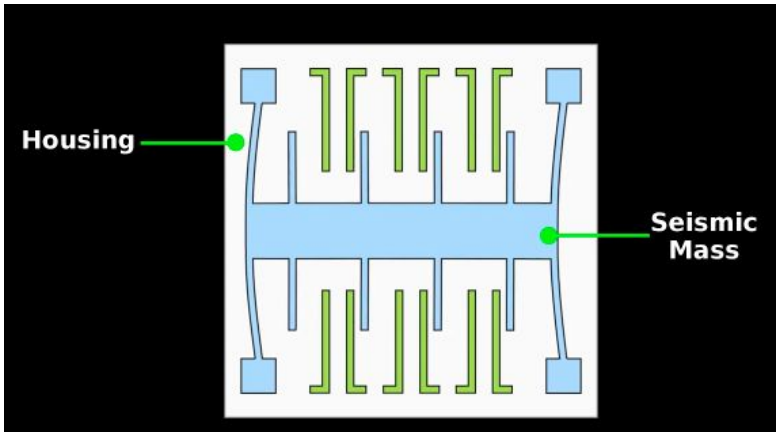
The Auto Correction System

Inertial Measurement Unit: MPU-6050
Micro-Controller: Arduino-UNO

In a nutshell: The MPU(motion processing unit) – 6050 does exactly what it's name suggests; It can sense how it is being moved. However this does not mean that it can create a map of its path because it can only detect changes in its linear velocity and angular position. Now the unit can send out information about these changes; this information is useless for an auto correction system unless it is used to control the craft's orientation. Therefore information given by the MPU must be sent to a device that will process that information to control the control-surfaces of the craft. A device that can do this kind of task is called a microcontroller (the Arduino in this case). The arduino micro-controller is programmable making it useful for other things too however this makes it slightly less compact.

Measurement:
MPU-6050 has an in-built accelerometer and gyroscope.
Accelerometer – This device is used in so many devices including your smart mobile phone, how do you think it knows up from down and can orient the display on the screen accordingly? All the accelerometer can do is measure linear acceleration or changes in speed. Imagine a ball suspended in the middle of a box by springs on all four sides, if the box is then pushed, you will notice that the inertia of the ball causes tension and compression on the springs: If you were to take the readings of these forces you would be able to calculate the acceleration that the box experienced when it was pushed. The same idea applies for an accelerometer accept that it does not look like that (because the "box" example is highly inefficient and bulky) an accelerometer looks more like

Figure 1.1:



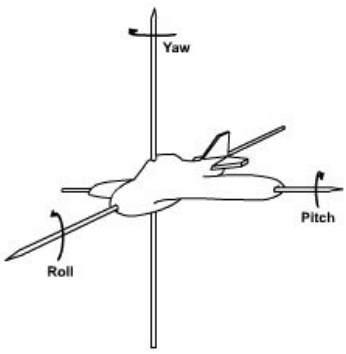
Here the 'Seismic mass' represents the ball in the example and the housing is the object whose change in linear velocity we are trying to measure. The Seismic mass is composed of silica (a

semiconductor) that when moves changes the capacitance of the two green bars in the diagram that surround it which corresponds to a change in the voltage across them. The blue fingers from the Seismic mass and the green ones surrounding them make up a deferential (trimmer) capacitor which is a capacitor with an adjustable capacitance.

In the case of our aircraft, this device is very good at telling up from down because the acceleration due to gravity would act on it in the same way that a force pushing it upwards without gravity would.

Gyroscope – When telling up from down. The accelerometer can do it's job quite well however it is not enough when we want to also measure changes in the craft's angular position. For this job, we use a 'Gyroscope'.You see this when you spin a top and the international space station uses the concept to be stable and prevent itself from spinning. What's special about this device is that it resists changes to its angular position and measurement of the opposing force can tell you how the angular position has changed. Why it is able to resist these changes is quite simple: If you think about it is more difficult to change the direction of the velocity vector of an object if it has a higher kinetic energy. This only applies when the force you are pulling the object with is stationary. To visualise this, imagine a ball flying through the air in a straight path and you suddenly (while standing firmly on the ground) pull it off its course with a string, while it is being pulled you will realize that it taking a circular path, this causes a centripetal acceleration that pulls the ball outwards resisting the change in direction. The same idea applies when turning a spinning wheel, the faster it spins, the harder it is to change its overall angular position.

For a plane, there is a name for each of it's 3 possible angular velocity vectors that point along each of the 3 axis on a Cartesian coordinate system(x/y/z) or (x1/x2/x3) they are, yawing, rolling and pitch. Figure 1.2 shows what each one is.



For the auto correction system; whenever the gyroscope detects a change in the angular position, the information is sent to a microcontroller which then accordingly moves the control surfaces using servos to correct the angular position of the craft.

This figure 1.3 better illustrates how the plane rotates about each axis

*The following diagram illustrates how the arduino-uno is wired to the MPU-6050
This does not include how the arduino is connected to the servos.