

## Individual Report

### Project Idea 1: AI-Powered Wildfire Early Warning System

**Keywords:** Wildfire prediction, AI, satellite imagery, IoT sensors, disaster response

#### Problem Statement

Wildfires are escalating globally due to climate change, causing catastrophic damage to ecosystems, infrastructure, and human lives (e.g., Southern California wildfires 2025). Current early warning systems rely on outdated models and lack real-time data integration, leading to delayed responses.

#### Empathy and User Needs

- Need precise, actionable alerts
- Require evacuation timelines and air quality updates.

#### Intended Deliverable

A cloud-based platform integrating; Real-time analysis of satellite data to detect heat anomalies; IoT-enabled gas sensors and cameras to monitor environmental conditions; Machine learning algorithms predicting fire spread and risk zones; Automated SMS/email notifications and multilingual emergency apps.

#### Innovation and Feasibility

- AI-powered gas sensors detect combustion gases (e.g., CO, VOCs) before visible flames, enabling ultra-early detection; Mobile apps allow communities to report fire risks via photos, which AI analyzes for fuel loads and fire severity.
- Use open-source satellite APIs (e.g., Sentinel Hub) and TensorFlow/PyTorch for ML; Partner with fire departments for testing and integration.

#### Domain Knowledge Integration

Time-series forecasting, computer vision for smoke detection, and NLP for crowdsourced data analysis

#### Declaration of GenAI Use

GPT-4 was used to help reorganize and refine the draft.

### Project Idea 2: AI-Optimized Backscatter Sensors for Wildlife Conservation

**Keywords:** Backscatter communication, AI, IoT, wildlife monitoring, energy efficiency

#### Problem Statement

Traditional wildlife tracking devices (e.g., GPS collars) are bulky, expensive, and drain power quickly. Backscatter technology offers a lightweight, low-cost alternative, but its performance in dense forests or remote areas is limited by signal interference and weak ambient RF sources.

#### Empathy and User Needs

- Need real-time data on animal movements, health, and behavior without disturbing wildlife.
- Require reliable, low-maintenance sensors for monitoring poaching and habitat changes.

#### Intended Deliverable

Ultra-low-power tags attached to animals or trees, using AI to optimize reflection patterns for maximum signal strength; Drones equipped with AI to identify strong RF sources (e.g., cell towers) in remote areas, enabling backscatter communication; Processes sensor data (e.g., temperature, location) to alert rangers of threats (e.g., poachers, wildfires).

#### Innovation and Feasibility

- Tags switch between FSK/BPSK based on environmental noise, extending communication range; Combines backscatter with solar/wind energy to power sensors perpetually
- Use off-the-shelf backscatter chips (e.g., ambient backscatter prototypes) and TensorFlow Lite for on-device AI.

#### Domain Knowledge Integration

Reinforcement learning for adaptive modulation, CNNs for signal denoising; RF signal processing, impedance matching for backscatter tags.

#### Declaration of GenAI Use

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