International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Development of IOT Based Automated Fire Fighting Drone for Wild Fire Detection and Extinguishing

Dr. Sumitha C[1], Dr. Nuthan A C[2], Arjun D S[3], Madhu S M[4], Mahesha B S[5], Varun S[6]

[1]Assistant Professor, Electrical and Electronics Engineering, G Madegowda Institute of Technology

[2]Professor & Head, Electrical and Electronics Engineering, G Madegowda Institute of Technology

[3]Student, Electrical and Electronics Engineering, G Madegowda Institute of Technology

[4]Student, Electrical and Electronics Engineering, G Madegowda Institute of Technology

[5]Student, Electrical and Electronics Engineering, G Madegowda Institute of Technology

[6]Student, Electrical and Electronics Engineering, G Madegowda Institute of Technology

---

Abstract - Wildfires are a growing environmental concern, causing widespread destruction to forests, wildlife, property, and human lives. Traditional firefighting methods often face challenges such as delayed response time, limited accessibility in remote areas, and risk to human safety. This project aims to develop an IoT-based automated drone system capable of detecting and extinguishing wildfires efficiently and autonomously.

The proposed system integrates sensors such as temperature, gas (CO, CO_2), and flame detectors to continuously monitor environmental conditions. These sensors are connected to an IoT-enabled microcontroller that processes data in real-time and communicates with a central control unit via wireless technologies. Upon detecting signs of fire, the drone autonomously navigates to the affected area using GPS and onboard navigation systems.

Equipped with a thermal camera and a fire-extinguishing payload (such as flame-retardant balls or liquid dispersers), the drone provides live video feedback and can suppress the fire at its early stage.

The system's automation reduces human intervention, enables rapid response, and allows deployment in inaccessible or high-risk regions. Multiple drones can work collaboratively to cover large forested areas.

This project demonstrates the potential of integrating IoT, autonomous aerial vehicles, and intelligent sensor networks in addressing the growing threat of wildfires through early detection and rapid response.

Key Words: *Drone, Water pump motor, Pipe*

1. INTRODUCTION

Currently, there is a lack of unmanned aerial vehicles that are being used with the purpose of extinguish a fire or help prevent one. An unmanned aerial vehicle (UAV) is an aircraft without a human pilot on board. Its flight can be controlled autonomously by computers in the vehicle, or by remote control under the direct command of a human.

In the United States and the rest of the world, most of the UAVs in existence are being used for the defense purpose. Fires that occur in homes, forest and nonresidential buildings as well as fires in wild lands cause plenty of health issues; including death to humans and animals, in addition to great economic losses in structures, equipment and vegetation. Furthermore, the first response teams, such as fire fighters, are exposing their lives to great risks in order to extinguish a fire. In addition to those huge problems, there is another one that does not cause so many struggles, but it does have a negative effect when a fire occurs. One of the most popular ways to extinguish fires is to spray water in the area affected by the flames. The water can be delivered via hose using a pressurized fire hydrant, fire sprinkler system, pumped from water sources, such as lakes, rivers or tanker trucks, or dropped from aircrafts in the case of wild land fires.

2. METHODOLOGY

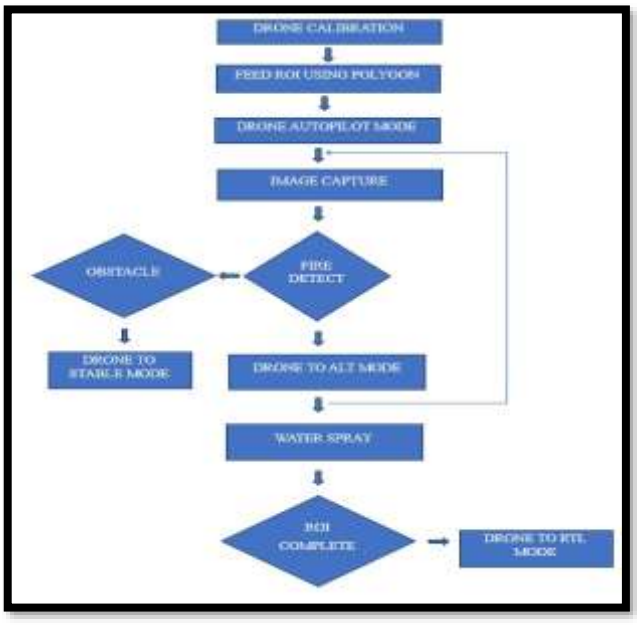

Fig. 1 Flow chart for drone operation

The connection is made to the drone to work as fire extinguisher, the nozzle is directly connected to the drone to through the pipe, the pipe is connected to Motor to the nozzle, the water pump is power with the lead acid battery the pump in let dipped in the water Tank outlet connected to nozzle. The fire detection is made through the fire sensor it is connected to the transmitter circuit which is mounted on the drone. if the fire is detected through the fire sensor the transmitter module contain relay that sends the signal and information to the Receiver Circuit Then water pump switch is on automatically Then water pump is pump the water to the nozzle which is attached to the drone nozzle is spray the water to the fire place the fire is extinguished.

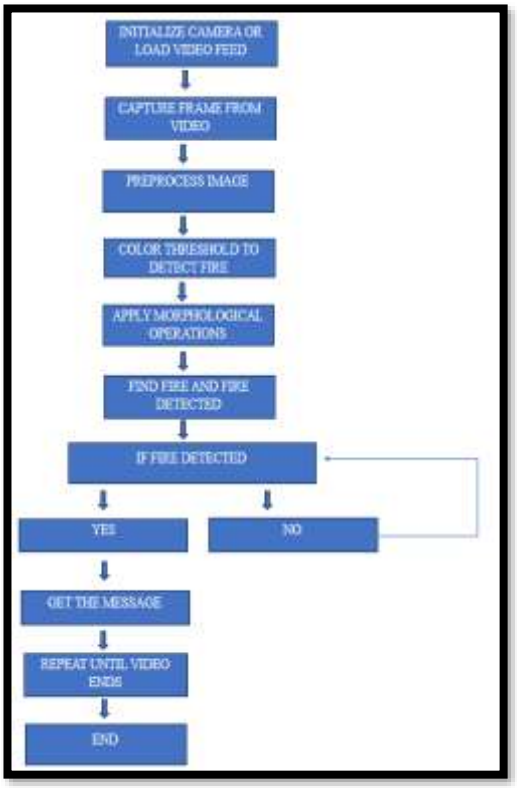

Fig. 2 Flow chart for fire detection using image processing method

The fire detection system using image processing works by analysing visual data from a live camera feed or video input to automatically identify the presence of fire. The process begins with capturing each frame from the video source, which is then pre-processed by resizing and converting it from the standard RGB color space to alternative Color spaces

like HSV (Hue, Saturation, Value) or YCbCr. These color spaces are more effective for segmenting fire-colored regions, as they separate brightness and color information. The system applies a color thresholding technique to isolate pixels that fall within the typical color range of fire, such as shades of red, orange, and yellow. This creates a binary image where potential fire regions appear as white areas and all others are black. to reduce noise and enhance the accuracy of detection, morphological operations such as erosion and dilation are applied. These operations help remove small false-positive spots and emphasize the actual fire-like regions. The system then identifies contours or shapes in the binary image and analyses them based on specific criteria such as size, shape, and color intensity. If the detected regions meet the defined parameters for fire, the system confirms the presence of fire. Upon detection, the system can trigger an alert mechanism—such as sounding an alarm, sending a notification, or activating a connected IoT-based response system. This method provides a fast, real-time solution for early fire detection and is especially useful in environments like forests, factories, and public areas where traditional sensors may fall short.

3. WORKING PRINCIPLE

Fig. 3 Model Picture

The IoT-based automated fire-fighting drone operates through a series of coordinated hardware and software components designed for early wildfire detection and rapid extinguishing. The drone is equipped with thermal cameras that continuously scan the environment for heat, smoke, and fire signatures. Upon detecting abnormal heat levels or smoke, the sensor data is processed by an onboard microcontroller. This data is analyzed using a machine learning model to differentiate between actual fires and false positives. Simultaneously, the drone uses GPS to record the exact location of the detected fire. The real-time information is transmitted via IoT protocols like MQTT to a central monitoring system or cloud server. A map-based dashboard receives this data for remote monitoring. Once the fire is confirmed, the drone activates its autonomous navigation system and flies to the target zone using pre-defined GPS coordinates and obstacle avoidance algorithms. Upon reaching the fire site, it deploys fire-extinguishing agents such as water mist, CO_2, or fire retardants stored in an onboard tank. The spraying mechanism is controlled via a servo motor and nozzle system for precise targeting. Environmental sensors on the drone continuously monitor wind speed, temperature, and air quality to adjust flight and extinguishing parameters. If the fire is successfully suppressed, the drone sends a confirmation signal back to the base station. In parallel, TTS (text-to-speech) alerts are generated to warn nearby personnel, and SMS notifications are sent to registered emergency contacts. The drone also stores all incident data locally and in the cloud for post-event analysis. If the battery runs low, it returns to the docking station autonomously for recharging. The system can operate during both day and night, supported by infrared vision. Overall, the drone performs a loop of detection, alert, localization, navigation, extinguishing, and reporting in a fully

autonomous manner, offering a smart and scalable approach to wildfire management.

4. RESULTS

We have developed a solar water purifier system that combines solar panels with water purification technology to utilize renewable solar energy for filtration and disinfection processes. The system comprises solar panels, a battery storage unit, and purification components like filters, UV lamps, or reverse osmosis units. This integrated setup ensures the delivery of clean, drinkable water, particularly in off-grid or rural areas, by harnessing the plentiful and sustainable energy provided by the sun. This solar water purifier design also incorporates a smart control system to optimize energy usage and ensure continuous operation even during low sunlight conditions. By using solar energy, the system reduces dependency on conventional electricity, making it eco-friendly and cost-effective in the long run. The implementation process involves careful site assessment, installation of solar panels at optimal angles, and regular maintenance to ensure efficiency. This sustainable solution not only addresses water scarcity but also promotes environmental conservation and energy independence in remote areas. The project begins with assessing the water quality and energy needs to determine the appropriate purification technology and solar power capacity. Following this, the solar panels are installed to capture and convert sunlight into electrical energy, which is stored in batteries to ensure continuous operation even during low sunlight conditions.

5. CONCLUSIONS

The development of an IoT-primarily based automated firefighting drone gives a promising option to the escalating issue of wildfires, which reason significant ecological and economic damage globally. This mission correctly demonstrates the combination of clever sensing, drone automation, and wi-fi communique technology to come across, report, and extinguish wildfires effectively. The gadget makes use of a mixture of flame, fuel, and temperature sensors to stumble on early symptoms of hearth, imparting real-time information to operators through an IoT-based totally platform. GPS and location monitoring modules beautify situational focus, enabling precise identity of the fire source.

Onboard cameras and laptop imaginative and prescient algorithms assist in confirming hearth presence and useful resource in powerful navigation. The drone's self-sustaining flight capabilities, powered through GPS waypoints and obstacle avoidance systems, permit it to attain far flung forest areas without human intervention. A water or fire retardant spraying mechanism is deployed to suppress detected fires, guided via sensor input and onboard manipulate structures.

Data transmission via or LoRa ensures dependable communique even in low-community wooded area environments. The integration of cloud services and cellular programs lets in government to screen incidents remotely and take well timed actions. Voice alert structures and SMS notifications may be covered for actual-time warnings to close by groups and reaction teams. The task emphasizes strength efficiency and patience, with solar charging alternatives explored to extend operational life in the course of long missions. All components have been selected for their reliability and compatibility with the rugged out of doors environment. Testing in controlled conditions showed correct detection prices

and a hit fire suppression The development of an IoT-based automatic fire extinguishing drone presents a promising solution for the growing question of fire, causing widespread organic and economic damage globally. The project successfully demonstrates smart sensing, drone automation and integration of wireless communication technologies, effective in detecting, reporting and extinguishing fires. The system uses a combination of flame, gas and temperature sensors to detect the first fire signals, providing real-time data to operators through an IoT-based platform.

GPS and site tracking modules improve the status awareness, enabling the exact identity of the fire source. On board cameras and computer vision algorithms help confirm the presence of fire and help with effective navigation. Autonomous flight skills to the drone, driven by GPS vapoints and barrier that avoids systems, now allow the remote forest areas without human intervention. A water or fire-inhibited spray system detected the fire is deployed to suppress the fire, directed by the sensor input and control systems on board. Data transfer through GSM or Lura also ensures reliable communication in the forest environment with little network. Integration of cloud services and mobile applications allows the authorities to monitor the events externally and take measures on time. Voice Alert System and SMS Alerts can be included for warnings on real time for society and response teams nearby. The project emphasizes energy efficiency and endurance, with solar charging alternatives that were discovered to expand the operating life under long assignments. All components were chosen for their credibility and compatibility with the robust external environment. Controlled conditions showed the correct detection rate and successful fire oppression

REFERENCES

[1] J. Weidinger, S. Schlauderer, and S. Overhage, ―Is the Frontier Shifting into the Right Direction? A Qualitative Analysis of Acceptance Factors for Novel Firefighter Information Technologies, Inf. Syst. Front., vol. 20, no. 4, pp. 669–692, 2018.

[2] L. L. Persons, ―Drone Efficacy Study (DES).

[3] EENA, ―Remote Piloted Airborne Systems (RPAS) and the Emergency Services, 2015.

[4] Yeum,C. M., & Dyke, S. J. (2015).Vision Based Automated Crack Detection for Bridge Inspection. Computer-Aided Civil and Infrastructure Engineering,30(10), 759-770.

[5] Hu, W. H., Tang, D. H., Teng, J., Said, S., & Rohrmann, R. G. (2018). Structural Health Monitoring of a Prestressed Concrete Bridge Based on Statistical Pattern Recognition of Continuous Dynamic Measurements Over 14 Years. Sensors (Basel, Switzerland), 18(12).

[6] Eschmann, C., Kuo, C.-M. C.-H. M. H., Kuo, C.-M. C.-H. M. H., & Boller, C. (2012).Unmanned Aircraft Systems for Remote Building Inspection and Monitoring. 6th European Workshop on Structural Health Monitoring 2012, EWSHM 2012, July 3, 2012 -July 6, 2012, 2, 1179–1186.

[7] Roberts, Mary Rose. "5 Drone Technologies for Firefighting". FireRescue 2014. Web2015.

[8] Sivak, John Joseph Student author R. B. E., et al. Quadrotor Uav. Worcester, MA U6 eBook:Worcester Polytechnic Institute, 2011.

[9] Telleria, Mike. "Boat Fires – Prevention, Suppression, Detection & Preparedness".

[10] WHO.Global Health Observatory Data Repository: Mortality and Global Health Estimates2012.

[11] Wysocki, Thomas." Nfpa Fire Protection Handbook: Carbon Dioxide and Application Systems".Quincy, MA: NFPA, 2008.

[12] "Geltech's Fireice Gaining Acceptance by Fire Departments, Police Departments, Hazmat Teamsand Colleges across the Northeast." 2016.

[13] Abinesh D. V, Deepak A. K, Chandraprakash K.Gowtham.M,Ananthi.I, Fire Fighting Drone IJIERE 2017, Volume 4, e-ISSN: 2394-3343.

[14] Dr. Ronald T. Wakeham & Dr. John C. Griffith, ―Unmanned Aerial Systems in the Fire Service: Concepts and Issues. JMER,June 2018, e-ISSN: 2536-8.

[15] Norman, John. Fire Officer's Handbook of Tactics. 4th ed. Tulsa, Oklahoma: PennWell Corporation, 2012.