Project Prospectus

Title: Predictive Maintenance for Industrial Equipment Using Machine Learning

Objective: The objective of this project is to develop a machine learning model that can predict the need for maintenance in industrial equipment to prevent unplanned downtimes, optimize maintenance schedules, and improve operational efficiency.

Question: How can machine learning algorithms be used to predict maintenance needs in industrial equipment to reduce unplanned downtimes and improve operational efficiency?

Data Requirements:

- **Dataset:** NASA Turbofan Engine Degradation Simulation Data Set (CMAPSS)
    - This dataset includes run-to-failure data for multiple engines, capturing sensor measurements and operational settings over time.
- **Additional Data:** *None,* I will not have access to industry data.
    - **Kaggle Datasets:** Various predictive maintenance datasets.

Features:

- **Sensor Measurements:** Temperature, pressure, vibration, etc.
- **Operational Settings:** Speed, load, power output, etc.
- **Time Cycles:** Number of operational cycles, time since last maintenance
- **Failure Scenario:** Dataset should have features that would indicate a system failure

Techniques:

1. **Data Preprocessing:**
    - Handle missing values.
    - Normalize sensor readings and operational settings.
    - Create a consistent time series format for analysis.
2. **Feature Engineering:**
    - Extract features that capture degradation patterns over time.
    - Create rolling window features to capture trends.
    - Generate domain-specific features based on expert knowledge.
3. **Machine Learning Models:**
    - **Linear Regression:** For initial feature importance and baseline predictions.
4. **Model Evaluation:**
    - **RMSE (Root Mean Squared Error):** To measure prediction accuracy.
    - **MAE (Mean Absolute Error):** To measure average error magnitude.
    - **R^2 Score:** To assess the proportion of variance explained by the model.

Expected Outcome: A robust machine learning model that can accurately predict the need for maintenance in industrial equipment. The model should help in reducing unplanned downtimes,

optimizing maintenance schedules, and ultimately improving operational efficiency. The project will demonstrate the practical application of machine learning techniques to real-world problems, showcasing your ability to handle complex datasets and derive actionable insights.

Potential Impact: The project has the potential to impact various industries, including manufacturing, transportation, robotics, and aerospace, by providing a framework for implementing predictive maintenance solutions. This can lead to significant cost savings, improved safety, and enhanced productivity.