# ACCELEROMETER - GYRO RESEARCH

Accelerometers output gravitational acceleration in the x, y and z directions and from these we can calculate the angle at which the sensor is positioned. We can then calculate the angle at which the sensor is positioned.
Gyroscopes measure the rotational velocity along the x, y and z directions. Integrating the rotational velocities gives us the angular position

Available standalone accelerometers
- ADXL335
- LIS3DH

Available standalone gyroscopes
- GY-521 (Unavailable in the market)

Combined accelerometers and gyroscopes
- MPU6050
- MPU9250/9150
- GY-85 IMU (unavailable in the local market)
- GY-80 L3G4200D ADXL345 HMC5883L BMP085

**ADXL335**

**SPECIFICATIONS**

| | |
|---|---|
| Operating voltage | 1.8 - 3.6V |
| Operating current | 350μA |
| Sensing range | ±3g (Full Scale) |
| Sensing axis | 3 axis |
| Sensitivity | 270 - 300 mV/g |
| Temperature range | 40 -85 |
| Communication | Serial |
| Dimension | 4mm*4mm*1.45mm |

**COST**

Sh. 150

**AVAILABILITY**
https://store.nerokas.co.ke/index.php?route=product/product&product_id=90

**LIS3DH**

**SPECIFICATIONS**

| | |
|---|---|
| Operating voltage | 1.71 - 3.6V |
| Operating current | As low as 2μA |
| Sensing range | ±2g/±4g/±8g/±16g dynamically selectable full scale |
| Sensing axis | 3 axis |
| Sensitivity | 1 to 192 mg/digit, depending on selected mode |
| Temperature range | 40 -85 |
| Communication mode | I2C, SPI 3-wire, & SPI 4-wire interfaces |
| Dimension | 4mm*4mm*1.45mm |

**COST**
Sh. 600

**AVAILABILITY**
https://www.pixelelectric.com/sensors/load-pressure-flow-vibration/imu-acc-mag-gyro/lis3dsh-three-axis-high-resolution-accelerometer/

**MPU 6050**

Combines a 3-axis gyroscope and a 3-axis accelerometer and a temperature sensor.

**SPECIFICATIONS**

| | |
|---|---|
| Operating voltage | 3 - 5V |
| Operating current | 5μA - 3.8mA |
| Sensing range | ±2g/±4g/±8g/±16g dynamically selectable full scale |
| Sensing axis | 6 axis |
| Sensitivity | Gyro-131<br>65.5<br>32.8<br>16.4 (LSB/deg/sec)<br>Accel - 16384<br>8192<br>4096<br>2048 (LSB/g) |
| Temperature range | 40 -85 deg |
| Communication mode | I2C |
| Dimension | 21.2mm (0.84") length x 16.4mm (0.65") width x 3.3mm (0.13") height. Weight: 2.1g (0.07oz) |

**COST**
Sh. 400

**AVAILABILITY**
https://store.nerokas.co.ke/index.php?route=product/product&product_id=98

**MPU 9250**
Combines a 3-axis gyroscope, a 3-axis accelerometer, a 3-axis magnetometer and a digital output temperature sensor.
It also has an auxiliary master I2C bus for reading data from external sensors(e.g. pressure sensor)

| | |
|---|---|
| Operating voltage | 4.4 - 6.5V. 3.3V if you solder the solder jumper near the on-board voltage regulator |
| Operating current | 8μA - 3.2mA |
| Sensitivity - | Gyro - 131 LSB/deg/sec<br>Accelerometer - 16,384 LSB/g<br>Magnetometer - 0.6 μT/LSB |
| Sensing axis | 9 axis |
| Sensing range | Gyro - ± 2000 deg/sec<br>Accel - ± 16 g<br>Magnetometer - ± 4800 μT |
| Temperature range | 40 -85 deg |
| Communication mode | I2C |
| Dimension | 25.5mm (1.004") long x 15.4mm (0.606") wide, 3mm (0.118") inside diameter of mounting holes |

**COST**
Sh.800

**AVAILABILITY**
https://store.nerokas.co.ke/index.php?route=product/product&product_id=2154

**GY-80 L3G4200D ADXL345 HMC5883L BMP085**

Is a 10DOF sensor.
Contains nine axis modules (three-axis gyro + three axis acceleration + tri-axial magnetic field ) + pressure sensor BMP085

-**L3G4200 specs**

Operating voltage: 2.5 to 5.5 V

- Supply current: 7 mA
- Output format (I²C/SPI): one 16-bit reading per axis
- Sensitivity range (configurable): ±250°/s, ±500°/s, or ±2000°/s

-**ADXL345 specs**

3V-6V DC Supply Voltage

- On-board LDO Voltage regulator
- Built-in Voltage level convertor (MOSFET based)
- It can be interfaced with 3.3V or 5V Microcontroller.
- Ultra-Low Power: 40uA in measurement mode, 0.1uA in standby@ 2.5V
- SPI and I2C interfaces
- Measuring Range: ±16g
- Measuring Values (-16g to +16g):
- X: -235 to +270
- Y: -240 to +260
- Z: -240 to +270

-**HMC5883L specs**

| | |
|---|---|
| Supply voltage | 3.3 - 6V |
| Heading accuracy | 1 - 2 deg |
| Magnetic field range | -8 to +8 gauss |
| I2C address | 0x1E (7-bit address) |
| Max. Data rate | 160Hz |
| Digital voltage level | 3.3V |

**COST**

Sh. 1500

**AVAILABILITY**

https://www.ktechnics.com/product/gy-80-l3g4200d-adxl345-hmc5883l-bmp085-arduino-module/

# RECOMMENDATION

To obtain the smallest possible avionics bay a module that combines a gyroscope and an accelerometer is recommended.
This leaves us with a choice between the MPU6050, MPU9250 and the GY-80 L3G4200D ADXL345 HMC5883L BMP085.
We leave out the MPU 6050 as it does not have a magnetometer and using a gyroscope without a fixed reference point causes yaw drift to happen on the Z axis on long sessions (this naturally happens due to earth's rotation).

The GY-80 L3G4200D ADXL345 HMC5883L BMP085 is the most preferable as it also allows for altitude measurement.
However we may have to use the MPU9250 as the GY-80 IMU does not arrive until early April.