CHAPTER 4

HARDWARE AND SOFTWARE DESCRIPTION

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4.1 HARDWARE DESCRIPTION

4.1.1 TELEMETRY

The beginning of industrial telemetry lies in the steam age, although the sensor was not called telemeter at that time. Examples are James Watt's (1736-1819) additions to his steam engines for monitoring from a (near) distance such as the mercury pressure gauge and the fly-ball governor.

Although the original telemeter referred to a ranging device (the range finding telemeter), by the late 19th century the same term had been in wide use by electrical engineers applying it refer to electrically operated devices measuring many other quantities besides distance (for instance, in the patent of an "Electric Telemeter Transmitter"). General telemeters included such sensors as the thermocouple (from the work of Thomas Johann See beck), the resistance thermometer (by William Siemens based on the work of Humphry Davy), and the electrical strain gauge (based on Lord Kelvin's discovery that conductors under mechanical strain change their resistance) and output devices such as Samuel Morse's telegraph sounder and the relay. In 1889 this led an author in the Institution of Civil Engineers proceedings to suggest that the term for the rangefinder telemeter might be replaced with tacheometer.

In the 1930s use of electrical telemeters grew rapidly. The electrical strain gauge was widely used in rocket and aviation research and the radiosonde was invented for meteorological measurements. The advent of World War II gave an impetus to industrial development and henceforth many of these telemeters became commercially viable.

Carrying on from rocket research, radio telemetry was used routinely as space exploration got underway. Spacecraft are in a place where a physical connection is not possible, leaving radio or other electromagnetic waves (such as infrared lasers) as the only viable option for telemetry. During crewed space missions it is used to monitor not only parameters of the vehicle, but also the health and life support of the astronauts. During the Cold War telemetry found uses in espionage. US intelligence found that they could monitor the telemetry from Soviet missile tests by building a telemeter of their own to intercept the radio signals and hence learn a great deal about Soviet capabilities.

Telemetry is the in-situ collection of measurements or other data at remote points and their automatic transmission to receiving equipment for monitoring. It allows for real-time information and communication in the form of a data stream. It enables applications to have a live icon of a moving drone displayed on a map. Although the term commonly refers to wireless data transfer mechanisms (it also encompasses data transferred over other media such as a telephone or computer network, optical link or other wired communications like power line carriers. Many modern telemetry systems take advantage of the low cost and ubiquity of GSM networks by using SMS to receive and transmit telemetry data. A telemeter is a physical device used in telemetry. It consists of a sensor, a transmission path, and a display, recording, or control device.

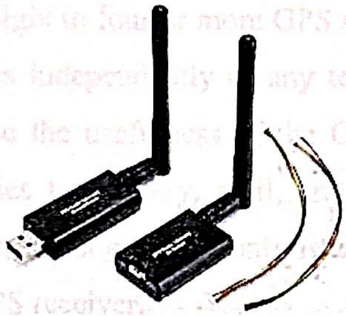

Fig 4.1: Telemetry

Electronic devices are widely used in telemetry and can be wireless or hard-wired, analog or digital. Other technologies are also possible, such as mechanical, hydraulic and optical. The telemetry 433mHz set which allows one to link a flight controller to a USB or UART-equipped device such as a computer, laptop, or tablet supporting a USB connection (OTG). This set has a separate Air & Ground module. Its transceivers can use UART or USB connections and support both modes. The Radio set lets you see live data, such as live GPS position overlaid on a map, system voltage, heading, waypoint navigation, and much more. Using open-source MAVlink based ground station software, drone's flight is taken care off. It offers a great low price, longer range, and superior performance. The system utilizes the 433MHz band and provides a full-duplex link using HopeRF's HM-TRP modules running custom, open-source, firmware.

Telemetering information over wire had its origins in the 19th century. One of the first data-transmission circuits was developed in 1845 between the Russian Tsar's Winter Palace and army headquarters. In 1874, French engineers built a system of weather and snow-depth sensors on Mont Blanc that transmitted real-time information to Paris. In 1901 the American inventor C. Michalke patented the selsyn, a circuit for sending synchronized rotation information over a distance. In 1906 a set of seismic stations were built with telemetering to the Pulkovo

Observatory in Russia. In 1912, Commonwealth Edison developed a system of telemetry to monitor electrical loads on its power grid.

4.1.2 GSP WITH COMPASS

The **Global Positioning System** (GPS), originally **Navstar GPS,** is a satellite-based radionavigation system owned by the United States government and operated by the United States Space Force. It is one of the global navigation satellite systems (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. It does not require the user to transmit any data, and operates independently of any telephonic or Internet reception, though these technologies can enhance the usefulness of the GPS positioning information. It provides critical positioning capabilities to military, civil, and commercial users around the world. Although the United States government created, controls and maintains the GPS system, it is freely accessible to anyone with a GPS receiver.

Fig 4.2: GPS with Compass

GPS (Global Positioning System) is the same system that we are all familiar with in road navigation systems. It is 72-channel M8 engine, on-board Ultra low noise 3.3V voltage regulator and has RF filter for noise blocking. It also features an additional front-end LNA for optimized performance and a front-end SAW filter for increased jamming immunity. Has build-in embedded GNSS patch antenna, low power consumption. The 15 x 15 mm patch antenna provides the best compromise between the performance of. a Right-Hand Circular Polarized (RHCP) antenna and a small size to be integrated in any design.

A global network of orbiting satellites sends signals that a GPS module picks up with a radio receiver. These signals allow the module to determine its position, speed, and time. The purpose of a compass is to help determine direction. All GPS receivers include a compass. The compass on a GPS receiver can provide a lot more information than the standard magnetic compass. The compass feature of a GPS receiver can help the user determine the current direction called the heading and the desired direction called the bearing. The GPS receiver has a pointer on the Compass Page which will provide direction to a selected destination. The GPS receiver has a compass ring that indicates the direction of North relative to direction you are going. The hash mark at the top of the Compass Ring indicates the heading. Features of M8q are:

Sl No.	ELEMENTS	SPECIFICATIONS
1.	Integrated Magnetic sensor	QMC5883L
2.	Velocity accuracy	0.05m/s
3.	Tracking & Navigation	-165dBm
4.	Cold Start	-145dBm
5.	Hot Start	-155dBm
6.	Input voltage range	4~5.5V
7.	Power consumption	40mA
8.	Interface for Compass QMC5883L	12C
9.	Interface for GPS SAM-M8Q	Uart
10.	Dimensions	L20 x W20 x H10 mm
11.	Weight	7 grams
12.	Power LED	Red
13.	Time pulse LED	Blue

Table 1: GPS with Module specifications

4.1.3 ELECTRONIC SPEED CONTROLLER:

Electronic speed controllers (ESCs) also referred to as electronic stability program (ESP) or dynamic stability control (DSC), is a computerized technology that improves a vehicle's stability by detecting and reducing loss of traction . When ESC detects loss of steering control, it automatically applies the brakes to help steer the vehicle where the driver intends to go. Braking is automatically applied to wheels individually, such as the outer front wheel to counter oversteer, or the inner rear wheel to counter understeer. Some ESC systems also reduce engine power until control is regained. ESC does not improve a vehicle's cornering performance; instead, it helps reduce the chance of the driver losing control of the vehicle.

In aerial vehicles they are devices that allow drone flight controllers to control and adjust the speed of the aircraft's electric motors. A signal from the flight controller causes the ESC to raise or lower the voltage to the motor as required, thus changing the speed of the propeller. Due to the differences in motor technology, different ESCs are required for drones with brushed motors and those with brushless motors.

Multirotor drones may have an ESC for each rotor, or an integrated device that handles all the rotors with one system. Many drone ECSs are designed as a system-on-chip (SoC), which means that all components, such as the microcontroller and power management unit, are integrated into a single module. This saves space and weight, making it an ideal solution for SWaP (size, weight and power) constrained UAVs. For drones are typically rated for a maximum current, ESCS that can handle a larger current draw will usually be larger and heavier, which may be an important consideration for smaller UAVs. They can also handle active or regenerative braking, a process by which a motor's mechanical energy is converted into electrical energy that can be used to recharge the drone's battery. During periods where the drone is decelerating, the motor can act as a generator, and the esc handles the excess current that can be fed back into the battery.

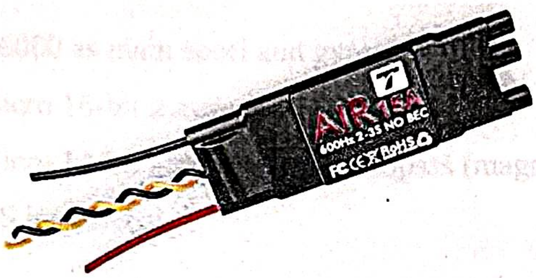

Fig 4.3: ESC

Different types of speed controls are required for brushed DC motors and brushless DC motors. A brushed motor can have its speed controlled by varying the voltage on its armature. (Industrially, motors with electromagnet field windings instead of permanent magnets can also have their speed controlled by adjusting the strength of the motor field current.) A brushless motor requires a different operating principle. The speed of the motor is varied by adjusting the timing of pulses of current delivered to the several windings of the motor.

Brushless ESC systems basically create three-phase AC power, like a variable frequency drive, to run brushless motors. Brushless motors are popular with radio controlled airplane hobbyists because of their efficiency, power, longevity and light weight in comparison to traditional brushed motors. Brushless DC motor controllers are much more complicated than brushed motor controllers.

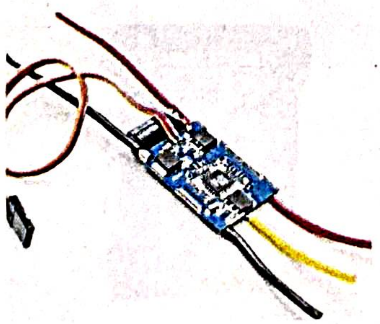

Fig 4.4: Circuitry of ESC

4.1.4 PIXHAWK:

PX4 autopilot is a 2-bit ARM Cortex M4 core with FPU open-source autopilot system oriented toward inexpensive autonomous aircraft. Low cost and availability enable hobbyist use in small remotely piloted aircraft. It is a popular general purpose flight controller based on the Pixhawk-project FMUv2 open hardware design (it combines the functionality of the PX4FMU + PX4IO). It runs PX4 on the NuttX OS. Originally manufactured by 3DR® this board was the original standard microcontroller platform for PX4.

- Sensors
  - MPU6000 as main accel and gyro
  - ST Micro 16-bit gyroscope
  - ST Micro 14-bit accelerometer/compass (magnetometer)
  - MEAS barometer
- Power
  - Ideal diode controller with automatic failover
  - Servo rail high-power (7 V) and high-current ready
  - All peripheral outputs over-current protected, all inputs ESD protected
- Interfaces
  - 5x UART serial ports, 1 high-power capable, 2 with HW flow control
  - Spektrum DSM/DSM2/DSM-X Satellite input
  - Futaba S.BUS input (output not yet implemented)
  - PPM sum signal
  - RSSI (PWM or voltage) input
  - I2C, SPI, 2x CAN, USB
  - 3.3V and 6.6V ADC inputs

Fig 4.5: Pixhawk

ArduPilot provides a large set of features, including the following common for all vehicles:

- Fully autonomous, semi-autonomous and fully manual flight modes, programmable missions with 3D waypoints, optional geofencing.
- Stabilization options to negate the need for a third party co-pilot.
- Simulation with a variety of simulators, including ArduPilot SITL.
- Large number of navigation sensors supported, including several models of RTK GPSs, traditional L1 GPSs, barometers, magnetometers, laser and sonar rangefinders, optical flow, ADS-B transponder, infrared, airspeed, sensors, and computer vision/motion capture devices.
- Sensor communication via SPI, I²C, CAN Bus, Serial communication, SMBus.
- Failsafe's for loss of radio contact, GPS and breaching a predefined boundary, minimum battery power level.
- Support for navigation in GPS denied environments, with vision-based positioning, optical flow, SLAM, Ultra Wide Band positioning.
- Support for actuators such as parachutes and magnetic grippers.
- Support for brushless and brushed motors.
- Photographic and video gimbal support and integration.
- Integration and communication with powerful secondary, or "companion", computers
- Rich documentation through ArduPilot wiki.
- Support and discussion through ArduPilot discourse forum, Gitter chat channels, GitHub, Facebook.

4.1.5 TXRX:

TX and RX are abbreviations for **Transmit and Receiver**, respectively. The user commands are used to control a drone remotely. The user commands are then received by the radio receiver (RX) which is connected to a flight controller.

Fig 4.6: TXRX

Works in the frequency range of 2.405 to 2.475GHz. This brand has been divided into 142 independent channels, each radio system uses 16 different channels and 160 different types of hopping algorithm. This radio system uses a high gain and high-quality multi-directional antenna, it covers the whole frequency band. Associated with a high sensitivity receiver, this radio system guarantees a jamming free long-range radio transmission

Each transmitter has a unique ID when binding with a receiver, the receiver saves that unique ID and can accept only data from the unique transmitter. this avoids picking another transmitter signal and dramatically increase interference immunity and safety.

This radio system uses low power electronic components and sensitive receiver chip. The RF modulation uses intermittent signal thus reducing even more power consumption.

AFHDS2A system has the automatic identification function, which can switch automatically current mode between single-way communication mode and two-way communication mode according to the customer needs.

AFHDS2A has built-in multiple channel coding and error-correction, which improve the stability of the communication, reduce the error ratio and extend the reliable transmission distance.

Model Number	FS i6-M2
Assembly Required	No
Batteries Required	Yes
Radio Control Number of Bands	6
Color	Multicolor
Product Dimensions	10.16 x 20.32 x 22.86 cm; 635.03 Grams
Batteries	4 AA batteries required
Item model number	FS i6-M2
Item Weight	635 g

Table 2: Specifications of TxRx

4.1.6 PROPELLERS

Propeller is a device with a rotating hub and radiating blades that are set at a pitch to form a helical spiral, that, when rotated, exerts linear thrust upon a working fluid, such as water or air. Depending on the propeller number the multirotor drones are classified as Bicopter (2 propellers), Tricopter (3), Quadcopter (4), Hexacopter (6) and so on. Propellers are used to create thrust to propel a boat through water or an aircraft through air. The blades are specially shaped so that their rotational motion through the fluid causes a pressure difference between the two surfaces of the blade by Bernoulli's principle which exerts force on the fluid. Most marine propellers are screw propellers with helical blades rotating on a propeller shaft with an approximately horizontal axis. The purpose of hexacopter propellers is to generate thrust and torque to keep your drone flying and to maneuver.

Fig 4.7: Propellers

A propeller is a rotating fan-like structure that is used to propel the ship by using the power generated and transmitted by the main engine of the ship. The transmitted power is converted from rotational motion to generate a thrust which imparts momentum to the water, resulting in a force that acts on the ship and pushes it forward.

A ship propels on the basis of Bernoulli's principle and Newton's third law. A pressure difference is created on the forward and aft side of the blade and water is accelerated behind the blades. The thrust from the propeller is transmitted to move the ship through a transmission system which consists of a rotational motion generated by the main engine crankshaft, intermediate shaft and its bearings, stern tube shaft and its bearing and finally by the propeller itself.

4.1.7 FRAMES

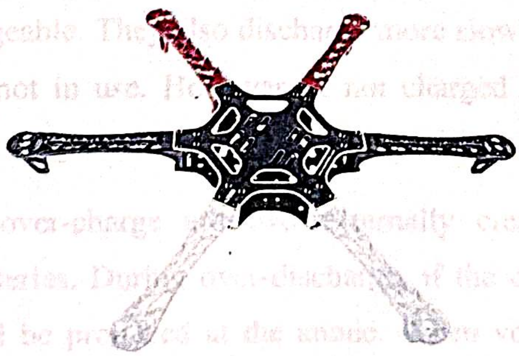

Fig 4.8: Frame

The DJIF450 frame is built from ultra-strong materials, which makes the quadcopter very resistant to crashes or other unpleasant events. The arms are built from PA66+30GF material and the main frame plates use a compound PCB material which is designed to implement high-strengths. The arms and plates are designed to protect the ESCs and the battery, and there is enough space between the top and bottom plates to add elements that need protecting. The frame as shown in figure4.1.1 is made Clear Polycarbonate Material 0.080"thick(2mm) clear polycarbonate dome weighs about 68gms and is very strong material which is used as the frame of the drone hence for strong and firm flight control. It is 450mm hexa frame built from quality materials. The0 main frame is glass fiber while the arms are constructed from ultradurable polyamide nylon. This version of the F450 features integrated PCB connections for direct soldering of your ESCs. Built from quality glass fiber and polyamide nylon. The Design weighs 394grams which is better quality for the purpose of the applications implemented in the drones.

4.1.8 LIPO-BATTERY

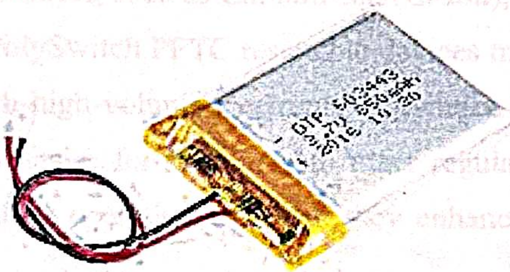

Fig 4.9: Lipo-Battery

Lithium polymer (LiPo) batteries are among the most common battery types used for drones because they offer the advantage of high energy density in relation to their size and weight, with a higher voltage per cell, so they can power the drone's on-board systems with fewer cells than other rechargeable. They also discharge more slowly than other types, so they'll hold a charge longer when not in use. However, if not charged or used properly, they can't provide peak performance for long and can even begin to smoke and catch fire.

Over-discharge and over-charge are two externally created events that can cause problems in Lithium-Ion batteries. During over-discharge, if the cell voltage drops lower than approximately 1.5V, gas will be produced at the anode. When voltage drops to less than 1V, copper from the current collector dissolves, causing internal shorting of the cell. Therefore, under-voltage protection is required and is provided by the battery protection IC. Over-charging creates gassing and heat buildup at the cathode when cell voltage reaches approximately 4.6V. Although cylindrical cells have internal protection from pressure, activated CIDs (current interrupt devices) and internal PTCs (positive temperature coefficient discs that increase in resistance when heated), LiPo cells do not have internal CIDs and PTCs. External overvoltage, over-gas, and over-temperature protection is especially critical for Li-polymer cells.

A variety of circuit protection options are available to help guard drone batteries against over-current and over-temperature conditions, including metal hybrid PPTC with thermal activation (MHP-TA) devices, Poly Switch PPTC devices, low resistance SMD PPTC devices, and surface-mount fuses. MHP-TA devices combine the advantages of low thermal cut-off temperatures, high hold-current ratings and compact size, which are invaluable for protecting LiPo batteries. The latest MHP-TA devices offer a 9VDC rating and a higher current rating than typical battery thermal cutoff (TCO) devices. They are capable of handling voltages and battery charge rates common in high-capacity LiPo cells. Many provide resettable and accurate over-temperature protection and their compact footprint and thin form factor simplifies circuit protection in ultra-thin battery pack designs.

For other battery chemistries, such as Lithium-Ion (Li-Ion), nickel metal hydride (NiMH), or nickel cadmium (NiCd), PolySwitch PPTC resettable devices may offer a better solution. Not only are they compatible with high-volume electronics assembly, but their UL, CSA, and TÜV agency recognitions make it easier for designers to meet regulatory requirements. Their low resistance helps increase battery operating time and they enhance over-temperature protection from thermal events.

Small-footprint, low-height-profile POLYFUSE LoRho Surface Mount Resettable PPTCs are well-suited for protection circuit modules for Li-ion and LiPo battery packs, providing fast over-current and over-temperature protection with ultra-low internal resistance, voltage drop, and power dissipation. By resetting automatically, they provide a low maintenance alternative to one-time fuses for over-current protection. Because they're packaged for surface-mounting on a printed circuit board, they can be mounted within an electronic protection module on the board, simplifying the assembly process.

Although fuses and PTCs are both over-current protection devices, PTCs are automatically resettable; traditional fuses need to be replaced after they are tripped. A fuse will completely stop the flow of current (which may be desirable in critical applications), but after most similar over-current events, PTCs continue to enable the equipment to function, except in extreme cases.

4.1.9 ROTORS:

Drones use rotors for propulsion and control. The rotor pushes down on the air, the air pushes up on the rotor. The faster the rotors spin, the greater the lift, and vice-versa. Drone can do three things in the vertical plane: hover, climb, or descend. To hover, the net thrust of the four rotors pushing the drone up must be equal to the gravitational force pulling it down. Increasing the thrust (speed) of the four rotors pulls the flight upwards and decreasing the thrust a little applies 3 forces on the drone: weight, thrust, and air drag which hovers. To descend the flight net force should be downward which is achieved by decreasing the rotor thrust (speed). The red rotors are rotating counter clockwise and the green ones are rotating clockwise. With the two sets of rotors rotating in opposite directions, the total angular momentum is zero. If there is no torque on the system, then the total angular momentum must remain constant.

Fig 4.10: Rotors

BLDC motors as shown in figure4.2 consists 1400KV Brushless DC Motor (BLDC) which is designed for RC Aircraft, RC Multi-Copter, RC multi-rotor applications. Which gives maximum efficiency as they control continuously at maximum rotation force (Torque) and controllability of the motors is stable compared to other motors. Brushless DC motors use electric switches to realize current commutation, and thus continuously rotate the motor. These electric switches are usually connected in an H-bridge structure for a single-phase BLDC motor, and a three-phase bridge structure for a three-phase BLDC motor. Usually the high-side switches are controlled using pulse-width modulation (PWM), which converts a DC voltage into a modulated voltage, which easily and efficiently limits the start-up current, control speed and torque. Generally, raising the switching frequency increases PWM losses, though lowering the switching frequency limits the system's bandwidth and can raise the ripple current pulses to the points where they become destructive or shut down the BLDC motor driver.

4.2 SOFTWARE DESCRIPTION

4.2.1 Mission Planner

Mission Planner is a free, open-source, community-supported application developed by Michael O borne for the open-source APM autopilot project.

Mission Planner is a ground control station for Plane, Copter and Rover. It is compatible with Windows only. Mission Planner can be used as a configuration utility or as a dynamic control supplement for your autonomous vehicle. Here are just a few things you can do with Mission Planner:

- Load the firmware (the software) into the autopilot board (i.e. Pixhawk series) that controls your vehicle.
- Setup, configure, and tune your vehicle for optimum performance.
- Plan, save and load autonomous missions into you autopilot with simple point-and-click way-point entry on Google or other maps.
- Download and analyse mission logs created by your autopilot.
- Interface with a PC flight simulator to create a full hardware-in-the-loop UAV simulator.
- With appropriate telemetry hardware you can:
  - ➢ Monitor your vehicle's status while in operation.
  - ➢ Record telemetry logs which contain much more information the the on-board autopilot logs.
  - ➢ View and analyse the telemetry logs.
  - ➢ Operate your vehicle in FPV (first person view).

- Mission planner (Flight controller software): Mission Planner is a free, open-source, community-supported application developed by Michael O borne for the open-source APM autopilot project. If you would like to donate to the ongoing development of Mission Planner, please select the Donate button on the Mission Planner interface.
- Select mission commands from drop-down menus.
- Configure autopilot settings for your vehicle.

- The features:
  - ➢ Point-and-click waypoint/fence/rally point entry, using Google Maps/Bing/Open Street maps/Custom WMS.
  - ➢ Select mission commands from drop-down menus.
  - ➢ Download mission log files and analyze them.
  - ➢ Configure autopilot settings for your vehicle.
  - ➢ Interface with a PC flight simulator to create a full software-in-the-loop (SITL) UAV simulator.
  - ➢ Run its own SITL simulation of many frames' types for all the Ardo Pilot vehicles.

Fig 4.11: Mission Planner window

4.2.1.1 Loading firmware onto board with existing Ardupilot firmware

These instructions will show you how to download the latest firmware onto the autopilot hardware that already has ArduPilot firmware installed. This process will use the Mission Planner ground control station.

4.2.1.2 Connect autopilot to computer

Once you have installed a ground station on your computer, connect the autopilot using the micro-USB cable. Use a direct USB port on your computer (not a USB hub). Windows should automatically detect and install the correct driver software.

4.2.1.3 Select the COM port

If using Mission Planner as the GCS, select the COM port drop-down in the upper-right corner of the window near the **Connect** button. Select **AUTO** or the specific port for your board. Set the Baud rate to **115200** as shown. Do not hit **Connect** just yet.

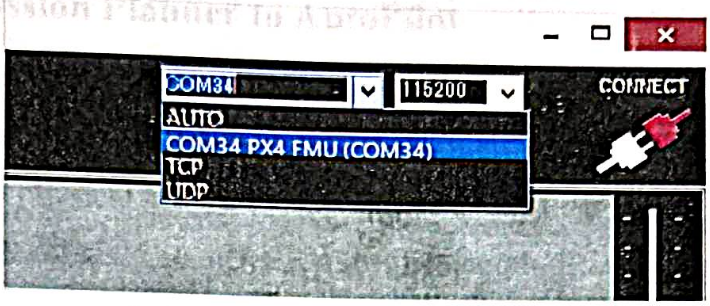

Fig 4.12: COM Port selection

4.2.1.4 Install firmware

In Mission Planner's SETUP | Install Firmware screen select the appropriate icon that matches your frame (i.e., Quad, Hexa).

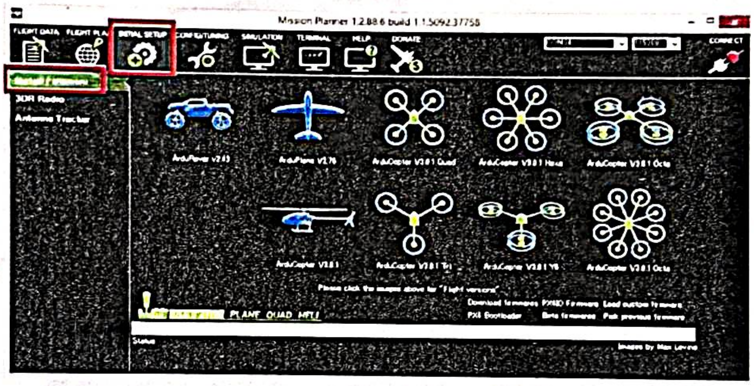

Fig 4.13: Install Firmware Screen

Mission Planner will try to detect which board you are using. It may ask you to unplug the board, press OK, and plug it back in to detect the board type.

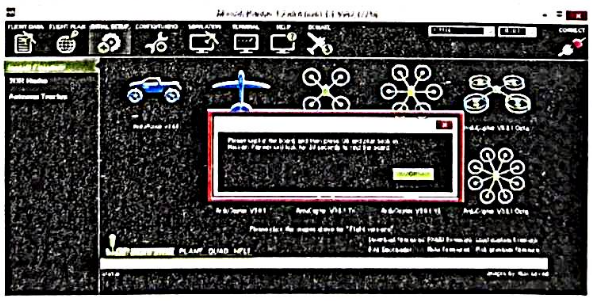

Fig 4.14: Install Firmware Prompt

If all goes well, you will see a status appear on the bottom right including the words: "erase…", "program…", "verify.", and "Upload Done". The firmware has been successfully uploaded to the board. It usually takes a few seconds for the bootloader to exit and enter the main code after programming or a power-up. Wait to press CONNECT until this occurs.

4.2.1.5 Connect Mission Planner to AutoPilot

Setting up the connection

To establish a connection, you must first choose the communication method/channel you want to use, and then set up the physical hardware and Windows device drivers. You can connect the PC and autopilot using USB cables, Telemetry Radios, Bluetooth, IP connections etc.

Fig 4.15: Connection using SiK Radio

On *Mission Planner*, the connection and data rate are set up using the drop-down boxes in the upper right portion of the screen.

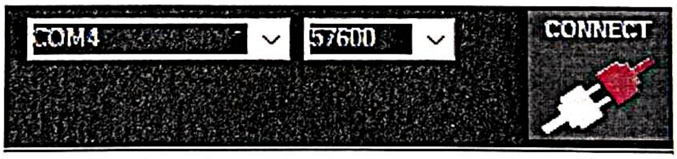

Fig 4.16: Connection through telemetry

Once you've attached the USB or Telemetry Radio, Windows will automatically assign your autopilot a COM port number, and that will show in the drop-down menu (the actual number does not matter). The appropriate data rate for the connection is also set (typically the USB connection data rate is 115200 and the radio connection rate is 57600). Select the desired port and data rate and then press the Connect button to connect to the autopilot. After connecting Mission Planner will download parameters from the autopilot and the button will change to Disconnect as shown:

Fig 4.17: For Disconnection of telemetry

The "Stats..." hotlink beneath the port selection box, if clicked, will give information about the connection, such as if Signing security is active, link stats, etc. Sometimes this window pops up beneath the current screen and will have to be brought to the front to be seen.

4.2.1.6 Mission Planner Features/Screens

Mission Planner Features are detailed in each of the following sections. The sections are organized to match the major section of the Mission Planner as selected in the menu along the top of the Mission Planner window.

- CONNECT (Upper right corner) - How to connect the Mission Planner to your ArduPilot. Selecting communication devices and rates.
- DATA - Information about what you see, and things you can do in the Flight Data screens.
- PLAN - Information about the various aspects of preparing flight plans (Missions), Fences, and Rally Points.
- SETUP - Information about what you see and things you can do in the Setup screens. Especially the mandatory setups required before operating.
- CONFIG - Information about what you see and things you can do in the Configuration/Tuning screens.
- SIMULATION - How you can use the Mission Planner and a flight simulator to 'simulate' flying.
- HELP - About the help screen, and how to get help with your questions about Mission Planner.
- Advanced Mission Planner Features - Mission Planner has a large number of additional functions and features. This section documents many of them.