

**Project Title:** Vision Based Autonomous Control of a Quadcopter

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### **Project Description**

In this project, an autonomous vision-based control system for a quadcopter is to be designed. A quadcopter from *3D robotics* autonomously takes off and executes mission plans under the guidance of system vision input. An industry-standard advanced autopilot, *Pixhawk*, is used to interface airborne sensors such as accelerometer, gyroscope, magnetometer, and GPS sensors. The *Pixhawk* is also used to control the quadcopter's motors. The overall system has 3 different modes such as diagnostic mode, manual mode, and mission mode. In diagnostic mode, the *Pixhawk* communicates with the radio-control (R/C) transmitter from the ground station to perform system diagnostics for mission preparation. In manual mode, the *Pixhawk* accepts manual commands from the R/C transmitter for emergency or testing purposes. In mission mode, the *Pixhawk* communicates with an airborne embedded system. The airborne system performs a video processing algorithm to track a target, where *ApriTags*, a type of two-dimensional bar coding system, is used for target localization. The mission plan of the quadcopter is to autonomously take off, fly to a waypoint with predefined GPS coordinates, locate a target equipped with an *AprilTag*, and land near the target.

### **System Inputs/Outputs**

Pixhawk (advanced autopilot system on the quadcopter):

Inputs:

- Override Commands
- Movement Commands
- GPS Coordinates
- Power
- Safety Switch

Outputs:

- Quadcopter Position and Heading
- Motor Control
- Status LED

Airborne Embedded System:

Inputs:

- Video Feed
- Quadcopter Position and Heading
- Mission Commands
- Power

Outputs:

- Movement Commands

## **Modes of Operation**

Diagnostic mode:

Pixhawk:

- The diagnostic mode is activated when the system is powered on.
- The system performs diagnostics including checking the availability of GPS, battery level, and radio-control connectivity.
- The system sends diagnostic codes to the LED.
- Once the diagnostics have passed, the manual mode is activated.

Airborne Embedded System:

- The system does not perform operations during the diagnostic mode.

Manual mode:

Pixhawk:

- The system accepts movement commands from the ground station.
- The system controls the speed of the quadcopters motors.

Airborne Embedded System:

- The system does not perform operations during the manual mode.

Mission Mode:

Pixhawk:

- The system receives movement commands from the airborne embedded system.
- The system provides the quadcopter's position and heading information to the embedded system.
- The system controls the speed of the quadcopter's motors.

Airborne Embedded System:

- The system receives the quadcopter's position and heading information from the *Pixhawk*.
- The system runs a real-time video processing algorithm to locate a target equipped with an *ApriTag*.
- The system sends out movement commands to the *Pixhawk*.