

HOLOGRAPHIC ROBOTIC SURGERY WITH 4G INTERFACING

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Technology degree in Biomedical engineering

by

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DEPARTMENT OF BIOMEDICAL ENGINEERING

SCHOOL OF BIO AND CHEMICAL ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **RAGHAVI.T (38240025)**, **SNEGA.V (38240037)** who carried out the project entitled "**Holographic Robotic Surgery With 4G Interfacing**" under our supervision from **September 2021 to May 2022**.

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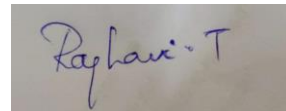
DECLARATION

We **Raghavi. T (38240025)**, **Snega. V (38240037)** hereby declare that the Project Report entitled “**Holographic Robotic Surgery With 4G Interfacing**” done by us under the guidance of Dr. **T. SUDHAKAR** M.Sc., Ph.D., Department of Biomedical Engineering is submitted in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering.

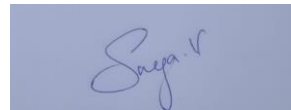
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**SIGNATURE OF THE
CANDIDATES**

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We are pleased to acknowledge my sincere thanks to the **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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ABSTRACT

Hologram is explicated to be a three-dimensional and free-standing image that does not simulate spatial depth or require a special viewing device. Holographic techniques manifest ethical enhancements in recoding strategies and have surged the availability of tools for interpreting holographic interfacing across all branches of medical domain. 3D images of biological specimens can be synthesized from a series of 2D radiological images using the techniques of holographic stereogram or multiple holograms. Holographic protocols is juxtaposed with 4G interfacing, which is the current peak data speed combined with ultra-low latency, etc., along with operating surgical robots. This technology is ameliorated along with secured Wi-Fi connectivity to assure that the EHR (electronic health record) is shielded from unauthorized access. SD Card reader make use of advanced authentication methods that restrict the access to confidential information to authorized personnel only and can be directly stored in the electronic health database created for the patient. These technologies consolidated together tend to scale up surgical precision, reduces risks of fatality and ascend the quality of life to be worth it.

LIST OF ABBREIVATIONS

ABBREIVATION

3DHPT

HER

BTH

SLM

PEC

CG

NPA

AR

CGH

DCGH

DMD

PFA

SRAM

VR

EXPLAINATION

3D HOLOGRAPHIC PROJECTION

ELECTRONIC HEALTH RECORD

BRITISH THOMSON-HOUSTON

SPATIAL LIGHT MODULATORS

PROXIMITY EFFECT CORRECTION

COMPUTER GENERATED

NANOPHO-TONIC PHASED ARRAY

AUGMENTED REALITY

COMPUTER GENERATED

HOLOGRAPHY

DYNAMIC COMPUTER-GENERATED

HOLOGRAPHY

DIGITAL MICROMIRROR DEVICE

PATELLOFEMORAL-

ARTHROPLASTY

STATIC RANDOM-ACCESS

MEMORY

VIRTUAL REALITY

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CHAPTER 1

INTRODUCTION

As we took a Da Vinci's system and T solution 1 as a reference, the idea for implementation is, along with the robot's arms, a holoscope with relative access will be installed for more precise views of live internal anatomy during surgery. Those holograms will be transcribed in monitors, by 4G interfacing, so as to ensure authorized data transfer and securing EHR from high risk factors. This hologram device has a card reader (TF CARD) that can store the patient database permanently and it can be checked timely whenever needed.

1.1 THE INTRODUCTION OF 3D HOLOGRAPHIC PROJECTION

Holography is a diffraction-based coherent imaging technique, which can reproduce a complex three-dimensional transparent object on a flat two-dimensional screen. Moreover, only holographic photography can reconstruct natural 3D scenes and give observers an extremely comfortable experience.

Nowadays, 3DHPT is rapidly evolving and has set off a wave in the market. endeavors, such as Endemol (Big Brother), Coco-Cola and BMW. (Ryan, 2009). Holography is a non-destructive tool for measuring the natural cavities, organs, and bone of the human body in the health care industry. This 3-D technology gives doctors a unique experience and gives physicians more power. In a contactless approach, it efficiently performs bone examinations.

1.2 HISTORY OF HOLOGRAPHIC PROJECTION

3D holography is a three-dimensional technology in which viewers can see stereoscopic virtual characters without wearing any special glasses or headsets. Holography is defined by Narendra Modi as follows: (2012) "Holography is a technique that enables a light field, which is generally the product of a light source scattered off objects, to be recorded and later reconstructed when the original light field is no longer present, due to the absence of the original objects". The 3DHPT

started from the time when the holographic method was invented, and then evolved step by step into mature 3DHPT today. Actually, the holography was discovered accidentally by the Hungarian-British Physicist Dennis Gabor when he was researching into improving electron microscopes at the British Thomson-Houston (hereinafter BTH) company. The work was finished in the late 1940s after his further research. Finally, he invented the holographic method. The technology was patented in December 1947 (patent GB685286) by the BTH Company. Moreover, due to the invention and development of the holographic method, Dennis Gabor was awarded the Nobel Prize in Physics in 1971. (THE NOBEL PRIZE, 2018.) Even though, the holography has been widely used in the field of electron microscopy, which is named electron holography, the well-known optical holography technology did not advance until the laser had a good development in 1960. Development of the lasers brought the first optical hologram recording a 3D object, which was invented by Yuri Denisyuk in the Soviet Union and by Emmett Leith and Juris Upatnieks at the University of Michigan, the USA in 1962.

1.3 EXAMINED OUTCOMES

Holographic interferometric algorithms have been successfully used to examine the cornea, tooth mobility, tympanic membrane, basilar membrane, cochlea, temporal bone, incudo-mallar joint, chest, skull, and bones, among other regions of the human body. Endoscopic holography is a strong technique for nondestructive measurements and noncontact high resolution imaging inside the natural cavities of human internal organs. Real-time observation of living biological specimens has been demonstrated using X-ray holography.

CHAPTER 2

LITERATURE SURVEY

De la Perriere et.al.,, (2020) From its Nobel prize winning discovery by Denis Gabor over half a century ago, Holography has been alternately put in the spotlight as a promising technique for its capacity of displaying 3D scenes, to be later forgotten regarding the complexity of performing holographic recording outside from optical laboratories. The later development of high resolution microdis-plays, high capacity CPU and GPU units raised the interest of using Holography as a mean to reproduce dynamic 3D scenes through the computation of holograms and the display of the associated interference pattern on a Spatial Light Modulators (SLMs). The computation process can for example be performed from a layered Computer Generated (CG) scene, using well-known convolution methods or other transfer function models from Fourier optics. The simplicity and speed of this technique is unfortunately compensated by its limitation to small object and scenes. We here want to demonstrate the possibility to use similar techniques to compute holograms of larger field of view, using perspective-projection layered scene and well-known Fourier optics tools.

Sun et.al.,, (2021) Holographic displays and computer-generated holography offer a unique opportunity in improving optical resolutions and depth characteristics of near-eye displays. The thermally-modulated Nanopho-tonic Phased Array (NPA), a new type of holographic display, affords several advantages, including integrated light source and higher refresh rates, over other holographic display technologies. However, the thermal phase modulation of the NPA makes it susceptible to the thermal proximity effect where heating one pixel affects the temperature of nearby pixels. Proximity effect correction (PEC) methods have been proposed for 2D Fourier holograms in the far field but not for Fresnel holograms at user-specified depths. Here we extend an existing PEC method for the NPA to Fresnel holograms with phase-only hologram optimization and validate it through computational simulations. Our method is not only effective in correcting the proximity effect for the Fresnel holograms of 2D images at desired depths but can also leverage the fast refresh rate of the NPA to display 3D scenes with time-division multiplexing.

Kim et.al., (2020) In this paper, we propose a new method for generating volumetric holograms using point cloud and mesh. Traditional digital holograms only record information about specific viewpoints. In this paper, we propose a method to store real objects in the form of omnidirectional 3D point cloud and mesh, and to generate holograms of various views of the stored point cloud. In order to record a better-quality hologram, a method of weighting the brightness of a light source according to the direction of light is proposed.

Lee et.al., (2020) The present research designed a tracking system of fish with 3D holographic augmented reality (AR). To track the fish, OpenCv through a camera with an algorithm was used. 3D holographic fish followed color marks that were used to track the fish. If the marks disappeared, 3D holographic fish stopped swimming. This process was repeated until the algorithm stopped. This experiment showed that 3D holographic fish followed the real fish.

Curtis et.al., (2021) Computer Generated Holography (CGH) is a promising technique for synthesizing 3D images on-demand. CGH systems sculpt light by computing a 2D modulation pattern to shape the phase or the amplitude of a coherent light source. Yet, static wave modulation restricts feasible holograms to a very small subset of all the possible illumination patterns where speckle noise is omnipresent. Here, we introduce Dynamic Computer Generated Holography (DCGH), a novel light sculpting technique that modulates light both spatially and temporally. DCGH has many more degrees of control to eliminate unwanted wave correlations and yields high fidelity, speckle-free 3D holograms. Our technique relies on an algorithm that simultaneously computes a set of engineered coherent wavefronts by optimizing them as a whole to best render the desired 3D illumination pattern when their contributions are rapidly superimposed and averaged in time. We have implemented DCGH with a Digital Micromirror Device (DMD) and synthesized 3D holograms made of up to 50 mutually optimized waves with refresh rates of 190 3D images per second. Our experimental results indicate that DCGH yields 3D images with improved resolution and contrast, successfully addressing the shortcomings of single-frame holography. Our technique can be implemented with

inexpensive, low-power hardware, as a compact, portable 3D display that is perfectly suited for virtual and augmented reality applications.

Xu et.al., (2021) Phase-only holograms are more attractive than the amplitude holograms for the higher energy utilization and the possibility to realize on-axis holographic 3D display without conjugate image. In this study, we propose a high-resolution phase-only holographic 3D display using the light field images rendered in the frequency domain. The high-resolution phase-only hologram contains a large number of elemental phase-only holograms (EPHs), and each EPH is calculated from the light field image of the corresponding viewing point in frequency domain through weighted GS (Gerchberg-Saxton) algorithm. Parallel calculation is performed to speed up the calculation in the row direction and the previous EPH is used as the initial phase for the current EPH calculation in order to improve the display quality due to the great similarity between adjacent light field images. Two high-resolution phase-only holograms both with the size of 64 mm×64 mm and the resolution of 200k×200k pixels were calculated and printed by our homemade holographic printer. The full-parallax and high quality 3D displays were verified by optical experiments, which have the potential to be applied in holographic advertising and other fields.

Andrés et.al., (2020) Single-element focused ultrasound devices have demonstrated its ability to non-invasively open the Blood Brain Barrier. However, skull irregularities and absorption produce strong aberrations in the ultrasound focus. Recently, 3D-printed acoustic holograms were used to compensate aberrations and to produce a sharp focus. In addition, using this technology the geometry of the ultrasonic focus can be matched to the shape of the brain structure of interest. In this work, we experimentally and numerically report 3D-printed acoustic holograms for bilateral focusing through an ex-vivo human skull. Using holograms, we target different cerebral nuclei and the ultrasonic focuses are adapted to the target volumes, minimizing the acoustic field outside. Simultaneously, skull aberrations are corrected using phased-conjugation methods. The holographic surfaces were manufactured for a 100-mm aperture and 140-mm focal focused transducer at 500 kHz to focus through an ex-vivo human skull.

Numerical and experimental results agree targeting several deep-brain nuclei: left-and-right putamen, caudate nuclei, and hippocampi, showing the potential of this low-cost technology to optimize BBBO or neuromodulation treatments.

Gilles et.al., (2021) Thanks to its ability to provide accurate focus cues, Holography is considered as a promising display technology for augmented reality glasses. However, since it contains a large amount of data, the calculation of a hologram is a time-consuming process which results in prohibiting head-motion-to-photon latency, especially when using embedded calculation hardware. In this paper, we present a real-time hologram calculation method implemented on a NVIDIA Jetson AGX Xavier embedded platform. Our method is based on two modules: an offline pre-computation module and an on-the-fly hologram synthesis module. In the offline calculation module, the omnidirectional light field scattered by each scene object is individually pre-computed and stored in a Look-Up Table (LUT). Then, in the hologram synthesis module, the light waves corresponding to the viewer's position and orientation are extracted from the LUT in real-time to compute the hologram. Experimental results show that the proposed method is able to compute 2K1K color holograms at more than 50 frames per second, enabling its use in augmented reality applications.

Vasileios Memos, et al. The Impact of IoT and 5G Technology in Telesurgery: Benefits & Limitations The surgeon looks from the screen and thereby operates his haptic arms and places the robotic equipment in the operating room on the patient's body in an appropriate manner. The robot translates the surgeons' natural hand motions at the control console into corresponding movements of the robotic instruments. Fully articulating robotic arms mimic the movement of hands Need for high bitrate which has the advantage to accommodate higher image quality in the video output. The solution in this concern is the introduction of 5G networks, which offer significantly improved bandwidth and notable lower latency.

Hisham Iqbal, et al. Augmented reality in robotic assisted orthopaedic surgery. This work explores the integration of AR within an orthopaedic setting by capturing and

replicating the UI of an existing surgical robot within an AR head-mounted display worn by the clinician. The resulting mixed-reality workflow enabled users to simultaneously view the operating-site and real-time holographic operating informatics when carrying out a robot-assisted patellofemoral-arthroplasty (PFA). Ten surgeons were recruited to test the impact of the AR system on procedure completion time and operating surface roughness. The integration of AR did not appear to require subjects to significantly alter their surgical techniques, which was demonstrated by non-significant changes to the study's clinical metrics, with a statistically insignificant mean increase in operating time (+0.778 s, $p = 0.488$) and a statistically insignificant change in mean surface roughness ($p = 0.274$).

Gharsa Elmarash, et al. 3D Hologram Technology A Hologram is a 3D record of the positive interference of laser light waves. Technology of three dimensional hologram (3DH) involves spatial displays which detaches the display technology from the user and integrate it into the real environment. This research paper examines the essential information about 3D Hologram technology in order to understand the importance of this technology in learning. It is of much very interesting to use this technology in the teaching process even if it is expensive to implement at present. The results of all articles reviewed have proved the significant of 3D Hologram as an effective tool for classroom. Meanwhile, the using of 3D hologram technology visualisation skill is important for students to develop abstract imagination of objects or concepts.

Sundeeep Mishra,(2018) Hologram the future of medicine, By using a holographic image, doctors can improve the quality of medical education and research. It used to reconstruct the image of tissue samples which helps to perform tissue surgeries. This technology is used for making the digital 3D prototype for neuroscience. Holography will significantly disrupt 3D imaging, as it offers better usability and addresses the shortcomings of current 3D solutions. It has the potential to impact each and every aspect of life but particularly, it can be a game changer in medical industries. Progress in image-guided therapies for heart diseases has opened new frontiers for minimally invasive, non-surgical interventions; coronary interventions,

catheter ablation therapy for arrhythmias and catheter-based structural heart therapies including heart valve replacements.

CHAPTER 3

AIM AND SCOPE

3.1 AIM:

- To develop 3D holographic models based on multi sourcing holographic device.
- To make use of 4G interfaced 3Ds player software, to give a vibrant and resolution defined 3d surgical scan images and videos without any cable connections and less glitches.

3.2 SCOPE.

- Telemedicine requires a network that can support real-time high-quality video, which often means wired networks. With 4G, healthcare systems can enable mobile networks to handle telemedicine appointments, which can greatly increase the reach of the program.
- While augmented reality (AR), virtual reality (VR) and spatial computing are already being used in healthcare on a limited basis, with the help of high network bandwidth may eventually further enhance a doctor's ability to deliver innovative, less invasive treatment.
- By using IoT devices, healthcare providers can monitor patients and gather data that can be used to improve personalized and preventive care.
- WIFI transmitted electrical powered holographic device is put into use along with LED panels and shafts that thereby rotate at a DC12V and thereby produce the popped out surgical image.

- Scalability of WiFi systems is much greater than that of the conventional systems and allows for a simpler and more effective installation and distribution of network connections on the network. It is cheaper and simpler to deploy cable data points than to mount additional AC outlets

CHAPTER 4

MATERIALS AND METHODOLOGY

4.1 METHODOLOGY:

- In terms of controlling surgical robots, holographic protocols are juxtaposed with 4G interfacing, which is the current peak data speed mixed with super low latency, etc.
- This technology is enhanced, together with protected WIFI connectivity, to ensure that unwanted access to the EHR (electronic health record) is prevented.
- SD Card readers employ advanced authentication mechanisms to limit access to private information to authorised individuals only, and the information can be directly recorded in the patient's electronic health database.
- When these technologies are combined, they tend to improve surgical precision, lower the risk of death, and raise the quality of life to a point where it is worthwhile.

4.1.1 Block Diagram

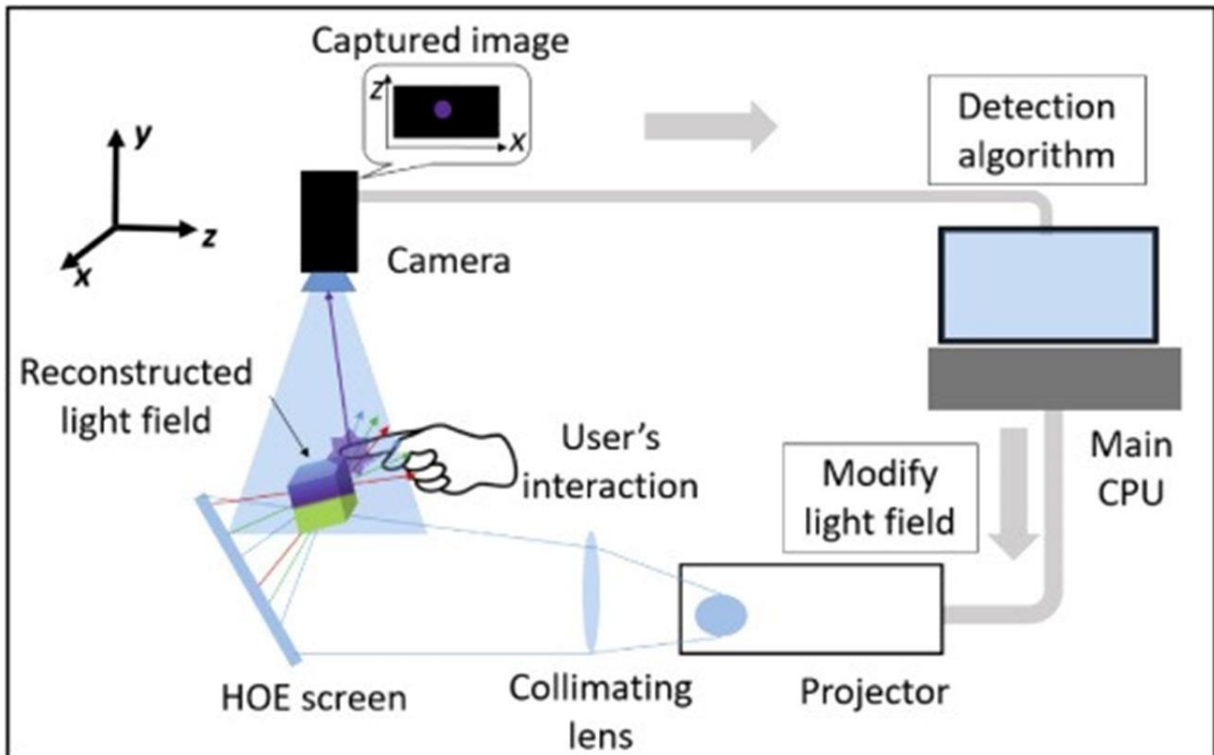


Fig::4.1.1: Proposed Methodology with Explanation

4.2 HARDWARE USED.

- AC MOTOR
- ARDUINO UNO
- MICROCONTROLLER
- SD CARD MODULE
- POWER SUPPLY MODULE
- LIGHT (HIGH BEAM LUMEN)
- BATTERY
- LOGIC CONVERTOR
- 12V/2 Amps ADAPTER

4.2.1 Power Supply Module.

The power force circuit consists of step-down motor which is 230v step down to 12v. In this circuit 4diodes are used to form ground therapy which delivers palpitating dc voltage & also fed to capacitor sludge the affair voltage from therapy is fed to sludge to exclude any A.C factors present indeed after rectification. The filtered DC voltage is given to controller to produce 12v constant DC voltage. 230V AC power is converted into 12V AC (12V RMS value wherein the peak value is around 17V), but the needed power is 5V DC; for this purpose, 17V AC power must be primarily converted into DC power also it can be stepped down to the 5V DC. AC power can be converted into DC using one of the power electronic transformers called as Rectifier. There are different types of cures, similar as half- surge therapy, full- surge therapy and ground therapy. Due to the advantages of the ground therapy over the half and full surge therapy, the ground therapy is constantly used for converting AC to DC.

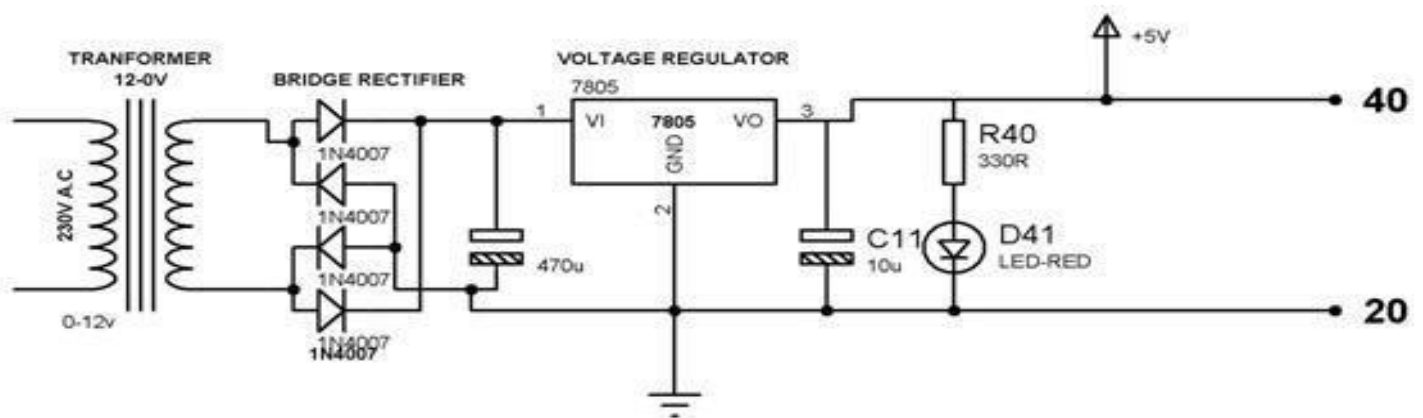


Fig: 4.2.1: Power Supply Module

4.2.2 Arduino Uno:

The Arduino Uno is an open-source microcontroller board created by Arduino.cc that is based on the Microchip ATmega328P microprocessor. The board includes digital and analogue input/output (I/O) pins that can be used to connect to expansion boards (shields) and other circuits. The board contains 14 digital I/O pins (six of which can be used to generate PWM output) and 6 analogue I/O pins, and it can be programmed using the Arduino IDE (Integrated Development Environment) and a type B USB connector. It can be powered by a USB cable or an external 9-volt battery, and it can handle voltages of 7 to 20 volts.

Memory

The Arduino sketch is saved in flash memory (programmable memory). When the sketch executes, variables are created and modified in SRAM (static random-access memory). EEPROM is a type of long-term memory that programmers can employ. Non-volatile memory types include flash memory and EEPROM (the information persists after the power is turned off). When the power is cycled, SRAM becomes volatile and is lost. On the Uno, the ATmega328P processor has the Arduino sketch is saved in flash memory (programmable memory). When the sketch executes, variables are created and modified in SRAM (static random-access memory). EEPROM is a type of long-term memory that programmers can employ. Non-volatile memory types include flash memory and EEPROM (the information persists after the power is turned off).

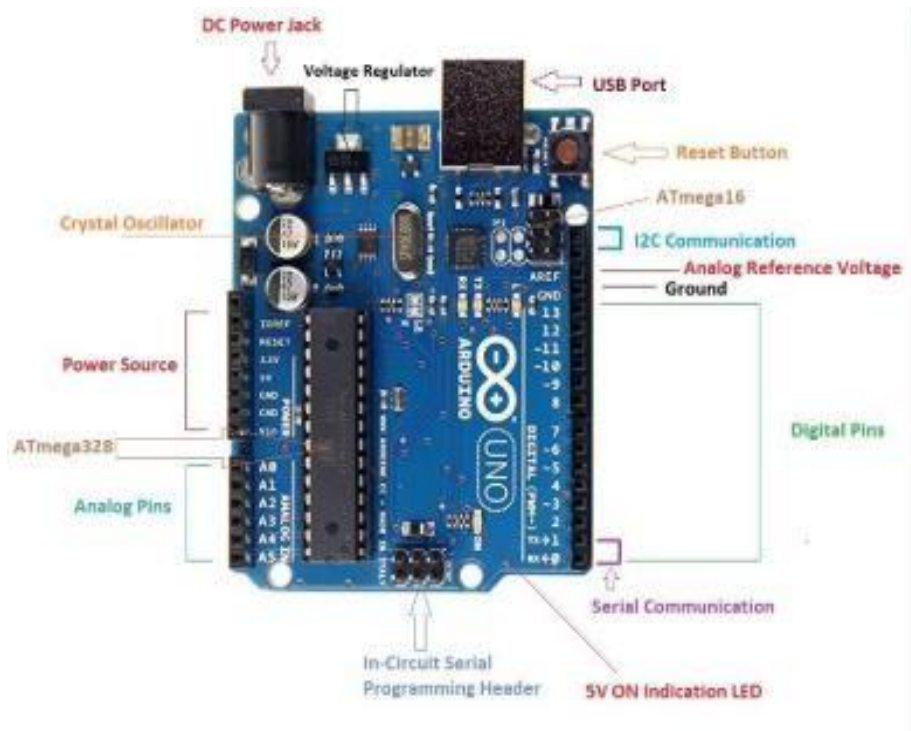


Fig: 4.2.2: Arduino UNO

4.2.3 Microcontroller

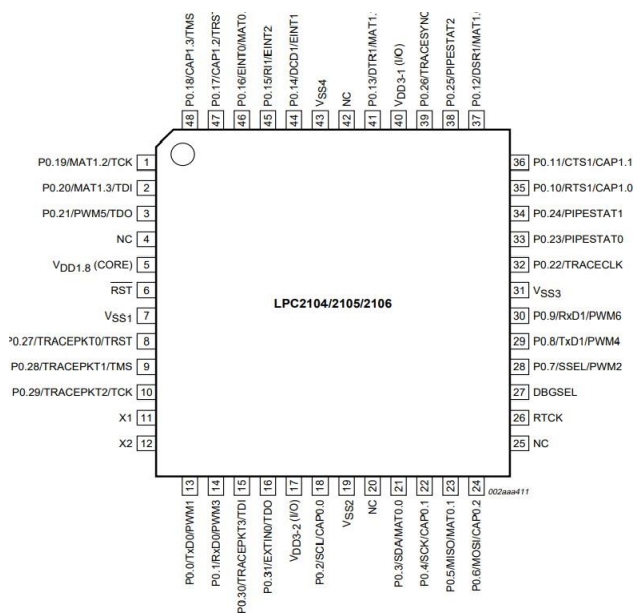


Fig: 4.2.3 Microcontroller

The LPC2104/2105/2106 are based on a 16/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, together with 128 Kbytes (kB) of embedded high-speed flash memory. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit law prosecution at maximum timekeeper rate. For critical law size operations, the necessary 16-bit Thumb Mode reduces law by further than 30 with minimum performance penalty. Due to their bitsy size and low power consumption, these microcontrollers are ideal for operations where miniaturization is a vital demand, similar as access control and point-of-trade. With a wide range of journal dispatches interfaces and on-chip SRAM options up to 64 kB, they're truly well suited for communication gateways and protocol manufacturers, soft modems, voice recognition and low-end imaging, furnishing both large buffer size and high processing power. Colorful 32-bit timekeepers, PWM channels and 32 GPIO lines make these microcontrollers particularly suitable for artificial control and medical systems.

4.2.4 Led (Smd3528/2835):

TUBE BALLAST TYPE (MODEL) – (150-200) LEDS

For the development of specialists and directors, a Corporate University has been established and operates in the company, including 9 departments in all main areas of exertion. Our device emits a high-visibility light that appears similar. We achieve this through the use of a combined high-brilliance LED and a lens, which is both enclosed in the same packaging. Light emitted by the LED is expanded and imaged by an optical system analogous that the expanded light behaves like similar light. It's therefore possible to achieve the light intensity distribution of blockish pseudo-resemblant light. Our LED system manipulates the expanded image with optics to enable the conformation of light patterns like places, circles, lines, and bends. These

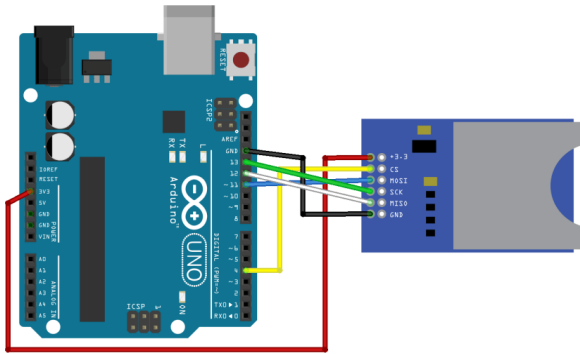
patterns, whose shape is determined by the shape of the LED emitter.



Fig: 4.2.4 Led Strips Smd3528

4.2.5 SD card Module

The SD card module is very handy for data logging tasks. Using the SD library, the Arduino may create a file on an SD card to write and store data. There are several versions from various providers, but they all operate in a similar manner, employing the SPI communication standard.



4.2.5 SD card Module

4.3 SOFTWARE USED:

4.3.1 3ds Player Application:

For device, the 3Ds player application is a software which we have been used in our project to encode the images and videos to project as 3DHPT. To support this application the MATLAB machine learning tools have been installed. For encoding MP4/AVI/RMVB/MOV/GIF/JPG/PNG these files are converted into BIN file and read by SD card reader and project it as a hologram image and videos. For prototype, the C++ code has been used to read SD card and covert it as HEX file.

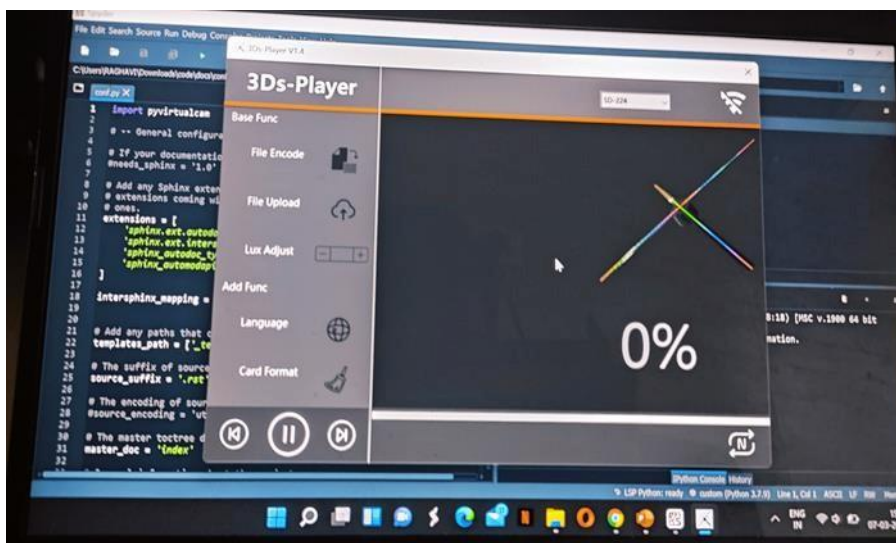


Fig: 4.3.1 3Ds Application Player

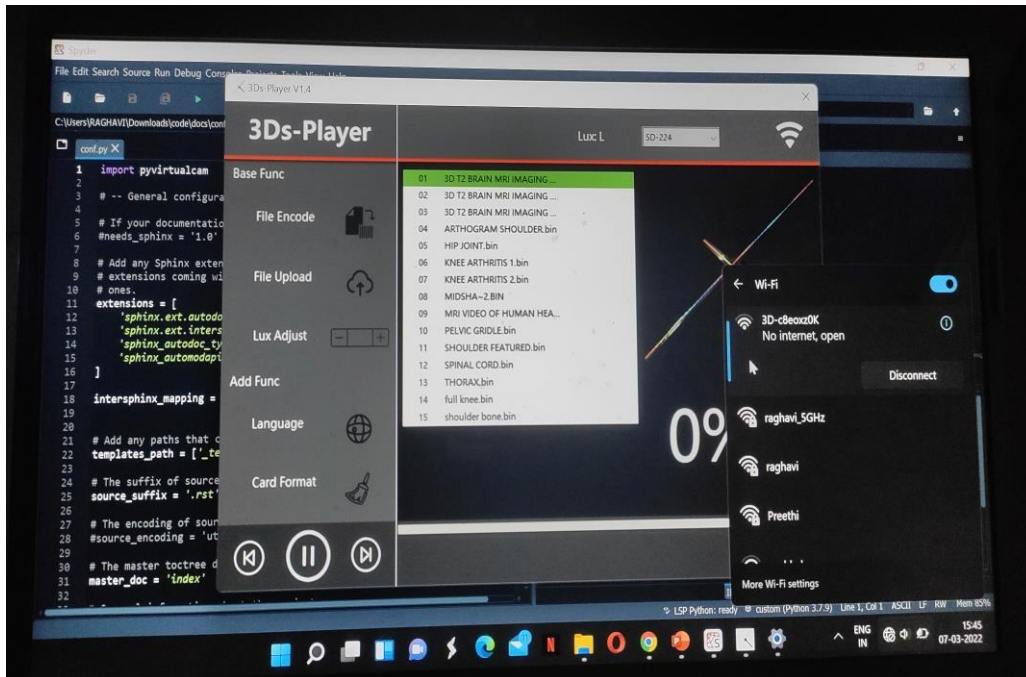


Fig: 4.3.2 Working of 3Ds Player Application

4.3.2 Arduino:

The Arduino software is utilised in this project. Beginners will find the Arduino programme simple to use, but seasoned stoners will find it adaptable. It's compatible with Mac, Windows, and Linux. It is used by professors and students to create low-cost scientific equipment, to demonstrate chemical and medicine principles, and to learn programming and robotics. Musicians and artists employ interactive prototypes for installations and to experiment with new musical instruments, which are created by introducers and masterminds. Makers, of course, utilise it to create a wide range of systems, like as those on show at the Maker Faire. When it comes to learning new effects, Arduino is a must-have tool. Anyone, including children, potters, painters, and programmers, may get started experimenting by following the

step-by-step directions in a manual or sharing ideas online with other Arduino members. For physical computing, there are a variety of additional microcontrollers and microcontroller platforms to choose from. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and a slew of other programmes have similar capabilities. All of these tools condense the complicated nuances of microcontroller programming into a user-friendly package. Although Arduino simplifies the process of working with microcontrollers, it has several benefits over other systems for preceptors, scholars, and curious enthusiasts.

- Cost-effective-Arduino boards are quite inexpensive when compared to other microcontroller platforms. The least expensive Arduino module may be constructed by hand, and pre-made Arduino modules can be found for less than \$50.

- Cross-platform: The Arduino Software (IDE) is compatible with Windows, Macintosh OSX, and Linux. The majority of microcontroller systems are only compatible with Windows

.

- Simple, clear programming terrain—The Arduino Software (IDE) is simple to use for newbies while still being flexible enough for expert drug users. It's accessible to preceptors since it's based on the Processing programming terrain, thus scholars learning to programme in that terrain will be familiar with the Arduino IDE.

- Open source and extendable software—The Arduino software is accessible as open-source tools, allowing knowledgeable programmers to extend it.

CHAPTER 5

RESULTS AND DISCUSSION

A hologram projector is a video projector that can display a two-dimensional (2D) image. Light is routed to a specific location, making the device efficient, and the projector has the capacity to produce video frame rates for a realistic hologram. It is a small device and can be integrated into laptops or mobile phones. The technology is mainly used in 2D applications, but models that can produce three-dimensional (3D) images are in development. Calculations made by a microchip process hologram patterns. The light produced by the device undergoes diffraction, which can be controlled to form a high-quality image, all without a bulky lens. A liquid crystal display is built on top of the chip, on which the pattern looks like a cluster of dots, while laser light provides the illumination to project the image onto a wall or screen. 3D devices are being designed, and one prototype even creates a tactile sensation when someone puts their finger out to touch the hologram. Ultrasound waves in the air allow a pressure sensation to be felt when the hologram is touched. The visual quality of the hologram is not affected. The idea of a hologram projector is not new, but the concept has been difficult to develop because incorporating holograms into video requires fast processing power. So many mathematical calculations take place that even powerful computers would take a long time to create individual video frames. Images projected this way have been low in quality, and the lasers required for the application have been very high- cost. Several companies have caught onto technologies that can support the processing speed needed. The dynamics of a hologram projector allow for small parts, so it can be small enough to be incorporated into small electronics such as laptops or personal digital assistants (PDA). Video images can be created that, until recently, looked like something seen only in science fiction.

5.1 OUTPUT IMAGES.



Fig: 5.1.1 Output Images (Oesteopetrosis)



Fig: 5.1.2 Output Image (Full Knee)

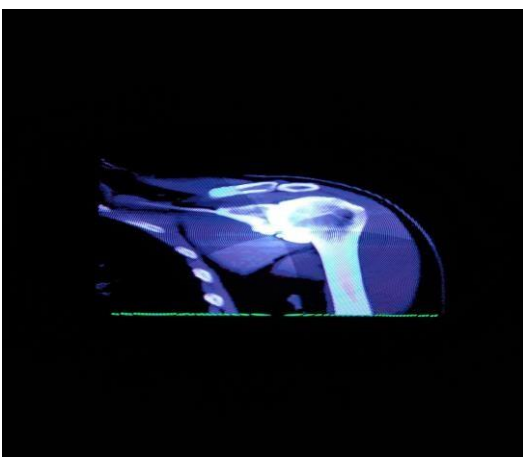


Fig: 5.1.3 Output Images (Shoulder Feature bone)



Fig: 5.1.4 Output Images (Spinal Cord)

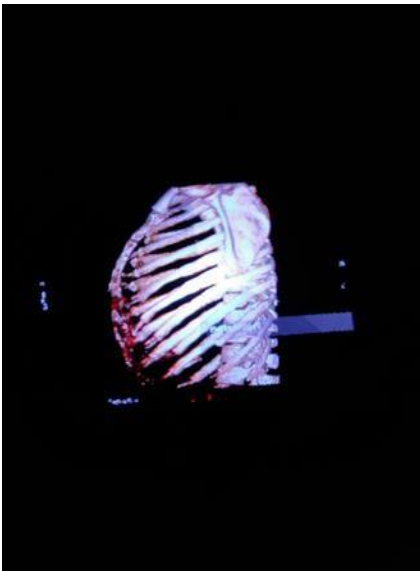


Fig: 5.1.5 Output Images (Pelvic Gridle)

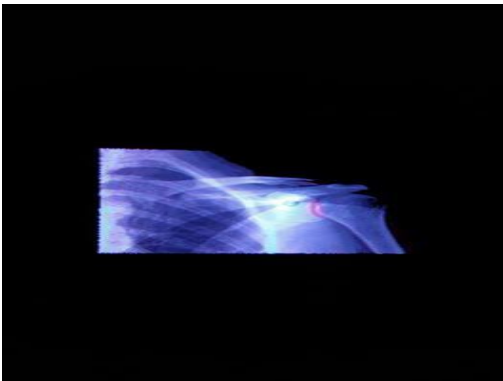


Fig: 5.1.6 Output Image(Anthrogram)

5.2 DISCUSSION:

- Easy for viewing teleoperated surgery
- All formats of file will be available for card reader (MP4/AVI/RMVB/MOV/GIF/JPG/PNG)
- For High Brightness RGB it will play in BIN File
- Due to better resolution and intensities, there might not be need for any specific viewing panels rather than the popped out image itself.
- High resolution vision system: Usually in the form of an endoscope with high resolution image processing equipment to produce 3D images or videos, of the operative world.
- Haptic Feedback Technology: Enables tactile feedback, allowing the surgeon to feel the tensile strength, texture and depth of the tissue from a remote system.

5.2.1 Specifications:

- IMAGE SIZE: 43*43Cm/ 60*60Cm (10*32Cm)
- INPUT: DC12V 3A/ DC13.5V 3.5A
- LED QUANTITY: 224 LEDS / 388 LEDS / 402 LEDS (132 pieces)
- MOTOR : 1000 RPM
- PLAYFILE: BIN FORMAT
- POWER RATING: 10 – 18W / 15 – 25W/ 25 – 35W (8W)
- RESOLUTION: 43Cm 512*224P /60Cm (1080p)
- SHEATHING MATERIAL: ABS+PC+HARDWARE
- VOLTAGE: Adapter AC100-240V, 50/60Hz.
- WEIGHT: 875g/pcs

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

The holography video calls can be implemented through implementing micro hologram projectors in the mobile display through LBO projector models in the way of computer-generated holography. The image will be visualized in 3D model. Their originality will be viewed by peaks and depths of each holographic images set into the video frames.

6.2 CONCLUSION

As we took a Da Vinci's system as a reference, the idea for implementation is, along with the robot's arms, a holoscope with relative access will be installed for more precise views of live internal anatomy during surgery. Those holograms will be transcribed in monitors, by 4G interfacing, so as to ensure authorized data transfer and securing EHR from high risk factors. It involves 50% of a physicians handling and the remaining gestures are automated.

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APPENDIXES

FOR DEVICE:

```
import pyvirtualcam
```

```
# If your documentation needs a minimal Sphinx version, state it here.
```

```
#needs_sphinx = '1.0'
```

```
# Add any Sphinx extension module names here, as strings. They can be
```

```
# extensions coming with Sphinx (named 'sphinx.ext.*') or your custom
```

```
# ones.
```

```
extensions = [
```

```
    'sphinx.ext.autodoc',
```

```
    'sphinx.ext.intersphinx',
```

```
    'sphinx_autodoc_typehints',
```

```
    'sphinx_automodapi.smart_resolver'
```

```
]
```

```
intersphinx_mapping = {'python': ('http://docs.python.org/3', None),
```

```
                      'numpy': ('https://numpy.org/doc/stable/', None)}
```

```
# Add any paths that contain templates here, relative to this directory.
```

```
templates_path = ['_templates']
```

```
# The suffix of source filenames.
```

```
source_suffix = '.rst'
```

```
# The encoding of source files.
```

```
#source_encoding = 'utf-8-sig'
```

```
# The master toctree document.
```

```
master_doc = 'index'
```

```

# General information about the project.
project = u'pyvirtualcam'
copyright = u'2020, Maik Riechert'

# The version info for the project you're documenting, acts as replacement for
# |version| and |release|, also used in various other places throughout the
# built documents.
#
# The short X.Y version.
version = pyvirtualcam.__version__
# The full version, including alpha/beta/rc tags.
release = version

# The language for content autogenerated by Sphinx. Refer to documentation
# for a list of supported languages.
#language = None

# There are two options for replacing |today|: either, you set today to some
# non-false value, then it is used:
#today = "
# Else, today_fmt is used as the format for a strftime call.
#today_fmt = '%B %d, %Y'

# List of patterns, relative to source directory, that match files and
# directories to ignore when looking for source files.
exclude_patterns = ['_build']

# The reST default role (used for this markup: `text`) to use for all
# documents.
#default_role = None

# If true, '()' will be appended to :func: etc. cross-reference text.
#add_function_parentheses = True

```

```

# If true, the current module name will be prepended to all description
# unit titles (such as .. function::).
#add_module_names = True

# If true, sectionauthor and moduleauthor directives will be shown in the
# output. They are ignored by default.
#show_authors = False

# The name of the Pygments (syntax highlighting) style to use.
pygments_style = 'sphinx'

# A list of ignored prefixes for module index sorting.
#modindex_common_prefix = []

# If true, keep warnings as "system message" paragraphs in the built documents.
#keep_warnings = False


#__Options for HTML output _____

# The theme to use for HTML and HTML Help pages. See the documentation for
# a list of builtin themes.
html_theme = "pydata_sphinx_theme"

# Theme options are theme-specific and customize the look and feel of a theme
# further. For a list of options available for each theme, see the
# documentation.
html_theme_options = {
    "search_bar_position": "navbar",
    "icon_links": [
        {

```

```

        "name": "GitHub",
        "url": "https://github.com/letmaik/pyvirtualcam",
        "icon": "fab fa-github-square",
    },
    {
        "name": "PyPI",
        "url": "https://pypi.org/project/pyvirtualcam",
        "icon": "fas fa-box",
    }
]
}

```

```

html_sidebars = {
    "**": []
}

```

Add any paths that contain custom themes here, relative to this directory.

```
#html_theme_path = [sphinx_rtd_theme.get_html_theme_path()]
```

The name for this set of Sphinx documents. If None, it defaults to

"<project> v<release> documentation".

```
#html_title = None
```

A shorter title for the navigation bar. Default is the same as html_title.

```
#html_short_title = None
```

The name of an image file (relative to this directory) to place at the top

of the sidebar.

```
#html_logo = None
```

The name of an image file (within the static path) to use as favicon of the

docs. This file should be a Windows icon file (.ico) being 16x16 or 32x32

pixels large.

```
#html_favicon = None
```

```
# Add any paths that contain custom static files (such as style sheets) here,  
# relative to this directory. They are copied after the builtin static files,  
# so a file named "default.css" will overwrite the builtin "default.css".  
html_static_path = []
```

```
# Add any extra paths that contain custom files (such as robots.txt or  
# .htaccess) here, relative to this directory. These files are copied  
# directly to the root of the documentation.  
html_extra_path = ['gh-pages']
```

```
# If not "", a 'Last updated on:' timestamp is inserted at every page bottom,  
# using the given strftime format.  
#html_last_updated_fmt = '%b %d, %Y'
```

```
# If true, SmartyPants will be used to convert quotes and dashes to  
# typographically correct entities.  
#html_use_smartypants = True
```

```
# Custom sidebar templates, maps document names to template names.  
#html_sidebars = {}
```

```
# Additional templates that should be rendered to pages, maps page names to  
# template names.  
#html_additional_pages = {}
```

```
# If false, no module index is generated.  
#html_domain_indices = True
```

```
# If false, no index is generated.  
#html_use_index = True
```

```
# If true, the index is split into individual pages for each letter.
#html_split_index = False

# If true, links to the reST sources are added to the pages.
#html_show_sourcelink = True

# If true, "Created using Sphinx" is shown in the HTML footer. Default is True.
html_show_sphinx = True

# If true, "(C) Copyright ..." is shown in the HTML footer. Default is True.
#html_show_copyright = True

# If true, an OpenSearch description file will be output, and all pages will
# contain a <link> tag referring to it. The value of this option must be the
# base URL from which the finished HTML is served.
#html_use_opensearch = ""

# This is the file name suffix for HTML files (e.g. ".xhtml").
#html_file_suffix = None

# Output file base name for HTML help builder.
htmlhelp_basename = 'pyvirtualcam'

autoclass_content = 'both'
```

FOR PROTOTYPE:

```
int NUMBER9[]={1,1,1,1,0,0,0,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1,
1,1,1,1,1,1,1,1};
int NUMBER8[]={0,1,1,0,1,1,1,0, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1,
0,1,1,0,1,1,1,0};
int NUMBER7[]={1,0,0,0,0,0,0,0, 1,0,0,0,1,0,0,0, 1,0,0,0,1,0,0,0, 1,0,0,1,1,1,1,1,
1,1,1,0,1,0,0,0};
int NUMBER6[]={1,1,1,1,1,1,1,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1,
1,0,0,0,1,1,1,1};
int NUMBER5[]={1,1,1,1,1,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1,
1,0,0,0,1,1,1,1};
int NUMBER2[]={1,0,0,0,0,0,1,1, 1,0,0,0,0,1,0,1, 1,0,0,0,1,0,0,1, 1,0,0,1,0,0,0,1,
0,1,1,0,0,0,0,1};
int NUMBER1[]={0,0,1,0,0,0,0,0, 0,1,0,0,0,0,0,0, 1,1,1,1,1,1,1,1, 0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0};
int NUMBER0[]={1,1,1,1,1,1,1,1, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1,
1,1,1,1,1,1,1,1};

int _[] = {0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0,0, 0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0};
int A[] = {1,1,1,1,1,1,1,1, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0,
1,1,1,1,1,1,1,1};
int B[] = {1,1,1,1,1,1,1,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1,
0,1,1,0,1,1,1,0};
int C[] = {0,0,1,1,1,1,0,0, 0,1,0,0,0,0,1,0, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1,
1,0,0,0,0,0,0,1};
```

```

int D[] = {1,1,1,1,1,1,1,1, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1, 0,1,0,0,0,0,1,0,
0,0,1,1,1,1,0,0};
int E[] = {1,1,1,1,1,1,1,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1, 1,0,0,1,0,0,0,1,
1,0,0,1,0,0,0,1};
int F[] = {1,1,1,1,1,1,1,1, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0,
1,0,0,1,0,0,0,0};
int G[] = {0,1,1,1,1,1,1,1, 1,0,0,0,0,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1,
1,0,0,0,1,1,1,0};
int H[] = {1,1,1,1,1,1,1,1, 0,0,0,0,1,0,0,0, 0,0,0,0,1,0,0,0, 0,0,0,0,1,0,0,0,
1,1,1,1,1,1,1,1};
int I[] = {1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1, 1,1,1,1,1,1,1,1, 1,0,0,0,0,0,0,1,
1,0,0,0,0,0,0,1};
int J[] = {0,0,0,0,0,1,1,0, 0,0,0,0,1,0,0,1, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,0,1,
1,1,1,1,1,1,1,0};
int K[] = {1,1,1,1,1,1,1,1, 0,0,0,1,1,0,0,0, 0,0,1,0,0,1,0,0, 0,1,0,0,0,0,1,0,
1,0,0,0,0,0,0,1};
int L[] = {1,1,1,1,1,1,1,1, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,0,1,
0,0,0,0,0,0,0,1};
int M[] = {1,1,1,1,1,1,1,1, 0,1,0,0,0,0,0,0, 0,0,1,0,0,0,0,0, 0,1,0,0,0,0,0,0,
1,1,1,1,1,1,1,1};
int N[] = {1,1,1,1,1,1,1,1, 0,0,1,0,0,0,0,0, 0,0,0,1,1,0,0,0, 0,0,0,0,0,1,0,0,
1,1,1,1,1,1,1,1};
int O[] = {0,1,1,1,1,1,1,0, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1, 1,0,0,0,0,0,0,1,
0,1,1,1,1,1,1,0};
int P[] = {1,1,1,1,1,1,1,1, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0, 1,0,0,1,0,0,0,0,
0,1,1,0,0,0,0,0};
int Q[] = {0,1,1,1,1,1,1,0, 1,0,0,0,0,0,0,1, 1,0,0,0,0,1,0,1, 0,1,1,1,1,1,1,0,
0,0,0,0,0,0,0,1};
int R[] = {1,1,1,1,1,1,1,1, 1,0,0,1,1,0,0,0, 1,0,0,1,0,1,0,0, 1,0,0,1,0,0,1,0,
0,1,1,0,0,0,0,1};
int S[] = {0,1,1,1,0,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1, 1,0,0,0,1,0,0,1,
1,0,0,0,1,1,1,0};

```

```

int T[] = {1,0,0,0,0,0,0,0, 1,0,0,0,0,0,0,0, 1,1,1,1,1,1,1,1, 1,0,0,0,0,0,0,0,
1,0,0,0,0,0,0,0};
int U[] = {1,1,1,1,1,1,1,0, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,0,1,
1,1,1,1,1,1,1,0};
int V[] = {1,1,1,1,1,1,0,0, 0,0,0,0,0,0,1,0, 0,0,0,0,0,0,0,1, 0,0,0,0,0,0,1,0,
1,1,1,1,1,1,0,0};
int W[] = {1,1,1,1,1,1,1,1, 0,0,0,0,0,0,1,0, 0,0,0,0,0,1,0,0, 0,0,0,0,0,0,1,0,
1,1,1,1,1,1,1,1};
int X[] = {1,1,0,0,0,0,1,1, 0,0,1,0,0,1,0,0, 0,0,0,1,1,0,0,0, 0,0,1,0,0,1,0,0,
1,1,0,0,0,0,1,1};
int Y[] = {1,1,0,0,0,0,0,0, 0,0,1,0,0,0,0,0, 0,0,0,1,1,1,1,1, 0,0,1,0,0,0,0,0,
1,1,0,0,0,0,0,0};
int Z[] = {1,0,0,0,0,1,1,1, 1,0,0,0,1,0,0,1, 1,0,0,1,0,0,0,1, 1,0,1,0,0,0,0,1,
1,1,0,0,0,0,0,1};

```

```

int* alpha[]={A,B,C,D,E,F,G,H,I,J,K,L,M,N};//,T,U,V,W,X,Y,Z};

```

```

int letterSpace;

```

```

int delayTime;

```

```

#define IR_pin 10

```

```

void setup()

```

```

{

```

```

    Serial.begin(9600);

```

```

    pinMode(IR_pin,INPUT);

```

```

    for( int i = 2; i<10 ;i++ ) // setting the ports of the leds to OUTPUT

```

```

    {

```

```

        pinMode(15, OUTPUT);

```

```

    }

```

```

    letterSpace =4;// defining the space between the letters (ms)

```

```

    delayTime =1;// defining the time dots appear (ms)

```

```

}

```

```

void printLetter(int letter[])
{
    int y;
    // printing the first y row of the letter
    for (y=0; y<8; y++)
    {
        digitalWrite(15, letter[y]);
    }
    delay(delayTime);
    // printing the second y row of the letter
    for (y=0; y<8; y++)
    {
        digitalWrite(15, letter[y+8]);
    }
    delay(delayTime);
    // printing the third y row of the letter
    for (y=0; y<8; y++)
    {
        digitalWrite(15, letter[y+16]);
    }
    delay(delayTime);
    for(y = 0; y<8; y++) {
        digitalWrite(15, letter[y+24]);
    }
    delay(delayTime);
    for(y = 0; y<8; y++) {
        digitalWrite(15, letter[y+32]);
    }
    delay(delayTime);
    // printing the space between the letters
    for (y=0; y<8; y++)

```

```
    {  
      digitalWrite(15, 0);  
    }  
    delay(letterSpace);  
  }
```

```
void loop()  
{  
  
  printLetter (P);  
  printLetter (O);  
  printLetter (V);  
  printLetter (_);  
  printLetter (_);  
  printLetter (D);  
  printLetter (I);  
  printLetter (S);  
  printLetter (P);  
  printLetter (L);  
  printLetter (A);  
  printLetter (Y);  
  printLetter (_);  
  
}
```