ECE Senior Design Project 2020-2021
Why Walk When You Can Fly?

Tufts University

Mustard Yellow Team:
Alejandro Colina-Valeri, Michael Eve, Collin Pond, Joseph Scott

1 Project Goal

Design and integrate a payload delivery system with a drone that can navigate itself autonomously given a predefined flight path. The mission is to have the drone distribute keys and IDs to students who get locked off their door.

2 AR Parrot 2.0 vs. Tello Edu

Tello Edu: Using the built in SDK for the Tello, a minimal functionality was achieved. Rather than expend resources expanding the functionality, the min. Functionality was determined to be adequate for a minimum valuable product.

AR Parrot 2.0: The drone is controlled using two ROS packages. Ardrone_autonomy and tum_ardrone were installed on the Ubuntu OS to allow the drone to fly autonomously using the PTAM/SLAM navigation system. The initial capturing of focal points in front of the drone helps it estimate its current position, thus preventing the drone to fly off course do to wind or to crash with obstacles that are within its vision.

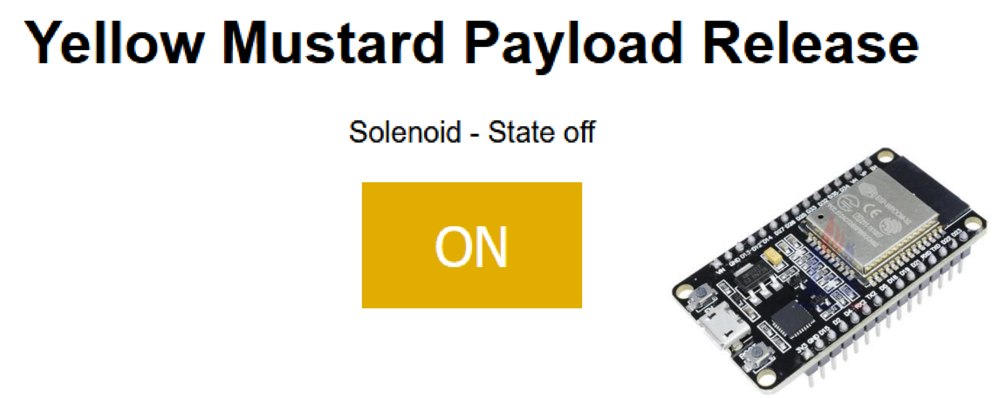
Tello EDU

AR Parrot 2.0

Modifications were made to the AR Parrot 2.0 drone to attach a payload underneath and improves it flight performance. 3D printed leg extension and carbon fiber propellers were added to enhance stable flight and payload accessibility.

3 Payload Design

The payload consists of a 3D printed box big enough to hold small items, such as keys and student ID's. A solenoid is attached to the bottom to release the contents inside the payload.



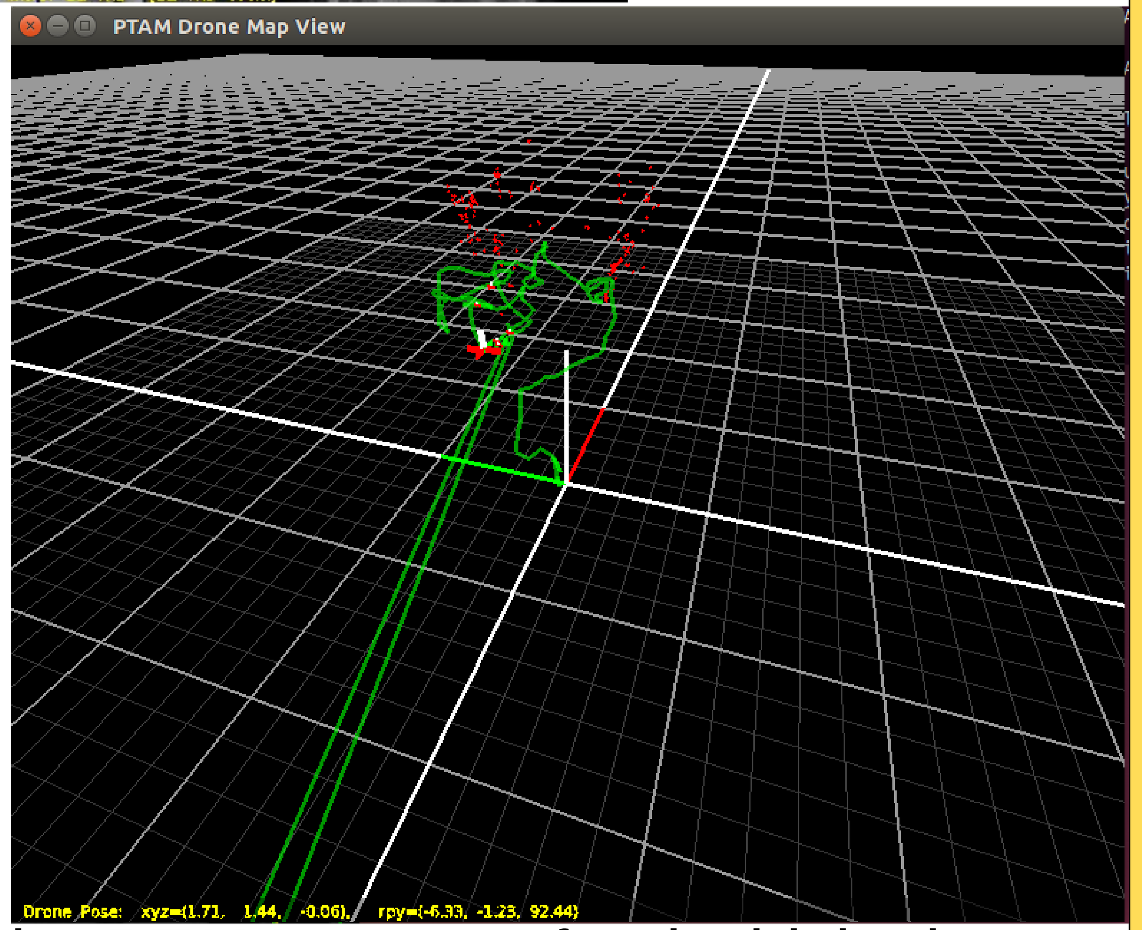
The release mechanism is activated by pressing an on/off bottom from a webserver created from an ESP32. The server can be accessed through phone.

4 PTAM/SLAM Breakdown

Parallel Tracking and Mapping (PTAM) is how the drone can keep track of itself given inertial data (IMU) and camera data (focal points). Simultaneous Localization and Mapping (SLAM) allows us the freedom to program a pre-specified flight plan on the AR 2.0. SLAM depends on PTAM in order to be able to function properly. The data collected from PTAM is processed into SLAM in order to approximate where the drone should be given a pre-defined flight path. This essentially gives the drone its autonomy.

PTAM camera Figure

SLAM Mapping Figure



The first image is the PTAM camera feed which shows us the furthest focal points from the drone (red) along with closer focal points (green, blue, yellow). The SLAM mapping in the second figure shows you a 3D mapping of the drone's flight path while it was airborne

5 Future Improvements

Integrating Object Recognition in the downward camera will help the drone locate landing pads.

Instead of relying on the ESP32, the solenoids can be integrated with the ROS environment to reduce weight.

This changes could lead to new improvements in on-board processing and mitigating even more risk to the drone and the users on a college campus.