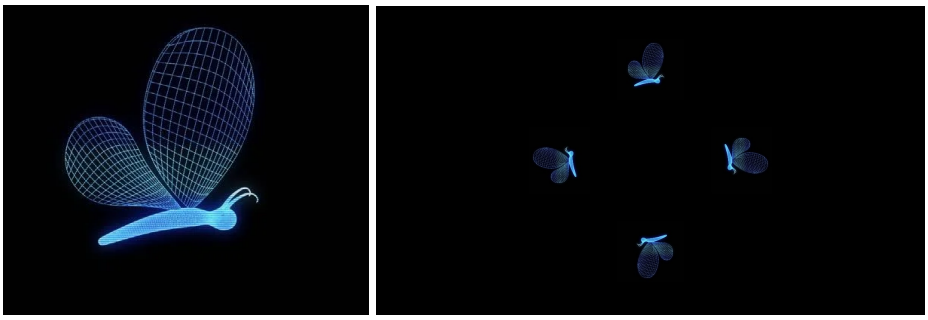
3.1. Image

Mentioned how can we upload the image. I am going to talk about how image must be load.

Image must be approximately square. Widht and height difference must be closer. Image back stage must be black. Because the environment must be dark We are reflecting the light. So there must be just image and black stage. There is example 3.1.

3.2. Reflection

The most importent thing in this project is reflection. Because we are using the Pepper's Ghost Theorem. 3.1. Placed and rotated image on the screen reflecting by glass to viewer.



(a) (b)

Figure 3.1: (a) Single Image (b) Hologram

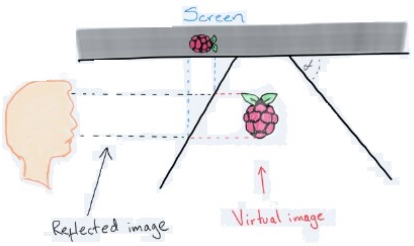


Figure 3.2: How the reflection work.

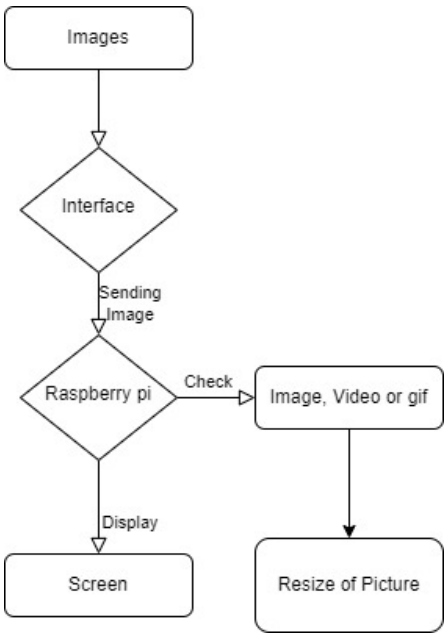


Figure 3.3: How the reflection work.

3.3. Diagram

There is an example diagram How the system work. 3.3.

4. CONCLUSIONS

Technical applications are represented by holograms used in medicine, engineering, architecture, and retailing. Conception of using hologram as the signage is mainly limited only by conditions of environment and content processing. This solution allows to demonstrate HD quality content. Raspberry Pi as a low cost solution provide possibility to demonstrate prepared content, but content rendering should be made on more powerful devices with GPU. Otherwise we are losing the smooth of work. The Raspberry Pi 3B has no limits due it support Ethernet and Wi-Fi. Remote and local controlling of content nowadays is have no limitation and supported by various types of hardware and software solutions.

Sending .png, .jpg, .jpeg and displaying it on screen. 2.2

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