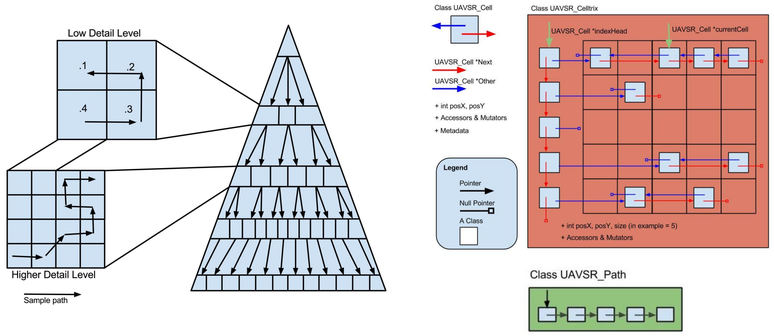
Augmenting Search and Rescue Operations with Unmanned Aerial Vehicles

Talha Agcayazi, Arsenie Jurgenson, Eric Cawi, Parham Ghassemi
Faculty Supervisor: Dr. Gerald Cook

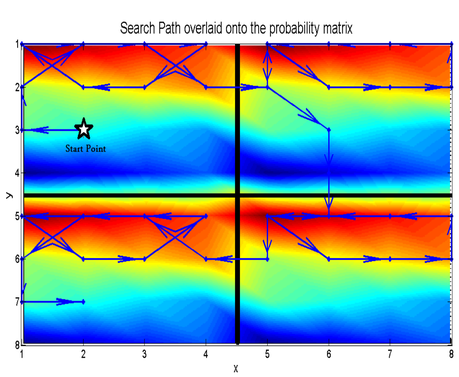
Mapping:

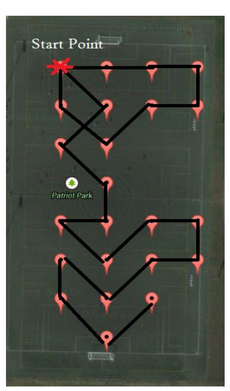
- The search area is subdivided into 4-16 sections to which probabilities of finding the target are assigned
- The sections are further split into cells corresponding to the camera field of view
- The path planning algorithm is run and data cell instances are created for the cells that will be visited
- The cells are organized into a sparse matrix with a link list corresponding to the planned path



Path Planning:

- Probability distributions predicting target behavior are used to generate paths through each level of the map matrix.
- First, the percentage of total flight time in each search area is calculated by minimizing the probability of failure formula presented in [1].
- Once flight time is allocated, local hill climbing algorithms are used to generate a path through an area[2].
- This path is converted to lat/lon waypoints and input to the flight controller.





Problem Statement:

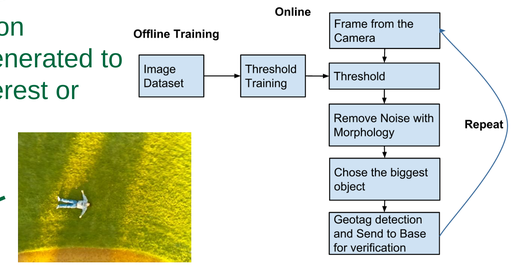
Unmanned Aerial Vehicles (UAVs) can swiftly search an area at a fraction of the cost required for a manned aerial search. The goal of this project is to develop an autonomous search system that:

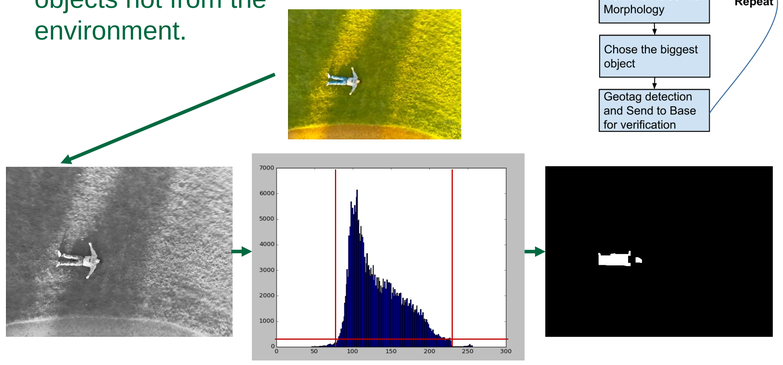
- Find the optimal path through a search area given a distribution predicting target location
- Maps the search area as it flies through the search pattern
- Processes pictures of the search area to identify targets/anomalies
- Interacts with valid targets by dropping a rescue package

Current Vehicle Setup:

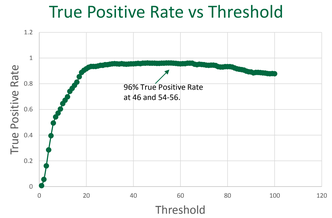
Target Detection:

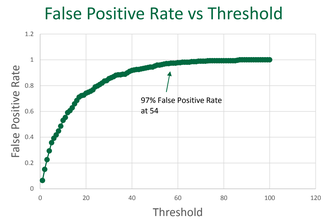
- An Anomaly Detection Algorithm [3] was generated to detect person of interest or objects not from the environment.





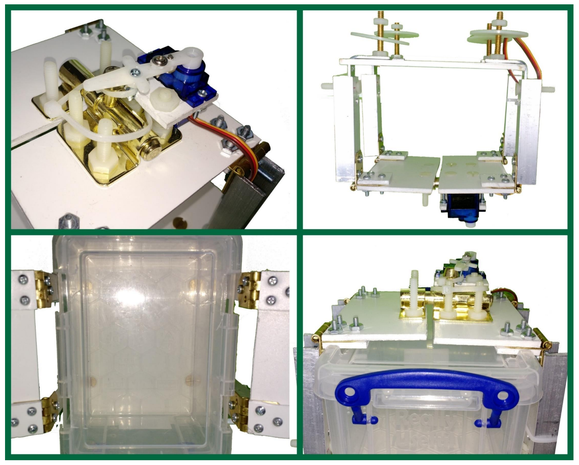
Threshold Training and Results





Rescue:

- A UAV will conduct the search operation and an alternate UAV will conduct the rescue operation.
- Once the target is found, the rescue UAV will locate the target and deliver the aid package in the vicinity of target.
- The aid package is secured in a holding apparatus that is locked with a pin
- To deliver the package, a servo will be commanded to unlock the pin allowing the aid package to drop



ACKNOWLEDGEMENTS

We would like to thank Dr. Cook, our faculty sponsor, for mentoring us this year, Dr. Lofaro for providing lab space and presentation feedback, Dr. Twardy for Search and Rescue help, and George Mason's OSCAR for conference support.

REFERENCES

[1] Joseph Kadane, "Optimal Discrete Search with Technological Choice," in press.
[2]S. H.Jacobson, E Yucesan, "Analyzing the Performance of Generalized Hill Climbing Algorithms," *J. of Heuristics*, volume 10, pp 387-405, 2004
[3] Agcayazi M., Cawi E., Jurgenson A., Ghassemi P., Cook G.Preliminary Results of a Search and Rescue Unmanned Aerial System. Submitted: International Conference on Intelligent Robots and Systems (IROS); 2015 September 28- October 02; Hamburg, Germany.