Early Warning Alert System for Forest Fires

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Agenda

- Project workflow
- Introduction
- Functional description
- Sustainability study
- Conclusion




Project Workflow

01

Selection of problem statement

02

Designing Early Fire Warning System and running tests using simulated fires

03

Design Implementation

04

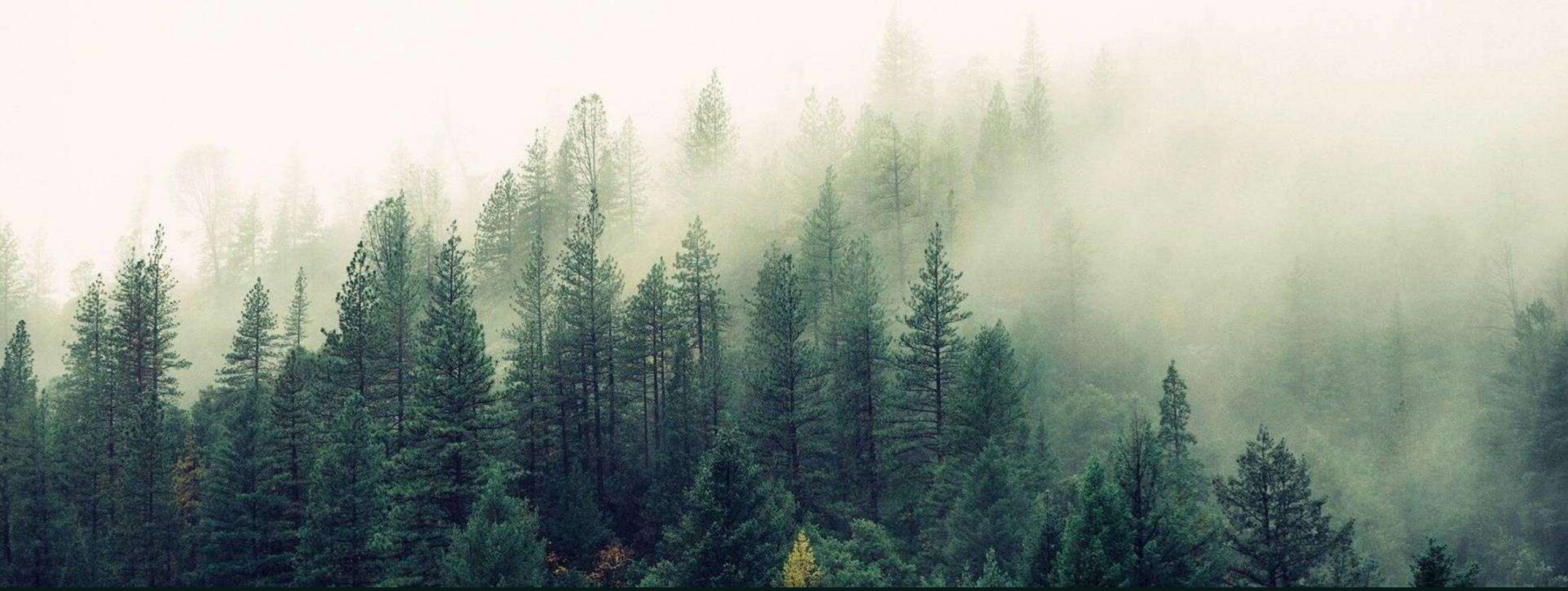
Sustainability Analysis through Case Study

05

Data Analysis to determine attribute relationships

Introduction

- Forest fires are the cause of massive flora, fauna, and economical losses every year. They also contribute to global warming and endanger human lives. More than 85% of forest fires are caused by human activities.
- A delay of 12 hours in the response time to forest fires means saving thousands of acres of forests from being burnt.
- We propose a novel method for early detection and containment of forest fires.



Functional Description

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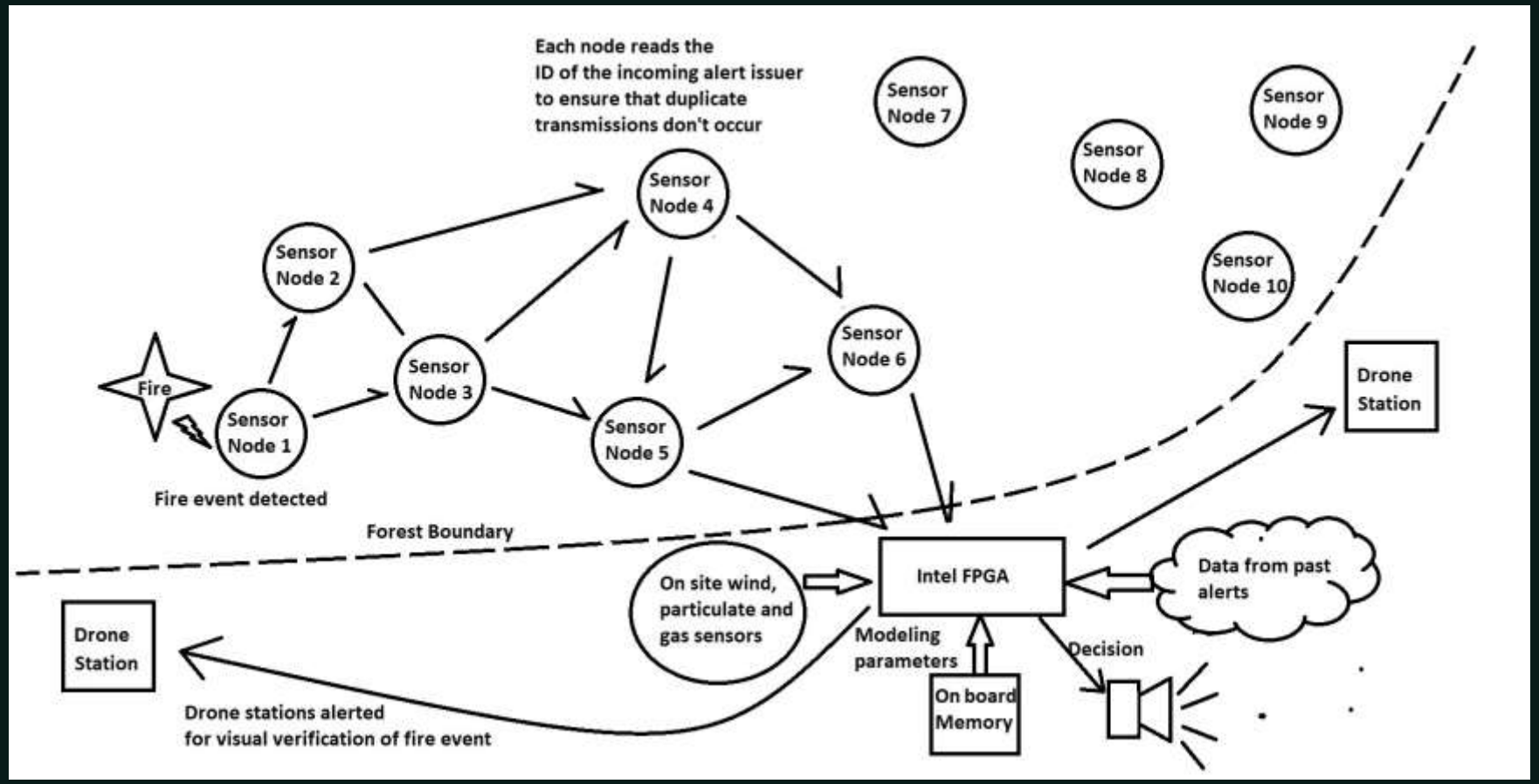


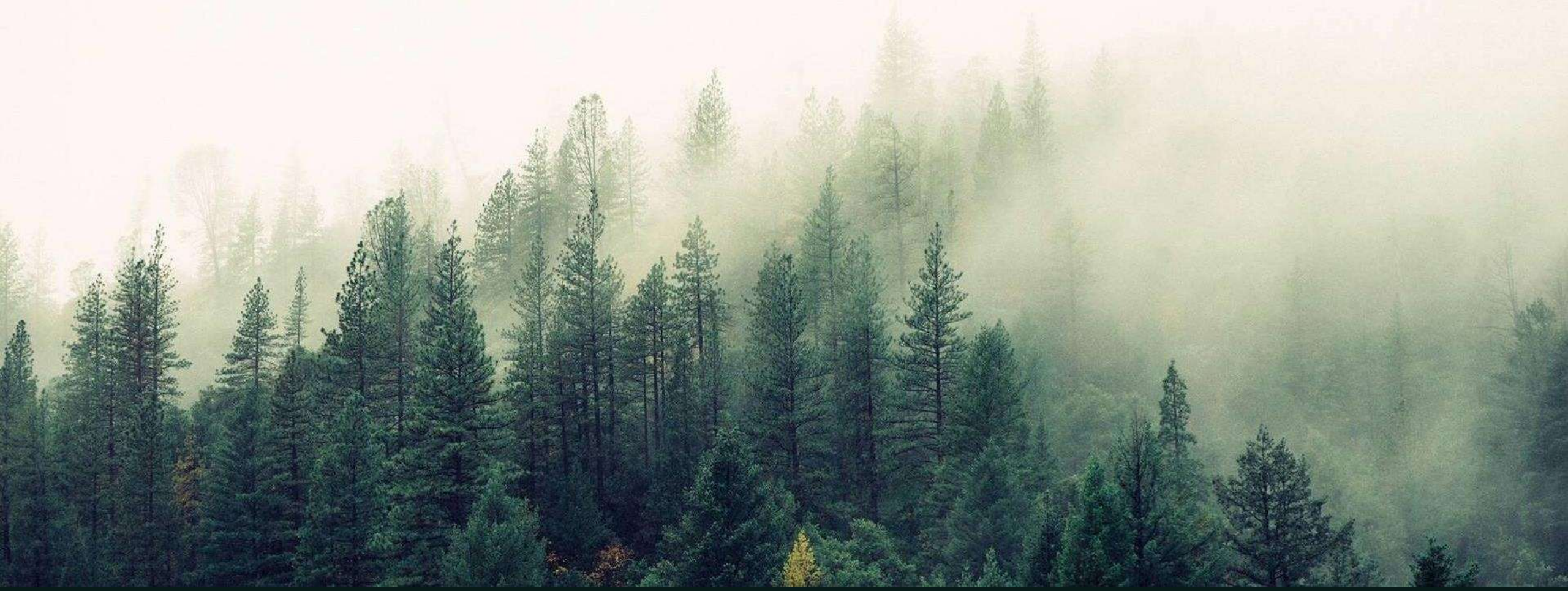
Functional Description

SENSOR NODES

- Sensor nodes equipped with Long-Range (LoRa) communication are scattered throughout the forest along the areas of human activity.
- Each node has a temperature sensor and can talk to two neighboring nodes.
- Network of nodes covers the entire forest. The nodes at the periphery of the forest are in contact with the FPGA.
- Nearest neighbor communication ensures that fire alerts are relayed to the FPGA which sits near the forest rangers' office.

FPGA BASE STATION

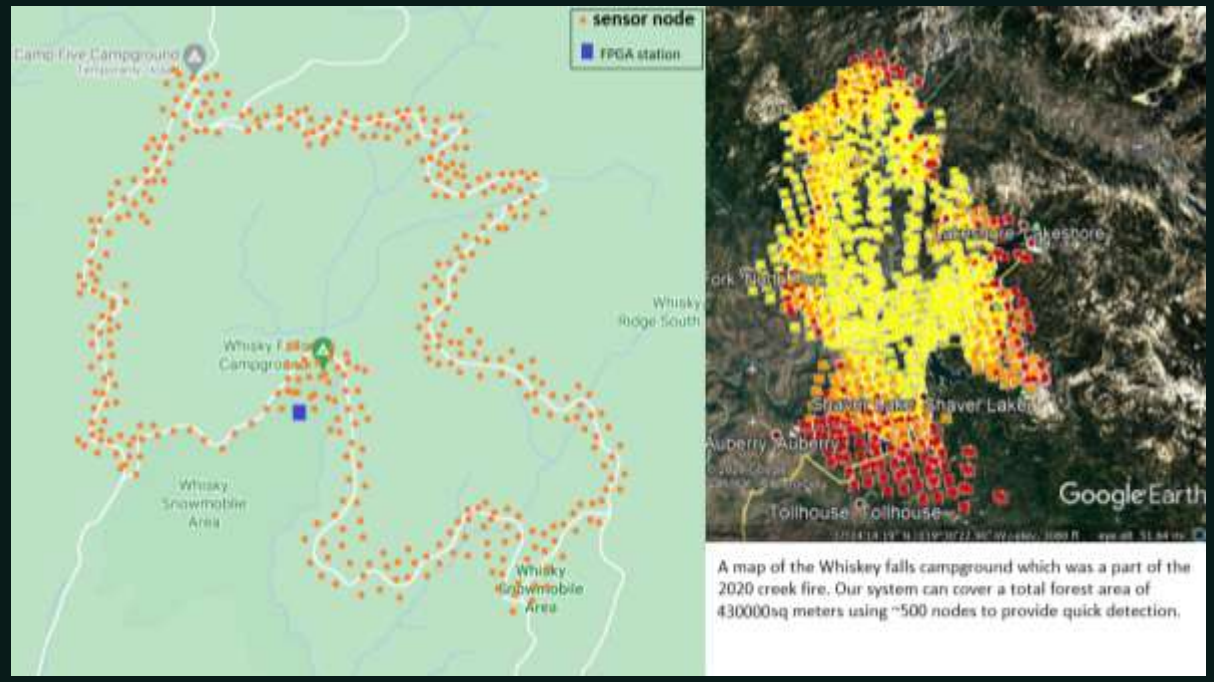
- Minimizes false alerts and keeps a log of past fire alerts.
- Logs incoming fire alert and lets the rangers know where the fire alert is originating using the unique Node-ID of the alerting node.
- The rangers can verify if the alert was true or if a node was falsely triggered.
- FPGA keeps a log of alerts data. When enough data is available, it can run a Multiple-Linear-Regression model to determine if an incoming fire alert is true.



Sustainability study

Sustainability study – The case of creek fire (2020)

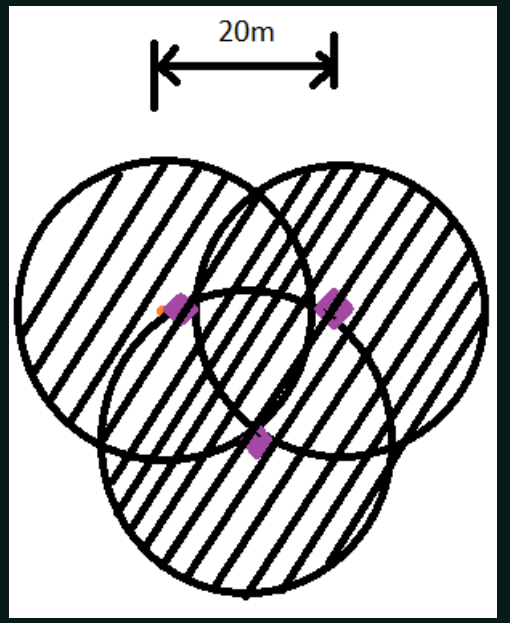
- The creek fire of 2020 burnt down 379,895 acres of forest and cost ~193mn USD.
- Containment efforts began a week after the fire started, driven by satellite images.
- Consider the deployment of our system at the Whiskey Falls campground, close to where the fire actually began.
- Cover areas that are frequented by humans- hiking trails, biking trails and camp grounds.

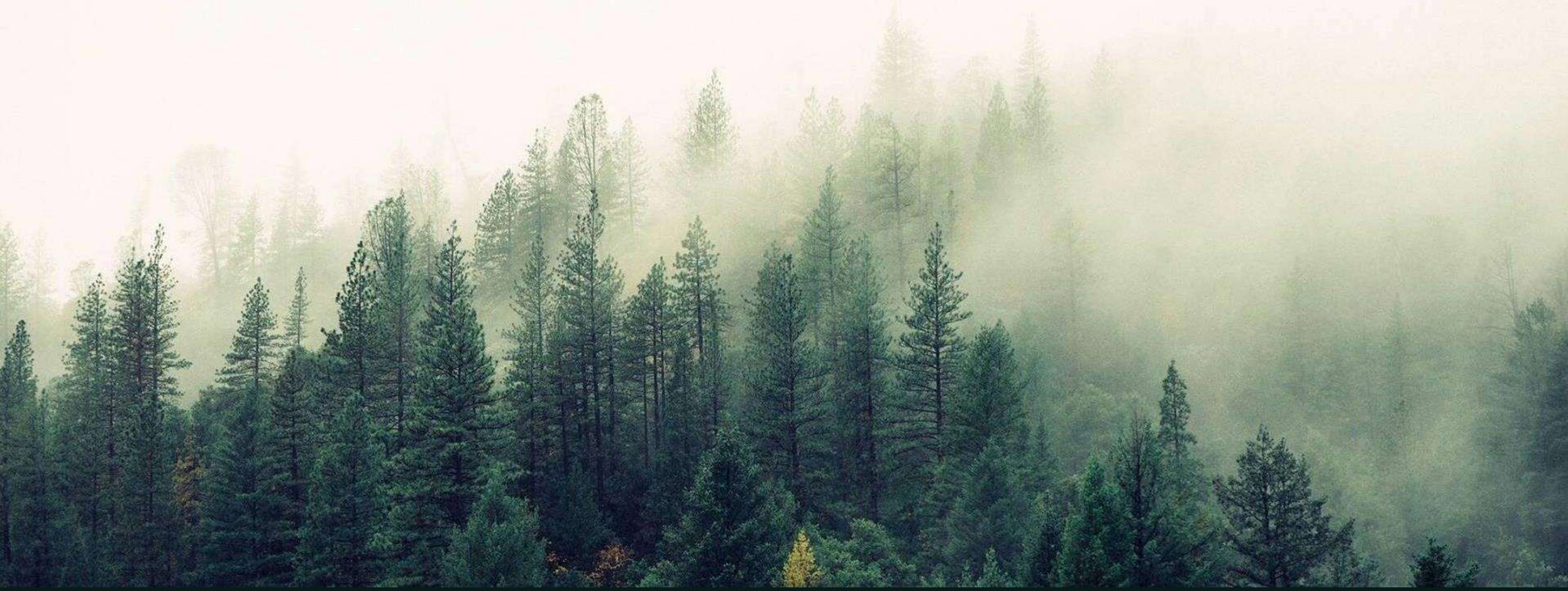


A map of the Whiskey falls campground which was a part of the 2020 creek fire. Our system can cover a total forest area of 430000sq meters using ~500 nodes to provide quick detection.

Sustainability study – The case of creek fire (2020)

- Each group of 3 sensor nodes covers an area of 2580sq m of forest.
- A network of ~500 nodes sufficient to cover the whiskey falls trails and camp ground.
- Total area covered = 430000 sq.m
- Total cost of deployment = $13K



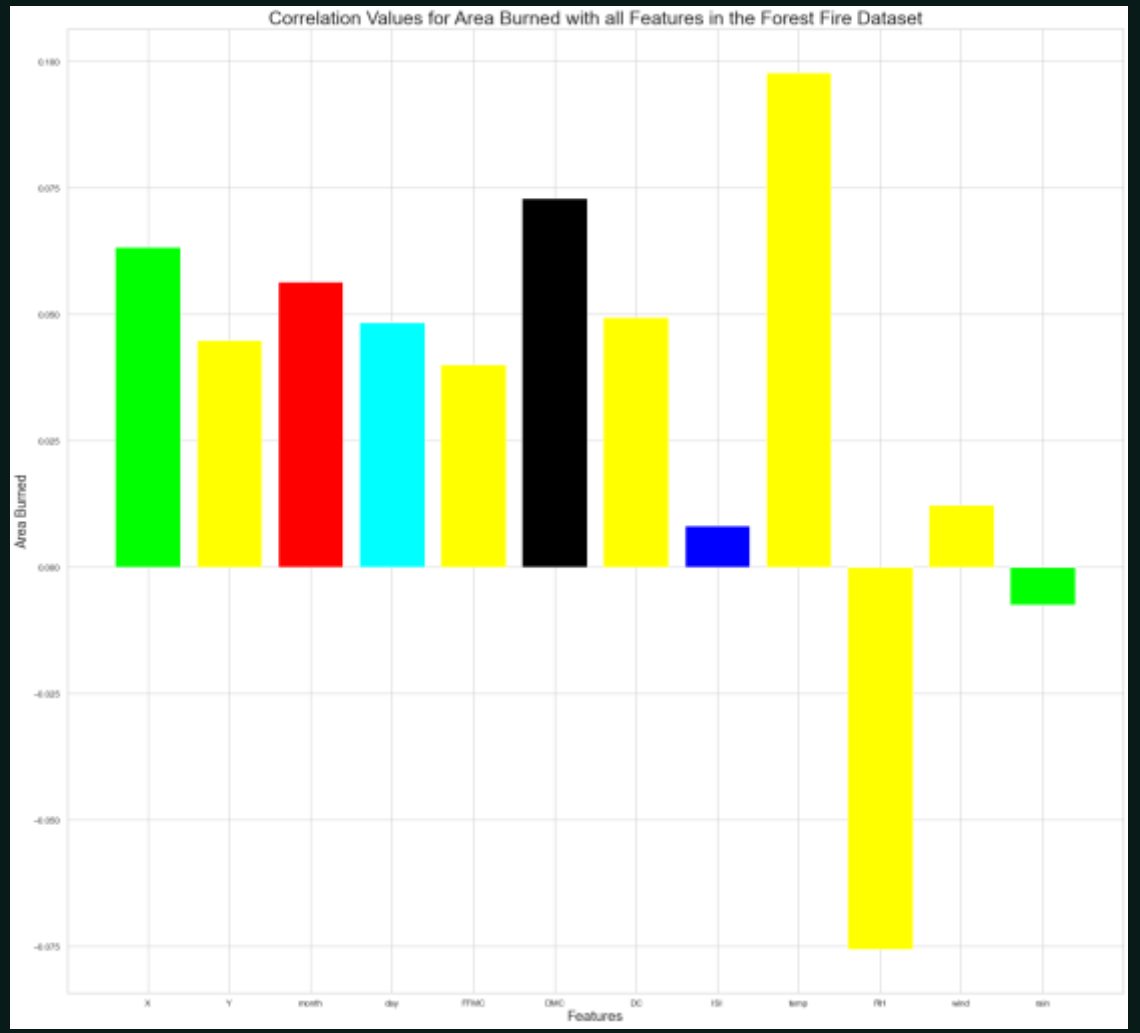


Exploratory Data Analysis

Exploratory Data Analysis

Dataset By-

P. Cortez and A. Morais. A Data Mining Approach to Predict Forest Fires using Meteorological Data



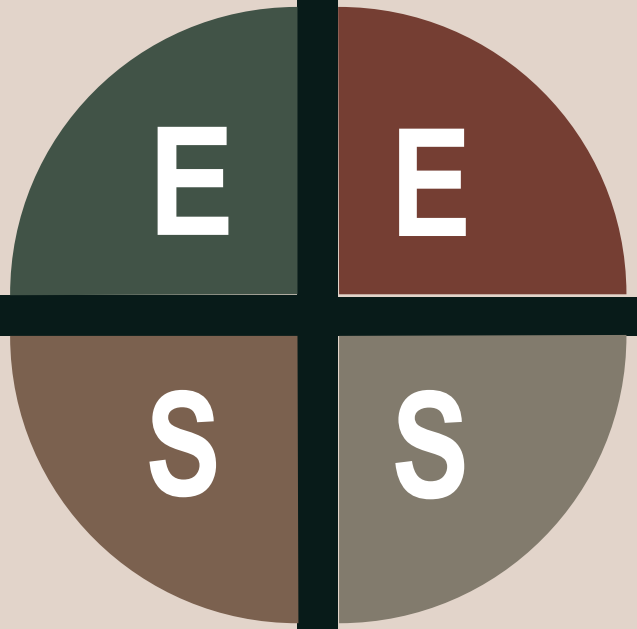
Conclusions

EFFICIENT

- Quick detection of forest fires
- FPGA makes the system adaptable and reprogrammable
- Reliable system with negligible false alarms

ECONOMICAL

- Zero maintenance cost
- Minimal implementation cost
- Estimated implementation cost of 13,650 USD to save ~193 million USD.



- Reliable in the long run
- Suggested tree topology can be scaled up very easily
- Built-in robustness and reliability that increases over time

SCALABLE

- Environmentally non-intrusive system
- Millions of hectares of forests can be saved by prompt response
- Proposed fire alert system becomes more technologically sustainable with time due to more data.

SUSTAINABLE

Thank you

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