Raspberry Pi Drone Design Document

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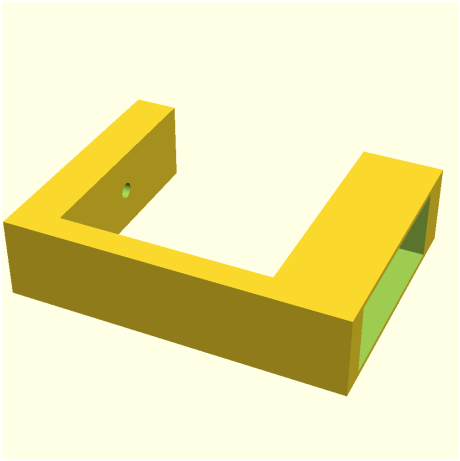

Fig. 1. The tilt gimbal base.

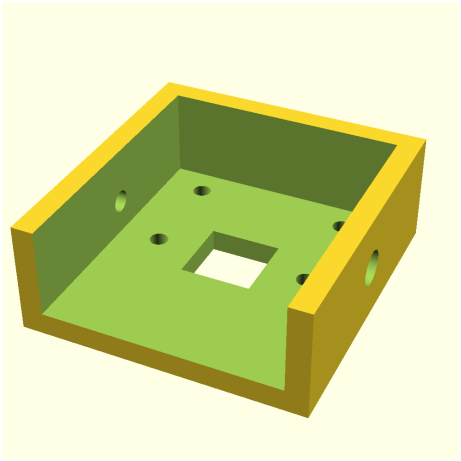

Fig. 2. The tilt gimbal camera mount.

I. Introduction

This document outlines the design and construction of a small drone for field testing of an autonomous landing algorithm. The drone body is entirely 3D printed for relatively easy production. This drone extends a simple drone design that is available at [2]. Additions to the original design are specified in `.scad` files, and the entire drone design is available at [1].

II. CAD Design

The original drone from [2] includes only a simple body with a peg-in-hole mounting system for the legs. The legs are symmetrical for interchangeability and design ease. This design retains the body and legs from the original drone with some additions.

The first addition to the original drone is a small tilt gimbal (shown in Figures 1 and 2), that is mounted on the front of the drone. The tilt gimbal includes a mount for a standard Raspberry Pi camera module and a space for a micro servo that serves as the gimbal's actuator. Its rotational axis is supported by a single screw and the rotational axis of the micro servo. The camera module is attached with screws, and its ribbon cable extends upwards above the drone body. The gimbal base is aligned with the

The second addition is a set of mounts for the drone's electronic speed controllers. The speed controllers fit into slots on the drone's body and are held in place simply with electrical tape. The design also includes mounting holes for the Raspberry Pi, power distribution board, and legs for quick and reliable assembly.

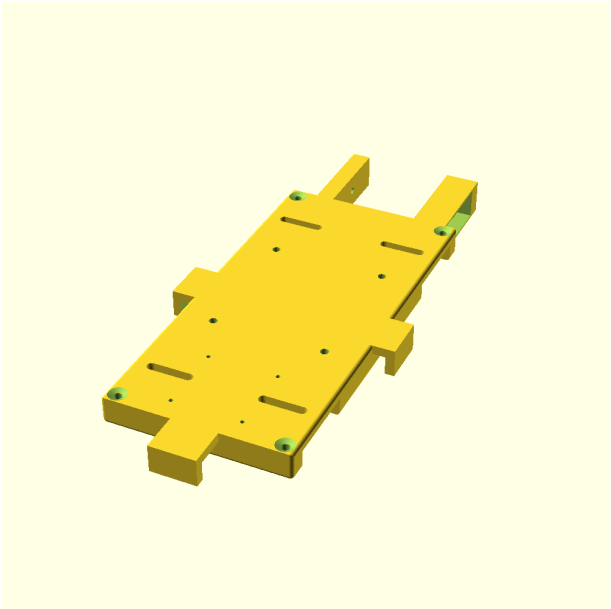

Fig. 3. The drone body with attached gimbal mount.

The drone body is flat on its top side (except for conical indentations that allow the leg screws to sit flush), so that it can be easily 3D printed upside down. The drone body is shown in Figure 3.

Finally, an "upper deck" (shown in Figure 4) provides

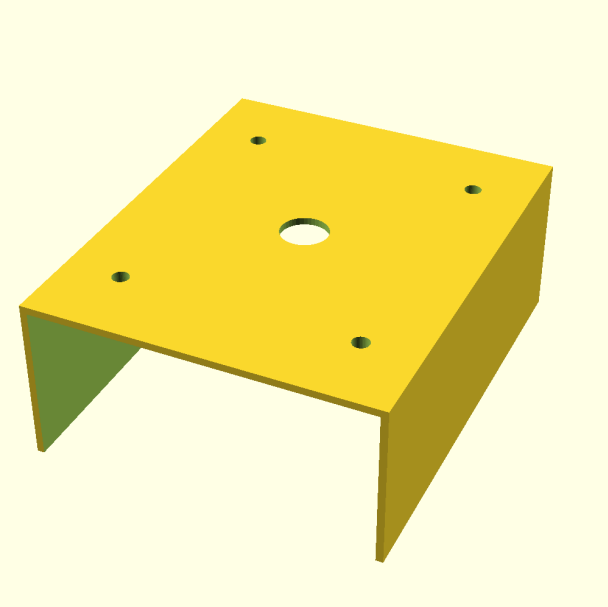

Fig. 4. Upper deck.

Fig. 5. The assembled drone.

additional component mounting space. It attaches to the holes for the Raspberry Pi and provides a flat area above the Raspberry Pi, as well as a hole for the cords that connect the components to the computing system.

III. Assembly

A "spacer plate" with a peg attaches the drone arms to the body with perfect-fit contact only. Since the drone will not experience high G-forces or intense maneuvers, this attachment is not supplemented by screws or glue. Screws attach the Raspberry Pi, power distribution board, and motors to the drone body. The electronic speed controllers and their wires are secured in their mounts by tape. The assembled drone is shown in Figure 5.

IV. Components

In addition to the 3D printed drone body, the drone includes following electronic components:

- **Raspberry Pi 3 B+:** the computational unit that runs the flight software.
- **Navio2:** a sensor shield designed to run ArduPilot on Raspberry Pi. The Raspberry Pi + Navio2 combination is referred to as the flight controller.
- **DJI Snail Propulsion System:** four motors and speed controllers that provide reliable and smooth thrust. Two of the motors spin clockwise, and two spin counter-clockwise for standard quadcopter control.
- **Raspberry Pi Camera Module V2:** provides video input to the flight controller.
- **FrSky 8-Channel Micro Receiver:** provides RC manual input to the Navio2 over the SBus interface.
- **Navio2 Power Module:** Provides 5V power to the flight controller from the battery.
- **Power Distribution Board:** a 1-to-4 interface that provides power to the electronic speed controllers from the battery.
- **Micro Servo:** actuates the gimbal.

References

[1] Joshua Springer. RPi Drone, 2021.

[2] Thingiverse.com. Raspberry Pi Drone (NIACAM: TXSEF 2016-2017) by arks007, 2017.