PREDICTIVE MAINTENANCE FOR HYDRAULIC SYSTEMS USING MACHINE LEARNING

ROCK DENG
UNIVERSITY OF COLORADO BOULDER

PROJECT OVERVIEW

1. **Objective**: Develop a machine learning model to predict hydraulic system failures using sensor data.
2. **Key Focus**: Real-time deployment feasibility and high accuracy and computational efficiency.
3. **Visual**: Flowchart showing the project pipeline (data → preprocessing → modeling → evaluation).

PROBLEM STATEMENT

Current Challenges:

1. Reactive maintenance leads to costly downtime
2. Manual inspections are time-consuming
3. Unexpected failures disrupt operations

RELATED WORK

Prior Research:

1. Machine learning models (Random Forests, SVMs, LSTMs) for failure prediction
2. Feature engineering techniques (PCA, time-series analysis)

RELATED WORK

Gaps in Research:

1. Need for interpretable and lightweight models.
2. Limited real-time deployment applications.

PROPOSAL WORK

Proposed Solution:

1. Predictive maintenance using machine learning.
2. Real-time monitoring and failure prediction.

EVALUATION

Classification Metrics:

1. Accuracy, Precision, Recall, F1-score

Model Efficiency:

1. Training time and inference speed

PROJECT TIMELINE

1. Week 1: Dataset exploration and preprocessing.
2. Week 2-3: Implement baseline models (Decision Trees, XGBoost).
3. Week 4: Experiment with time-series models (LSTM, ARIMA).
4. Week 5: Evaluation and performance comparison.- Week 6: Final report writing and refinements.

DATA PREPROCESSING

1. **Handling Missing Values**
2. **Feature Engineering**

   Extracted statistical features for each sensor per cycle

Model Training and Evaluation

Random Forest Classifier

Random Forest, an ensemble learning method, trained using 80% of the dataset and evaluated on the remaining20%.

Accuracy: 99.77%

Model Training and Evaluation

XGBoost Classifier

XGBoost, a gradient boosting algorithm, was used to compare against the Random Forest model. XGBoost is known for handling complex relationships in data efficiently.

Accuracy: 99.09%

THANKS!