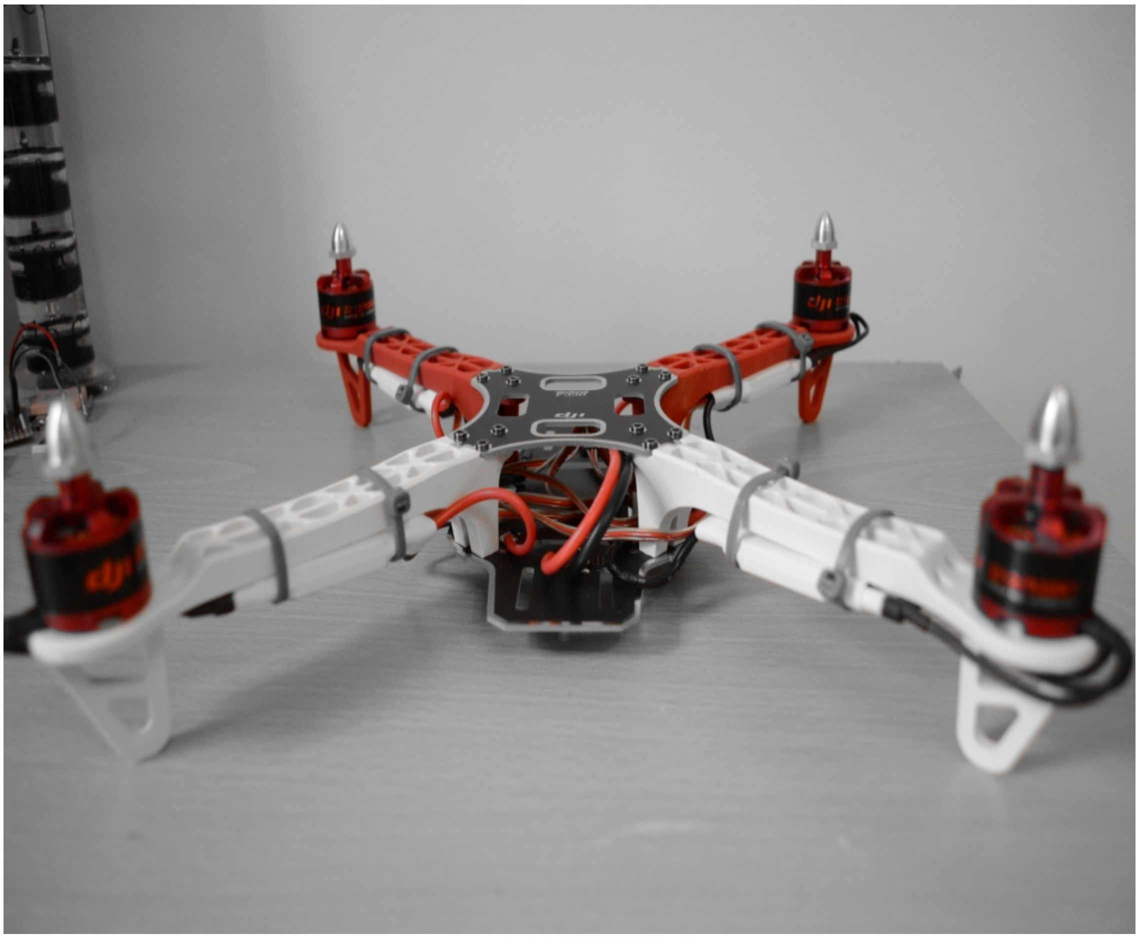
HIGH SPEED TERRORIST AIR FIGHTER



HIGH SPEED TERRORIST AIR FIGHTER

A Case Study

Submitted in Partial Fulfilment of the Requirement for the Award of the Degree of

Bachelor of Engineering

In

Electrical Engineering

By

KHAN AFROZ

FODKAR SALMAN

DAKHWAY SUFIYAN

MULLA SAEED AHMED

KHAN ABDUL HAKIM

Under the Guidance of

Prof. Syed Kaleem

Department of Electrical Engineering.

A.I.K.T.C , NEW PANVEL

2014-2015

CERTIFICATE

This is to certified that, this B.E Electrical Synopsis report titled "***HIGH SPEED TERRORIST AIR FIGHTER"***presented by Mr.KHAN ABDUL HAKIM Mr.MULLA SAEED AHMED, Mr. KHAN AFROZ Mr.FODKAR SALMAN Mr.DAKHWAY SUFHYAN is approved by me for submission. It is certified furtherthat to the best of my knowledge, the report represents work carried out by the students.

SIGNATURE	SIGNATURE
(Prof. Syed kaleem)	(Prof. Sayed kaleem)
PROJECT GUDE	HOD
DEPT OF ELECTRICAL ENGINEERING	DEPT OF ELECTRICAL ENGINEERING

EXTERNAL EXAMINER	SIGNATURE OF DIRECTOR
	(Dr. ABDUL RAZZAK H)

ACKNOWLEDGEMENT

We take great pleasure to thank our project guide **Prof. Syed Kaleem** for his simulating guidance and useful suggestions.

We would like to thank **Prof. Syed Kaleem**, HOD of Electrical Engineering department for his useful help and proper guidance. We would also like to thank all the faculty members of department of Electrical Engineering for their help.

We thank **Dr. ABDUL RAZZAK H**, Director of **KALSEKAR TECHNICAL CAMPUS, NEW PANVEL** for providing us required facilities through college for carrying out the project work.

ABSTRACT

The military use of unmanned aerial vehicles (UAVs) has grown because of their ability to operate in dangerous locations while keeping their human operators at a safe distance. The larger UAVs also provide a reliable long duration, cost effective, platform for reconnaissance as well as weapons. They have grown to become an indispensable tool for the military. The question we posed for our project was whether small UAVs also had utility in military and commercial/industrial applications. We postulated that smaller UAVs can serve more tactical operations such as searching a village or a building for enemy positions. Smaller UAVs, on the order of a couple feet to a meter in size, should be able to handle military tactical operations as well as the emerging commercial and industrial applications and our project is attempting to validate this assumption.

To validate this assumption, my team considered many different UAV designs before we settled on creating a Quadcopter. The payload of our Quadcopter design includes a camera and telemetry that will allow us to watch live video from the Quadcopter on a laptop that is located up to 2 miles away. We are presently in the final stages of building the Quadcopter but we still improving our design to allow us to have longer flight times and better maneuverability. We are currently experimenting with new software so that we will not have to control the Quadcopter with an RC controller but will instead operate by sending commands from a remote laptop.

Our project has verified that it is possible to build a small-scale Quadcopter that could be used for both military and commercial use. Our most significant problems to date have been an ambitious development schedule coupled with very limited funds. These constraints have forced compromise in components selected and methods used for prototype development. Our team's Quadcopter prototype is a very limited version of what could be created in a

production facility using more advanced technology. Currently our Quadcopter has achieved only tethered flight because it cannot maintain a stable position when flying. Our next step is to fix the software so that we can achieve controllable untethered flight. We are also working on integrating our own Graphical User Interface (GUI) which will allow us to have direct control over all systems. Although there are many enhancements that we could do to the design, we have proven that it is possible to produce a small scale UAV that performs functions of interest to the military as well as commercial/industrial applications.

TABLE OF CONTENTS

1. INTRODUCTION

A quadcopter also called quadrotor helicopter, quadrotor is multirotor helicopter that is lifted and propelled by four rotors. Quacopter are classified as rotorcraft, as opposed to fixed wing aircraft, because there lift is generated by a set of rotors(vertically oriented propeller).

Unlike most helicopters, quadcopters use 2 sets of identical fixed pitched propellers; 2 clockwise (CW) and 2 counter-clockwise (CCW). These use variation of RPM to control lift and torque. Control of vehicle motion is achieved by altering the rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics.

Early in the history of flight, quadcopter (referred to as 'quadrotor') configurations were seen as possible solutions to some of the persistent problems in vertical flight; torque-induced control issues (as well as efficiency issues originating from the tail rotor, which generates no useful lift) can be eliminated by counter-rotation and the relatively short blades are much easier to construct. A number of manned designs appeared in the 1920s and 1930s. These vehicles were among the first successful heavier-than-air vertical take off and landing (VTOL) vehicles.[2] However,early prototypes sufferedfrompoorperformance, and latter prototypes required too much pilot work load, due to poor stability augmentationand limited control authority.

More recently quadcopter designs have become popular in unmanned aerial vehicle (UAV) research. These vehicles use anelectronic control system and electronic sensors to stabilize the aircraft. With their small size and agile maneuverability, these quadcopters can be flown indoors as well as outdoors.

There are several advantages to quadcopters over comparably-scaled helicopters. First, quadcopters do not require mechanical linkages to vary the rotor blade pitch angle as they spin. This simplifies the design and maintenance of the vehicle. Second, the use of four rotors allows each individual rotor to have a smaller diameter than the equivalent helicopter rotor, allowing them to possess lesskinetic energy during flight. This reduces the damage caused should the rotors hit anything. For small-scale UAVs, this makes the vehicles safer for close interaction. Some small-scale quadcopters have frames that enclose the rotors, permitting flights through more challenging environments, with lower risk of damaging the vehicle or its surroundings.

2. Motivation

We realize that the quadcopter is a well-researched topic and models like the one wewish to design have already been implemented. So we intend this project to be solely foreducational purposes. We believe that we will gain tremendous knowledge about micro-controllers and control systems via this project. We will also learn a lot about ightdynamics and aero-modelling. Last but not the least, it is extremely exciting to build adevice that can y! Also we realize that once the quadcopter has taken ight, there area number of uses that we can put it too.

3. Preliminary Approach

In this section, we will discuss the mechanics of ight control. The quadcopter'smovementis controlled by varying the relative thrusts of each of the 4 rotors. These rotors are alignedin a diamond. Motors on one diagonal rotate in the clockwise direction and on the otherin the anti-clockwise direction.

• Moving forward

To move forward we reduce the power in the front motor. This tilts the quadcopterforward and the rotors provide su_cient thrust to move forward. Speed is decidedby the power given to the rotors.

• Moving back

To move backwards we reduce the power in the back rotor, tilting the quadcopterbackwards and then again the thrust from the motors takes it in reverse.In addition to this, the quadcopter has 3 degrees of freedom namely:5

1. Yaw

Yaw (turning left and right) is controlled by turning up the speed of the regular rotating motors and taking away power from the counter rotating; by taking away the same amount that you put in on the regular rotors produces no extra lift (it won't go higher) but since the counter torque is now less, the quadcopter rotates and control becomes a matter of which motor gets more power and which one gets less.

2. Roll

Roll (tilting left and right) is controlled by increasing speed on one motor and lowering on the opposite one.

3. Pitch

Pitch (moving up and down, similar to nodding) is controlled the same way as roll, but using the second set of motors.

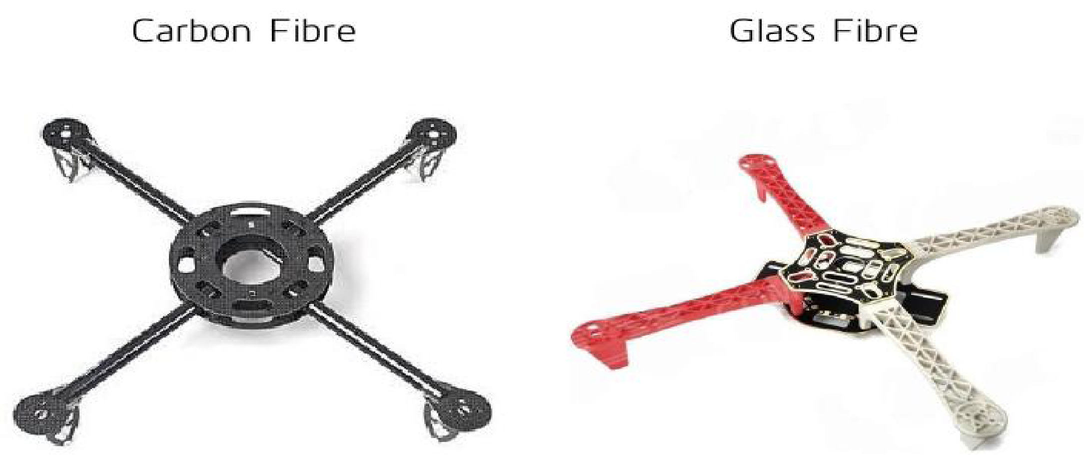
4. Hardware

4.1 Frame

A frame is a structure that holds all the components together. It should be rigid, and beable to minimize the vibrations induced by the motors. Our quadcopter frame consists
of three parts:

- The centre plate where the electronics and batteries are mounted
- Four arms connecting to the centre plate
- Four motor brackets attaching the motors to the end of the arms

We have chosen carbon _bre frame since its beginner friendly and due to the smallsize of the frame, the cost is also reasonable.



4.2Motors

We have used brushless motors. Ordinary DC motors have coils and magnets which areused to drive the shaft. They have a brush on the shaft which takes care of switching thepower direction in the coils. Brushless motors don't have this brush. Instead they havecoils on the inner side (centre) of the motor, which is _xed to the mounting.On the outer side, they contain a number of magnets mounted to a cylinder that isattached to the rotating shaft. So, the coils are _xed which means wires can go directly

Figure 1: Types of frames

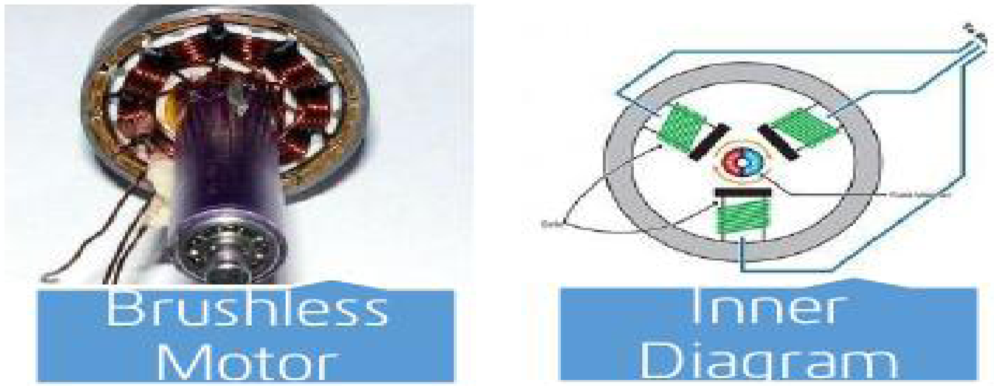


Figure 2: Types of motors

to them and therefore there is no need for a brush. They spin at a much higher speedand use less power than DC motors (at same speed). Also there is no power loss due tobrush transition.Brushless motors come with a Kv-rating which indicates how many RPMs (Revolu-tions per minute) the motor will do if provided with V volts under no load. The RPMscan be calculated in this way: RPM=Kv _ VWe are using 1240 Kv with max power of 150 watts. These motors can provide athrust of 400 gm at 10 Amps and upto a maximam of 700 gm at 16 Amps. Thrush ofabout 250 gm (from each motors) would be sufficient for hovering.

4.3 Propellers

On each of the brushless motors there is mounted a propeller. In a quadcopter, propeller shave opposite tilts. One is for clockwise motion and one for anti-clockwise. This makesthe yaw angle stable. Propellers come in various sizes and pitch. We plan to use either1045 (10 diameter and 4.5 pitch) or 8045 (8 diameter and 4.5 pitch). These are the mostcommonly used propellers for mid-sized quadcopters. The diameter gives the area and the pitch gives active area. With same diameter andlarger pitch the propeller would generate more thrust and lift more weight but requiresmore power. A higher RPM of the propeller gives more speed and more ability but lifts less amount of weight. The power drawn by the motor increases as the effective area

Figure 3: ESC

of the propeller increases. At bigger diameter or higher pitch one will draw more powerat the same RPM, but also produces much more thrust and lift more weight. In choosinga balanced motor and propeller combination, you have to figure out what you want your quadcopter to do. If you want to y around stably with heavy objects like a camera, youwould probably use a motor that manages lesser revolutions but can provide more torqueand a longer or higher pitched propeller (which uses more torque to move more air inorder to create lift). For a quadcopter to y we need 1:2 ratio for weight and thrust. Power(watts) = Kp*D4 *P *RPM3.

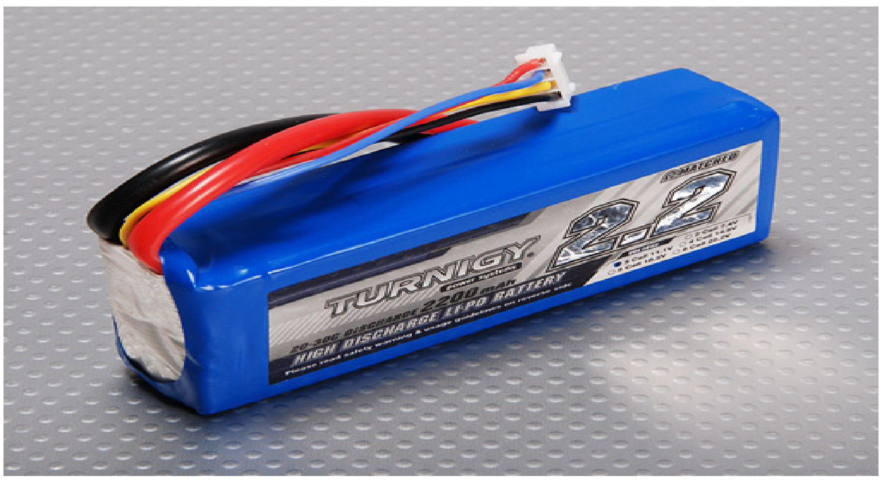
Here D is diameter, P is pitch and Kp for mid sized propellers are around 1.2

4.4 ESC { Electronic Speed Controller}

The brushless motors are normally 3 phased, so direct supply of DC power will not turnthe motors on. Electronic Speed Controllers generate three high frequency signals, with different but controllable phases, continuously to keep the motor turning.ESC has a battery input and a three phase output for the motor. Each ESC iscontrolled independently by a PPM signal (similar to PWM). The frequency of the signalsvary a lot, but for a Quadcopter it is recommended that the controller should supporthigh frequency signal, so the motor speeds can be adjusted quick enough for optimalstability (i.e. at least 200 Hz or even better 300 Hz PPM signal). We are using 30 AmpESCs with PWM control.

4.5 Battery

In Quad rotors, Lithium Polymer (LiPo) Battery is the most commonly used PowerSource because of its light weight and its high current rating. NiMH Battery is a cheaperalternative but is much heavier than LiPo Battery. A single LiPo cell can provide avoltage of upto 3.7 volt.ALiPo battery has two characteristic parameters:



1. Capacity

It is measure of how much energy is stored in battery. It is measured in mAh (Amphour). A battery with capacity of 4000 mAh can power a 0.8 kg Quad rotor for 5minutes of full throttle and 20 min of hovering.

2. Discharge rate

This is the rare at which battery can discharge. It is also called C-rate and expressedin C units. The maximum current that can be drawn from a battery is simplyproduct of Discharge rate and Capacity. A 4000mAh 30C 3S LiPo can give up to120 Amps of maximum current. The specifications of the battery we are using are as follows -

Capacity: 4000mAh

Voltage: 3 Cell / 11.1V

Discharge: 25C

4.6 IMU (Inertial Measurement Unit)

The IMU is an electronic sensor device which measures the velocity, orientation and acceleration along different directions. This sensor allows the control system to navigatethe bot in the environment. The readings of the IMU are fed to the main controllerwhich are then compared with the set points and then appropriate action is taken by themotor controller system. The IMU is a combination of a 3-axis gyroscope and a 3-axisaccelerometer, which together makes it a 6 degree of freedom sensor. Sometimes a 3-axismagnetometer is also included to get an absolute yaw control relative to the Earth's magnetic field. This makes the IMU a 9 degree of freedom sensor.

4.6.1 Components of the IMU

1. Accelerometer

The accelerometer measures the acceleration relative to the gravitational force. So,the 3-axis accelerometer basically gives us components of acceleration in all the 3directions. It can be used to measure the orientation, vibration and shock and henceis critical for the stability of the Quad copter (in our case). The disadvantage ofonly using the accelerometer is that it may become extremely sensitive to unwantedvibrations and noise (for example motor vibrations) and may lead to instability ofthe bot.

2. Gyroscope

A gyroscope is a device which measures and maintains the orientation based on the principle of angular momentum. It measures the angular velocity i.e., how fast something is spinning about an axis as well as rotational acceleration. Unlikeaccelerometers gyroscopes are not a_ected by gravity, so they make a great complement to each other. Accelerometer measure acceleration along the specified axeswhereas Gyroscopes measure acceleration about the axes.

3. Magnetometer

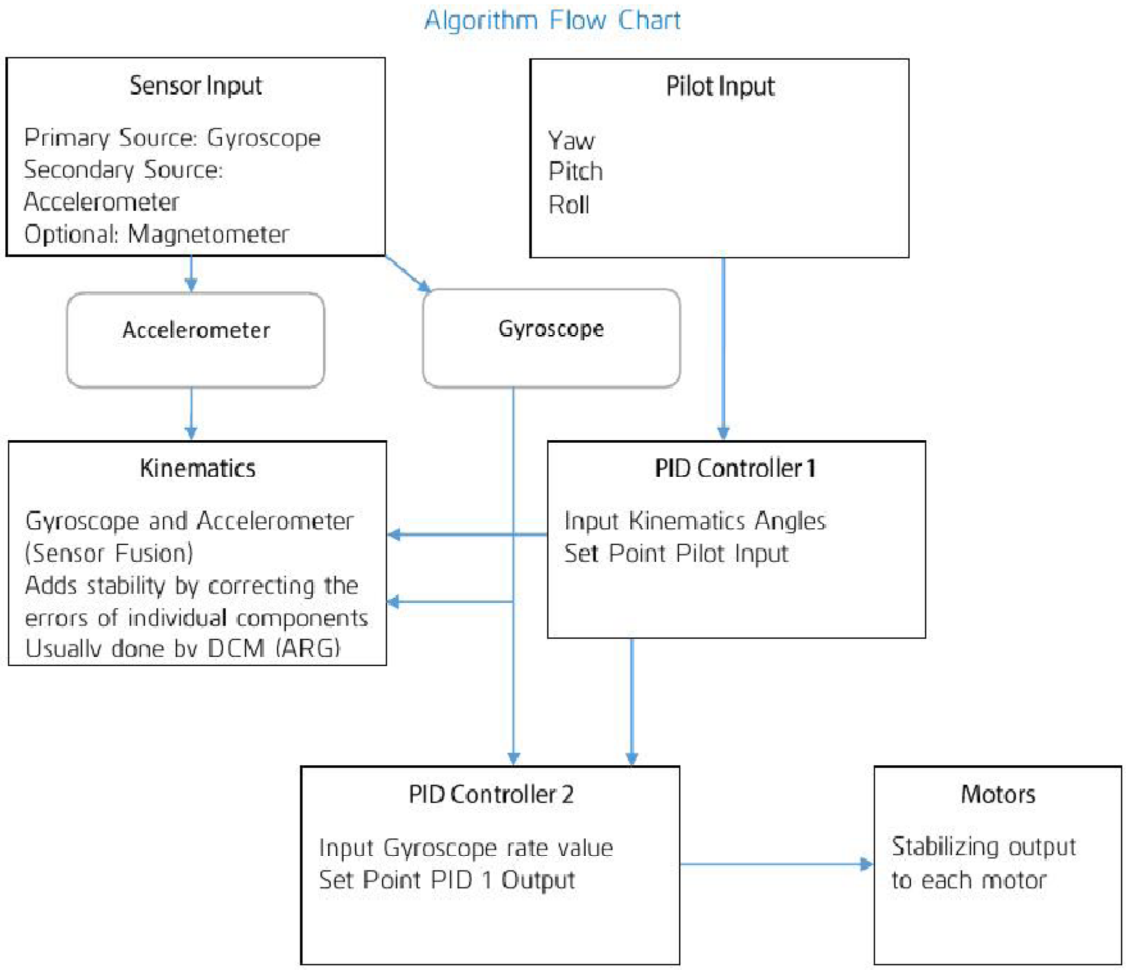
A magnetometer measures the strength and the direction of magnetic fields and hence can be used to determine the orientation of the bot with respect to Earth's magnetic field. This helps in additional Yaw stability.

4.6.2 Interface

Interfacing an IMU is one of the critical tasks since it depends on the availability ofembedded protocols in the respective microcontroller. Most of the IMUs available in themarket give output data via an analog, serial or I2C (a multi-master two wire serial bus)interface.

4.7 Shield

Shield is a PWB(Printed Wiring Board) which is used to mechanically support and electrically connect electronic components using conductive pathways(copper tracks).It consists of a non-conducting substrate, printed copper tracks and holes for attaching the Arduino and other components (using screws & nuts). The substrate provides enduring _rmness to the connections involving the Arduino which is being stacked over byother components. The motive being to make the whole body detachable and compact, which helps while debugging and thus, ultimately saving time.



Algorithm Flow Chart
Sensor Input
Primary Source: Gyroscope
Secondary Source:
Accelerometer
Optional: Magnetometer
Pilot Input
Yaw
Pitch
Roll
Accelerometer
Gyroscope
Kinematics
Gyroscope and Accelerometer
(Sensor Fusion)
Adds stability by correcting the
errors of individual components
Usually done by DCM (ARG)
PID Controller 1
Input Kinematics Angles
Set Point Pilot Input
PID Controller 2
Input Gyroscope rate value
Set Point PID 1 Output
Motors
Stabilizing output
to each motor

Figure :5

5. Modules

5.1 Kinematics

Right now we have raw gyroscope data and raw accelerometer data, but neither one ofthese sensor outputs give us an accurate enough estimate to be used in our stabilization algorithm. What we will do, is combine accelerometer and gyroscope outputs via complementary filters. Output from our kinematics will feature strongly suppressed noise from theaccelerometer along with the gyroscope output without the "drift".

5.2 Receiver-Transmitter

5.2.1 Obtaining Signal from Receiver

This algorithm along is illustrated in the flow chart given in figure (6)

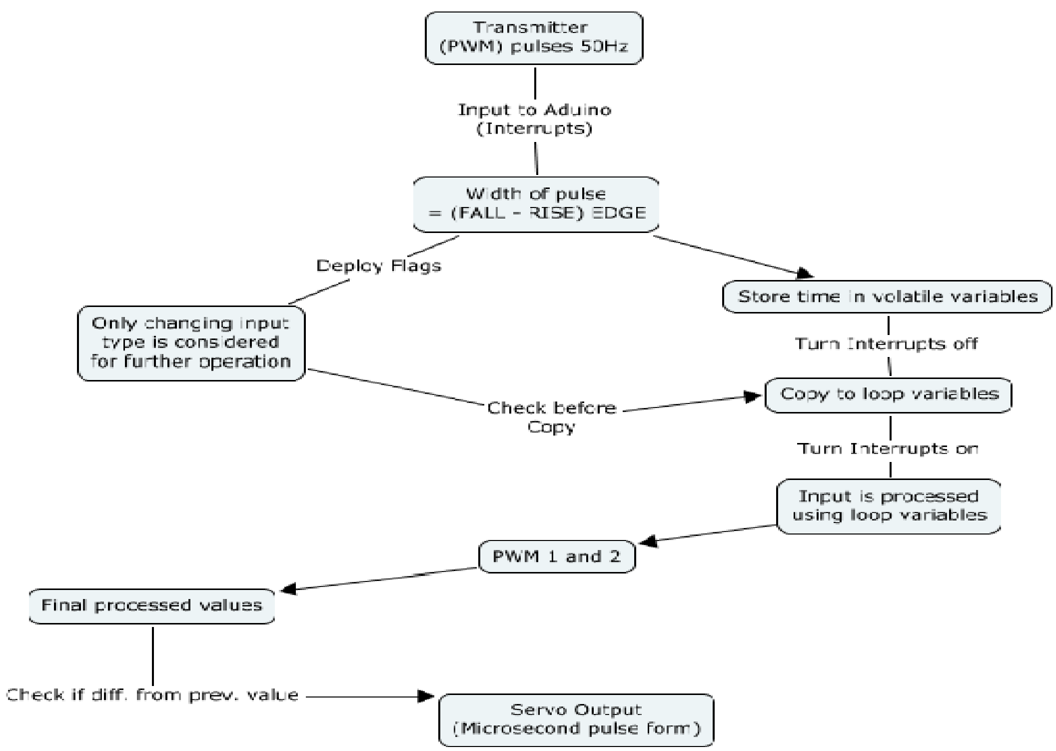


Figure 6: This is the complete block diagram for inputs from Transmitter and output to Servos

The output from Transmitter is of PWM format where the length of pulse width determines the power output to the motors (shown in figure[7]).The motors are powered through the ESCs using PWM signal which can be generated from the Arduino board using the Servo library. A servo expects a pulse of between 1and 2 milliseconds to be sent about every 20 milliseconds.We need to measure the width of input pulses from the receiver using interrupts along with the Pinch angeInt library [10]. Reasons for choosing this library are enumeratedas-1. By using the conventional functions like pulseln() or normal interrupts. We need to

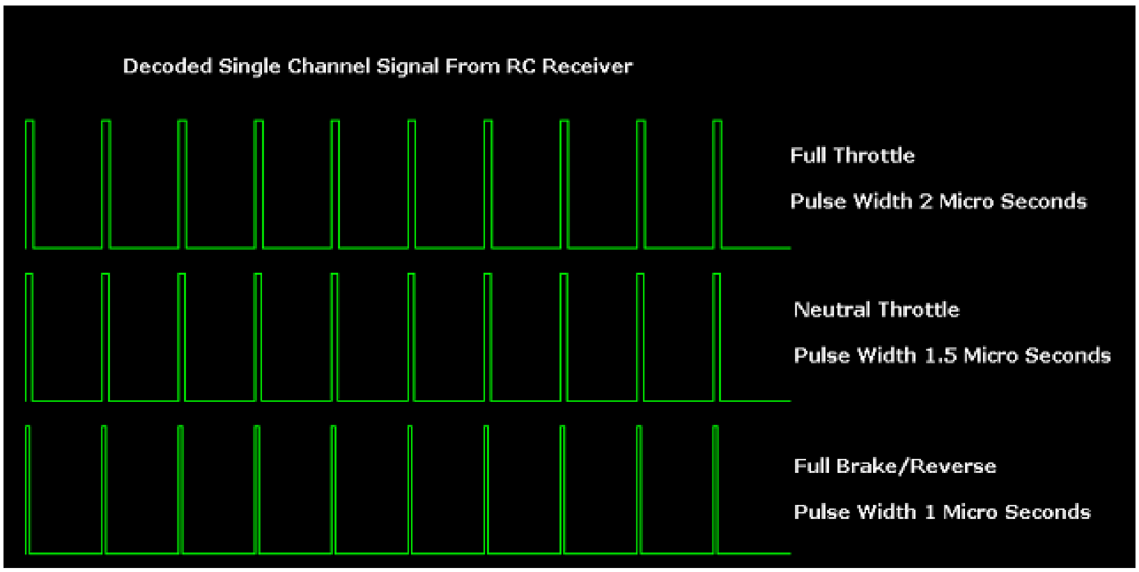


Figure 7: Types of signals obtained from Radio Receiver

stop receiving signals from the transmitter for atleast 2 milli second duration andthus, we have wasted computational power equivalent to 32,000 operations on anArduino.

2. Provides individual interrupt handler functions for upto 21 external interrupts andwe are able to use the timer function directly in the interrupt block

3. It provides the additional functionality of pin number and state to be available foraccess inside the interrupt handler

4. The Servo library for the Arduino UNO can be used for controlling upto 12 Servosat a time on a single Arduino UNO.

5.2.2 Output to Servos

We have to take into accont the following precautions before giving output to servo motors:

1. Shared variables are updated by the ISR and read by loop. Before execution of themain program loop we must immediately take local copies so that the ISR can keepownership of the shared ones and stop the interrupts2 during this copying processand immediately switch them back on so we are able to receive new signals.

2. Shared variables should be kept volatile because they are used both in main loopand ISR. The local values can be kept static and only they should be used in maincode processing.

3. Updating a servo output continuously can consume system time and power so, wehave deployed appropriate flags at transmitter inputs which change only when theincoming input varies. Thus only the changed input values are copied to servos (orused for processing in the main code)

4. The copying of the inputs to the servos will consume system time. So, we will onlystart copying when the relevant input is given and rest of the time the copying isstopped. This will increase the system efficiency manifold.

5.3 Filter

5.3.1 Converting the data to angles and filtering

We set a global frame comprising of the magnetic North, West and Zenith as the 3 axes.

This is illustrated below

5.3.2 Inputs to this block

1. Magnetometer

Provides the 3 element vector giving the (x; y; z) coordinates of global North in thebody frame

2. Accelerometer

3 element vector giving the (x,y,z) components of the acceleration in the body framewith the assumption that when hovering the reading is +g along z.

3. Gyroscope

Angular velocity components (x,y,z) of the rotation of the global frame as viewedin body frame.

5.3.3 Important Functions

1. Obtain North from magnetometer

North is obtained directly from magnetometer input reading

2. Obtain Zenith from accelerometer

To obtain Zenith we make the assumption that the quadcopter acceleration is alwaysalong the body `z'. Thus any components along the `x' and `y' axes are due togravity and this enables us to obtain the orientation of the vertical (Zenith) of theglobal frame.

3. Obtain North from gyroscope

We know the angular velocity of the zenith in the body frame. This can be used toobtain the x, y and z velocities of the Zenith vector in the body frame. Integratingthis one can obtain the coordinates of the zenith vector in the body frame.

4. Obtain West from gyroscope

Follow the exact same procedure as above

5. Obtain Thurst

Subtracting out the gravity vector from the vector formed by the accelerometer data, one can get the thrust acting along the body `z' axis.

6. Filter the data

We use a simple complimentary _lter which is a weighted average of the two inputs.We use it to filter the north obtained from the gyroscope and from the magnetometeras well as the zenith obtained from the accelerometer and the gyroscope.

7. Obtain West

This is done by simply taking a cross product of the _ltered North and Zenith directions.

8. Correct North

It may be possible that our North,West and Zenith may not be perfectly orthogonal.So we recalculate the North direction by taking a cross product of West and Zenith.At this point we have obtained the axes of the global frame in the body frame.The next step is to normalize all the vectors.

We then note that one can body `z' axis by taking the `z' components of the aboveobtained North, West and Zenith vectors and similarly for the other body axes.

9. Get the pitch angle

10. Get the roll angle

This algorithm along is illustrated in the flow chart given in figure (8)

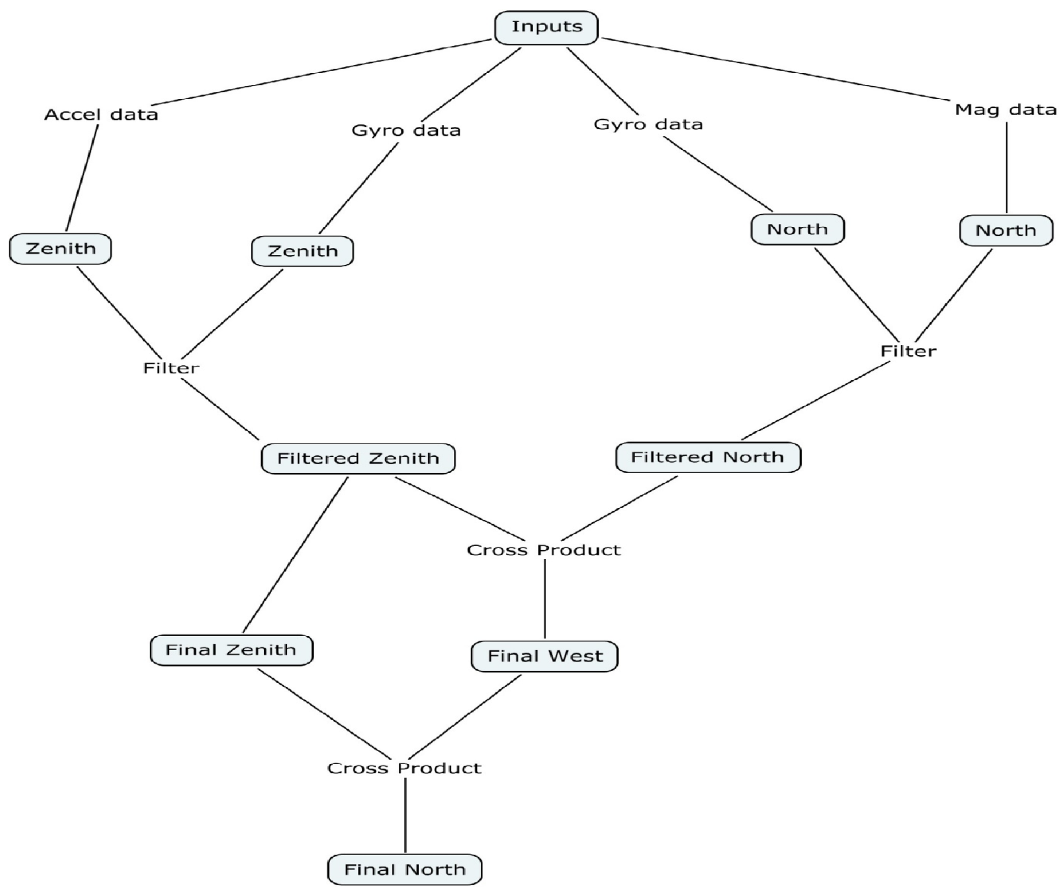


Figure 8: This is the block diagram for

5.4 First PID

From the diagram below you can see that our first PID controller will take output from our pilot as "Set Point" and kinematics (containing current estimation of yaw, pitch and roll angles) as input.

Output from our first PID controller will contain the angle desired by pilot +- currentkinematics angle. This acts like an "accelerant" for the second PID. In this case "accelerant" means that the value from our first PID controller willdetermine how "fast" we want to correct for the current stabilization error. We are directly controlling Thrust and Yaw angular velocity but for pitch and roll weneed to have a control on angle as piloting by giving angular velocity is a very difficult. To do this we implement control of roll and pitch in two steps. There are two PID loops running here:

1. Roll (angle) PID

Input - Roll angle from filter

Set point - Roll angle from Receiver

Output - Set point for Roll(velocity) PID

2. Pitch (angle) PID

Input - Pitch angle from filter

Set point - Pitch angle from Receiver

Output - Set point for Pitch(velocity) PID

5.5 Second PID

The second PID controller takes the "accelerant" from the first PID and Receiver as "SetPoint" and current gyroscope output (gyro Rate) and Thrust from filter as input.

The resulting output from the second PID controller is the decimal value representingforce that has to be applied to each of the axes to correct for the stabilization error. In our case this force is generated by spinning propellers, and can be controlled byadjusting the speed of the rotating propellers. There are four PID running controlling one degree of freedom each.

1. Roll (velocity) PID

Input - Roll velocity from Gyroscope

Set point - Output of Roll(angle) PID

Output - U2 (PID sum controlling Roll)

2. Pitch (Velocity) PID

Input - Pitch velocity from Gyroscope

Set point - Output of Pitch(angle) PID

Output - U3 (PID sum controlling Pitch)

3. Thrust PID

Input - Thrust from Filter

Set point - Thrust from receiver

Output - U1 (PID sum controlling Thrust)

4. Yaw (velocity) PID

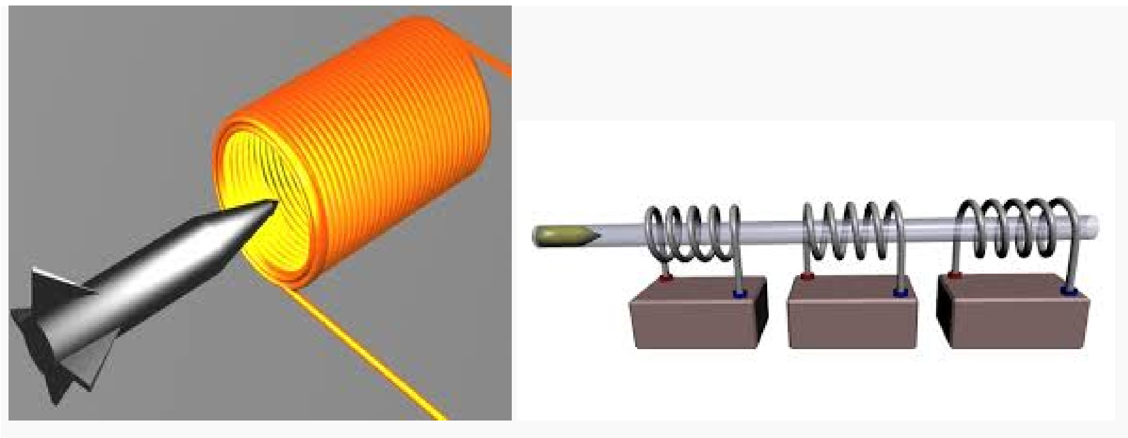
Input - Yaw velocity from Gyroscope

Set point - Yaw angular velocity from Receiver

Output - U4 (PID sum controlling Yaw)

6.Electromagnetic Gun

6.1 ELECTROMAGNETIC COIL:-



An **electromagnetic coil** is an electrical conductor such as a wire in the shape of a coil, spiral or helix. Electromagnetic coils are used inelectrical engineering, in applications where electric currents interact with magnetic fields, in devices such as inductors, electromagnets, transformers, and sensor coils. Either an electric current is passed through the wire of the coil to generate a magnetic field, or conversely an external *time-varying* magnetic field through the interior of the coil generates an EMF (voltage) in the conductor.

A current through any conductor creates a circular magnetic field around the conductor due to Ampere's law. The advantage of using a coil shape is that it increases the strength of magnetic field produced by a given current. The magnetic fields generated by the separate turns of wire all pass through the center of the coil and add (superpose) to produce a strong field there. The more turns of wire, the stronger the field produced. Conversely, a *changing* external magnetic flux induces a voltage in a conductor such as a wire, due to Faraday's law of induction. The induced voltage can be increased by winding the wire into a coil, because the field lines intersect the circuit multiple times.

The direction of the magnetic field produced by a coil can be determined by the right hand grip rule. If the fingers of the right hand are wrapped around the magnetic core of a coil in the direction of conventional current through the wire, the thumb will point in the direction the magnetic field linespass through the coil. The end of a magnetic core from which the field lines emerge is defined to be the North pole.There are many different types of coils used in electric and electronic equipment.

ADVANTAGES:-

- Small-scale quad -copters have frames that enclose the rotors, permitting flights through more challenging environments, with lower risk of damaging the vehicle or its surroundings.
- Small-scale UAV's makes the vehicles safer for close interaction.
- Quadcopters do not require mechanical linkages to vary the rotor blade pitch angle as they spin. This simplifies the design and maintenance of the vehicle.
- The use of four rotors allows each individual rotor to have a smaller diameter than the equivalent helicopter rotor, allowing them to possess less kinetic energy during flight.

DISADVANTAGE:-

- The most significant problem to date have been an ambitious development schedule coupled with very limited funds.
- The ambition is followed by complexity in calculation and designing.

6.2 Projector:-

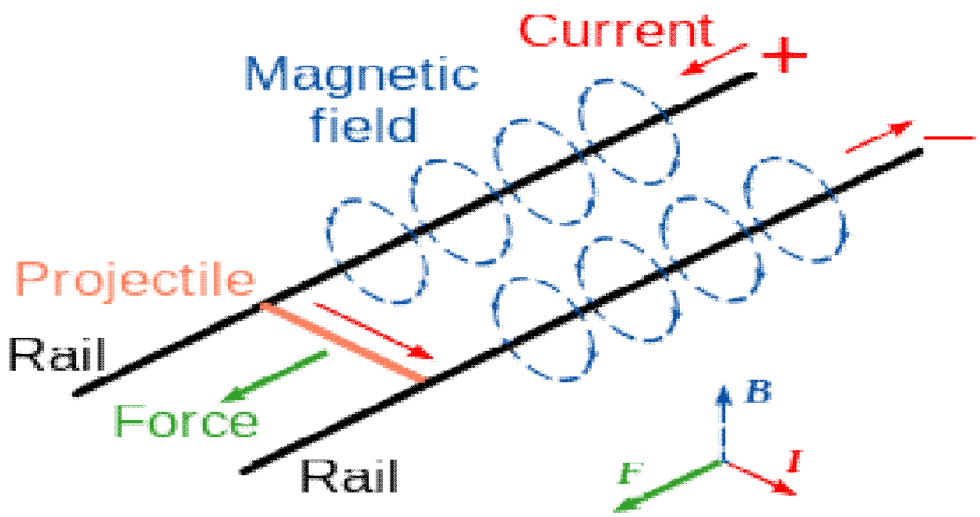


Figure. 7.2 Schematic diagram of a rail gun

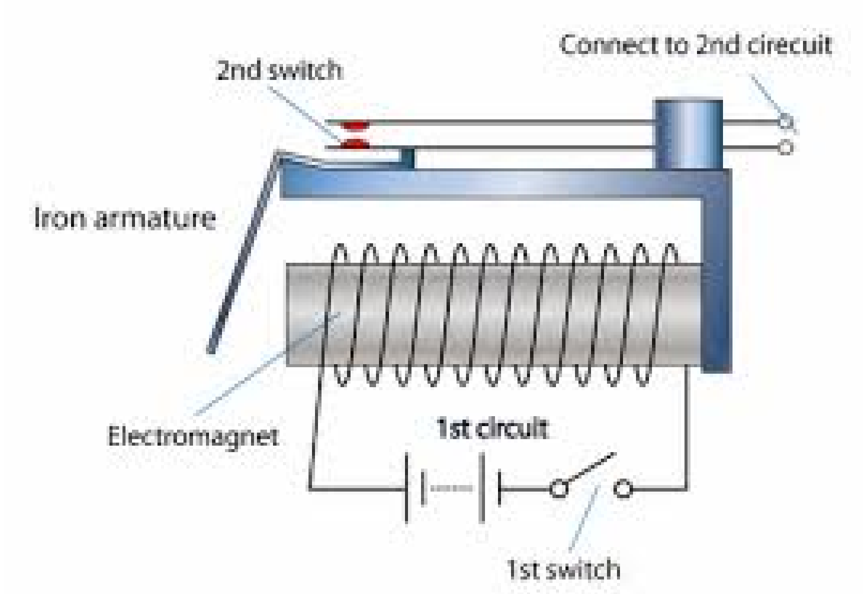
The armature may be an integral part of the projectile, but it may also be configured to accelerate a separate, electrically isolated or non-conducting projectile. Solid, metallic sliding conductors are often the preferred form of rail gun armature but "plasma" or "hybrid" armatures can also be used. A plasma armature is formed by an arc of ionised gas that is used to push a solid, non-conducting payload in a similar manner to the propellant gas pressure in a conventional gun. A hybrid armature uses a pair of "plasma" contacts to interface a metallic armature to the gun rails. Solid armatures may also "transition" into hybrid armatures, typically after a particular velocity threshold is exceeded.

In its simplest (and most commonly used) form, the rail gun differs from a traditional homo polar motor in that no use is made of additional field coils (or permanent magnets). This configuration is thus a self-excited linear homo polar motor formed by a single loop of current. A relatively common variant of this configuration is the **augmented railgun** in which the driving current is channelled through additional pairs of parallel conductors, arranged to increase ("augment") the magnetic field experienced by the moving armature.[5] In electric motor terminology, augmented railguns are usually series-wound configurations.

A rail gun requires a pulsed, direct current power supply. For potential military applications, rail guns are usually of interest because they can achieve much greater muzzle velocities than guns powered by conventional chemical propellants. Increased muzzle velocities can convey the benefits of increased firing ranges while, in terms of target effects, increased terminal velocities can allow the use of kinetic energy rounds as replacements for explosive shells. Therefore, typical military rail gun designs aim for muzzle velocities in the range of 2000–3500 m/s with muzzle energies of 5–50 MJ. For comparison, 50MJ is equivalent to the kinetic energy of a school bus weighing 5 metric tons, travelling at 509 km/h (316 mph).[6] For single loop rail guns, these mission requirements require launch currents of a few million amperes, so a typical rail gun power supply might be designed to deliver a launch current of 5 MA for a few milliseconds. As the magnetic field strengths required for such launches will typically be approximately 10 T, most contemporary rail gun designs are effectively "air-cored", i.e. they do not use ferromagnetic materials such as iron to enhance the magnetic flux.

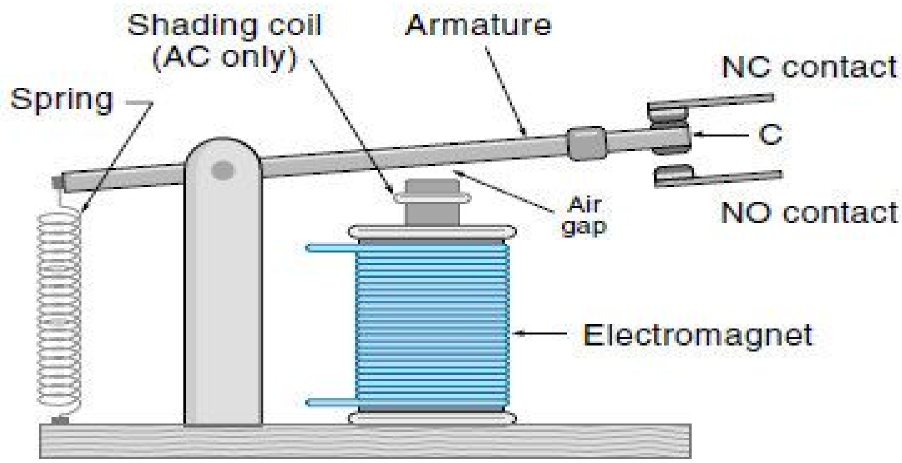
It may be noted that rail gun velocities generally fall within the range of those achievable by two-stage light-gas guns; however, the latter are generally only considered to be suitable for laboratory use while rail guns are judged to offer some potential prospects for development as military weapons. In some hypervelocity research projects, projectiles are "pre-injected" into rail guns, to avoid the need for a standing start, and both two-stage light-gas guns and conventional powder guns have been used for this role. In principle, if rail gun power supply technology can be developed to provide compact, reliable and lightweight units, then the total system volume and mass needed to accommodate such a power supply and its primary fuel can become less than the required total volume and mass for a mission equivalent quantity of conventional propellants and explosive ammunition. Such a development would then convey a further military advantage in that the elimination of explosives from any military weapons platform will decrease its vulnerability to enemy fire.

6.3 Electromagnetic Relay:-



A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

An electromagnetic relay.



(a) Parts of the relay

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

8.camera

need:

Windows Vista®, Windows® 7 (32-bit or 64-bit) or Windows® 8

Basic requirements:

- 1 GHz
- 512 MB RAM or more
- 200 MB hard drive space
- Internet connection
- USB 1.1 port (2.0 recommended)

For HD 720p video calling and HD recording:

- 2.4 GHz Intel® Core™2 Duo
- 2 GB RAM
- 200 MB hard drive space
- USB 2.0 port
- 1 Mbps upload speed or higher
- 1280 x 720 screen resolution

Warranty Information

2-year limited hardware warranty

Package Contents

- Webcam with 5-foot cable
- User documentation

Part Number

- PN 960-000585

  Technical Specifications

  The specs:

    - HD Video calling (1280 X 720 pixels) with recommended system
    - HD video capture: Up to 1280 X 720 pixels
    - Logitech Fluid Cyrstal™ Technology
    - Photos: Up to 5 megapixels (software enhanced)
    - Built-in mic with noise reduction
    - Hi-Speed USB 2.0 certified (recommended)
    - Universal clip fits laptops, LCD or CRT monitors

  Logitech webcam software:

    - Pan, tilt, and zoom controls
    - Video and photo capture
    - Face tracking
    - Motion detection

9. ESTIMATION & COSTING

SR.NO	COMPONENT	RATING	QUANTITY	COST
01.	FRAME(FIBRE)	-	01	1500
02.	PROPELLER(FIBER)	<30,8”	04	200
03.	CONTROLLER	K.K2.0	01	4000
04.	BRUSHLESS DC MOTOR	3000RPM,18KV	04	7200
05.	ECS	18AMP	04	600
06.	STAND(FIBRE)	-	01	500
07.	CAMERA		01	2000
08.	BATTERY	2200AMH	02	4400
09.	RADIAO ANTENNA(REC/TRAN)	40KHZ	02	500
10.	REMOT CONTROL		01	500
11.	ELECTROMEGNATIC COIL	6MM^2,T=250	04	800
12.	ELECTROMEGNATIC RELAY	18AMP	02	400
13.	PROJECTOR	4”,D=10MM	01	100
14.	TV TUNNER		01	1500
15.	MISCELLENOUS	-	-	1000
	TOTAL			25200

10. CONCLUSION

The project is presently in the final design stages and we have completed several tethered test flights. We have resolved several issues encountered in this project to date, and we continue to work on outstanding issues. Although a lot of work remains, we continue to be optimistic that we will complete the project on schedule. When the basic flight control systems are complete, the Quadcopter will be ready for experimental missions. At that point the project could go in a variety of directions since the platform seems to be as flexible as we initially intended. As a team, we can completely change what function it performs and we are able to integrate any technology that would prove to be useful. This project will clearly demonstrate the goals of proving that small scale UAVs are useful across a broad range of applications.

11. APPENDICES

1. UAV (Unmanned Ariel Vehicle)

2. GUI (Graphical User Interface)

3. HAE UAV ACTD (High altitude Endurance Unmanned Ariel Vehicle Advance Concept Technology Demonstrator)

4. DARPA (Defense Advanced Research Projects Agency)

5. DARO (Defense Airborne Reconnaissance Office)

6. UAS (Unmanned Ariel System)

7. DIY (Do It Yourself)

8. GPS (Global Positioning System)

9. IMU(Inertial Measurement Unit)

10. TTL (Transistor – Transistor – Level)

11. NTSC (National Television System Committee)

12. FPS (Frames Per Second)

13. BPS (Bits Per Second)

14. ESC (Electronic Speed Controller)

15. Lipo (Lithium ion Polymer

12. REFERENCE

[1] Arducopter project (model used for Flight gear simulations)

[2] http://oddcopter.com/2012/02/06/choosing-quadcopter-motors-and-props/

[3] http://www.ctn-dev.org/index.php?page=news&article=6

[4] http://www.flybrushless.com

[5] https://www.sparkfun.com/products/10724

[6] Arduino wire library

[7] Arduino Pinchange Int library