

# ABSTRACT

Mining operations often involve working in high-risk environments characterized by potential hazards such as underground fires, structural collapses, and exposure to extreme environmental conditions. Ensuring the safety of mine workers is therefore of paramount importance. This paper presents a real-time mine safety monitoring system that leverages Underground Soil Communication (UGSC) technology to enhance situational awareness and enable early hazard detection. The system is built around the Arduino Uno microcontroller, which collects and processes data from a suite of environmental sensors, including temperature, flame, vibration, and moisture sensors. These sensors are strategically deployed to continuously monitor critical parameters within underground mining areas.

To facilitate reliable data transmission in subterranean conditions, the system employs UGSN (Underground Sensor Network) transmitter (TX) and receiver (RX) modules. These modules enable secure and efficient communication through soil mediums, overcoming challenges associated with conventional wireless technologies in such environments. Real-time data is displayed on an integrated LCD screen, providing immediate visual feedback to mine personnel.

Additionally, the system is capable of issuing alerts in response to abnormal readings, thereby allowing timely preventive actions and reducing the risk of accidents. This approach not only enhances the safety and well-being of workers but also contributes to more intelligent and responsive mine management practices. The proposed system demonstrates the potential of integrating low-cost microcontroller platforms with innovative communication technologies for robust and scalable underground safety solutions.