



Smart sensor Lite

Manual 1.0

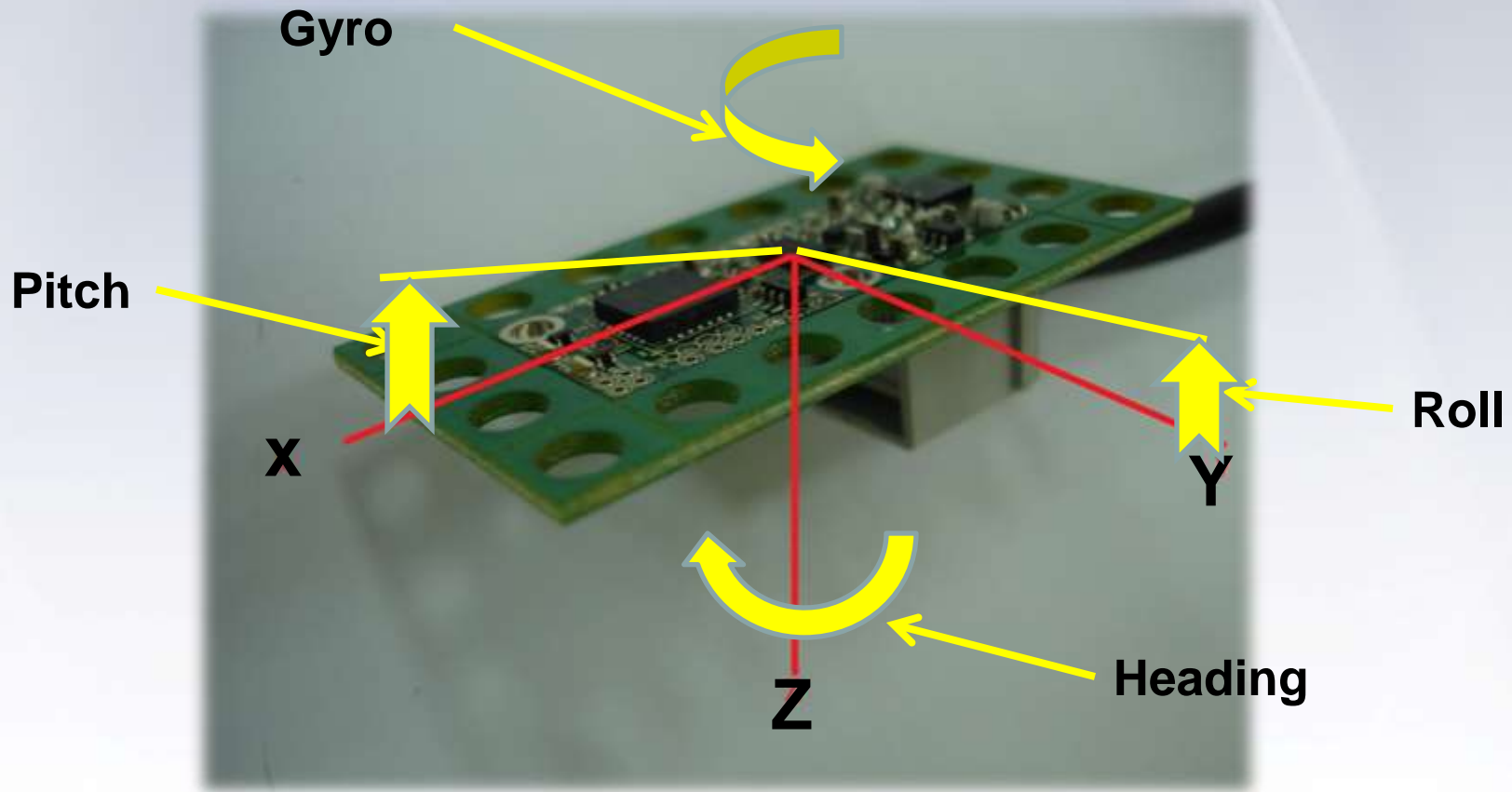
May 2010

Technical spec

- Smart sensor Lite included following MEMS sensors:
 - 3D magnetic sensor
 - 3D G sensor (acceleration sensor)
 - 1 axis Gyro sensor
 - A 32 Bit MCU in charge of signal filtering and position calculation.
- Smart sensor Lite reports following data:
 - MEMS raw data:
 - Original data from magnetic sensor, (Mx_RAW, My_RAW, Mz_RAW)
 - Original data from G sensor (Ax_RAW, Ay_RAW, Az_RAW)
 - Original data from Gyro sensor (Grto_RAW)
 - 3D vector represent orientation with angles related to X, Y,Z axis in Cartesian coordinate system (Pitch, Roll, Yaw), defined as following;
 - Pitch - angle of X body axis relative to horizon.
 - Roll - angle of Y body axis relative to horizon.
 - Yaw - angle of X body axis relative to North.

Orientation of Smart sensor lite

Arrows indicate positive reading



Hardware connection

- Connecting Smart sensor Lite to NXT with standard NXT cable into the input port.



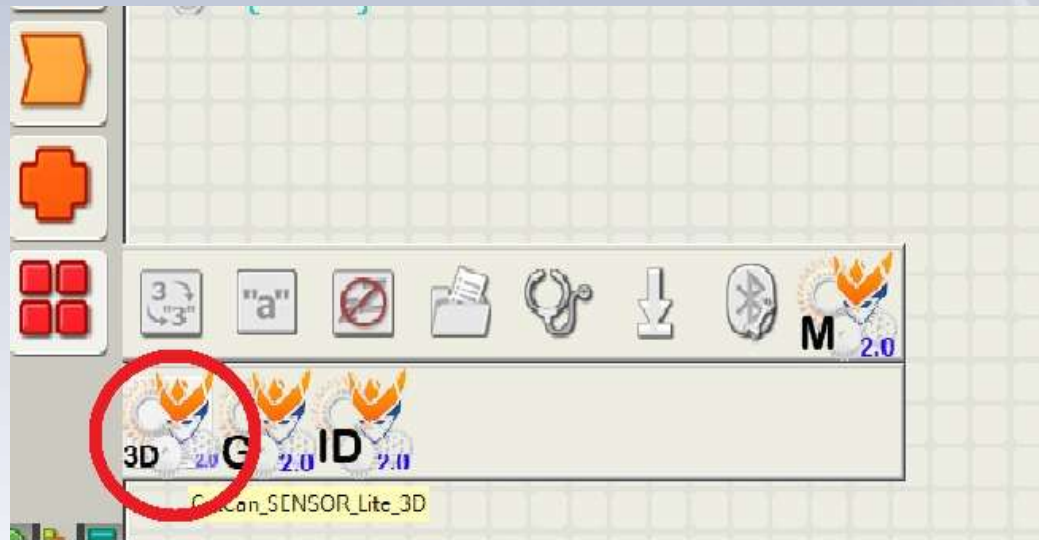
SW for NXT

- CATAN provide block for NXT 1.1 and 2.0 both can be download from:

https://sites.google.com/a/catcan.com.tw/www/home-1/customerservice/file_download

The importing steps of block are discripted in technical note “Gear Up 2” as block for servo, can be down loaded also from above link.

After correct importing, a block for sensor lite will appear as following





Pitch angle out put -180 to +180

Roll angle out put -180 to +180

Heading out put 0 to 360

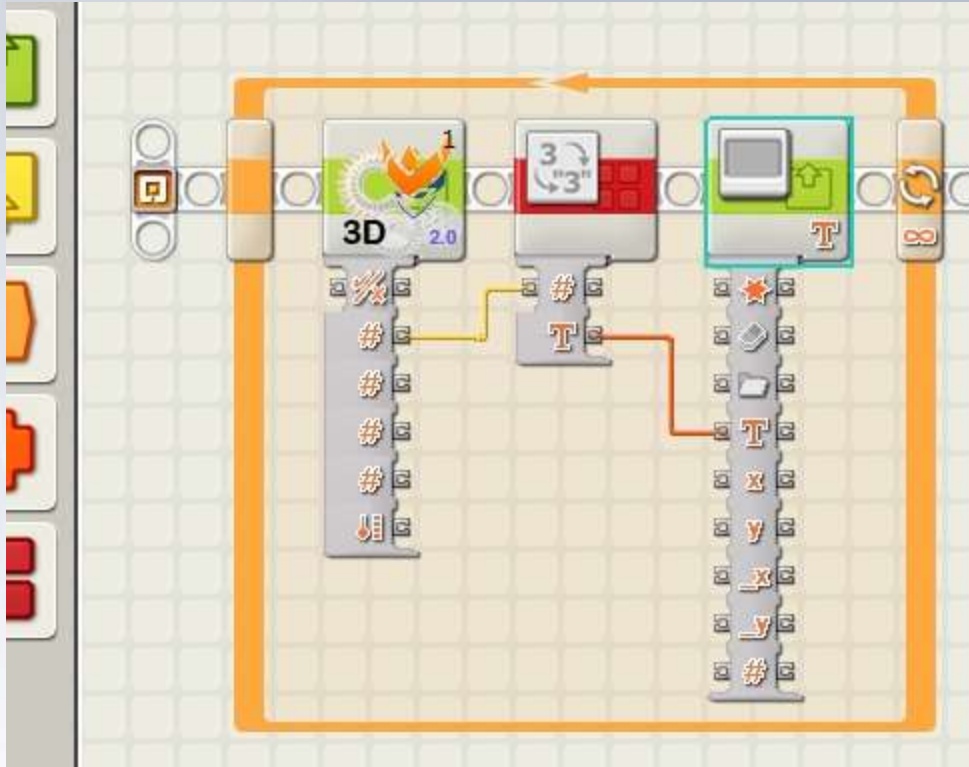
Gyro out put 0 to 300

Temperature out put

Indicate the port
connected with smart
sensor lite

Select for signal
filtering(recommended
to keep it selected)

Reading example

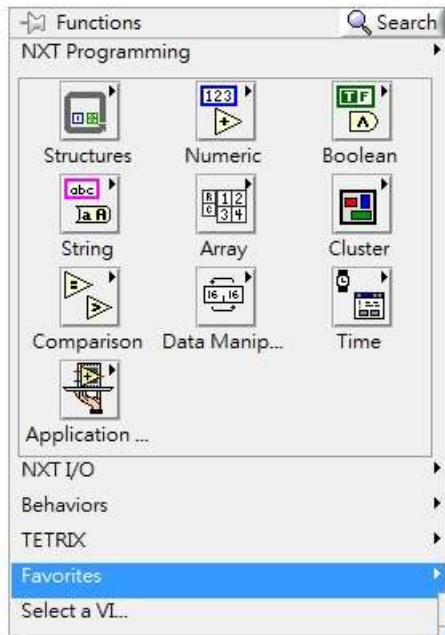


On the left is a pitch reading example, this simple program will show the pitch on the screen.

By simply changing the yellow line, you may read other data.

SW for Lab View

- CATCAN provide smart sensor VI for labview, down load “Catcan Toolkit for LabVIEWmarch312010.zip” from:
- https://sites.google.com/a/catcan.com.tw/www/home-1/customerservice/file_download
- Unzip the file and read the “read me” file first, this file will explain how to import the VI into labview.



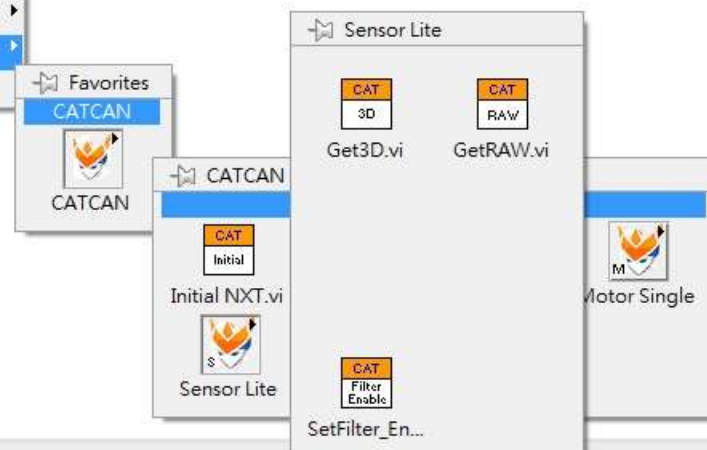
Once import the VI as the “read me” , you can find CATCAN sub VI in the “favorites”.

In the sub VI of sensor Lite there are 3 VIs

SetFilter_Enable

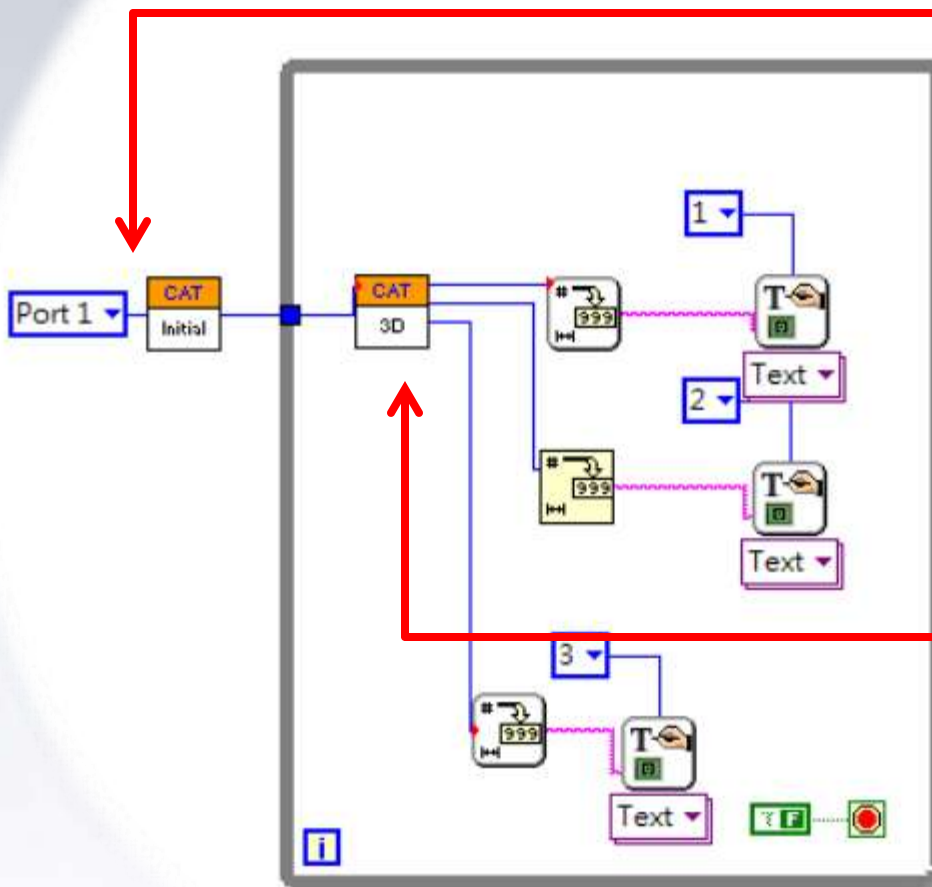
Get3D

GetRAW



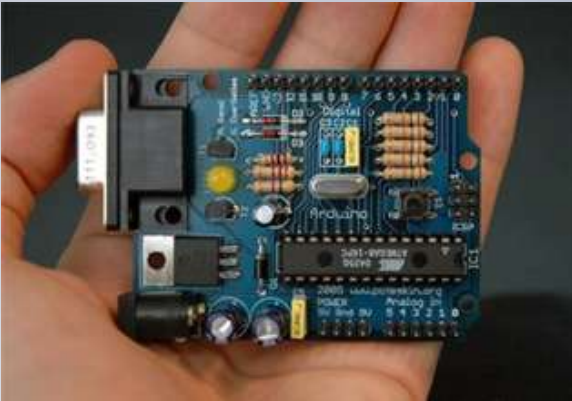


Example of 3D reading:



Initial VI is serve to initial NXT input port, create a constant to assign the port connected to sensor Lite

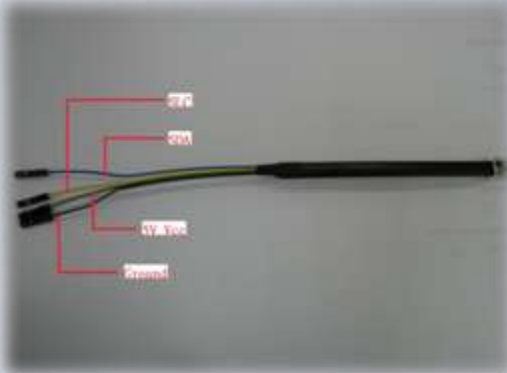
3D VI present the calculated 3D angles pitch,roll, yaw and gyro, temperature.



Arduino

- Here by we assume user is already familiar with arduino, if not please refer to <http://arduino.cc/>
- Following pages are dedicated to HW connection and how to read out sensor data with wire.h function included in arduino SW.

HW connection



A special cable is made for connecting IIC device to NXT. One end with NXT connector, and the other end comes with 2.54 female connectors.

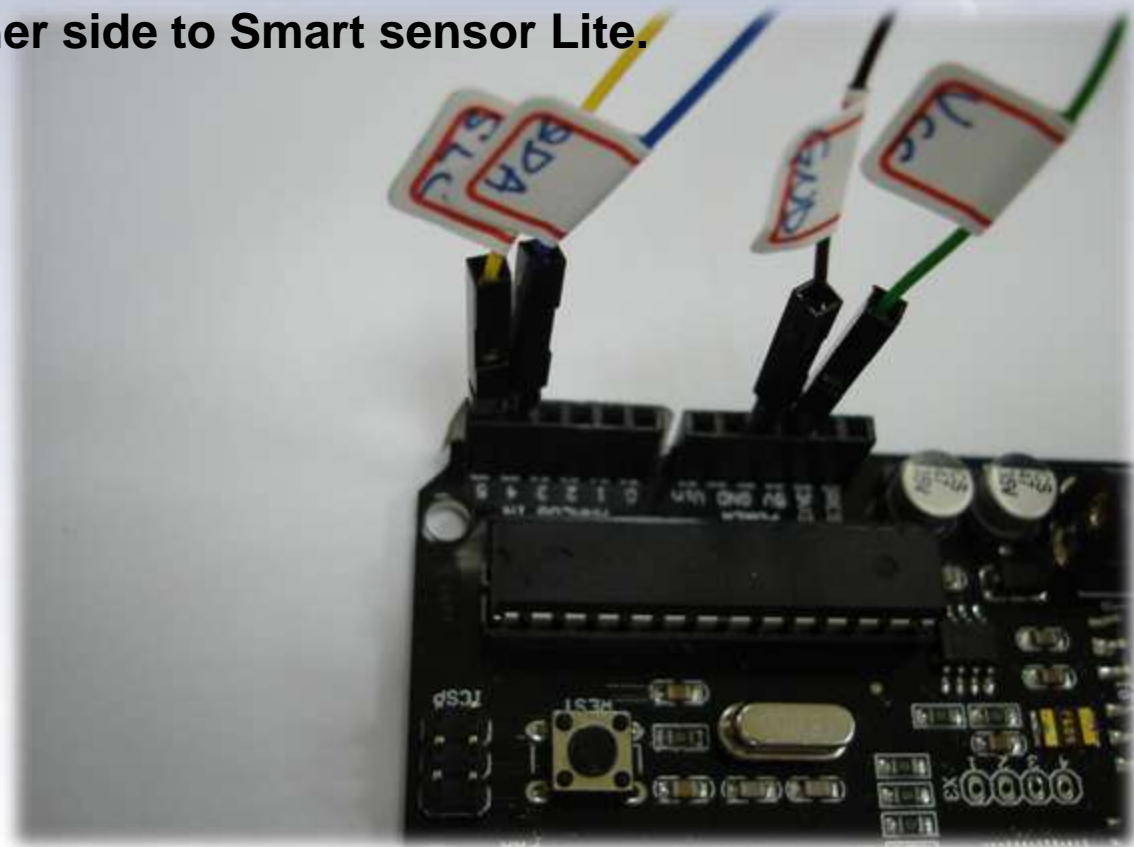
Part Nr. 0140-1526-01, Pin define as following:



Blue: SDA
Yellow: SCL
Green: 5V Vcc
Black: Ground

Connection example using Duemilanove:

1. Using pins to connect these 2 female connectors.
2. The green 5V pin and black Ground pin need to be connected to the 5V and GND of POWER connector on arduino
3. Connect the Yellow (SLC) pin to Analog IN pin 5, and Blue(SDA) pin to Analog IN pin 4.
4. Connect the other side to Smart sensor Lite.



SW structure

- Smart sensor Lite is communicated through IIC registers, it's important to know the registers and their values.
- Register table can be download from:
- http://docs.google.com/View?id=ddb75j5j_1sjsf92g4

Register table

Reg Address	Name	Type	0x11 (10/ChipID)	Byte Size
0x00	Pitch	Read	Low Byte/High Byte	2
0x01	Roll	Read	Low Byte/High Byte	2
0x02	Yaw	Read	Low Byte/High Byte	2
0x03	Temp	Read	Low Byte/High Byte	2
0x04	Gyro	Read	Low Byte/High Byte	2
0x05	Ax_RAW	Read	Low Byte/High Byte	2
0x06	Ay_RAW	Read	Low Byte/High Byte	2
0x07	Az_RAW	Read	Low Byte/High Byte	2
0x08	Mx_RAW	Read	Low Byte/High Byte	2
0x09	My_RAW	Read	Low Byte/High Byte	2
0x0A	Mz_RAW	Read	Low Byte/High Byte	2
0x0B	Gyro_RAW	Read	Low Byte/High Byte	2
0x0C	Mx_max	Read	Low Byte/High Byte	2
0x0D	Mx_min	Read	Low Byte/High Byte	2
0x0E	My_max	Read	Low Byte/High Byte	2
0x0F	My_min	Read	Low Byte/High Byte	2
0x10	Mz_max	Read	Low Byte/High Byte	2
0x11	Mz_min	Read	Low Byte/High Byte	2
0x12	Gyro_Cal	Read	Low Byte/High Byte	2
0xF1	Low Filter Disable			
0xF0	Low Filter Enable			

Notes on the register table

- The address of smart sensor is set at 0x18(7bit mode)
- Each register address contain 2 bytes of data, when read status, LSB returned first, followed by MSB.
- Pitch and Roll data are signed int, and has been multiplied by 100, Yaw is unsigned int, also multiplied by 100, so when combined MSB and LSB these data need to be divided by 100
- Multiple data can be read in one command as long as data are next to each other. Will be show in following example.

Example: reading pitch



```
#include <Wire.h>           //library of arduino wire.h
byte Data[2]={0,0};        // data array used to receive data from sensor
float Pitch;               // after divided by100, pitch should be float
void setup()
{
  Wire.begin();
  Serial.begin(9600);      // for serial monitoring
}
void loop()
{
  Wire.beginTransmission(0x18); // indicate the slave address 0X18
  Wire.send(0x00);          // send the starting register address 0x00=pitch
  Wire.endTransmission();
  Wire.requestFrom(0x18, 2); // read 2 bytes from 0X18
  while(Wire.available())
  {
    Data[0]=Wire.receive(); // first received data LSB
    Data[1]=Wire.receive(); // second received data MSB
  }
  Pitch=(Data[1] <<8|Data[0] )*0.01; // combine MSB,LSB and divided by 100
  Serial.println(Pitch);         // show pitch data on serial monitor
  delay(100);
}
```

Example: sub function for reading all 12 data

```
void Get_SSL_Data(void) // in the register table from pitch(0x00) to
                        //Gyro_RAW (0x08), 12 data contain 24bytes
                        // data[ ] need to be declare min 24bytes
{
  int i;
  Wire.beginTransmission(0x18);
  Wire.send(0x00);      //Wirte starting registry to smart sensor
  Wire.endTransmission();
  //Read Data from SSL
  Wire.requestFrom(0x18, 24);
  while(Wire.available())
  {
    for(i=0;i<24;i++)
      data[i]=Wire.receive();
  }
}
```

These 2 functions serve to combine MSB and LSB signed short ByteToSInt(byte MSB,byte LSB)

```
{
return data[MSB]*256+data[LSB];
}
```

unsigned short ByteToUInt(byte MSB,byte LSB)

```
{
return data[MSB]*256+data[LSB];
}
```

Using above function to form the 12 data

```
Pitch=(float)ByteToSInt(1,0)*0.01; //deg
Roll=(float)ByteToSInt(3,2)*0.01; //deg
Heading=(float)ByteToUInt(5,4)*0.01; //deg
Temp=(float)ByteToUInt(7,6)*0.01; //C
Gyro=(float)ByteToSInt(9,8)*0.01; //deg/s
//raw data value
AccRaw[0]=ByteToSInt(11,10);
AccRaw[1]=ByteToSInt(13,12);
AccRaw[2]=ByteToSInt(15,14);
MagRaw[0]=ByteToUInt(17,16);
MagRaw[1]=ByteToUInt(19,18);
MagRaw[2]=ByteToUInt(21,20);
GzRaw=ByteToUInt(23,22);
```