

Department of Electrical Engineering

City University of Hong Kong

EE4092/EE4905/EE4291 Training II
Module A2 - Microcomputer (Raspberry Pi)

Sense HAT

What is Sense HAT?

- Hardware Attached on Top (HAT) is an add-on board for Raspberry Pi
- The board allows you to make measurements of temperature, humidity, pressure, and orientation, and to output information using its built-in LED matrix
- There is an online emulator you will use in your browser to write and test code for the Sense HAT: <https://trinket.io/sense-hat>
- Sense HAT API Reference: <https://pythonhosted.org/sense-hat/api/>

Environment Measurement

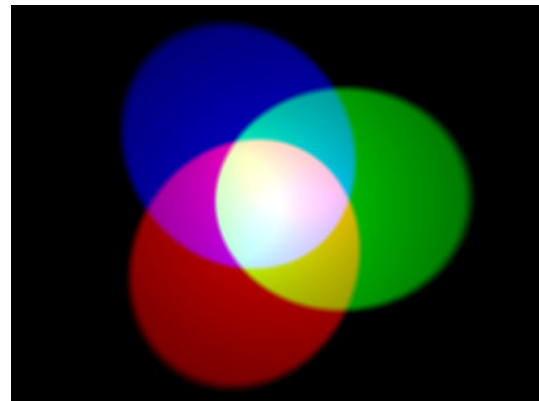
How to measure the environment?

- The Sense HAT has a set of environmental sensors for detecting the surrounding conditions.
- The sensors can measure **temperature**, **humidity** and **pressure**.
- You will use this function to build a simple IoT project later.

8x8 RGB LED Matrix

RGB Color Codes

- The variables R, G, and B represent the colors red, green, and blue. Their values specify how bright each color should be, each value can be between **0 and 255**.
- Can be define all three RGB values of a color using a single line of code (R value, G value, B value)
- Example for the basic colors:
 - Red = (255, 0, 0)
 - Green = (0, 255, 0)
 - Blue = (0, 0, 255)
 - White = (255, 255, 255)
- You can check the value of the color from the link below:
https://www.rapidtables.com/web/color/RGB_Color.html



Movement Detection

How to detect the movement?

- The Sense HAT has an **Inertial Measurement Unit** (IMU) chip which measures the kinds of movement it experiences.
- IMU is actually three sensors in one:
 - A **gyroscope**: measures momentum and rotation
 - An **accelerometer**: measures acceleration forces, can be used to find the direction of gravity
 - A **magnetometer**: measures the Earth's own magnetic field, a bit like a compass

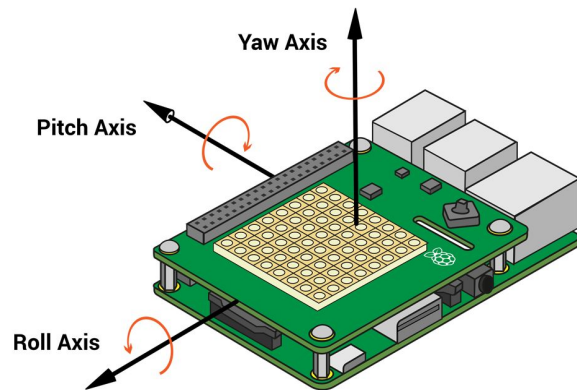
What is pitch, roll, and yaw?

- All objects have three axes around which they can rotate.

These are:

- **Pitch** — imagine a plane taking off
 - **Roll** — imagine a plane doing a victory roll
 - **Yaw** — imagine steering a plane like a car
- If you know how much rotation has happened on each axis of an object, then you know which way the object is pointing. The image shows where the three axes are in relation to the Sense HAT.
 - You can watch the video below to have a better understanding:

<https://www.youtube.com/watch?v=pQ24NtnaL18>



Joystick

How to use the joystick?

- The Sense HAT joystick is mapped to the four keyboard cursor keys, and the joystick's middle-click is mapped to the Enter key.
- Using the joystick has exactly the same effect as pressing those keys on the keyboard. Remember that the **down direction** is with the HDMI port facing downwards.



Challenge 1

Try to write a “Snake Game” with LED matrix and joystick in online emulator with the following rules:

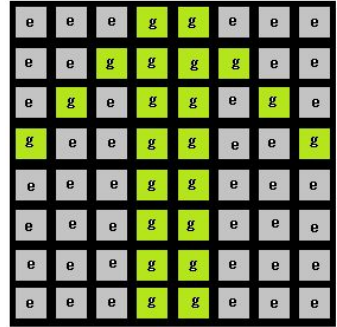
- a. A red pixel refers to an apple and it will appear randomly
- b. Snake can control by joystick and increase its length by 1 when it eats an apple
- c. A new apple will appear randomly again after the snake eat the apple
- d. The apple cannot appear inside the snake
- e. The snake can go through the wall from one side to others
- f. Reset the game when the snake bump into itself

After finish your work, please demonstrate your result to the technical staffs. Then, copy your code (.py) to a .txt file and zip it, then upload to Canvas, name it “**yourSID_Challenge1**”.

Challenge 2

Try to write a “Random Arrow Game” with LED matrix and IMU sensor in online emulator with the following rules:

1. Try to display the following image (green arrow) with the LED matrix
2. Show a message to indicate the game start
3. A green arrow rotate in random direction (0, 90, 180, or 270 degrees)
4. The player need to keep the arrow pointing down within 3 seconds
5. If the result correct, the player gets 1 score
6. The screen will show a message to indicate correct
7. The green arrow rotate in random direction again
8. If the result incorrect, show a message to indicate the game ends
9. Show the scores of the player



Challenge 2

After finish your work, please demonstrate your result to the technical staffs. Then, copy your code (.py) to a .txt file and zip it, then upload to Canvas, name it “**yourSID_Challenge2**”.