Artificial Intelligence for Commodity Hardware Aerial Drones

Abstract
We use computer vision, position tracking, and object detection to autonomously route a cost-efficient — and ordinarily human-controlled — consumer aerial drone (Parrot AR Drone 2.0).

Motivation
- Cost of military miniature unmanned aerial vehicles: $5,000 - $50,000
- Uses expensive hardware: GPS, 3D imaging, extra sensors
- Cost of Parrot AR Drone 2.0: $300
- Goal: To achieve autonomous flight in aerial vehicles with minimum costs

System Design
- Hardware: 2 cameras, motion sensors, telemeter
- AR Drone wifi enabled
- Video, Angle, Velocity data input
- Direction, Command output

System Execution
1. Input: Destination coordinates (Ex. 5 meters in x-direction, 10 meters in y-direction)
2. Calculates correct orientation to face
3. Rotates to calculated direction (Ex. turn 15 degrees to the left)
4. While destination not reached & no obstacles, move forward

Techniques
- Integration of velocity over time to calculate position. Linear algebra and trigonometry to calculate orientation
- Optical flow to detect obstacles
- Color Thresholding used to locate destination and improve accuracy when traveling final few meters

Evaluation
- Odometry: 5.1% error
- Color Thresholding: 100% success if destination sighted
- Optical Flow: Objects detected, but not in real time

Future Work
- Improve odometry algorithms to better account for hardware sensor deficiencies
- Replace color thresholding with more robust object detection algorithm
- Record flight data so the drone can learn which objects are obstacles to improve overall path finding
- Modify existing algorithms so the drone can fly in less controlled environments