Motivation:

In January 2020, devastating wildfires struck Australia, leaving a profound impact. Homes, trees, and cherished memories were consumed by the flames. Amidst the chaos, distressed animals and displaced families painted a heartbreaking picture. Brave firefighters battled relentlessly, but the widespread destruction and loss of beloved pets weighed heavily on us. The toll on nature deepened our sorrow.

From this tragedy emerged a resolute determination. While we couldn't prevent every fire, we committed to enhancing safety. Our mission was clear: develop tools and technologies to address the challenges posed by wildfires. Connectivity issues, early detection, predictive capabilities, and ensuring safe water sources became focal points. Our aim: safeguard communities and the places we hold dear.

Our Solutions:

Our solution utilizes both a mobile application and website, seamlessly integrated with cutting-edge drone technology.

- **Application &Website**
- **Drone Technology**

Mobile Application & website:

"Wildguard" is a comprehensive platform designed to empower communities by providing vital information about wildfire monitoring and water quality and it combines mobile applications and a dedicated website to offer real-time data and alerts to users. Here's how it all works seamlessly:
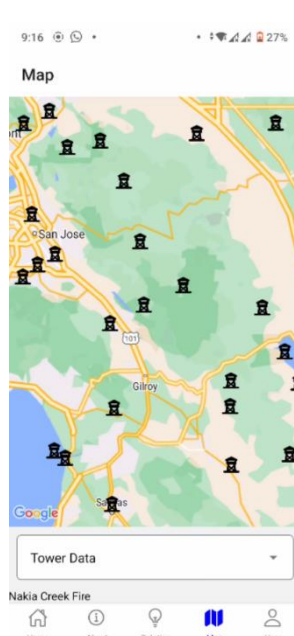
1) **Mapping Application:** Wildguard's mapping application is primarily focused on utilizing various methods to protect community resources and prevent wildfires effectively:

   - By providing access to historical wildfire hotspot data, Wildguard enables users to study past fire occurrences. This information aids in understanding the areas prone to wildfires, facilitating better land management practices and land-use planning to reduce future fire risks.

   - **Real-time Wildfire Detection**: The application leverages MODIS and VIIRS data to detect and display active wildfires as soon as they happen. This real-time information is vital for early detection, allowing communities to mobilize resources quickly, evacuate if necessary, and deploy firefighting efforts promptly to minimize the spread of fires.

   - **Strategically Positioned Towers:** Displaying the locations of strategically positioned monitoring towers on the map provides valuable insights into fire surveillance. These towers

serve as early warning systems, allowing authorities to spot fires in their infancy and respond swiftly to contain them before they escalate.
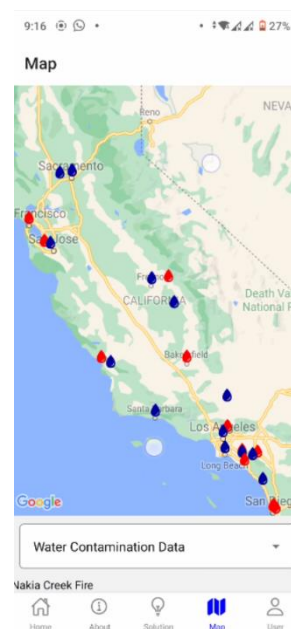
- **Water Quality Monitoring:** A drone equipped with seven probes and a linear actuator collects water quality data via sensors. The drone sends this data in real-time to our website.Wildguard's ability to identify areas of water contamination and safe water sources on the map plays a crucial role in protecting public health. Red markers highlight potential risks, alerting communities to water quality issues so that necessary precautions can be taken. Blue markers signify safe water sources, ensuring residents have access to clean water during wildfire emergencies.

- **Advanced Satellite Imagery and Machine Learning:** Wildguard's integration with the NASA Earth Data Global Imagery Browse Services API is a game-changer. By collecting images from Earth-observing satellites and applying advanced machine learning algorithms, the application can swiftly detect wildfires within these images. This technology allows for rapid pinpointing of fire locations on the map, enabling faster response coordination and resource allocation.
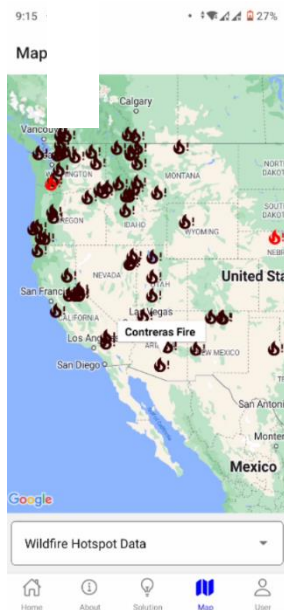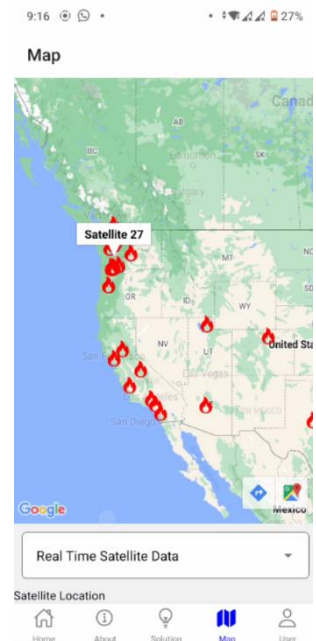

Historical Wildfire Data Analysis   **Strategically Positioned Towers   Water Quality Monitoring   Advanced Satellite Imagery and Machine Learning**

3)Fire Monitoring with Drone Images:

- The drone has a vital role in fire monitoring, capturing images of fire-affected areas using its thermal camera, even those invisible to satellites.

- These images are transmitted to our computer servers for in-depth analysis.

- Additionally, in proximity to the fire, we utilize a messaging service to send alerts and messages.

4) Advanced Environmental Monitoring and Wildlife Protection

- Utilizing deep learning models trained on extensive wildlife datasets, our drones conduct real-time wildlife detection.
- During wildfires, our drone application focuses on swiftly detecting and tracking wildlife in harm's way. AI algorithms identify animals at risk due to the fire, ensuring their protection.

4)Offline Alert System:

- In cases where users are not online, we rely on FM transmission to send emergency alerts.

- This ensures that users receive critical information even when they are not connected to the internet.

5)Emergency Broadcast via FM Radio:

- In extreme scenarios of network failure, we utilize FM radio to broadcast crucial information widely through standard FM receivers.

6)User Data Contribution:

- Users can actively contribute to the system by submitting fire-related data to our website.

- This data aids in analysis and provides real-time updates on fire incidents.

7) Data Verification with Machine Learning and Drones:

- Our machine learning algorithm will verify the input.

- Drones are used for in-depth analysis and validation of fire-related data.

8)Geo-Tagged Image Validation:

- Our app allows users to upload geo-tagged images for wildfire validation.

- Users can capture and share images of potential fire incidents with precise location data.

- This feature assists authorities and emergency responders in identifying and addressing fire threats swiftly.
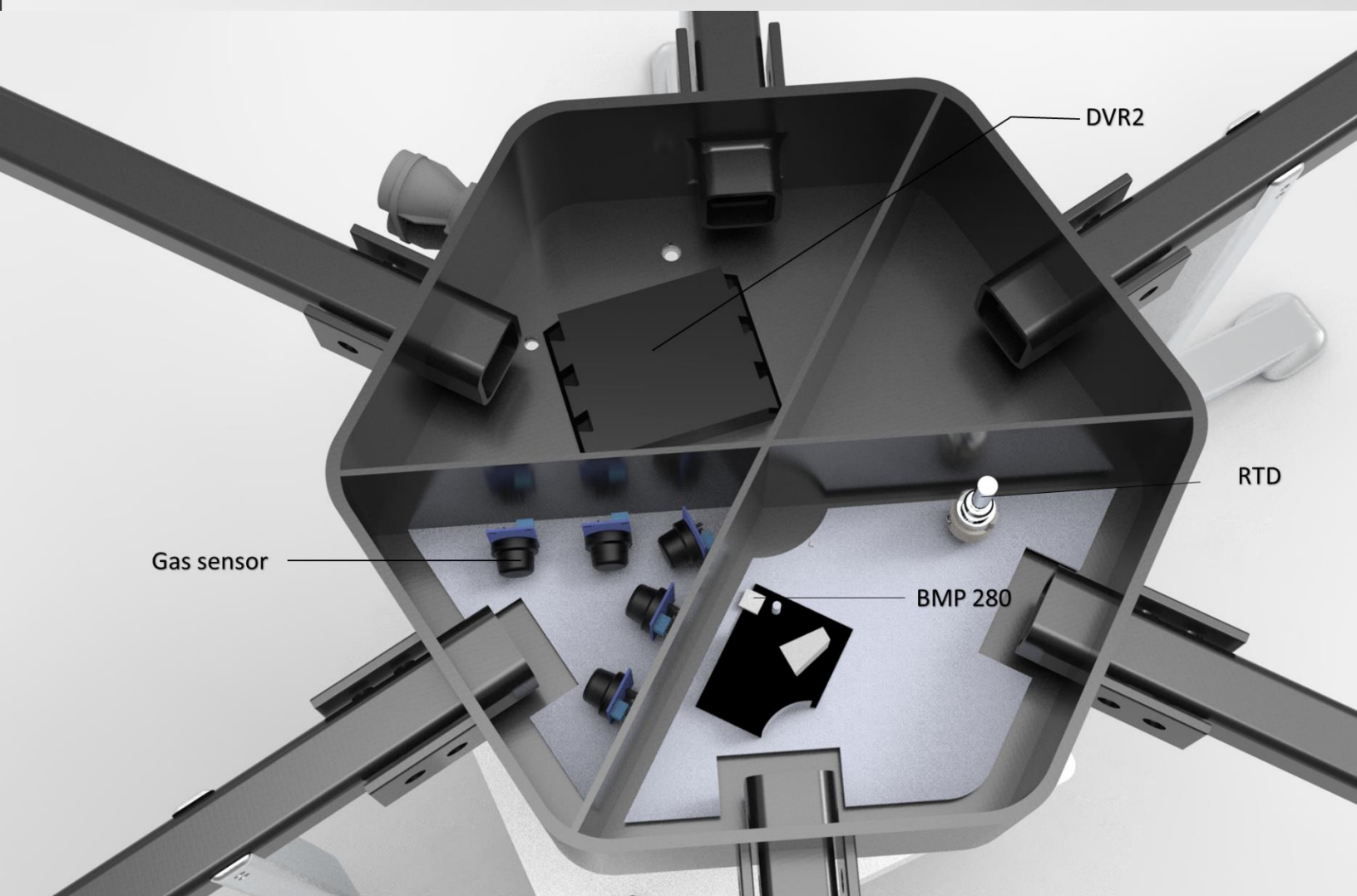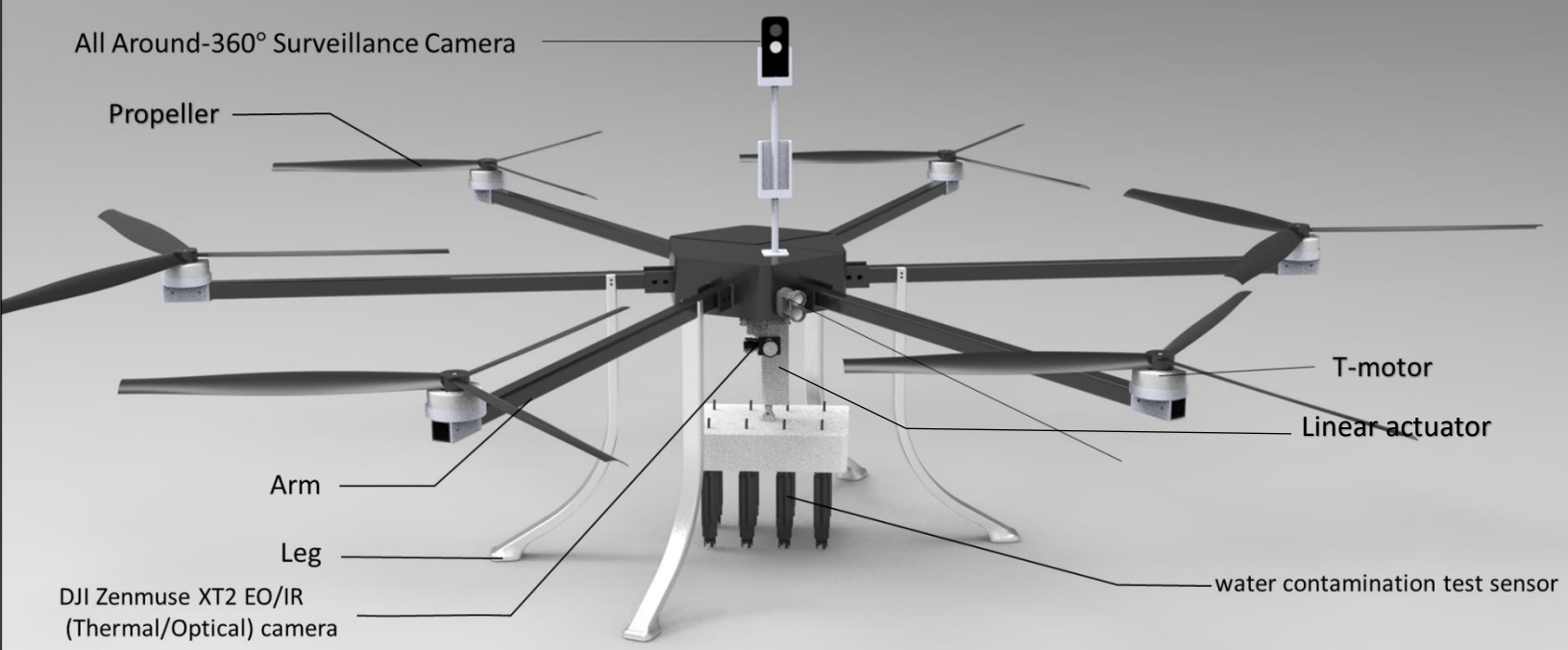
9)Integration with NASA Data:

- We leverage NASA's wildfire data and real-time MODIS and VIIRS updates for effective wildfire monitoring.

- Users can access historical and current wildfire hotspots, particularly in regions like California.

10) Offline Alerts and Notifications:

- Wildguard ensures that users receive timely alerts about emerging wildfire threats, when they are in offline, through FM transmitting.

Drone Technology

All Around-360° Surveillance Camera

Propeller

Arm

Leg

DJI Zenmuse XT2 EO/IR
(Thermal/Optical) camera

T-motor

Linear actuator

water contamination test sensor

DVR2

RTD

Gas sensor

BMP 280

Thermal camera:

The DJI Zenmuse XT2 camera system combines an electro-optical (EO) camera and a thermal imaging sensor for real-time streaming. It's versatile for various applications like search and rescue, agriculture, and infrastructure inspection.
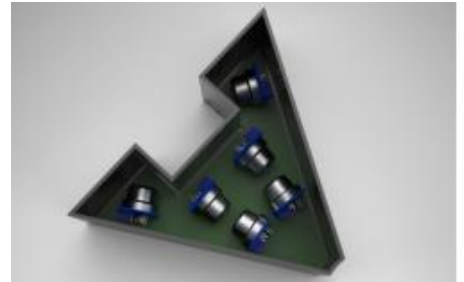
All Around-360 Surveillance Camera (AASCAM)

AASCAM provides the UAV with a 360-degree view,
capturing high-resolution video and photos. It's mounted on a selfie stand for better angles
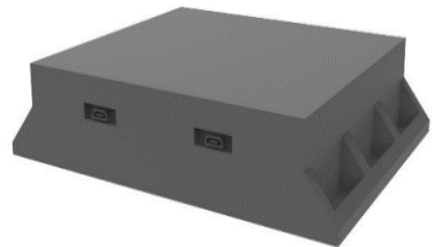
HAGL Laser Altimeter (AHAG-LLA)

AHAG-LLA offers precise altitude measurements unaffected by external factors, making it ideal for automated landings and precise hovering
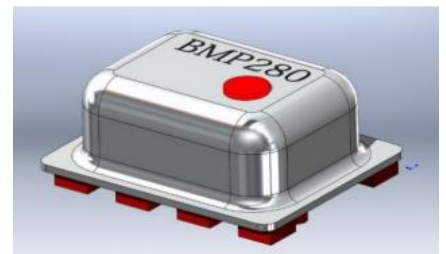
Gas sensor:

This sensor identifies gas percentages in weather conditions, allowing real-time analysis of atmospheric gases during flight

Sensor	Gas Detection	Advantages
MQ 135	NH3, NOx, CO2 Detection	Wide detecting scope
		Fast response, High sensitivity
		Stable and long life
MQ 131	OZONE (O3)	Long life and stability
		Ozone concentration detection (10~1000ppb)
		Fast response and easy detection
MQ-7	Carbon Monoxide (CO)	The detection range is 10 to 500 ppm
SO-421	Oxygen (O2)	It can monitor gaseous O2
		Fast Response
MQ 4	Methane	Can detect concentrations between 200 to 10000ppm.

Combined Pressure and Humidity Sensor:

The BMP 280 sensor measures pressure and humidity efficiently in Martian daylight. It's compact, low-power, and features a responsive humidity sensor with high accuracy, alongside a precise pressure sensor when temperature mode is off.

Water contamination test sensor:

pH sensor:

A pH meter is a precise instrument that measures the hydrogen ion concentration in water and provides a pH value

TDS sensor:

A TDS meter measures the total concentration of dissolved solids in water, often expressed

in parts per million (ppm)

Conductivity Sensor:

Measures the ability of water to conduct electrical current

Turbidity sensor:

Turbidity Sensor or Turbidimeter: Measures the cloudiness or haziness of water due to suspended particles

Advantages:

1. **Wildlife Protection:** WildGuard's use of deep learning models on drones for real-time wildlife detection and protection during wildfires is a unique feature. It prioritizes the safety of both human and animal populations in affected areas.

2. **Offline Alert System:** The use of FM transmission for emergency alerts when users are offline is a crucial feature that ensures that critical information reaches users, even in areas with limited connectivity.

3. **User Data Contribution:** WildGuard actively involves users in the system by allowing them to contribute fire-related data, enhancing the accuracy and real-time nature of the information.

4. **Water Quality Monitoring:** WildGuard places a strong emphasis on water quality monitoring. Equipped drones collect real-time data on water parameters, ensuring that communities have access to safe drinking water during wildfire emergencies.

Tool Used:

- Solidworks
- Pycharm
- visual studio code

Resources:

Space Agency Data:

1. EONET API: https://eonet.gsfc.nasa.gov/api/v3/events: To get real time and historical data for detecting wildfire hotspot

2. imagery: https://api.nasa.gov/planetary/earth/assets?lon=-95.33&lat=29.78&date=2018-01-01&&dim=0.10&api_key=DEMO_KEY: To get real time image for a location from satelliteEARTH API: 3. EARTH API:

GIBS: To get real time image for a location from satellite

- Geographic - EPSG:4326: https://gibs.earthdata.nasa.gov/wms/epsg4326/best/wms.cgi

- Web Mercator - EPSG:3857: https://gibs.earthdata.nasa.gov/wms/epsg3857/best/wms.cgi

- Arcticpolar stereographic EPSG:3413:https://gibs.earthdata.nasa.gov/wms/epsg3413/best/wms.cgi

- Antarctic polar stereographic - EPSG:3031: https://gibs.earthdata.nasa.gov/wms/epsg3031