Smart Helmet for Miners using IOT

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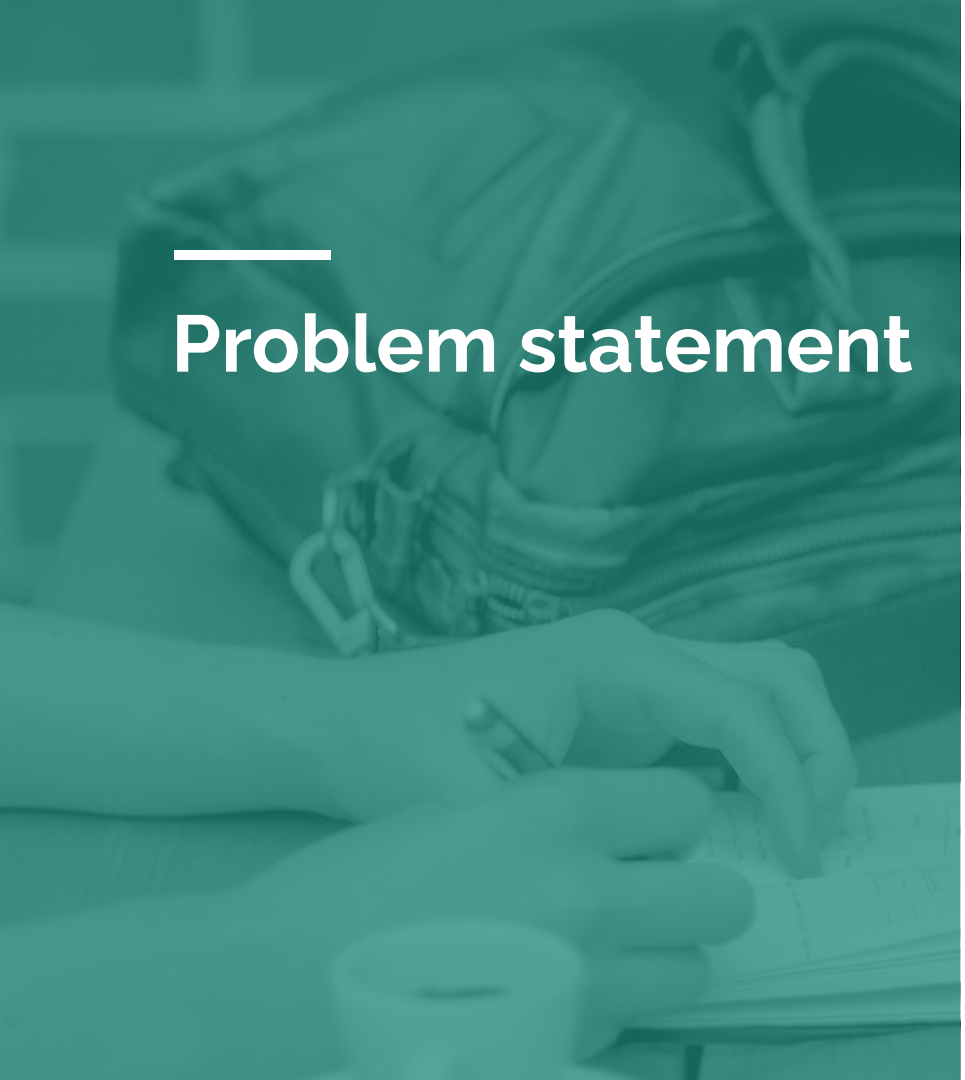
Outline

Introduction to mining safety.

- Mining is essential to many industries, yet it involves significant risks. Miners face dangers like exposure to toxic gases, structural collapses, and health hazards.
- Recent technological advances, such as IoT, offer ways to enhance safety in real-time.



Problem statement

Miners face risks such as:

- Exposure to toxic gases
- High temperatures and humidity
- Structural collapses

Real-time monitoring is essential to detect and respond to hazards, which this smart helmet aims to address.

Projects Objectives

This project aims to;

- Design a smart helmet that monitors environmental and health conditions in real-time.
- Ensure data is transmitted reliably to a monitoring platform, alerting miners and monitoring stations to dangers.

Technology and Design Features

Sensor Array:

- MQ2 gas sensor (methane, CO2)
- DHT11 temperature & humidity sensor
- MAX30105 heart rate sensor
- Wazidev Microcontroller: central processing unit that gathers and transmits data.

Figure 1: Smart Helmet Architecture

Connectivity Solution.

- LoRaWAN technology chosen for its long-range (up to 7km) and reliability in challenging environments.
- Reduces infrastructure needs and increases coverage compared to alternatives (e.g., Zigbee, RF).

Figure 2: Gateway built using Raspberry Pi and LoRa hat.

Data transmission and real time monitoring

- Sensor data is collected by Wazidev and sent to Wazigate gateway via LoRaWAN
- Data then goes to cloud-based WaziCloud, enabling real-time monitoring, alerting, and data analysis.

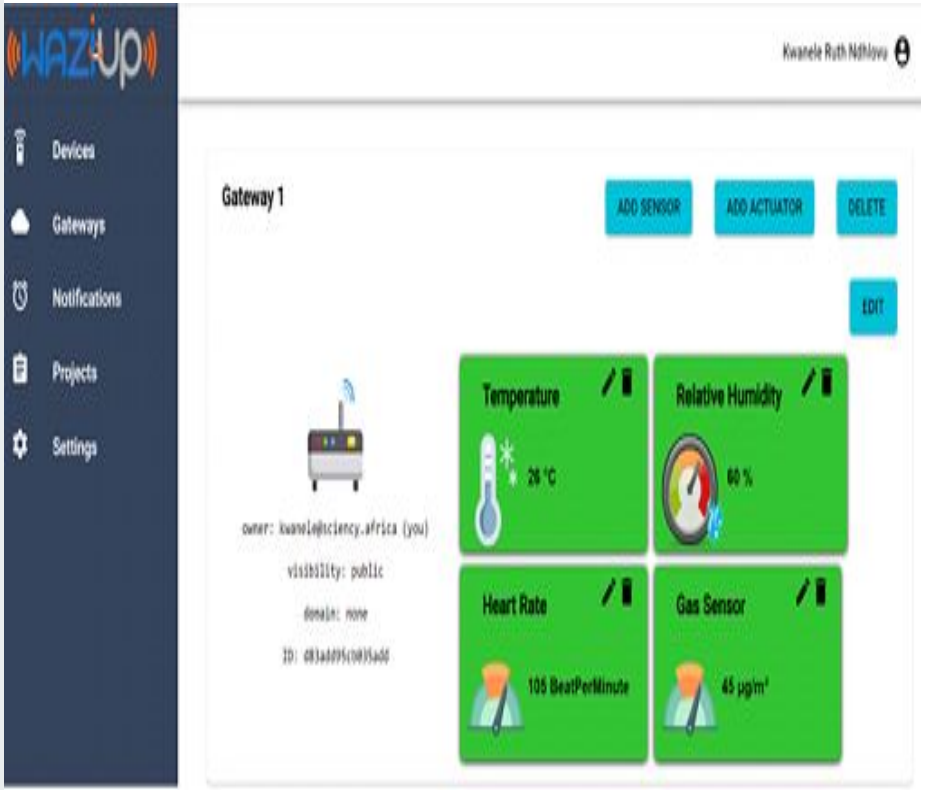


Figure 3: Sensor readings dashboard on the WaziCloud

Field testing and results

- Tested in mining sites with positive miner feedback
- Miners found real-time alerts helpful and data transmission stable even within challenging environments.

Figure 4: Field testing of smart helmet in mineshaft.

Impact on Mining & Safety

- Real-time environmental monitoring, health tracking, and emergency alerts
- Reduces risks and enhances emergency response times, improving overall safety on mining sites.

Challenges and Limitations

- Battery life may be limited during lengthy underground shifts
- Connectivity affected by geological factors
- Future work to explore alternative power solutions and connectivity improvements.

Recommendations for Future Work

- Expand predictive algorithms on sensor data for early hazard detection
- Investigate alternative energy sources to extend operational time in remote mining areas.

Thank You!!!