**Marine Engine Preventive Maintenance – Risk Classification Report**

**1. Introduction**

Predictive maintenance has become an essential practice in modern engineering, particularly in sectors such as marine transportation and energy. This project focuses on classifying marine engine conditions based on sensor data to determine the likelihood of failure, using machine learning. Early detection of potential failures allows for timely maintenance, reducing downtime, costs, and risks.

**2. Objective**

The goal of this project is to develop a machine learning model that classifies engine status as either:

* Normal, or
* Risk (needs preventive maintenance)

A temperature threshold of 95°C was used to generate the binary risk labels.

**3. Data Overview**

The dataset includes sensor readings from marine engines such as:

* Engine temperature
* Oil pressure
* Fuel consumption
* Vibration level
* RPM
* Coolant and exhaust temperatures
* Running period, load, and other variables

The dataset was preprocessed and labeled using the following rule:

if engine\_temp > 95:

risk = 'risk'

else:

risk = 'normal'

**4. Methodology**

The analysis was performed in Python (Thonny IDE) using the following steps:

* Data loading and inspection
* Risk labeling based on temperature
* Feature selection
* Data splitting (80% training, 20% test)
* Model training using Random Forest Classifier
* Model evaluation using classification metrics

**5. Results**

| **Metric** | **Value** |
| --- | --- |
| Accuracy | 100% |
| Precision | 100% |
| Recall | 100% |
| F1-score | 100% |

Confusion Matrix and Feature Importance plots were generated and saved.

**6. Interpretation**

The model performed perfectly on the test set, correctly classifying both normal and risk cases. This performance suggests that the temperature threshold at 95°C is a strong predictor of failure risk in this dataset. However, such high accuracy should be evaluated with caution to rule out overfitting.

**7. Conclusions & Future Work**

This project successfully demonstrates the use of classification algorithms for preventive maintenance in marine engines. The outcome is a basic but effective predictive tool that can be integrated into decision-support systems.

Future enhancements may include:

* Using additional thresholds (e.g., vibration + temperature)
* Implementing more complex classifiers (e.g., ensemble or neural networks)
* Integrating a dashboard for real-time monitoring

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