



Design and Implementation of Digital Hologram Display

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Design and Implementation of Digital Hologram Display

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ABSTRACT: This project comprises of circular display made by a string of LEDs. Using a motor and some power trans-unit, LED string mounted on a printed circuit board are duly interfaced to a SoC. This displays some message and a clock timing taking advantage of persistence of vision. Without the single line of LEDs in space multiplexing mode if one would have to display a photo, number of LEDs as high as around 82,000 would have been used. Here the project uses only 360 LEDs. Thus material count, hardware requirement, brings the overall cost to very affordable price. The synchronizing is being implemented through software.

AeroGram Displays is a new type of LED display in which it uses Persistence Of Vision (POV) as its principal. POV is a type of optical illusion, Persistence of vision (POV) refers to the phenomenon of the human eye in which an afterimage exists for a brief time. A POV display uses this phenomenon to recreate holograms using LED display. It creates the images in mid-air with a 1-Dimensional led Line and a motor which help it to take a 2-dimensional form. By using proper content we can make it look like 3D images and videos.

1. INTRODUCTION:

Hologram is unique way of presenting images and videos (content) and its 3-dimensionality floating in the Mid Air creates new possibility of use of content like representing products and showing human organs and reports. A Hologram displays product, objects in more attractive and enables seemingly objects to appear like it is floating completely freely in Mid-Air. To design a working DIGITAL HOLOGRAM DISPLAY and test it with different file inputs. We will be using Image processing algorithms to make new frame data that will be unique to our display.

Holography, stands for developing a unique photographic Content with no use of a concave or convex glass. The photographic data of the content is Hologram, which is to be an non recognizable pattern of stripes and whorls but which brought by

coherent light, a laser light beam creates the light into a 3- D presentation of the original subject.

Persistence of vision (POV) is an optic illusion that occurs on the Human Eye. when the visual perception of any object is still present after the light rays are emitted from the source, and our eye still compute that the object is present. I use this phenomenon for developing display. Not only Aerogram display but majority of the display currently available in the market have used it from decades, Also AC device switch ON and OFF like AC bulb flickers(toggle) at 50hz. The main idea behind this project is to use less number of Hardware components possible to create a Mid-Air floating display with the lowest amount of power usage. The LED count can be kept to a minimum by following a circular-style display. The LEDs are soldered on a PCB (printed circuit board) That is on a aluminum blade. The RGB LEDs are controlled by Orange PI. Individual Pixel intensity is send to the respective LEDs in the form of 8 bit and these 8bit data is processes by the decoder and depending on the value a PWM in send for that color. The written program or code is loaded into the

Orange PI, which is connected to the LEDs via GPIO. An AC motor rotates the LEDs and Orange PI in a circular motion. An infrared sensor is used to determine the starting point of the display.

II. RELATED WORK:

Hologram display had already long been a difficult problem in various fields. Various methodologies and techniques have been described in several research papers. The most important goal of this literature review is to assess a few of these approaches and their efficacy.

The intensity factor of the display which is proportionally dependent on the Speed of the motor and vise versa.[1]

Main building block of a simple Persistence of vision propeller Led Display is explained by use of IR Module sensor also clearly explained the schematic of the circuits.[2]

The phenomenon POV (Persistence of Vision) which says that if some object appears in the same place consistently, at least 30-40 times every second, human brains assumes that it's permanently present at that spot when it is not. All synchronization is done in software. The clock's software is working using interrupts and timers.[4]

The use of RGB LEDs and how to control them as a line. It clearly explains the steps to follow in order to create a similar hardware and working flow of the code .[5]

All the fonts are saved in the bit wise form and save in the micro controller in the code we get this bit mapped matrix notation fonts and display them in a sequence to form a meaning full work. The positive terminal (anode) of the LEDs are wired together and connected to a 5v supply. Low logic level is connected to the gate of LED through micro controller.

III. SYSTEM DESIGN AND IMPLEMENTATION

All the fonts are saved in the bit wise form and save in the micro controller in the code we get this bit mapped matrix notation fonts and display them in a sequence to form a meaning full work. The positive terminal (anode) of the LEDs are wired together and connected to a 5v supply. Low logic level is connected to the gate of LED through micro controller .

A. Hardware Implementation

The Main part of the Aerogram display are:

1. Orange Pi Zero LTS Board
2. AC inductive Motor
3. RGB LED
4. IR Module
5. Slip ring
6. Display Structure

1 Orange PI Zero LTS

Orange PI is an Open-source, low cost, credit card size single board computer with a SOC on it. It is developed by a company Shenzhen Xunlong Software CO . It supports my linux based operating system which are Ubuntu, Debian, Rasbian, Android. It's a full pc where you connect it to the monitor and start working in it. It has a broad range of development board to select from based on the requirement of your project. Most of the boards are used for developing wireless server and as a PC for developing Linux based software. I have selected orange pi based board as its open source and all the schematic for the development board is available, and I can use this schematic to develop my own board.

I have selected Orange PI Zero LTS specifically because of its small size form factor and for the low price and also

for the support of Linux on which I have a good hold. This helped me a lot in easily understanding and developing the code. This board have a lot of inbuild peripheral like SPI, UART, TWI for communication with other interface and SDIO for storage apart from that we have High speed Ethernet and USB 2.0 full support. We have a HDMI interface I/O and CSI for Camera support.

Orange Pi zero LTS comes in two variant 256 MB RAM and 512 MB RAM. We have a 2x13 and 1x13 GPIO header given below,

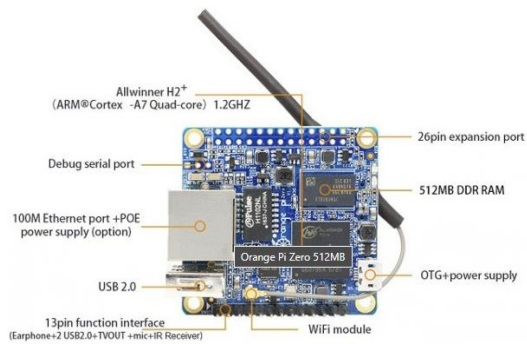


Fig 1:Orange PI On Board Components
Front Side

2 AC Induction Motor

An AC induction motor is where a ring of electromagnets are arranged around the side which is named as stator, which are designed to reproduce a magnetic field in circular. In the stator,

there is solid core metal axle, and copper wire looped in order to produce rotating magnetic field, and coil, and squirrel cage made of metal bars mostly cast iron and interconnections properly spaced in the rotating cages, this conduct electricity in and out. In comparison with DC motor, we give current to the rotor, but in an AC motor we give current to the inner core and it creates magnetic field in the metal core and it starts rotating that makes the stator. The coil is properly lined in pair, and with sequence, to create a loping magnetic field that forms around the outer core of the motor.

The Stator of an induction motor has current carrying poles to induce magnetic fields that goes through the rotor. For an accurate distribution of the magnetic field there are slots around the stator so that magnetic field is completely utilize.

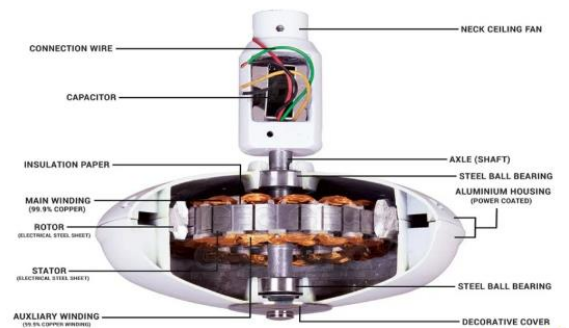


Fig 2 Internal Parts of the Ceiling Fan

We are using Specifically the AC ceiling fan motor for its more durable run time and easily availability and low price.

3 RGB LED

We are using RGB LED pixel which have an internal controller inside the Led Package . It is called APA102 RGB Pixel LED. And individual addressable LED. we are using easily available 5050 package for its durability and bright light.

RGB Pixel LED has a digital port data latch and a signal shaping circuit which amplifying the drive input and output. RGB Pixel LED also includes an internal oscillator and a constant current output port for taking 5 Voltage this makes sure that the power to the pixel is consistent at any given point of time in order to get better color accuracy.

RGB Pixel LED are mostly used in the full color panels to reduce the PCB wiring, and in color soft lights, decorative lighting that we see outside house and hotels and video led screen.

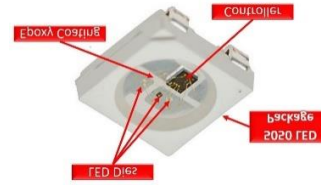


Fig 3 Inside of the RGB Addressable LEDS

We have six pinout from the LED which are

- SDI: Data input
- CKI: Clock input
- SDO: Data output
- CKO: Clock output
- Ground
- VCC 5V

4 IR Module

An IR Module is a pair of IR transmitter and IR receiver. By using the IR module we will be detecting any object in front of this module. The IR transmitter which is an IR LED will be always on and IR receiver is facing the same direction as of the IR LED. when ever an object comes in front the IR light is reflected and IR receiver will be detecting this light and raising and interrupt

We will be processing the interrupt accordingly.



Fig 8 Image of Display when the camera shutter rate not set

The size of the display is about 6 feet by 6 feet and this huge display with a LED pitch of around 7MM have used only 400-450 LEDs on whole, If we compared this to the LED panel display which would have taken around 70,000 LEDS.

B. Software Implementation

Armbian

Armbian is Linux OS for ARM based Development boards, it is a light weight OS making is suitable Single board computers (SBCs). Its based on 2 different distribution Ubuntu and Debian special rewritten for ARM based processor. Every system is compiled and assembled for each development board it supports for better optimized running.

It is Simple to build because of its GUI interface on the terminal. It works very well for desktop application and as a server.

Python is one of the most widely used language because of it simplicity and vast level of support from open source community. We use Python with computer vision and numerical python Libraries to read any stored image and then decode it to pixel values which we will be sending to LEDS.

We used Anaconda based IDE called spyder to develop the initial code and get the output on the pc and I verified the output with test parameter to get a proper resolution.

FFMPEG is a media player and media framework, which can do encoding, decoding, transcode, mux, demux, filter, stream and play almost all types of media content. It has many libraries. We use FFMPEG to decode videos files and for stream the data from internet.

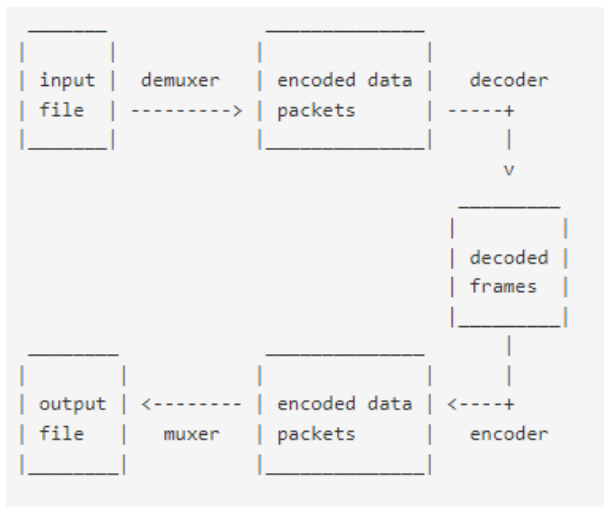


Fig 9 Input file decoding Flow

NumPy

Please note that this is a collection of general-purpose array processing functions. An array object, as well as a collection of utilities for working with them, are provided by the library. In scientific computing, it's the most essential Python package out there. As a starting point, here are a few: An N-dimensional array object having a strong structure. Broadcasting has high-tech capabilities. Tools for integrating C/C++ and Fortran code. Capabilities in linear algebra, Fourier transformation, and generation of random numbers Even though NumPy has obvious scientific applications, it may also be used as an efficient general-purpose multi-dimensional data container. Using

NumPy, any data type may be simply and quickly connected to a wide range of databases.

Pandas

Using strong data structures, this free Python library is able to handle and analyse high-performance data. When it comes to doing calculations, Python was the go-to language. Analysis of data was not affected in any substantial way. How to repair it? Pandas found out. Regardless of the source of the data load, the five main stages of data processing and analysis with Pandas are preparation, manipulation, modelling, and analysis. A wide range of industries, including academic and business fields such as finance, economics, statistics, analytics and more, employ Python with Pandas. Matplotlib The Python 2D charting toolkit Matplotlib's publications look beautiful on every device, whether they're printed on paper or displayed in an interactive environment. There are a variety of places where Matplotlib can be used: scripts written with either Python or I Python; Jupiter Notebooks; web app servers; and four different GUI frameworks.

Image Conversion

Images Conversion is coded in python and we have used CV2 and numpy libraries to decoded from the JPEG or PNG format into Pixel data. We have executed the code Spyder IDE with is part of Anaconda platform tools. The output images of the python code is show below. we have also added final output images of the display.

```
Python console
[In [38]: runfile('C:/Users/G114488/Downloads/college_work/imageconversion.py', wdir='C:/Users/G114488/Downloads/college_work')
Loading Input Image
Input image shape height and width(resolution)
(525, 848, 3)
Input image color resolution
uint8
max resolution for output image based on the input image resolution
246
output image shape height and width(resolution)
(391, 247, 3)
output image color resolution
uint8
converting image data into pixel data
decoding Line number 0 into pixel data
decoding Line number 1 into pixel data
decoding Line number 2 into pixel data
decoding Line number 3 into pixel data
decoding Line number 4 into pixel data
decoding Line number 5 into pixel data
decoding Line number 6 into pixel data
decoding Line number 7 into pixel data
decoding Line number 8 into pixel data
decoding Line number 9 into pixel data
decoding Line number 10 into pixel data
decoding Line number 11 into pixel data
decoding Line number 12 into pixel data
decoding Line number 13 into pixel data
decoding Line number 14 into pixel data
decoding Line number 15 into pixel data
decoding Line number 16 into pixel data
decoding Line number 17 into pixel data
decoding Line number 18 into pixel data
decoding Line number 19 into pixel data
decoding Line number 20 into pixel data
decoding Line number 21 into pixel data
decoding Line number 22 into pixel data
```

Fig 10 Output from the Spyder console when we run the code

Output images from Python



Fig 11 Input image to the python code

Above is a sample input image which we have used for testing the image conversion code. This images was specifically used as we have a flower in the center and upon conversion we can easy see all the flower pallets came in line



Fig 12 Output image from the code



Fig 13 Few other Input output files



The input file is read by using the CV2 function and it is converted into pixel matrix then each row of this image is read and stored accordingly into new matrix to create output image that will be send to the display system.

After we have the output file tested visually we can use this files and send this file to the aerogram display to get the projection on the display.

Final Output of the Display

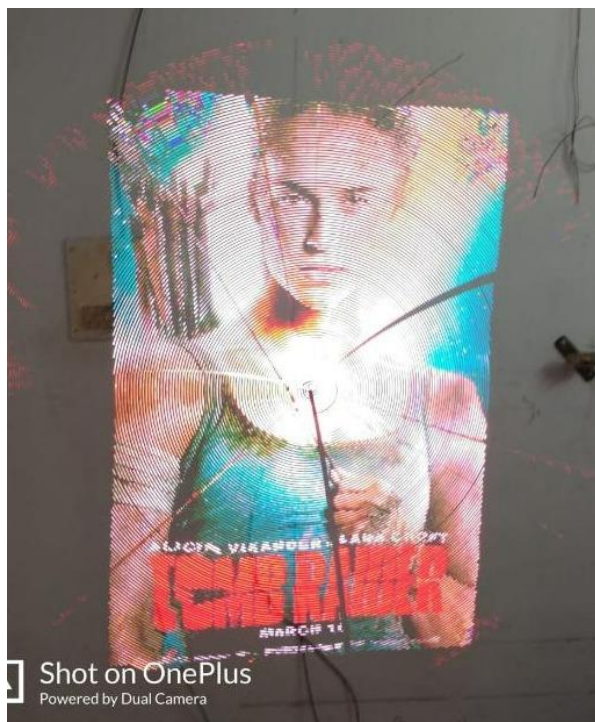


Fig 14 Final output image in the Aerogram display



Fig 15 Output image on the display

If the frame rate of the display and shutter rate of camera does not matches we will see a blur image or a partial image like above.

IV. CONCLUSION

Images and Videos will be created an illusion in 3-Dimension such that object are floating in the mid-Air . It will be able to decode multiple filesystems and will stream videos from mobile and computers. A large display size will be viewed. A glass free 3-dimensional hologram display will be achieved. It does not require any projection screen. It will be cost efficient. Marketing will attract more viewer and improve virtual reality. The controllers are tested in Simulink and after that implemented on

microcontroller. Their benefits are emphasized. The user can change displayed images using an Android application which communicates with designed system via Bluetooth.

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