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Problem -

➔ For more casual uses like vlogging or more serious uses such as military operations/rescue missions, there needs to be an “eye in the sky” that is able to track personnel and provide live video feed of what is going on on the ground

Scope -

➔ Build a drone system that is able to track the user from a birds-eye view and capture live video feed of the user as they walk. The user will have a device on their person that performs the CV compute, has limited control of the drone (ex. tracking elevation) and streams a lower quality video feed. The actual higher quality video feed that the drone captures will be stored on an SD-card.

Requirements -

- Components:
  - Drone itself
  - Small microcontroller w/ wifi capabilities that is attached to the drone itself and interfaces with the camera to stream the video over wifi/capture it onto SD card
  - Camera - 12MP
  - Wearable wrist device for the user that performs the compute
    - Consists of a wrist display which is hooked up to a bulkier compute board (either located on the user themselves or within user backpack/pocket)
- Metrics
  - detection precision, and recall in terms of recognizing the desired user from the other objects in the video feed:
    - Precision = True Positives / Predicted Positives
    - Recall = True Positives / Actual Positives
  - Accuracy of tracking
    - Go frame by frame and measure pixel distance of center of user to center of frame
  - Quality of captured video:
    - At least 720P
  - Quality of streamed video:
    - bandwidth limit of video transmission for FPS
    - Probably want at least 480P
  - Run time - want around 5 - 10 minutes of flight time per battery charge
  - Power consumption- uncertain
  - Assuming object free testing environment

Challenges-

- The most important and difficult task will be the stable control of the drone through software.
  - Our drone will have a high level motion planning embedded board as well as a low level flight controller that actually outputs commands to the motor controllers. The flight controller is off-the-shelf, and we only need to tune its PID controllers. We will write the motion planning software, starting with basic commands to fly left or right, and eventually

developing a 6D (position and orientation) waypoint generator for flight trajectory since the drone may need to fly fast to follow a person.

- Another important task will involve computer vision: tracking a person through live camera feed.
    - Our initial approach will involve basic HSV color filtering and blob detection to segment the person. Since images are 2D and lack depth perception, we will only consider horizontal and vertical centering of the target person. After the MVP, we will consider more advanced methods with Convolutional Neural Networks (CNN) to track people wearing similar-looking clothing. We will test tracking with different backgrounds to verify robustness.

Implementation -

- To implement this, we plan on using the Iris 3D+ drone we already have. This is because it has an expected 16 to 22 minutes of flight time using a 5100mAH battery and is able to be interfaced with using ROS.
- save high quality video onboard sd card, stream low quality down for tracking through on board microcontroller that will also receive control signals from compute on ground to feed into the microcontroller
- The received video from the microcontroller on the drone will be processed by a more powerful compute such as Jetson nano. This compute is on ground to minimize weight and power of the drone for longer flight. The compute will also be sending signals back to the drone on board microcontroller to feed into the flight controller.
- The video will be stream to a wearable touch display via the on ground compute.

MVP

- For the MVP, the user we are tracking will wear a brightly colored hat
- The user will be able to access a wrist display and a start/stop button
    - On start, the drone will rise to the desired altitude (30ft) and start following the user
    - On stop, the drone will land
- While in motion, drone will capture video to an SD card while also streaming the video to the users wrist display