ABSTRACT

This document presents an overview of a state-of-the-art autonomous multipurpose drone designed to excel across a diverse range of applications with minimal human intervention. The drone integrates cutting-edge technology to provide robust and adaptive solutions for various sectors, including surveillance, environmental monitoring, agriculture, and emergency response.

At the core of its design is an advanced autonomous flight control system, enabling the drone to operate with precision and reliability in complex and dynamic environments. The drone is equipped with a suite of high-resolution cameras, including optical and thermal imaging sensors, which facilitate detailed data collection and real-time monitoring. Its GPS-guided navigation system ensures accurate positioning and path planning, allowing the drone to execute missions with high efficiency.

Overall, the autonomous multipurpose drone represents a significant advancement in unmanned aerial technology, providing enhanced operational capabilities and flexibility across multiple fields. Its integration of autonomous systems and adaptable features positions it as a valuable tool for modern applications, optimizing efficiency, accuracy, and safety in complex and demanding scenarios.

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1. INTRODUCTION

1.1 ABOUT THE PROJECT

The development of autonomous drones has made significant strides in recent years, pushing the boundaries of what is possible in unmanned aerial vehicle (UAV) technology. This mini project report presents the design and capabilities of an innovative autonomous drone equipped with six wings, engineered to deliver advanced performance and versatility for a range of applications.

Central to the functionality of this drone is the Pixhawk 2.4.8 flight controller, a highly regarded component in the UAV industry known for its reliability and precision. The Pixhawk 2.4.8 integrates seamlessly with Mission Planner software, which is utilized for both firmware updates and mission planning. This combination ensures that the drone operates with optimized performance and adaptability, making it suitable for a variety of tasks with minimal user intervention.

One of the key features of the drone is its impressive flight endurance, offering a flight time of 20 to 30 minutes on a single charge. This extended operational period enhances the drone’s effectiveness in applications such as surveillance, environmental monitoring, and search and rescue missions, where prolonged aerial coverage is essential.

Versatility is another cornerstone of this drone's design. With its modular capabilities, the drone can be adapted for multiple purposes with minimal to no modifications. Whether employed for aerial photography, infrastructure inspection, or agricultural monitoring, the drone's flexibility allows it to be customized for specific needs, maximizing its utility across various fields.

1.2 OBJECTIVE

The primary objective of this project is to develop a highly adaptable and reliable autonomous drone with a six-wing configuration, optimized for a range of applications through the integration of advanced flight control and planning technologies. Specifically, the objectives of this project are:

1. **Implement Advanced Flight Control**: Integrate the Pixhawk 2.4.8 flight controller to ensure precise and stable flight performance, enabling the drone to operate autonomously with high reliability.
2. **Utilize Mission Planning Software**: Employ Mission Planner software for firmware management and mission planning, allowing for seamless programming and execution of complex flight paths and tasks.
3. **Achieve Extended Flight Endurance**: Design the drone to achieve a flight time of 20 to 30 minutes, providing sufficient operational duration for extended missions and diverse application needs.
4. **Ensure Safety and Reliability**: Incorporate a fail-safe system to handle critical situations such as low battery or signal loss, ensuring safe and controlled responses to prevent potential damage or loss of the drone.
5. **Enhance Versatility and Adaptability**: Develop a modular drone that can be easily adapted for various purposes, such as surveillance, environmental monitoring, and agricultural assessment, with minimal modifications required for different tasks.

These objectives aim to deliver a versatile and high-performance autonomous drone that meets the demands of modern UAV applications while maintaining a focus on safety, reliability, and extended operational capability.

1. SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

Drone technology has advanced rapidly over the past decade, with significant improvements in flight stability, control systems, and application versatility. Modern drones are equipped with sophisticated components such as GPS navigation systems, high-resolution cameras, and advanced sensors, making them valuable tools in various fields including surveillance, agriculture, infrastructure inspection, and environmental monitoring. Key developments include:

1. **Enhanced Flight Controllers**: Many drones now use advanced flight controllers that offer improved stability, precision, and autonomous flight capabilities.
2. **Longer Flight Times**: Battery technology has progressed, resulting in drones capable of longer flight durations and extended operational range.
3. **Improved Communication Systems**: Advances in communication technology have enabled better real-time data transmission and remote-control capabilities.
4. **Modular Payload Systems**: Many drones feature modular designs that allow for the easy attachment and swapping of different sensors and cameras to suit various applications.

1.1.1 Disadvantages of Existing System

Despite these advancements, several disadvantages persist in current drone technology:

1. **Limited Flight Time and Battery Life**: While flight times have improved, they are still limited by battery life. Many drones can only operate for 20-30 minutes on a single charge, necessitating frequent recharging or battery changes for extended missions.

2. **High Cost**: Advanced drones with sophisticated features and high-quality sensors can be prohibitively expensive, making them less accessible for small businesses or hobbyists.
3. **Complexity and Learning Curve**: The integration of advanced flight controllers and mission planning software can result in a steep learning curve. Users may face challenges in configuring and operating these systems effectively, especially in complex or dynamic environments.
4. **Limited Adaptability**: Many drones are designed for specific applications and lack the modularity needed for easy adaptation to different tasks. This can lead to increased costs and downtime when switching between applications.
5. **Regulatory and Safety Concerns**: Drones are subject to various regulations and safety requirements, which can vary by region and application. Navigating these regulations can be complex and restrictive, potentially limiting operational flexibility.
6. **Vulnerability to Failures**: Existing systems may not always incorporate comprehensive fail-safe mechanisms. In critical situations, such as loss of signal or low battery, drones without robust fail-safe systems can experience uncontrolled landings or crashes.
7. **Environmental Sensitivity**: Many drones are sensitive to environmental conditions such as strong winds, rain, or extreme temperatures, which can impact their performance and reliability.

2.2 PROPOSED SYSTEM

The six-wing autonomous drone represents a cutting-edge advancement in UAV technology, designed to deliver exceptional performance, reliability, and versatility for a variety of applications. Below is a detailed description of its key features:

a. Pixhawk 2.4.8 Flight Controller

The core of the drone's flight control system is the Pixhawk 2.4.8 flight controller, a renowned and highly reliable component in the UAV industry. This flight controller provides advanced capabilities such as:

- **Precision Flight Control**: The Pixhawk 2.4.8 ensures stable and accurate flight performance through sophisticated algorithms and real-time adjustments. It is capable of handling complex flight manoeuvre's and maintaining stability under various conditions.
- **Autonomous Operations**: It supports autonomous flight modes and mission planning, allowing the drone to execute pre-programmed flight paths and tasks with minimal human intervention.

b. 5500 mAh Lithium-Polymer Battery

The drone is powered by a high-capacity 5500 mAh lithium-polymer (LiPo) battery, providing several advantages:

- **Extended Flight Time**: The robust battery allows the drone to achieve a flight time of 30-40 minutes on a single charge, significantly extending operational periods and reducing the frequency of battery replacements or recharges.
- **Efficient Power Management**: The LiPo battery is designed for efficient power delivery, ensuring stable and reliable performance throughout the flight duration. Its high energy density supports longer missions and enhanced operational capability.

c. Inbuilt Gyroscope and GPS

The drone features an inbuilt gyroscope and GPS system, which contribute to its advanced navigational and stability features:

- **Gyroscope**: The integrated gyroscope provides real-time orientation and stabilization, ensuring that the drone maintains a steady and balanced flight even in turbulent conditions. This sensor helps in precise control and manoeuvrability.
- **GPS**: The built-in GPS system allows for accurate positioning and navigation, enabling the drone to follow predetermined flight paths, conduct waypoint missions, and perform geofencing. The GPS also aids in location tracking and autonomous return-to-home functions.

d. Obstacle Detection and Path Redirection

Path redirection occurs when the drone recalculates its trajectory based on the detected obstacle. The system selects a new, collision-free path, allowing the drone to continue toward its destination efficiently. The path planning process may involve decision-making algorithms like A* or Dijkstra, which ensure that the new route is both optimal and safe, considering constraints like flight time and available battery power.

2.2.1 Advantages of Proposed System

The proposed system is an advanced autonomous drone featuring a six-wing design, tailored to address key limitations of current drone technology. This system integrates cutting-edge technologies to enhance performance, reliability, and versatility, making it suitable for a wide range of applications.

a. Extended Flight Time

The proposed drone achieves a notable improvement in flight endurance. By utilizing advanced battery technology and optimizing the drone’s power management system, it offers a flight time of approximately 20-30 minutes on a single charge. This extended flight duration allows the drone to carry out longer missions, reducing the frequency of recharging or battery replacements and enhancing operational efficiency.

b. Advanced Fail-Safe Mechanisms

To address vulnerabilities and ensure reliable operation, the proposed drone incorporates a comprehensive fail-safe system:

- **Automatic Return-to-Home (RTH)**: The drone is equipped with an automatic return-to-home feature that activates in scenarios such as low battery or loss of signal. This system ensures the drone returns safely to its base or performs a controlled landing, protecting against potential loss or damage.
- **Emergency Landing Protocols**: In extreme situations, such as sudden signal loss or critical battery depletion, the drone has built-in emergency landing protocols that allow for a safe and controlled descent, reducing the likelihood of crashes and ensuring operational safety.

c. Enhanced Adaptability and Versatility

The proposed drone is designed with a high degree of adaptability to support various applications with minimal modifications:

- **Modular Payload System**: The drone features a modular payload system that allows for easy attachment and swapping of different sensors and tools. This modularity enables the drone to be customized for diverse tasks such as aerial photography, environmental monitoring, search and rescue operations, and infrastructure inspection without requiring extensive reconfiguration.
- **Robust Environmental Performance**: The drone is engineered to perform reliably in a range of environmental conditions. Its design accommodates moderate winds and varying temperatures, ensuring stable operation and data accuracy even in challenging weather conditions.

d. Additional Features

- **User-Friendly Interface**: The drone is equipped with an intuitive user interface that simplifies mission planning and control, making it accessible to users with varying levels of experience.

2.3 FEASIBILITY STUDY

2.3.1 Details

The development of autonomous drones has made significant strides in recent years, pushing the boundaries of what is possible in unmanned aerial vehicle (UAV) technology. This mini project report presents the design and capabilities of an innovative autonomous drone equipped with six wings, engineered to deliver advanced performance and versatility for a range of applications.

Central to the functionality of this drone is the Pixhawk 2.4.8 flight controller, a highly regarded component in the UAV industry known for its reliability and precision. The Pixhawk 2.4.8 integrates seamlessly with Mission Planner software, which is utilized for both firmware updates and mission planning. This combination ensures that the drone operates with optimized performance and adaptability, making it suitable for a variety of tasks with minimal user intervention.

One of the key features of the drone is its impressive flight endurance, offering a flight time of 20 to 30 minutes on a single charge. This extended operational period enhances the drone's effectiveness in applications such as surveillance, environmental monitoring, and search and rescue missions, where prolonged aerial coverage is essential.

Safety is a paramount concern in autonomous drone operations, and this drone is equipped with a fail-safe system designed to address potential issues and ensure reliable performance. The fail-safe mechanism activates in critical situations, such as low battery or loss of signal, to safely return the drone to its base or perform a controlled landing, thereby mitigating the risk of damage or loss.

Versatility is another cornerstone of this drone's design. With its modular capabilities, the drone can be adapted for multiple purposes with minimal to no modifications.

2.3.2 Impact on Environment

Drones have a multifaceted impact on the environment, offering both positive and negative effects. On the positive side, drones facilitate environmental monitoring and conservation efforts by providing detailed aerial data on wildlife populations, deforestation, and climate changes. They enable precise mapping, reduce the need for invasive ground surveys, and enhance disaster response capabilities.

However, drones also present environmental challenges. Their operation can contribute to noise pollution, which may disturb wildlife and disrupt natural habitats. Additionally, the production, use, and disposal of drone batteries and electronic components pose environmental concerns related to resource extraction and waste management.

2.3.3 Safety

Drone technology has advanced significantly, incorporating various safety features to ensure reliable and secure operation. Modern drones are equipped with fail-safe mechanisms such as automatic return-to-home functions, collision avoidance systems, and emergency landing protocols to handle critical situations like low battery or signal loss. These features enhance operational safety and reduce the risk of accidents.

2.3.4 Ethics

This project follows the general software and hardware ethics. This system does not harm an individual in any way.

2.3.5 Cost

This project is comparatively economical to what is available in the market for the same features. The hardware components present in this project are very cost efficient without compromising on the functionality and features. Not just that, the parts can be easily replaced in case of discrepancies.

2.3.6 Type

This project comes under the Unmanned Aerial Vehicle (UAV) technology or more casually, drone technology. It involves knowledge of fields of Aeronautical engineering, Electrical engineering, Communication engineering and Computer engineering. Thus, making it a diverse project and combining the best of all the fields across engineering domain.

2.4 SCOPE OF THE PROJECT

Drone technology has a broad and expanding scope, revolutionizing numerous fields with its versatility and advanced capabilities. Drones are increasingly used in areas such as aerial photography and videography, agriculture for crop monitoring and precision farming, environmental conservation, and infrastructure inspection. They play a crucial role in emergency response and disaster management, providing real-time data and enhancing search and rescue operations. Additionally, drones are utilized in logistics and delivery services, surveying, and even in scientific research.

As technology continues to evolve, the scope of drones is expected to grow, incorporating advancements such as enhanced automation, longer flight times, and more sophisticated sensors, further broadening their applications and impact across various industries.

2.5 MODULES DESCRIPTION

1. Input Module

- Remote controlled instructions
- Battery
- Flight controller

2. Processing Module

- Flight controller
- Micro processor
- Firmware

3. Output Module

- Fully autonomous hex drone

4. Software

- Mission Planner

2.6 SYSTEM CONFIGURATION

2.6.1 Hardware Requirements

- Pixhawk flight controller V2.4.8 (Used for transmitting the commands)
- G.P.S (Global Positioning System for manoeuvre)
- Electronic Speed Controllers (For converting D.C signal to A.C signal)
- 935 KV brushless motors (Propellers)
- Fibre frame (To host the components)
- Fly sky remote control (To control the drone)

- Camera (To transmit video data)

2.6.2 Software Requirements

- Mission planner (For designing the drone and transmitting the firmware)
- Python (For implementing Computer vision)

2. LITERATURE OVERVIEW

Research Paper-1:

"Advancements in Drone Technology: A Review by Smith J & Liu Y"

This review paper synthesizes recent progress in drone technology, emphasizing significant improvements across various domains. The authors delve into enhancements in drone design, such as the use of lightweight and durable materials, which have led to increased flight times and payload capacities. They also explore innovations in control systems, including advancements in GPS and inertial measurement units (IMUs) that enhance flight stability and accuracy. Software improvements are discussed, particularly those related to autonomous flight and obstacle avoidance. The paper concludes with a look at emerging applications, such as drones in disaster response, precision agriculture, and infrastructure inspection.

Research Paper-2:

"Autonomous Drone Navigation in Complex Environments: Challenges and Solutions by Patel R & Lee M"

This paper addresses the difficulties faced by autonomous drones when navigating intricate and cluttered environments. It reviews various navigation techniques and algorithms, including those based on LiDAR, stereo vision, and simultaneous localization and mapping (SLAM). The authors provide an in-depth analysis of how these technologies help drones detect and avoid obstacles, maintain stable flight, and navigate through confined spaces. The paper also includes simulations and real-world experiments to demonstrate the effectiveness of these techniques. Challenges such as sensor limitations, computational constraints, and real-time processing are thoroughly discussed.

Research Paper-3:

"The Impact of AI on Drone Technology: Enhancements and Ethical Considerations by Johnson K & Chen S"

This research paper explores the transformative role of artificial intelligence in drone technology. It highlights how AI has improved drones' capabilities in areas like object recognition, autonomous decision-making, and adaptive behavior. The paper reviews various AI techniques used in drones, such as convolutional neural networks (CNNs) for image processing and reinforcement learning for path optimization. Additionally, the authors address ethical issues, including privacy concerns related to surveillance drones, the potential for AI to be used in harmful ways, and the need for regulatory frameworks to address these challenges.

Research Paper-4:

"Energy Efficiency in Drone Design: Innovations and Future Directions by Nguyen T & Zhang L"

This study focuses on optimizing energy efficiency in drone design, an area crucial for extending flight durations and improving overall performance. The paper reviews innovations such as advanced battery technologies, including lithium-sulfur and solid-state batteries, which offer higher energy densities and longer lifespans compared to traditional lithium-ion batteries. It also examines the use of energy-efficient propulsion systems and aerodynamics improvements that reduce power consumption. The authors discuss energy harvesting techniques, such as solar panels integrated into drone surfaces, and future research directions aimed at achieving even greater efficiency.

Research Paper-5:

"Swarm Robotics and Drone Technology: Collaborative Systems for Enhanced Performance by Davis A & Roberts P"

This paper explores the concept of swarm robotics as applied to drone technology, where multiple drones operate collaboratively to accomplish tasks more efficiently. The authors discuss algorithms for swarm coordination, including decentralized control strategies and communication protocols that allow drones to work together seamlessly. They present case studies demonstrating the benefits of swarm systems in various applications, such as environmental monitoring, where swarms of drones can cover larger areas and gather data more effectively than single drones. The paper also addresses challenges in swarm robotics, such as managing drone interactions and ensuring reliable communication in dynamic environments.

3. SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

The evolution of autonomous drone technology represents a remarkable convergence of advancements in various fields, including robotics, artificial intelligence (AI), and aerospace engineering. This development has enabled drones to perform tasks with minimal human intervention, revolutionizing industries and creating new opportunities for automation. This essay explores the key aspects of autonomous drone technology, including sensor advancements, navigation improvements, control systems, AI integration, communication technologies, and regulatory considerations.

Navigating through various environments requires accurate localization and robust navigation systems. Global Positioning Systems (GPS) and Global Navigation Satellite Systems (GNSS) are essential for outdoor navigation, providing precise location and altitude data. However, GPS is less reliable in indoor or GPS-denied environments. In such cases, Simultaneous Localization and Mapping (SLAM) algorithms become crucial. SLAM enables drones to create and update maps of their surroundings while continuously tracking their position within these maps. Additionally, sensor fusion techniques combine data from multiple sensors, such as Inertial Measurement Units (IMUs) and cameras, to enhance the accuracy and reliability of navigation.

The flight controller is the heart of an autonomous drone, managing its stability and flight dynamics. Modern flight controllers, such as the Pixhawk series, integrate data from various sensors to maintain stable flight and execute commands. Autonomous flight algorithms are pivotal in this regard. These algorithms include path planning, obstacle avoidance, and decision-making processes. Path planning algorithms determine the optimal route for the drone, while obstacle avoidance systems ensure that the drone can navigate around obstacles safely. Decision-making algorithms allow the drone to adapt its behavior based on changing conditions and mission requirements.

Artificial intelligence (AI) has significantly enhanced the capabilities of autonomous drones. AI integration allows drones to perform complex tasks such as object recognition and adaptive behaviour. Machine learning techniques, particularly reinforcement learning, enable drones to learn from their experiences and improve their performance over time. For example, reinforcement learning can optimize flight strategies and responses to dynamic environments, making drones more efficient and adaptable. The incorporation of AI and machine learning represents a leap forward in the autonomy and intelligence of drones.

The advancements in autonomous drone technology have led to its adoption across various industries. In agriculture, drones are used for crop monitoring and precision farming. In logistics, they facilitate package delivery and warehouse management. Infrastructure inspection is another area where drones provide significant value, enabling the evaluation of structures such as bridges and power lines with minimal disruption. Additionally, military and surveillance applications leverage autonomous drones for reconnaissance, surveillance, and tactical operations.

4.1.1 Modules Description

Designing an autonomous multipurpose drone involves planning what are the hardware components that are required as compatibility acts as the main issue. Apart from that many environment variables comes into picture as nature can be unpredictable. But with proper planning and knowledge, a fully autonomous multipurpose drone can be achieved.

1. Flight Controller: Pixhawk 2.4.8

- **Role**: The Pixhawk 2.4.8 is the central control unit of the hexacopter. It manages the overall flight stability, navigation, and communication with other components.
- **Connections**:
    - Receives inputs from the GPS module, Electronic Speed Controllers (ESCs), and other sensors.

- Sends commands to the ESCs and motors based on its flight algorithms and inputs.

2. GPS Module

- **Role**: Provides satellite positioning data to the flight controller, which is essential for navigation, altitude hold, and autonomous flight modes.
- **Connections**:
  - Connected to the Pixhawk via a dedicated GPS port.
  - Provides real-time location and altitude information.

3. 40A Electronic Speed Controllers (ESCs)

- **Role**: Regulate the power supplied to the brushless motors based on commands from the flight controller.
- **Connections**:
  - Each ESC is connected to one of the six brushless motors.
  - The ESCs are connected to the Pixhawk via PWM (Pulse Width Modulation) outputs.

4. 935 kV Brushless Motors

- **Role**: Provide the thrust needed for the drone's flight. The KV rating (935 kV) indicates the motor's RPM per volt, which affects its power output.
- **Connections**:
  - Each motor is connected to an ESC.
  - The ESCs control the motor speed based on commands from the flight controller.

5. 5500 mAh Lithium Polymer (LiPo) Battery

- **Role**: Powers the entire drone, including the flight controller, ESCs, motors, GPS module, and other peripherals.
- **Connections**:
    - Connected to the power distribution board, which distributes power to the ESCs and the Pixhawk.
    - Typically connected via XT60 or similar high-current connectors.

6. Camera for Live Video Feed

- **Role**: Provides real-time video footage from the drone, which can be used for FPV (First Person View) flying or recording.
- **Connections**:
    - Typically connected to a video transmitter (VTX), which sends the live feed to a receiver.
    - The VTX may also be powered through the drone's power distribution system or a separate battery.

7. Flysky Radio Control

- **Role**: Provides the pilot with control inputs to manoeuvre the drone.
- **Connections**:
    - The Flysky radio control communicates with a receiver that is connected to the Pixhawk.
    - The receiver translates the pilot's commands into signals that are sent to the flight controller.

8. Mission Planner Software

- Mission Planning
- Pre-Flight Configuration and Tuning
- Real-Time Flight Monitoring
- Autonomous Flight Control
- Mapping and 3D Model Generation
- Simulation and Testing
- Communication and Control
- Custom Scripting and Extensions
- Compatibility and Versatility

Architecture Overview

1. **Power System**:
    - Battery (5500 mAh LiPo) → Power Distribution Board → ESCs, Flight Controller (Pixhawk), and Camera/VTX.
2. **Control System**:
    - Flysky Radio Control → Receiver → Flight Controller (Pixhawk).
3. **Flight Control and Navigation**:
    - **Pixhawk** receives inputs from:
        - **GPS Module** for position and navigation data.
        - **ESCs** (via PWM) for motor control.
    - **Pixhawk** sends commands to:
        - **ESCs** to adjust motor speeds and maintain stability.
4. **Motors and Propulsion**:
    - ESCs → Brushless Motors.
5. **Camera System**:
    - Camera → Video Transmitter (VTX) → Receiver/Display for live feed.

Integration Summary

- The **Pixhawk Flight Controller** integrates all data from the GPS module and controls the ESCs based on this data.
- The **ESCs** adjust the speed of the **brushless motors** to control the drone's flight.
- The **Flysky Radio Control** provides manual inputs to the flight controller, allowing the pilot to control the drone.
- The **camera** provides visual feedback through a video feed, which is transmitted via the VTX.

4.2 SYSTEM DESIGN

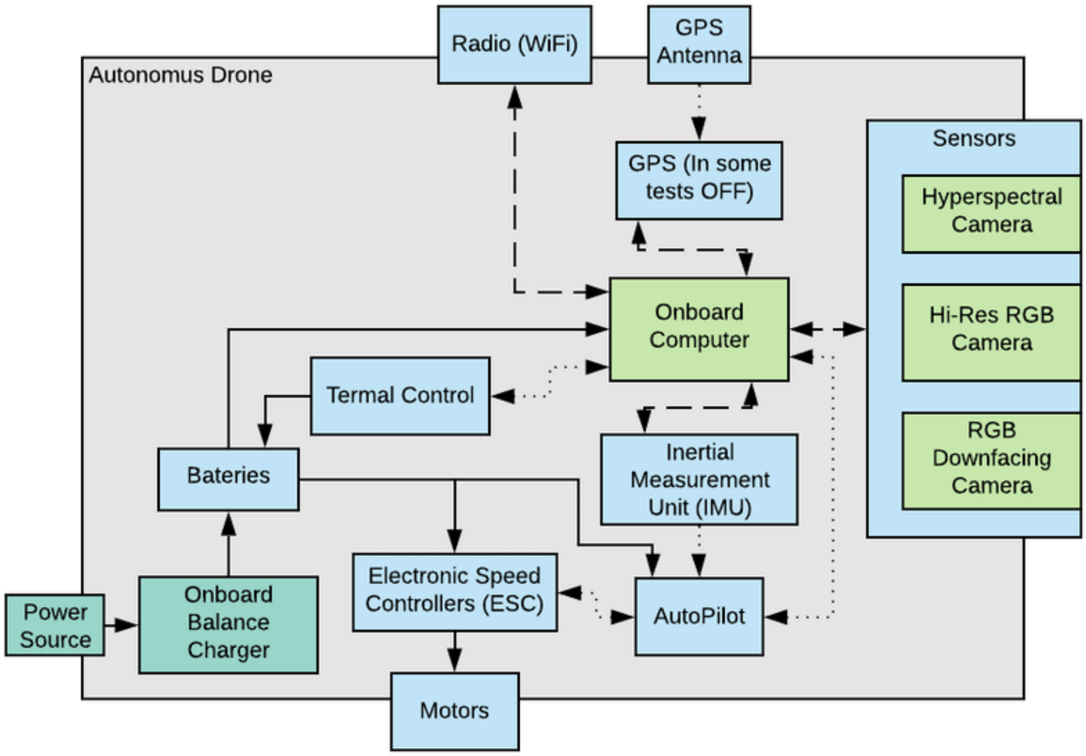

Fig 4.1 System Design

4.3 UML DIAGRAMS

4.3.1 USE-CASE DIAGRAM

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use case in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by the other types of diagrams.

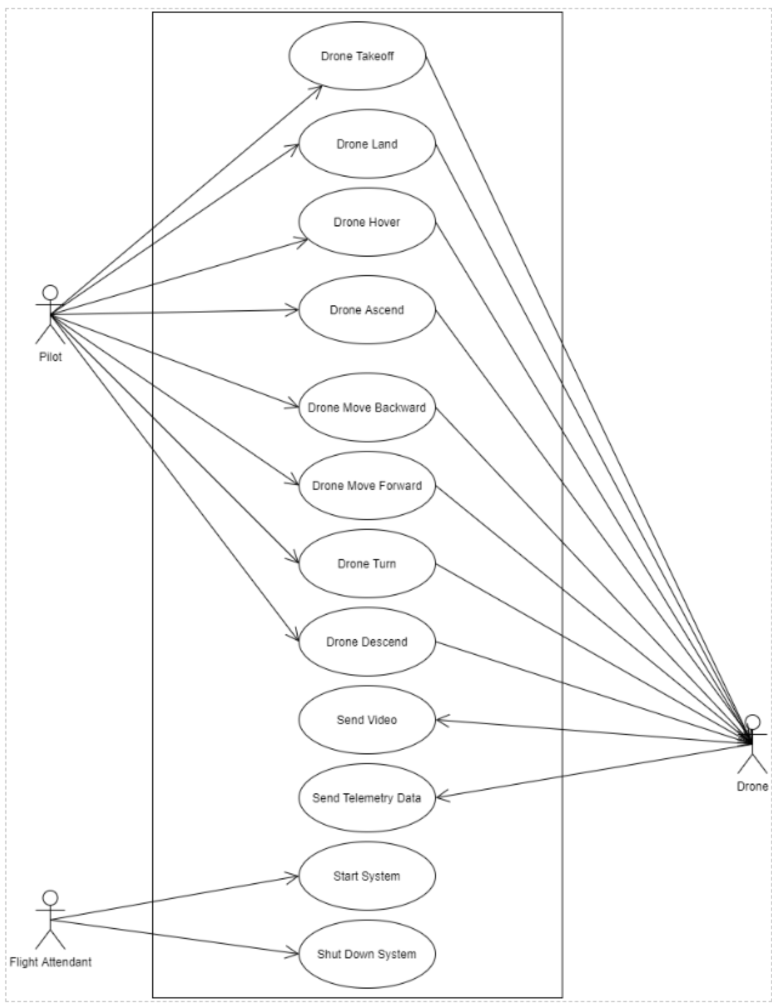

Fig 4.3.1 Use-case Diagram

4.3.2 SEQUENCE DIAGRAM

A sequence diagram simply depicts the interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function

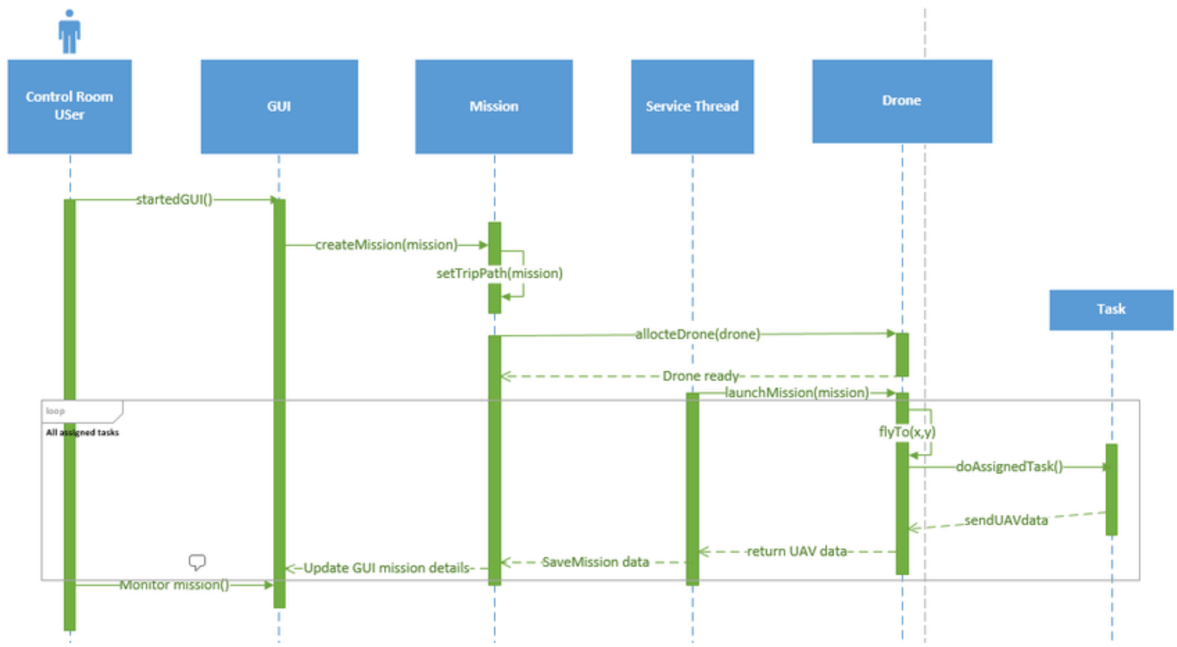

Fig 4.3.2 Sequence Diagram

5. IMPLEMENTATION

5.1 IMPLEMENTATION

To implement the autonomous drone, you will start by selecting the hardware and software components required to develop the project. It is essential to choose components which fulfils the needs of the required features and also is cost effective. Then after choosing the hardware components, it is time to plan the firmware for instructions. The most important component in an autonomous drone is a flight controller. It acts as the brain of the vehicle. All the commands are sent through this component. It is important to make sure that all the components are compatible with each other or it may lead to ultimate failure of the system. Battery in this case has both advantage and disadvantage. For instance, a battery with higher capacity can increase the flight time of the drone but also adds on a lot of weight which makes the propellers heated up really quick. But in the contrary, a battery with lower capacity will reduce the weight and also the flight time. So, choosing a battery type which will suit your particular needs is essential. After hardware components comes the software and firmware. The most recommend and open-source software for this purpose is the ‘Mission planner’ software. It is a one-stop solution for all the hardware to software needs. Not just drones, but it also contains software required to support all types of vehicles. Along with the prebuilt library software, ‘OpenCV’ library from python is used to implement the computer vision.

5.2 Sample Code

```
#include <FirebaseESP8266.h>

#include <ESP8266WiFi.h>

#include <DHT.h>
```

```
#define FIREBASE_HOST "your-project-id.firebaseio.com"

#define FIREBASE_AUTH "your-firebase-database-secret"

const char* ssid = "25437162";

const char* password = "12345678";

#define DHTPIN D2

#define DHTTYPE DHT11

DHT dht(DHTPIN, DHTTYPE);

#define TRIG_PIN D3

#define ECHO_PIN D4

#define IR_SENSOR_PIN D5

void setup() {

  Serial.begin(115200);

  dht.begin();

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {

    delay(1000);

    Serial.println("Connecting to WiFi...");

  }
```

```
  Serial.println("Connected to WiFi");

  Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);

  Firebase.reconnectWiFi(true);

  if (Firebase.ready()) {

    Serial.println("Firebase Connected");

  } else {

    Serial.println("Firebase connection failed");

  }

  pinMode(TRIG_PIN, OUTPUT);

  pinMode(ECHO_PIN, INPUT);

  pinMode(IR_SENSOR_PIN, INPUT);

}

void loop() {

  float temp = dht.readTemperature();

  float humidity = dht.readHumidity();

  if (isnan(temp) || isnan(humidity)) {

    Serial.println("Failed to read from DHT sensor");

  } else {
```

```
  Serial.print("Temperature: ");
  Serial.print(temp);
  Serial.print(" °C, Humidity: ");
  Serial.print(humidity);
  Serial.println(" %");
  Firebase.setFloat(firebaseData, "/sensors/temperature", temp);
  Firebase.setFloat(firebaseData, "/sensors/humidity", humidity);
}
digitalWrite(TRIG_PIN, LOW);
delayMicroseconds(2);
digitalWrite(TRIG_PIN, HIGH);
delayMicroseconds(10);
digitalWrite(TRIG_PIN, LOW);
long duration = pulseIn(ECHO_PIN, HIGH);
float distance = duration * 0.034 / 2;
Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");
```

```
  Firebase.setFloat(firebaseData, "/sensors/distance", distance);

  int irState = digitalRead(IR_SENSOR_PIN);

  if (irState == HIGH) {

    Serial.println("Object detected by IR sensor");

  } else {

    Serial.println("No object detected by IR sensor");

  }

  Firebase.setInt(firebaseData, "/sensors/ir_sensor", irState);

  delay(2000);

}
```

6. TESTING

6.1 TESTING

The purpose of testing is to discover errors. Testing is the purpose of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. And it is the process of exercising software with the intent of ensuring that the software system meets its requirements and expectation and does not fail in an unacceptable manner.

6.2 TEST CASES

S. No	Test Case	Expected Output	Actual Output	Result
1	Connection test	The signals are transmitted to the flight controller	The signals are transmitted to the flight controller	Success
2	Live status	Status of the drone is accessed in real time	Status of the drone is accessed in real time	Success
3	Live feed test	Live video feed	Live video is accessible	Success
4	Fail safe test	The drone should return to home location	The drone returned to the home location	Success
5	Flight time	The flight time should be between 20-30 minutes	The drone flew well over 30 minutes	Success

7. OUTPUT SCREENS

Fig 7.1 User Interface

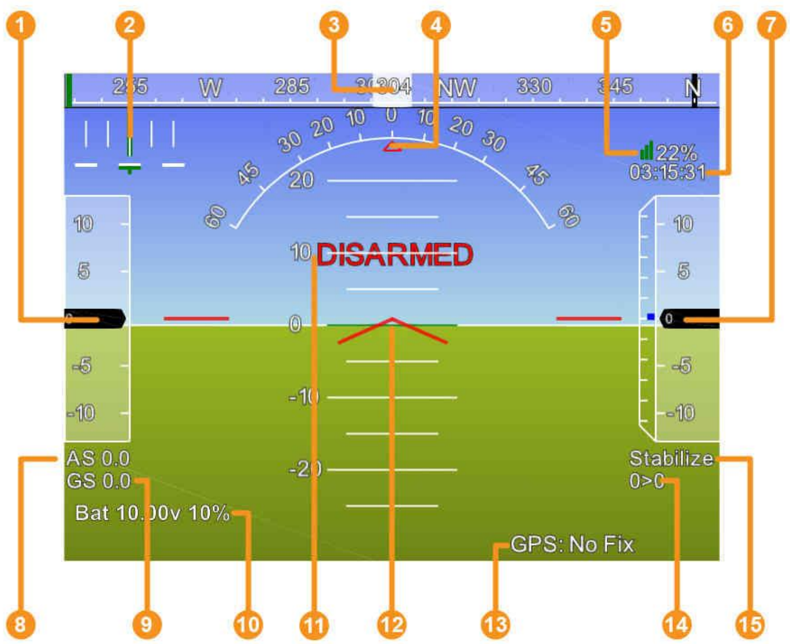

Fig 7.2 Detailed Explanation

8. CONCLUSION

8.1 CONCLUSION

The development of autonomous drone technology is a testament to the progress in robotics, AI, and aerospace engineering. Through advancements in sensors, navigation systems, control algorithms, and communication technologies, drones are becoming increasingly capable of performing tasks with minimal human intervention. As technology continues to evolve, the potential applications of autonomous drones are expanding, offering new opportunities for automation and efficiency across various sectors. The ongoing research and development in this field promise to further enhance the capabilities and applications of autonomous drones, shaping the future of aerial technology.

8.2 FUTURE ENHANCEMENTS

The future of drone technology holds immense potential for innovation and transformation. Advances in AI, navigation, energy systems, communication, and safety will drive the development of more capable, efficient, and versatile drones. As these technologies continue to evolve, they will expand the range of applications for drones, making them integral tools across various sectors and reshaping how we interact with and utilize aerial technology.

9. BIBLIOGRAPHY

9.1 BOOKS REFERENCE

"Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms by Nikolaus Correll, Bradley J. Myers, David J. Anderson, and Alin Albu-Schäffer "

This book provides a comprehensive introduction to the fundamentals of autonomous robots, including drones. It covers key concepts such as mechanisms, sensors, actuators, and algorithms, with a focus on how these elements are integrated to create autonomous systems. The book is highly valuable for understanding the underlying technologies that drive autonomous drones, including their control systems and navigation algorithms.

"Drones: Their Many Civilian Uses and the Challenges They Present by Michael J. Boyle"

This book explores the diverse applications of drones in civilian contexts, from agriculture to surveillance and disaster response. It discusses the technological advancements that have enabled these applications and addresses the regulatory and ethical challenges associated with drone use. The book is an insightful resource for understanding the impact of drones on various sectors and the issues that need to be addressed for their effective and responsible use.

"Drone Technology: Applications and Strategies for Managers by George C. Marshall"

Focused on the strategic implementation of drone technology, this book provides practical insights for managers and decision-makers. It covers various applications of drones in industries such as logistics, agriculture, and infrastructure inspection.

These books offer a range of perspectives on drone technology, from technical fundamentals and practical applications to strategic management and industry impact.

9.2 WEBSITE REFERENCES

Ultimate guide to autonomous drone: Benefits, Applications and top models

Building an autonomous drone

10. APPENDICES

A. Software Used

- Mission planner
- OpenCV

B. Methodologies Used

- PixHawk V2.4.8
- ESCs
- GPS
- Brushless motors

C. Testing Methods Used

- System Testing
- Fail safe Testing

11. PLAGARISM REPORT

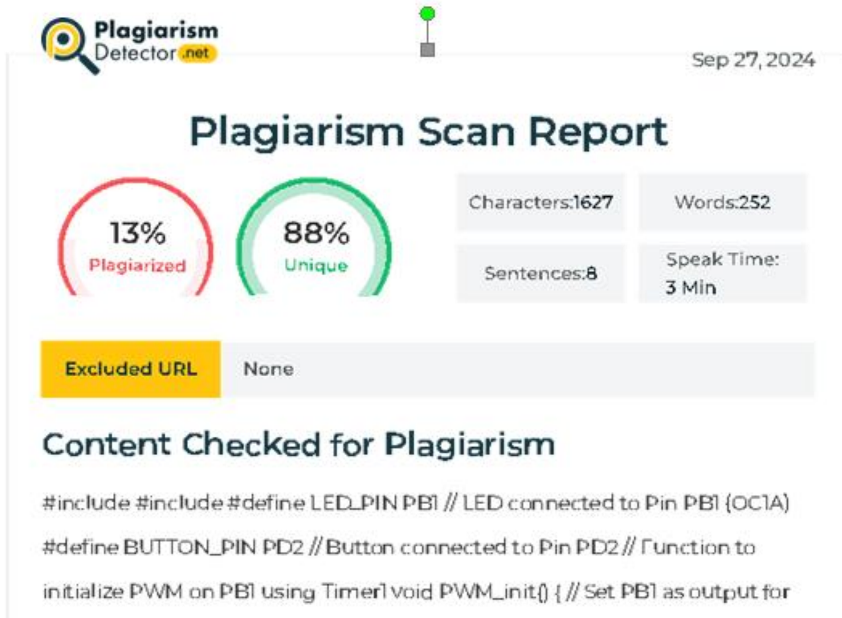

Fig 11.1 Plagiarism Report