

# Managing Fire: Increasing Community-based Fire Management Opportunities



**Team: TUNSA Space  
Robotics: Task Force 2**

**Participants:**

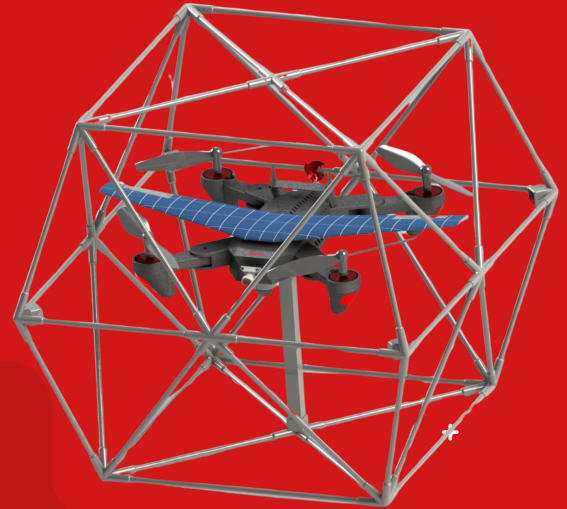
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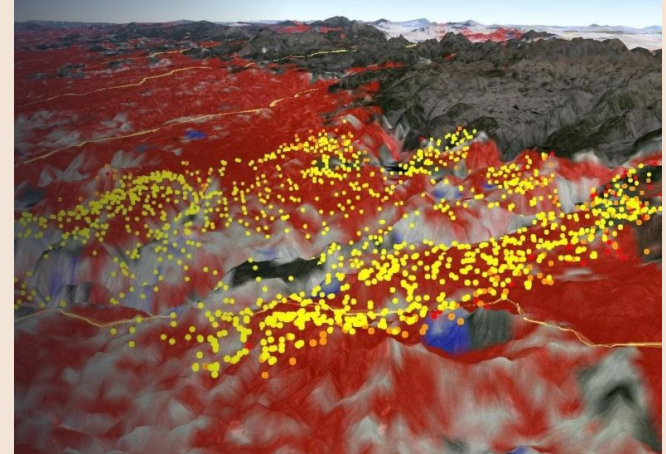
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# PROBLEM STATEMENT

In the face of increasing wildfires, the need for broader access to satellite-derived active fire data and its utilization by diverse stakeholder groups, including local communities, is pressing. Wildfires have devastating consequences, including biodiversity loss, air quality degradation, soil erosion, and greenhouse gas emissions, often disproportionately impacting communities residing near or within forests. To address this issue, our challenge is to find innovative ways to harness technology and publicly available data for fire and natural resource monitoring, enabling local communities to report and monitor fires, improve current data distribution, and develop community-based forest management solutions.



# PROPOSED SOLUTION: FireFly Guardian

## A Fire Verification, Monitoring, and Rescue Drone System



### Scenario 1: Satellite detects a possible fire in a location



Knowing what is going on allows emergency services to make better decisions such as what resources to send or how best to extinguish the fire.



The system also allows the emergency control center to take control of the drone at any time to gather more information and track the fire environment.

### Scenario 2: A watch tower detects a possible fire in a location



Sends the coordinates of the fire and commands to the available drone(s)

Sends in real time all the information it collects via RF communication protocol available

If it goes out of range, it switches automatically to the LoRa protocol, lowers the data transfer frequency and further compresses the data

Once the mission is over, the drone returns to the hangar and gets ready for future flights, automatically recharging its Lithium-Ion batteries.

Drone(s)



Flies autonomously to that point, even in conditions of low visibility, and collects optical and thermal images



Lands on a surface occasionally to take detailed images of a fire location (saving energy)

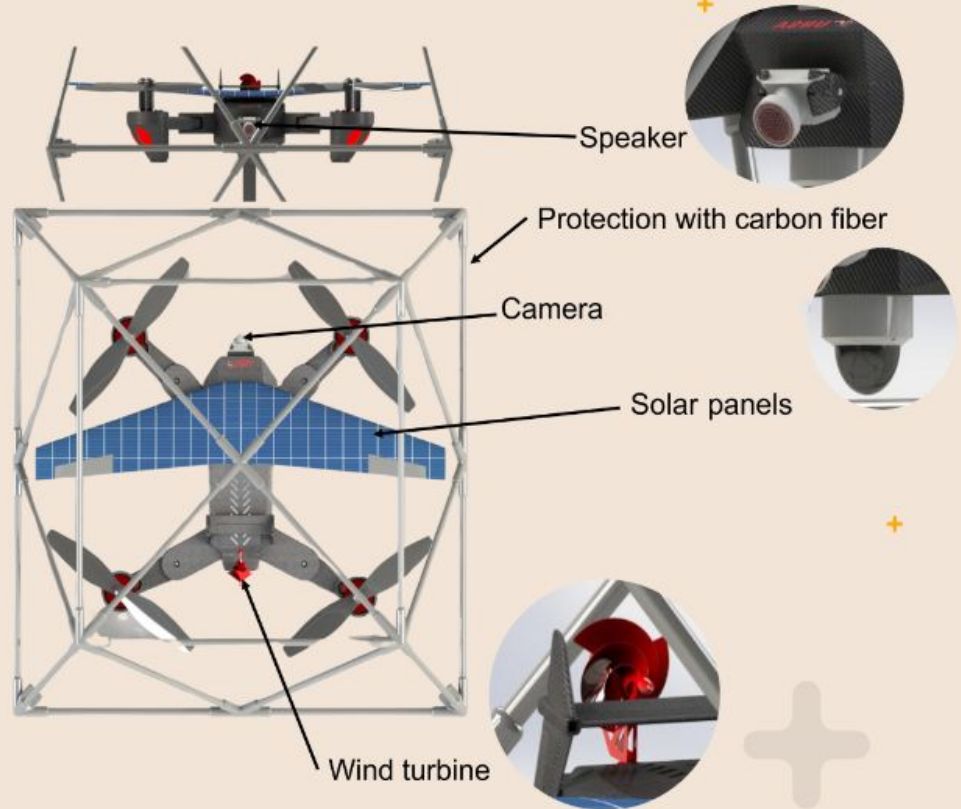


The drone then goes to the nearest population and shouts with its speakers information about the fire.



# MECHANICAL DESIGN

- **Aerodynamic Wings:** Decreases power consumption during long flights.
- **Solar Panels:** Reduces reliance on the Lithium ion battery.
- **Wind generator:** Further boosts the battery life.
- **Body Cage:** Guarantees safety of the drone and the pedestrians.
- **Carbon fiber body:** Lowers body weight thus increasing flight times.
- **360° camera FOV:** Cost-effective opposite-side 180° cameras for real-time monitoring.





**LoRa Module:**  
Long-Range  
Communication,  
Low-Power



**Temperature Sensor:**  
Ambient Temperature,  
Measurement



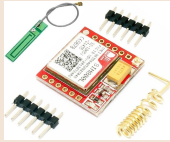
**Motors:** Propulsion,  
Brushless, Thrust



**Electronic Speed  
Controllers (ESCs):**  
Speed Regulation,  
Feedback



**Propellers:** Blades,  
Lift, Rotation



**GSM 3G Modem:**  
Cellular  
Communication,  
GSM/UMTS

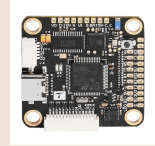


**Smoke Sensor:** Smoke  
Detection, Air Quality

# HARDWARE COMPONENTS



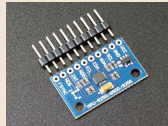
**360° Camera:**  
High-Resolution  
Imaging, Magnification



**Flight Controller:**  
Brain, Control,  
Communication



**Pressure Sensor:**  
Atmospheric Pressure,  
Measurement



**Gyroscope & Accelerometer:**  
Measurement of Velocity, and  
Acceleration



**GPS:** Positioning,  
Satellite Signals



**Thermal Camera:**  
Infrared Imaging,  
Temperature



**Lithium Ion Battery:**  
Power Source, High  
Energy



# SOLUTION CHALLENGES

## **Surviving Harsh Environmental**

**Conditions:** Drones must endure extreme weather while ensuring the accuracy of sensors.

## **Navigating Complex Forest Terrain:**

Precision in dense canopies.

## **Meeting Regulatory Drone**

**Compliance:** Navigate airspace rules.

## **Gaining Community Acceptance:**

Addressing public concerns.



# FUTURE WORK



- ★ Optimizing communication for faster and reliable signals.
- ★ Optimizing power consumption for extended flight endurance.
- ★ Leveraging machine learning for dynamic flight path planning.
- ★ Developing AI-driven predictive maintenance algorithms for reliability.
- ★ Implementing swarm intelligence for collaborative and efficient operations.✚

