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Advanced Unmanned Aerial Vehicle (UAV) with Hybrid Propulsion and AI-Based Autopilot System

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Abstract: This paper presents the design and development of an advanced Unmanned Aerial Vehicle (UAV) equipped with a hybrid propulsion system, combining gasoline engines and solar panels to enhance flight endurance. The UAV integrates cutting-edge navigation technologies, including GPS, gyroscopic stabilization, real-time computer vision, and AI-powered autopilot. The project aims to deliver long-range, high-efficiency aerial operations for applications such as disaster relief, environmental monitoring, military reconnaissance, and smart delivery systems. Key features include real-time telemetry transmission, autonomous obstacle avoidance, payload delivery mechanisms, and robust ground control with video feedback.

I. INTRODUCTION

The development of UAVs has revolutionized the aerospace industry. From military operations to civilian applications, drones offer unmatched flexibility, safety, and efficiency. In this project, we present a hybrid-powered UAV capable of autonomous navigation and payload delivery, designed to operate in diverse and remote environments.

A. System Overview

The UAV is built with a hybrid powertrain combining a high-torque gasoline engine and solar energy capture via onboard panels. The integration of AI and advanced sensors facilitates real-time decision-making, route optimization, and payload management. The onboard vision camera and thermal sensors allow for dynamic mapping and surveillance.

B. Hardware Components

Key hardware components include a gyroscopic sensor (MPU6050), GPS module (NEO-6M), vision and thermal cameras (ESP32-CAM and MLX90640), and long-range RF modules (SX1278). The propulsion system features a 70-80 kg torque brushless engine supported by large-capacity LiPo batteries and optional solar panels for extended missions.

C. Control System Design

The flight controller is built around the Arduino Mega, chosen for its expandability. The gyroscopic sensor and GPS module ensure stable and guided navigation. The ground control unit communicates via RF and features a joystick-based control panel with additional buttons for payload release, camera switching, and return-home functions.

D. Communication System

The UAV employs a hybrid communication architecture using LoRa for low-power long-distance communication and Wi-Fi/Satellite uplink for video streaming and telemetry. This dual-mode system ensures redundancy and reliable performance during long-range missions or in GPS-denied environments.

E. Propulsion System

The propulsion is handled by a robust gasoline engine paired with a brushless electrical starter system. The UAV includes a heavy-duty propeller setup to generate the required thrust. Engine performance is monitored via sensors feeding into the Arduino for dynamic adjustments. The system is supported by 6-cell (22.2V) 10000mAh LiPo batteries.

F. Autopilot and AI Integration

An AI-based autopilot system is implemented using a Raspberry Pi interfaced with the Arduino. This enables real-time object recognition, obstacle avoidance using LiDAR, and autonomous decision-making during missions. Waypoints can be uploaded in real-time, and the UAV adapts to weather, terrain, and other variables.

G. Payload Mechanism

A servo-controlled mechanical latch system manages payload release. The controller includes a dedicated release button. The system is designed for modular payloads — such as small parcels, sensors, or emergency supplies — and ensures reliable drop at the designated GPS location.

H. Ground Control Unit

The ground controller includes a custom joystick panel with a screen to view live camera feed and telemetry data. It uses an Arduino Mega with an integrated RF receiver. The onboard display (TFT 3.5-inch) shows GPS coordinates, altitude, video feed, and signal status. Buttons for mode switch, emergency return, and payload release are included.

II. RESULTS AND DISCUSSION

Initial field tests have shown promising results in terms of stability, range, and autopilot accuracy. The hybrid engine enables flight durations exceeding 2 hours, with real-time feedback and video stability maintained over 3 km. The payload system demonstrated reliable release within 2 m accuracy from the intended GPS coordinates.

III. FUTURE ENHANCEMENTS

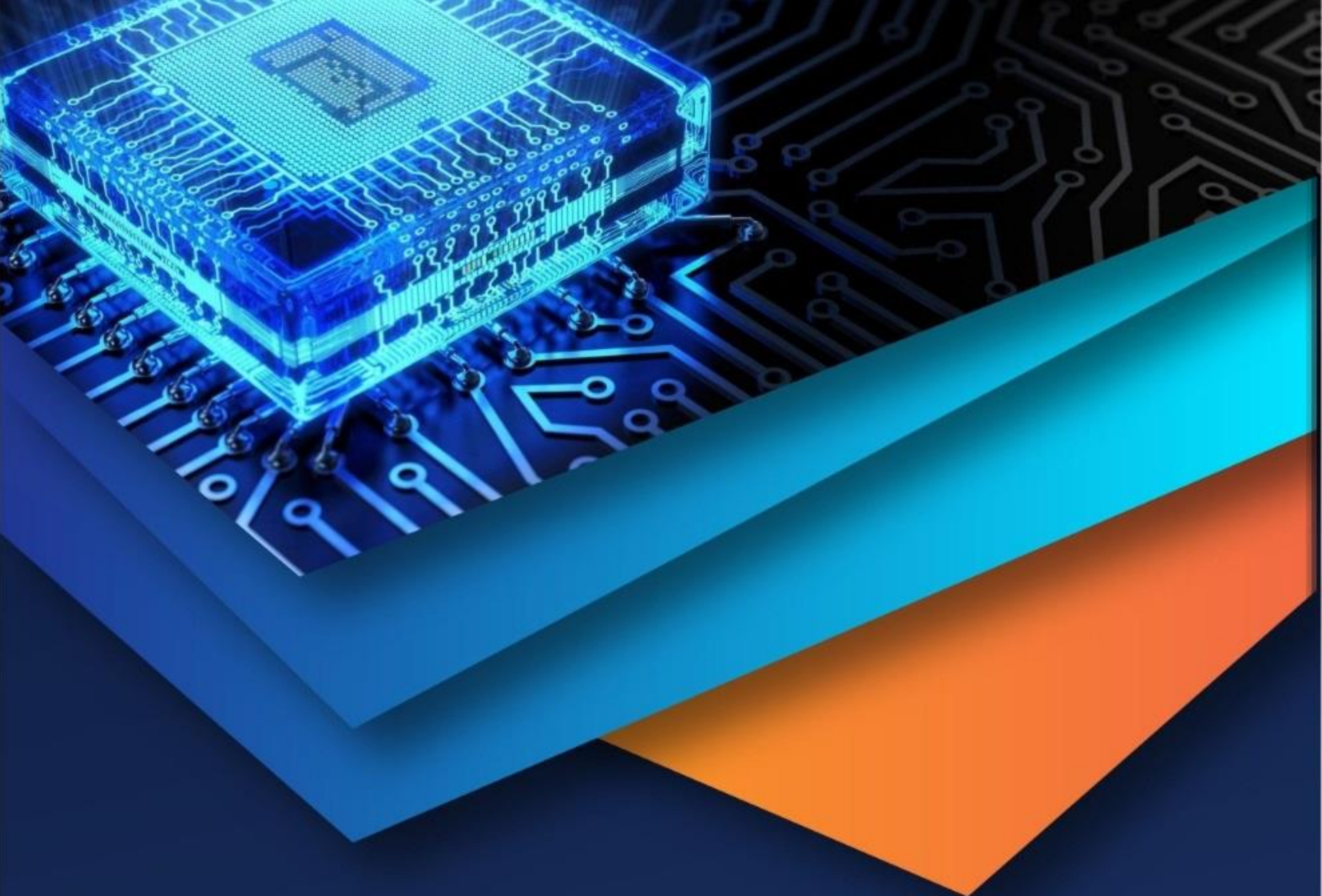
Planned future upgrades include AI-powered object tracking, real-time swarm communication between multiple UAVs, solar panel efficiency improvements, integration with 5G networks, and lightweight composite airframes to further enhance performance.

IV. CONCLUSION

This project showcases the potential of hybrid UAV systems equipped with smart features for autonomous and long-range missions. With modular architecture and scalable design, the UAV can adapt to various civil, military, and industrial applications.

REFERENCES

[1] Arduino Documentation
[2] Raspberry Pi AI Toolkit
[3] LoRa Communication Protocols
[4] IEEE Journals on UAV Swarm Intelligence
[5] Research on Hybrid UAV Systems - Springer, 2023



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