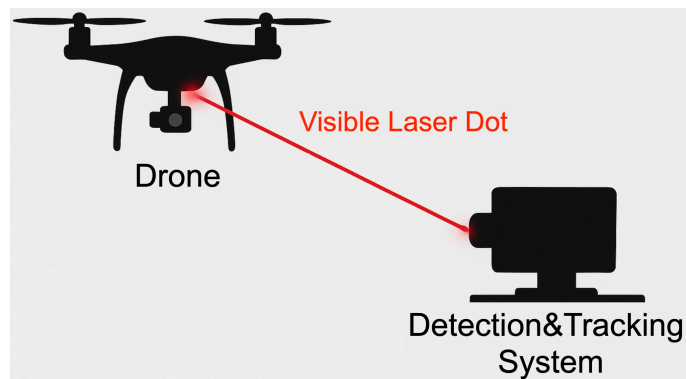# Long-Range Camera-Based Drone Tracking System with Laser Alignment

The increasing use of drones in civilian, commercial, and security-related applications creates the need for precise visual tracking and interaction technologies. This project is motivated by the challenge of designing an intelligent system that can detect drones and continuously follow them with a visible laser beam — a task with potential applications in surveillance, calibration, and interaction systems.

The primary aim is to develop a drone detection and tracking system that ensures a visible laser dot remains consistently projected on the drone during its motion. Drone detection and tracking must be performed using an image stream captured by a passive camera. Once detected, the drone's position must be mapped to the laser alignment control module such that the laser stays visibly on the drone's surface throughout its motion.

The design must have the following features:
- The system must be able to accurately detect a drone with a width of 30 cm from a distance of at least 50 meters, within a field of view of no less than 180° azimuth, under outdoor conditions.
- The initial detection time for the drone must not exceed 3 seconds.
- The system must achieve real-time tracking at typical drone speeds of 3-6 m/s.
- The laser dot must be visible on the drone for at least 80% of the time during tracking.
- The system must be robust to variable daylight conditions.
- The system must operate autonomously on an embedded processor
- The laser pointer must be eye-safe (class 1 or 2).

Drone simulators/videos, toy drones, or mock visual targets may be used when developing the design. It is also helpful to provide a visual interface for displaying the camera feed, detection boxes, and laser status in demo mode. Some possible extra features of the system are the following:
- An extended field of view of 360° azimuth
- Autonomous calibration for camera-laser alignment
- Dynamic target switching between multiple drones
- Integration with logging or analytics platform (e.g., flight path recording)