Team 14: Automatic Drone Tracking

Andre Fuentes, Byron Denham, Corbett Stephens, Parker Weber, Zachery Gansz
Dr. Khoa Luu

UNIVERSITY OF ARKANSAS
College of Engineering

Computer Science & Computer Engineering

Introduction

The goal of this project is to build a system that incorporates a drone and facial recognition technology in order to enable the drone to track a humans face autonomously. Use cases for this technology include videography and surveillance. There are a variety of drones already on the market that perform this task. Our solution is open source, which allows developers and users to adjust, modify and add functionality to the system that suits their needs. The open source nature of the project also gives an extremely low-cost entry point for people to utilize the technology.

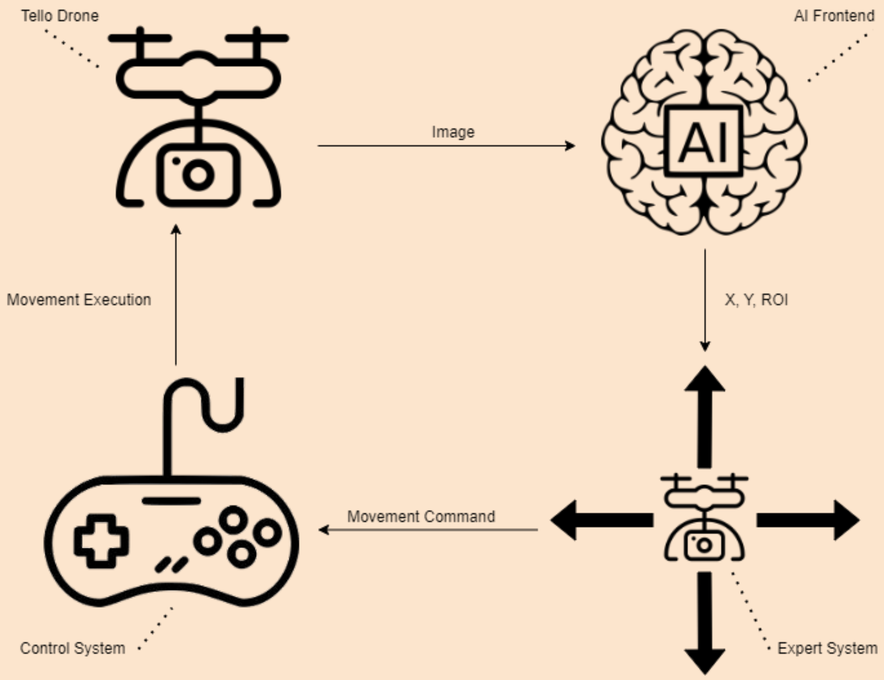
Hardware

The system's hardware consists of two components. The first component is a sufficiently capable laptop to interpret the video feed and perform facial recognition. The second component is a DJI Tello drone. The DJI Tello is a small, eighty gram drone equipped with a high definition camera. The drone also has propeller protection and collision detection to ensure safety of users.

AI

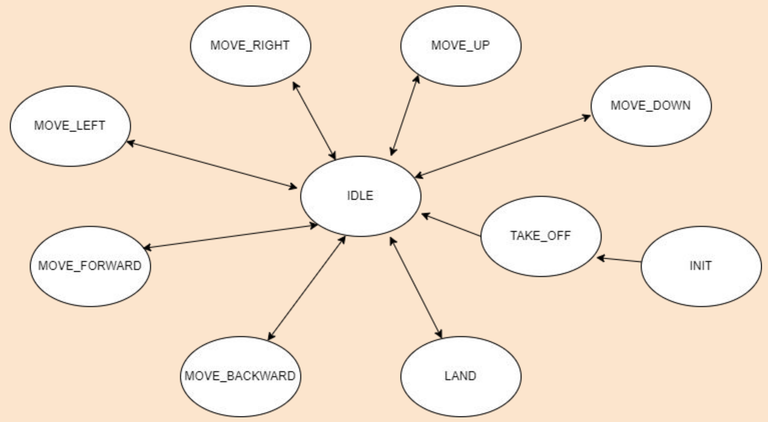
The face detection is done by an AI backend that incorporates OpenCV and a Haar Cascade classifier. OpenCV is a Python module designed for real-time computer vision. The cascade classifier object uses an XML file of pretrained weights to determine whether an input video frame contains a face. If a face is detected, the classifier outputs a four-tuple containing the face's 'X' coordinate and 'Y' coordinate in the frame, as well as its' width and height. These values are then passed to the expert system for decision making.

High Level Architecture



Expert System

The expert system sends movement commands based on received information. It makes choices of which command to send using a finite-state machine model. In order to move the drone so that it follows a person's face, it needs information that is provided by the AI system. The information that it uses are the 'X' and 'Y' coordinates, as well as the area of the face it is tracking, with this all being relative to the drone's camera. This system uses this information to compare current data with previous data, then sends movement commands based on calculations.



Controller

The Controller is the portion of the code that acts as the main program. This is where both a Tello and PyGame object are created and initialized. The Tello initialization sets the starting directional velocities and establishes the video stream and command connection between the client and the drone. These connections use UDP protocol and connect to the DJI Tello drone's on board Wi-Fi. Another responsibility of this code is to issue data coordinates extracted from the video frame and pass them to the expert system for it to calculate a movement command. Lastly, the Controller issues updates to the drone for it to make the necessary adjustments.

Conclusion

Each component of the design was integrated together. The system is capable of tracking an individual's face in real-time while making flight adjustments to keep the subject in view.

Future Work

- More FSM states to account for all possible scenarios, such as adjusting the drone's camera without moving, relocating the face and resetting the initial tracking location, and landing the drone in its original takeoff location in the event of a nearly empty battery.
- Addition of pre-trained weights to account for differing amounts of light and also faces at different angles, resulting in more consistent tracking.
- Proper tracking in the occurrence of multiple faces being present in the camera's frame.