Collaboration between Multiple UAVs for Fire Detection and Suppression

Kevin Rivera, Eve Lizel Javier, Parjit Khakh, Kevin Roldan, Duc Nguyen, Krystle Illisastigui, Natalie Nyaung

Abstract

This poster discusses the autonomous coordination between two unmanned aerial vehicles (UAVs) for fire detection and suppression. One S1000 UAV detects a fire that gives instructions for a second S1000 UAV to suppress the fire using a fire suppressant ball. Further, design, fabrication, and testing of UAV mechanisms will also be shown as well as the flight test results of the overall mission for autonomous coordination between two UAVs for fire detection and suppression.

Introduction

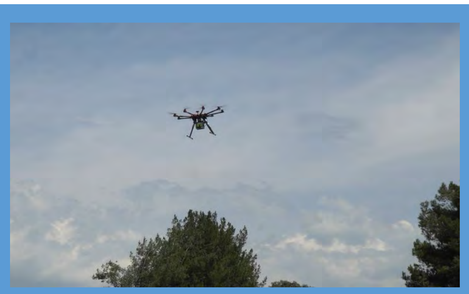
Human advancement has added to the rate of manmade. Due to this, wildfires left unchecked rapidly grow out of control and often pose many risks to the firefighters who risk their lives trying to put out large dangerous fires. The potential for loss of property as well as significant loss of life poses a real risk to not only those affected by the fires but those fighting the fires directly. This danger raises the demand for swift and accurate fire suppression and detection methods that not only help maintain a level of safety for firefighters but also aid in their ability to combat these fires. The world of traditional firefighting can be combined with new advancements in fields such as aerospace and AI technology to help take the ease off firefighters and allow them to do their jobs not only more efficiently but safely. The ability to introduce more autonomous forms of firefighting will open countless opportunities for surveillance, detection, and suppression not only making the fires easier to combat but to make future hotbed areas of wildfires easier to control.

Methodology

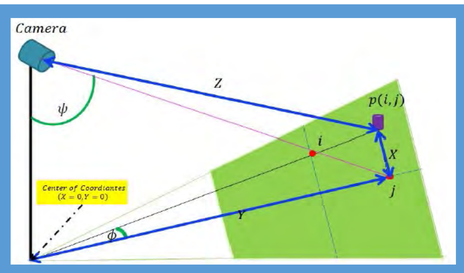
The fire detection UAV is equipped with a FLIR thermal camera and an onboard computer is programmed to fly a predetermined path autonomously to search for fire hotspots. Once a fire is detected, the fire location is saved and sent to the suppression UAV. The suppression UAV will then autonomously fly to the location of the fire and drop a suppressant fireball from a safe distance above the fire. When the fireball comes in contact with the fire, its fire retardant is spread out in a small explosion eradicating the fire. After completing the mission, both UAVs return to their home waypoint and land autonomously. The UAVs used are two S1000 multicopters from DJI. Algorithms for fire detection and autonomous coordination have been developed in flight simulation and flight tests.

Results

Throughout various stages of testing, multiple upgrades and enhancements were made to both S1000 UAVs. Both S1000 adopted autonomous flight algorithms. For flight, the detection UAV integrated a Ubquiti Bullet M2 to transmit a live feed of the FLIR Boson 320 to a ground computer. Using the FLIR Boson 320, the location of the fire that found using an automated triangulation method shown in Figure 1 was transmitted to the suppression UAV. The suppression UAV was able to receive the coordinates of the fire, autonomously take off and automatically drop the fire suppressant ball over the fire using a custom design drop mechanism. All flight was monitored through mission planner for both UAVs to show all telemetry data. After multiple flight tests and troubleshooting, the UAVs were able to work in tandem to successfully suppress a small fire.



S1000 in Test Flight



Triangulation Method [1]

Flight Path Mission Planner

Fire Suppressant Mechanism

S1000 Detection UAV with Boson 320 FLIR

Conclusion

After weeks of design changes and multiple iterations the two UAV system was able to autonomously detect and suppress a small fire. Some areas of future work would be to implement more UAVs to work together for larger fires as well as implementing a tree replenishment system by using the current dropping mechanism.

References

[1] Y Salih and A. S Malik. “Depth and Geometry from a Single 2D Image Using Triangulation.” In 2012 IEEE International Conference on Multimedia and Expo Workshops, 511–515. IEEE, 2012.

Acknowledgments

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Alternate Text

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Figure 1. S1000 in Test Flight

Figure 2. Triangulation Method [1]

Figure 3. Flight Path Mission Planner

Figure 4. Fire Suppressant Mechanism

Figure 5. S1000 Detection UAV with Boson 320 FLIR

Conclusion: After weeks of design changes and multiple iterations the two UAV system was able to autonomously detect and suppress a small fire. Some areas of future work would be to implement more UAVs to work together for larger fires as well as implementing a tree replenishment system by using the current dropping mechanism.

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