Droneforge Indoor Flying Drone with Precision Landing Manual

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1. Introduction:

Welcome to the manual for the DroneForge Indoor Flying Drone with Precision Landing system, developed by our team consisting of Sabrina, Shreya, Diego and Suhaib as part of the CSE 4317-001 course at the University of Texas at Arlington, under the guidance of Professor McMurrough.

This manual serves as a comprehensive guide for assembling, operating, and maintaining our innovative drone system. The DroneForge system is designed to enable indoor flight operations with precise landing capabilities.

Our team has meticulously designed and integrated various components, including flight controllers, GPS modules, telemetry radios, motors, propellers, receivers, transmitters, sensors, and mounting hardware, to create a robust and reliable drone system. The inclusion of advanced features such as optic flow sensors and LiDAR sensors enhances the drone's navigational capabilities, enabling precise positioning and obstacle avoidance in indoor environments.

This manual provides detailed instructions on assembling the drone, operating it safely and effectively, performing routine maintenance, troubleshooting common issues, and adhering to safety guidelines. By following the instructions outlined in this manual, users can maximize the performance and longevity of the DroneForge system while ensuring safe and responsible operation. We hope that this manual serves as a valuable resource for users seeking to harness the full potential of the DroneForge Indoor Flying Drone with Precision Landing system.

2. System Overview:

The DroneForge Indoor Flying Drone with Precision Landing system represents a sophisticated integration of hardware and software components to enable precise and controlled flight operations in indoor environments. This section provides a detailed overview of the key components and functionalities of the system:

Flight Control System: The core of the DroneForge system is the Cube Orange Flight Controller, a powerful and reliable flight control unit that governs the operation of the drone. Equipped with advanced sensors and processing capabilities, the flight controller ensures stable flight performance and precise control over the drone's movements.

Navigation System: To facilitate accurate navigation and positioning, the DroneForge system is equipped with the Here3+ RTK GPS module. This high-precision GPS module offers centimeter-level accuracy, enabling the drone to precisely locate itself in indoor environments where traditional GPS signals may be limited or unavailable.

Communication System: Real-time communication between the drone and ground control station is facilitated by the RFD900x-US Telemetry radio set. This telemetry radio system provides reliable data transmission over long distances, allowing operators to monitor and control the drone remotely.

Propulsion System: The propulsion system of the DroneForge drone consists of 2212 920KV Brushless Motors and 1045 propellers, which provide the thrust necessary for stable and

maneuverable flight. Paired with 2-4S 40A Brushless ESCs, these motors offer efficient power delivery and responsive control.

Control Interface: The FrSky Taranis Q X7 Access Transmitter serves as the primary control interface for the drone, allowing operators to pilot the drone with precision and ease. With its intuitive controls and ergonomic design, the transmitter enables smooth and intuitive flight operations.

Sensing System: To enhance situational awareness and obstacle avoidance capabilities, the DroneForge system incorporates an optic flow sensor and LiDAR sensor. These sensors provide real-time data on the drone's surroundings, enabling it to navigate safely and autonomously in complex indoor environments.

Mounting Hardware: The structural integrity of the drone is ensured by M3 threaded 60m aluminum standoffs, M3 nylon acorn nuts, and M3 and M2.5 nylon screw kits, which secure the components to the frame. Anti Vibration Rubber Balls are used to dampen vibrations and ensure stable sensor readings, while rubberized battery straps and double-sided removable mounting tape provide secure attachment for batteries and electronic components.

By combining these components into a cohesive system, the DroneForge Indoor Flying Drone with Precision Landing system offers a reliable and versatile platform for a wide range of indoor flight applications, including mapping, inspection, and surveillance.

3. Components:

- XT60 battery connectors

- Deans battery connectors

- Deans female to XT60 male adapter

- 5200mAh 11.1v LiPo battery

- XT60 battery pigtails

- Cube Orange Flight Controller

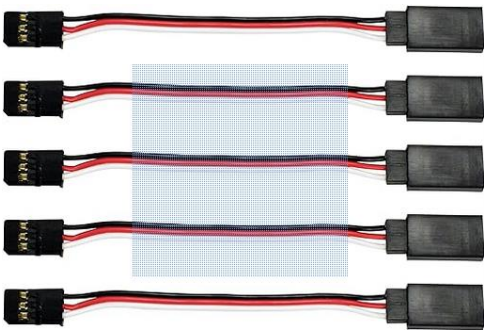
- Here3+ RTK GPS

- RFD900x-US Telemetry radio set

- 2212 920KV Brushless Motors

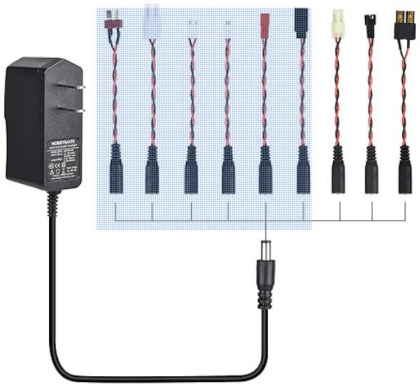
- 2-4S 40A Brushless ESC

- Servo extension wires



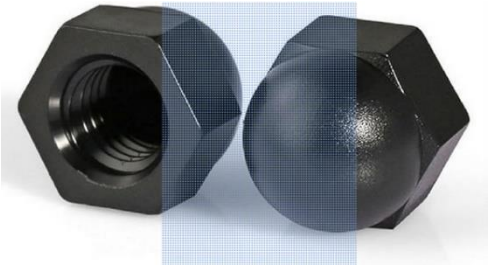
- 1045 propeller pack

- RC Battery Charger (for FrSky transmitter battery)



- M3 threaded 60m aluminum standoffs

- M3 nylon acorn nuts



- M3 nylon screw kit

- M2.5 nylon screw kit

- Anti Vibration Rubber Balls

- Rubberized battery straps

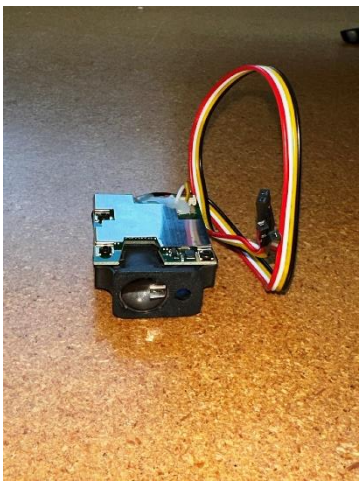
- Double-sided removable mounting tape

- Zip ties 3.6mm

- Zip ties 2.5mm

- Optic flow sensor

- LiDAR sensor



- Taranis X7 controller

4. Assembly Instructions:

1. Frame Assembly:

a. Lay out the drone frame components, including the main frame plates, arms, and hardware.

b. Attach the arms to the main frame plates using the provided screws and nuts. Ensure that the arms are securely fastened and aligned properly.

c. Install the M3 threaded 60mm aluminum standoffs at the corners of the main frame plates using the provided screws.

d. Use the M3 nylon acorn nuts to secure the standoffs in place, ensuring a tight fit.

2. Motor and Propeller Installation:

a. Attach the 2212 920KV Brushless Motors to the motor mounts on the arms using the provided screws.

b. Slide the 1045 propellers onto the motor shafts and secure them in place with the included propeller nuts. Ensure that the propellers are properly balanced and tightened.

3. Electronic Speed Controller (ESC) Installation:

a. Connect the 2-4S 40A Brushless ESCs to the motor leads, ensuring that the correct polarity is maintained.

b. Secure the ESCs to the arms using double-sided mounting tape or zip ties, ensuring that they are positioned away from the motor heat and have proper ventilation.

4. Flight Controller and Sensor Installation:

a. Mount the Cube Orange Flight Controller onto the center of the drone frame using the provided mounting hardware.

b. Connect the Here3+ RTK GPS module to the flight controller using the included cables. Ensure that the GPS module is oriented correctly and has a clear view of the sky.

5. Telemetry Radio and Receiver Installation:

a. Connect the RFD900x-US Telemetry radio set to the designated ports on the flight controller using the provided cables.

b. Install the FrSky Taranis X8R Receiver onto the drone frame using double-sided mounting tape or zip ties. Ensure that the receiver antennas are properly positioned for optimal signal reception.

6. Transmitter Setup:

a. Power on the FrSky 2.4GHz Taranis Q X7 Access Transmitter and ensure that it is bound to the receiver.

b. Configure the transmitter settings according to the manufacturer's instructions and personal preferences.

7. Power System Setup:

a. Connect the XT60 battery connectors to the 5200mAh 11.1v LiPo battery.

b. Use the Deans female to XT60 male adapter to connect the battery to the power distribution board on the drone frame.

8. Sensor Mounting:

a. Mount the optic flow sensor and LiDAR sensor onto the drone frame using the provided mounting hardware.

b. Ensure that the sensors are securely attached and properly aligned for accurate data collection.

9. Final Checks:

a. Double-check all connections and fasteners to ensure that they are secure.

b. Perform a pre-flight inspection to verify that all components are functioning properly.

c. Calibrate the flight controller and sensors according to the manufacturer's instructions.

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5. Operating Instructions:

1. Pre-flight Checklist:

a. Ensure that the drone's battery is fully charged and properly connected.

b. Verify that all components, including motors, propellers, flight controller, sensors, and telemetry radio, are functioning properly.

c. Check the transmitter's battery level and ensure that it is fully charged.

d. Confirm that the FrSky Taranis Q X7 Access Transmitter is bound to the FrSky Taranis X8R Receiver and calibrated according to the manufacturer's instructions.

2. Powering On the Drone:

a. Place the drone on a flat, level surface away from any obstacles or obstructions.

b. Connect the LiPo battery to the drone's power distribution board using the XT60 connector.

c. Power on the FrSky Taranis Q X7 Access Transmitter by pressing and holding the power button until it initializes.

3. Flight Preparation:

a. Wait for the flight controller to initialize and perform its pre-flight checks. This may take a few moments.

b. Verify that the telemetry radio is connected and transmitting data to the ground control station.

c. Check the GPS signal strength and wait for a sufficient number of satellites to acquire a stable GPS lock.

4. Takeoff:

a. Once all pre-flight checks are complete and the drone is ready for flight, arm the motors by following the procedures outlined in the flight controller manual.

b. Slowly increase the throttle to lift the drone off the ground. Takeoff should be smooth and controlled.

5. Flight Control:

a. Use the transmitter sticks to control the drone's movements. The right stick controls throttle (up/down) and yaw (left/right), while the left stick controls pitch (forward/backward) and roll (left/right).

b. Practice flying in open areas before attempting more complex maneuvers. Start with gentle movements and gradually increase speed and agility as you gain confidence.

6. Navigating to Desired Location:

a. Use the transmitter to pilot the drone to the desired location within the indoor environment.

b. Utilize the telemetry data and GPS position information to maintain situational awareness and ensure accurate navigation.

7. Precision Landing:

a. Once the drone reaches the designated landing area, initiate the precision landing procedure using the flight controller.

b. Follow the on-screen prompts or commands to activate the precision landing mode.

c. The drone will autonomously navigate to the specified coordinates and perform a controlled descent for landing.

8. Post-flight Procedures:

a. After landing, disarm the motors and power off the transmitter.

b. Disconnect the LiPo battery from the drone and ensure that all components are powered down.

c. Perform a visual inspection of the drone for any signs of damage or wear.

6. Maintenance and Troubleshooting:

1. Regular Inspections:
    - Perform visual inspections of the drone before and after each flight to check for any signs of damage, wear, or loose components.
    - Pay particular attention to the frame, motors, propellers, and electronic connections.
2. Cleaning:
    - Keep the drone clean and free from dust, dirt, and debris.
    - Use compressed air or a soft brush to remove any accumulated dirt from the frame, motors, and propellers.
3. Battery Care:
    - Monitor the condition of the LiPo battery and ensure that it is not swollen, punctured, or damaged.
    - Store the battery in a cool, dry place when not in use, and avoid overcharging or discharging it beyond recommended levels.
4. Propeller Maintenance:
    - Inspect the propellers for any signs of damage, such as chips, cracks, or imbalance.
    - Replace damaged or worn propellers to maintain optimal performance and stability.
5. Software Updates:

- Regularly update the firmware and software of the flight controller, transmitter, and other components to ensure compatibility and access to the latest features and improvements.

6. Calibration:
    - Periodically calibrate the sensors, including the GPS, compass, and accelerometer, according to the manufacturer's instructions to maintain accuracy and reliability.

Troubleshooting:

1. Drone Won't Power On:
    - Check the battery connection to ensure it is securely attached.
    - Verify that the LiPo battery is charged and not damaged.
    - Inspect the power distribution board and wiring for any loose connections or damage.
2. Motor Issues:
    - If a motor fails to spin or behaves erratically, check the motor connections and ESC calibration.
    - Inspect the motor and propeller for any obstructions or damage.
    - Swap the motor with a known working one to isolate the issue.
3. Flight Controller Errors:
    - If the flight controller displays error messages or behaves unpredictably, check for firmware updates and calibration issues.
    - Ensure that all sensors are properly connected and functioning.

- Reset the flight controller to factory defaults and reconfigure as needed.

4. GPS Signal Loss:
    - If the GPS signal is lost or inaccurate, check for interference from nearby buildings or structures.
    - Verify that the GPS module is properly connected and positioned for optimal signal reception.
    - Consider using an external GPS antenna or relocating the drone to a different area with better GPS coverage.
5. Telemetry Radio Connection Issues:
    - If telemetry data is not being transmitted or received, check the radio connections and antenna orientation.
    - Verify that the telemetry radio settings are configured correctly in the ground control station software.
    - Troubleshoot potential interference from other electronic devices or radio sources.
6. Sensor Calibration Problems:
    - If sensors such as the compass or accelerometer are not calibrated correctly, follow the calibration procedures outlined in the manufacturer's instructions.
    - Ensure that the drone is placed on a level surface during calibration and that there are no magnetic or electronic sources nearby.
7. Propeller Vibration or Imbalance:
    - If the drone experiences excessive vibration or instability during flight, check the balance of the propellers and motors.

- Balance the propellers using a propeller balancer and ensure that they are securely attached to the motor shafts.

7. Safety Guidelines:

Flying Environment:

- Always fly the drone in a controlled indoor environment.
- Keep bystanders clear of the flight area.
- Do not attempt to modify or tamper with any components while the drone is powered on.
- Follow local regulations and guidelines for drone operation.

Battery Safety:

- Handle LiPo batteries with care and follow proper charging and storage procedures.
- Avoid overcharging or discharging the battery beyond recommended levels.
- Dispose of damaged or swollen batteries properly and do not attempt to use them.

Continuous Learning:

- Stay informed about the latest developments in drone technology, safety best practices, and regulatory requirements.
- Participate in training programs, workshops, and community forums to enhance your knowledge and skills as a drone pilot.