CHAPTER 3

METHODOLOGY

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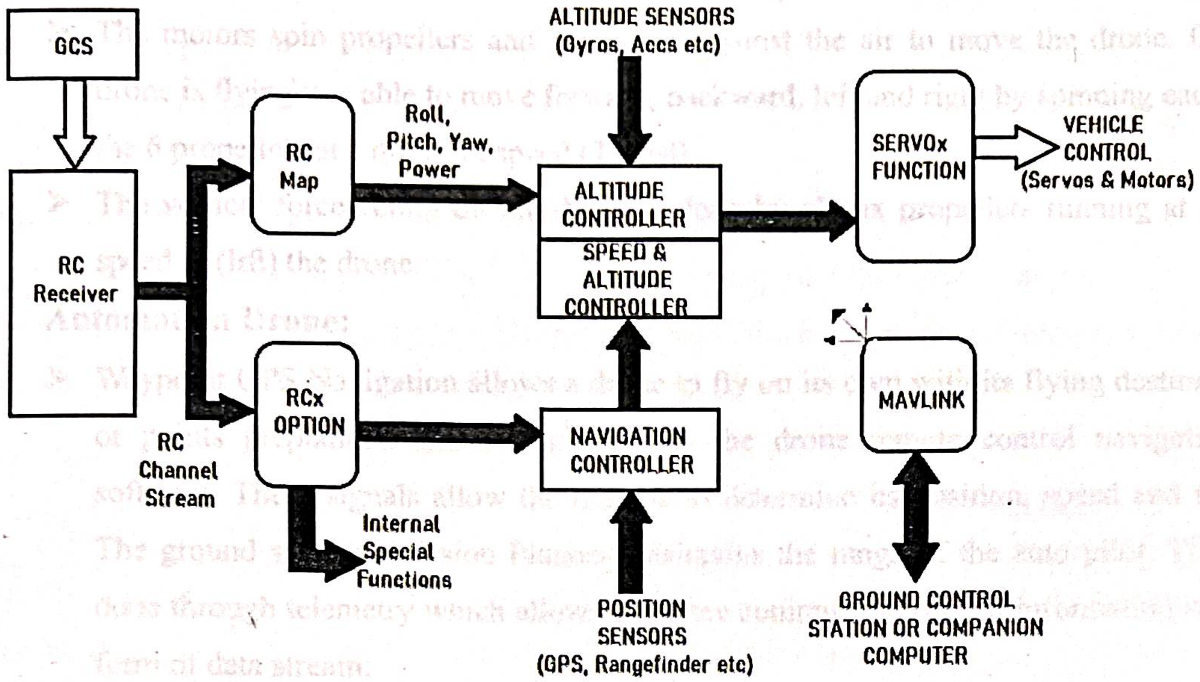

Fig. 3.1: Block Diagram of autonomous delivery drone

3.1 BASIC WORKING PRINCIPLE

Generally, hexacopter drones are six propeller bots which uses six rotors working clockwise and anticlockwise respectively. The new hexacopter platform features an open-source ecosystem and modular architecture with rigorous data-security protocols, and is designed to be highly adaptable, with easy integration of additional sensors and payloads to accomplish unique mission objectives.

Autonomous Drone contains obstacle detection and avoidance component, Raspberry pi board, Pixhawk flight controller, GPS sensor, and motor controllers The flow of the drone navigation algorithm starts with inserting the delivery location. After that drone automatically sets the current location as the home location (ground station). Then it checks whether the package is loaded or not, if the package is loaded, then the drone automatically take-off and flies to the target location. Followed by, drone lands at the given target location and waits for the customer to accept the package through the mobile app. When the package is accepted, then it releases the package from the container box and flies back to the home location. If there's any signal lost situation, then the drone automatically flies back to home location.

- Robotic Arm : it also consists of a motor driver and two gear motors, which is used for the movements of robotic arm.

i. Drone working:

- All the six rotors are spinning at the same angular velocity with three rotating clockwise and three counter clockwise, the net torque about the axis is zero (Torque).
- The motors spin propellers and they push against the air to move the drone. Once drone is flying it is able to move forward, backward, left and right by spinning each of the 6 propellers at a different speed (Thrust).
- The vertical force acting on the drone is done by all six propellers running at high speed to (lift) the drone.

ii. Automation Drone:

- Waypoint GPS Navigation allows a drone to fly on its own with its flying destination or points preplanned and configured into the drone remote control navigational software. These signals allow the module to determine its position, speed and time. The ground system (Mission Planner) maintains the range of the auto pilot. This is done through telemetry which allows real time communication and information in the form of data stream.
- The drones take the input from user and flies to the last-long or location given by the user executing the command required.

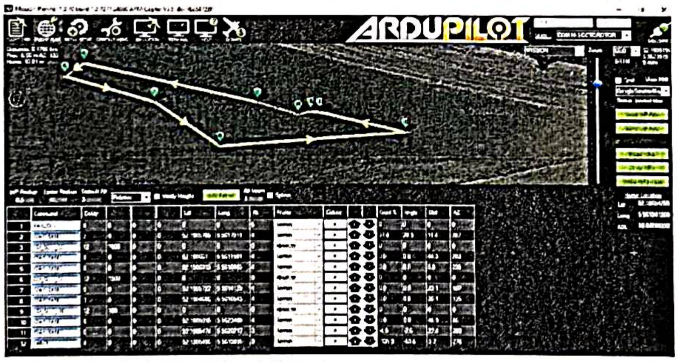

Fig 3.2: Mission Planner

- Data collected by the ground system like accelerometer, gyroscope, barometer, GPS is transferred to Pixhawk then the Pixhawk analyses the data and assigns the sensors to perform their respective function.
- Once command is executed it either returns to launch or waits for the next command.
- Using the available data, the drone moves from the source to destination and delivers the package when the transmitter switches to open the servo mechanism to release the package.

iii. Autopilot

There are many sensors in the drone which are necessary for it to fly autonomously. Inertial sensors such as an accelerometer help the drone remain in flight by providing data to allow the autopilot to adjust motor speeds (multirotor configuration) or control surface deflections (fixed-wing configuration) to steer the drone. Navigation sensors such as a GPS or magnetic sensors aid the drone to fly along a specific path or to a specific waypoint by measuring the drone's location and orientation with respect to the earth. Air flow sensors allow the drone to measure the air speed, temperature, and density, and that information maintain safe control of the aircraft. The drone may also use these sensors to estimate the wind speed and direction to assist with package delivery and/or landing maneuvers.

iv. Powertrain

Delivery drones need powerful motors to keep both the drone and payload aloft. Brushless DC motors are most typically used in drones because they have become cheap, lightweight, powerful, and small. The propeller blades of the drone turn at very high speeds, so the optimal material used for these rotor blades maximizes the strength to weight ratio. Some are made from carbon-fiber reinforced composites while others are made of thermoplastics because they are cheaper so the cost of replacement when the drone crashes is smaller. Lithium-ion batteries are used in most drones because they offer enough energy and power, and they are relatively light so they do not weigh down the drone too much.

v. Ground control system

Delivery drones rely on ground control systems both for safe operations and for their commercial operations. For safe operations, the drone operator needs to manage their fleet of aircraft and how they integrate into the broader airspace. For commercial use cases, the ground systems allow for receiving and tracking orders.