

# Design and Implementation of Rainbow-Colored Pi Hat

Thuzar Khin

Faculty of Computer System and  
Technology, Myanmar Institute of  
Information Technology, Mandalay  
[thuzar\\_khin@miit.edu.mm](mailto:thuzar_khin@miit.edu.mm)

Kyi Kyi Khaing

Faculty of Computer System and  
Technology, Myanmar Institute of  
Information Technology, Mandalay  
[kyi\\_kyi\\_khaing@miit.edu.mm](mailto:kyi_kyi_khaing@miit.edu.mm)

Khaing Khaing Wai

Department of Information Technology  
Support and Maintenance, University  
of Computer Studies, Mandalay  
[khaingkhaing.73@gmail.com](mailto:khaingkhaing.73@gmail.com)

**Abstract**— *This paper presents a simple design and implementation display of rainbow-colored Pi Hat designs on raspberry pi 3 model B with unicorn HAT . This system used four major components which are Raspberry pi 3 Model B, Unicorn HAT (8x8 RGB LED), micro SD card, micro USB power supply. In this paper we are going to use Micro-SD card to provide the initial main storage for the Operating System and files. The main objective of this paper is to display the rainbow-colored pattern with unicorn hat by using Python Codes.*

**Keywords**— *Raspberry pi 3 Model B, Unicorn HAT, micro SD card, network cable, micro USB power*

## I. INTRODUCTION

RASPBERRY PI 3 is a development board in PI series. It can be considered as a single board computer that works on LINUX operating system. The board not only has tons of features it also has terrific processing speed making it suitable for advanced applications. PI board is specifically designed for hobbyist and engineers who are interested in LINUX systems and IOT (Internet of Things)[7]. To improve the educational levels of learners in developing countries, it is important to implement a computing environment that is affordable and durable. Raspberry Pi is a multi-purpose low-cost Advanced Reduced-Instruction-Set-Computer (ARM) processor-based miniature device that has been utilised as a standalone machine in schools to improve the education provision in rural areas [1]-[2]. The Raspberry Pi is a progression of credit card-sized single-board PCs created in the United Kingdom by the Raspberry Pi Foundation with the plan to advance the educating of essential PCs. This system proposed a low-cost system by combination of raspberry pi 3 Model B and unicorn hat.

## II. HARDWARE COMPONENTS

### A. Raspberry Pi 3 Model B

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote teaching of basic computer science in schools and in developing countries.

The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards and mice) or cases. However, some accessories have been included in several official and unofficial bundles[3] . The organisation behind the Raspberry Pi consists of two arms. The first two models were developed by the Raspberry Pi Foundation. After the Pi Model B was released, the Foundation set up Raspberry Pi Trading, with Eben Upton as CEO, to develop the third model, the B+. Raspberry Pi Trading is responsible for developing the technology while the Foundation is an educational charity to promote the teaching of basic computer science in schools and in developing countries [4].

The Raspberry pi 3 Model B board has the following components:

- 40 GPIO pins
- Chip antenna
- 4xUSB 2.0 ports
- microSD card slot
- DSI display connector
- 1 GB LPDDR2 memory
- 1x 10/100 Ethernet port
- 802.11 b/g/n Wireless LAN
- Dimension:85x56x17mm
- 1xRCA video/audio connector
- 1xHDMI video/audio connector
- 64-bit quad-core ARM Cortex-A53
- Bluetooth 4.1(Classic &Low Energy)
- microUSB connector for 2.5A power supply
- Broadcom BCM2837 chipset running at 1.2 GHz
- Dual core Video core IV Multimedia co-processor
- Supports all the latest ARM GNU/Linux distributions and Window 10 IoT

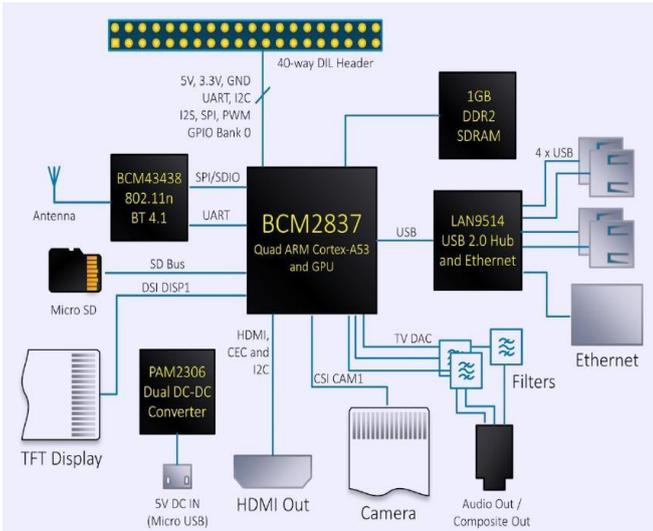


Fig.1 Block diagram of Raspberry Pi 3

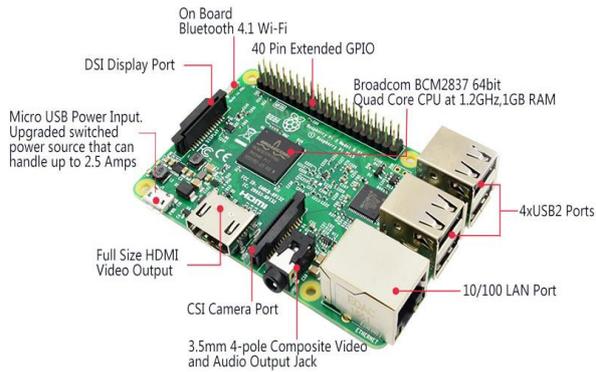


Fig.2 Raspberry Pi 3 Board Configurations

**B. Unicorn HAT (8x8 RGB LED)**

The Pimoron Unicorn Hat is a very nice 8x8 matrix that can produce a really bright display. ScratchGPIO has several commands so that it can be controlled using Scratch. To use it with ScratchGPIO, please install the software from Pimoroni You will need your Pi to be connected to the internet and then launch an LX Terminal session and type[8].

The Pimoroni Unicorn HAT is a “shield” for the Raspberry Pi that sports a matrix of 64 (8x8) addressable RGB LEDs that are powered directly from the Pi. The Unicorn HAT provides a wash of controllable color that is ideal for mood lighting, 8x8 pixel art, persistence of vision effects, status indications, or just blasting color into your surroundings.

Each Pimoroni Unicorn Hat easily snaps on top of a Raspberry Pi equipped with a 40-pin (2x20) GPIO. Pimoroni has created a GitHub repository bundling the Unicorn Hat software with a set of examples to get you

started in an easy-to-use Python module, so all you have to worry about is setting the color you want each pixel to be.

**Features:**

- 64 RGB LEDs (WS2812B)
- Python API
- Compatible with Raspberry Pi 3, 2, B+, and A+
- EEPROM with Raspberry Pi HAT configuration details
- LED data driven via DMA over PWM

Its often use the term HAT to defined a Raspberry Pi extension. It’s not only for the first meaning, but it stands for “Hardware Attached on Top”. In short it’s an additional card, that you plug on the top of your Raspberry Pi to bring new features[9].

Generally, it uses the GPIO ports to connect the two cards together. The Raspberry Pi will recognize the HAT thanks to an EEPROM module on the board that identifies the HAT model So don’t be afraid to use HAT with your Raspberry Pi, it’s really easy, and close to an additional PCI cards on your computer. Just plug it, maybe install one thing, and it’s ready to use. It requires no soldering, so you can plug and unplug it when you want[10].

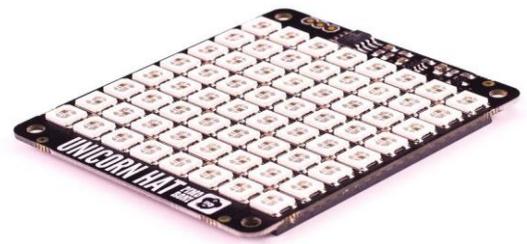


Fig.3 Unicorn HAT

**C.Sense HAT**

The Sense HAT is the one absolutely need to try

It’s a bestseller, with a lot of reviews, tests and publications.

The sense HAT provides a lot of new sensors to the Raspberry Pi:

- Accelerometer (get the movement speed of the PI)
- Gyroscope (capture the rotation movement of the Raspberry Pi)
- Magnetometer (magnetic field measurement)
- Air pressure sensor
- Temperature and humidity sensors

And there is also a LED display matrix and a joystick on the top of it.

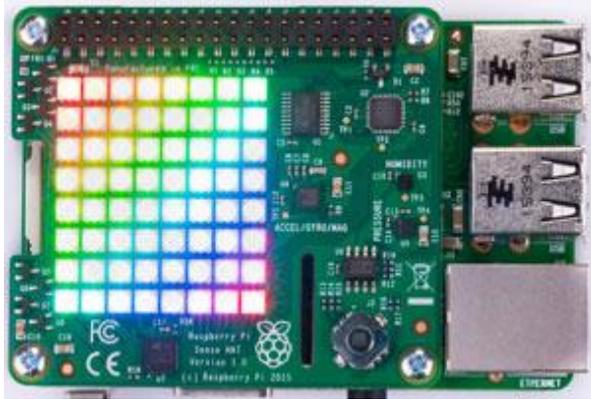


Fig.4 Raspberry Pi 3 with sense HAT

### III.IMPLEMENTATION PROCESSES

In this paper, the implementation of Rainbow-Colored pattern is based on both hardware and software. For the pattern to be implemented, we will be using Raspberry Pi 3 board, interface with some other hardware components.

#### Step -1 Interfacing Unicorn HAT with RPi

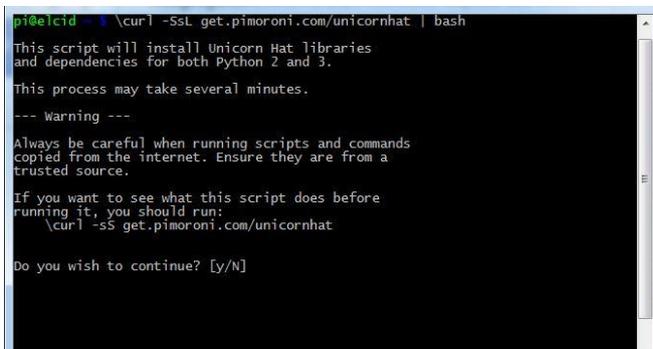
You need to press the HAT down on the pins firmly so that the metal of the pins is fully inserted into the HAT and no longer visible. The Unicorn HAT board should be one top of the RPi fully covering it at the top. All the GPIO pins will be used up. Note: Unicorn HAT uses some special PWM trickery, performed with the same hardware that lets your Pi produce sound through the audio jack ( analog audio ) so you can't use both at the same time! Let us how to install its driver before start using it.

#### Step-2 Installing Unicorn HAT Driver

Unicorn Hat is easy to set up. We've created a one-liner ( that's one line of text you enter at the Terminal ) to get everything installed.

With Step 2 above in mind, fire up the Terminal and enter the following command:

```
curl https://get.pimoroni.com/unicornhat | bash
```



This command downloads an install script from the internet, which should then run automatically through all the steps required to get Unicorn Hat installed and working. During installation, you'll be asked if you want to install Flask for Unicorn Paint. It's up to you, but I'd

recommend it! Unicorn Paint is fun. Once the install is done, the script will ask if you want to download example code, answer yes.

Note: Unicorn Paint is only supported in Python 2.x!

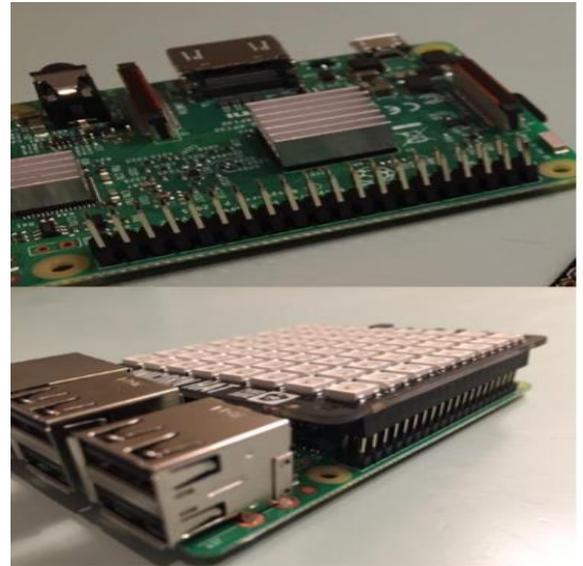


Fig.5 Unicorn HAT with RPi

#### Step-3 Verify that Unicorn Hat is installed and working

Finally, you should make sure everything has installed properly.

Still in LXTerminal, type:

```
cd ~/Pimoroni/unicornhat/examples/
```

And then;

```
~ sudo python simple.py
```

If everything is working, we should see the UnicornHat fill with pinky-purple pixels. If so, hurrah! We're ready to move on to the next pattern.

### IV. DISPLAY PATTERN RESULT

Once the file is copied modify the newly created python file using nano editor 1. For example: nano mySimple.py 3. Using the mySimple.py do the following:

- (a). Change the colour of the simple patterns (Red, Green, Blue)
- (b). Change the speed of moving of LEDs
- (c) Look at other python examples and pick one suitable file and change the pattern of display by making some changes to the python code in it.

Implement the python code simple.py to create a pattern which light only the alternate LED (alternate.py) in each line, in both directions. To run the display these pattern type the following comment in LXTerminal and show its pattern following figure.

```
~ sudo python alternate.py
```

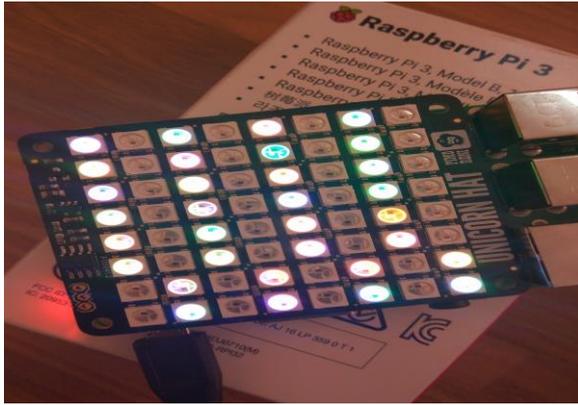


Fig. 6 Alternate LED Displays pattern

Implement the python code to create a square.py which draws from the outer most to inner most squares, in a single colour .The python code and display pattern are shown the following .

```
#!/usr/bin/env python
import time
import unicornhat as unicorn
```

```
print("""Simple
```

Turns each pixel on in turn and updates the display.

If you're using a Unicorn HAT and only half the screen lights up, edit this example and change 'unicorn.AUTO' to 'unicorn.HAT' below.

```
""")
```

```
unicorn.set_layout(unicorn.AUTO)
unicorn.rotation(0)
unicorn.brightness(0.5)
width,height=unicorn.get_shape()
```

```
a = 0
b = 7
```

```
for a in range(7):
```

```
    for y in range(height):
        for x in range(width):
            if (x == a or x == b or y == a or y == b):
                unicorn.set_pixel(x,y,0,255,255)
                unicorn.show()
                time.sleep(0.05)
```

```
    a+=1
    b-=1
time.sleep(1)
```

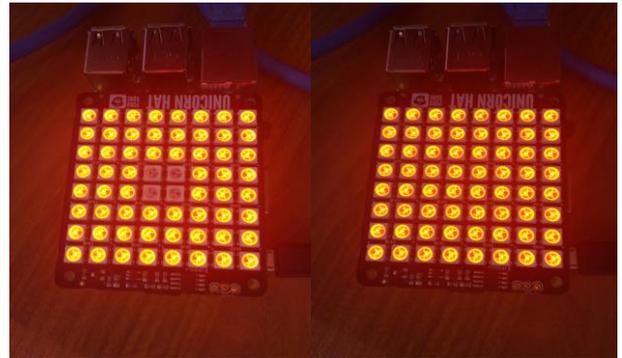


Fig. 7 Outer most to inner most square pattern

Another implement the python code to create a cross.py which generates different colours in the alternating LEDs.The python code and display pattern are shown the following .

```
#!/usr/bin/env python
import time
import unicornhat as unicorn
print("""Simple
```

Turns each pixel on in turn and updates the display.

If you're using a Unicorn HAT and only half the screen lights up,

edit this example and change 'unicorn.AUTO' to 'unicorn.HAT' below.

```
""")
unicorn.set_layout(unicorn.AUTO)
unicorn.rotation(0)
unicorn.brightness(0.5)
width,height=unicorn.get_shape()
CrossX = [7, 6, 5, 4, 3, 2, 1, 0]
```

```
R1 = [30, 60, 90, 120, 150, 180, 210, 240]
```

```
G1 = [240, 210, 180, 150, 120, 90, 60, 30]
```

```
B1 = [30, 60, 90, 120, 150, 180, 210, 240]
```

```
G2 = [30, 60, 90, 120, 150, 180, 210, 240]
R2 = [240, 210, 180, 150, 120, 90, 60, 30]
B2 = [20, 120, 90, 230, 180, 220, 40, 150]
cnt = 0
for cnt in range (2):
    for y in range(height):
        for x in range(width):
            if x == y and cnt == 0:
                unicorn.set_pixel(x,y,R1[x],G1[x],B1[x])
            if x == y and cnt == 1:
                unicorn.set_pixel(CrossX[x],y,R2[x],G2[x],B2[x])
        unicorn.show()
        time.sleep(0.05)
    time.sleep(1)
```

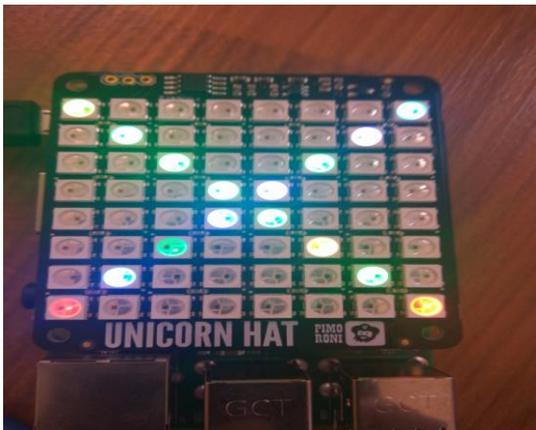


Fig .8 Cross Pattern

The last pattern which generate the rainbow colours in the alternating LEDs .



Fig .9 Rainbow colours pattern

## V.CONCLUSIONS AND FUTURE WORK

The purpose of this paper is to learn how to connect simple raspberry pi 3 Model B devices with Unicorn HAT (8x8 RGB LED) and implement a display pattern that uses these devices. We will use python code and show the display of rainbow-colored pattern on the Unicorn HAT.

In future the work can be reached out with the Web camera that can naturally figure and keep up the attendance for understudies in a foundation utilizing a picture handling. Next, RPi is also operate display the monitor by connecting with HDMI for various applications. Try various other patterns and draw lines with random length, clear the screen after 8 lines are drawn with different colours.

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