Document 1: Smart Predictive Maintenance System (SPMS)

1. Project Title

SPMS – AI-Powered Predictive Maintenance & Equipment Health Monitoring

2. Problem Statement

Industrial plants face unplanned downtime due to equipment failures. Maintenance teams rely on scheduled checks or reactive fixes, which:

- Cause production losses
- Increase operational costs
- Risk safety incidents

Current challenges:

- Lack of real-time monitoring of equipment health
- No AI-assisted prediction for potential failures
- Data scattered across sensors, logs, and maintenance records

3. Proposed Solution

Develop an AI-powered predictive maintenance system using:

- IoT sensor data analysis
- Machine Learning (time-series forecasting)
- Automated alert generation
- Integration with existing SCADA systems

The system can:

✅ Predict equipment failures before they happen

✅ Suggest maintenance actions

✅ Generate health reports

✅ Integrate with plant dashboards

✅ Track maintenance history and KPIs

4. Project Objective

- Reduce downtime by 50%
- Optimize maintenance schedules
- Improve equipment lifespan
- Centralize equipment health knowledge

5. System Architecture

- **IoT Data Layer:** Collect sensor readings (temperature, vibration, pressure)
- **Data Processing Layer:** Python + Pandas + NumPy for preprocessing
- **AI Layer:** LSTM / Prophet models for predictive analysis
- **Frontend Dashboard:** React + Tailwind for visualization
- **Notification System:** Alerts via email/SMS

6. Technology Stack

- Frontend: React, Tailwind CSS, D3.js (charts)
- Backend: Python, FastAPI, Pandas, NumPy, scikit-learn
- Database: PostgreSQL + InfluxDB (time-series)
- Deployment: Docker, AWS EC2, or Azure IoT Hub

7. Dataset Details

- Sensor readings (temperature, vibration)
- Maintenance logs
- Failure reports
- Operational parameters

8. Features

- Equipment health scoring
- Failure probability prediction
- Maintenance action suggestions
- Historical trend visualization

9. Sample Use Cases

User	Use Case
Maintenance Engineer	Predict failure in motor X
Supervisor	Generate weekly health summary
Manager	Track KPIs of plant uptime

10. Metrics of Success

- Downtime reduction ≥ 50%
- Accuracy of failure prediction ≥ 85%
- Response speed < 2 seconds

11. Future Enhancements

- Multi-plant monitoring
- AI-powered spare parts inventory optimization
- Voice assistant for on-site engineers

12. Why This Project is Valuable to John Cockerill

- Supports Industry 4.0 initiatives
- Reduces operational costs and downtime
- Enhances industrial safety
- Demonstrates ability to integrate AI in mechanical and electrical systems

13. Conclusion

SPMS delivers actionable predictive insights to optimize maintenance, increase uptime, and save operational costs.

14. Author

Developed By: Prakriti Sharma
Specialization: AI, IoT, Predictive Systems