The background features a dark blue gradient with faint, light blue concentric circles and a scale. The scale is a semi-circular arc on the left side, with numerical markings from 150 to 260 in increments of 10. Several dashed and solid circular lines with arrows indicate a clockwise direction of movement or flow.

PROGNOSAI: AI-DRIVEN PREDICTIVE MAINTENANCE SYSTEM USING TIME-SERIES SENSOR DATA

PREPARED BY: DURGA VEERA PRASAD V

DATASET: NASA TURBOFAN JET ENGINE (CMAPSS)

ABSTRACT

- PrognosAI is an AI-driven predictive maintenance framework that estimates the Remaining Useful Life (RUL) of turbofan jet engines using time-series sensor data. The system integrates deep learning, dynamic alerting, and visualization dashboards to provide interpretable insights and optimize maintenance planning.

INTRODUCTION AND OBJECTIVES

- Predictive maintenance aims to forecast equipment failures before they occur.
- Objectives:
 - - Develop an LSTM model for accurate RUL prediction
 - - Implement dynamic alerts for maintenance scheduling
 - - Provide a real-time visualization dashboard

DATASET DESCRIPTION

- Source: NASA CMAPSS Dataset
- Features: 21 sensors + 3 operational settings
- Units: Multiple engine units (FD001–FD004)
- Target: Remaining Useful Life (RUL)

SYSTEM ARCHITECTURE

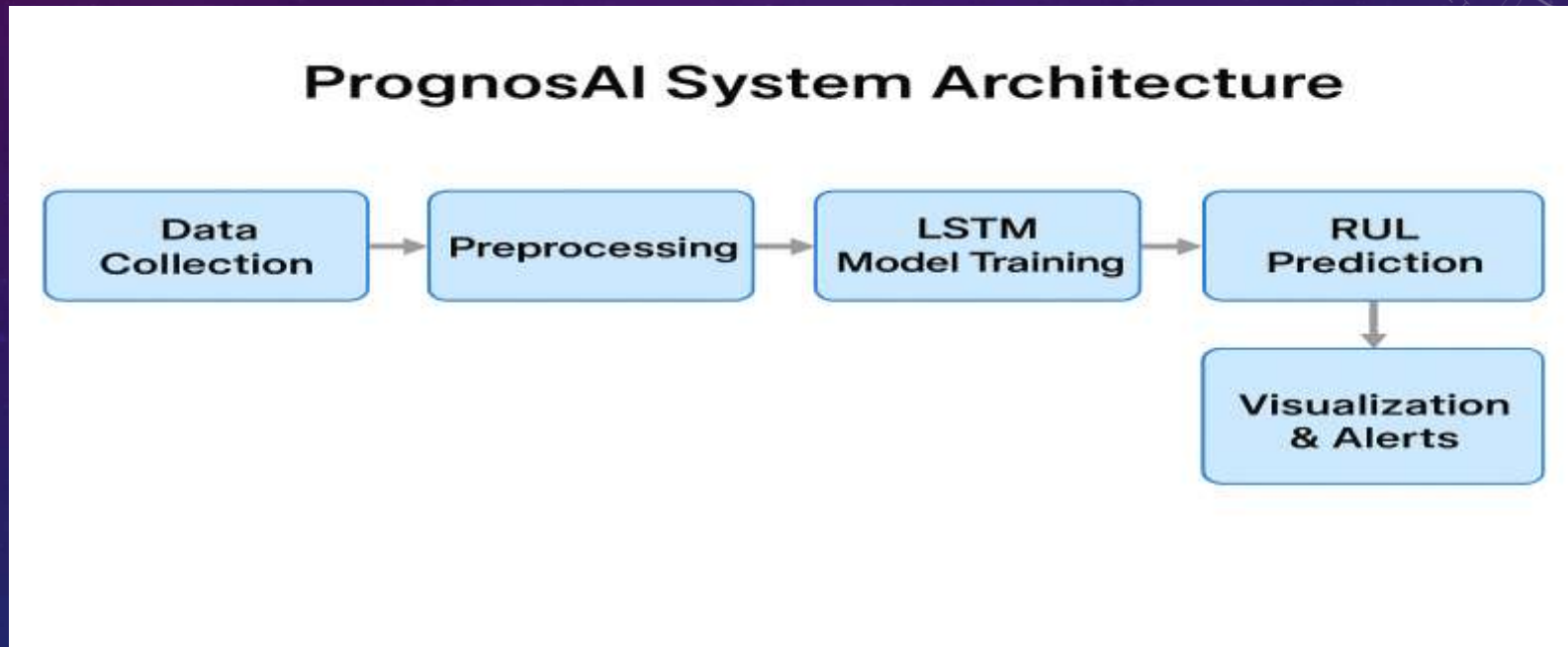


Figure1: PrognosAI System Architecture

MILESTONE 1 – DATA PREPARATION

- • Loaded CMAPSS datasets
- • Calculated RUL per engine cycle
- • Applied MinMaxScaler for normalization
- • Generated time-window sequences for LSTM input
- Libraries: pandas, numpy, sklearn.preprocessing

MILESTONE 2 – MODEL DEVELOPMENT

- • Built LSTM model using Keras Sequential API
- • Layers: LSTM(128) → Dropout → Dense(64, 32, 1)
- • Optimizer: Adam | Loss: MSE
- • Used 5-Fold Cross-Validation
- • Saved model and scalers for deployment
- Libraries: tensorflow, keras, sklearn

MILESTONE 3 – EVALUATION AND ALERT SYSTEM

- • Achieved $R^2 > 0.95$ with low RMSE and MAE
- • Dynamic alert thresholds:
 - - Critical: $RUL \leq 20\%$
 - - Warning: $20\% < RUL \leq 50\%$
 - - Normal: $RUL > 50\%$
- • Generated alert summaries and visual reports
- Libraries: numpy, pandas, sklearn.metrics, matplotlib, plotly

MILESTONE 4 – VISUALIZATION DASHBOARD

- • Developed interactive Streamlit dashboard
- • Allowed upload of test CSV/TXT files
- • Displayed engine-wise RUL predictions and alerts
- • Supported result download and threshold control
- Libraries: streamlit, pandas, numpy, plotly, joblib, tensorflow.keras
- Figures 2,3 and 4: Dashboard Screens, RUL Trends, Alert Distribution

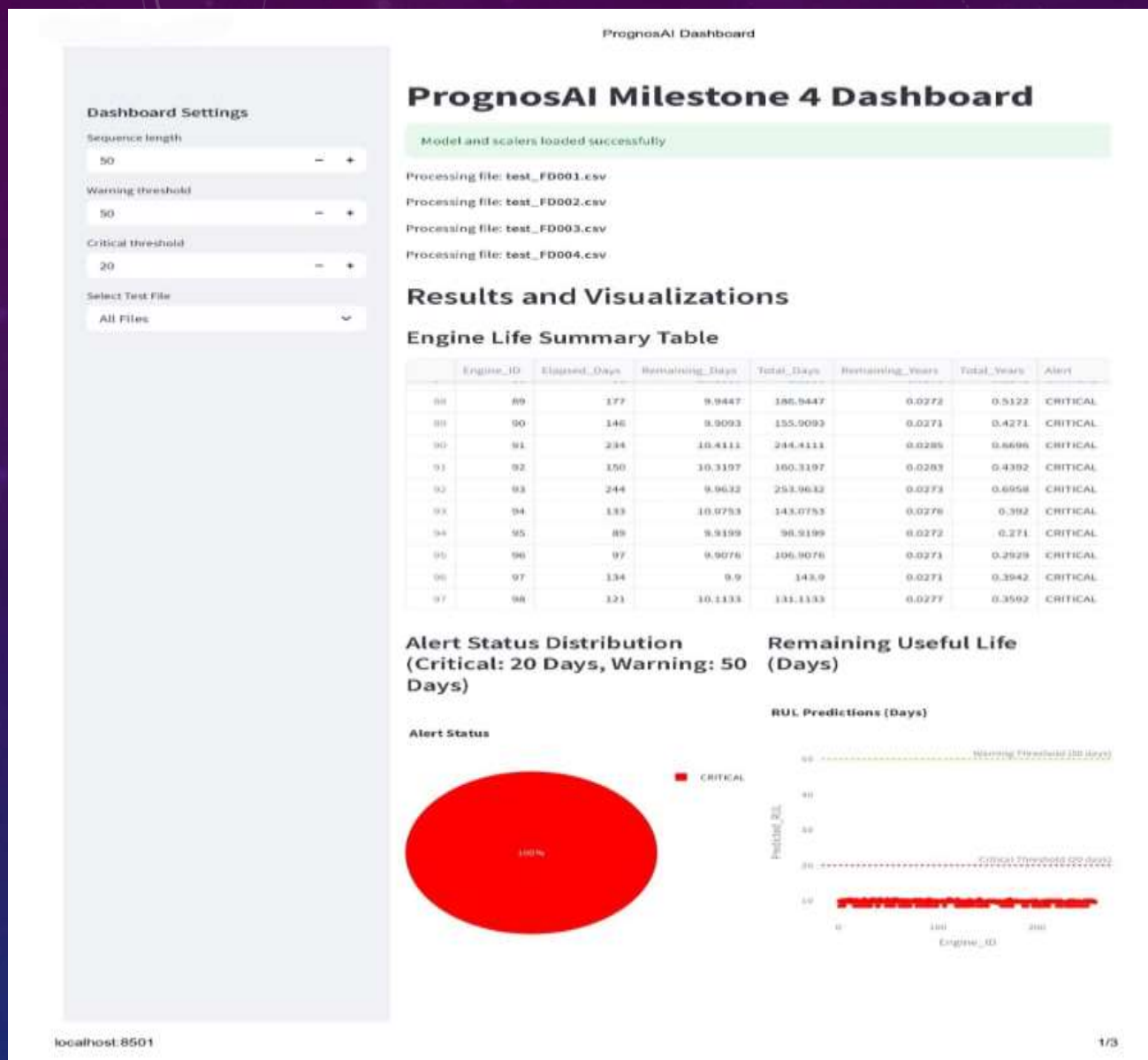


Figure2: PrognosAI Dashboard Visualization

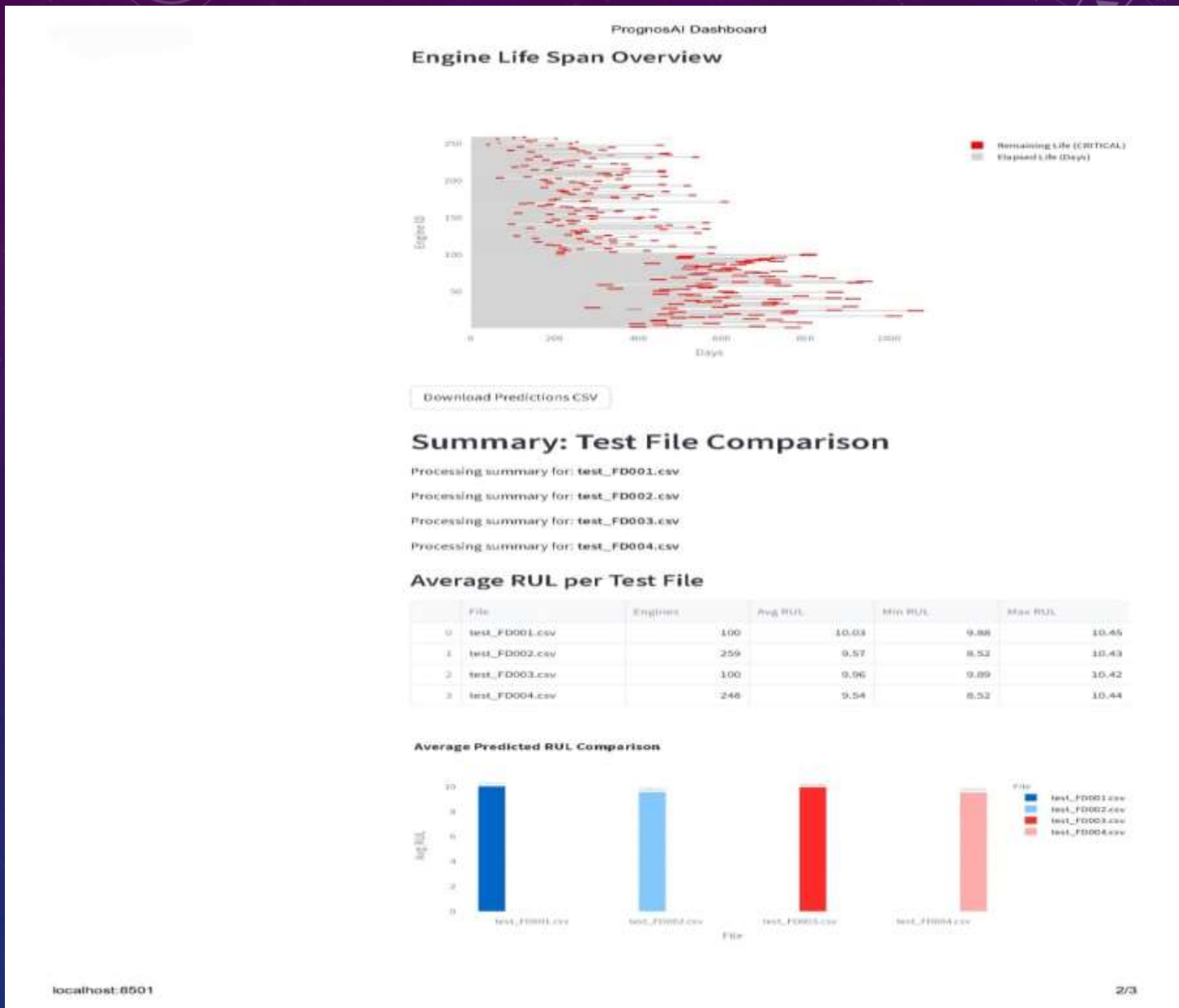


Figure3: PrognosAI Engine Life Span

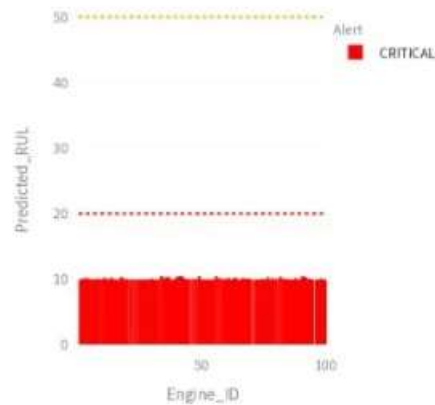
Detailed File Exploration

Select a test file to explore details

test_FD001.csv

Detailed View: test_FD001.csv

RUL for Each Engine



Alert Status Distribution

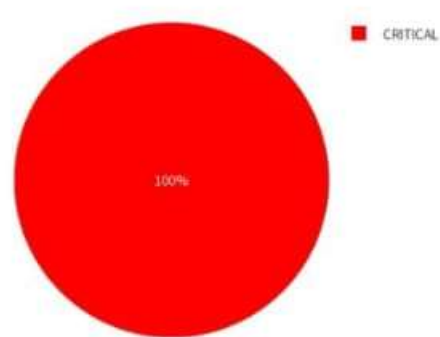


Figure4: PrognosAI Alert Distribution

RESULTS AND PERFORMANCE

- Metrics:
 - - R^2 : >0.95
 - - RMSE: Low
 - - MAE: Low
- Highlights:
 - - Stable LSTM performance
 - - Accurate RUL predictions with low error
 - - Effective alert-based decision support

CONCLUSION AND FUTURE SCOPE

- Conclusion:
- PrognosAI effectively predicts Remaining Useful Life (RUL) using AI-based modeling and visualization.
- Future Enhancements:
 - - Real-time IoT data integration
 - - Adaptive online learning
 - - Cloud deployment and API services

ACKNOWLEDGMENT

- Grateful acknowledgment to mentor and NASA for CMAPSS dataset.
- Thanks to peers and collaborators for support.

REFERENCES AND TOOLS USED

- Languages: Python 3.10
- Libraries: tensorflow, keras, pandas, numpy, sklearn, matplotlib, plotly, streamlit, joblib, reportlab
- Dataset: NASA CMAPSS
- Environment: Jupyter Notebook / VS Code / Streamlit

The background is a gradient from dark purple at the top to dark blue at the bottom, filled with a pattern of small white stars. In the top right corner, there is a large, detailed technical diagram of a circular scale or dial with concentric circles and radial markings. In the bottom right corner, there is a smaller diagram showing concentric circles with arrows indicating a clockwise direction. In the bottom left corner, there is another diagram showing a partial circle with an arrow indicating a counter-clockwise direction.

Thank You