A

Detailed Report

on

SURVEILLANCE DRONE

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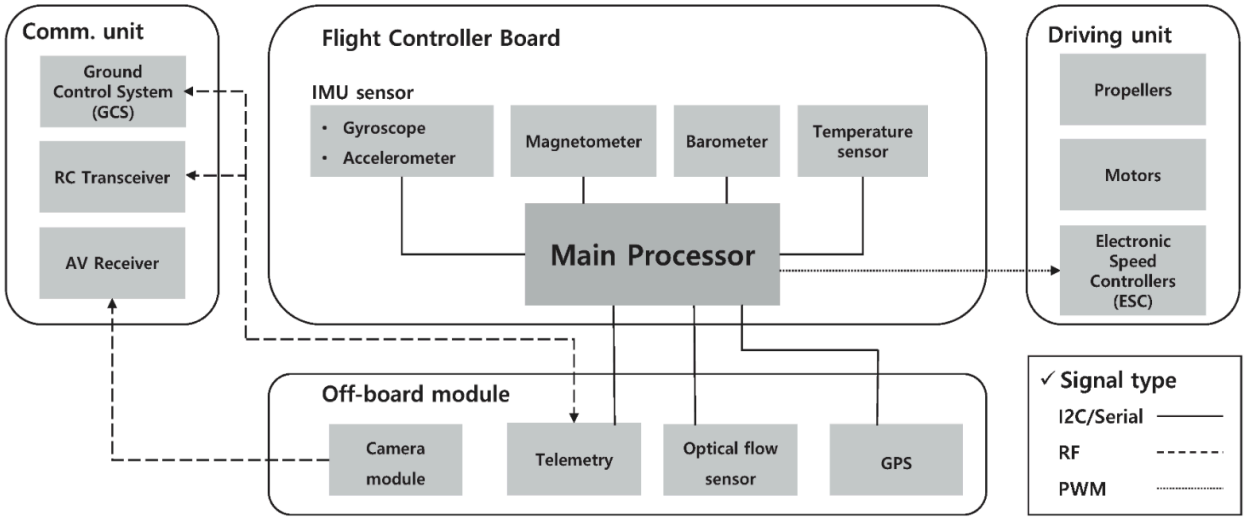
REPORT ON SURVEILLANCE DRONE

This report provides a comprehensive overview of various components and systems essential for drone operations, including materials used for drone frames, flight controllers, electronic speed controllers (ESCs), brushless DC motors, batteries, cameras, sensors, and mission planning software. Each section elaborates on the specifications, advantages, and functionalities of the respective components, emphasizing their roles in enhancing the overall performance and capabilities of drones.



Block Diagram of Surveillance Drone

1. Drone FRAME: Made of ABS Material

Material Selection: ABS (Acrylonitrile Butadiene Styrene)

ABS (Acrylonitrile Butadiene Styrene) is a thermoplastic polymer that is widely used in manufacturing various products, including drone frames. Its properties make it an excellent choice for drone applications, as it

combines lightweight characteristics with exceptional durability and impact resistance. This material has gained popularity in the drone industry due to its ability to withstand the rigors of flight while maintaining a manageable weight.

Advantages of ABS for Drone Frames:

- **Durability and Impact Resistance**:
    - One of the standout features of ABS is its strong impact resistance, which significantly reduces the risk of damage during minor crashes or rough landings. This is crucial for maintaining the structural integrity of the drone, especially when operating in challenging environments.
    - ABS is also resilient to various physical stresses, including vibration and flexing, which helps protect sensitive internal components such as flight controllers, batteries, and communication devices from damage.
- **Lightweight**:
    - The lightweight nature of ABS contributes to the overall agility of the drone. By minimizing the weight load on the motors, ABS helps improve flight efficiency and extend flight times. This characteristic is particularly advantageous for applications that require quick maneuvers and prolonged flight durations, such as aerial photography or surveying.

- **Cost-Effectiveness**:
    - Compared to high-performance materials like carbon fiber, ABS is relatively affordable. This cost-effectiveness makes it a practical choice for hobbyist drones or budget-sensitive projects, allowing users to build robust drone frames without incurring high costs.

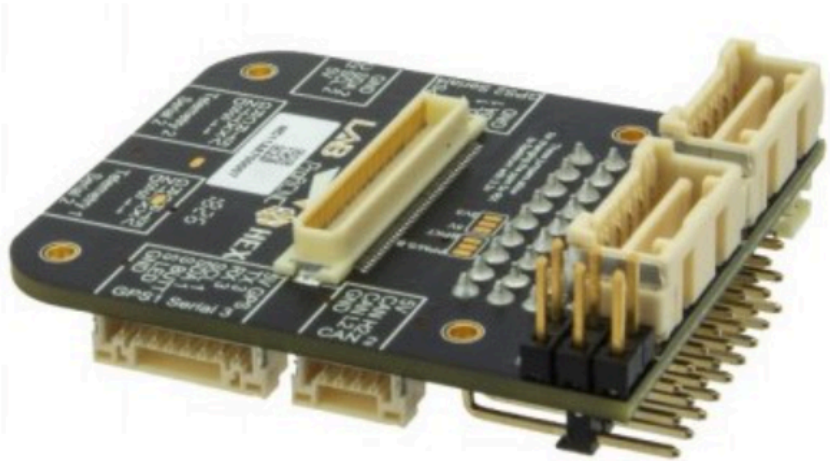
- **Ease of Molding and Customization**:
    - ABS can be easily molded into various shapes and sizes, providing flexibility in design. This allows manufacturers to create custom frames tailored to specific aerodynamic or structural requirements, enhancing the drone's performance and efficiency.

Considerations:

- **Structural Integrity**:
    - While ABS is durable, it may not provide the same rigidity as materials like carbon fiber. Under high-stress conditions, this can result in a slight reduction in structural integrity. For applications requiring maximum strength, alternative materials might be more suitable.

- **UV Degradation**:
    - ABS can be susceptible to UV degradation when exposed to direct sunlight for extended periods. To mitigate this issue, additional coatings or protective measures may be necessary for outdoor use, ensuring the longevity of the frame.

2. Mini Carrier Board Flight Controller



Overview

A mini carrier board flight controller is a compact, integrated control system utilized in drones and other unmanned aerial vehicles (UAVs). This system combines essential flight components and offers multiple connection ports, delivering a streamlined solution for managing flight dynamics, navigation, and communication. Its compact size makes it ideal for small drones, where space and weight constraints are critical.

Key Features:

- **Compact Design**:
  - The mini carrier board's small and lightweight design enables it to fit into confined spaces within smaller UAVs, allowing for easy integration without compromising the drone's overall performance.
- **Integrated Components**:
  - The flight controller often includes essential sensors such as accelerometers, gyroscopes, and magnetometers. These components provide full orientation and stabilization capabilities, allowing the drone to maintain stable flight in various conditions.
  - Additionally, the mini carrier board supports a range of peripherals, including GPS modules, optical flow sensors, and telemetry radios, which enhance navigation and control, allowing for advanced flight features like waypoint navigation and altitude hold.
- **Multiple Connectivity Options**:
  - Typically equipped with UART, I2C, and CAN bus interfaces, the mini carrier board allows for flexible connections with various sensors and communication devices. This versatility enables users to customize their drone's functionality based on specific mission requirements.

- Power supply connections are optimized for efficient energy distribution across components, ensuring stable performance during flight and reducing the risk of power loss.

- **Versatility in Applications**:
  - This type of flight controller is suitable for a wide range of UAV applications, from small recreational drones to more advanced projects requiring precise control in GPS-denied environments. Its compatibility with popular open-source firmware like ArduPilot and PX4 allows for extensive customization and fine-tuning of flight parameters.

Other integrated sensors are:

1. **Gyroscope**
2. **Accelerometer**
3. **Magnetometer (Compass)**
4. **Barometer.**

3. Electronic Speed Controller (ESC)

T-Motor AIR 40A 600Hz ESC

The T-Motor AIR 40A 600Hz ESC is specifically designed for high-performance drones, providing smooth control and quick response for motors such as the MN2806. This ESC plays a critical role in regulating the speed and torque of the motor, ensuring stable and efficient operation under various flight conditions.

Key Features:

- **Continuous Current Rating**:
    - The 40A continuous current rating ensures consistent power delivery to the motors, even under high load conditions. This capability is crucial when the drone is carrying heavy payloads or operating in demanding scenarios, as it maintains performance stability and prevents motor overheating.
- **High Frequency (600Hz)**:
    - The high PWM frequency of 600Hz enhances the motor's response time, allowing for precise control in fast-paced drone applications such as surveillance, agricultural mapping, and high-speed racing. This feature ensures that the ESC can react quickly to changes in flight dynamics, contributing to overall flight safety and control.
- **Lightweight Design**:
    - The ESC is designed to be compact and lightweight, minimizing additional weight on the drone. This lightweight nature contributes to better flight performance and efficiency, enabling longer flight times.
- **Compatibility with MN2806**:
    - The T-Motor AIR 40A ESC is well-matched to the MN2806 motor, allowing the motor to perform optimally by delivering the right amount of current while maintaining energy efficiency. This compatibility enhances the overall performance of the drone, especially in applications requiring high thrust and precise control.

Functionality:

The ESC modulates the voltage supplied to the motor, ensuring it can handle sudden changes in power demand. This capability is essential for drones flying in varying environments, where abrupt maneuvers are often required. The high-frequency modulation also ensures smooth motor control, critical for precise tasks such as spraying in agriculture or surveying large areas, where stability and accuracy are paramount.

Air 40A ESC of T motors are available with a special core program and special optimized firmware. Highly-intelligent and adaptive Air T-motor ESC comes with Twisted pair design of the throttle signal cable which effectively reduces crosstalk produced in signal transmission and helps to make flight more stable. Compatible with various disc-type motors and supports a signal frequency of up to 621Hz.

4. Brushless DC Motors

Introduction to Brushless Motors

Brushless DC motors (BLDC) are electronically commutated motors that eliminate the need for physical brushes, which are present in traditional brushed motors. In a BLDC motor, the control system sends electrical pulses to the motor windings, managing the speed and torque of the motor. These motors provide significant torque over a wide range of speeds, making them ideal for drones, where smooth operation, efficiency, and responsiveness are essential.

Main Components:

- **Rotor**:
    - Contains permanent magnets and rotates in response to the energized stator.
- **Stator**:
    - Remains stationary and houses electromagnets that are energized sequentially to create a rotating magnetic field.
- **Electronic Speed Controllers (ESCs)**:
    - Regulate the motor’s rotation by controlling the current supplied to the stator based on the rotor's position. This electronic commutation allows for efficient and precise motor control, which is vital for drone flight dynamics.

Types of Brushless Motors:

1. **Inner Rotor Design**:
    - The rotor is located in the center of the motor, surrounded by stator windings. This design facilitates better heat dissipation as the rotor's position helps radiate heat outwards, reducing the risk of overheating issues.
    - Inner rotor motors produce high torque and are typically used in applications requiring substantial force, such as heavy-lift

drones or racing applications where quick acceleration is necessary.

2. **Outer Rotor Design**:
    - In this design, the rotor surrounds the winding located at the motor's core. While this arrangement can trap more heat, limiting its dissipation, it is more suitable for low-current applications.
    - The outer rotor design is commonly utilized in the MN2806 motor for drones, where lower cogging torque and current efficiency are vital for maintaining smooth flight and control during low-speed operations.

Comparative Analysis of Drone Motors:

- **MN2806 Motor**:
    - Efficient and reliable, designed for agricultural and surveillance drones. It provides superior thrust at lower RPMs, making it highly efficient for precision tasks like spraying or surveying where stability is crucial.
- **T-Motor F90**:
    - Known for its lightweight design and excellent thrust-to-weight ratio, making it ideal for drones that prioritize agility and speed. This motor is suited for applications where rapid maneuverability is essential.
- **XING 2806.5**:
    - This motor features high RPM capabilities and robust construction, suitable for high-speed applications. However, it may lack the efficiency required for precision tasks where control and stability are critical.

Why Choose KV400 Over KV650?

- **Higher Torque**:
    - The KV400 motor produces more torque than the KV650, which is crucial when carrying heavier payloads such as pesticide

tanks in agricultural applications. This capability ensures that the drone can lift and maneuver substantial weights effectively.

- **Larger Propellers**:
    - The KV400 motor is better suited for larger propellers, which generate more thrust at lower speeds. This design is beneficial for stable flights with heavy payloads, enhancing the drone's capability in demanding environments.
- **Battery Efficiency**:
    - The KV400 motor operates at lower RPMs, which reduces energy consumption, leading to longer flight times. This efficiency is especially important for large-scale surveillance or agricultural spraying missions, where extended operational periods are necessary.

- **Stability and Control**:
    - Lower KV motors, such as the KV400, offer smoother and more stable flight characteristics. This stability is ideal for precision tasks like surveillance, pesticide application, and terrain mapping, where maintaining control is paramount.
- **Increased Payload Capacity**:
    - The design of the KV400 motor allows it to handle larger payloads efficiently, making it highly suitable for drones that need to carry significant amounts of equipment or liquids, thereby expanding the operational versatility of the UAV.

5. Battery Selection for Drone: Orange 4200mAh 6S 35C

Overview

For my drone setup, I have chosen the Orange 4200mAh 6S 35C battery. This specific battery offers a well-rounded combination of performance, reliability, and affordability, making it an ideal choice for long-duration flights, consistent power delivery, and compatibility with my drone's requirements.

Key Reasons for Choosing the Orange 4200mAh 6S 35C Battery:

- **Extended Flight Time**:
    - With a capacity of 4200mAh, this battery provides a higher charge than smaller counterparts, translating to longer flight durations. This is particularly beneficial for tasks requiring the drone to remain airborne for extended periods, such as surveillance or transporting payloads.
- **High Current Output**:

    - The 35C discharge rate ensures that the battery can handle the high current demands of the drone, especially under heavy loads. This feature is essential for maintaining consistent performance during demanding conditions, such as when lifting the drone's weight of 2.2 kg or carrying additional payloads. The high discharge rate also mitigates the risk of overheating, helping maintain steady motor performance.
- **Voltage Compatibility**:
    - As a 6S battery, it provides 22.2V (up to 25.2V when fully charged), which aligns perfectly with the voltage requirements of my T-Motors. This compatibility ensures that the motors operate at their peak performance without the risk of underpowering or voltage drops, which is essential for maintaining the drone's stability and efficiency.
- **Balanced Weight and Power**:
    - The 4200mAh capacity provides a good balance, offering ample energy storage without adding excessive weight to the drone. This helps extend flight time without compromising agility or maneuverability, unlike smaller batteries that might reduce flight duration or larger ones that could burden the drone with excess weight.

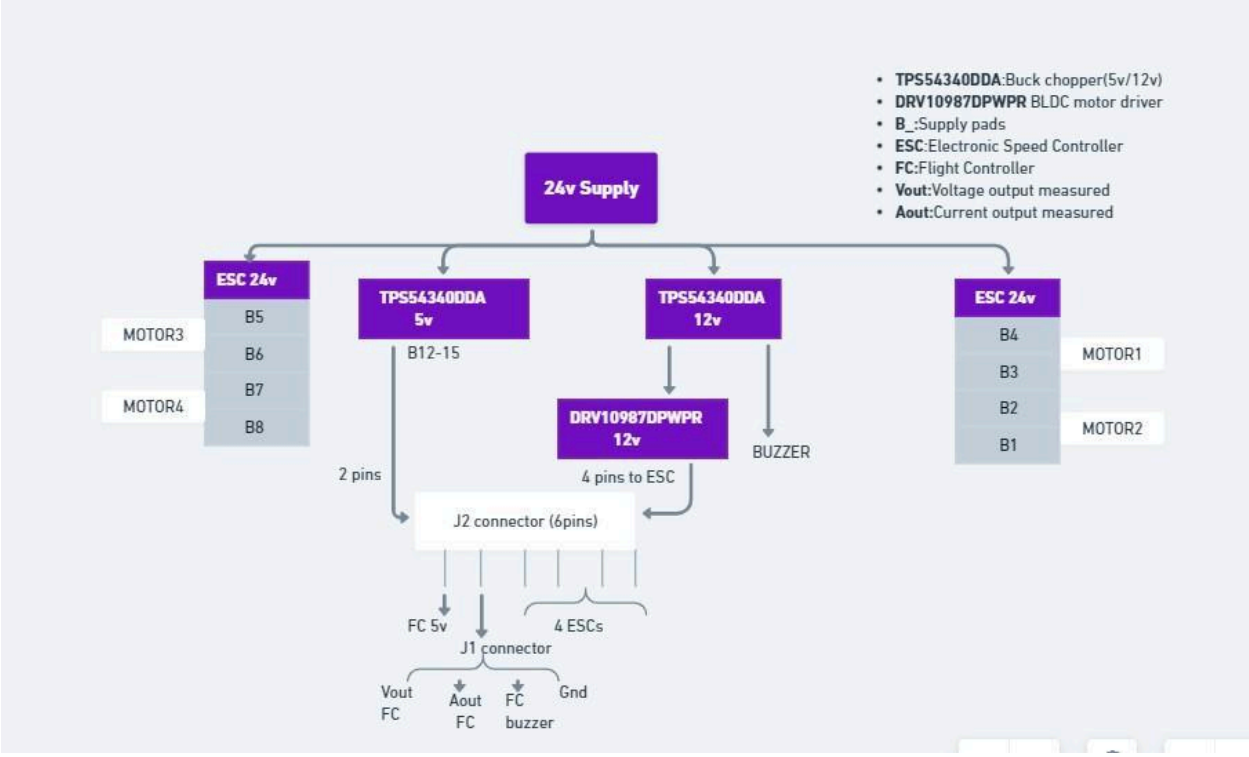
Why Orange Batteries Are Ideal for This Project:

- **Reputation for Reliability**:
    - Orange batteries are widely regarded for their consistent performance and reliability. They are trusted by hobbyists and professionals alike because they consistently deliver the promised power and capacity, resulting in stable performance and dependable flight times.
- **True Capacity and Balanced Cell Resistance**:
    - Unlike some other brands, Orange batteries are known for their true capacity ratings and well-matched cell resistance, which improves overall efficiency and lifespan. This reliability means

that I can trust them to deliver the promised power throughout the flight, reducing the chances of unexpected power drops.

- **Affordable High Performance**:
    - Despite their high quality, Orange batteries come at a reasonable price point, making them an excellent value for money. I wanted a high-performing battery without breaking the bank, and Orange fits that need perfectly.

6.Power Distribution board Architecture:



Architecture of PDB

A power distribution board is a central component in a drone that distributes electrical power from the main battery to the various components of the drone. It ensures that each component receives the appropriate voltage and current needed for its operation.

Power Distribution:

- The 24V supply is distributed to the different components using the supply pads (B1-B8).
- The TPS54340DDA buck choppers generate 5V and 12V supplies, which are then used by the flight controller, motor drivers, and other components.
- The DRV 10987 DPWPR motor driver receives the 12V supply and controls the BLDC motors.
- The ESCs receive the 24V supply and control the motors based on the PWM signals from the flight controller.

7. First Person View (FPV) Camera

Overview

FPV cameras are specialized drone-mounted cameras that enable pilots to view a live video feed from the drone's perspective. This capability is essential for FPV racing, freestyle flying, and aerial photography, providing an immersive piloting experience.

Turbowing 5.8G 48CH 25mW NTSC/PAL 700TVL FPV Camera:

- **Resolution and Image Quality**:
    - With a resolution of 700TVL, this camera provides clear analog video suitable for real-time viewing. It also has a wide field of view (approximately 120 degrees), making it easier for pilots to navigate and avoid obstacles during flight.
- **Integrated Video Transmitter**:
    - Operating on a 5.8GHz frequency band with 48 available channels, this camera ensures strong video transmission with minimal interference. This feature is particularly useful for short-range flying and enhances the overall FPV experience.

- **On-Screen Display (OSD) Support**:
    - The built-in OSD offers telemetry data such as battery voltage and flight time, which can be customized based on pilot preferences. This real-time feedback is crucial for maintaining situational awareness during flight.
- **Audio Support**:
    - Equipped with a built-in microphone, this camera enables audio feedback, which can be beneficial in specific flying scenarios where sound cues are essential.
- **Lightweight and Compact**:
    - Weighing approximately 4-5 grams, the Turbowing camera is ideal for small drones, with a durable casing that protects against impacts and debris. Its compact size ensures it doesn't add significant weight to the drone.

Alternate Option:

- **REES52 600TVL 170 Degree Mini FPV AV Camera**:
    - This camera provides a 170-degree viewing angle and better video stability. However, it lacks an integrated video transmitter, making it less suitable for FPV applications that require a streamlined setup.

8. Sensors

8.1 RFD900 Radio Modem

- **Overview**: The RFD900 is a high-power radio modem designed for long-range communication over the 900MHz frequency, supporting both EU (868MHz) and US (900MHz) regions.

Key Features:

- **Range**: Capable of communication over distances exceeding 40 km, depending on antenna setup, making it suitable for long-range drone operations.
- **Transmit Power**: Provides up to 1W transmit power, ensuring robust and stable connections, which is critical for reliable data transmission.
- **Connectivity**: Features dual RP-SMA RF connectors, allowing for flexible antenna configurations and enhancing communication reliability.
- **Open-Source Firmware**: Supports custom modifications and firmware updates, enabling users to tailor the modem's functionality to specific mission requirements.
- **Configuration**: Easily configurable through Mission Planner software, with LED indicators that provide real-time connection status feedback.
- **Power Requirements**: An external power supply is recommended when connected to autopilots with limited current on telemetry ports, ensuring adequate power for reliable operation.

8.2 Hex Here3+ GNSS (M8P) RTK GPS Module

- **Overview**: The Hex Here3 GNSS M8P RTK GPS module offers high-precision RTK positioning, suitable for UAVs requiring centimeter-level accuracy.

Key Features:

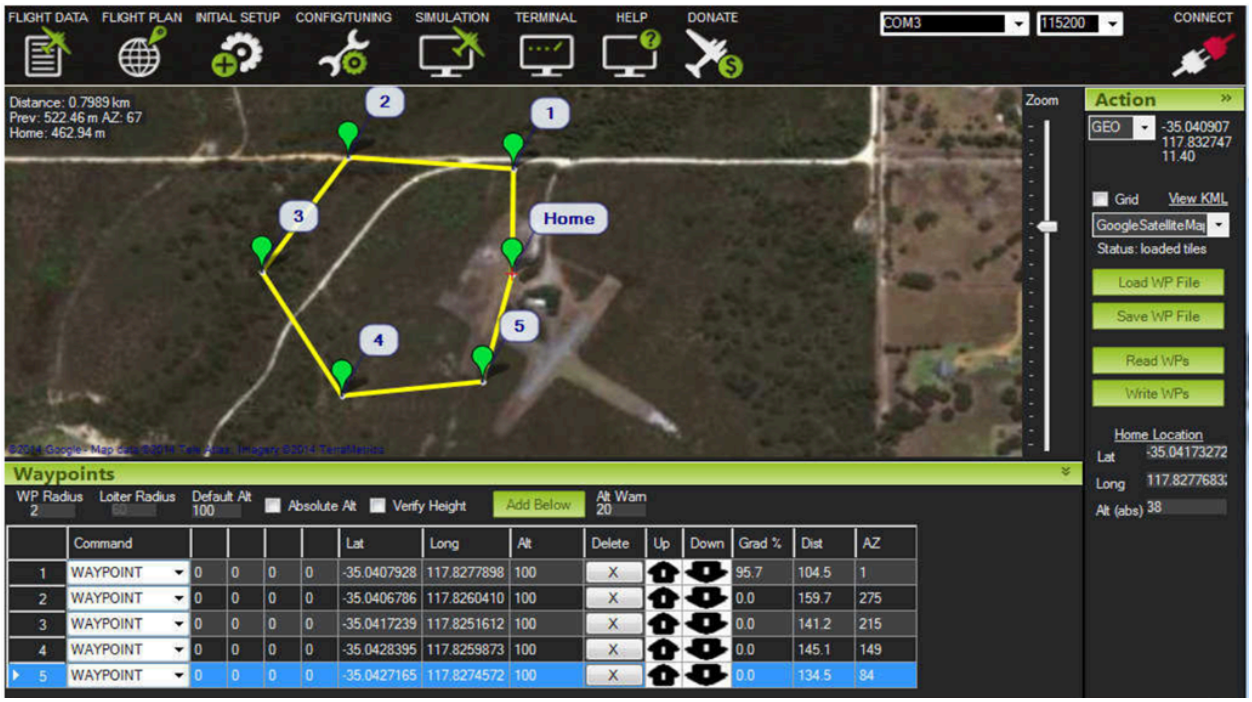
- **Positioning Accuracy**: Delivers centimeter-level precision using RTK positioning, which is critical for applications requiring high accuracy, such as surveying and mapping.
- **GNSS Engine**: Supports the Ublox M8P engine, which includes dual-band reception and advanced interference mitigation, enhancing signal reliability.
- **Additional Components**: Features a built-in safety switch, IMU, and magnetometer, providing enhanced stability and navigation capabilities, essential for complex flight tasks.

- **Communication Protocol**: Operates over the CAN protocol, making it compatible with ArduPilot systems, facilitating easy integration into existing drone setups.

OTHER sensors included in the flight controller are:

E.g.Digital Barometric Pressure Sensor (MS5607/MS5611),Digital Humidity Sensor (HTU21D(F)).

9. Mission Planner Software

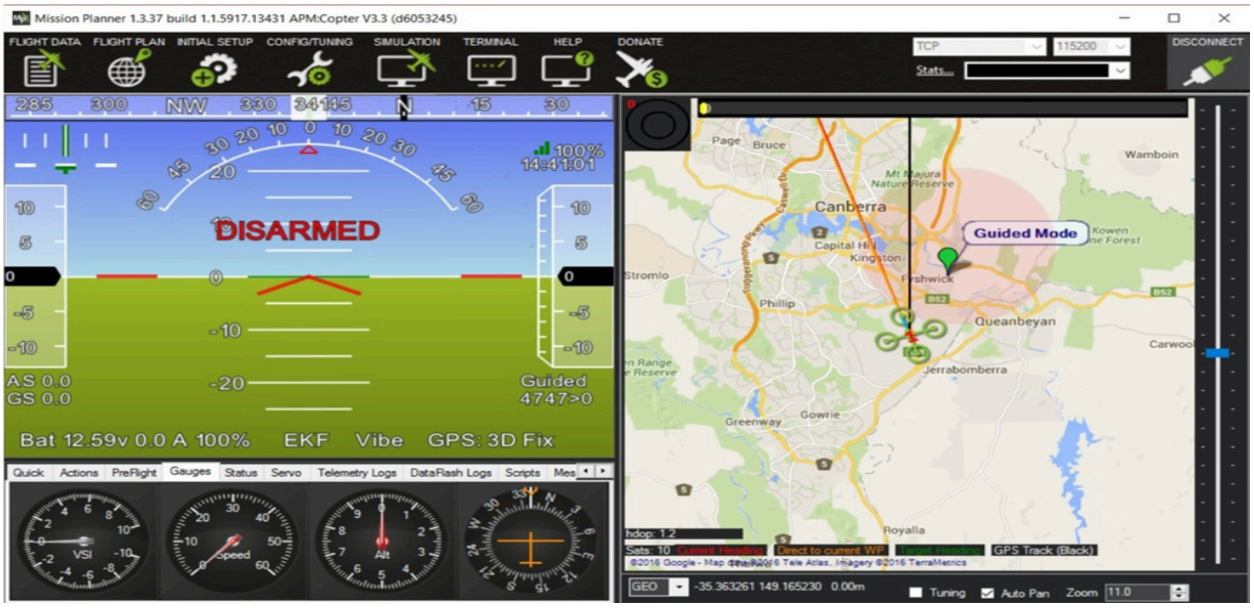


Overview

Mission Planner software is a versatile Ground Control Station (GCS) primarily used for planning, configuring, and monitoring UAV or drone missions. It serves as a comprehensive platform for drone operations, offering users the ability to efficiently manage their drone missions.

Key Functionalities:

- **Plan Missions**:
    - Users can define flight paths, set waypoints, and configure flight parameters for autonomous drone missions. This capability allows for advanced mission planning that maximizes operational efficiency and effectiveness.
- **Configure Vehicle Settings**:
    - Adjustments can be made to autopilot settings, including flight modes, sensor configurations, and communication protocols, ensuring that the drone operates optimally based on specific mission requirements.
- **Monitor Operations in Real-Time**:
    - The software provides live updates on vehicle status, sensor data, and flight performance, enhancing situational awareness. This real-time feedback is crucial for making informed decisions during flight operations.
- **Data Transfer**:
    - Mission Planner facilitates the upload and download of mission plans, vehicle configurations, and flight data between the GCS and UAV. This feature supports mission planning and post-flight analysis, enabling users to refine their operations continually.



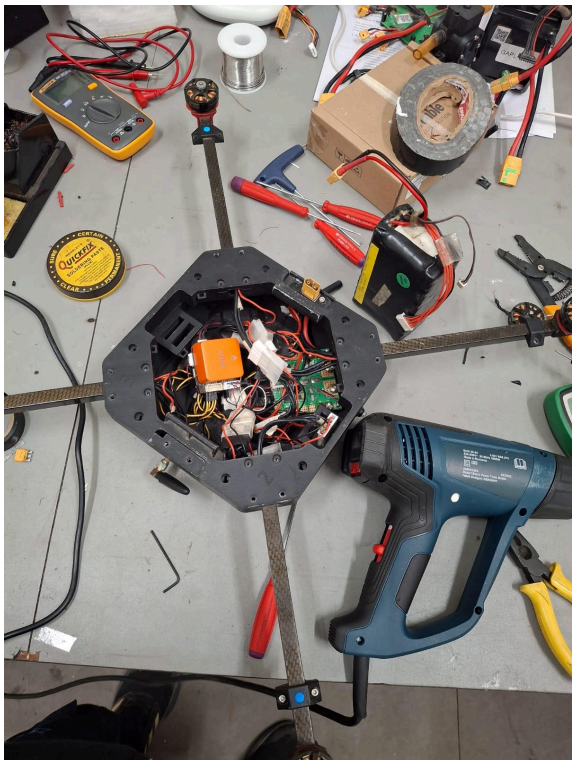
Key Features:

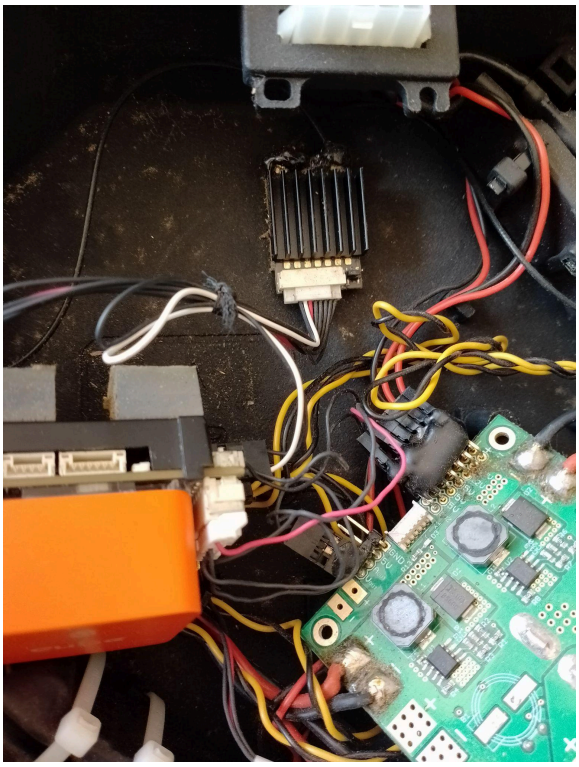
- **Simulation Mode**:
  - This feature allows users to test and refine mission plans in a virtual environment before conducting real-world operations, reducing the risk of errors during actual flights.
- **Autopilot Compatibility**:
  - The software is compatible with popular autopilot systems like ArduPilot and PX4, making it adaptable to various UAV platforms and enhancing its usability across different drone setups.
- **Real-Time Data Visualization**:
  - Provides a live display of sensor data, flight telemetry, and other relevant information during flight operations, enabling users to monitor performance effectively and respond to any anomalies in real-time.
- **Open-Source Options**:
  - The software includes free open-source alternatives, such as Mission Planner for general UAV use and Litchi, which is tailored for DJI drones, allowing users to choose the solution that best fits their needs.

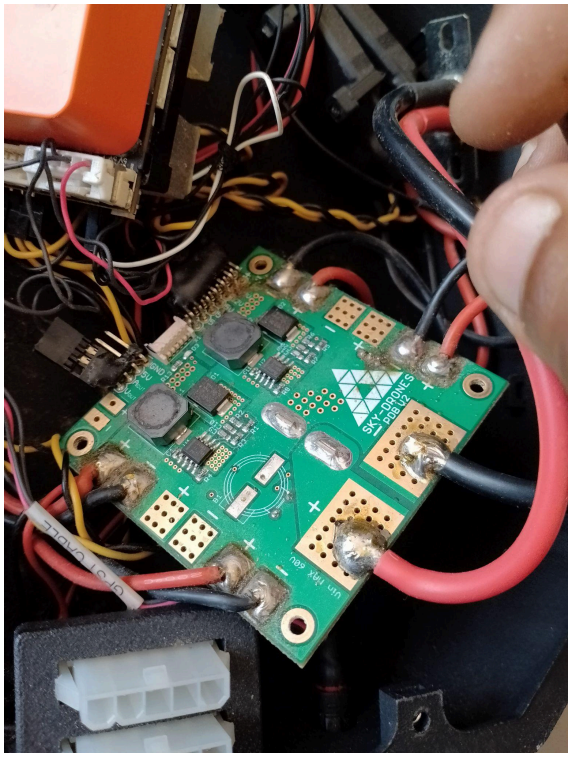
10.Conclusion

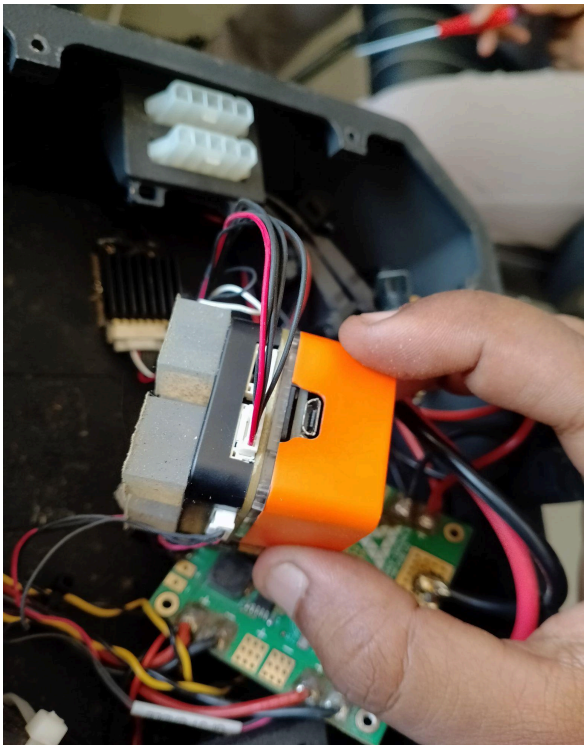
The various components and systems outlined in this report are integral to the successful operation of drones. From the material selection for drone frames to advanced flight controllers and ESCs, each element plays a crucial role in enhancing the drone's performance and functionality. The careful integration of high-quality components, such as brushless DC motors, reliable batteries, advanced sensors, and effective software, ensures that drones can perform a wide range of tasks with precision and efficiency. This holistic approach to drone design and operation is essential for meeting the growing demands of various applications, from agriculture to surveillance and beyond.

Related Images









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