

Quad-Copter (Drone)

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A Project and Thesis submitted in partial fulfillment of the
requirements for the Award of Degree of Bachelor of
Science in Computer Science and Engineering

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This Project/internship titled “**Quad-Copter(Drone)**”, submitted by **Rajesh Das**, ID No: **172-15-10024** and **Fazla Rabbi**, ID No: **172-15-10232** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **7th Oct 2020**.

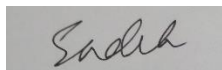
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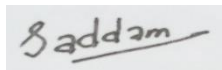
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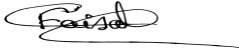
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DECLARATION

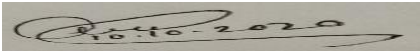
We hereby declare that, this project has been done by us under the supervision of **Mr. Fahad Faisal, Assistance Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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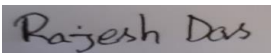
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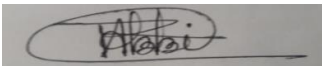


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ABSTRACT

Quad-Copter is working principle on Aerial vehicle, which can be implemented in different application. It means airplane, helicopter, etc... A Quad-Copter can achieve vertical flight in a stable manner and be used to monitor or collect data in a specific region such as loading a mass. Technological advance has reduced the cost and increase the performance of the low power Ardupilot base microcontroller that allowed the general public to develop their own Quad-Copter. The goal of this project is to build, modify, and improve an existing Quad-Copter kit to obtain stable flight, gather and store GPS data, and perform auto commands, such as auto landing and return to landing. This project develops for Agriculture field (Assisting Farmers). The Quad-Copter is controlled through Remote control/smart phone/computer etc.... Quad-Copter and communicating device communicate via wireless communication system. The Quad-Copter balancing control by APM (Ardupilot Mega) 2.6 flight controller. For smooth flying and landing it has electronic ultrasonic sensor (Accel/Gyro, Magnetometer, Barometer). All signal control and process by APM (Ardupilot Mega) 2.6 flight controller. This Quad-Copter accept load up to 2000gm during its flying time. It's flying time based on Battery performance and also, we used telemetry 2.4Gz, micro SD card and mission planner software for configuration flight controller, Brush Less Direct Current Motor (BLDC), Electric Speed Controller (ESC). When we cannot visit our field for natural disaster or bad field condition to check our harvest condition. That's why we use a Camera for video capturing and photography to check harvest condition. Camera send/store photo/video in our display device/storage device, and also, we can see live video/photo.

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CHAPTER 1

Introduction

A Quad-Copter is a type of Aerial Vehicles have large potential for performing tasks that are not easy for humans. It is also called UAV (Unmanned Aerial Vehicle). Examples: Monitoring wildlife, Defense system, inspection of high structure construction, firefighting and human rescue, Agriculture field monitoring, transporting medicine, tourism and hospitality, cinematography or videography, assisting search and rescue team. It is very useful in this purpose.

Over the last few years, we have seen increased day by day in the manufacture and sales of remote-control airborne vehicles like as Quad-Copter. These aerial-vehicle have four arms and fixed pitch propellers which are set in a “X” or “+” symbol. There is no physical connection between the environment and the Quad-Copter and no cooperation between the Quad-Copters if would have the capabilities to collaborate the number of possibilities grows even future. For example: a group of Drone would be able to efficiently and autonomously search a missing person in a large area by shearing data between. Or, the combine load capacity of a group of Quad-Copters can use to deliver medicine in remote areas.

This research is aimed at designing a real time wireless Quad-Copter that is appropriate for search and videography. Starting off with position control, additional controller logic can be implemented to counteract the forces imposed by mass connected to the Quad-Copter.

Quad-Copter Material:

2.1 Frame

Frame is a very important and basic part of a Quad-copter because it is a main infrastructure of this device. There are many more types of quad-copter frame for example: Plus, True-X, Square, Hybrid-X, Stretched-X, X-Y6A, H, V, and custom size etc. Basically, there is a 4 type of frame most popular Plus, X-Y6A, V and H. It is different design for specific different type of work for example H shape design for reaching purpose, Plus and X-Y6A design for normal operation. We are comparing two type of frame plus and X-Y6A shape Because this type of frame perfect for our working operation.

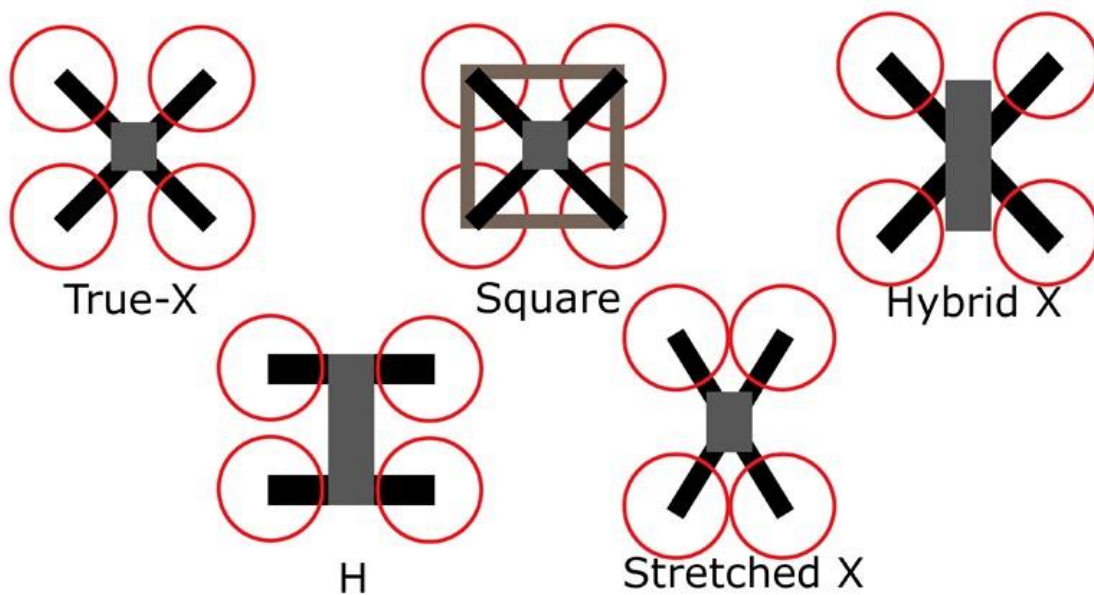


Fig 2.1.1: Type of Frame

Finally, we are select one type of frame X-Y6A this is a most popular frame and it's controlling system is very well. In this type of frame S500 model frame is the most efficient and making a frame of light weight material [1].

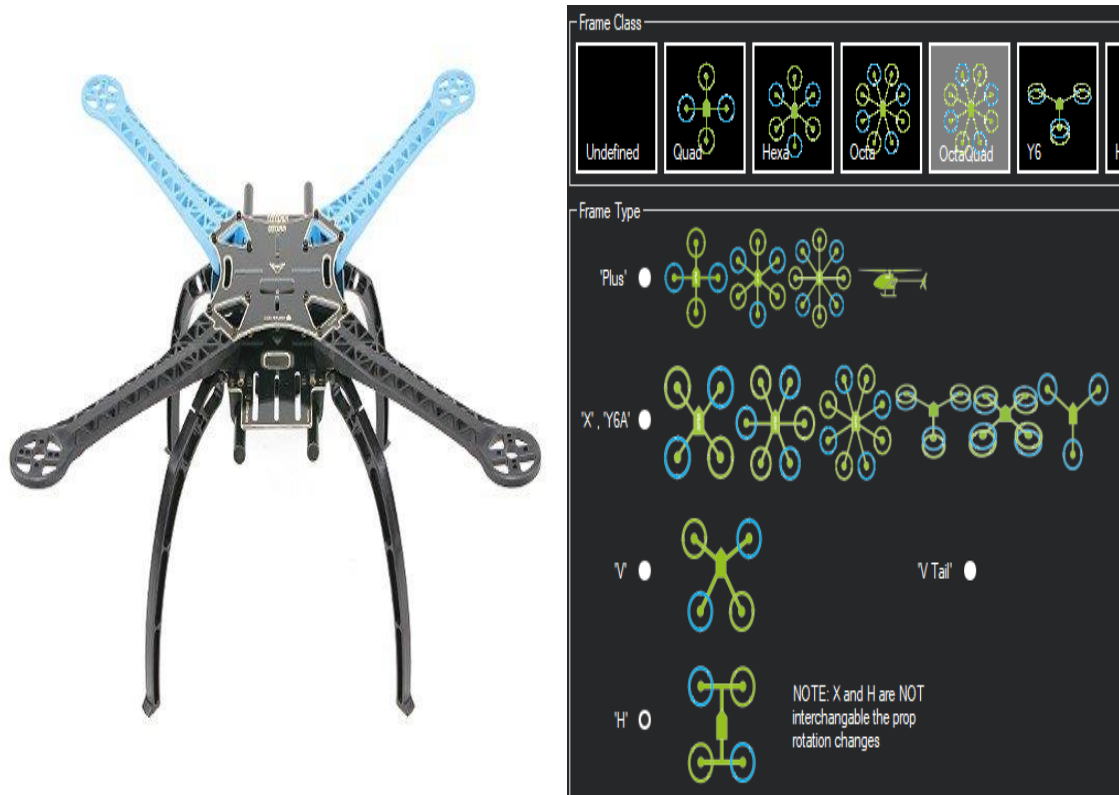


Fig 2.1.2: X-Y6A type and S500 model Frame

The frame makes carbon-fiber and high quality ultra-strength material to protect any normal crash. Is has a high-speed DC transfer PCB bord to supply DC voltage in the device. It is very light weight.

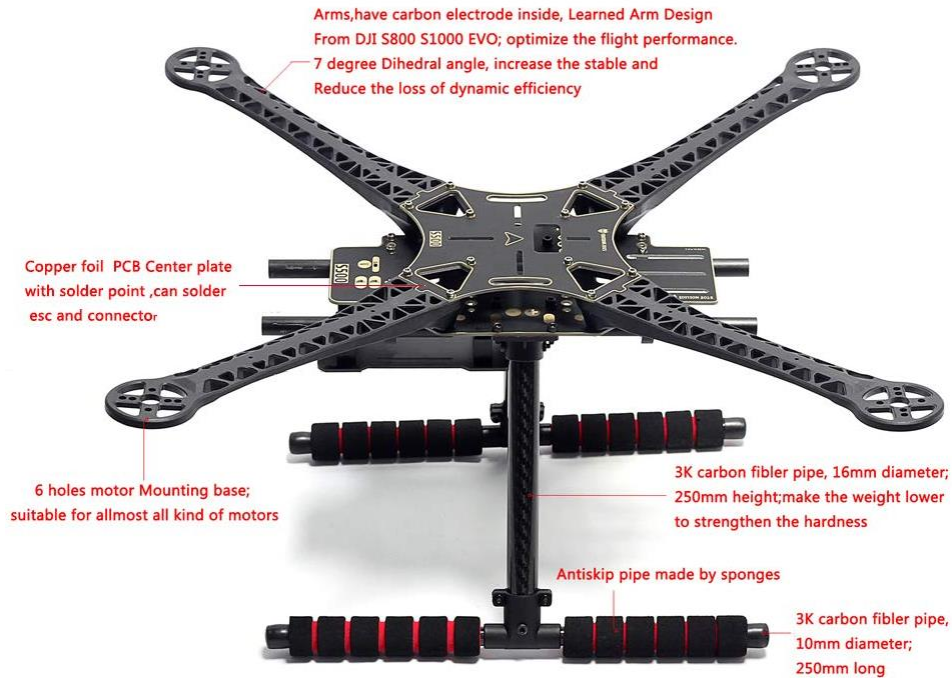


Fig 2.1.3 : Full Frame

This is a very reliable for vibration . The glass figer and corbon fiber protect the vibration in flight time. The 4 arms are equal distance in the center position. The gimbal, battery, lending gear, carema and extra component can be placed undernests the downspace. It has one specific plate to placed the battery. Every arms has 6 holes to suitable and hardly replace for allmost all kind of motors.

2.2 MOTORS



Fig 2.2.1: E-MAX Outside Runner Motor

The Brushless DC motor is the high speed motor and it designed to run form direct current power supply. There is a two type of bldc motor one is inside-runner and another is outside-runner components. Inside-runner spin or rotation only inside and outside-runner spin or rotation only outside. Bldc motor is a unversal motor it can rotation clock wise and anti clock wise. There are many more motor company available in the world EMAX is the best motor construction, low cost, better performance and realibility for Aerial vehicle and maximum aerial vehicle use in this motor [2].

We are using outside runner motor. Outside runner Brushless DC motor using permanent magnet in outer side int motor case housing and stator is the fixed. Stator arrange the sequence of the winding coil (copper wire). the stator has a coil arrangement. These windings can be arranged in star or delta connection. The stator must be choosing with

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current rating of the voltage depending on the power supply capability. For robotic, automotive and small actuating applications, 48V or less voltage BLDC motors are preferred for industrial applications and automation system. 100V or higher rating motors are used.

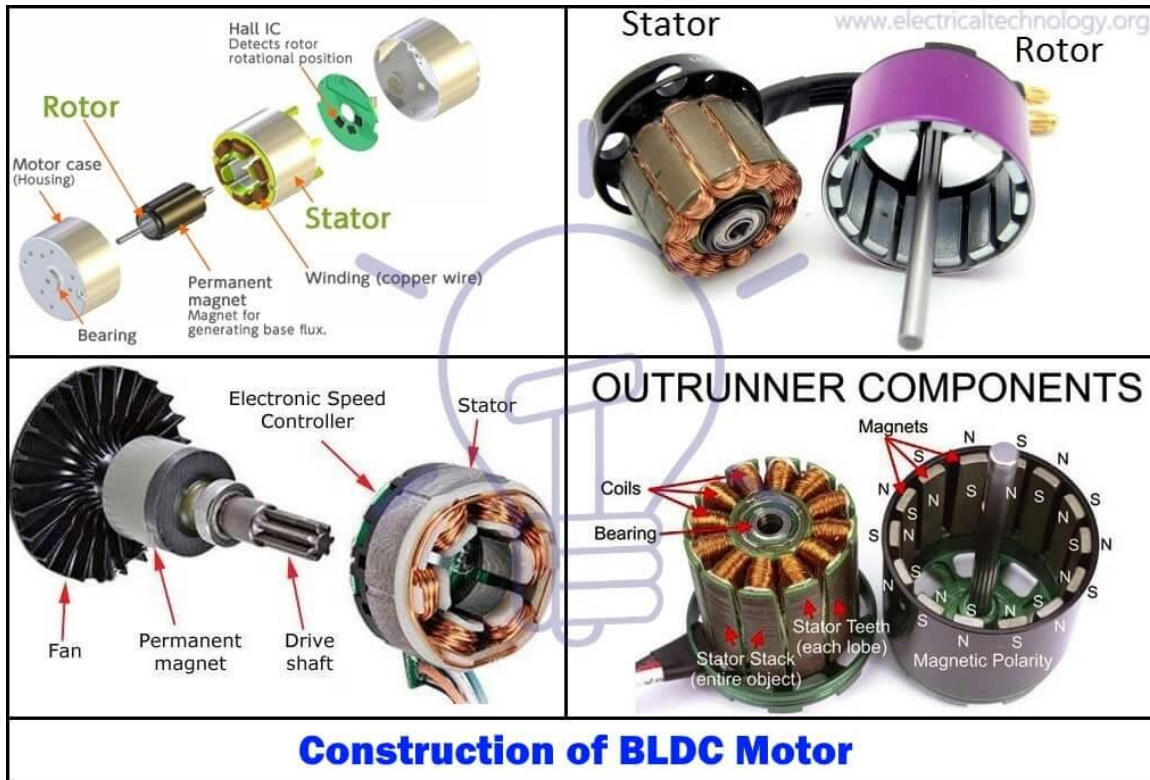
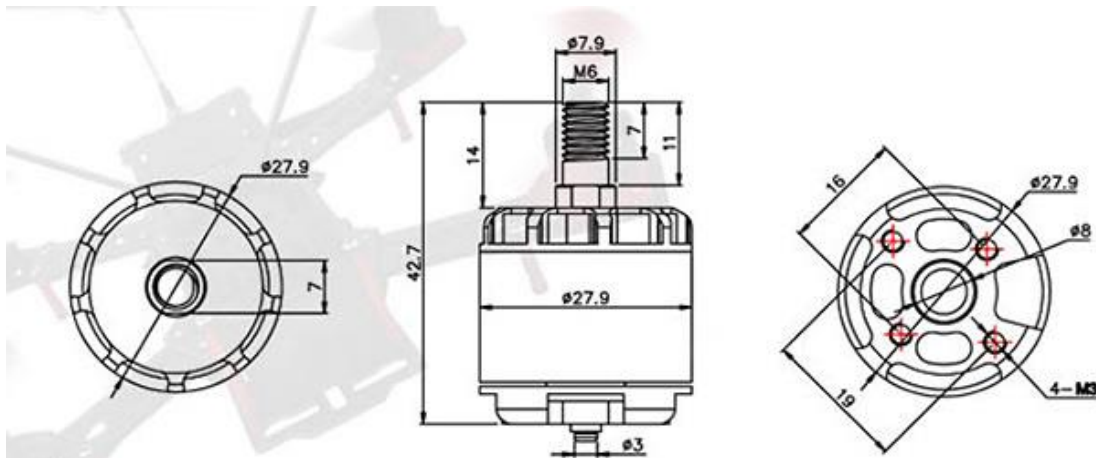


Fig 2.2.2 : Internal Diagram of BLDC

Brushless DC motor can be made in many types of physical configuration depending on the stator winding, there are configurations as single-phase, two-phase, three-phase etc. We are using a three-phase motor and this motor's permanent magnet rotor is most commonly used.

BLDC motor working principle is similar to a general DC motor and follows the Lorentz force law. Brushless DC motor contains a permanent (fixed in place) magnet on the outside.

Specification of E MAX MT-2216 motor:



Framework: 12N14P
KV: 810KV
Length: 42.7MM
Diameter: 27.9MM

No. of cells: 3-4S
Max. thrust: 950g
Shaft: 3MM
Propeller: 8"-10"
weight: 63g

Motor type	The voltage (V)	propeller size	current (A)	thrust (G)	power (W)	efficiency (G/W)	speed (RPM)
MT2216 II - 810KV	11.1	EMAX8045	6.6	480	73.3	6.5	7440
		DJI9450	7.9	600	87.7	6.8	7200
		EMAX1045	9.8	670	108.8	6.2	6620
	14.8	EMAX8045	10.5	760	155.4	4.9	9320
		DJI9450	11.8	910	174.6	5.2	8020
		EMAX1045	14.6	950	216.1	4.4	7890

Fig 2.2.3 : Motor Specification

Advantage of BLDC Motor:

- It has no use mechanical commutator
- Using permanent magnet rotor for high efficiency

- It has high speed operation
- Survive for a long time
- Less electromagnetic interference
- It has no brushes
- Power loss is very low to other motos
- Low noise
- Light weight

Disadvantage of BLDC Motor:

- It is costly
- Required to ESC
- Requires complex driver circuitry
- Need to additional sensors
- Need to high power supply
- Need to silicon wair for better performance

Electronic Speed Control (ESC)



Fig 2.3.1 : Electronic Speed Control(ESC)

An Electronic Speed Control(ESC) is na electronic circuit with the purpose to vary and electric motor's speed, its direction and possibly also to act as a dynamic brake. The electronic speed controller to control the speed of the motors how fast to spin at a given time in the Quad-copter. Perfectly are needed 4 ESC in the Quad-copter. One ecs control one motor only. One esc can be control multiple motors but, we are design one esc control one motor. ESC directly connect motor, battery and flight controler or receiver after then control the motor [3].

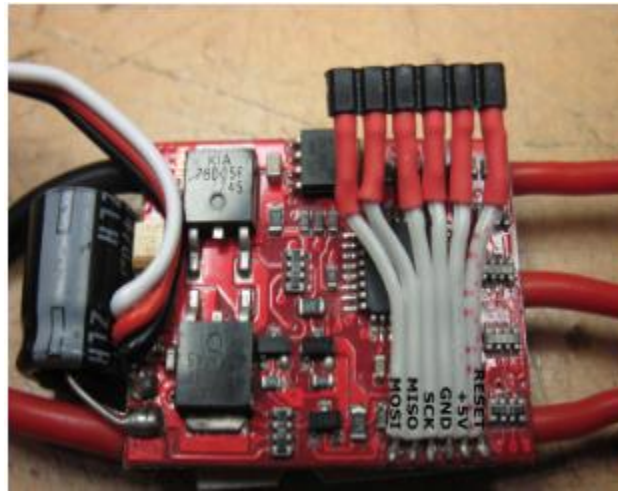


Fig 2.3.2: Electronic Speed Control(ESC) Hardware Connection

One esc has minimum 2 wire to connect battery and opsite side 6 wire, 3 wire to connect motor and 3 wire to connect flight controller or receiver another 6 pin to programming purpose. It is a programable device. We can suitable program for in our different type of operation or working purpose. 3 wire to connect motor in this wire left and right side motor power supply and clock-wise or anti clock-wise spin and middel wire for control speed or RPM in the motor.



Fig 2.3.3 : ESC Connection Diagram

Another 3 wire connect to flight controller or receiver. It has 3 types of colours: Red, yellow or white and black or gray. Red is a positive pin and black or gray is a negative pin and yellow or white is a signal pin.

Battery connecting two wires: Red and Black are connected positive and negative to connect ESC to battery and this wire must be a silicon cable because this cable transfers high rate power supply for motor. Battery voltage 11.1 for 3 cells and 14.8 for 4 cells minimum voltage. Motor connects 3 wires and sends same voltage to receive battery. This wire also uses the same silicon cable. Receiver and flight controller 3 wires are not mandatory silicon cable. This wire supplies voltage normally 5 volt positive, negative and signal. This wire receives signal to flight controller or receiver to change spin motor. This wire is an input signal from receiver or flight controller and output signal is one middle wire to connect in motor.

Battery



Fig 2.4.1 : 500mAh Lipo Battery

Lipo (lithium Polymer) is a rechargeable battery. It is most popular for light weight and high discharge rate to need of powering Quad-copter. This battery has two wiring group one is input for charging purpose another output is discharging purpose and supply voltage in the Quad-copter.

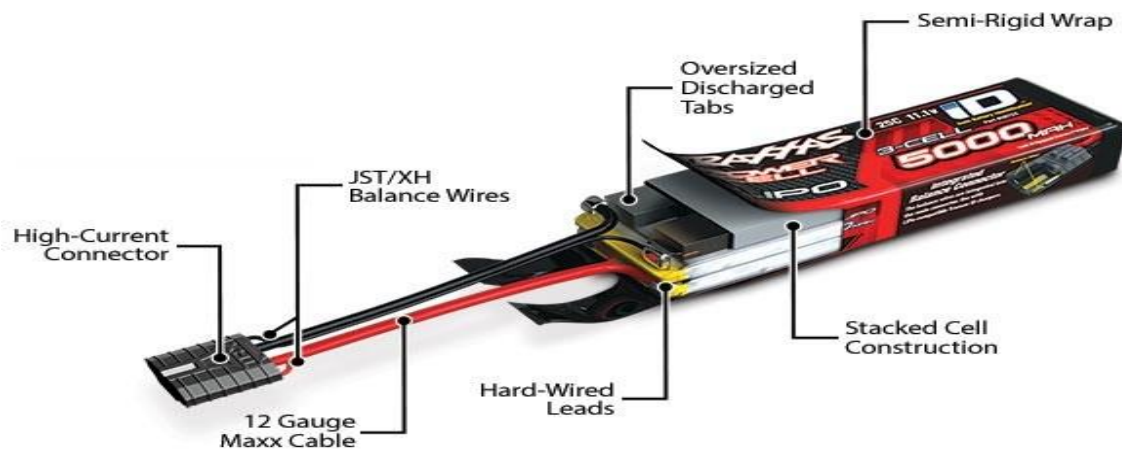


Fig 2.4.2 : Battery Connection and Specification

Lipo battery make lithium-ion and lithium-metal. This type component is vary light weight and store high energy and instance supply high rates voltage. Lipo battery lite time of only 300 to 400 charge cycles. Lipo is the high power battery so care full to connect any device because of the volatile electrolyte used in lipo they can burst or catch fire easily when mishandled.

Nicd battery cells that have a voltage of 1.2 volts per cell and lipo battery cells that have a voltage 3.7 volts per cell. We use 3 cell lipo battery than 3.7 multiply by 3 total battery voltage 11.1(3S) and we can use 4 cell battery than 3.7 multiply by 4 and total battery voltage 14.8 volt(4S) [4] [5].

Lipo battery capacity indicages or unit how much power the total battery pack can hold and it is indicated in miliamp hours(mAh) unit. 5000mAh would be completely discharged in one hours with a 5000mAh miliamp load placed on it, it would take 2 hours to drain down. If We want to more flight time use more power full capacity battery like 5000mAh.

Lipo battery all cell are usually connected series connection because we know series connection add all cell voltage and create of a large amount of voltage and we also know series connection is voltage high.

Propeller



Fig 2.5.1 : 10"/25.4 CM Propeller

There are two type of propuller clock-wise and anti clock-wise. This is a mendatory hardware for Quad-copter or RC aerial device. We want to use two edge or terminal propuller fig :2.5.1 this is a 10'' or 25.4cm propuller. Why we select the 10''/25.4 cm propuller because our quad-copter also supported maximum 10''/25.4cm propuller. A quad-copter can not fly the propuller. When motor spin with propuller after than propuller pushing the air from top to bottom continuously as a result the quad-copter flying in the sky. We use fixed size of propuller for smooth fly. Propeller make many more type of metarial for example plastic, carbon fiber, glass fiber , wood etc... we are using carbon fiber because carbon fiber is very hard and light weight. Carbon fiber can not vibration and absorb and normal damage.

Transmitter & Receiver



Fig 2.6.1 : Radio Link Transmitter

This is a Radiolink AT10-II version 2.4GHz 12 channel transmitter. We need to 2.4GHz any transmitter for support our flight controller and to direct the quad-copter and position.

A 2.4GHz Transmitter send controlling signal and 2.4GHz Receiver receive signal and forward signal from the flight controller on the air. A transmitter is a hand-held programmable controller device we use to remotely control our quad-copter or aerial vehicle. If you buy the transmitter you will get the receiver free.



Fig 2.6.2 : Identify Font Part,Stick and Switch name of Transmitter



Fig 2.6.3 : Identify Back Part,Port name of Transmitter

The transmitter have two stick one is left side another is right side. Left side control Rudder/Elevator and right side control Aileron/Throttle. Two stick is mandatory for any transmitter.

Key function:

- Model key to select model type
- End key to go back position
- LCD panel to show all type to paramitter
- Rudder trim lever to fixed Rudder
- Elevator trim lever to fixed Elevator
- Power LED to make sure to supply power
- Trinal rate switch to change the select mode

- VRA(Knob) it is use for servo
- Antenna send 2.4GHz radio signal
- Power switch to send power transmitter from battery
- Alierron/Throttle Trim lever fixed alierron/Throttle
- Dial key to change paramitter
- Cursor lever help to go one paramitter to another paramitter
- Hook to connect your ribbon

We want need any trainer or simulator easy to connect trainer or simulator function connector port. Is has 3-4s lipo battery and built in pin. we can connect 7-15V 3-4S lipo battery for better performance and long use.

It has quad-copter and any aerial vehicle battery power status to show battery power level when we are flying the aerial vehicle and show the transmitter battery level and remimber battery power signal.

Quick Guide of Transmitter basic menu:

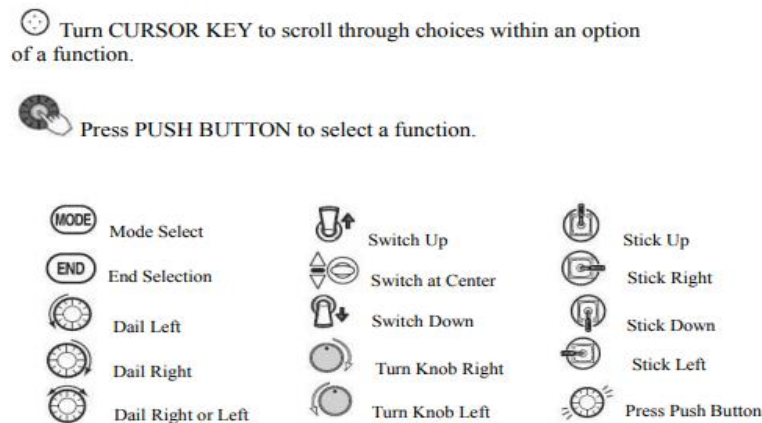


Fig 2.6.4 : Transmitter Menue Interface

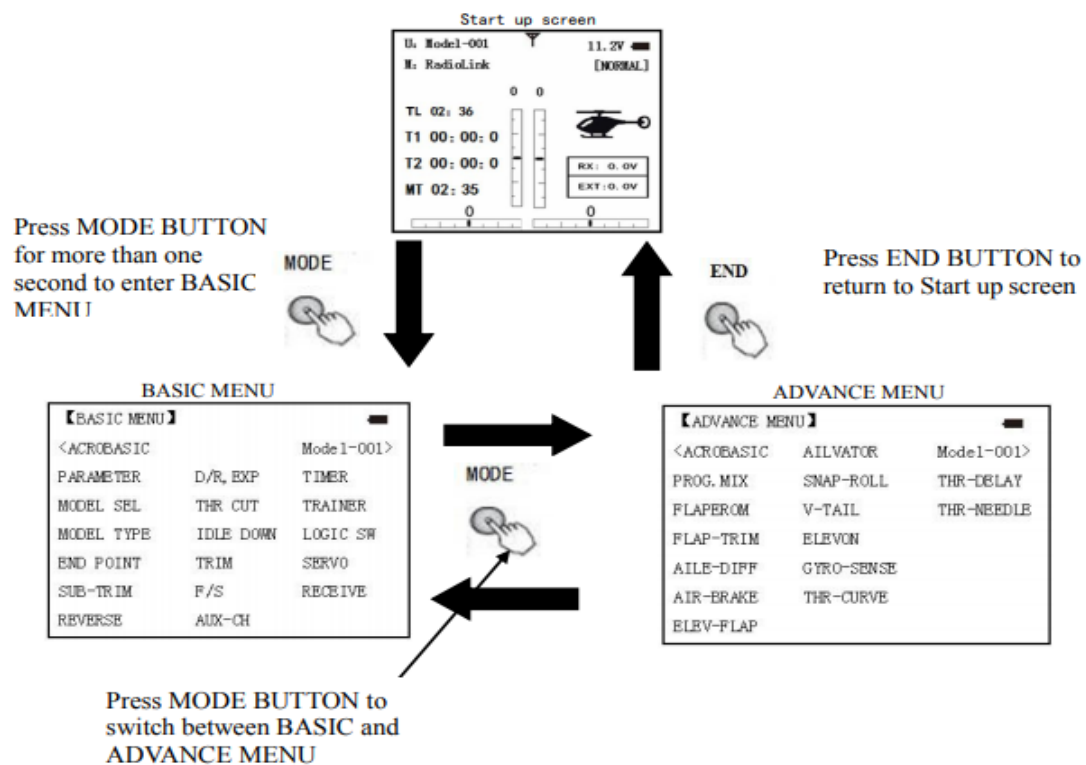


Fig 2.6.5 : Transmitter Basic and Advance Menue Interface

Model Select:

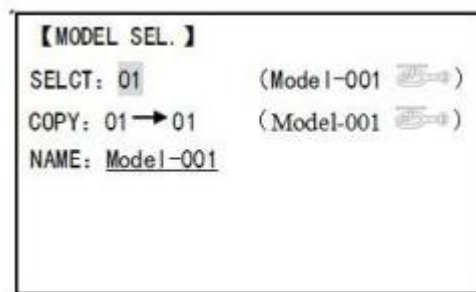


Fig 2.6.6 : Model Interface of Transmitter

Model submenu: There are three type of function that manage model memory, MODEL SELECT, MODEL COPY and MODEL NAME. Since these functions are related, and all basic features are used with most models, they are together in the Model submenu.

This transmitter has 15 different model stored in the system. Every model control different type device. We can identify very easy any model because every model has model name, model type and model number as a result we can using 15 different device control for one transmitter. We can copy data one model to another model very easy.



Fig 2.6.7 : Home Screen Display

Channels:

It has 12 channels built-in, 1-4 channel for dedicated for STK-1 to STK4 (AILE, ELEV, THRO, RUDD) channel 9-12 for servo direction and channel 5-8 for mode change and user define switch. Channel 5-12 also called AUX-CH(Auxiliary channel) switch.

【AUX-CH】	
CH5: SwG	CH1: STK1
CH6: VrA	CH2: STK2
CH7: VrC	CH3: STK3
CH8: VrB	CH4: STK4
CH9: SwB	CH11: SwD
CH10: SwA	CH12: VrE

Fig 2.6.8 : Auxiliary channel

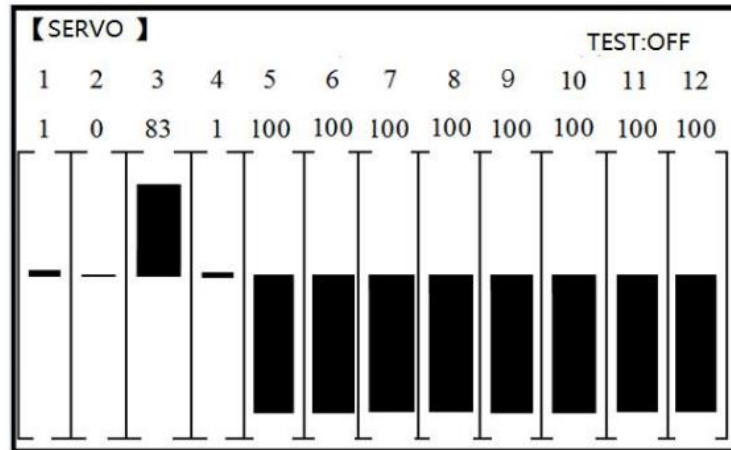


Fig 2.6.9 : Switch working simulation

We can see transmitter display our every switch and channel work or not work in the transmitter and maximum or minimum working level. We can learn in more details to go Radiolink AT10-II user manual. Link in the below

Link:

“<https://img.banggood.com/file/products/20161205031250AT10II%20user%20manual-2016.11.25.pdf>”

Receiver:



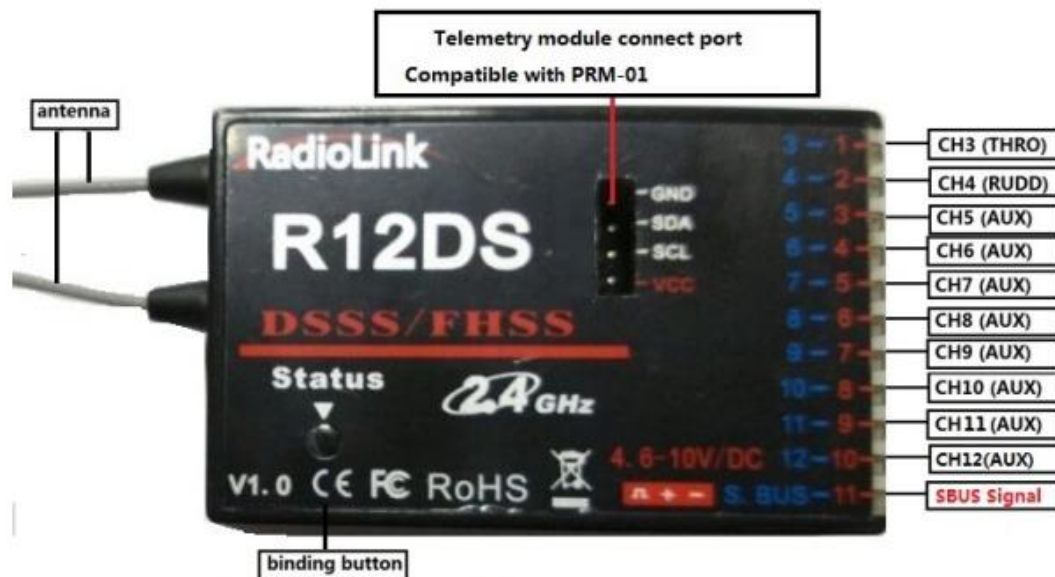
Fig2.6.10 : R12DS 12 channels RadioLink receiver

This is a 12 channels radiolink receiver it has 2.4GHz DSSS and FHSS technology that operate side by side to reduce signal interference, is a 12-channel receiver that SBUS and PWM signals output. It is compatible with radiolink transmitters AT9-AT-10II upgraded with the latest firmware.

PWM and S-BUS Signal output working mode:

Receiver indicator is Blue(Purple) with 12 channels output in total and synchronously output SBUS and PWM signal.

S-BUS signal channel (marked in BLUE) outputs 12 channels of S-BUS signal while PWM signal channels(CH3 to CH12 marked in BLUE) output PWM signals with 12 channel in total. The actual channel quantity of PWM signal output depends on that of SBUS signal output used. Eg. If 4 channels are used for SBUS signal output then there are only 8 channels of PWM signal output left.



SBUS signal working mode:

Blue/purple LED , 12 channels totally

Row 11 output SBUS signal, row 1 to row 10 output PWM signal

Fig 2.6.11 : Receiver Channel Name

Binding:

- Put the transmitter and the receiver close to each other within 50 centimeters.
- Power on the transmitter and R12DS. The RED led on R12DS will start flashing slowly.
- Switch on the transmitter and it will automatically bind to the closest receiver.
- There is a black binding button on the side of receiver. Press the button for more than 1 second and release, the RED led will flash quickly, meaning binding process is ongoing.
- When the RED led stops flashing and is always on, binding is complete.
- Verify servos connected with the receiver can be operated by the transmitter.

Note: Once upgraded with the latest firmware, the channel quantity of the transmitter(AT9/AT9S/AT10/AT10II) needs to be changed from 10 to 12 to work with R12DS, the 12 channel receiver.

Press Mode button to enter BASIC MENU => Rotate the dial to select SYSTEM and Enter => Change CH-SELECT from 10CH to 12CH.

APM (Ardupilot Mega) 2.6 flight controller board has a built-in three axis gyroscope and three acceleration sensors with self-stabilizing function which gives it a super smooth stable flight performance and it is supported all type of general receivers.

Technical Parameters:

- Channels Qty: 11 channels for PWM signal output; 12 channels for SBUS&PWM signal output.
- Operating Voltage: 4.8-10V
- Operating Current: 38-45mA (input voltage: 5V)
- Size: 50*31.5*14.5 MM (1.97"*1.24"*0.57")
- Weight: 14g (0.49oz)
- Section Precision: 4096, 0.25us per section

Radio Telemetry



Fig 2.7.1 : 2.4GHz Radio Telemetry

Radio Telemetry is a communication device. It is allowed to communicate our flight controller like APM, PIXHAWK, NAZA, multirotor device etc.... via a USB port such as a computer, any smart device to support any type of USB. The radio telemetry creates live data communication in our quad-copter. It is provided live data such as live GPS position in the google map. It also provides to system voltage, controlling system, navigation level of device and so much more, using open source MAV link-based ground station software. We can fly our quad-copter with one live joystick or controlling device and update settings through our computer and it is supported full-duplex communication and it is open source device. The firmware upgrades and configuration are fully supported in the APM Mission planner free software. Configuration is also possible through the 3DR Radio configuration and AT commands [6].

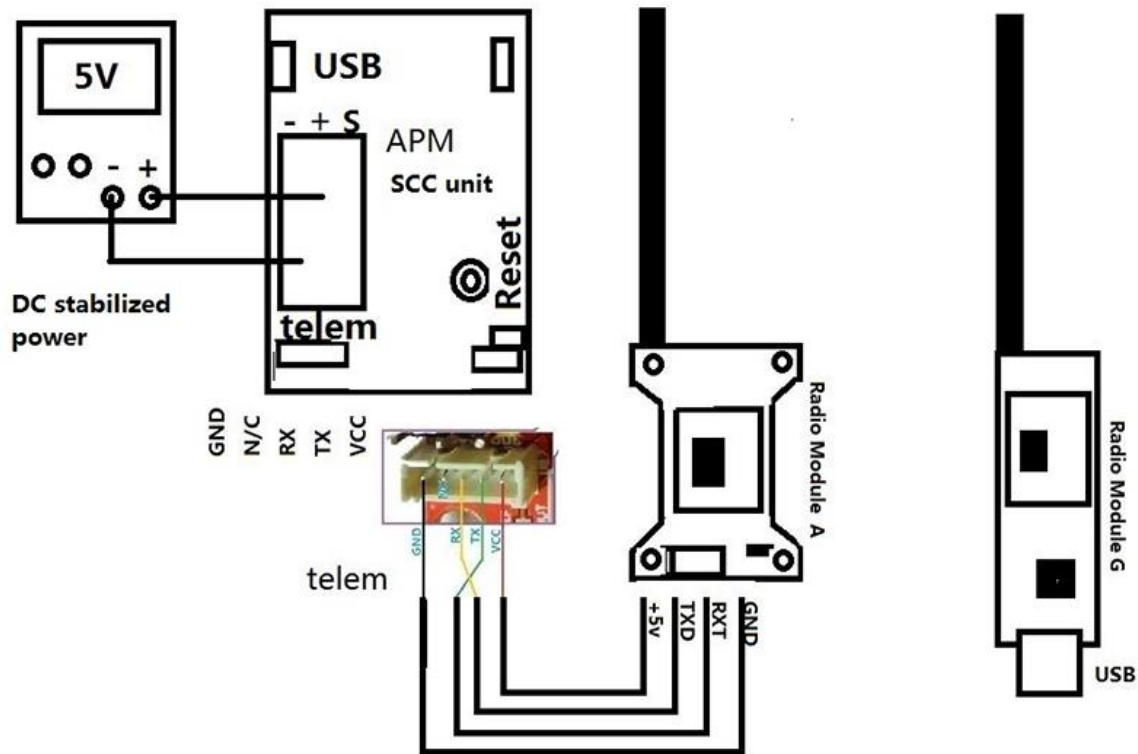


Fig 2.7.2 : Internal Circuit Diagram of Radio Telemetry

- First of all connect the device following the diagram.
- Connect the radio module in our computer system via USB port.
- Connect another radio module in the flight controller device in telemetry port.
- Open the Mission Planner and you will see the interface below.

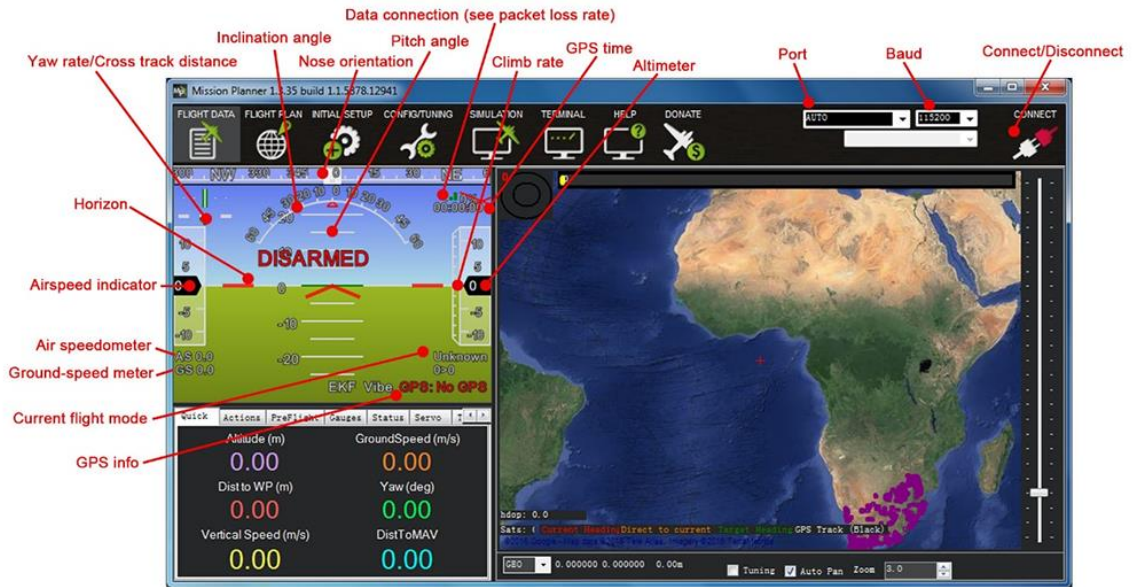


Fig 2.7.3 : Connection Mission Planner to APM in Radio Telemetry

- Choose the specific port and select 57600 as the baud rate, click connect.
- If the two modules have been connected correctly, the red light in the module will blink and the connect icon will change from red to green.

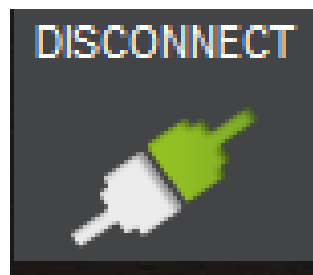


Fig 2.7.4 : Connection and Disconnection Button in Mission Planner

Flight controller and GPS Module

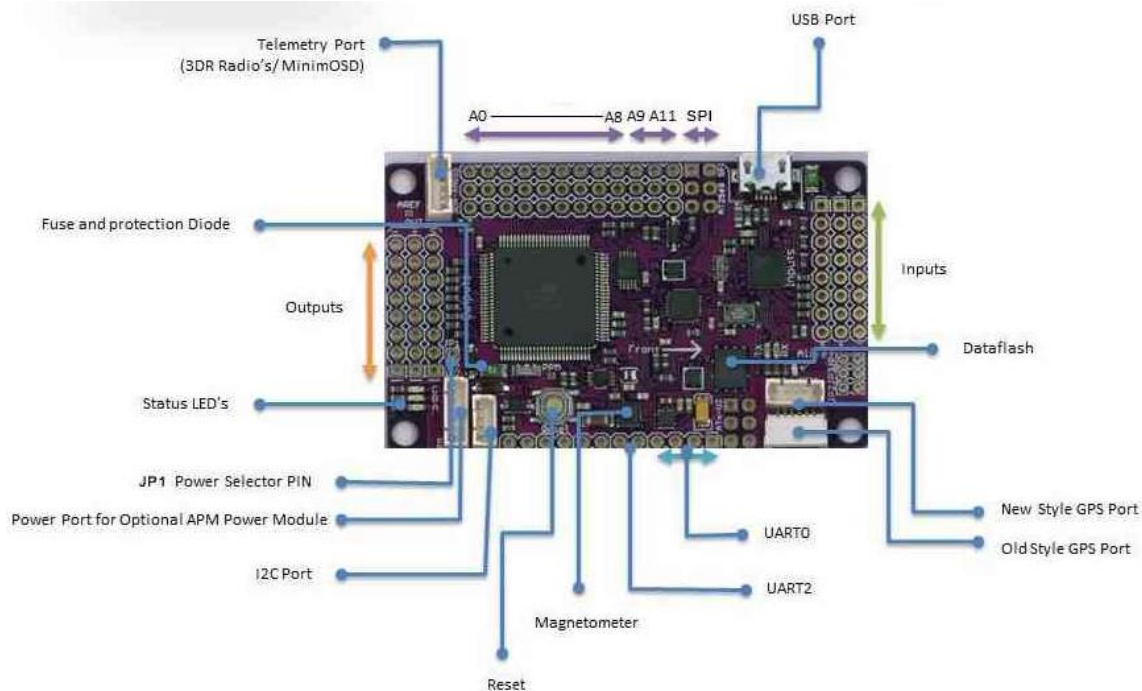


Fig 2.8.1 : APM 2.6 Flight controller

First of all, we need a central controller device to control our every part smoothly. This device also called Flight controller. APM Flight controller is a central controller device to control quad-copter. APM control Global Positioning System, Radio Telemetry, Electric Speed Controller with Motor, Servo, Gimbal with Camera. The flight controller input signal receiver and Radio Telemetry. APM (Ardupilot Mega) is a Complete open source autopilot system and we can install any and update firmware. This board has no built in compass, it is design only vehicles where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference.

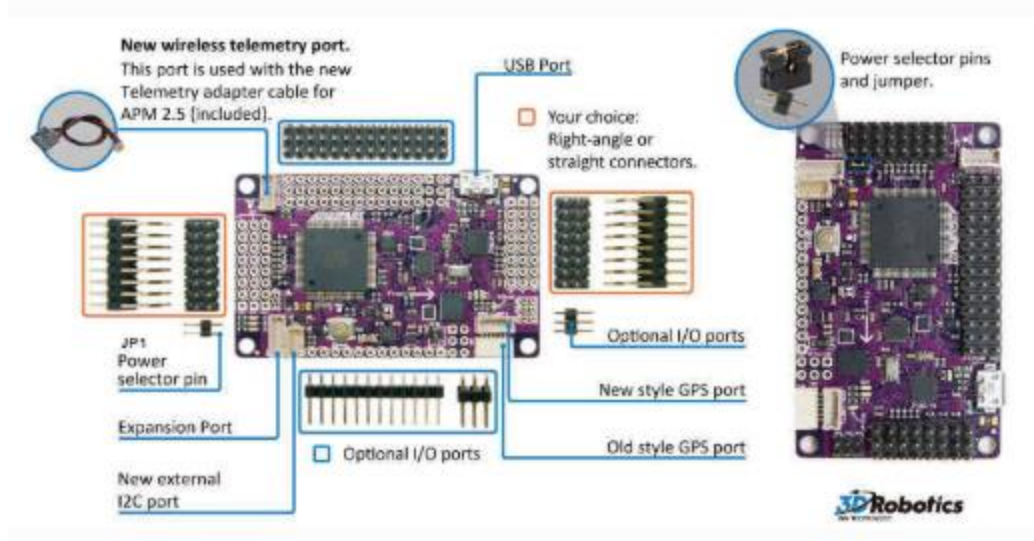


Fig 2.8.2 : Board Assembly Options

This is an APM board Assembly diagram. We are following the diagram to connect input, output and optional input-output pin. This board uses 1-3 step pin because this board has 1-3 step pin diagram, one pin for GND, middle pin for VCC and 3rd pin for Signal. It has on-board roll gyroscopes, pitch gyroscopes, and yaw gyroscopes for stabilize the quad-copter [7].

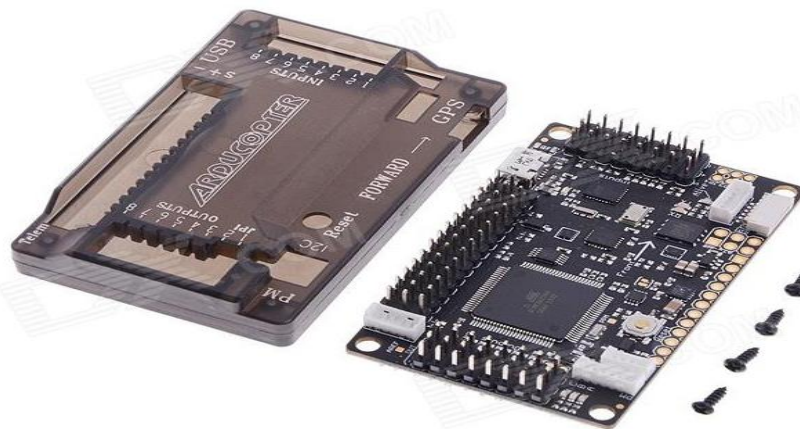


Fig 2.8.3 : Board Case in APM

Working of Gyroscopes:

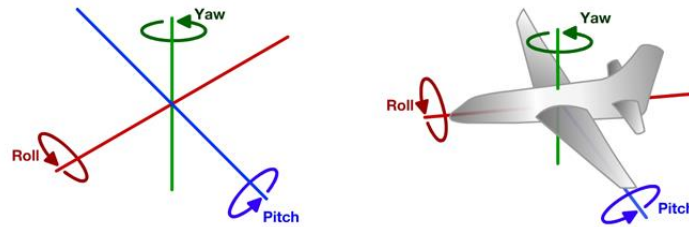


Fig 2.8.4 : Gyroscopes System

During flight aircraft can rotate freely in any dimension and this motion is defined as normal longitudinal and lateral axes. Axes is an imaginary straight line which passes through the center of gravity of an aircraft. This axis will move along with the aircraft and also rotate relative along the earth. This rotation is produced by torque. This axis is produced by moving a control surface and this varies with the center of mass of an aircraft.

Normal axis is also called as vertical axis or yaw axis. This axis is from fuselage's top to bottom which passes through the center of gravity of an aircraft. Motion of this axis is called as yaw motion. Yaw motion moves the aircraft left and right. This yawing motion is controlled by rudders. These rudders are placed on vertical stabilizers.

Second is lateral axis this axis is also called as pitch axis. Pitch axis is from one wingtip to another wingtip which passes through the center of gravity of an aircraft. Motion of this axis is called as pitching motion. This pitching motion moves the nose of aircraft up and down. This motion is controlled by elevators. These elevators are placed on horizontal stabilizers.

Lastly comes longitudinal axis. This is also called as roll axis this axis is from nose to tail which passes through the center of gravity of an aircraft. Motion of this axis is called as rolling motion. This motion moves aircraft up and down. This motion is controlled by ailerons. Ailerons are placed on the wing of an aircraft.

APM (ArduPilot Mega) Connection/wiring Diagram:

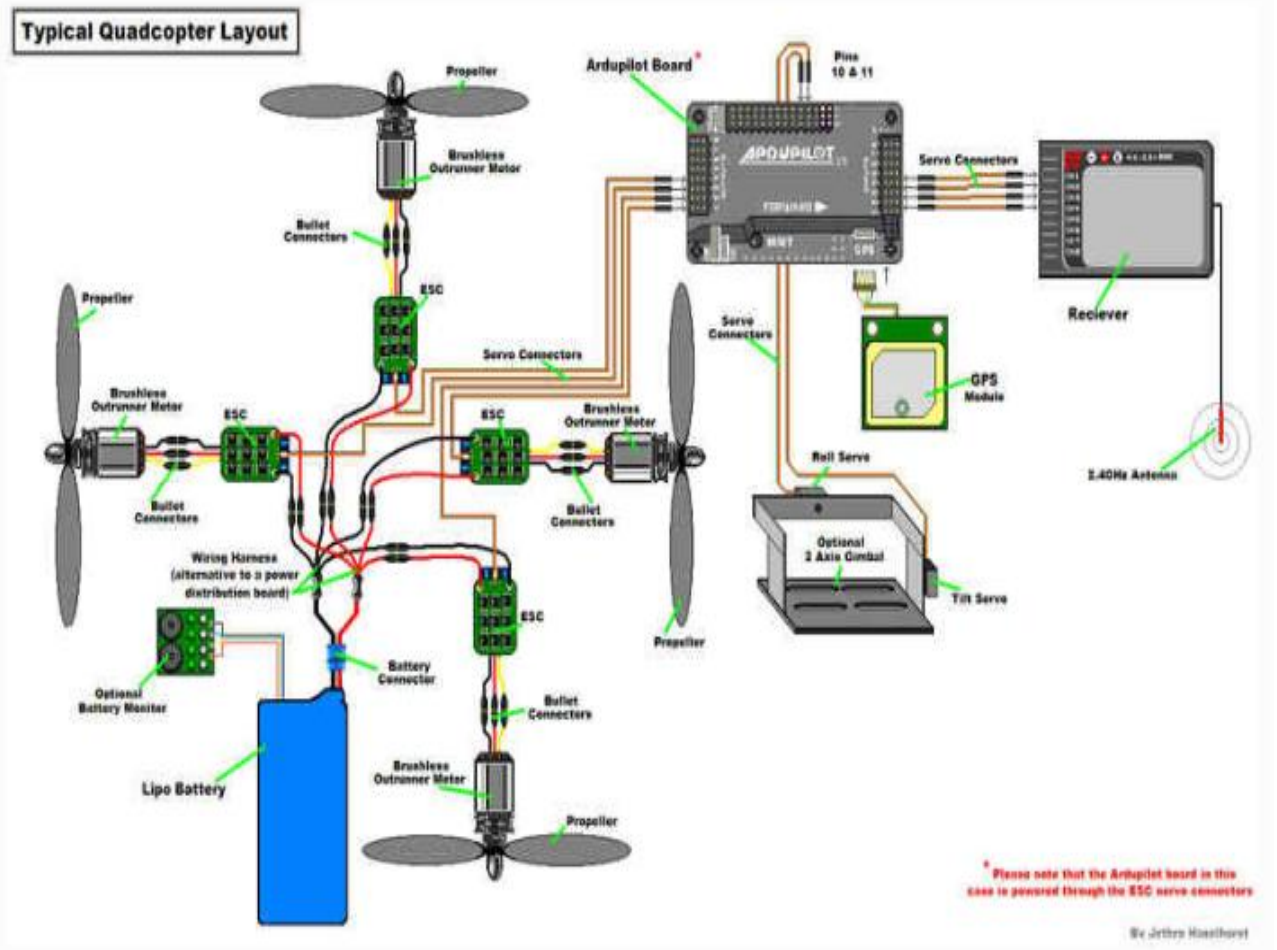


Fig 2.8.5 : APM Connection Diagram to other Element

Powering the APM:

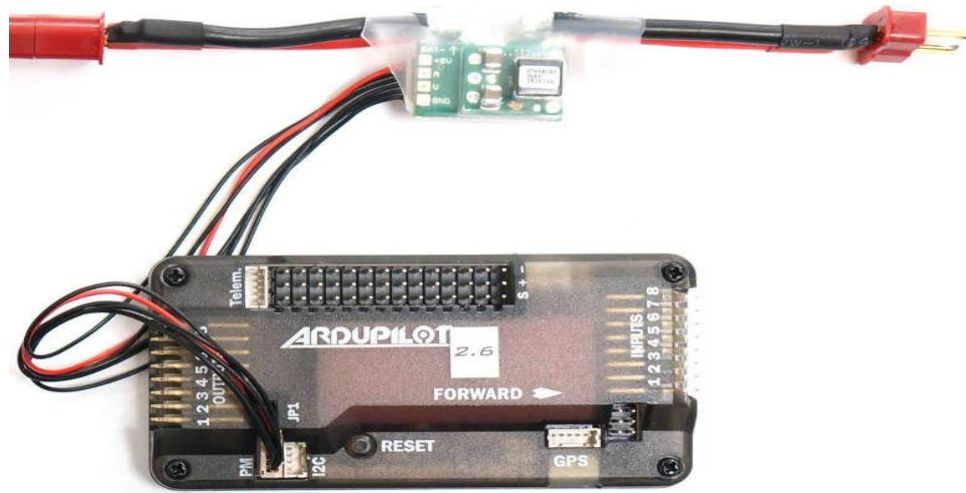


Fig 2.8.6 : Connection of APM and Power module

We know that power module supplies the power in AMP. The power module can accept 7-volt to 16-volt DC power. It has one input and two output. Input wire connect to battery source and output connect AMP and Electric Speed Controller. This device output voltage is different type 5-Volt and 7-Volt to 16-Volt. Output 6 wire for AMP and output 2 wire for Electric Speed Controller. 6 wire output voltage 5-volt power for APM, because we know that APM power voltage only 5-volts. Power module 7-Volt to 16-Volt power input and output battery source to Electric Speed Controller.

Specification:

- Maximum input voltage of 18-volt for 4-cell battery.
- Maximum of 90 Amps (cable only 60 Amps).
- Provides 5.37-volt and 2.25Amp power supply to the autopilot.

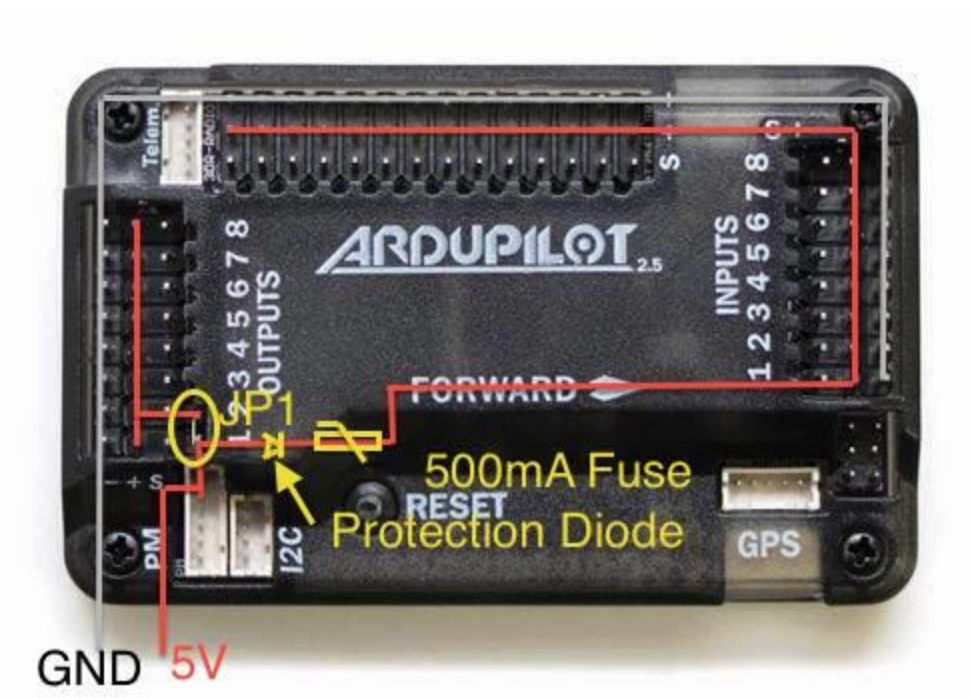


Fig 2.8.7 : APM Power Circuit

There are three type of pin in the APM. one positive pin in the center row side (show the picture in red color line), left row side that means out-side pin and it is a ground pin in the board. Right row side pin is a signal or control pin in the device. This pin control other device to connect APM.

Connecting the Radio Receiver:

There are 8 input pin or channels in the APM connect to corresponding channels of radio receiver. In the AMP 1 to 4 input channel dedicated for radio receiver another 4-input channel using for auxiliary mode switch.

1. **ROLL / AILERON**
2. **PITCH / ELEVATOR**
3. **THROTTLE**
4. **YAW / RUDDER**
5. **AUX 1 (Mode Switch)**

6. AUX 2 (optional)
7. AUX 3 (optional)
8. AUX 4 (optional)

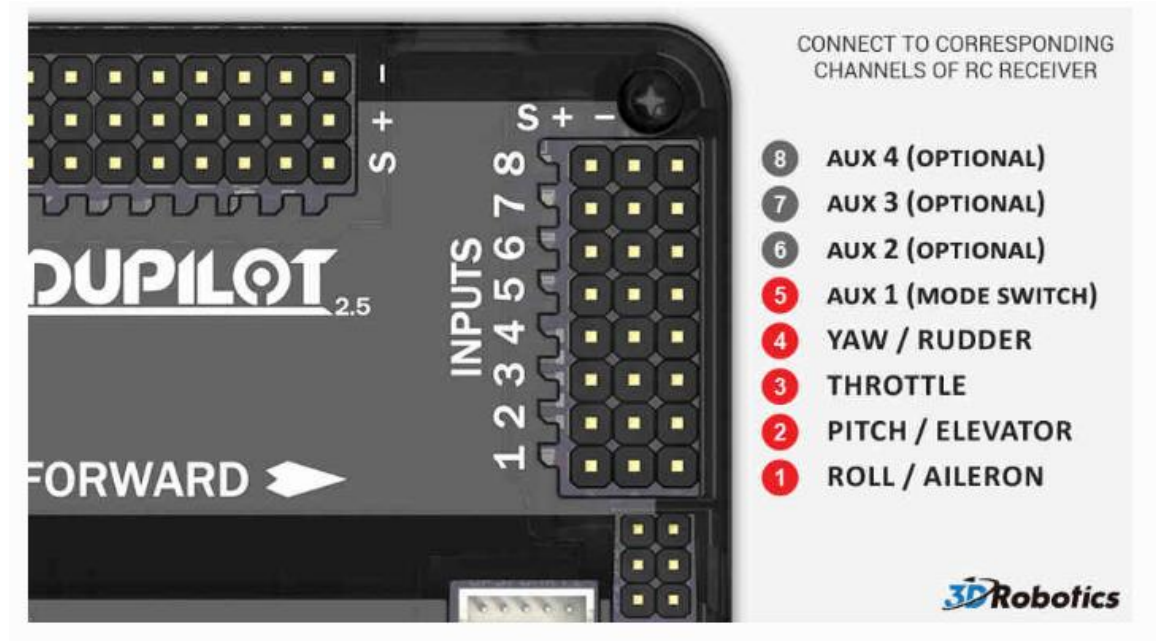


Fig 2.8.8 : Connecting a Receiver

GPS Installation:

GPS is an External Compass in the quad-copter. This compass has been providing more efficiency when we are flying. It has backward and forward direction like APM and we must be installing AMP and GPS as the same direction forward and backward. It has global positioning system and we can find our device easily in the smart networking device. GPS try to fixed flight mode problem by the external compass. Is has provide there are many more feature for example Return to launch, auto Land, LOITER (Circles point where mode switched), circle lock (cannot go out of circle) etc.

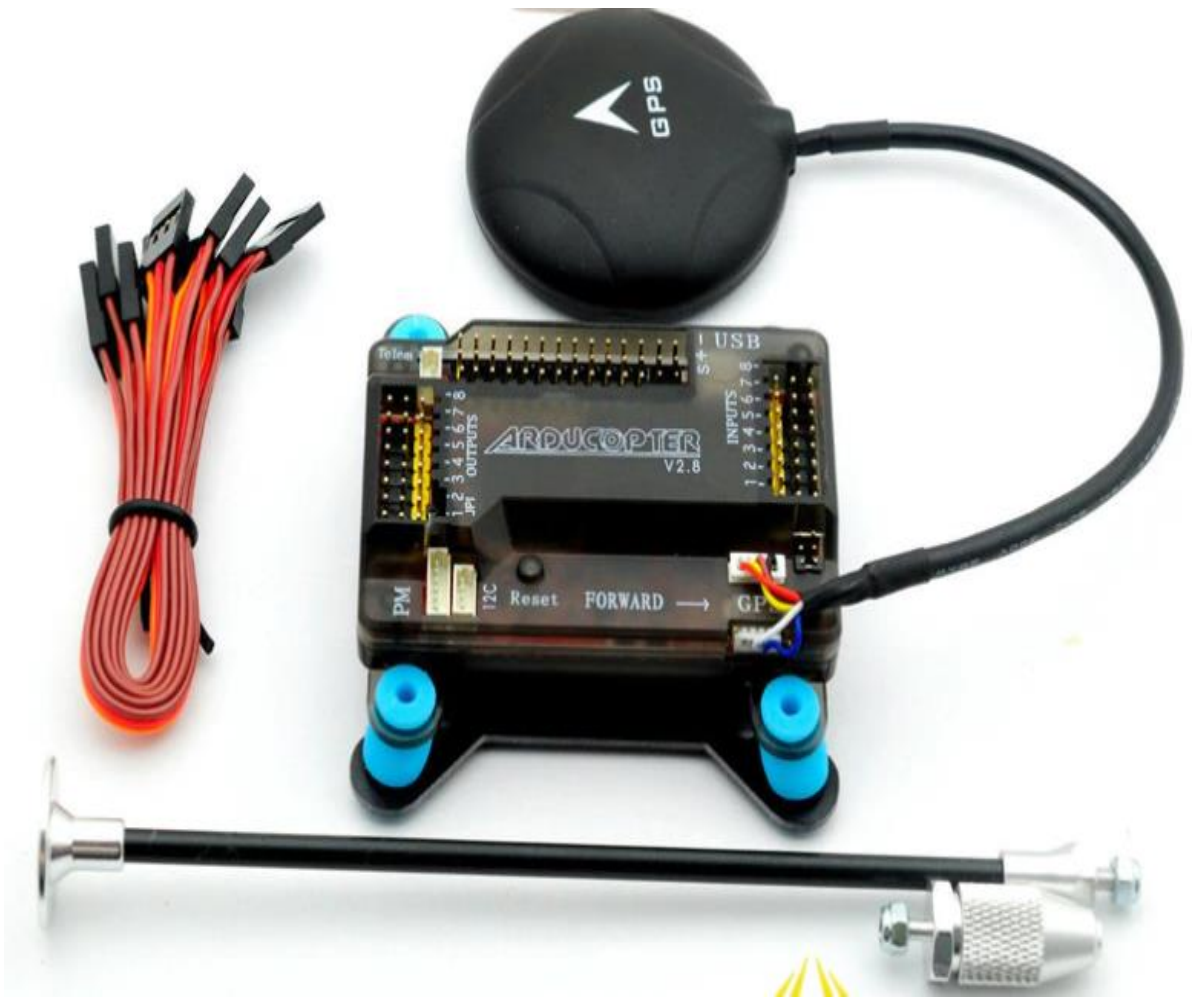


Fig 2.8.9: Connect to APM and GPS

CHAPTER 3

APM Configuration:

1. Install Mission Planner Software
2. Quad-Copter System Assembly without propeller
3. Connect mission planner to APM
4. Configuration

3.1 Mission Planer Software Install: -

Go to Microsoft store and search mission planner software and download mission planner. Open mission planner and connect APM to mission planner by the micro USB cable in micro USB port to USB port.

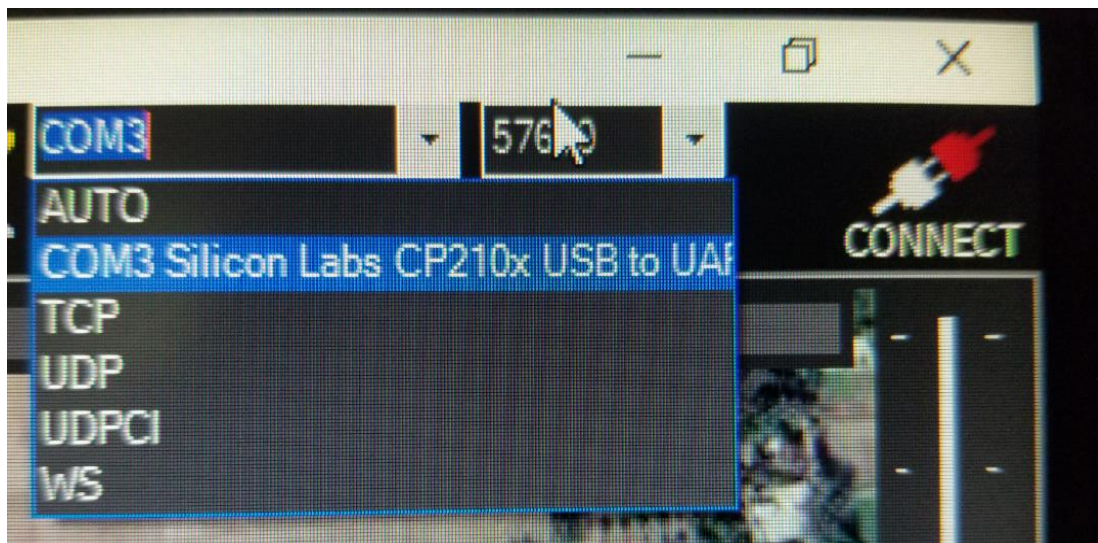
3.2 Quad-Copter System Assembly without propeller: -

First of all, we need to connect all component to Flight Controller without to propeller. We will connect the propeller at last time because when we will supply the power suddenly the propeller may turn and we can not control our device.

1. Connect power module to Flight Controller in PM port
2. All BLDC Motor to ESC with pin diagram
3. All ESC to Flight Controller with pin diagram in output pin
4. Again, Power Module to ESC
5. Connect GPS Module to Flight controller in GPS port
6. Connect Radio Telemetry to Flight Controller in telem port for wireless communication.
7. Connect Radio Receiver to Flight Controller in input pin

3.3 Connect Mission Planner to APM: -

Open Mission Planner software in our Computer and select micro USB cable. We know that micro USB cable to mail port one USB port another Micro USB. USB cable connect to computer and Micro USB connect to flight controller and go to mission planner software select the port and number and then click the connect button.



Configuration: -

3.4.1 Load Firmware: -

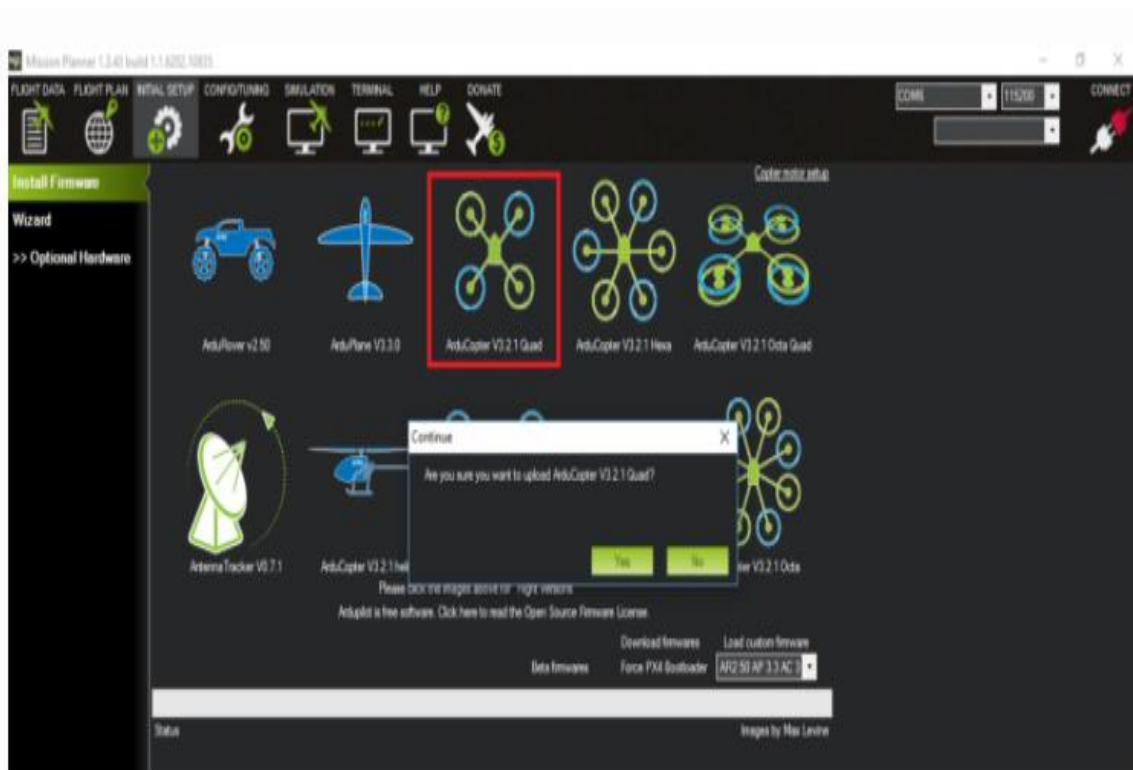


Fig 3.4.1: Load Firmware in APM for Quad-Copter

Here in this step first of all load the firmware in the flight controller. Open the mission planner go to “INSTALL SETUP” and select “X” type frame. Setup for this step we need to connect internet because the firmware download from internet. Click X type frame than wait some time to download firmware. Download complete than unplug and plug flight controller and return connect mission planner to flight controller. Enter some parameters mission planner to flight controller.

3.4.2 Frame Type: -

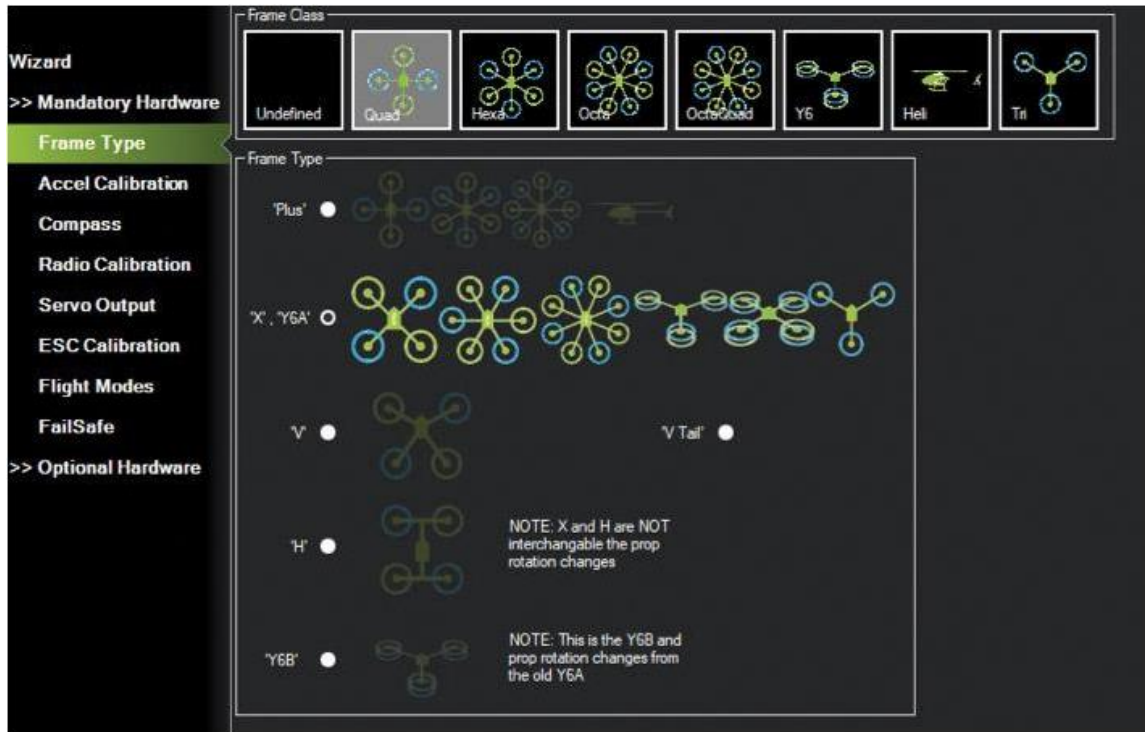


Fig 3.4.2 : Select Frame Type

Go to install setup or setup menu than click Mandatory hardware tab and select Frame type than show the frame type option “X”, “Y6A” for X type frame. Our flight controller receiver and send command X type device frame.

3.4.3 Accelerometer Calibration: -

This step creates device position. Position means left side, right side, up and down etc. Go to Accel Calibration setup our device level position in the first time.

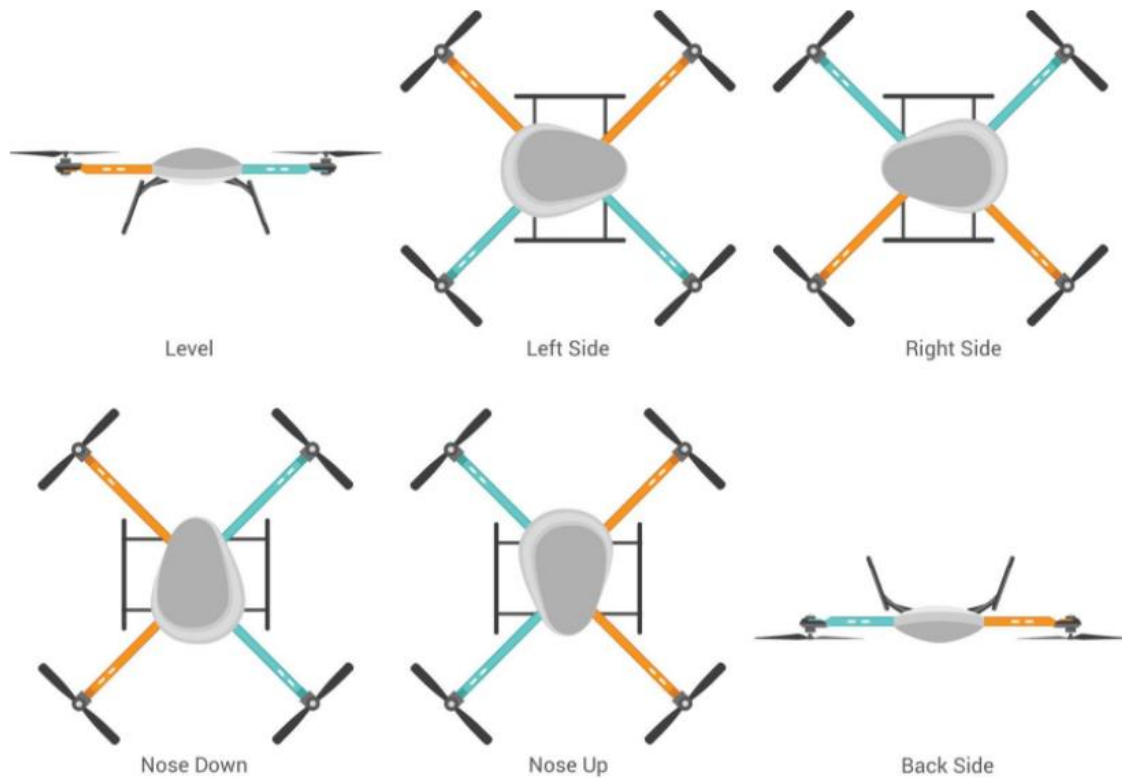


Fig 3.4.3 : Accelerometer Calibration Positions

First of all, keep the device or flight controller in the equal places than click “Calibrate Accel” button and now start Accel Calibration and we can sure our device place level position according to the picture and press any key the keyboard. Again, show the message mission planner “Place Vehicle on its LEFT side and press any key.” We place device left side according to the picture another message show as like same just follow according to the picture and finally show the calibration successful and complete the accelerometer calibration.

3.4.4 Compass Calibration: -



Fig 3.4.4 : compass calibration

Go to “Compass” tab and we see some compass setting option. We select mission planner mag calibration option and click live calibration button this is the easy option for compass calibration.

Show the message “please click ok and move the autopilot around all axes in the circular motion”

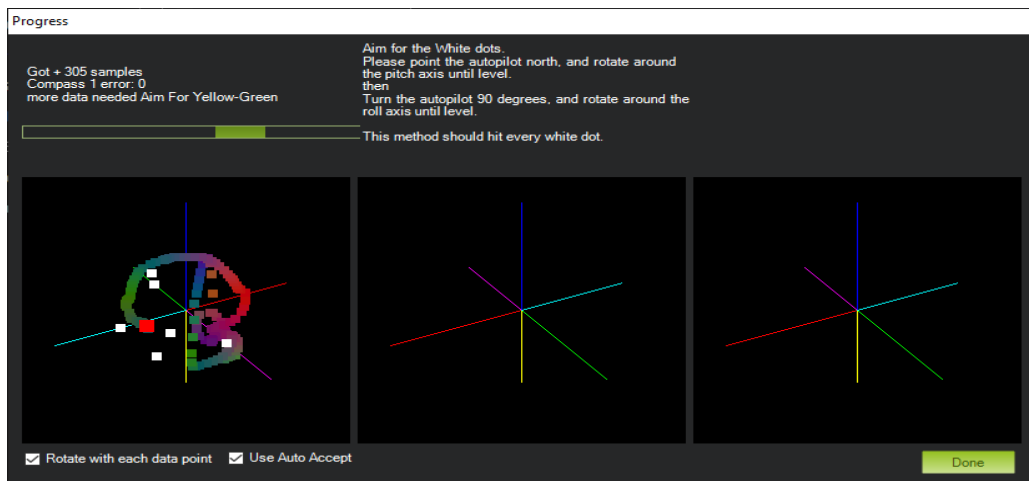


Fig 3.4.4.1 : set every direction offset for compass

This time move our device or quad-copter each direction some time and try to move new direction not repeat direction. When complete our compass calibration after than show ©Daffodil International University

message new offsets for compass and show #1 are -56 3 -15 this number is 3 axis and this number every time make new offsets.

3.4.5 Radio Calibration: -

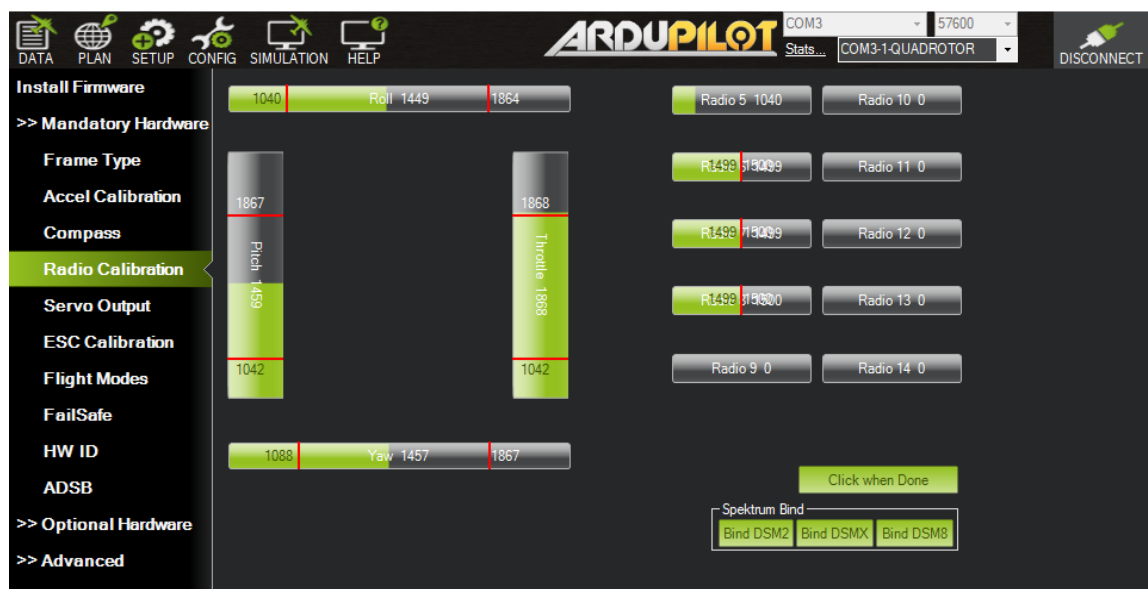


Fig 3.4.5 : Radio calibration

First of all we ensure our Quad-Copter without propeller because it is possible to accidentally arm the device during the Radio Transmitter Controller Calibration process than Power on our flight controller and Radio Transmitter and we also ensure that Radio Transmitter all button and switch down or off position. Rudder / Elevator stick in the left side this stick set to down position and Aileron / Throttle stick set to center position.

Open mission planner software and go to Radio Calibration tab and we see the radio channel, switch and “Calibrate Radio” button. Click on “Calibrate Radio” button and mission planner send pop up window **“Ensure your transmitter is on add receiver is powered and connected and ensure your motor does not have power no props!!!”** than click ok button and show again show message **“Click OK and move all RC stick and switches to their extreme positions so the red bars hit the limits”**. Then click ok button. Now we move the two stick and all switch are extreme position and change the

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value low to high stick and switch. We sure all stick and switch move perfect position than and calibration complete than click **“Click when Done”** button and complete the radio calibration. Finally show message **“Ensure al your stick are Centered and throttle is down and click ok to continue”**. This is the final message for Radio Calibration and show the channel value we are using in the pop-up window than click ok button.

3.4.6 Flight Mode: -

After Go to Flight Mode tab and we see the 6 type of flight mode 1 to 6. There is some flight mode provide in our flight controller for easy to fly our device and we can set individual flight mode in our wish. When completely setup our flight mode than click complete button and automatic save some value in the right side.

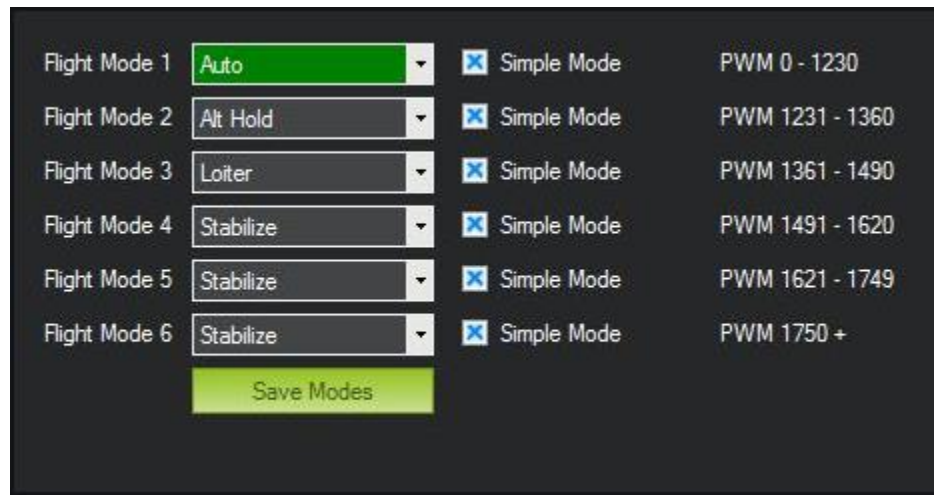


Fig 3.4.6 : Flight Mode Setting

3.4.7 Fail-Safe Mode: -



Fig 3.4.7 : - Fail-Safe Mode Setting

Sometimes we can not remember flight time which minute has gone or another problem sometime our device battery and Transmitter battery charge finish our device Skyfall to land and broken. Sometime receiver not connect to our transmitter or device loss transmitter signal in this situation our flight controller make diction to destination.

CHAPTER- 4

4.1 Camera



Fig 4.1.1: Mobius camera and components

We are using Mobius action 1080P HD mini sports camera with wide angle edition. This camera has wide angle lens and approximate horizontal field of view of 120 degrees in 1080P mode. It is a small size of camera and some people called spy camera. The camera record video and audio very smoothly. The camera has built-in battery in internally and battery provides approximately 130 minutes of recording time per charge. The camera uses rechargeable battery and 820mAh battery use 3.7 volt and changing voltage 5+ and less than 6 volts. The camera popular for low price, high performance, easy installation, easy maintain and most advanced mini action camera available records in loop recording or still images takes up to 32GB micro SD card and we also can be used as a Dash camera (Start/Stop Recording).The wide-angle lens mobius camera make Japanese and it has support full HD video Quality. The camera can record 1080P HD in 30 frames per second this is a high video quality. This camera also recording in 720P 60 frames per second either 720P 30 frames per second.



Fig 4.1.2 : Identify All Measurement, Switch, Port and Indicator

Weighing in a approx. 1.5 ounces, it is both lightweight and compact, measuring approximately 2.4" x 1.4" x 0.75". it has three primary button power, mode and shutter or record, one micro SD slot, one USB mini B port, built-in microphone LED indicator and heat sink for cooling device or control internal device heat. Micro SD memory card changeable 1GB up to 32GB support and we can remove and inject any time. The USB port use for connected to a computer or other device for use camera or transfer of video or image files. It is fully configurable by using the any free software configuration by the computer or other smart device. This device also supported any wireless communication device. USB mini B port connects any wireless video transfer device very easily and transfer signal sender to receiver. The targeted delay times range from 0.25 to 60 sec.

4.2 Video Transmitter and Receiver



Fig 4.2.1: Video Transmitter and Receiver with Cable and Antenna

This device is perfect for any drone or RC or DJI to send live video for the air to ground station. We can connect any camera very easy. The transmitter directly connects to camera device, the camera sends video and audio signal to transmitter and transmitter send same signal to receiver using wireless communication. The transmitter and receiver communication 5.8GHz frequency. This wireless communication system is good for up to 500m flying device with the supplied antenna. The device external antenna can be extending range to 1KM+ and it has built-in microphone.

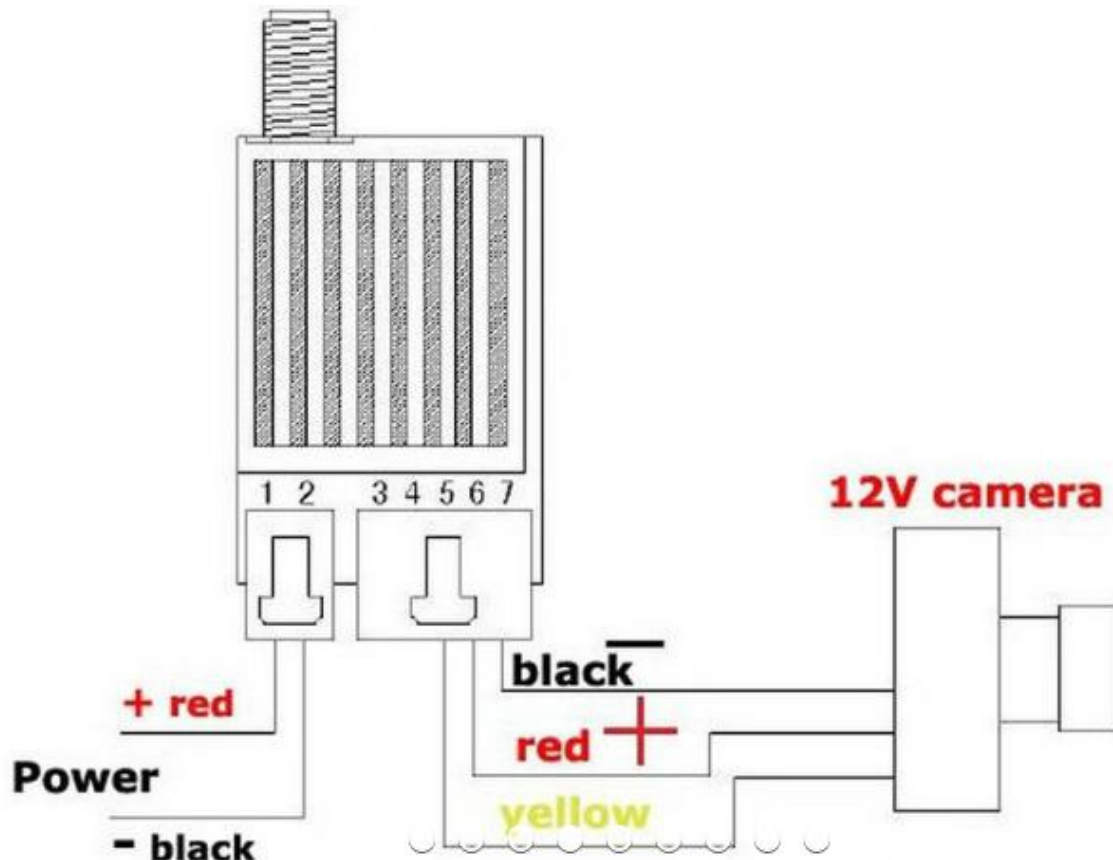


Fig 4.2.2 : Camera and Transmitter are directly connect

Transmitter Specification:

- Transmitter frequency: 5705 to 5945MHz
- Number of Channel: 8CH
- Transmitting distance: up to 2000M(Open area)
- AV input: analog AV signal input
- Power Supply: 6.5-15 volts
- Current supply: 200mA
- Weight: 30g
- Size: 55 x 26 x 17mm

Frequency of each channel:

CH1:5705 - CH2:5685 - CH3:5665 - CH4:5645

CH5:5885 - CH6:5905 - CH7:5925 - CH8:5945

Remark: The transmitter's power input is ranging from 7-12V, however the voltage output from the TX for the camera is 0.5V, lower than the input power. It's suggested to use 3S lipo 11.1V battery.

Note: antennas must be attached before powering on.

2-pin connector:

Red: DC8-12 Volts Input

Black: GND

5-pin connector:

Red: V output for your camera, normally 0.5V less than the DC input from the 2-pin connector.

Black: GND

Yellow: VIDEO

4.3 Receiver

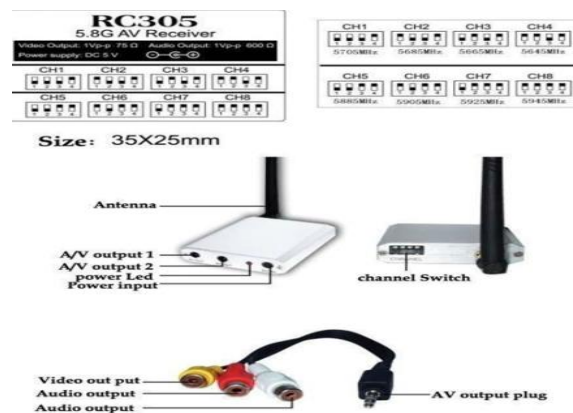


Fig 4.3.1 : Camera Receiver Switch and Port Connection Diagram

RC-305 5.8GHz AV receiver with 8 channels. The receiver receives high quality video and audio signals with broadband receiving frequency 5725 up to 5865MHz.

It is small size, light weight, easy installation and easy to carry. It has 4 channel switches for change channel. Two AV port AV1 and AV2 for video and audio output. And one power port for supply DC voltage and another port is antenna port to direct connect in antenna for wireless communication.

Receiver Specification:

- Channels: **8**
- Receiver operating voltage: **5VDC**
- Operating temp: **-10~85C**
- Video bandwidth: **0~8.0MHz**
- Audio frequency: **6.5MHz**
- Video input level: **0.8~1.2Vp-p**
- Video input impedance: **75Ohm**
- Audio input level: **0.5~2.0Vp-p**
- Audio input impedance: **10K/Ohm**
- Weight: **43g**
- Antenna connector: **RP-SMA**
- Dimensions: **61x52x13mm**

Chapter 5

5.1 Comparison

Type	Our Device	Other Device
Price	Low to Average (20,000to 40,000)	Average to High (60,000 to 25,50,000)
Battery	Not Fixed and we can change different type of battery for long time fly.	Fixed battery and we not change and use other type of battery
Customize	We can Customize any part of device for example: Battery, Motor, Propeller, GPS, ESC, Frame and Flight Controller etc.	We can not Customize any part of device.
Frame type Layout	We face design layout problem for some work than we can change it.	This device layout is fixed. Normally we can not change it.
Broken	Suddenly any problem broken any part of device, smoothly we can change it.	We can not change it and must be change hole device.
Work Type	Work type not fixed for this device.	Work type almost fixed.
Camera	We can set up any light weight camera.	We can only use the camera with it.
Add Auxiliary device	We can easily add any type of light weight auxiliary device.	We can not use any type of light weight auxiliary device.
Channel	We can increase and decrease transmitter and receiver channel.	Transmitter and receiver number of channels fixed.
Carry	This device can carry a weight of 4 kg (depend of motor and propeller)	Work type different that's why all device can not carry. Some device carries only.

Flight Mode	Flight Mode setup customize open. User can change this mode.	Flight Mode fixed. We can not change it.
Performance	Average to high	High for specific work.
Program and Configuration	We can change program and configuration.	Normally we can not change program. If we change the program, the performance will down.
Life Time	This device life time is high.	This device life time short.

5.2 Discussion and Conclusion

Finally, we have finished to our Quad-Copter project. After all, by the grace of God we just make it. Using this project (Quad-Copter) people easily collecting video information. It is helpful to people to collect video information.

We have heard a lot about the challenges to create and this project when we will be making a project like this. It was a wonderful learning experience and, in the future, we will start to create other Quad-Copter, which is why we choose the idea. We always kept in mind to make the project user friendly. Our focus was to make the system acceptable to any user.

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Appendix

Appendix A:

This mission was really challenging and interesting for us. We developed it and enjoy it very much. We understand and learn many things during the developing period. We have continually developed and share each other's ideas. Just how successful our community meetings were having been interesting. The time seems to pass and still we have still done a lot and tried to support many on the road to a concrete policy outcome.

Appendix B:

Block Diagram:

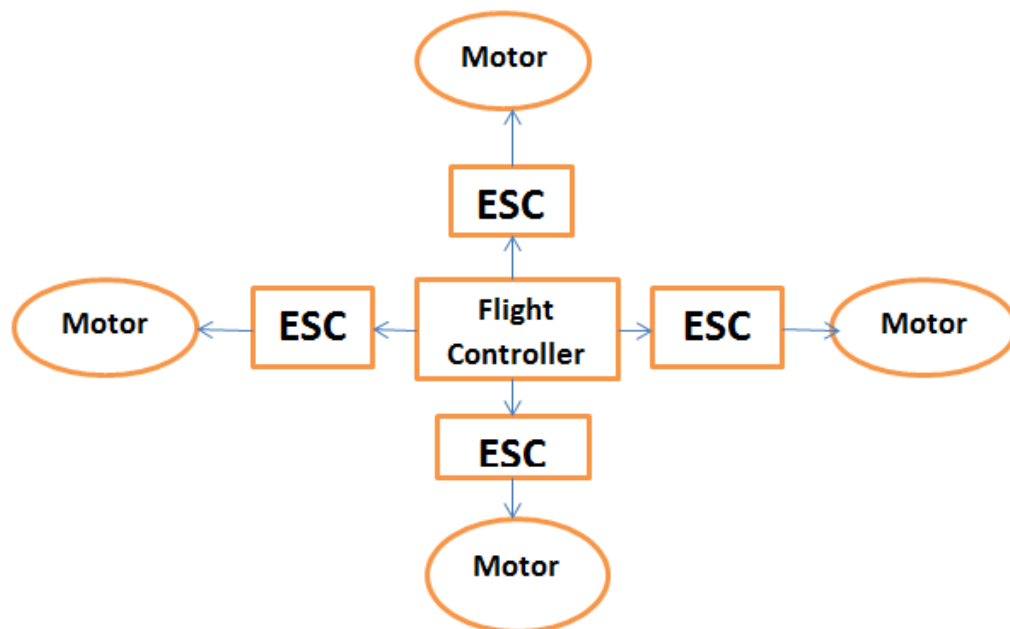


Fig 5.1.1 : Quad-Copter Design layout

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