

# Self-Autonomous Drone for Flame Detection and Extinguishing using High-Pressure Water

Uttheya Nithi S M  
B.E Mechatronics

Bannari Amman Institute of Technology  
Erode, India  
uttheyanithi.mc22@bitsathy.ac.in

Amarnath G  
B.E Mechatronics  
Bannari Amman Institute of Technology  
Erode, India  
amarnath.mc22@bitsathy.ac.in

Kaveyan P  
B.E Electronic Instrumentation  
Bannari Amman Institute of Technology  
Erode, India  
kaveyan.cs22@bitsathy.ac.in

A novel approach to damping out fires in hard-to-reach places, such as high-rise buildings or forests, is to use autonomous drones for flame detection and extinguishing using high-pressure water. Flame detection sensors aboard the drone provide information to the control center. The drone flies to the fire's location once it has been located and utilizes high-pressure water to put out the flames. It can also be manually operated in emergencies as it has a camera attached it can be easily monitored and controlled. This technique can save lives, dramatically cut down on property damage, and significantly reduce the amount of time it takes to put out flames.

**Keywords**—*high-rise, autonomous and high-pressure water.*

## I. TECHNOLOGY IMPLEMENTED BEHIND UNMANNED AERIAL VEHICLES (UAV) FOR FIREFIGHTING

UAVs are autonomous drones that can do the work given to them. It can be fully automatic and we can also manually control it if we desire. Rather than using complex algorithms simple coding with conditions can be used to make it autonomous. And using PID controls with it will make navigation easy as it reduces all unwanted movements. It can navigate through fire and can even go to inaccessible regions. Using various sensors, it can find the region affected by fire and extinguish it. Water is used as it can be used in most situations and is the best possible choice out of foam and chemicals. Combining everything in a drone gives our firefighter UAV which can be used in many situations to save people's lives.

### A. Various types of equipment used

1) *For sensing flames:* Detecting flames is the main part that can be crucial for the UAV as only if it can detect fire properly then it can go to that location. And it should also be precise or it may encounter an obstacle and may fail the work given. So we are using two sensors which are a fume sensor and a flame detection sensor. The flame detection sensor can find the region of fire using temperature but it can be precise like it can detect inside the wall so the drone may hit. So we use a fume sensor so that it follows the fumes and then detects the area where the flame resides.

2) *For controlling the fire:* Detecting flame can be a huge job but the next crucial part is controlling because only by controlling it we can save lives faster. We are using water as the main source because it's cheap and also the best option which can be used in most situations. Using a servo motor for rotation and fixing another servo motor behind it can make the nuzzle rotate and revolve unidirectional so the water can be sprayed in even in corners of rooms or even ceilings. Using a refillable water tank. The water tank is typically made of lightweight and durable materials, such as carbon fiber or aluminum, and is capable of holding several liters of water. The nozzle system is designed to produce a high-pressure stream of water that can be precisely aimed at the target. The

system typically includes a pump that pressurizes the water and a nozzle that shapes the water into a focused stream. The nozzle may also be adjustable, allowing the operator to control the flow rate and pattern of the water stream.

a) *Autonomous and manually controlling technology:* We can use Arduino or raspberry pi which can be precise with the necessary coding and we can use a Bluetooth module to connect to the drone for the manual operation which is done by a joystick connected to the drone. Certain algorithms are used for PID control so that it won't hit any obstacle and reaches its destination in minimal time and minimal movement.

### B. The benefits and limitations of using drones for fire suppression

The UAV has certain limitations i.e. it can't be used in complex structures but it can be solved if we manually controlled but that too can be hard if the pilot doesn't know the location precisely. This problem can be solved by using a mapping system where the joystick shows a screen where it displays the place in a map format which can further aid in fire suppression.

It can be used in inaccessible regions, for example, it can even be used to suppress forest fire as it can travel quickly and suppresses the fire and it can even go to regions where the fire is intense where a normal person can't enter. It can reach the place faster as its travels in the sky. It can even be used for suppressing flame in buildings where it can go through windows and suppress the fire.

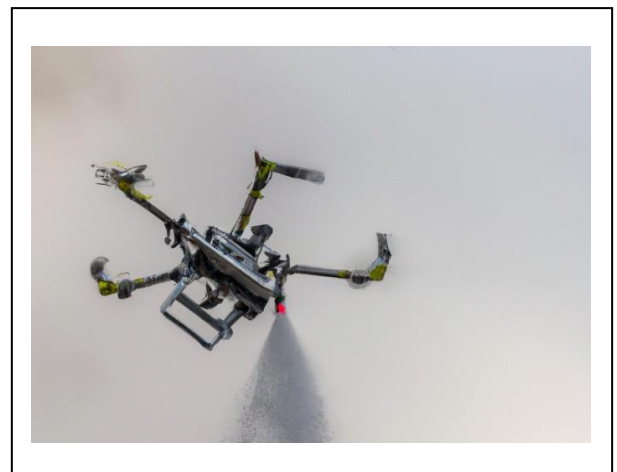


Fig. 1. An UAV using high-pressure water to suppress the fire and the nuzzle can be moved in all directions.

## II. THE FUTURE OF FIRE CONTROL TECHNOLOGY AND THE ROLE OF DRONES IN IT

The future of drones is vast as they can become more precise as more advanced technology comes. It can become much faster and if we used the 5G network we can directly surveilance any area without the need for much hardware. And we can also make different kinds of slots so that for each type of fire it uses suitable ones like for electrical appliances it uses foam etc.

More kinds of algorithms can be found for efficient routing and finally, it can be made such that it can lift the debris during fire accidents which can save a lot of lives.

### ACKNOWLEDGMENTS

This research was partially supported by Vignesh Sridhar. We thank our colleagues from Bannari Amman Institute of Technology who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

We thank you for your assistance with writing research journals, and Vignesh Sridhar's special lab in charge of Bannari Amman Institute of Technology for comments that greatly improved the manuscript.

### REFERENCES

- [1] Dimitris Mourtzis, John Angelopoulos, Nikos Panopoulos, "Unmanned Aerial Vehicle (UAV) manipulation assisted by Augmented Reality (AR): In the case of a drone", IFAC-PapersOnLine, Volume 55, Issue 10,2022, Pages 983-988, ISSN 2405-8963. 26 October 2022.
- [2] Nikolaos A. Kyriakakis, Magdalene Marinaki, Nikolaos Matsatsinis, Yannis Marinakis, "Moving peak drone search problem: An online multi-swarm intelligence approach for UAV search operations, Swarm and Evolutionary Computation", Volume 66,2021,100956, ISSN 2210-6502. 31 July 2021.
- [3] Mario Arturo Ruiz Estrada, Abraham Ndoma, "The uses of unmanned aerial vehicles –UAVs- (or drones) in social logistics: Natural disasters response and humanitarian relief aid", Procedia Computer Science, Volume 149, 2019, Pages 375-383, ISSN 1877-0509. 12 March 2019
- [4] Mahmoud Hussein, Réda Nouacer, Federico Corradi, Yassine Ouhammou, Eugenio Villar, Carlo Tieri, Rodrigo Castiñeira, "Key technologies for safe and autonomous drones, Microprocessors and Microsystems", Volume 87,2021,104348,ISSN 0141-9331, 22 October 2021.
- [5] Soonil Nam, "Boilover upon suppression of cooking oil fire by water spray", Fire Safety Journal, Volume 39, Issue 5, Pages 429-432, ISSN 0379-7112, 12 March 2004.
- [6] Mahesh, Raktim Lal Baruah, Krishan, Preeti, Sansh Bir Dagar, "Firefighter drone with robotic gripper", Materials Today: Proceedings, Volume 79, Part 2, Pages 334-337, ISSN 2214-7853, 21 December 2021.