Project Title: AI-Driven Predictive Modeling for Methane Gas Concentration in Underground Coal Mines

Abstract: The accumulation of methane gas in underground coal mines presents a significant and persistent safety risk, leading to potential explosions. Current sensor networks provide real-time data but are fundamentally reactive, triggering alarms only after dangerous concentrations are reached. This proposal outlines the development of a proactive early warning system that uses machine learning to predict hazardous methane levels before they occur.

Our solution involves creating a Long Short-Term Memory (LSTM) neural network model to analyze time-series data from a variety of sources. We will integrate historical data from methane sensors, ventilation system logs (air flow rates, fan pressure), and mining activity schedules (location of cutting machines). The model will be trained to identify complex patterns and correlations that precede a rapid rise in methane concentration.

The project aims to deliver a predictive dashboard that can forecast high-risk conditions 30-60 minutes in advance, allowing for preemptive safety measures such as adjusting ventilation or temporarily halting operations. This data-driven, predictive approach to safety management will significantly reduce the risk of methane-related incidents and improve the overall safety environment in underground mining operations.