**Problem Statement-3**

**Title of Problem Statement:** Indigenous development of Intelligent Monitoring and Control System for Ventilation and Fire Management System in Underground Coal Mines

**Issues:**

Underground coal mines require robust ventilation systems to ensure the safety and health of miners. Effective ventilation is crucial for maintaining air quality, controlling dust, and removing hazardous gases. Traditional ventilation systems often rely on manual monitoring and control, which can be inefficient and slow to respond to changing conditions. The integration of smart technologies can significantly enhance the efficiency and responsiveness of mine ventilation systems, improving both safety and operational efficiency.

Moreover, Underground coal mines are highly susceptible to fire hazards, which pose significant risks to worker safety and operational continuity. Traditional fire detection and management systems may be inadequate in detecting and responding promptly to such incidents in the complex underground environment

The objective is to develop an intelligent system for monitoring and controlling the ventilation and fire management of underground coal mines. This system should incorporate IoT sensors, digital anemometers, and advanced algorithms to continuously (24x7) monitor and adjust ventilation parameters, ensuring optimal air quality and flow. The system should monitor environmental parameters and air quantity measurements using digital anemometers at district intake, return, and Last Ventilation Connection (LVC).

**Expected Outcomes**:

A comprehensive hardware and software solution that includes:

1. **Real-Time Environmental Monitoring and fire monitoring**: Deploy IoT sensors to monitor key parameters such as temperature, humidity, methane levels, carbon monoxide levels, and dust concentration in compliance with DGMS statute. Utilize a network of IoT sensors to detect smoke, temperature changes, and gas levels.
2. **Air Quantity Measurements**: Use digital anemometers to measure air quantity at district intake and return, and at the Last Ventilation Connection (LVC) to monitor air velocity and flow rates.
3. **Data Analysis and Prediction**: Implement machine learning algorithms to analyze collected data, detect anomalies, predict hazardous conditions, and optimize ventilation operations.
4. **Automated Control**: Develop a control system capable of automatically adjusting fans, dampers, & other ventilation components based on real-time data & predictive analysis.
5. **Alert System**: Integrate an alert mechanism to notify miners and control room operators of potential hazards or system malfunctions in real-time. Offer automated alerts and response mechanisms to ensure rapid mitigation.
6. **User Interface**: Create an intuitive interface for mine operators to monitor system performance, view historical data, and manually override controls if necessary. This interface should be accessible via computers and mobile devices.
7. **Energy Efficiency**: Optimize the ventilation system to reduce energy consumption while maintaining safety and air quality standards.

The system should be resilient and reliable in the harsh conditions of an underground mine.

**Mentor:**

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