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Project Preliminary Write-Up

Introduction

My project will consist of retrofitting a flying device with a microcontroller and sensors to wireless transmit data about the flight to a control device during the flight. The flying device used will be a small drone designed for the hobbyist industry. The microcontroller used will be the Raspberry Pi Pico (W) with wireless data transmission capabilities built in.

My project relies on an existing flying device as well as manufactured sensor devices. The purpose of this project will be to integrate everything together and then do testing to determine the specifications this device is working within and provide a baseline to calibrate the sensors. This project will effectively make a small hobbyist drone much more capable with many new features for future users.

Goal:

The goal of this project is to retrofit an existing flying device to include sensors that will relay real-time information about the flight to the user on the ground.

Objectives:

1) Design a mounting system to attach a Raspberry Pi Pico W, an accelerometer, a distance sensor, and a camera to an existing drone.
2) Integrate the accelerometer, distance sensor, and camera to the Raspberry Pi Pico W.
3) Send real-time accelerometer, distance, and camera feed data wirelessly to the user.
4) I will test the sensors to determine their working tolerances.
5) Implement calibration based on the conducted sensor tests.

Materials and Methods

Design

I will be using 3D-printed parts to mount all of these devices to the drone. Each sensor has slightly different mounting requirements. The camera must be situated in a way that is helpful to the user when piloting the drone. The distance sensor must be situated on the bottom of the drone such that the distance to the ground can be measured. The accelerometer must be mounted in a stable orientation so that the acceleration can be correctly measured. Finally, all the devices must be mounted such that they can survive a moderate amount of damage sustained during a drone crash or accident.

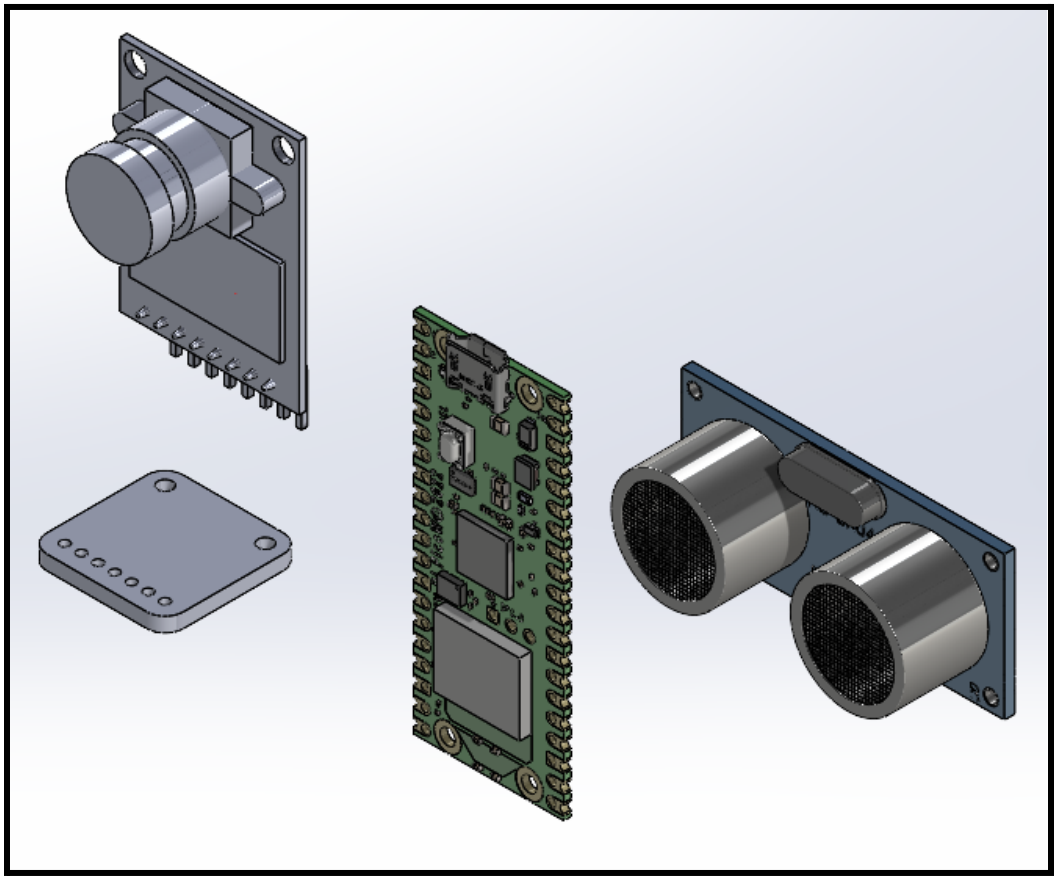

Figure 1: CAD model of the sensor components

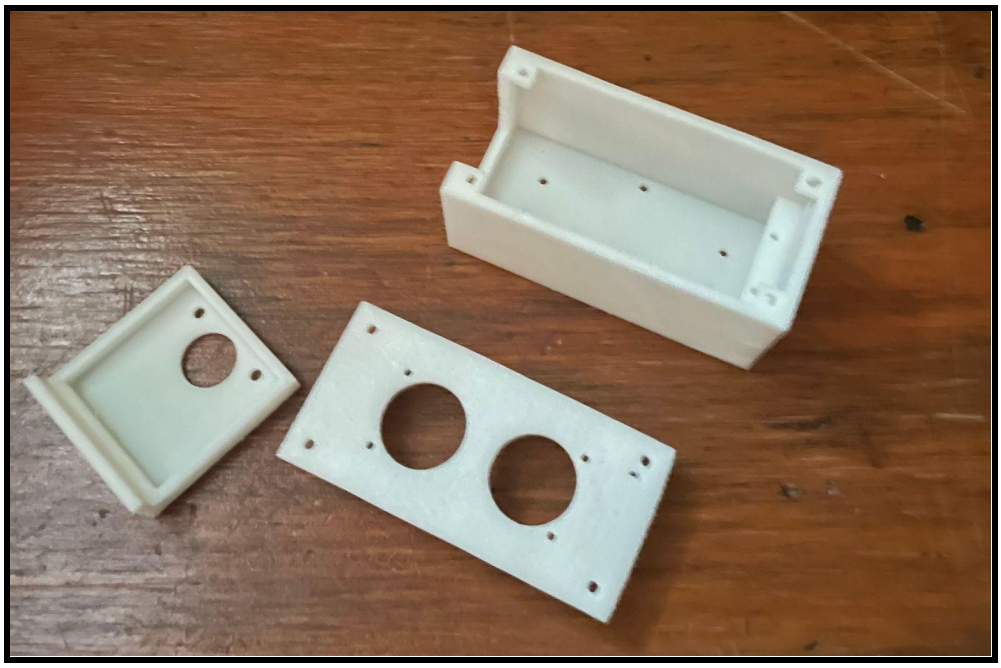

Figure 2: 3D Printed Mounting Components

Further CAD models will include the drone, the 3D printed parts, and the mounting hardware used in the construction of the project.

Integrate

I will be integrating the sensors together using the Raspberry Pi coding language. All of these sensors have to be initialized, ran correctly, and analyzed correctly before useful information can be sent to the user. In this section, I will describe the code design process for this project to integrate all these sensors and components together electronically.

Send

A big challenge of this project will be wirelessly sending this information to the user on the ground. This objective of the project will be accomplished using the Raspberry Pi Pico W, which has the capability to send information wirelessly. Additionally, I will be rating to final project on the latency of information when all the sensor information is sent through the bandwidth of the Raspberry Pi Pico.

Sensor Testing Plan

The sensors attached to the flying device are a big part of the project. I will attach an accelerometer to measure the acceleration and speed of the vehicle. This will allow the ground computer to know how fast the device is moving at any time. In order to test the system, the speed of the flying device can be calculated in a simple experiment using a timer and a known flying distance. The orientation of the accelerometer can be tested as well using a level and the data from the accelerometer.

I will attach a distance sensor to the flying device as well. This distance sensor will be will allow the ground computer to know how far the device is from the ground at any time. In order to test the system, the distance measured by the device will be compared to the height of a known object like a small building, a basketball hoop, a fence, or a lamppost.

Finally, I will attach a camera to the flying device as well. This camera will allow the ground computer to visualize the arial view of the drone and make flight decisions based off the images received. Because of the use by the operator, the image delay must not be more than three seconds.

BOM

Device	**Usage / Notes**	**Manufacturer**	**Expected Measurement Sensitivity**	**Arrived**	**Tested**
Raspberry Pi Pico (W)	Control board	Raspberry Pi Pico (Wireless)	N/A	Yes	Yes
Accelerometer	Acceleration data, and speed data	ADXL326	+/- 1 m/s and 1 m/s^2 max	Yes	Yes*
Distance Sensor	Measure distance to the ground	HC-SR04	+/- 1m max	Yes	Yes*
Lithium Ion Battery	Power the circuit	150mAh #1317B	N/A	Yes	No
Drone	Flying vehicle	Self Sourced - Owned	N/A	Yes	Yes
Camera	Pictures from the air	Self Sourced - Arducam Mini Module Camera Shield - Link - $26.99	-3 s max delay	Yes	Yes*

		- 5V/3.3V ports			
3D Printed Mount	Used to mount the sensors and microcontrollers to the drone body	Self Sourced - 3D Printed	N/A	Yes	Yes
Hardware (#4, #6, #8, #10 nuts and bolts)	Used to attach the devices to the body	Self Sourced - Hardware Kit	N/A	Yes	Yes

* Tested with Arduino board

* Camera using too much memory in the pi device, still working out this small issue

Results and Discussion

Conclusions

Appendix