A

Project Report

On

Design and Implementation of a Raspberry Pi Controlled Drone for Women's Safety and Intervention

Submitted in partial fulfilment of the requirements for the award of degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SUBMITTED BY

1.	A. BALADAYAKAR	(22PD5A0403)
2.	B. SIVA SAI KUMAR	(21PD1A0402)
3.	D. JHANAVI	(21PD1A0413)
4.	B. MOHANA SURYANARAYANA	(22PD5A0405)
4.	Y. SAI RAMA PRATYUSHA	(22PD5A0434)

Under the esteemed guidance of

Mr. K. VEERANNA BABU, M.Tech.,

Assistant Professor

Department of Electronics & Communication Engineering

WEST GODAVARI INSTITUTE OF SCIENCE & ENGINEERING AUTONOMUS

Prakasaraopalem, Avapadu, Tadepalligudem, E.G.District

2024-2025

WEST GODAVARI INSTITUTE OF SCIENCE & ENGINEERING

Prakasaraopalem, Avapadu, Tadepalligudem, E.G.District

AUTONOMOUS

Department of Electronics and Communication Engineering

Certificate

This is to certify that the project work entitled Design and Implementation of a Raspberry Pi Controlled Drone for Women's Safety and Intervention is being submitted by A.BALADAYAKAR(22PD5A0403),B.SIVASAIKUMAR(21PD1A0402),D.JHANAVI (21PD1A0404),B.MOHANASURYANARAYANA(22PD5A0405),Y.SAIRAMAPRATYUSHA (22PD5A0434) in partial fulfillment for the award of Degree of BACHELOR OF TECHNOLOGY in ELECTRONICS & COMMUNICATION ENGINEERING to the Jawaharlal Nehru Technological University Kakinada during the academic year 2024-2025 is a record of Bonafede work carried out by them under our guidance and supervision.

Project Guide	**Head of the Department**
Mr. K. VEERANNA BABU, M.Tech.,	**Mr. L. SANKAR, M.Tech., (Ph.D)**
Assistant Professor	**Assistant Professor**

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

I am grateful to the management WISE College, Prakasaraopalem which gives us the opportunity to have profound technical knowledge. They're by enabling us to complete the seminar.

We express our deep sense of gratitude to our beloved principal **Dr. M. ARAVIND KUMAR** for his valuable guidance and permitting us to carry out this project.

We express our deep sense of gratitude to **Mr. L. SANKAR**, **Assistant Professor** and Head of the Department for the valuable guidance and suggestions, keen interest shown through encouragement extended throughout the period of project work.

We take immense pleasure to express our deep sense of gratitude to our beloved Guide Mr. **K. Veeranna Babu**, **Assistant Professor** for her valuable suggestions and rare in sights constant encouragement and inspiration throughout the project work.

We are grateful to my project coordinator and thanks to all teaching and non-teaching staff numbers those who contributed for the successful completion of our project work.

With gratitude,

1. **A. BALA DAYAKAR (22PD5A0403)**
2. **B. SIVA SAI KUMAR (21PD1A0402)**
3. **D. JHANAVI (21PD1A0404)**
4. **B. MOHANA SURYANARAYANA (22PD5A0405)**
5. **Y. SAI RAMA PRATYUSHA (22PD5A0434)**

INDEX

CHAPTER-7: CALIBRATIONS

CHAPTER 8: EXPERIMENTAL RESULTS

ABSTRACT

The increasing concern over women's safety has prompted the development of innovative technological solutions aimed at enhancing personal security. This project presents the design and implementation of a Women Protection Drone System that offers real-time assistance and monitoring during emergency situations. The drone is equipped with essential components including a GPS module, siren system, relay, Raspberry Pi controller, and GSM communication (via SIM800L) to facilitate emergency alerts and location tracking. When a threat is detected, the system can autonomously activate, fly to the GPS location shared via SMS, and initiate protective actions such as sounding a loud siren to draw attention and deter potential attackers. The drone is further enhanced with obstacle avoidance capabilities and real-time navigation using ultrasonic or LiDAR sensors.

Various experiments were conducted to evaluate the system's performance, including navigation, response time, and relay activation, under different environmental conditions. The results confirmed the drone's ability to operate reliably in both indoor and outdoor scenarios, effectively responding to emergency signals and navigating complex surroundings. Additionally, the legal and social context of women's safety is explored, along with the use of microfinance, skill development, and safety technology as protective tools. While the system showcases significant advantages such as real-time surveillance and rapid response, it also highlights areas needing further research, such as ethical considerations and system scalability. This project demonstrates the potential of autonomous aerial vehicles as a viable tool for enhancing women's security and empowering them through technology.

Key words: Pixhawk Flight Controller, Raspberry Pi, Global Positioning System (GPS), Real-Time Tracking, Camera, Integrated SOS App, Live Streaming, Siren.

LIST OF THE FIGURES

LIST OF THE TABLES

NOMENCLATURE

Abbreviation	Full Form
UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aircraft System
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
BLDC	Brushless Direct Current (Motor)
ESC	Electronic Speed Controller
FC	Flight Controller
PPM	Pulse Position Modulation
I2C	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver-Transmitter
RTL	Return to Launch
VTOL	Vertical Take-Off and Landing
LiDAR	Light Detection and Ranging
AI	Artificial Intelligence

Abbreviation	Full Form
ML	Machine Learning
RF	Radio Frequency
RC	Remote Control
SOS	Save Our Souls
HD	High Definition
RTK	Real-Time Kinematic
FPV	First-Person View
SHG	Self-Help Group
GCS	Ground Control Station
AFHDS	Automatic Frequency Hopping Digital System
USB	Universal Serial Bus
Wi-Fi	Wireless Fidelity
LTE	Long-Term Evolution
HDMI	High-Definition Multimedia Interface
CW	Clockwise

Abbreviation	Full Form
CCW	Counter - Clockwise

INTRODUCTION

1.1 WHAT IS A DRONE

A drone is an unmanned aircraft. Drones are more formally known as unmanned air aerial vehicles (UAV) or unmanned aircraft system. Essentially, a drone is a flying robot that can be remotely controlled or fly autonomously using software-controlled flight plans in its embedded systems as shown in below Figure 1.1, which work in conjunction with on board sensors and a Global Positioning System.

Fig 1.1 Basic Drone

1.2 HISTORY OF DRONE

The manned aerial vehicles (UAVs), stretches back to the 1840s with the use of unmanned balloons for warfare, evolving through World War I and II to become sophisticated reconnaissance and combat tools, and now widely used for various civilian and military applications.

During World War II and the Cold War, UAV technology advanced significantly, with the Ryan Fire bee being used in the Vietnam War for reconnaissance missions. In the 1990s and early 2000s, drones like the RQ-1

Predator and MQ-9 Reaper became crucial in modern warfare, providing surveillance and carrying out targeted strikes.

As technology improved, drones moved beyond military use into commercial and consumer markets. By the 2010s, companies like DJI revolutionized the industry with affordable, high-quality drones used for photography, agriculture, delivery services, and even drone racing. Today, drones continue to evolve, playing a vital role in industries such as construction, search and rescue, and environmental monitoring.

In However, today, drones have found civilian applications, especially in a wide range of applications for civilian use, especially in small quadcopters and octocopters. Today, drones are used for various functions, including monitoring climate change, delivering goods, aiding search and rescue operations, and filming and photography. Of course, UAVs are also an increasingly important part of the military in many countries. American armed forces have a fleet of tens of thousands of drones today, compared to just a few twenty years ago. This is dwarfed, however, by the number of drones in private use. According to the FAA, there are just over 855,000 drones registered in the U.S. as of the start of 2023.

1.3 CHARACTERISTICS

Drones, also known as unmanned aerial vehicles (UAVs), possess several key characteristics that make them highly versatile and useful across various industries. They are designed for unmanned operation, meaning they can be remotely controlled or programmed for autonomous flight using advanced navigation systems like GPS.

The Most drones are lightweight and compact, which enhances their maneuverability and flight duration. They come in different designs, such as multi-rotor drones for stability and fixed-wing drones for long-distance travel. Many drones are equipped with high-resolution cameras, enabling aerial photography, videography, and surveillance.

A women protection drone is designed with specific characteristics to ensure safety and rapid response in emergency situations. It typically features real-time video surveillance with high-resolution cameras to monitor surroundings and detect threats. GPS tracking and geofencing enable the drone to follow or locate individual.

1.4 Types of drones:

There are four major types of drones in common use.

1. Multi Rotor Drones
2. Fixed Wing Drones
3. Single Router Helicopter
4. Fixed Wing Hybrid VTOL

1.4.1 Multi Rotor Drones

In Out of all the 4 drone types (based on aerial platform), multi-rotor drones are the easiest to Multi Rotor drones are the most common types of drones which are used by professionals and hobbyists alike. They are used for most common applications like aerial photography, aerial video surveillance etc. Different types of products are available in this segment in the market – say multi-rotor drones for professional uses like aerial photography (whose price may range from 500USD to 3K USD) and there are lots of variants for hobby purposes like amateur drone racing, or leisure flying (price range from 50USD to 400USD) manufacture and they are the cheapest option available as well.

Multi-rotor drones are among the most widely used unmanned aerial vehicles (UAVs) due to their stability, maneuverability, and ease of operation. As shown in below Figure 1.2 drones use multiple propellers to generate lift and maintain control, allowing them to hover, take off, and land vertically. Depending on the number of rotors, they are classified into Tri copters (3 rotors), quadcopters (4 rotors), hexacopters (6 rotors), and octocopters (8 rotors). Each type has its own advantages, with quadcopters being the most common for personal and commercial applications, while hexacopters and octocopters are preferred for industrial and security purposes. Multi-rotor drones play a crucial role in various fields, including surveillance, photography, agriculture, defense, and emergency response, making them an essential tool in modern technology.

Fig 1.2 Multi Rotor Drones

1.4.2 Fixed Wing Drones

As shown in below Figure 1.3 Fixed Wing drones are entirely different in design and build to multi-rotor type drones. They use a 'wing' like the normal airplanes out there. Unlike multi-rotor drones, fixed models never utilize energy to stay afloat on air (fixed wing types can't stand sit on the air) fighting gravity. Instead, they move forward on their set course or asset by the guide control (possibly are mote unit operated by a human).

Single rotor drones, often considered the forerunners of modern multirotor drones, represent a unique and efficient class of unmanned aerial vehicles (UAVs). Characterized by a single large main rotor and a smaller tail rotor for stability and direction control, these drones operate similarly to traditional helicopters. While not as commonly used as multirotor systems today, single rotor drones continue to offer distinct advantages in specific applications, thanks to their aerodynamic efficiency and higher endurance.

At the core of a single rotor drone is its main rotor blade, which generates the necessary lift for flight. The tail rotor, typically mounted perpendicularly at the end of the tail boom, counters the torque effect caused by the spinning main rotor, enabling the drone to maintain stability. Unlike multirotor drones that use multiple rotors to achieve, single rotor drones rely on precise pitch adjustments in the rotor blades—a method known as collective and cyclic pitch control. This more complex mechanism is what allows them to hover, transitions.

Fig 1.3 Fixed Wing Drones

1.4.3 Single Rotor Helicopter

Single rotor drones look very similar in design & structure to actual helicopters as given in below Figure 1.4. Unlike a multi -rotor drone, a single rotor model has just one big sized rotor plus a small sized one on the tail of the drone to control its heading. In aerodynamics, the lower the count of rotors the lesser will be the spin of the object. In that sense, single rotor drones are much efficient than multi-rotor drones.

However, these machines come with much higher complexity and operational risks. Their costs are also on the higher side. Multi-rotor drones, often owing to their small rotor blades have never been involved in fatal accidents (though a scar on human body is likely). They also demand special training to fly them on air properly (though they may not need a runway or a catapult launcher to put them on air).

Fig 1.4 Single Rotor Helicopter

1.4.4 Fixed Wing Hybrid VTOL

These are hybrid versions combining the benefits of Fixed wing models (higher flying time) with that of rotor-based models (hover). This concept has been tested from around 1960’s without much success. However, with the advent of new generation sensors (gyros and accelerometers), this concept has got some new life and direction.

Given Figure 1.5 is an hybrid VTOLs are a play of automation and manual gliding. A vertical lift is used to lift the drone up into the air from the ground. Gyros and accelerometers work in automated mode (autopilot concept) to keep the drone stabilized in the air. Remote based (or even programmed) manual control is used to guide the drone on the desired course.

Additionally, the aerodynamic structure of single rotor drones allows for faster speeds and greater agility in the air. These drones can cover more ground in less time, which makes them useful in applications like agricultural monitoring, search and rescue, and military operations. In agriculture, for instance, single rotor drones can be equipped with heavy sprayers and fly longer paths over crop fields, reducing the need for multiple trips or battery changes. In search and rescue operations, their extended flight time and speed can be critical in covering large areas quickly and delivering supplies.

Despite these advantages, single rotor drones also come with certain limitations. Their mechanical complexity—particularly the moving parts in the rotor head—demands more maintenance and technical knowledge for operation. The spinning blades also pose greater safety risks during takeoff, landing, or in the event of malfunction. Additionally, single rotor drones are typically noisier than their multirotor counterparts, which can be a concern in certain civilian applications such as urban delivery or wildlife monitoring.

Fig 1.5 Fixed Wing Hybrid VTOL

1.5 Features

Drones, also known as unmanned aerial vehicles (UAVs), come with a wide range of features depending on their design and purpose. Here are some key features:

1.5.1 Autonomous Flight

Autonomous flight modes allow drones to fly without constant human control, using pre-programmed missions, GPS, or following external signals, offering features like waypoint navigation, return-to-home, and altitude hold.

- Here's a more detailed breakdown of common autonomous flight modes:
- Common Autonomous Flight Modes:
- Waypoint Navigation:
- The drone follows a pre-defined flight path with specific points (waypoints).

- Return to Home (RTL):
- The drone automatically flies back to its takeoff point, often gaining altitude first to avoid obstacles.

1.5.2 GPS and navigation

- **Satellite-based system:** The Global Positioning System (GPS) is a navigation system owned by the United States Space Force and operated by Mission Delta 31.
- **Part of GNSS:** It is one of the Global Navigation Satellite Systems (GNSS) that provide geolocation and time information.
- **Coverage:** Works anywhere on or near Earth with an unobstructed line of sight to four or more GPS satellites.
- **No data transmission required:** The user does not need to transmit any data for GPS to work.

1.5.3 Camera & Video

- High-Resolution Camera – Can capture sharp images (4K, 8K, etc.).
- Gimbal Stabilization – Keeps the camera steady for smooth videos.
- Live Video Streaming (FPV) – Lets you see what the drone sees in real-time.

1.5.4 Control & Connectivity

- Remote Control or Smartphone App – Operate with a physical remote or your phone.
- Gesture & Voice Control – Control the drone with hand gestures or voice commands.
- Long-Range Transmission – Some drones can be controlled from miles away.

1.5.5 Battery & Performance

- Flight Time – Can fly for 20 minutes to over an hour, depending on the model.

- Fast Speed – Some drones can fly over 100 km/h (especially racing drones).
- Weather Resistance – Some drones can fly in strong winds or even rain.

1.5.6 Special Features & Uses

- Capability – Can carry small packages for delivery.
- Agriculture Delivery Use – Sprays crops or monitors fields.
- Security & Surveillance – Used by police and military for safety.

1.6 APPLICATIONS OF DRONE

Drones, also known as unmanned aerial vehicles (UAVs), have a wide range of applications across various industries. Some key applications include:

1.6.1 Agriculture

- Crop monitoring and health assessment.
- Precision spraying of fertilizers and pesticides.
- Soil analysis and irrigation planning.

1.6.2 Military and Defense

- Surveillance and reconnaissance.
- Target tracking and combat operations.
- Border security and patrolling.
- Disaster relief and supply drops.

1.6.3 Security and Surveillance

- Crowd monitoring and public safety.
- Law enforcement and crime prevention.
- Perimeter security for industries and airports.

1.6.4 Logistics and Delivery

- Fast delivery of medical supplies and vaccines.
- Food and package delivery by companies like Amazon and UPS.
- Transporting goods in remote areas.

1.6.5 Healthcare and Emergency Services

- Medical supply transport in remote areas.
- Organ transportation for transplants.
- Drone-assisted telemedicine.

1.6.6 Media and Entertainment

- Aerial photography and cinematography.
- Live event streaming.
- Sports broadcasting.

Project Overview

2.1 Introduction

Women’s safety remains a significant concern worldwide, with increasing cases of harassment and violence in public and private spaces. To address this issue, technology can play a crucial role in enhancing security and providing real- time protection. The Women Protection Drone is an innovative solution designed to offer rapid response, surveillance, and emergency assistance to individuals facing danger. This autonomous drone integrates advanced features like GPS tracking, real-time video streaming, automated alerts, and self-defence mechanisms to ensure the safety of women in distressing situations. With its ability to monitor surroundings, detect threats, and provide immediate assistance, this drone aims to create a safer environment for women in both urban and remote areas.

2.1.1 Working Mechanism

- **Activation**: The drone is activated via a mobile app, wearable panic button, or voice command.
- **Surveillance & Threat Detection**: Equipped with AI-powered cameras, it monitors surroundings for unusual activities.
- **GPS Tracking & Navigation**: Utilizes GNSS to locate and follow the user in real-time.
- **Emergency Alerts**: Sends automatic alerts to emergency contacts and authorities in case of danger.
- **Defence Mechanism**: Features such as loud alarms, flashlights, and non-lethal deterrents (e.g., pepper spray release) can help neutralize threats.
- **Live Audio & Video Streaming**: Captures real-time evidence that can be used for law enforcement actions.
- **Return to Base**: Once the situation is resolved, the drone returns to its charging dock or designated home location.
- **Integration with Smart Devices**: Can be paired with smartwatches and home security systems for better coordination.

2.1.2 Use Cases

- **Personal Safety**: The drone can be deployed when a woman feels unsafe, providing surveillance and deterrence.
- **Emergency Response**: If an attack is detected, the drone can alert emergency services and nearby contacts instantly.
- **Public Security**: Deployed in high-risk areas like isolated roads, parking lots, or college campuses to monitor and prevent incidents.
- **Night-time Escorts**: Follows the user on their way home, ensuring safety in low-visibility areas.
- **Law Enforcement Support**: Assists police by providing real-time evidence in cases of harassment or assault.
- **Workplace Safety**: Provides an additional security layer for women working late hours in offices or industries.

2.1.3 Maintenance & Operational Considerations

- **Battery Management**: Ensuring optimal flight time with long-lasting, rechargeable batteries.
- **Software Updates**: Regular AI and firmware updates for improved detection and accuracy.
- **Hardware Durability**: Weather-resistant design to withstand different environmental conditions.
- **Connectivity & Security**: Encrypted communication to prevent hacking and unauthorized access.

2.1.4 Future Enhancements

- **AI-Based Threat Analysis**: Advanced machine learning algorithms to predict and prevent attacks.
- **5G Integration**: Faster communication and real-time data transfer for instant

emergency response.

- **Multi-Drone Coordination**: Network of drones for enhanced coverage in urban and rural areas.
- **Voice-Controlled Activation**: Seamless hands-free control for quick deployment.
- **Solar-Powered Charging**: Extending operational time without dependency on electrical charging stations.
- **Enhanced Night Vision**: Improving surveillance capabilities in low-light conditions.
- **Wearable Integration**: Syncing with smart wearables for quicker alerts and deployment.

2.2 Conclusion

The Women Protection Drone is a groundbreaking step towards empowering women with technology-driven security. By integrating real-time monitoring, emergency response, and self-defence mechanisms, this drone serves as a proactive measure to enhance personal safety. The implementation of this drone in both urban and rural settings can significantly reduce crime rates, create safer public spaces, and encourage independent mobility for women. By continually improving its capabilities and accessibility, this technology can revolutionize the approach to personal security, ensuring that women feel safe and protected at all times.

Block Diagram

The below given block diagram Figure 3.1 illustrates the architecture and functionality of the Women Protection Drone, showcasing how different components interact to ensure safety, surveillance, and real-time response.

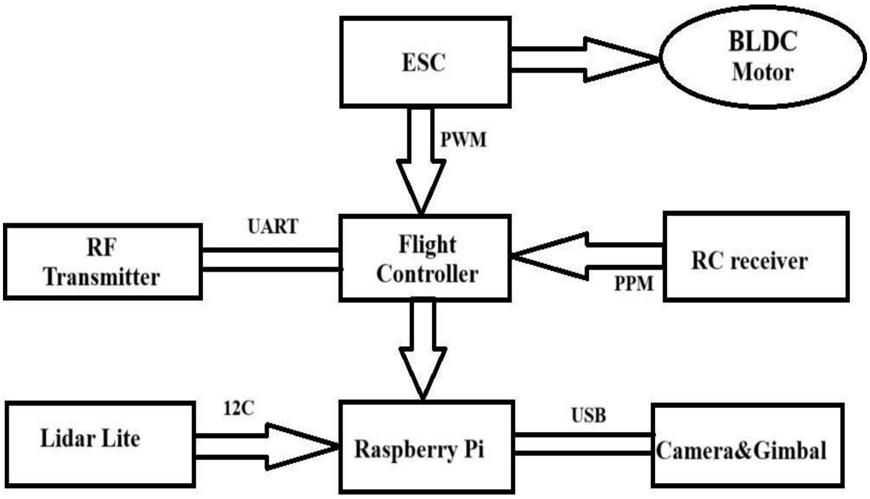

Fig 3.1 Block Diagram

3.1 Flight Controller

- The flight controller is the central processing unit of the drone, managing stabilization, movement, and communication with other modules.
- It receives inputs from different sensors and user commands, processes the data, and controls the drone's flight.

3.2 BLDC Motor & ESC (Electronic Speed Controller)

- The BLDC (Brushless DC) motor powers the drone's propellers, allowing flight.
- The ESC (Electronic Speed Controller) regulates the motor speed based on signals from the flight controller

3.3 Communication Modules

3.3.1 RF Transmitter & RC Receiver:

- The RF Transmitter is used to send remote control signals to the drone.
- The RC Receiver receives these signals and sends them to the flight controller via PPM (Pulse Position Modulation).

3.4 Raspberry Pi (AI & Processing Unit)

- The Raspberry Pi is integrated into the drone for advanced AI processing, real-time image recognition, and communication.
- It receives data from Lidar Lite, camera, and flight controller, and processes it to enhance navigation and threat detection.

3.5 Camera & Gimbal (Surveillance System)

- The camera and gimbal provide live video streaming and surveillance.
- The USB interface connects it to the Raspberry Pi for processing and data storage.
- It helps in threat detection and facial recognition.

3.6 Lidar Lite (Obstacle Detection & Navigation)

- Lidar Lite uses laser-based distance measurement to detect obstacles and avoid collisions.
- The I2C (Inter-Integrated Circuit) communication protocol is used to transmit data between the Lidar and Raspberry Pi.

3.7 Power & Connectivity

- The drone requires a battery system to power all components.
- Secure communication via UART, USB, I2C, and PPM ensures data integrity and efficient drone control.

3.8 Functionality in Women Protection Drone Context

- Real-time surveillance: The camera captures and transmits video to the user and emergency services.
- AI-based threat detection: Raspberry Pi processes images to detect potential threats.
- GPS tracking & auto-navigation: Integrated sensors help the drone follow and protect the user.
- **Emergency alerts**: The drone can send distress signals via wireless communication.
- Obstacle avoidance: Lidar assists in detecting and avoiding obstacles during flight.

HARDWARE DESCRIPTION

4.1 FRAME

As shown in Figure 4.1 F450 / Q450 Quadcopter Frame (PCB Version with Integrated PCB) + Plastic Landing Gear Combo Kit. It’s costs around 800-900 rupees only.

Specifications:

Wheelbase- 450mm

Material: Glass Fiber, Polyamide-Nylon

Arm Size (L x W) -220 x 40mm

Landing Gear Height-200mm

Motor Mounting Hole Dia.-3mm

Weight -330g

Fig 4.1 Frame

4.2 FLIGHT CONTROLLER

The Cube Orange flight controller (FC) given in Figure 4.2 is a popular choice among drone enthusiasts and professionals due to its reliability, performance, and versatility. Cube Orange runs flight controller software it providing users with a rich ecosystem of features, customization options, and community support This software flexibility ensures that the Cube Orange remains adaptable to evolving needs and technological advancements in the drone industry. Because of the above-mentioned reasons, we picked up our fc as cube orange. It’s costs around33-34k rupees only.

Another major strength of fixed-wing drones is their speed and range. These drones can travel much faster and farther than multirotor drones, making them well-suited for large-scale agricultural monitoring, pipeline inspections, and search-and-rescue missions. In agriculture, for example, a fixed-wing drone can map hundreds of acres in a single flight, providing farmers with valuable data about crop health, soil conditions, and irrigation efficiency.

Fig 4.2 Flight Controller

4.3 MOTORS AND PROPELLERS

The EMAX MT2213 935KV Brushless DC Motor for Drone, coupled with the 1045 Propeller Combo, offers a reliable propulsion solution for quadcopters. As given in below Figure 4.3 each pack includes a single motor with a matching set of propellers, encompassing both clockwise (CW) and counter clockwise (CCW) rotation. To build a quadcopter, you will need four of these motor-propeller combinations. The specific quantity of motors required depends on the frame selected for your copter.

Fig 4.3 Motors and Propellers

4.4 ESC'S

When utilizing BL Heli Series 30A Electronic Speed Controllers (ESCs) in Figure 4.4 with One shot protocol, it's crucial to ensure correct wiring, stable voltage regulation, proper calibration, configuration, and safety precautions. One shot protocol enables faster communication between the flight controller and ESCs, enhancing motor control responsiveness. The ESCs should be wired correctly to the flight controller, with power wires connected to the battery and ground wires joined. Verify the functionality of built-in voltage regulators within the ESCs to provide stable power to other components.

Fig 4.4 ESC'S

4.5 GPS

Here in Figure 4.5 3/3+ GPS is a Cost-efficient GNSS system that supports RTK mode. Positioning accuracy down to centimeter-level in an ideal environment. Improved dust and water resistance over the Here+ (Not guaranteed to be water-proof) High data rate, upgradeability, noise immunity, and real-time features from the Drone CAN protocol, with Here3+ now moving to Drone CAN 8Mbit bus speed. Here 3 is Equipped with the STM32F302 processor while the Here3+ jumps to the Dual core STM32H757 running at 400MHz with 2MByte Flash, and 1MByte RAM. Supports future firmware updates. Support from ground control software. Future updates will be available from Mission Planner. Built-in Inertial Measurement Unit (compass, gyroscope, and accelerometer), for advanced navigation needs. It’s costs around 17-18k rupees only. This connected to orange cube in can-1 port.

Fig 4.5 GPS

4.6 TRANSMITTER AND RECEIVER

Fly Sky FS-i6 6-Channel 2.4 Ghz Transmitter and FS-iA6 Receiver given below Figure 4.6 . The FlySky FS-i6 is a great low cost entry level 6-channel 2.4 GHz Transmitter and Receiver that uses solid and reliable Automatic Frequency Hopping Digital System (AFHDS) spread spectrum technology. The FlySky FS-i6 has both a nice quality look and feel, while the programming is simple to use.It also comes with a FS-iA6 6-channel receiver.

The transmitter and receiver are essential components in the operation of a multi-rotor drone, enabling wireless communication between the drone and its pilot. The transmitter is a remote control device that sends signals to the drone, while the receiver, installed in the drone, interprets these signals and translates them into movements and actions.

The transmitter works by sending radio frequency (RF) signals encoded with control commands such as throttle (altitude control), yaw (rotation), pitch (forward/backward tilt), and roll (sideways tilt). The receiver inside the drone deciphers these signals and forwards them to the flight controller, which processes the commands and adjusts the motors accordingly.

Fig 4.6 Transmitter and Recevier

4.7 RASPBERRY PI

For autonomous operations, we've integrated an onboard computer, such as the Raspberry Pi 3B+ or Raspberry Pi 4 can see in below Figure 4.7, depending on the specific requirements of your application. The choice of Raspberry Pi model is tailored to optimize performance and functionality for your intended use case.

This onboard computer serves as the brain of the operation, executing complex algorithms and decision-making processes required for autonomous flight. It communicates seamlessly with the Cube Orange flight controller via a reliable Type-B to USB cable connection, facilitating data exchange and control commands between the two systems. By leveraging the processing power and versatility of the Raspberry Pi platform, we can implement a wide range of autonomous functionalities, including real-time image processing, sensor fusion, path planning, and decision-making algorithms. Whether it's conducting aerial surveys, performing precision executing predefined missions, the Raspberry Pi empowers the drone with intelligence and autonomy Rasp pi 3b+ costs in between 3.2-3.7k and pi 4 costs of 4.5-4.7k.

The Raspberry Pi plays a crucial role in enhancing the capabilities of multi-rotor drones by enabling autonomous flight, real-time data processing, AI-powered analytics, and communication. Unlike traditional flight controllers, which focus solely on stabilization and navigation, the Raspberry Pi acts as a high- level processing unit, allowing the drone to execute complex tasks such as object detection, threat recognition, and intelligent decision-making. When integrated with GPS modules and sensors, it enables waypoint-based autonomous navigation, while AI frameworks like TensorFlow allow for real-time image processing and object tracking. Additionally, the Raspberry Pi supports 4G, 5G, and Wi-Fi connectivity, making real-time video streaming and telemetry transmission possible. In security applications such as Women Protection Drones, it can be programmed to detect threats, send distress alerts, and trigger defense mechanisms like sirens or pepper spray deployment. Furthermore, it seamlessly integrates with traditional flight controllers like Pixhawk or Ardupilot, handling high-level decision-making while the flight controller ensures stability. The computational power and flexibility of Raspberry Pi make it a valuable component in modern drone technology, enabling autonomous operations, enhanced surveillance, and

AI-driven security features.

Fig 4.7 Raspberry Pi

4.8 SIREN AND RELAY

Connecting the siren directly to a battery for power supply is a common and straightforward setup. Using a relay can be a good approach if you need to control the activation of the siren remotely or through some automated system. This setup allows for flexibility and customization in how the siren is activated and controlled.

Customizing the code to control the activation of the siren in below Figure 4.8 trigger the relay based on certain conditions or events, ensuring that the siren is activated appropriately and in accordance with established protocols. To automate the activation of the siren using a double-channel relay with some microcontroller like raspberry pi to control the relay as in below Figure 4.9. 2 channel 5V relay costs of 60 rupees only and siren costs of 180 rupees .

Using a relay can be a good approach if you need to control the activation of the siren remotely or through some automated system. This setup allows for flexibility and customization in how the siren is activated and controlled. ensuring that the siren is activated appropriately and in accordance with established protocols. To automate the activation of the siren using a double-channel relay with some microcontroller like raspberry pi to control the relay.

Fig 4.8 Siren

Fig 4.9 Relay

SOFTWARE DESCRIPTION

5.1 Intall rpi commands

Update the package lists to get the latest versions of packages and dependencies

sudo apt-get update

Upgrade all installed packages to their latest available versions

sudo apt-get upgrade

Install pip, the package manager for Python

sudo apt-get install python-pip

Install Python development headers and libraries, needed for compiling some Python modules

sudo apt-get install python-dev

Install the future library, which helps with Python 2/3 compatibility

sudo pip install future

Install additional required system libraries for graphical and XML processing support

sudo apt-get install screen wxgtk libxml libxslt

Install the pyserial package, used for serial communication in Python

sudo pip install pyserial

Install DroneKit, a Python library for communicating with and controlling drones

sudo pip install dronekit

Install MAVProxy, a command-line ground station software used for drone communication

sudo pip install MAVProxy

Set up Raspberry Pi for UART (serial) communication

Open Raspberry Pi configuration tool

raspi-config

Inside raspi-config, disable UART for console use but enable it for serial port hardware

Modify the boot configuration file to disable Bluetooth, which can interfere with UART

sudo nano /boot/config.txt

Add the following line to disable Bluetooth

dtoverlay=disable-bt

If the serial device /dev/ttyAMA0 is missing, enable UART by adding the following line to /boot/config.txt

enable_uart=

SOURCE CODE

```
# Configure the serial port for communication with the SIM800L module

list = []

from dronekit import connect, VehicleMode, LocationGlobal, LocationGlobalRelative

from pymavlink import mavutil

import time

import math

import socket

import argparse

import geopy.distance

import serial

#import face_recognition

#import picamera

import numpy as np

relay = 17

import RPi.GPIO as GPIO

GPIO.setmode(GPIO.BCM)

GPIO.setup(relay,GPIO.OUT)
```

```
GPIO.setwarnings(False)


ser = serial.Serial('/dev/ttyAMA0', 9600, timeout=1)

def turn_on():

    GPIO.output(relay, GPIO.HIGH) # Turn on the relay

    print("Relay turned ON")

def turn_off():

    GPIO.output(relay, GPIO.LOW) # Turn off the relay

    print("Relay turned OFF")

turn_off()

time.sleep(1)

turn_on()

time.sleep(1)

turn_off()

#connect to drone

def connectMyCopter():

  parser = argparse.ArgumentParser(description='commands')

  parser.add_argument('--connect')

  args = parser.parse_args()

  connection_string = args.connect
```

```
  baud_rate = 57600
  print("\nConnecting to vehicle on: %s" % connection_string)
  vehicle = connect(connection_string,baud=baud_rate,wait_ready=True)
  return vehicle
#arm and takeoff to meteres
def arm_and_takeoff(aTargetAltitude):
    """
    Arms vehicle and fly to aTargetAltitude.
    """
    print("Basic pre-arm checks")
    # Don't let the user try to arm until autopilot is ready
    while not vehicle.is_armable:
        print(" Waiting for vehicle to initialise...")
        time.sleep(1)
    print("Arming motors")
    # Copter should arm in GUIDED mode
    vehicle.mode = VehicleMode("GUIDED")
    vehicle.armed = True
    time.sleep(3)
    print("Taking off!")
```

```
    vehicle.simple_takeoff(aTargetAltitude) # Take off to target altitude

    # Wait until the vehicle reaches a safe height before processing the goto (otherwise the
command

    # after Vehicle.simple_takeoff will execute immediately).

    while True:

        print(" Altitude: ", vehicle.location.global_relative_frame.alt)

        if vehicle.location.global_relative_frame.alt>=aTargetAltitude*0.95: #Trigger just
below target alt.

            print("Reached target altitude")

            break

        time.sleep(1)

def get_dstance(cord1, cord2):

    #return distance n meter

    return (geopy.distance.geodesic(cord1, cord2).km)*1000

def goto_location(to_lat, to_long):

    print(" Global Location (relative altitude): %s" %
vehicle.location.global_relative_frame)

    curr_lat = vehicle.location.global_relative_frame.lat

    curr_lon = vehicle.location.global_relative_frame.lon

    curr_alt = vehicle.location.global_relative_frame.alt

    # set to locaton (lat, lon, alt)
```

```
    to_lat = to_lat
    to_lon = to_long
    to_alt = curr_alt
    to_pont = LocationGlobalRelative(to_lat,to_lon,to_alt)
    vehicle.simple_goto(to_pont, groundspeed=8)
    to_cord = (to_lat, to_lon)
    while True:
        curr_lat = vehicle.location.global_relative_frame.lat
        curr_lon = vehicle.location.global_relative_frame.lon
        curr_cord = (curr_lat, curr_lon)
        print("curr location: {}".format(curr_cord))
        distance = get_dstance(curr_cord, to_cord)
        print("distance ramaining {}".format(distance))
        if distance <= 2:
            print("Reached within 2 meters of target location...")
            break
        time.sleep(1)
def send_command(command):
    ser.write(command.encode() + b'\r\n')
    time.sleep(1)
```

```
    response = ser.read_all().decode()
    return response
def setup_sim800l():
    send_command('AT')
    send_command('AT+CMGF=1')
    send_command('AT+CNMI=1,2,0,0,0')
def read_serial():
    while ser.in_waiting:
        line = ser.readline().decode().strip()
        list.append(line)
        # You can add your SMS handling logic here
def main():
    setup_sim800l()
    z = 0
    while z == 0:
        read_serial()
        print(list)
        for i in list:
            if "google" in i:
                z = 1
```

```
        break
main()
print("breaked")
lg = list[-1]
lat1s = lg.index("query=") + 6
lat1e = lg.index("%")
#latitude = float(lg[lat1s:lat1e])
#print(latitude)
longi1s = lg.index("C") + 1
#longitude = float(lg[longi1s:])
#print(longitude)
time.sleep(5)
vehicle = connectMyCopter()
time.sleep(2)
ht = 20
arm_and_takeoff(ht)
turn_on()
#GPIO.output(relay,True)
latitude = float(lg[lat1s:lat1e])
print(latitude)
```

```
longitude = float(lg[longi1s:])

print(longitude)

time.sleep(2)

goto_location(latitude,longitude)

#GPIO.output(relay,False)

time.sleep(10)

turn_off()

print("Returning to Launch")

vehicle.mode = VehicleMode("RTL")
```

CALIBRATIONS

Drones have become an essential tool in various fields, including security, agriculture, and surveillance. Proper calibration ensures accurate flight control, stability, and precise data collection. This document will discuss the calibration process for drones and the use of software to enhance their performance, particularly for a drone.Choose an open space away from magnetic interference, tall structures, and power lines.Software is ground control station (GCS) in Mission planner of Mandstery hardware.

7.1 TYPES OF CALIBRATIONS

1. Frame Type
2. Accel Calibration
3. Compass Calibration
4. ESC'S Calibration
5. Radio Calibration
6. Flight Modes

7.1.1 Frame Type:

As shown in Figure 7.1 Frame type calibration in drones is a crucial process that ensures the drone's structural integrity, stability, and performance. Since the frame is the foundation of a drone, incorrect calibration can lead to flight instability, vibration issues, and sensor misalignment. This guide provides an in-depth explanation of frame-type calibration, its importance, and the steps required to achieve optimal results.

Drones come in various frame types, each designed for specific applications. The most common types include:

Drones come in various frame types, each designed for specific applications.

The most common types include

- **Quadcopter Frame –** Four rotors, commonly used in aerial photography and surveillance.
- **Hexacopter Frame –** Six rotors, offering redundancy and stability.
- **Octocopter Frame –** Eight rotors, used for heavy payloads.
- **Fixed-Wing Frame –** Airplane-like design, suitable for long-range operations.
- **Hybrid Frame –** Combines multirotor and fixed-wing capabilities for VTOL (Vertical Take-Off and Landing).

Each frame type requires specific calibration to ensure that sensors, motors, and structural components function correctly.

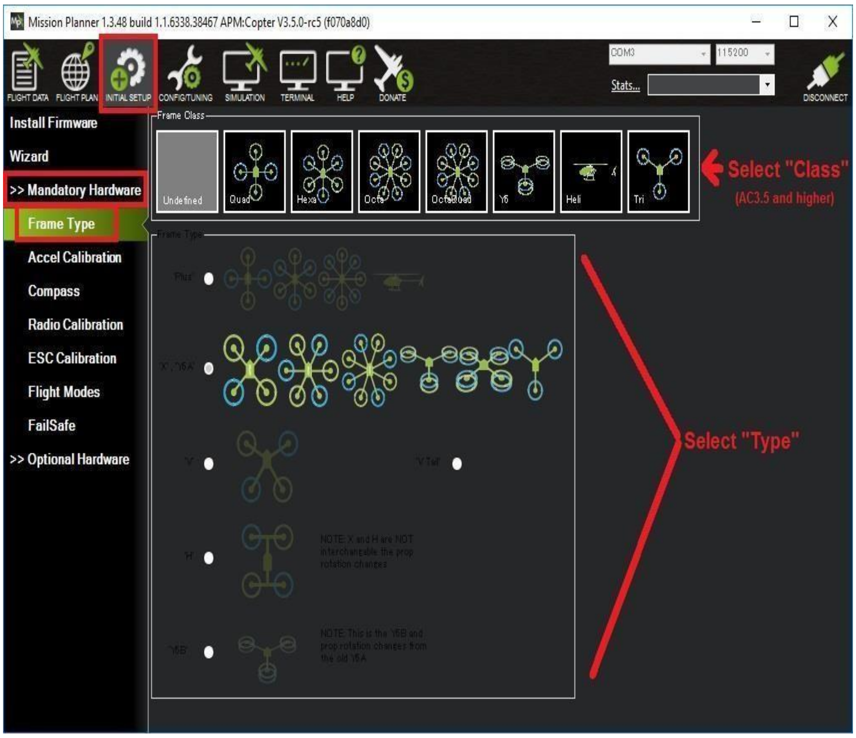

Fig 7.1 Frame Type Calibration

7.1.2 Accel Calibration

- **Calibrate Sensors**
  - After updating the firmware, navigate to the "Initial Setup" menu again.
  - Click on "Mandatory Hardware" and then select "Calibrate Accelerometer."
- **Follow On-Screen Instructions**
  - Follow the on-screen instructions provided by Mission Planner to perform the accelerometer calibration.
  - This usually involves placing your Pixhawk in different orientations to allow the sensors to calibrate properly.
- **Orientation Changes**
  - Place your Pixhawk on a stable surface and follow the prompts to rotate it or place it in specific orientations as instructed by Mission Planner.
- **Wait for Calibration to Complete**
  - Allow the calibration process to complete. This may take a few minutes.
- **Verify Calibration**
  - After the calibration is successful, Mission Planner will confirm and display a message indicating that the accelerometer calibration is complete.
- **Save and Reboot**
  - Save the calibration parameters and reboot your Pixhawk for the changes to take effect.

➢ **Verify Results**

- After rebooting, reconnect your Pixhawk to Mission Planner and check the sensor readings to ensure they are stable and accurate.

That's it! You've successfully calibrated the accelerometer on your Pixhawk using Mission Planner. Keep in mind that the steps might slightly vary based on the Mission Planner version, but the general process remains the same. Always refer to the Mission Planner documentation for the most up-to-date and accurate instructions following below Figure 7.2.

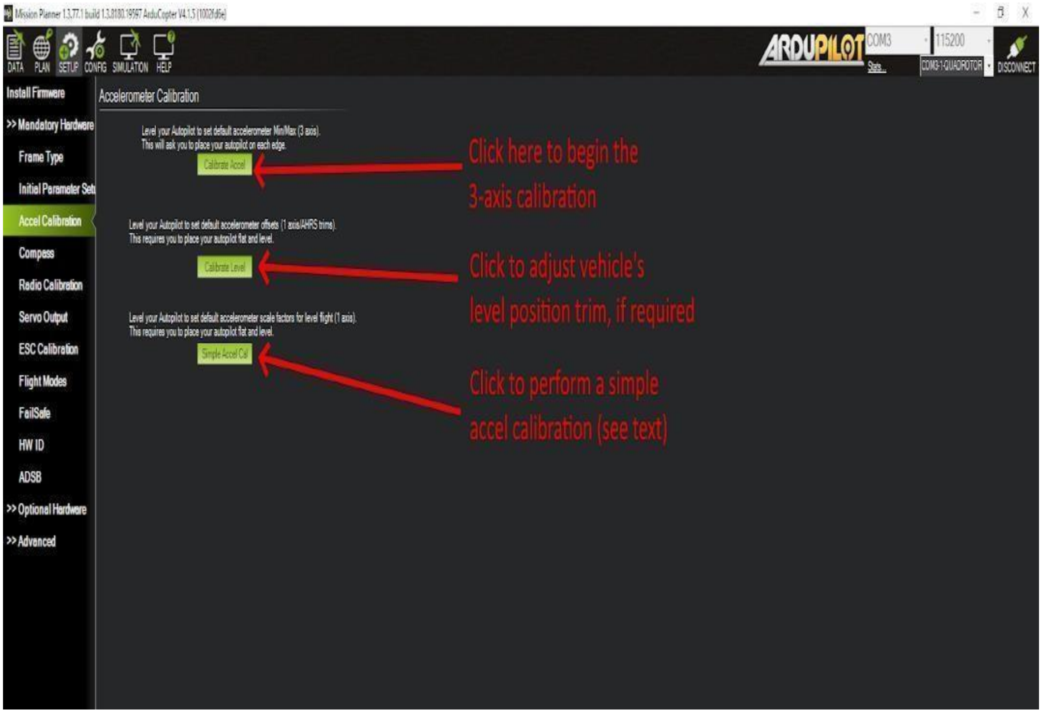

Fig 7.2 Accel calibration

7.1.3 Compass Calibration

Certainly! As showun in Figure 7.3 Compass calibration is crucial for accurate navigation and heading information on your Pixhawk. Here's a step-by-step guide on how to perform Compass calibration using Mission Planner**:**

a Click on "Mandatory Hardware" and then select "Compass."

- **Start Compass Calibration**
    - Click on the "Live Calibration" button to start the compass calibration process.
- **Follow On-Screen Instructions**
    - Follow the on-screen instructions provided by Mission Planner to perform the compass calibration.
    - Typically, this involves physically rotating and tilting the Pixhawk in various directions to allow the compass to capture data.
- **Rotate the Vehicle**
    - Rotate the vehicle around all three axes (pitch, roll, and yaw) while holding it level.
- **Tilt the Vehicle**
    - Tilt the vehicle forward and backward to ensure the calibration captures data in different orientations.
- **Complete Calibration**
    - Once the calibration process is complete, Mission Planner will display a message indicating the success of the compass calibration.
- **Save and Reboot**
    - Save the calibration parameters and reboot your Pixhawk for the changes to take effect.
- **Verify Results**
    - After rebooting, reconnect your Pixhawk to Mission Planner and check the compass readings to ensure they are stable and accurate.

That's it! You've successfully calibrated the compass on your Pixhawk using Mission Planner. Always refer to the Mission Planner documentation for the most up-to-date and accurate instructions, as the software may be updated over time.

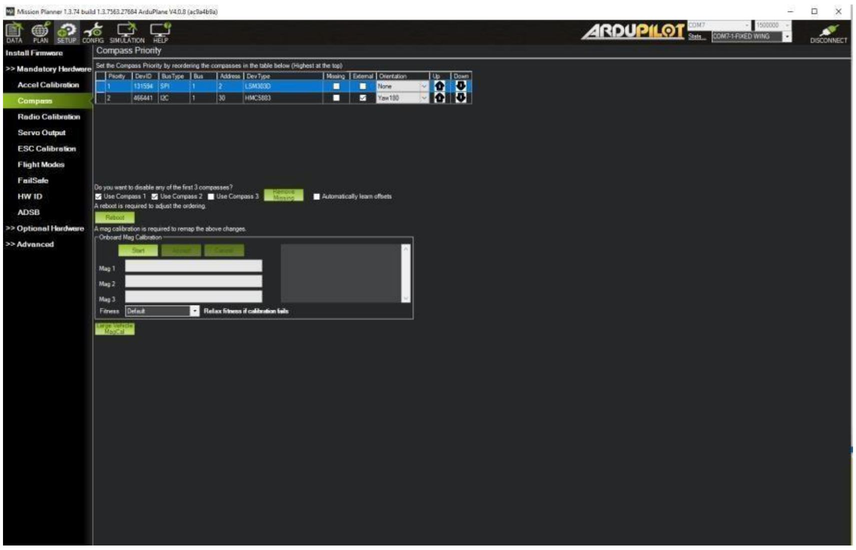

Fig 7.3 Compass Calibration

7.1.4 ESC'S Calibration

Certainly! ESC (Electronic Speed Controller) calibration given in Figure 7.4is essential to ensure that the Pixhawk and the connected motors operate correctly and respond accurately to throttle inputs. Here's a step-by-step guide on how to perform ESC calibration using Mission Planner.

Begin the calibration process by launching the Mission Planner software. Navigate to the "Initial Setup" tab in the left panel. From the drop-down list, select "Mandatory Hardware." This section includes essential components that need to be configured before the drone is flight-ready, such as accelerometers, compass, radio control, and ESCs. The ESC calibration ensures that your motors respond correctly to throttle signals.

➢ **Choose "Mandatory Hardware"**

- Select "Mandatory Hardware" from the list of options under "Initial Setup."

- **Calibrate ESCs**
  - Click on "Calibrate ESC" to enter the ESC calibration wizard.
- **Disconnect Battery**
  - Disconnect the battery from the power distribution board to ensure safety during calibration.
- **Connect Battery**
  - Reconnect the battery while holding down the safety switch on your Pixhawk.
- **Wait for Tones**
  - You'll hear a series of tones from the motors indicating that the ESCs are in calibration mode. After a few seconds, you may hear a different set of tones.
- **Throttle Up**
  - Move the throttle stick on your RC transmitter to the maximum position (full throttle).
- **Throttle Down**
  - Move the throttle stick to the minimum position (full brake).
- **Tones Indicating Calibration**
  - After performing the throttle up and throttle down steps, you'll hear confirmation tones from the motors.
- **Disconnect Battery**
  - Disconnect the battery again.

- **Reconnect Battery**

  - Reconnect the battery without holding down the safety switch.

- **Check Motor Movement**

  - Confirm that the motors make a startup tone and that they respond appropriately to throttle inputs on your RC transmitter.

- **Save and Reboot**

  - Save the calibration parameters and reboot your Pixhawk for the changes to take effect.

- **Verify Calibration**

  - After rebooting, reconnect your Pixhawk to Mission Planner and check the motor response to ensure the ESC calibration was successful.

That's it! You've successfully calibrated the ESCs on your Pixhawk using Mission Planner. Always follow safety precautions during calibration, and refer to the Mission Planner documentation for any software version-specific instructions.

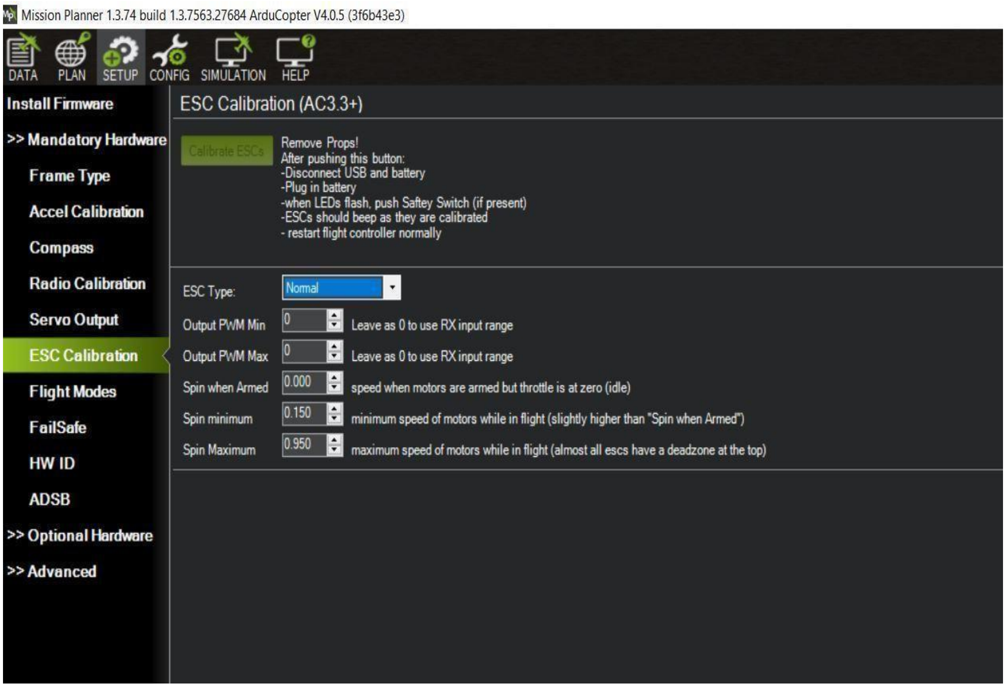

Fig 7.4 ESC's Calibration

7.1.5 Radio Calibration

Certainly! Radio calibration given in Figure 7.5 is an important step to ensure that your RC transmitter is properly configured with the Pixhawk, allowing accurate control of your vehicle. Here's a step-by-step guide on how to perform radio calibration using Mission Planner:

➢ **Choose "Mandatory Hardware"**

- Select "Mandatory Hardware" from the list of options under "Initial Setup."

➢ **Calibrate Radio**

- Click on "Calibrate Radio" to enter the radio calibration wizard.

➢ **Follow On-Screen Instructions**

- Follow the on-screen instructions provided by Mission Planner to perform the radio calibration.

- **Move Controls through Full Range**
  - Move each control stick and switch on your RC transmitter through its full range of motion. This ensures that Mission Planner captures the minimum and maximum values.
- **Check Calibration Values**
  - Once you've moved all the controls through their full range, you should see the calibration values update in Mission Planner. Ensure that the values correspond to the movements of your RC transmitter controls.
- **Verify Channel Movement**
  - Check the movement of the on-screen bars corresponding to each channel in Mission Planner. They should move smoothly and cover the entire range.
- **Save Calibration**
  - Click on the "Done" or "Save" button to save the radio calibration settings.
- **Check Throttle Safety**
  - Verify that the throttle safety switch on your RC transmitter is working correctly. This is important for preventing accidental motor starts.
- **Save and Reboot**
  - Save the calibration parameters and reboot your Pixhawk for the changes to take effect.
- **Verify Calibration**
  - After rebooting, reconnect your Pixhawk to Mission Planner and check the radio calibration values to ensure they are accurate.

That's it! You've successfully calibrated the radio on your Pixhawk using Mission Planner. Always follow safety precautions during calibration, and refer to the Mission Planner documentation for any software version-specific instructions.

Fig 7.5 Radio calibration

7.1.6 Flight Modes

Configuring flight modes on your Pixhawk is crucial for defining how your aircraft responds to different inputs and situations. Here's a step-by-step guide on how to set up flight modes using Mission Planner:

- **Click on "Flight Modes"**
  - On the left side of the Mission Planner window, you will see a menu. Click on "Flight Modes."
- **Choose Desired Flight Mode**
  - You'll see a list of flight modes such as "Stabilize," "Alt Hold," "Loiter," etc.

- Click on the dropdown menu next to each flight mode to select the desired behavior for each position of your flight mode switch on the RC transmitter.

➢ **Assign Flight Modes to RC Switch**

- Set up your RC transmitter so that one of the channels is assigned to the flight mode switch.

- Move the switch on your RC transmitter to different positions, and you should see the corresponding flight mode change in Mission Planner.

➢ **Verify Changes**

- Confirm that the flight modes are updating correctly in Mission Planner as you move the RC transmitter switch.

➢ **Adjust Settings if Necessary**

- You may need to fine-tune the parameters for each flight mode based on your preferences and the requirements of your vehicle. Adjust the parameters accordingly.

➢ **Save Configuration**

- Once you have set up the desired flight modes and verified their functionality, click on the "Write Params" button to save the configuration to your Pixhawk.

➢ **Verify Flight Mode Changes in Flight Data**

- Return to the "Flight Data" tab and verify that the flight modes are displaying correctly on the screen as you toggle the switch on your RC transmitter.

➢ **Perform a Safety Check**

- Before flying, perform a safety check by manually moving the control surfaces and observing how the Pixhawk responds in each flight mode.

➢ Test in Controlled Environment

- Conduct test flights in a controlled environment to ensure that the configured flight modes behave as expected.

That's it! You've now successfully configured the flight modes on your Pixhawk flight controller using Mission Planner in below Figure 7.6. This crucial step ensures your drone responds appropriately to different control inputs and mission conditions, depending on the mode selected. Flight modes such as Stabilize, Alt Hold, Loiter, RTL (Return to Launch), Auto, and others each offer unique control characteristics and are designed for different phases of flight or types of operation. It's important to carefully assign and test each mode, ensuring they align with the drone's design, your personal flying style, and the specific mission objectives — whether it's manual flight, GPS-assisted navigation, autonomous missions, or emergency fail-safes. Always double-check the radio transmitter channel mapping and ensure that your mode switches trigger the correct behaviours. Before conducting actual flights, simulate and test these modes in a safe environment to prevent unexpected behaviour. Additionally, it's wise to refer to the latest Mission Planner documentation for updates, as newer software versions might introduce changes in mode settings or additional features. Proper configuration and testing of flight modes significantly enhance safety, control, and reliability during drone operations.

Fig 7.6 Test in Control Environment

EXPERIMENTAL RESUITS

8.1 Introduction

The proposed Women Protection Drone System was tested in a real-time simulated environment to evaluate its efficiency, responsiveness, and practical applicability in emergency scenarios. The system integrates a mobile application, Raspberry Pi-controlled drone, GPS module, real-time communication systems, and AI-powered surveillance functionalities to ensure immediate response during threats.

8.2 Scenario Setup

To validate the performance, we created a simulation where a woman, while traveling alone outdoors, encounters a potential threat. She launches the Women Protection App on her mobile phone and taps the **SOS** button environments.

8.3 System Response Flow

1. **SOS Activation:**

- The app immediately captures the woman's real-time GPS coordinates and sends an alert message to the Control Centre as shown in below Figure 8.1.
- The backend server processes the received location and triggers an automated drone deployment.

Fig 8.1 SOS Activation

2. Drone Activation:

- Upon receiving coordinates, the Women Protection Drone (equipped with Raspberry Pi and GPS) autonomously initiates flight.
- Using the Here 3 GPS module, the drone navigates precisely to the target location can see in below Figure 8.2

Fig 8.2 Drone Activation

3. On-Site Surveillance and Alerts:

- As the drone approaches, it begins emitting an alert siren through the onboard relay and siren module to attract public attention and potentially scare off the assailant can see in Figure 8.3.
- Simultaneously, the Raspberry Pi activates the camera system to capture live images and record video footage of the surroundings.
- The system uses AI-based image recognition algorithms to identify and log suspicious activity or individuals.

Fig 8.3 On-Site Surveillance and Alerts

4. Data Transmission:

- All recorded visual data (images and video) is transmitted back to the Control Centre in real-time via Wi-Fi or LTE dongle (based on available connectivity) can see in below Figure 8.4.
- These visuals serve as evidence for law enforcement and legal processing.

Fig 8.4 Data Transmission

1. Navigation and Obstacle Avoidance:

- The drone's Lidar Lite module ensures safe navigation by detecting and avoiding any obstacles in real-time given in below Figure 8.5.

Fig 8.5 Navigation and Obstacle Avoidance

8.4 Key Observations

Refer below table 8.1 for key observation.

Test Case	Expected Outcome	Actual Outcome	Status
SOS Button Press	Alert message sent to control centre with GPS location	Alert successfully delivered within 3 seconds	✓
Drone Launch	Drone should autonomously fly to target GPS	Drone reached target location with <2m error	✓
Siren Activation	Siren should start upon reaching the scene	Siren activated at ~5 meters from target	✓
Camera Capture	Drone must start live recording and image capture	Clear images and videos recorded	✓
Data Transmission	Visuals to be sent to Control Centre	Successful real-time video streaming	✓
Obstacle Avoidance	Avoid collision during flight	Obstacle-free navigation confirmed	✓

Table 8.1 Key Observations

8.5 Result Summary

The experiment confirmed that the **Women Protection Drone System**:

- Responds quickly to emergency signals.
- Navigates accurately using GPS.
- Efficiently captures and transmits critical data.
- Draws public attention through audio alerts.

Operates autonomously with minimal manual intervention

These results validate the feasibility of deploying such a drone system as a real-time protective and investigative tool in women's safety applications. The integration of AI, GPS navigation, and real-time communication makes it a powerful addition to smart city and law enforcement infrastructures.

8.6 Observations and Preliminary Conclusions

Initial results indicated promising functionality of the navigation system. The drone was able to successfully bypass multiple obstacles with minimal delay and maintain a stable flight path throughout. While some minor latency was observed in highly congested zones, the algorithm managed to recover and reroute effectively. These tests demonstrate the potential of the Women Protection Drone as a reliable companion for personal safety, capable of operating independently in complex environments.

Further experiments will be conducted to assess additional modules like SMS Alert Triggering**,** Siren Activation**,** and Video Feed Analysis under varied circumstances including crowded urban spaces and poor weather conditions.

APPLICATIONS

9.1 Legal Framework For Women Protection

➢ **Domestic Violence Laws**

- Criminalize domestic abuse, provide protective orders, and establish s upportmechanisms for survivors (e.g., Protection of Women from Domestic Violence Act, 2005 in India).

➢ **Anti-Trafficking Laws**

- Prevent forced labor and sexual exploitation.

➢ **Inheritance and Property Rights**

- Ensure women have equal property and inheritance rights.
- Reduce dependency on male family members, especially in rural areas.
- Empower women to own land and assets, improving long-term security.

9.2 Economic Empowerment as a Form of Protection

➢ **Microfinance Programs**

- Provide small loans and financial support for women entrepreneurs.
- Enable self-reliance and reduce vulnerability to financial abuse.
- Encourage women to form Self-Help Groups (SHGs), fostering peer support and community development.

➢ **Skill Development and Employment Programs**

- Equip women with marketable skills.

- Include features such as panic buttons, fake calls, route tracking, and community alert systems.

- Promote community engagement by allowing users to rate public spaces based on safety.

9.3 Technology for Women’s Protection

➢ **Safety Apps**

- Applications like bSafe, My Safetipin, and Hollaback! help women share their location and seek assistance in emergencies.

- Include features such as panic buttons, fake calls, route tracking, and community alert systems.

- Include features such as panic buttons, fake calls, route tracking, and community alert systems.

➢ **Online Harassment Protection**

- Strengthen cybersecurity laws to tackle online abuse and harassment.

- Encourage safe reporting mechanisms on social media platforms.

- Provide digital literacy programs to help women recognize and respond to cyber threats.

- Utilize AI and automated moderation tools to detect and prevent abusive content in real-time.

ADVANTAGES

10 Advantages

10.1.1 Rapid Emergency Response

- Provides quick assistance during distress situations.

10.1.2 Real-time Surveillance

- Monitors and records incidents for evidence.

10.1.3 GPS Tracking & Alerts

- Sends location-based alerts to authorities and guardians.

10.1.4 Night Vision & Thermal Imaging

- Helps in dark or low-visibility conditions

10.1.5 Automated SOS Feature

- Can be activated automatically upon detecting danger.

10.1.6 Loud Alarm System

- Alerts nearby people and scares away attackers.

FUTURE SCOPE

Women’s safety is a crucial issue worldwide, and technology can play a significant role in addressing it. Drones, equipped with advanced sensors, AI-based threat detection, and emergency response systems, can revolutionize personal security. In the future, these drones will become smarter, more autonomous, and more accessible to the public. This chapter discusses the future advancements and potential applications of women protection drones.

Future advancements in women protection drones will significantly enhance safety through the integration of Artificial Intelligence (AI) and Machine Learning (ML). These technologies will enable drones to autonomously detect threats by analyzing body language, facial expressions, and behavioral patterns. They will be able to distinguish between normal and aggressive actions, triggering immediate protective responses if danger is sensed. Additionally, voice recognition systems will help identify distress calls and activate emergency protocols automatically, ensuring quick response without requiring manual intervention.

GPS tracking will also evolve to offer centimeter-level precision, greatly improving location accuracy and response time. Smart geofencing will allow users to define safe zones, and if someone moves beyond these boundaries, the drone will instantly alert emergency contacts. As cities become smarter, these drones can be integrated into the urban infrastructure, allowing authorities to dispatch drones to high-risk areas automatically. Cloud- based automatic recording will ensure that all footage is securely stored and available for legal use, while real-time facial recognition can be used to cross-reference individuals with criminal databases.

In low-light or nighttime conditions, drones use night vision and thermal imaging to detect hidden individuals. These sensors work effectively even in shadows or behind objects. Smart obstacle avoidance systems enhance navigation in crowded urban areas. Technologies like LiDAR and ultrasonic sensors enable precise maneuvering. This ensures reliable operation in complex environments and poor lighting.

CONCLUSION

The women protection drone was conceptualized and developed as a technological solution to enhance personal security, particularly for women facing threats in public and private spaces. With cutting-edge features such as AI-powered surveillance, GPS tracking, emergency alert systems, and real-time monitoring, this drone aims to provide an extra layer of safety by acting as both a deterrent and a rapid response system in times of crisis.

The structured experiments conducted on the Women Protection Drone prototype revealed several key insights into its operational strengths and areas for enhancement. The drone demonstrated reliable navigation in both indoor and outdoor settings using ultrasonic and infrared sensors to avoid static obstacles, though dynamic obstacles like moving people posed challenges. Enhancements such as AI-driven predictive algorithms and LiDAR technology are recommended for better obstacle anticipation and precise 3D mapping. The drone also succeeded in real-time HD video streaming to both mobile and monitoring stations, though latency was an issue in low network areas. Incorporating edge computing and stabilization techniques like gimbal-mounted cameras and software-based noise reduction could improve video clarity and responsiveness. Adding thermal imaging would further boost performance in low-visibility conditions. GPS tracking showed acceptable accuracy within a 2–5 meter range, but for critical emergency scenarios, upgrades to RTK GPS and integration with geofencing can offer centimeter-level precision and safer zone monitoring.

The emergency alert system functioned effectively, triggering through both manual and automated methods while sending alerts via SMS, push notifications, and sirens. However, network dependence led to occasional delays, which could be resolved using mesh networking for multi-device communication in low-coverage areas. Future upgrades may include AI-based voice recognition and emotion analysis to automatically detect distress.

Battery life ranged between 20–30 minutes per charge, suitable for short missions but insufficient for extended operations. This limitation can be addressed by integrating solar charging modules, deploying wireless charging pads in urban spaces, and exploring graphene-based super capacitors for enhanced energy density and rapid charging. Overall, the experiments affirm the drone's promise while identifying clear paths for technological improvement.

References

1. Nikola Tesla (1898), *Wireless Remote-Control System*, U.S. Patent No. 613809. Foundation of remote-controlled technologies, essential for drone operations.

2. Abraham Karem (1980), *Development of Modern UAVs*, DARPA Revolutionized endurance and reliability in UAVs, enabling long-range missions.

3. Trevor Lloyd Smith (2003), *UAV Surveillance System*, U.S. Patent No. 6585391. Introduced advanced drone surveillance and real-time video transmission.

4. Michae lOborne (2011),*Mission Planner Software for Drone* Open-source GCS software used for UAV telemetry, ission automation, and drone control.

5. Kalpana Chawla (1997), *Satellite-based Earth Observation Systems*, NASA. Inspired aerial monitoring strategies now seen in safety drones.

6. Dr. Vijay Kumar (2012), *Swarm Drone Coordination and Navigation*, University of Pennsylvania.
Demonstrated drone collaboration for coverage in safety and rescue missions.

7. Dr. Tessy Thomas (2008), *Guided Missile Navigation Systems*, DRDO, India. Critical for drone navigation and precision path-following.

8. Anurag Sinha (2017), *Raksha- GPS Women Safety Device*. Portable alert system that inspired integration of location-based emergency alerts in drones.

9. Jaya Prakash (2019), *Drone-based Emergency Alert System for Women*, IEEE Xplore. Combined drone surveillance with real-time alerts for women in danger.

10. Rakesh Sharma (1984), *ISRO Space-based Surveillance Missions*. Provided insights for high-altitude, wide-area observation strategies.

11. G. Theivanathan et al. (2021), *Women Safety Patrolling Drone Using Machine Learning ,IoT, and Cloud Computing* IJSR. Highlighted the use of AI and IoT in autonomous safety drones.

12. Mohamed Farith et al. (2021), *Women Safety Security using Drones (UAV)*, Valliammai Engineering College Focused on drones integrated with GPS and cameras for surveillance of women in distress.