ESP32 Mini Drone

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Abstract: "This paper presents the design and development of an affordable, lightweight mini quadcopter using the ESP32 microcontroller. The primary objective is to create a cost-effective flight control system that integrates real-time surveillance capabilities. The system utilizes an ESP32-WROOM-32 for flight dynamics management and an ESP32-CAM module for live video streaming via an HTTP web server. A customized PID (Proportional-Integral-Derivative) algorithm is implemented to ensure flight stability and precise maneuverability. Experimental results demonstrate that the drone maintains stable hover and provides a low-latency video feed, making it suitable for indoor monitoring and educational purposes. The final prototype weighs less than 250g, adhering to micro-UAV regulations."

Keywords: *ESP32, ESP32-CAM, Flight Controller, PID Algoritham, Surveillance Drone, Quadcopter, IOT.*

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I. INTRODUCTION

Unmanned Aerial Vehicles (UAVs) or drones have gained significant importance in various sectors such as agriculture, logistics, and security surveillance. However, commercial drones with programmable flight controllers are often expensive and hard to customize. This research focuses on developing a low-cost, open-source mini drone using the ESP32 microcontroller. The dual-core processor of the ESP32 allows for efficient flight management and real- time data transmission. Additionally, the integration of an ESP32-CAM module enhances the system by providing live video feedback for monitoring purposes.

II. LITERATURE SURVEY

➤ *Overview of Drone Technology*

The development of mini-drones has seen a shift from complex flight controllers to SoC-based systems like ESP32. This research explores how these low-cost modules can be used for stable flight and surveillance."

➤ *Component Selection and Analysis*

The selection of the ESP32 microcontroller is based on its dual-core architecture and built-in Wi-Fi capabilities. For stabilization, the MPU6050 sensor is chosen due to its integrated 3-axis gyroscope and 3-axis accelerometer. These components provide a balanced trade-off between cost and performance for micro-UAV applications.

III. HARDWARE ARCHITECTURE

➤ *ESP32 Controller*

The main brain of the drone that handles flight stability and wireless communication.

➤ *MPU6050 Sensor*

A 6-axis sensor that helps the drone keep its balance by measuring tilt and rotation.

➤ *ESP32-CAM*

A specialized camera module that streams live video to a web server for surveillance.

➤ *Motors and ESC*

Four BLDC motors controlled by Electronic Speed Controllers to provide thrust and flight control.

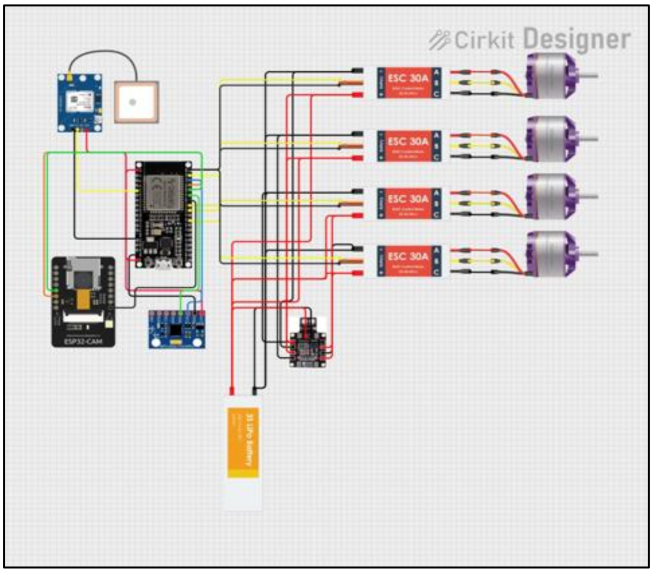

Fig 1 Circuit Diagram and Hardware Interfacing of Drone System

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IV. METHODOLOGY

The drone system is implemented using an ESP32 microcontroller, programmed through the Arduino IDE. A PID (Proportional-Integral-Derivative) algorithm is used to process data from the MPU6050 sensor to stabilize flight. Simultaneously, the ESP32-CAM module acts as a web server to provide real-time surveillance video streaming over Wi-Fi.

➢ *Software Implementation*

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The flight controller code is developed using the Arduino IDE. It includes libraries for MPU6050 data processing and Wi-Fi communication for the ESP32-CAM module.

➢ *Stability Control*

A PID (Proportional-Integral-Derivative) algorithm is used to maintain the drone's balance. It takes real-time data from the gyroscope and accelerometer to adjust motor speeds instantly.

➢ *Wireless Surveillance*

The ESP32-CAM is programmed to create a local web server. Users can connect to the drone's IP address to watch the live video feed during flight.

Fig 2 Final Project of the Ending

V. RESULTS AND DISCUSSION

The drone was successfully tested for flight stability and real-time video streaming. It was observed that the PID tuning provided a stable hover with minimal drift. The ESP32-CAM module successfully transmitted a 640x480 resolution video feed at 15-20 FPS over a local Wi-Fi network. The average flight time recorded was approximately 8-10 minutes using a 3S Li-Po battery.

VI. CONCLUSION

This project demonstrates the successful implementation of a low-cost surveillance drone using the ESP32 microcontroller and MPU6050 sensor. The integration of the ESP32-CAM provides an efficient solution for real-time monitoring. Future work includes the integration of GPS for autonomous flight and improving the battery life for longer missions.

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REFERANCES

[1]. Espressif Systems, "ESP32 Series Datasheet," v3.9, 2023. [Online]. Available: https://www.espressif.com.
[2]. InvenSense, "MPU-6050 Product Specification Revision 3.4," 2013.
[3]. A. M. Rahat and N. I. Mondal, "Development of a Low- Cost Surveillance Drone using ESP32-CAM," International Journal of Robotics and Automation, vol. 9, no. 2, pp. 45-51, 2021.
[4]. J. Smith and R. Patel, "Implementation of PID Control Algorithm for Quadcopter Stability," IEEE Explore, 2019.
[5]. Arduino, "ESP32-CAM Video Streaming Server Tutorial," [Online]. Available: https://docs.arduino.cc.