IEEE
NEPAL SUBSECTION

DAY 3:

ROBOCAMP

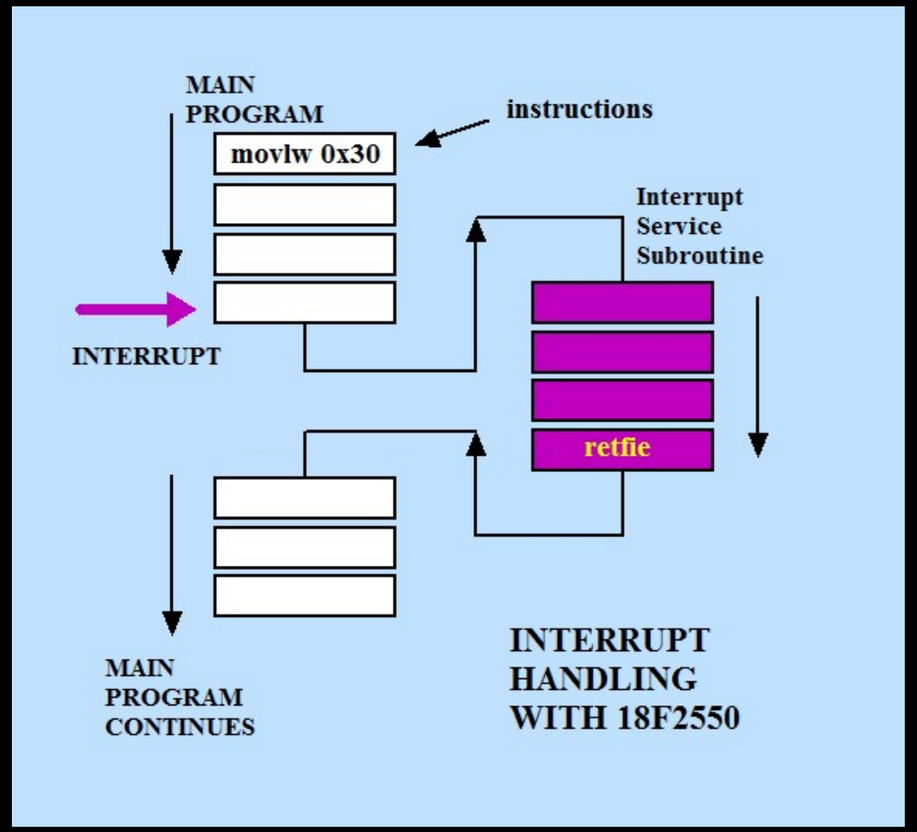
ADC AND MPU6050

INTERRUPTS, ADC AND MPU6050

- Interrupt and Timer
- Button Interrupt
- Analog to Digital Convertors(ADC)
  - Reading POT value using ADC
  - Interfacing Joystick Module
- Micro Electro-Mechanical System
  - MEMS Sensors
  - I2C Protocol
  - MPU6050

INTERRUPTS

- Interrupts the normal flow of a program's execution
- Sleep wastes processor resource
- Polling also wastes processor resource
- Respond quickly to external events without wasting CPU cycles continuously checking for those events
- Software and Hardware Interrupts
- Triggered by timers, external peripherals like buttons, network data



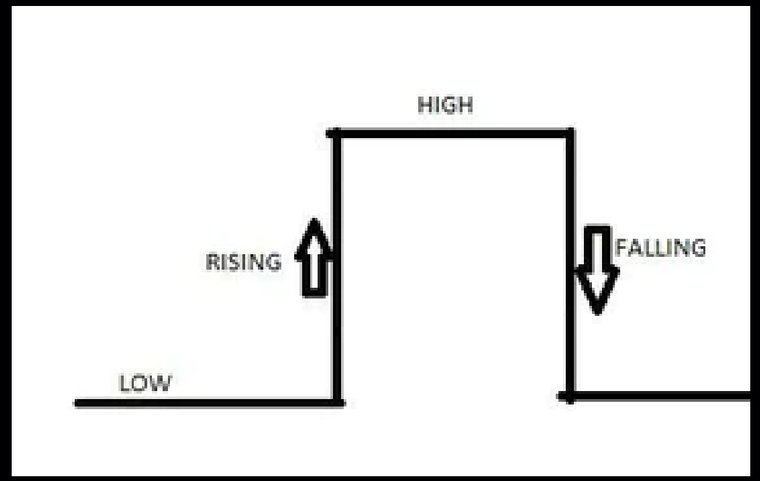
TAKING INPUT FROM BUTTON AS INTERRUPT

```
from machine import Pin

led = Pin(25,Pin.OUT)
but = Pin(18,Pin.IN, Pin.PULL_UP)

def blink(Pin):
    if but.value():
        led.toggle()

but.irq(trigger=Pin.IRQ_RISING, handler=blink)
```



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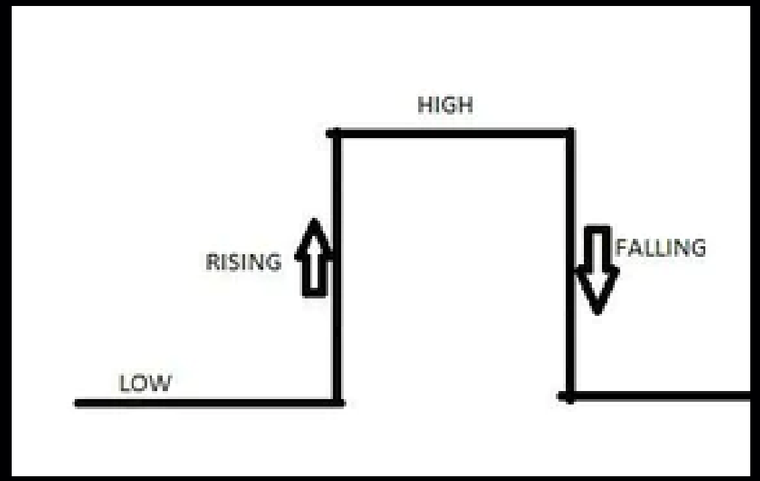

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TIMERS IN RP2040

```
from machine import Pin, Timer

led = Pin(25,Pin.OUT)

def blink(t: Timer):
    led.toggle()

tim = Timer()
tim.init(mode=Timer.PERIODIC, freq=2.5, callback=blink)
```

- sleep() functions halts the micro controller
- let micro controller do other task rather than sleep
- periodic task doesn't need to exist within the super loop
- delayed task also don't need to exist within the super loop
- One Shot and Periodic Timers

The three arguments of Timer() function:

- Period: This is the total time until the callback is called.
- Mode: We can choose between two mode types: ‘Timer.PERIODIC’ or ‘Timer.ONE_SHOT.’
- Callback: The third argument is the callback which is executed whenever a timer is triggered. When we will use the timer in periodic mode, the callback function will be called after every period which we will specify.

ANALOG TO DIGITAL CONVERTORS

- An Analog to Digital Converter (ADC) is a feature that converts an analog voltage on a pin to a digital number.
- In real-life applications, ADC is used to
  - convert microphone signal to digital signal
  - convert light appearing in digital camera, into a digital signal.
  - convert the surrounding temperature into digital value by digital thermometers.

when continuous voltage source is connected to ADC pins of RP2040, It converts the voltage into digital value.

RP2040 has 4 ADC pins among which 3 are useable.

- They are ADC0(GP26), ADC1(GP27), ADC2(GP28)

The resolution of the measured values is 12 bits, so the values are between 0 and 0 to 4095 (2^12 - 1).

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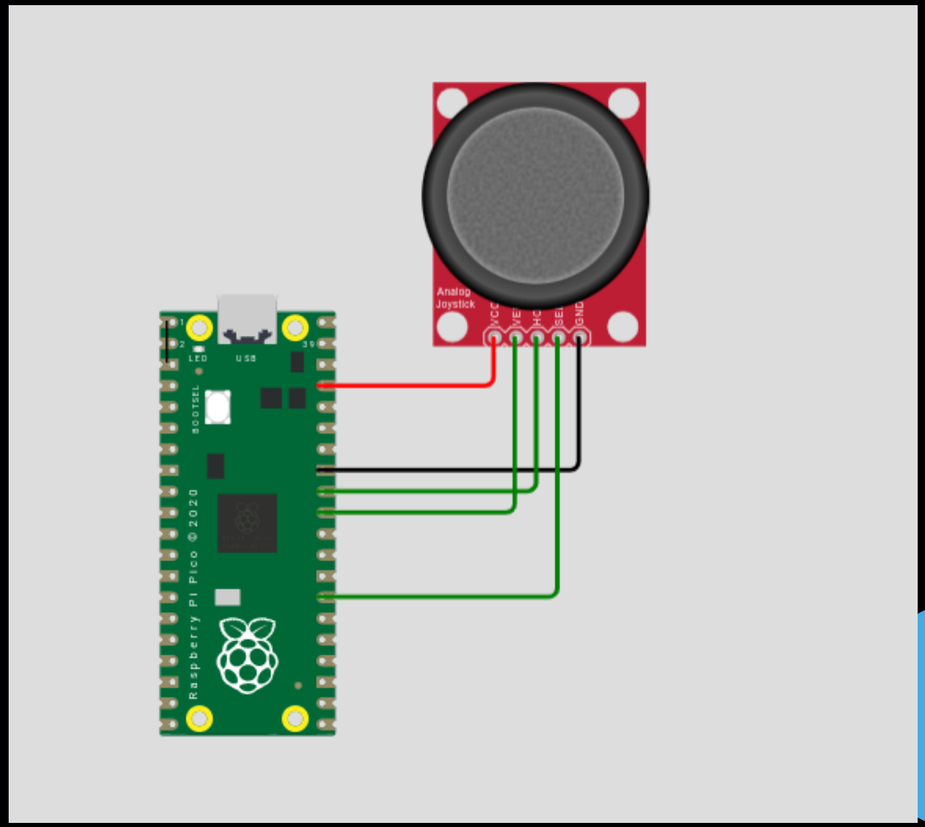
INTERFACING JOYSTICK

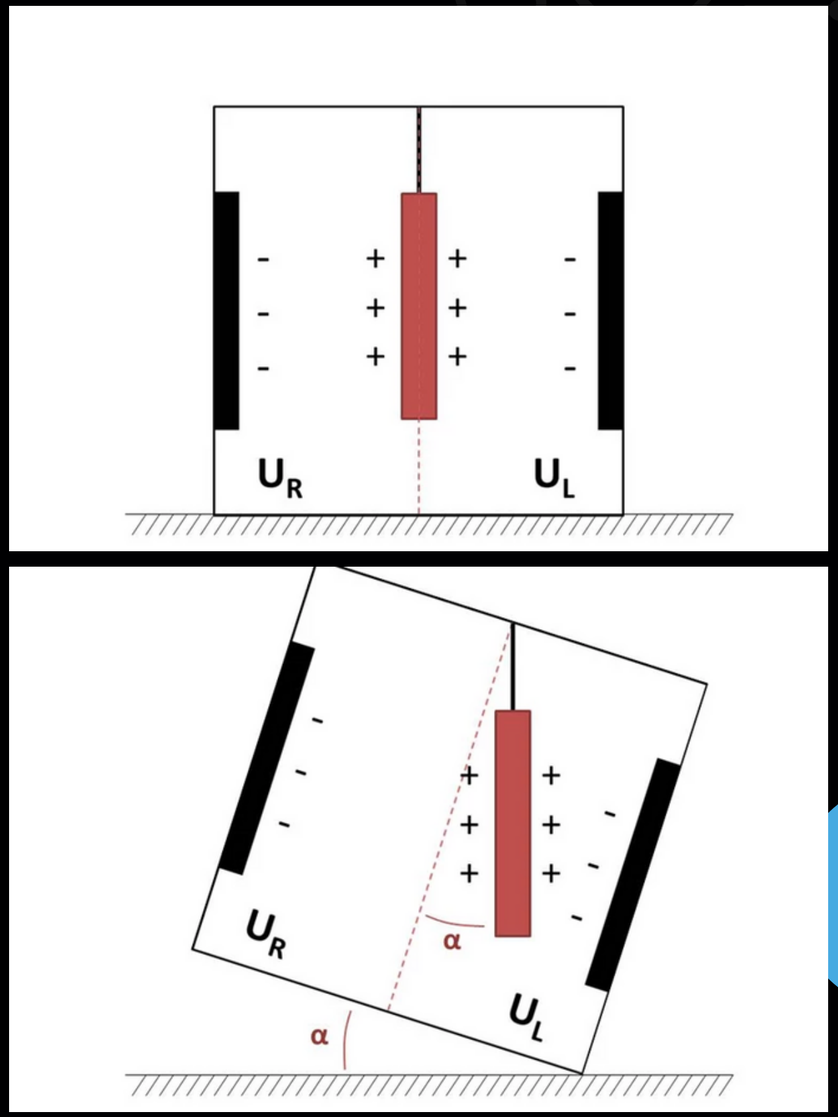


MICRO ELECTRO-MECHANICAL SYSTEM

MEMS SENSORS

- MEMS, OR MICRO ELECTRO-MECHANICAL SYSTEM, IS A CHIP-BASED TECHNOLOGY WHERE SENSORS ARE COMPOSED OF A SUSPENDED MASS BETWEEN A PAIR OF CAPACITIVE PLATES.

- WHEN THE SENSOR IS TILTED, A DIFFERENCE IN ELECTRICAL POTENTIAL IS CREATED BY THIS SUSPENDED MASS. THE CREATED DIFFERENCE IS THEN MEASURED AS A CHANGE IN CAPACITANCE.



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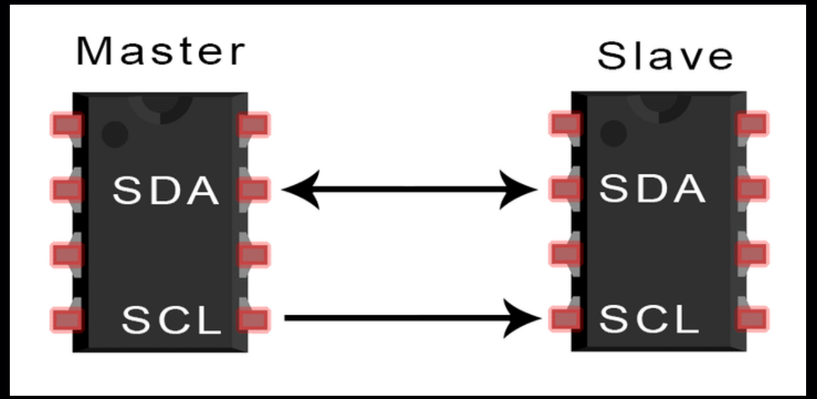
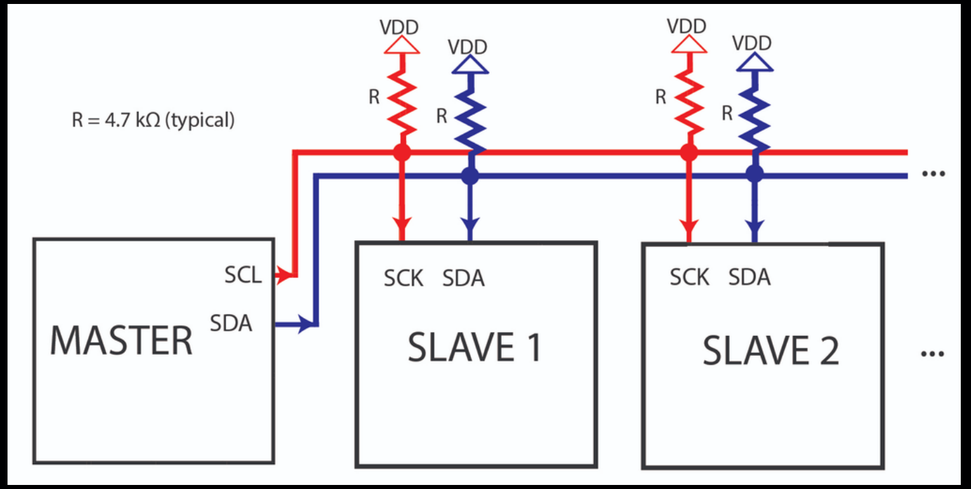
I2C PROTOCOL

- Serial Communication: only two wires: a data line (SDA) and a clock line (SCL).
- Master-Slave Architecture: master initiates communication and controls the data transfer to and from the slave devices.
- Addressing: Each I2C device has a unique address that allows the master to identify and communicate with specific devices on the bus.
- Half-Duplex Communication: I2C supports half-duplex communication, allowing data to be transferred in either direction, but not simultaneously.





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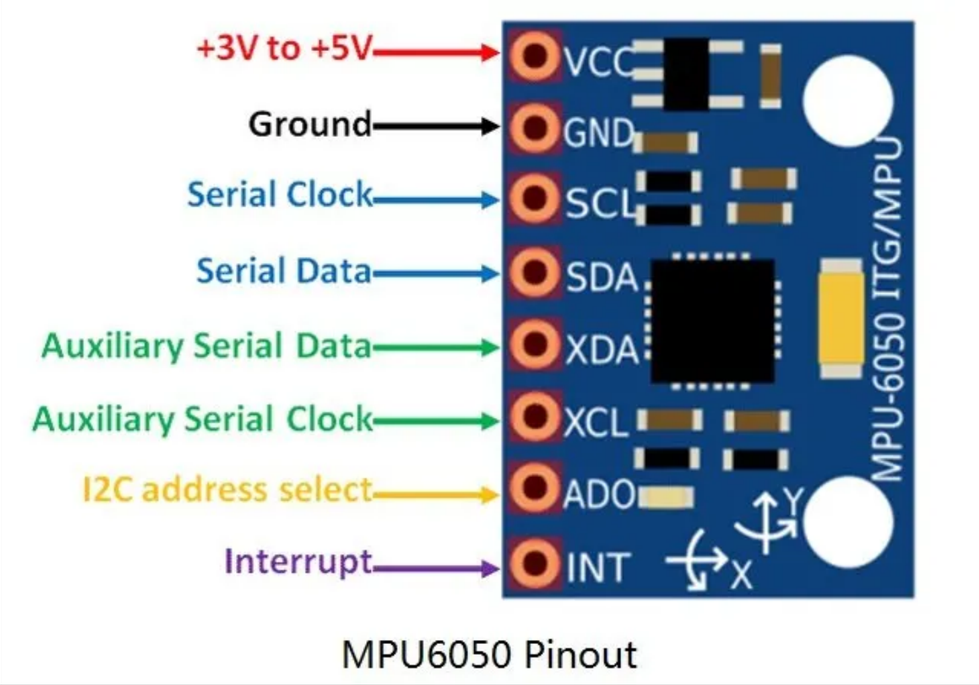
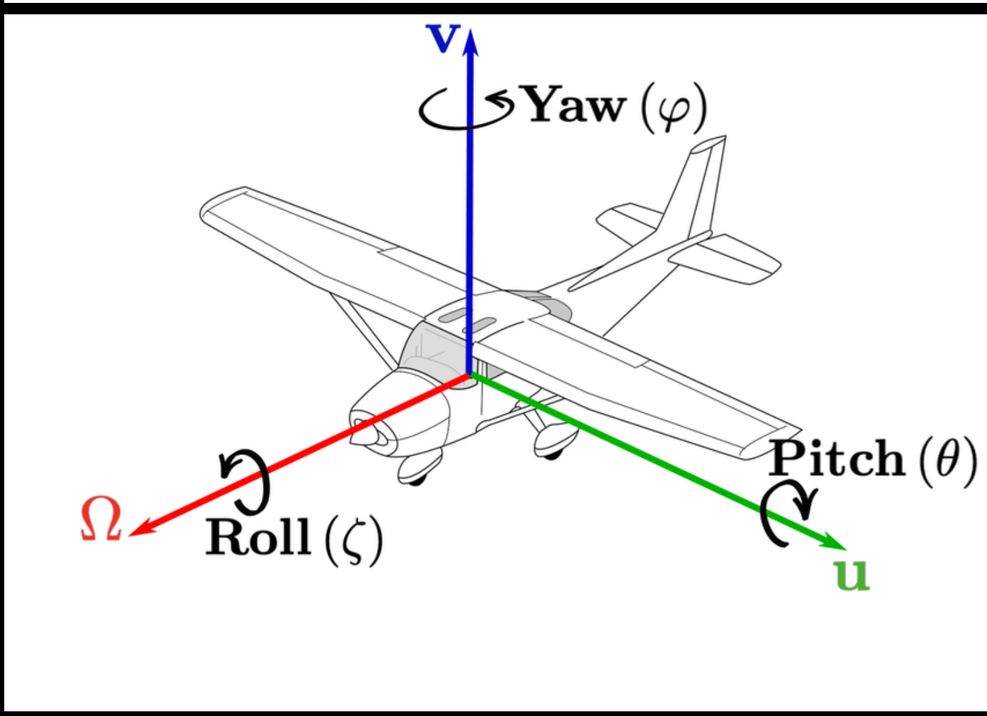
MPU6050

- MPU6050: The MPU6050 is a popular and widely used 6-axis motion tracking sensor.
- Gyroscope: It features a 3-axis gyroscope, which measures angular velocity or rotational motion.
- Accelerometer: The MPU6050 includes a 3-axis accelerometer, which measures linear acceleration.
- Inertial Measurement Unit (IMU): It combines both the gyroscope and accelerometer to provide accurate motion sensing capabilities.
- I2C Interface: The sensor communicates with the microcontroller using the I2C protocol.



MPU6050 Pinout



EXTERNAL LIBRARIES IN MICROPYTHON

- You may need to interface you microcontroller with various components.
- Not all components can be easily interfaced and run

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INTERFACING MPU6050