機械與機電系統研究所

MECHANICAL AND MECHATRONICS SYSTEMS
RESEARCH LABORATORIES, MMSL.

UNMANNED AERIAL VEHICLE(UAV)

Flight Control System Technology

Modern flight controllers manage data processing, attitude control, and flight trajectory planning but often face stability issues due to interference and cybersecurity risks. To address these challenges, we developed a flight controller with certified cybersecurity protection, hardware expandability, and ROS/ROS 2.0 compatibility, enabling users to develop and integrate secondary intelligent functions.

Technical Advantages and Features

Cybersecurity and Smart Flight

- Built-in sensors enhance reliability by providing more than 3 sets of redundant and cross-checked computations.
- AES-128 encryption ensures data security.

Highly Compatible and Easy to Develop

- Based on the open-source Pixhawk system, compatible with PX4 and Ardupilot.
- Supports ROS/ROS2 for developing intelligent payloads and integrated applications.

Flexible Assembly Design

- Expandable to support AI computing modules.
- Integrates with high-precision positioning systems for advanced development.

Industrial Benefits and Business Opportunities

Industry Applications:
Unmanned Vehicle Industry (e.g., drones, unmanned ships, autonomous cars).

Application Examples:
The flight control module has been integrated into an X8 UAV designed for cleaning applications, including insulator washing, power tower maintenance, and building façade cleaning, and is currently undergoing field testing in Taiwan and Japan.

Mini Flight Controller

Deployed in logistics drones for automated delivery services in Taiwan and Japan

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Insulator Cleaning Drone

In the electric power transmission system, the insulators on high-voltage electric towers require cleaning and maintenance to reduce the risk of arcing or erosion, thereby ensuring the stability of the power supply. Whether performed through manual climbing or by using helicopters equipped with water guns, cleaning remains a high-risk and costly operation. The insulator cleaning drone significantly reduces the risk exposure to personnel and offers a more competitive model for maintaining the transmission network.

Technical Advantages and Features

Complete System Development

- Capable of autonomous flight operations.
- Single-trip payload capacity can reach up to 38 liters of water.
- Featuring frontal autonomous obstacle avoidance.
- Stable hovering cleaning mode near electric tower proximity points.

Water Nozzle Functional Payload

- Water pressure of 20 MPa, effective cleaning distance of 3 meters.
- The gimbal's servo controls the water nozzle, complying with the standard operating procedures for cleaning insulators along multi-segment paths.
- Remote real-time monitoring of the cleaning process.

Tracking Control

- The onboard AI automatically recognizes the type and distance of the insulator strings and calculates the necessary adjustments for water nozzle gimbal control.
- An algorithm for image processing that resists mist interference.

Industrial Benefits and Business Opportunities

Industry Applications:

Operation and Maintenance of Electric Power Infrastructure and Industries Requiring High-Altitude Cleaning Services (such as Insulator Cleaning and Building Cleaning).

Application Examples:

Obtained the first-phase test flight certificate for high-voltage electric tower sites and is currently verifying cleaning performance in the field. Derivative applications include horizontal spraying on large fruit trees, demonstrating effective penetration through large tree canopies.

Drone-Based Insulator Cleaning Operation

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Customized Technology for High-Efficiency Drone Motors and Smart Electronic Speed Controller

For military or commercial drones, the motors and electronic speed controllers directly affect the dynamic performance of the flight. These components need to be developed based on the overall takeoff weight and power configuration of the drone and must be matched with the propeller output settings to optimize the drone's durability and controllability. This technology addresses the domestic shortage of high-thrust electric propulsion modules for medium to large drones, thereby accelerating the development of the entire power system and enhancing flight reliability.

Technical Advantages and Features

Autonomous High-Efficiency Motor

- Equipped with development examples and trial production capabilities for series items under 5 kW.
- Customized design and the local supply chain.
- The housing's optimized air-cooled flow channel design ensures sustained high output.

Autonomous Electronic Speed Controller

- Optimized sensorless control technology enhances performance for medium to high thrust output.
- Capable of receiving dual input commands via CAN/PWM.
- Real-time monitoring and recording of motor operational status.
- Optimized housing design for heat dissipation supports sustained high current output.

Safety Certification

- Obtained TAF, IP55, and IECQ certifications (dustproof, waterproof, low temperature, vibration).
- Assisting in obtaining EMI/EMC certifications.
- Assisting in obtaining MIL-STD-related certifications.

Industrial Benefits and Business Opportunities

Industry Applications:

Related to Unmanned Vehicles, Including Drones, Unmanned Boats, and Autonomous Vehicles.

Application Examples:

The drone motors and electronic speed controllers developed through this technology are suitable for medium to large multi-rot or drones. Specifications have been adjusted according to manufacturer demands. The technology has been transferred to two domestic manufacturers, who will establish production lines and become parts of the drone supply chain.

Motor

Electronic Speed Controller

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UNMANNED AERIAL VEHICLE(UAV)

Multi-Purpose UAV Technology and Applications

UAVs face adverse conditions during missions, from complex terrain to unpredictable weather, challenging navigation and flight stability. To meet diverse application needs, system providers require a versatile UAV platform that adapts to varying environments, enhances endurance and payload capacity, and allows rapid hardware and software customization.

Technical Advantages and Features

Long Endurance and Precision Flight

- Up to 30 minutes of hover time with a 5kg payload.
- Maximum flight speed: 50 km/h.
- Hover accuracy: ± 15 cm.

Propulsion System Redundancy and Cybersecurity Protection

- Redundant propulsion system ensures safe landing even with failure of 2 non-coaxial motors.
- Certified with mid-level cybersecurity compliance for UAVs to protect mission data.

Versatile Applications and Quick Folding

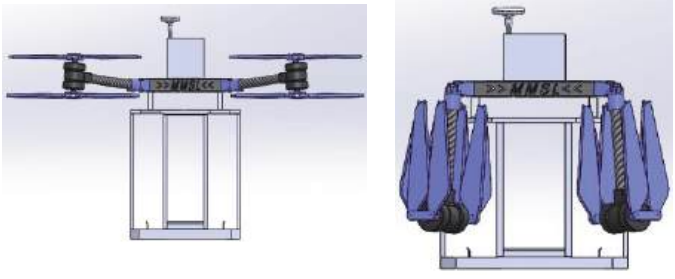
- Foldable arm design reduces volume by 55% (folded size: 74×74×80.5 cm), enhancing portability.
- Modular payload system supports flexible applications, including logistics, power grid and wind turbine blade inspection, geomagnetic surveys, and water quality monitoring.

Industrial Benefits and Business Opportunities

Industry Applications:
Logistics Delivery, Inspection, and UAV System Integration Providers.

Application Examples:
1. Partnered with Japanese company TOMPLA for UAV cargo delivery, demonstrating system stability and practical value in smart logistics applications.
2. Integrates with power grid image recognition technology to complete inspections in 20 minutes, over 3 times faster than manual methods.

UAV for Logistics Delivery



UAV Deployment and Folding

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