Introduction

As drone usage has increased in the last few years there needs to be an optimal way of coordinating them in a team the current way of using a single operator to a single Unmanned Aerial Vehicles (UAVs) can be improved. Giving a single operator a team of drones which can be controlled and/ or monitored on a single screen would make it much easier to have the UAVs work better as a team. However, finding the right user interface (UI) which can display the necessary information to the single operator without overwhelming them.

Approach

Giving the user the software on a simulated Ipad that displays the four UAVs operating on one of two modes: semi-autonomous and autonomous. The UAVs would patrol a certain area looking to find a target. The region of region of interest (ROI) would consist of 5x5 meter sized cells with 1708 cells in total. On the bottom part of the screen there are color coded boxes which displaces a closer view of what each UAV is looking at. The UAVs on the autonomous mode would search the ROI by utilizing a greedy algorithm [1][2][3]. The UAVs prioritize areas that have not been seen the longest. The UAVs have a priority of moving in the four cardinal directions. The target will have a priority of moving straight and has the low possibility of standing still or turning. The target will not be able to move into cells that are greater than five meters above its current elevation, On the user interface, the there is a yellowish cloud that highlights areas that have not been seen in a certain time frame (20 clicks). This is to show the user where the UAVs are moving towards. Long pressing the screen on time mode would do nothing as all user interaction is disabled. However, in the semi-autonomous test, operators can interrupt the autonomy by placing waypoints if they feel that the UAVs are not working together in the most efficient way. This of course would mean that they user has distrust for the UAVs because they feel they can control the group better. To end the test the operator must hit done either after the they have found the target or if the simulation fails.

Experiments

Giving the users control of the UAVs with the two previously mentioned modes will help test the controllers trust in the autonomy. In both tests the user will have to end the experiment when he or she spots the target in one of the screens. However, to test the best way of getting users to trust the UAVs to find the target, some subjects were given a more in-depth training than others. The data that was recorded was the time it took to find the target; the number of waypoints the user made and the if the target was seen but the simulation was not ended would all be recorded. Finally, to ensure that doing semi-autonomous or autonomous first would not skew the data, subjects we randomly assigned to either first and only compared to others who did the tests in the same order.

Analysis and Conclusion

The results showed that the users who had the most training no matter which test they did first did had the most distrust of the machine both recorded by themselves in the post operation survey and in the number of waypoints. Not only that but most of the way points were put into the yellow fog suggesting that the yellow fog makes people more likely to put way points in it rather than to expect the UAVs to search that area on its own. With operator trust it seems that learning how the UAVs work observing them survey the area yields the highest levels of user trust.

Citations

[1]Veluchamy A and Anderson M, "Target Acquisition in Resource Constrained Stationary Camera Systems," in Proceedings of 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems, IEEE, Taipei Taiwan, (October 2010).

[2] Dukeman, A and Anderson M, "A CSP Solution to Multi-Camera Surveillance and Target Tracking," in IEEE International Conference on Systems, Man, and Cybernetics (SMC), Anchorage AL, (October 2011).

[3]Velachumy A, and Anderson M, “Balancing Target Acquisition and Target Tracking in Existing Resource Constrained Stationary Camera Systems,” Intelligent Service Robotics, Vol 4, No 3 pp 181-190, (2011).