Autonomous Tracking Drone

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Introduction

According to the U.S. General Services Administration Office of Motor Vehicle Management, there are 6.42 million car crashes in the United States per year, and 98%, or 6.29 million of them are because of human error. With this statistic, the need to implement autonomous driving becomes apparent. With many companies making autonomous vehicles, the idea of being a part of the making of autonomous vehicles seemed rational to be a part of the growing industry.

In the growing world of aircraft and automation, there is a greater demand for the ability of autonomous flight in an aircraft combined with the ability to take manual control of the aircraft. The problem is designing, building, and programming a drone that has the ability to fly under the operation of a controller or lock on to a predefined color, and then autonomously track. The biggest part of any vehicle design is safety which is why it is imperative that the drone be programmed to autonomously land safely in the case of any failure or other critical scenario like a low battery.

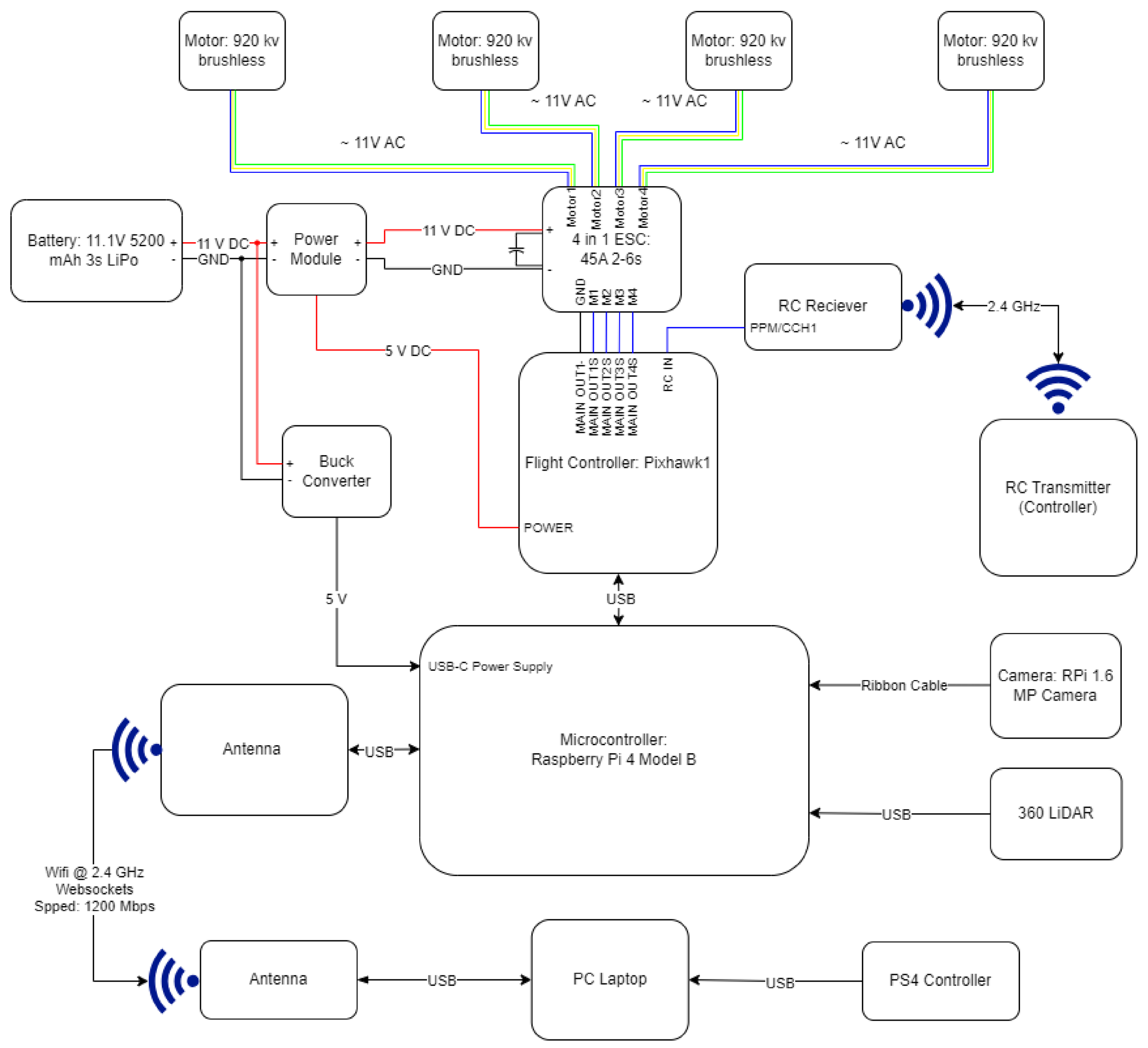

Figure 1: Drone Wiring Diagram

Materials

Software used were:

- Python IDE used to program Raspberry Pi.
- Mission Planner app used to setup Pixhawk.
- OpenCV to run image analysis on camera feed

Hardware used in this project included:

- Raspberry Pi 4B
- 360 degree LiDAR scanning sensor
- Pixhawk flight controller
- 4-in-1 45A ESC
- 1.6 MP Raspberry Pi camera
- 4 920KV Motors
- Antenna
- PS4 Controller
- 3s LiPo Battery

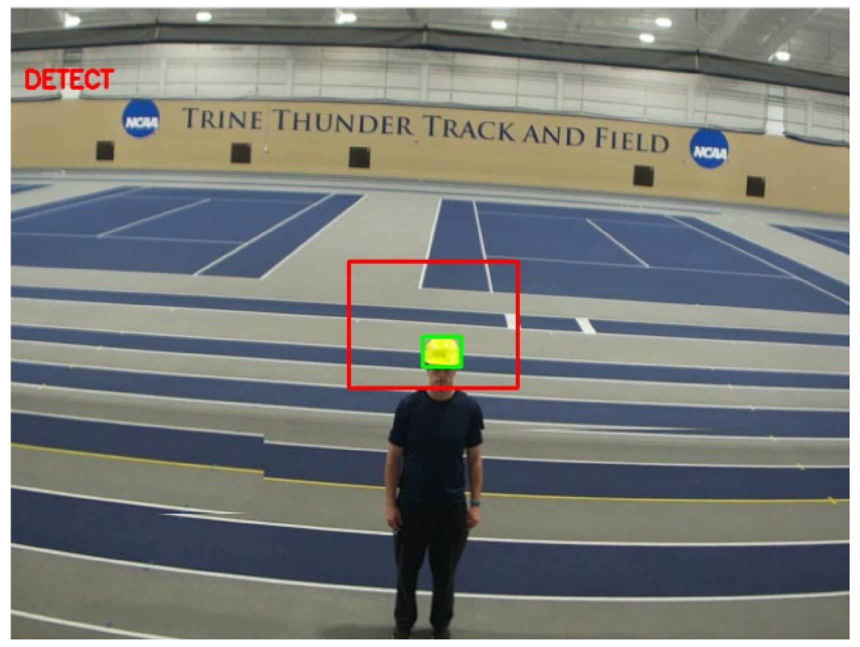

Figure 2: Real-time video feed of drone's POV

Development Process

To assemble and configure the final drone, the main steps include the following:

- Wire all components together using soldered wires and cables.
- Configure the flight controller.
- Program the 360 degree lidar to detect objects and activate the automatic landing function.
- Program the camera with OpenCV to take and process images to allow for tracking commands.
- Integrate the code into a multiprocessing program.
- Tune parameters to ensure smooth flight while tracking.

Results

Our drone presents the following features:

- Ability to manually control the drone's thrust and angles of yaw, pitch, and roll.
- Fly autonomously/manually for about 7 minutes .
- Detect objects within 10 feet of the drone and promptly land to avoid collisions.
- Read battery voltage to detect for low battery level.
- At the press of a button or when certain failsafes are activated, drone will lower its altitude until safely on the ground.
- Detects target object by color and autonomously sends flight commands to maintain target detection.
- Under autonomous tracking, drone maintains a distance of about 10 feet away from the target.
- Live video feed is broadcasted to the user's laptop for real time feedback of the drone's perspective.

Controls

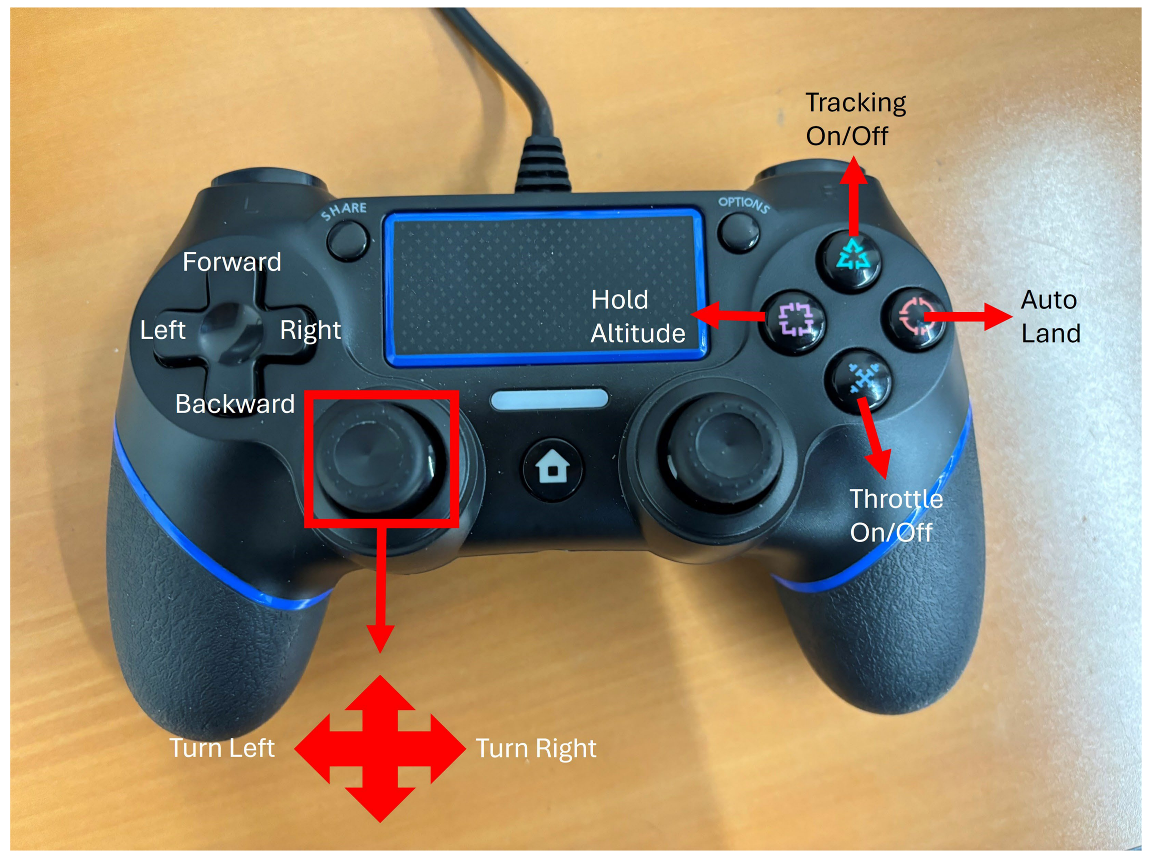

Figure 3: Controller's button and joystick functions

Figure 4: Controller bumber controls the drone's thrust

Conclusion

Creating and designing a project of higher magnitude comes with its challenges. From creating the initial design plan and scope to the many hours spent testing the design, it takes strong communication, teamwork, and self motivation to be successful. This project showcased the ability of these students to work together while maintaining personal responsibilities and doing so in a timely manner. This project taught many new ways to approach a problem, design solutions, and collaborate as a group. It also allowed for the showcase of the students' skills and what Trine University has provided by way of education for their professional lives.

Ethical Implications

While designing the Autonomous Tracking Drone, the ethical implications of safety, privacy, and legality were measured:

- Infringement of individuals' privacy rights
- Security risks of hacking
- Malicious use by users
- Accountability for public trust

Future Applications

Potential customers may use the Autonomous Tracking Drone to solve problems today. The following are some examples:

- Tracking Animals or Wildlife
- Search and Rescue
- Public Defense
- Film Industry
- Personal and Commercial Filming

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