ECE 5780 – Quadcopter

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Progress

- Proto-PCB was made, and PCB layout was completed. IMU was selected, components are with us, and documentation has started.
- Custom PCB assembled; verified power delivery and MOSFET response to PWM signals from the Pi Pico 2W.
- Integrated MPU6050 gyroscope with the Pi Pico 2W over I2C using interrupts at 1 kHz; applied calibration to correct offset drift. Began ADC-based battery voltage monitoring and confirmed PWM motor control through MOSFETs on our custom PCB and frame.

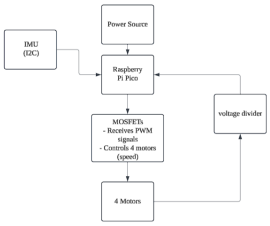

Figure 1: block diagram

Implementation and Results

Motor Control Testing

Custom PCB assembled and tested: PWM duty cycles applied from 0% to 75% resulted in expected MOSFET switching and motor spin-up. Figure 3 shows the current setup used for these tests.

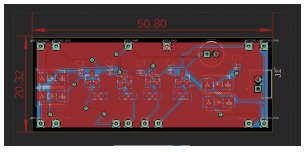

Figure 2: PCB Layout.

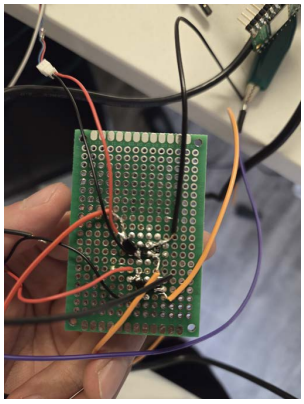

Figure 3: Prototype

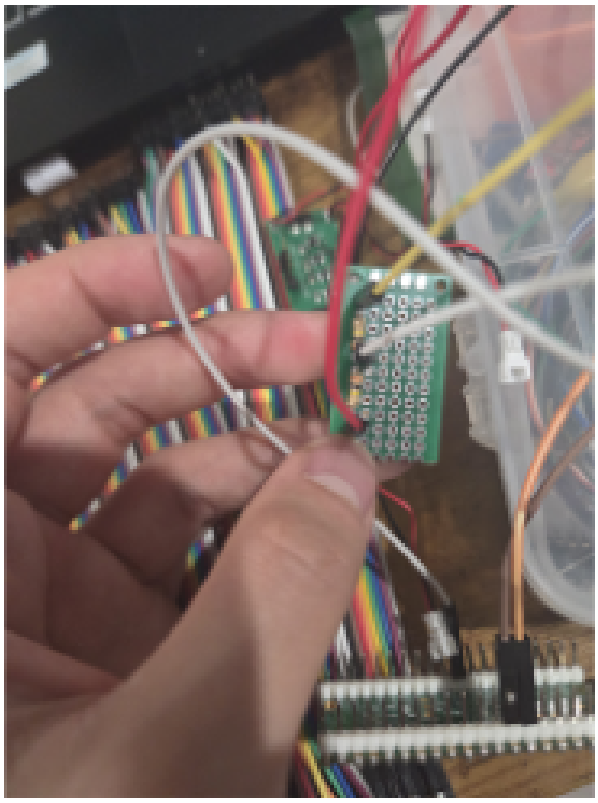

Figure 4: Battery voltage divider for ADC input.

Figure 5: Voltage reading from multimeter

IMU Calibration and Sensor Fusion

The MPU6050 was read via interrupt at 1 kHz. Initial bias drift of 2°/s was reduced to <0.5°/s after offset correction. A complementary filter fused accelerometer and gyroscope data to output stable roll and pitch. Figure 6 shows zero-input drift under static conditions.

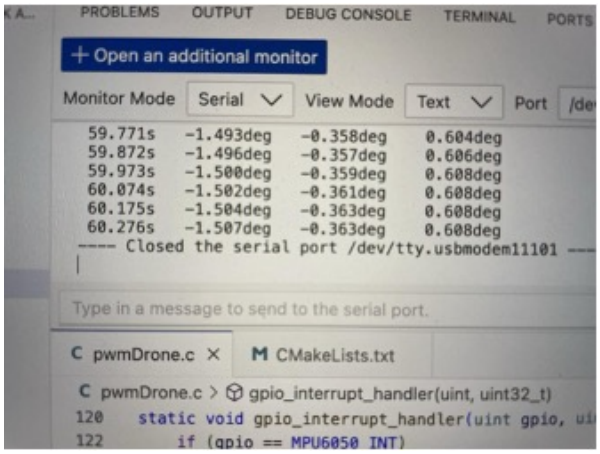

Figure 6: Serial monitor output of calibrated MPU6050 angular drift test.

Result

- Improve PCB layout, check connections, and prepare for manufacturing; begin testing key software functions (motor control, sensor data, communication) via breadboard or simulation before PCB arrival.

- Integrate the MPU6050 gyro sensor by establishing stable I2C communication with the Pi Pico 2W to enable dynamic motor control based on gyro data.

- Integrate all components—gyroscope, PWM motor control, and battery voltage monitoring—and demonstrate that the drone flies.

Challenges

- Determining appropriate capacitor values for driving the motor and selecting resistor values for the MOSFET gate power supply.

- Potential communication delays impacting real-time I2C reliability between microcontroller, IMU, and motor drivers.

- Lack of a stable mounting rack led to a short circuit and loss of a PCB board; will design a secure, organized mounting frame.

- Limited ADC resolution and analog noise in the Pi Pico's ADC caused voltage readings to be less accurate than those measured with a multimeter.