**Assignment:**

**Proposal and Architecture Design for Intelligent Factory Monitoring System**

**Scenario**

You are tasked with designing an intelligent monitoring system for a highly automated factory equipped with an extensive array of sensors and connected systems. Over the past 10+ years, the factory has collected a rich collection of data, including:

1. **Operational Data**
   * Sensor readings from various machines and production lines (temperature, pressure, vibration, etc.)
   * Machine performance metrics (runtime, downtime, output rates, etc.)
   * Environmental data (humidity, ambient temperature, etc.)
2. **Event Data**
   * Historical records of machine downtimes, including start and end times, causes, and resolutions.
   * Anomaly detection logs capturing deviations from normal operational patterns and their resolutions.
   * Preventative maintenance records specifying schedules, performed actions, and outcomes.
3. **Maintenance and Fixes Data**
   * Comprehensive maintenance logs, including routine checks, emergency repairs, and upgrades.
   * Manuals and procedural documents detailing standard operating procedures (SOPs) and troubleshooting guides.
   * Employee notes and observations regarding machine performance, anomalies, and fixes.

The goal is to harness this historical data to create an advanced monitoring system capable of predicting future events (such as machine downtimes and safety incidents) based on current operational parameters.

Upon predicting an event, the system should conduct a root cause analysis and generate a detailed summary using a language model. This summary should be automatically sent via email to the appropriate department, ensuring timely and informed intervention.

**Objective**

Design an architecture for an intelligent factory monitoring system with the following key objectives:

1. **Predictive Monitoring**
   * Develop and implement advanced predictive models to assess the likelihood of various events (machine downtimes, anomalies) occurring based on real-time and historical data.
   * Incorporate machine learning algorithms and techniques to enhance the accuracy of event predictions.
2. **Root Cause Analysis and Summarization**
   * Leverage historical data to perform root cause analysis for predicted events.
   * Integrate a language model to draft detailed summaries of predicted events, including root causes, historical context, and suggested resolutions.
3. **Automated Communication**
   * Design an automated notification system that sends event summaries to the relevant department (engineering, management, maintenance, safety) via email.
4. **Scalable and Robust Architecture**
   * Ensure the architecture is scalable to handle the vast amounts of data generated by the factory's sensors and systems.
   * Design for robustness and reliability to minimize downtime and ensure continuous monitoring and alerting.

**Requirements**

**Items to Submit**

1. **Proposal Document**
   * **Objectives:** Detailed objectives of the system, including predictive monitoring, root cause analysis, and automated notifications.
   * **Scope:** Definition of the project's scope, including data sources, models to be used, and the departments involved.
   * **Timeline:** Proposed timeline for the development and implementation of the system.
2. **Architecture Diagram**
   * **Components:** Detailed architecture highlighting key components such as data ingestion, preprocessing, model training, prediction, root cause analysis, and notification system.
   * **Technologies:** Specification of the technologies and tools to be used for each component (e.g., data storage solutions, machine learning frameworks, language models, email servers).
   * **Integration:** Illustration of how the system will integrate with existing factory systems and databases.
3. **Technical Details**
   * **Model Training:** Approach for training predictive models using historical data. Take care to highlight the specific models you may choose.
   * **Event Prediction:** Algorithms and techniques for event prediction.
   * **Root Cause Analysis:** Techniques for performing root cause analysis using historical fixes and maintenance logs.
   * **Language Model Integration:** Process for integrating a language model to generate event summaries.
4. **Implementation Plan**
   * **Phased Approach:** Step-by-step plan for implementing the system in phases.
   * **Deployment:** Plan for deploying the system in the factory environment.
   * **Maintenance:** Recommendations for maintaining and updating the system post-deployment.