Duke University- Humans and Automation Laboratory

Autonomous Law Enforcement Unmanned Aerial Vehicles (UAV's)

Sghier Samih

Dr. Marry Cummings

Research Proposal REU- Summer 2018

Autonomous Law Enforcement Unmanned Aerial Vehicles (UAV's)

Abstract:

This paper represents a research proposal for the Electrical and Computer Engineering REU-Summer 2018 organized at Duke University. As Unmanned Aerial Vehicles, also commonly referred as drones or unmanned aerial systems, become more prominent among civilians, the revolutionary technology holds distinguishable promises for commercial, military and civil forces. The practical applications for UAV's have no boundary, drones are used worldwide by firefighters to monitor-prevent possible natural catastrophes, however their presence among police units is less important. My research aims to change that by injecting a useful technology among civil forces with surveillance, tracking and possible pursuit purposes.

Keywords:
Autonomous navigation, Machine learning, Supervised learning scatterplot inputs/outputs

Introduction:

When a crime occurs in a populated zone, a fast and effective governmental intervention is necessary to ensure the safety of the population. One of the main issues with this procedure is the length of the reactivity. While calling 911 in an emergency, the average police response time is 18 minutes due to traffic obstacles and other external factors. Aerial deployment is proven to be much faster and effective on many levels. Having eyes in the sky allows ground units to retrieve from the crime scene ensuring their safety and avoiding collateral damage.

This project also relaxes its necessity during a search, rescue mission. As it is becoming much harder to track a suspect in a highly populated area. Drones have the advantage of being less detectable by the suspect, decreasing the odds of a possible escape. Paradoxically, this technology can also be used for internal affairs investigations among the unit.

Assumptions:

Before we move into the specifics of my proposal, we consider a number of assumptions that accurately reflect an ideal environment for our drone.

1. The weather is clear or the drone is weather proof.
2. Coordinates of the crime scene must be retrieved by a Human Operator.
3. Human Operator must confirm the necessity of aerial deployment to the location.
4. Drone only flies in the current uncontrolled airspace or Class G.

Our projects hold these assumptions, and further research can omit our dependency on the previous elements.

Machine Learning- Face recognition (search missions):

In many cases where authorities are searching for an inmate or an individual representing a threat to National Securities, search missions are necessary. An efficient algorithm that correlates between facial recognition, authoritarian notification and instant tracking must be developed. Furthermore, I suppose programming environments, which are suited for matrix-based computation such as Matlab, R are ideal to implement face recognition software.

Autonomy is optional:

Currently, most military or non-official UAV's require human guidance to overview different tasks.

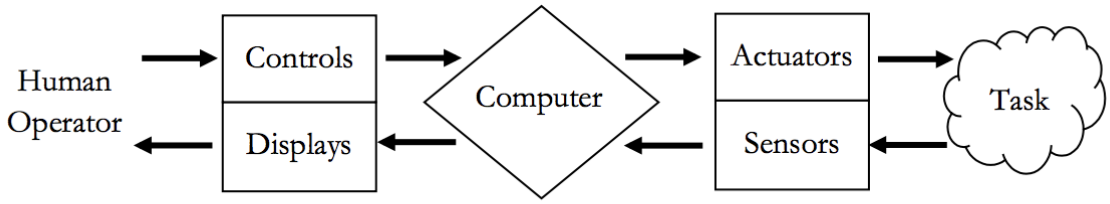

Figure 1: Human Supervisory Control (Sheridan and Verplank 1978)

My proposal eliminates human involvement, and moves this field to a decentralized system.

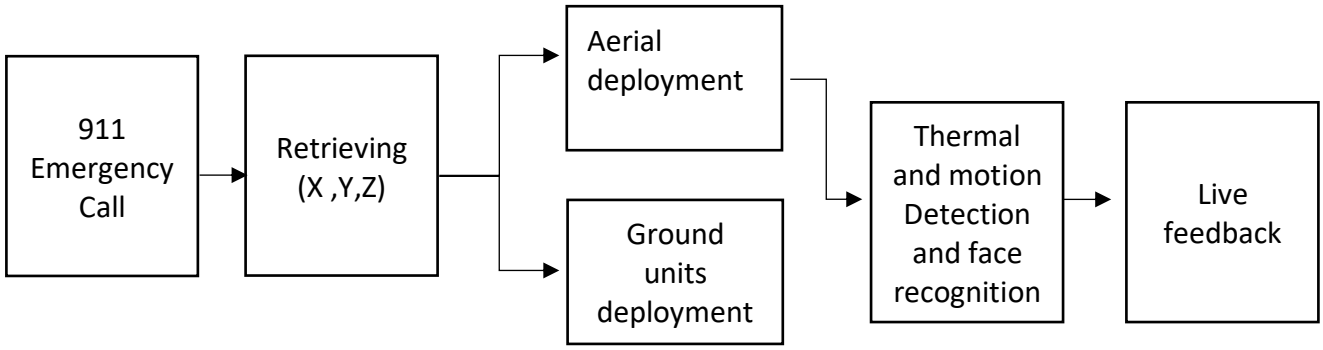

Figure 2: Autonomous Supervisory System

Additional proposal interest:

There has been extensive research attempting to organize “clandestine” flights of small unmanned aerial vehicles by creating a Low Altitude Air Traffic Control System that could manage the current disruptive flights.
Long range data communication- iridium satellite modems installed in each vehicle displaying current location and flight path could be a possible alternative to the project conducted by the National Aeronautics and Space Administration (NASA) [1].

[1] “UTM: Air Traffic Management for Low-Altitude Drones” (2017) Nasa’s Research Efforts and Management of Unmanned Aircraft Systems Report No. IG-17-025

Reference:

Sheridan, T.B., & Verplank, W. (1978). Human and Computer Control of Undersea . Tele operators. Cambridge, MA: Man-Machine Systems Laboratory, Department of Mechanical Engineering, MIT.

Materials suggested (incomplete) :

- 1 x F550 frame (Clone DJI Flame Wheel) with landing gear
- 3 x Hobbypower 2212 920KV Brushless motor CW
- 3 x Hobbypower 2212 920KV Brushless motor CCW
- 6 x HP Simonk 30A Speed Controller
- 1 x APM2.8 Flight controller
- 1 x NEO-7M GPS
- 2 x Gemfan 1045(CW+CCW) Black Propeller
- 1 x Gemfan 1045(CW+CCW) Red Propeller
- 1 x GPS Bracket
- Turnigy 9X Transmitter with Receiver Module
- APM Power Module
- 5800mah 3s Lipo
- Telemetry Kit

Tools:

- Drone Kit (as above)

- 2m & 2.5m Allen Keys
- Soldering Iron
- Solder
- Soldering Flux
- Cable Ties
- Adhesive Pads
- Ibrid Satelite modem