





Lesson 7 Reading the Data of MPU6050

In this lesson, we will learn how to read the data of MPU6050.

7.1 Components used in this course

Components	Quantity	Picture
AdeeptPixie Drive Board	1	
Micro USB Cable	1	
3 pin jumper wire	1	
MPU6050	1	

7.2 About MPU6050

7.2.1 Introduction of MPU6050

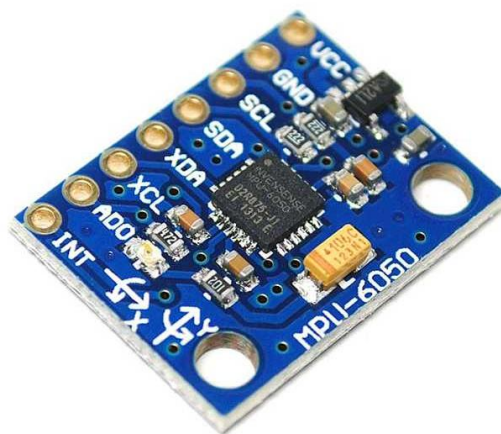
MPU-6050 is the world's first integrated 6-axis Motion Tracking device. It integrates a 3-axis MEMS gyroscope, a 3-axis MEMS accelerometer, and an expandable digital motion processor DMP (Digital Motion Processor), which can be connected to a third-party digital sensor, such as a magnetometer, with an I2C interface. After expansion, it can output a 9-axis signal through its I2C or SPI interface (SPI interface is only available in MPU-6000). MPU-60X0 can also be connected to non-inertial digital sensors, such as pressure sensors, by its I2C interface.

MPU-6050 uses three 16-bit ADCs for the gyroscope and accelerometer, respectively, to convert the measured analog quantity into an output digital quantity.

The gyroscope can measure angular velocity, and the accelerometer can measure acceleration. In order to accurately track fast and slow motion, the measuring range of the sensor is controllable, the gyroscope can measure the range of ± 250 , ± 500 , ± 1000 , $\pm 2000^\circ/\text{sec}$ (dps), and the accelerometer can measure the range of ± 2 , ± 4 , ± 8 , $\pm 16g$ (gravitational acceleration).

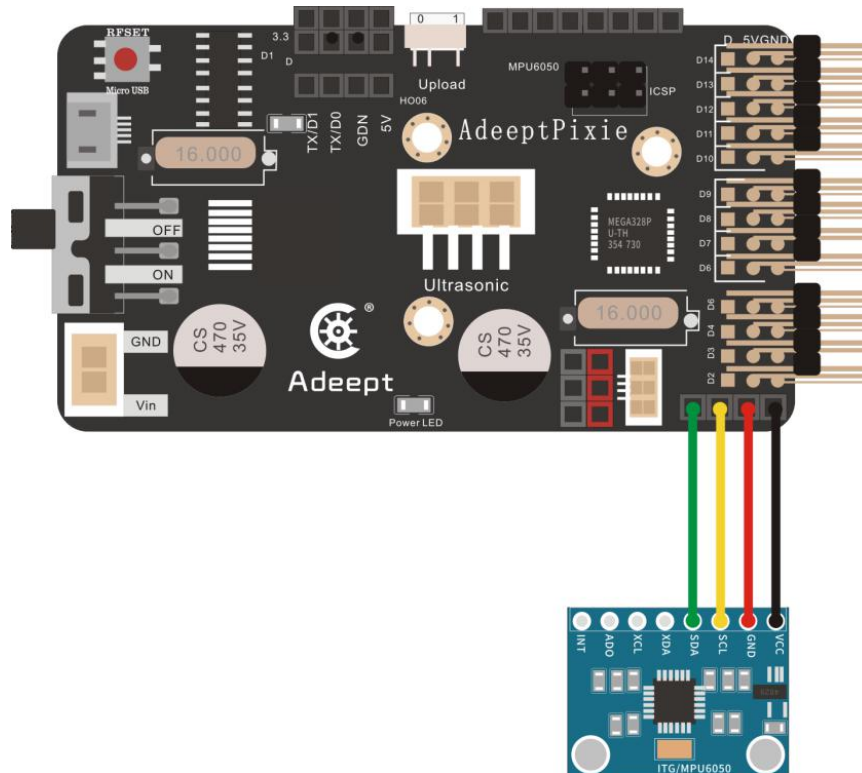
An on-chip 1024-byte FIFO helps reduce system power consumption. The communication with all device registers uses a 400kHz I2C interface. In addition, a temperature sensor and an oscillator with a $\pm 1\%$ variation in the working environment are embedded on the chip. And there is a programmable low-pass filter.

Regarding the power supply, the MPU-6050 module can support the working voltage range of VCC: 3~5VDC.



7.3 Wiring diagram (circuit diagram)

Connect the components used in this lesson to the circuit as shown in the figure below. Connect the MPU6050 module to the MPU6050 port on the AdeeptPixie Drive Board. Pay attention to the corresponding pin numbers, as shown in the figure below:

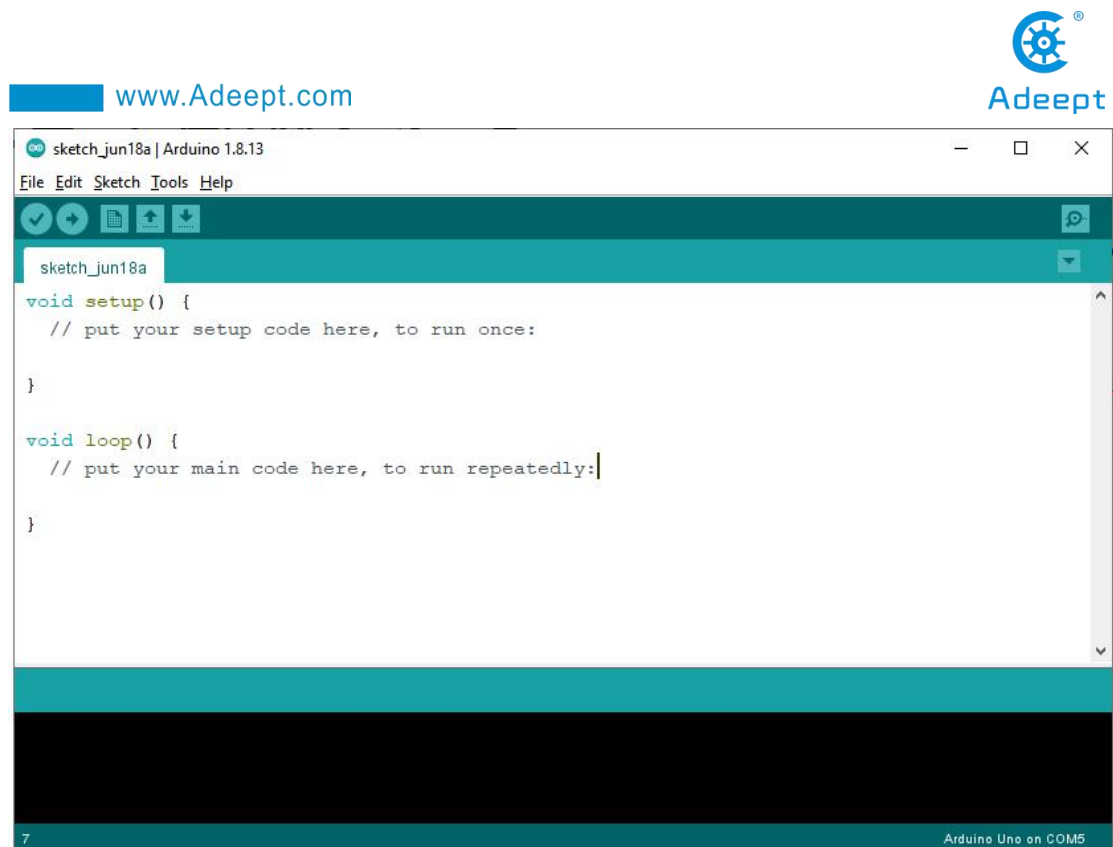


7.4 How to read the data of MPU6050

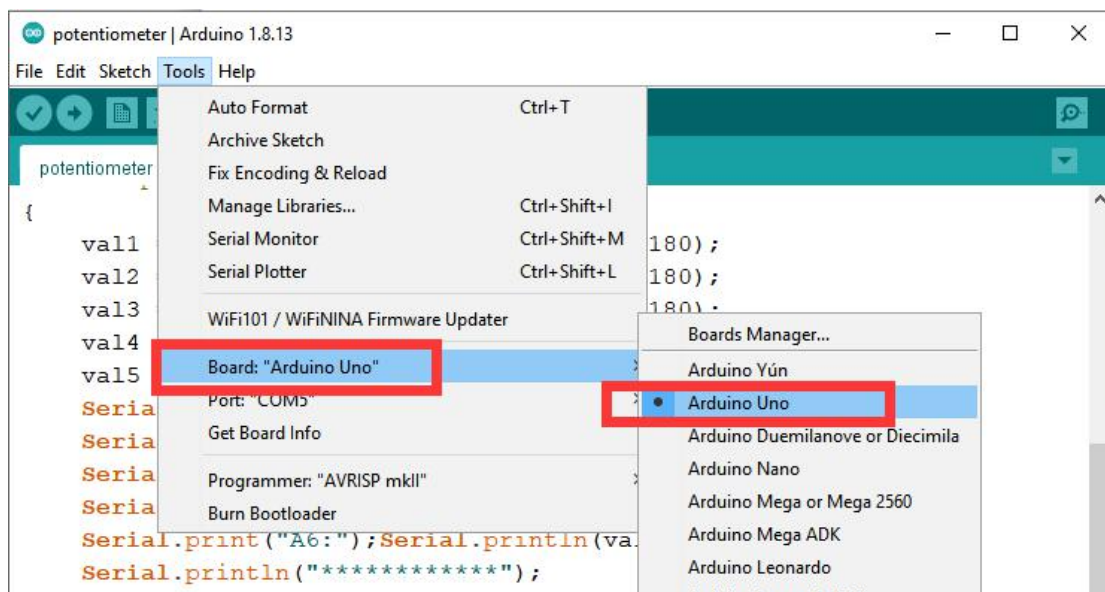
We use the Arduino IDE to use the C language to program and read the value of the super MPU6050 sensor on the AdeptPixie Drive Board. You need to master the C language. Let's learn how to read the value of the MPU6050 sensor.

7.4.1 Running the code program of this lesson

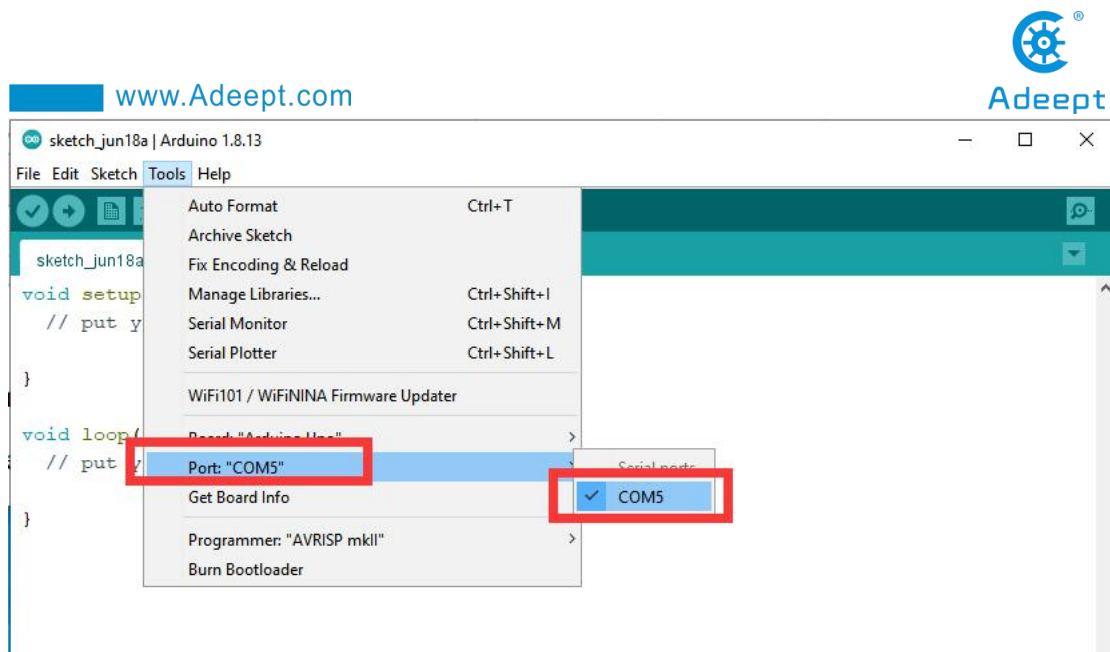
1. You need to use Micro USB Cable to connect AdeptPixie Drive Board to your computer, and then open the Arduino IDE, as shown below:



2. In the Tools toolbar, find Board and select Arduino Uno, as shown below:



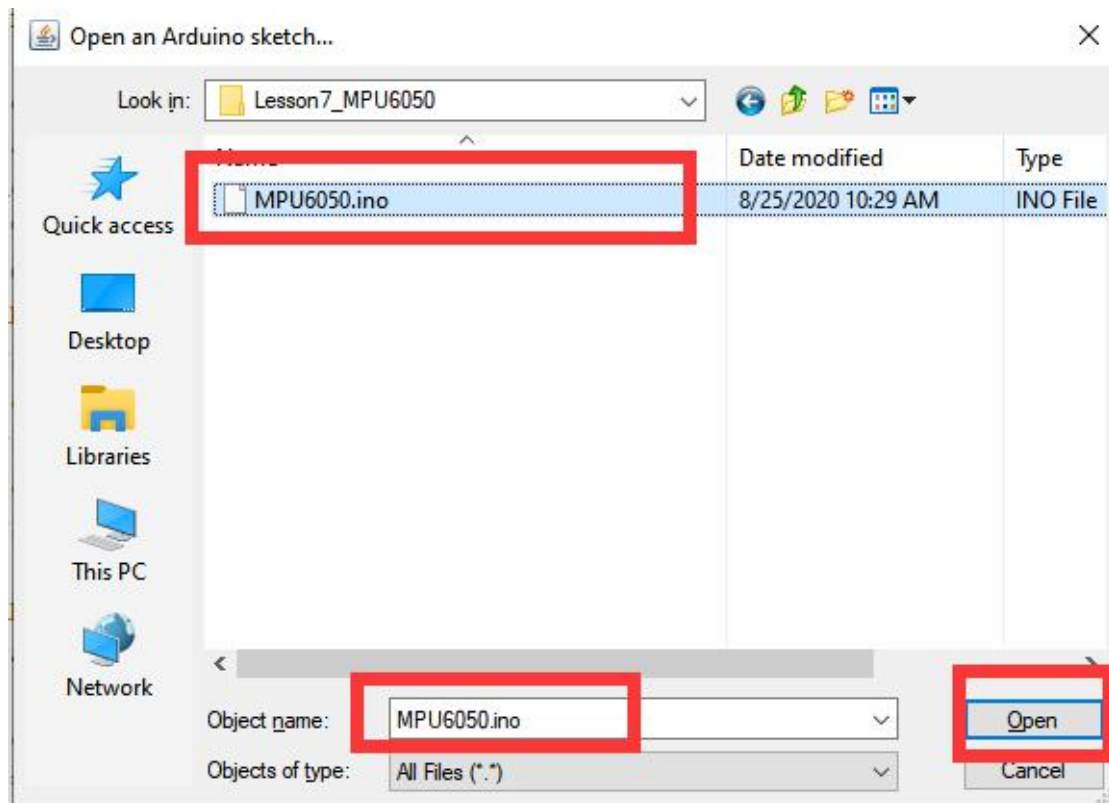
3. Click "Tools" and select the port number of the connected AdeeptPixie Drive Board in "Port": COM5, as shown in the figure below:




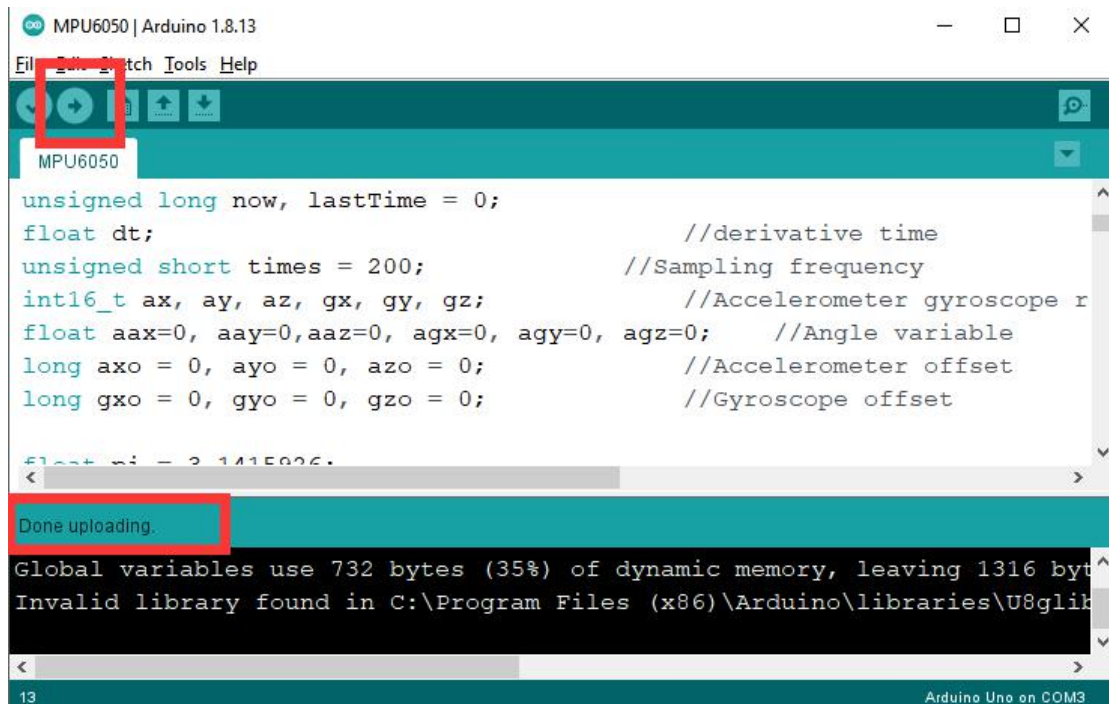
4. You need to open the code program of this lesson. In the File in the upper left corner, click Open, as shown below:




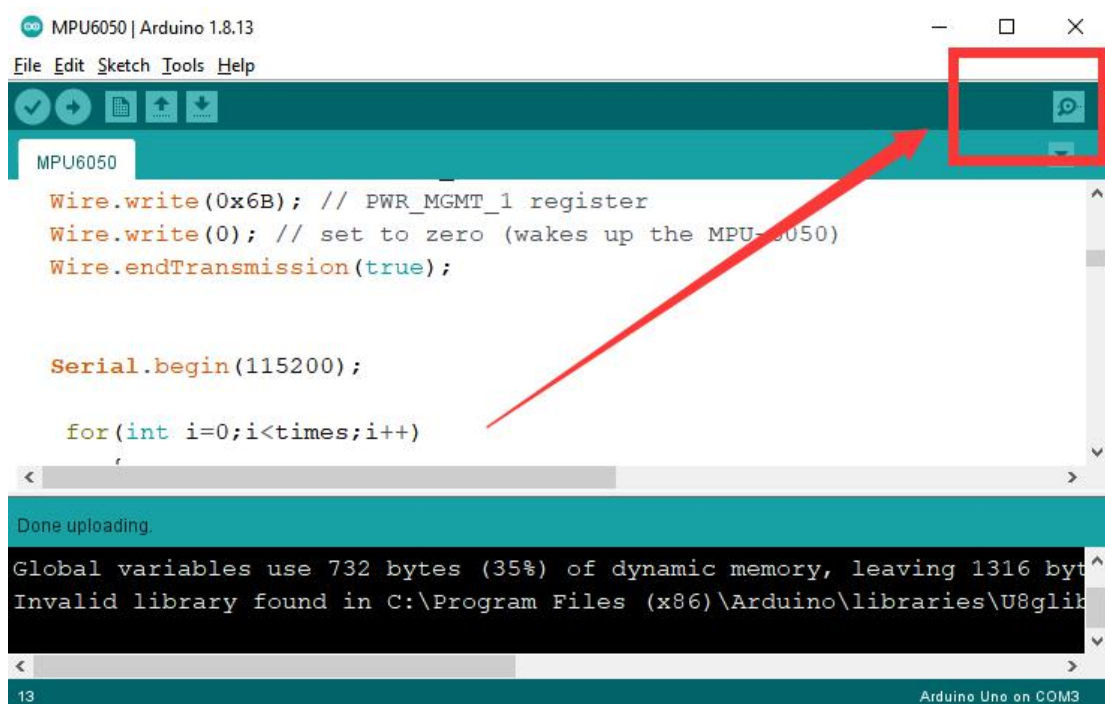
5. Find the file information provided by Adept: Hexapod 6 Legs Spider Robot Kit for Arduino\03Course code, open the Lesson7_MPU6050 folder, select MPU6050.ino, this file is the code program we need to use in this lesson, and then click Open.




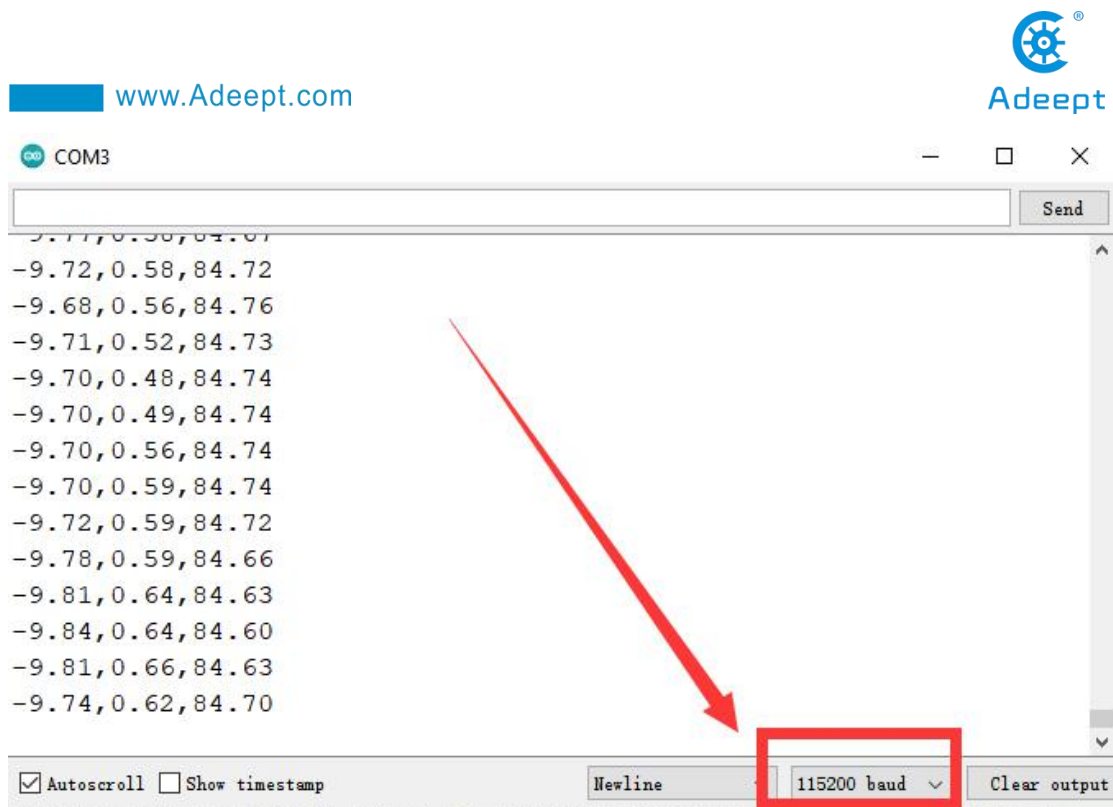
6. After successfully opening the file, you need to click the button  to upload the code program to the AdeeptPixie Drive Board. After the upload is successful, the console will not appear a red warning, and the prompt text "Done uploading" appears in the upper left corner, as shown in the figure below:



7. After successfully running the program, we need to open the serial monitor on the Arduino IDE and observe the acquired data with the serial monitor. How to open the serial monitor? You need to click the "Serial Monitor" button  in the upper right corner, as shown below:



8. After clicking , the serial monitor window will pop up, and you will observe the data of MPU6050. The printout is the value of X, Y, Z axis. You can swing the MPU6050 sensor and these data will change. Pay attention to choose 115200 baud ,As shown below:



7.4.2 Main code program

After the above practical operation, you must be wondering how we use C language to program and read the data of MPU6050 sensor on the AdeeptPixie Drive Board. Below we will introduce how the main code program is implemented.

In the `setup()` function, use `Wire.beginTransmission(MPU_addr)` to turn on the data transmission of MPU6050, use `Serial.begin(115200)` to turn on the serial monitor, use the `getMotion6()` function in the for loop to read the six-axis raw data of MPU6050, and perform a cumulative calculation on the data. After the For loop, average the data to obtain a standard value.


```
void setup()
{
  Wire.begin();
  Wire.beginTransmission(MPU_addr);
  Wire.write(0x6B); // PWR_MGMT_1 register
  Wire.write(0); // set to zero (wakes up the MPU-6050)
  Wire.endTransmission(true);
  Serial.begin(115200);
  for(int i=0;i<times;i++)
  {
    getMotion6(); // read the original value of six axes
    axo += AcX; ayo += AcY; azo += AcZ; //sampling interval
    gx0 += GyX; gyo += GyY; gzo += GyZ;
  }
  axo /= times; ayo /= times; azo /= times; //Calculate the acceler
  gx0 /= times; gyo /= times; gzo /= times; //Calculate the acceler
}
```

In the loop() function, the count6Axle() function uses the Kalman filter algorithm to calculate the X, Y, Z axis data of the angular acceleration of the MPU6050 with the read six-axis raw data. The detailed calculation process can be viewed in the source code of this lesson.

```
void loop()
{
  count6Axle();
}
```