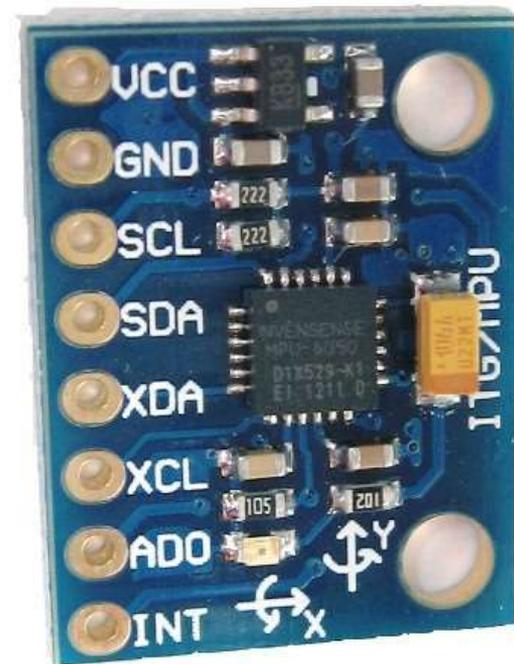
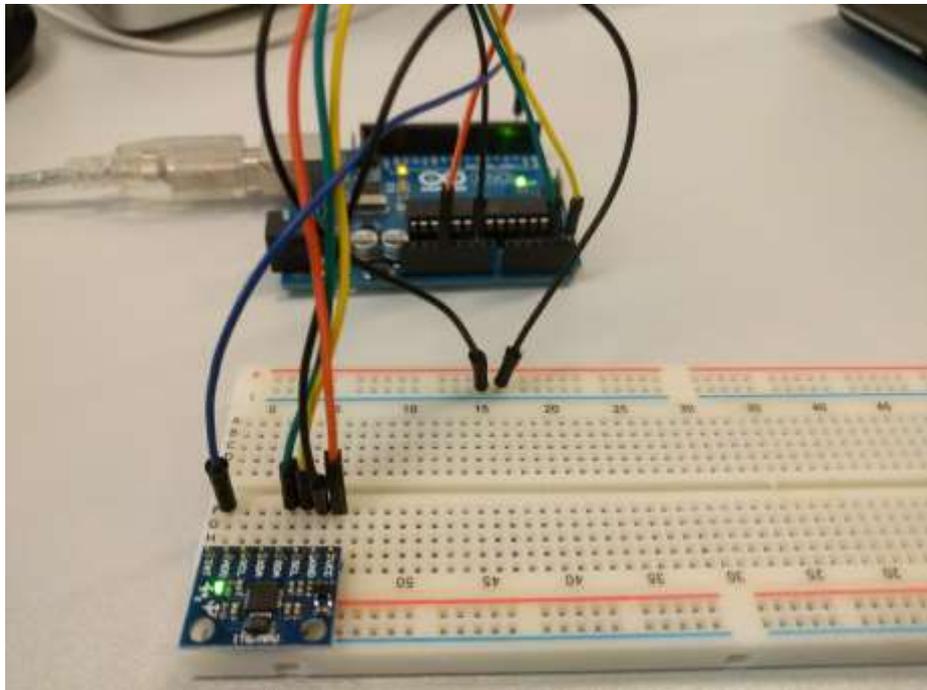


MPU-6050 Inertia Measurement Unit (IMU) with Arduino



Startathon (20 Feb 2016)
Designathon (9 Jan 2016)

By: Yeo Kheng Meng (yeokm1@gmail.com)
<https://github.com/SustainableLivingLab/imu-mpu6050-usage>

Equipment check

1. Laptop installed with Arduino IDE
 - <https://www.arduino.cc/en/Main/Software>
2. Arduino Uno
3. USB cable
4. MPU-6050
5. Breadboard
6. At least 5 jumper wires

What is an IMU?

- Inertia Measurement Unit
- Measures rate of change of movement via acceleration sensors along the axes
 - Commonly called accelerometers
- Measures orientation changes via gyroscopic sensors

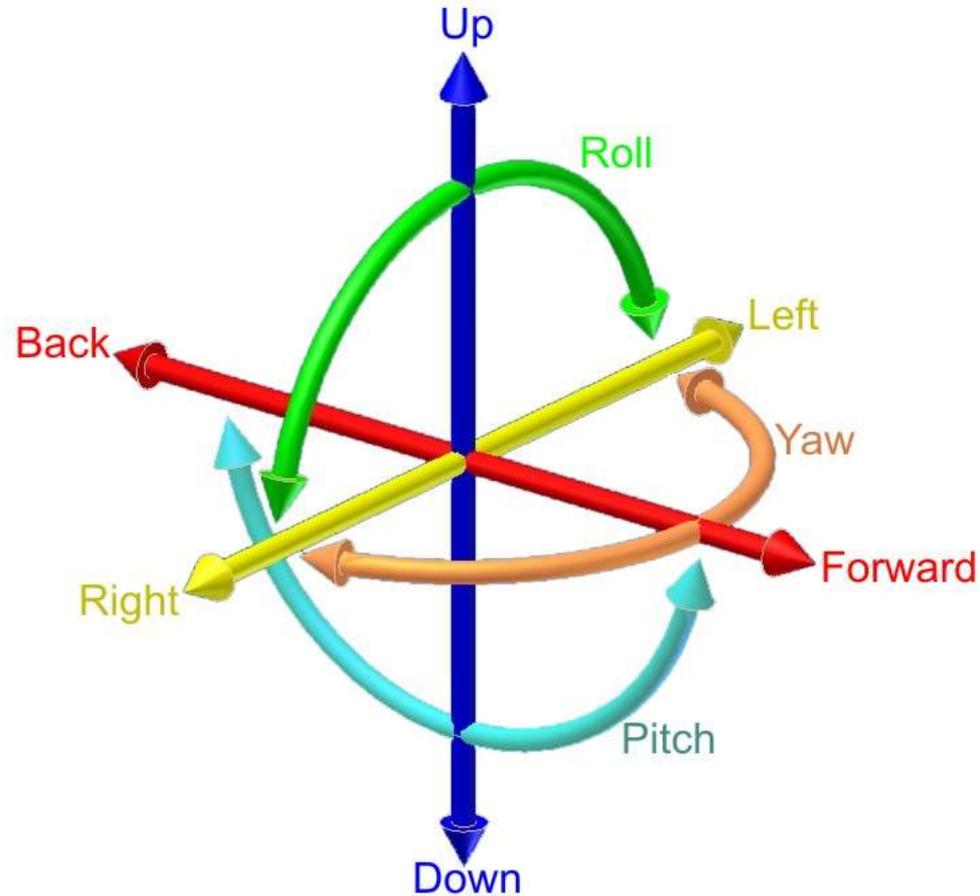
What is MPU-6050?



Note the axes

- An IMU that includes a temperature sensor
- Accelerometer + Gyroscope -> 6 degrees of freedom

6 degrees of freedom



- Accelerometer: Left-Right, Back-Forward, Up-Down
- Gyroscope: Pitch, Roll, Yaw

Code

- Download and extract zip file
- <https://github.com/yeokm1/imu-mpu6050-usage>
- Remove “-master” from directory name
 - imu-mpu6050-usage-master -> imu-mpu6050-usage
- Open “imu-mpu6050-usage.ino”

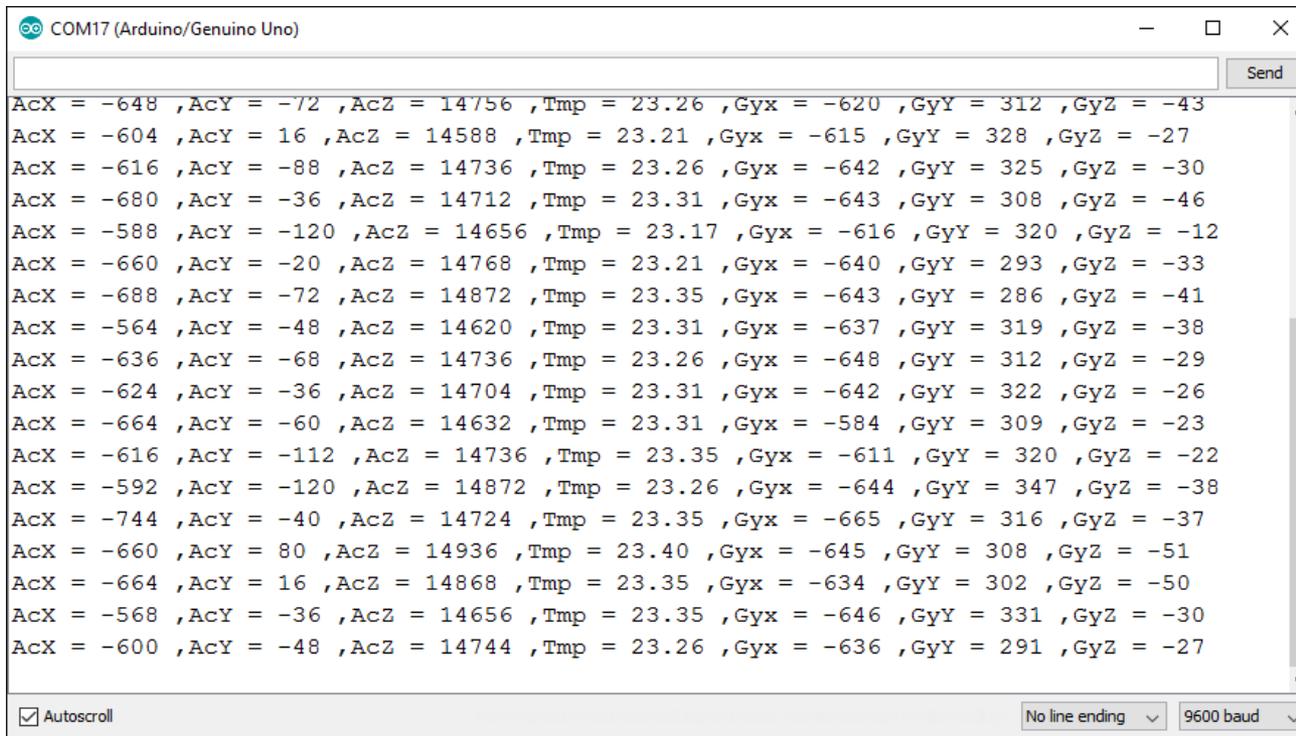
Concept of I²C

- Two-wire connection between components
 - SDA and SCL
- One master and many slaves
- Master: Arduino
- Slave: MPU6050
- Every slave has its own address
 - MPU6050 default address = 0x68

Arduino I²C command structure

- Start I2C transmission
 - `Wire.beginTransmission("address")`
- Set register to write to
 - `Wire.write("register")`
- Read/Write to register
 - `Wire.read()`, `Wire.write("value")`
- End I2C transmission
 - `Wire.endTransmission(true);`

MPU-6050 results



The screenshot shows the Arduino Serial Monitor window for COM17 (Arduino/Genuino Uno). The window displays a stream of sensor data lines. Each line contains the following values: AcX, AcY, AcZ, Tmp, GyX, GyY, and GyZ. The data is as follows:

```
AcX = -648 ,AcY = -72 ,AcZ = 14756 ,Tmp = 23.26 ,GyX = -620 ,GyY = 312 ,GyZ = -43
AcX = -604 ,AcY = 16 ,AcZ = 14588 ,Tmp = 23.21 ,GyX = -615 ,GyY = 328 ,GyZ = -27
AcX = -616 ,AcY = -88 ,AcZ = 14736 ,Tmp = 23.26 ,GyX = -642 ,GyY = 325 ,GyZ = -30
AcX = -680 ,AcY = -36 ,AcZ = 14712 ,Tmp = 23.31 ,GyX = -643 ,GyY = 308 ,GyZ = -46
AcX = -588 ,AcY = -120 ,AcZ = 14656 ,Tmp = 23.17 ,GyX = -616 ,GyY = 320 ,GyZ = -12
AcX = -660 ,AcY = -20 ,AcZ = 14768 ,Tmp = 23.21 ,GyX = -640 ,GyY = 293 ,GyZ = -33
AcX = -688 ,AcY = -72 ,AcZ = 14872 ,Tmp = 23.35 ,GyX = -643 ,GyY = 286 ,GyZ = -41
AcX = -564 ,AcY = -48 ,AcZ = 14620 ,Tmp = 23.31 ,GyX = -637 ,GyY = 319 ,GyZ = -38
AcX = -636 ,AcY = -68 ,AcZ = 14736 ,Tmp = 23.26 ,GyX = -648 ,GyY = 312 ,GyZ = -29
AcX = -624 ,AcY = -36 ,AcZ = 14704 ,Tmp = 23.31 ,GyX = -642 ,GyY = 322 ,GyZ = -26
AcX = -664 ,AcY = -60 ,AcZ = 14632 ,Tmp = 23.31 ,GyX = -584 ,GyY = 309 ,GyZ = -23
AcX = -616 ,AcY = -112 ,AcZ = 14736 ,Tmp = 23.35 ,GyX = -611 ,GyY = 320 ,GyZ = -22
AcX = -592 ,AcY = -120 ,AcZ = 14872 ,Tmp = 23.26 ,GyX = -644 ,GyY = 347 ,GyZ = -38
AcX = -744 ,AcY = -40 ,AcZ = 14724 ,Tmp = 23.35 ,GyX = -665 ,GyY = 316 ,GyZ = -37
AcX = -660 ,AcY = 80 ,AcZ = 14936 ,Tmp = 23.40 ,GyX = -645 ,GyY = 308 ,GyZ = -51
AcX = -664 ,AcY = 16 ,AcZ = 14868 ,Tmp = 23.35 ,GyX = -634 ,GyY = 302 ,GyZ = -50
AcX = -568 ,AcY = -36 ,AcZ = 14656 ,Tmp = 23.35 ,GyX = -646 ,GyY = 331 ,GyZ = -30
AcX = -600 ,AcY = -48 ,AcZ = 14744 ,Tmp = 23.26 ,GyX = -636 ,GyY = 291 ,GyZ = -27
```

The window also features a 'Send' button, an 'Autoscroll' checkbox (checked), and dropdown menus for 'No line ending' and '9600 baud'.

- Open Serial Monitor and observe results
- Try rocking the IMU side to side/rotating/moving in a regular manner
- Accelerometer results
 - AcX, AcY and AcZ
- Gyroscope results
 - GyX, GyY and GyZ

Making sense of the results

- Disable autoscroll
- Copy paste values to spreadsheet like Excel
- Select column A
- Data Tab, Text to columns, Delimited, tick Space, Finish

- Add an empty row above the first row
- Add column titles above values on first row
 - AcX, AcY, AcZ, GyX, GyY, GyZ
- Delete unused rows
- Creating a chart
 - Select only the 6 columns
 - Insert Tab, Line chart
 - See how the data corresponds to the movement

Some sample results

