

Low-Cost Open-Source Micro-Drone Platform

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Introduction

Advances in drone robotics have made drone swarm research^[1, 2] an exciting field to be a part of. However, existing drone platforms are proprietary or expensive for research or educational usage. By creating an open-source micro-drone platform that costs under \$50 per drone, the project aims to make drone swarms more accessible to students and researchers.

Objective

Design a low-cost micro-drone platform can be designed and optimized for reliable flight and used as an educational tool for drone robotics research and instruction

Methodology

1. Implement a state estimator that can fit on an ESP32^[3]
2. Integrate various sensors to accurately position hold the drone with brushed motors
3. Attempt to keep costs at a minimum to explore making swarm drone robotics cheaper
4. Open-source the firmware, so the project can be used for teaching and outreach

Methodology (Continued)

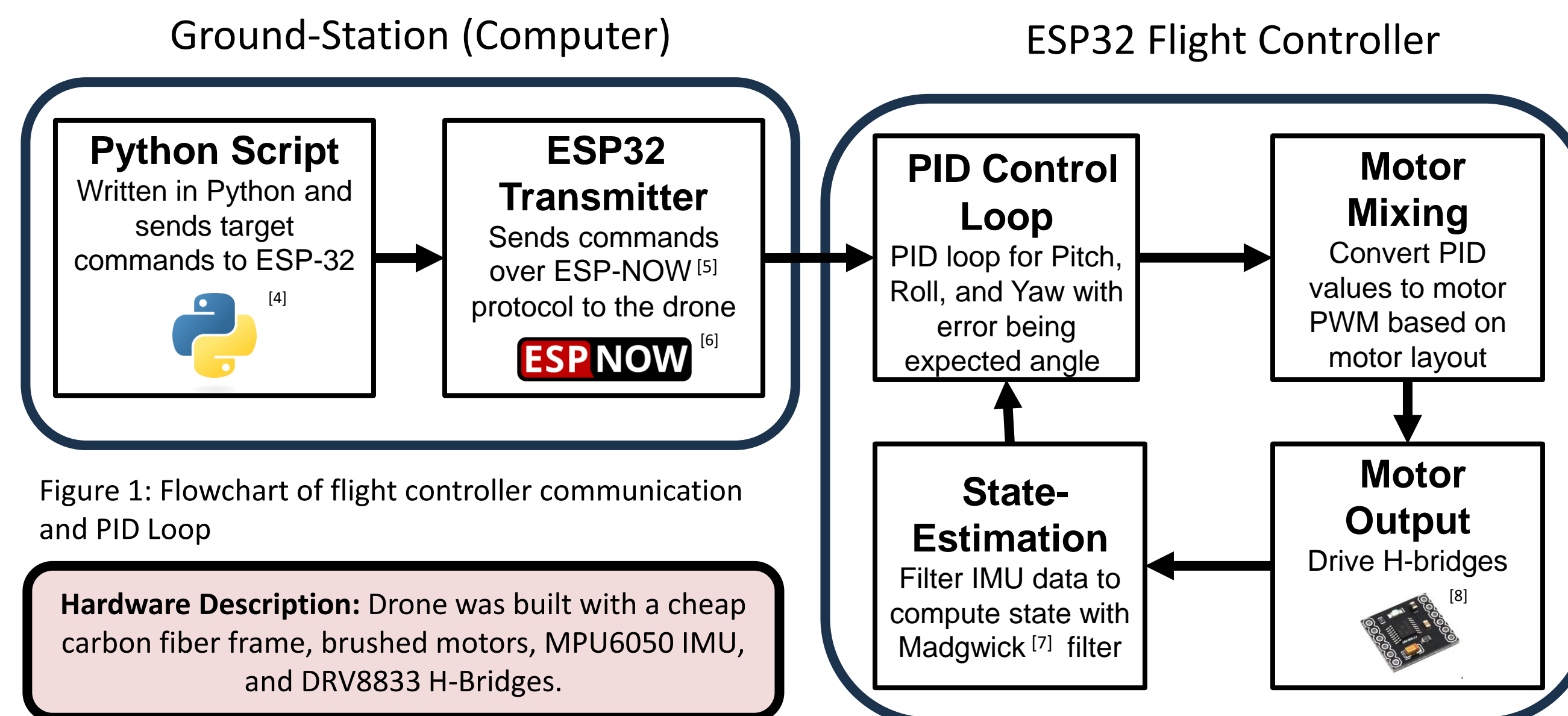


Figure 1: Flowchart of flight controller communication and PID Loop

Hardware Description: Drone was built with a cheap carbon fiber frame, brushed motors, MPU6050 IMU, and DRV8833 H-Bridges.

Data

Thrust Data

- I designed a thrust stand utilizing a strain gauge-based load cell that interfaces with an Arduino microcontroller.
- The drone was attached to a mounting plate using zip ties

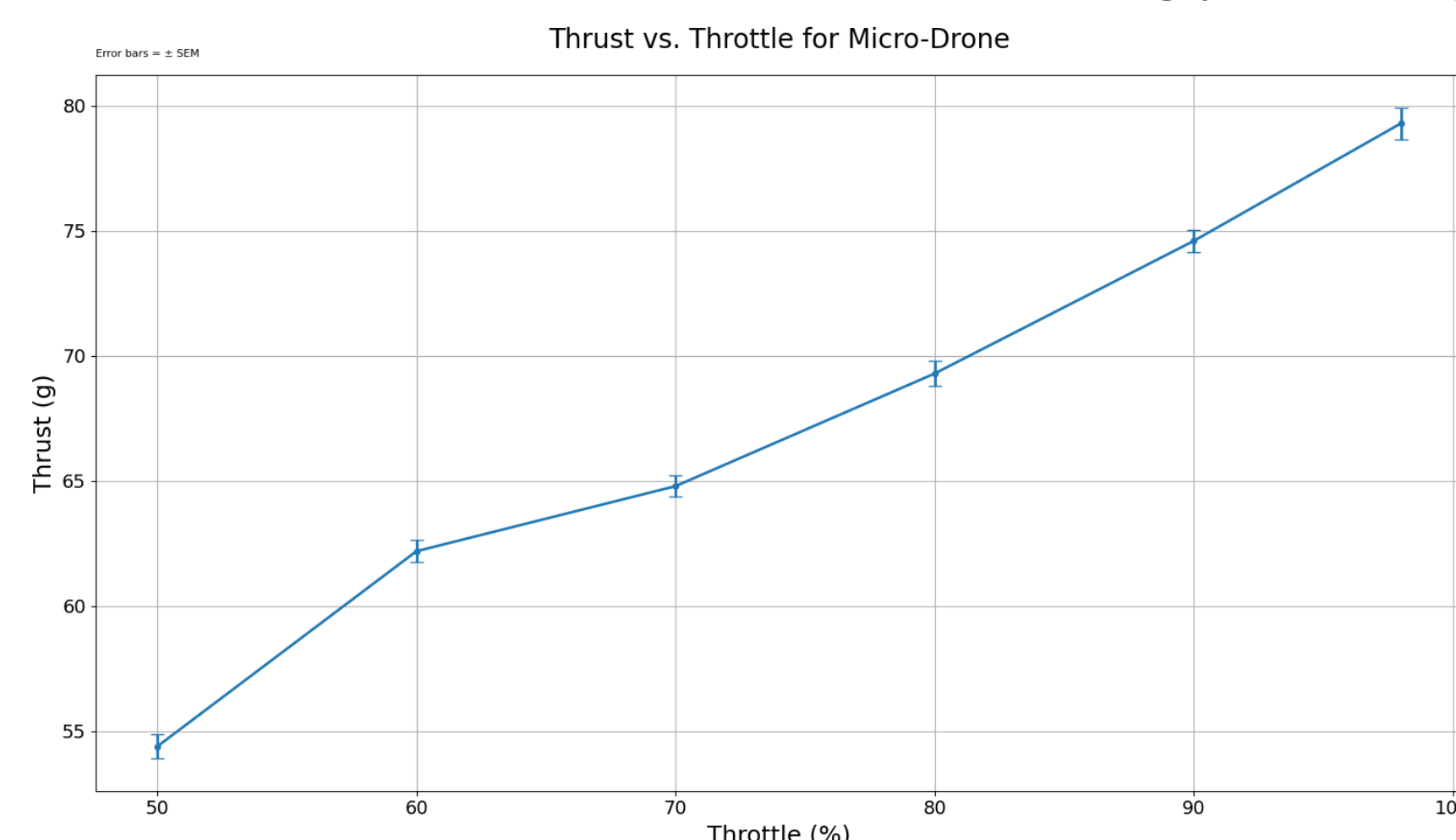


Figure 2: Graph generated from the thrust stand

Throttle (%)	Thrust (g)	Std Dev (g)
50	54.4	1.5
60	62.2	1.4
70	64.8	1.3
80	69.3	1.6
90	74.6	1.4
98	79.3	2

Figure 3: Data subset of thrust data



Figure 4: Pictures of micro-drone

Analysis

Thrust Analysis

- The thrust data shows that the drone can fly with an adequate thrust to weight ratio

Observations

- Drone flies mostly stable. There is slight oscillation that can be fixed by tuning PID controller.
- A position controller is needed to prevent positional drift

Conclusion/Future Work

Position Drift

- Implementing an optical flow sensor was the initial plan, but couldn't due to time constraints
- Using optical flow, position controller, and Kalman filter could improve drift performance

Open-Source

- The plan is to clean up the codebase and open-source the project files and code in order to give researchers access to a cheap drone platform

References

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