Electric Motor Temperature Prediction Using Machine Learning

Introduction

Electric motors are critical components in industrial machinery, electric vehicles, and automation systems. Monitoring motor temperature is essential because excessive heat can reduce efficiency, damage components, and lead to system failure. This project proposes a Machine Learning-based predictive system to estimate Permanent Magnet (PM) temperature using operational parameters.

Problem Statement

Electric motors generate heat during operation due to electrical losses and mechanical friction. Failure to monitor temperature may result in reduced motor lifespan, unexpected breakdowns, and increased maintenance costs. The goal is to predict motor temperature using machine learning techniques.

Objective of the Project

The objectives include building a regression-based machine learning model, preprocessing and analyzing the dataset, training and evaluating an algorithm, deploying the model using Flask, and providing a user-friendly prediction interface.

Dataset Description

The dataset contains motor operating parameters such as u_q, coolant, stator_winding, u_d, stator_tooth, motor_speed, i_d, i_q, stator_yoke, ambient, torque, and profile_id. The target variable is pm (Permanent Magnet temperature).

Methodology

The methodology includes data collection, preprocessing (handling missing values), model selection, training, evaluation, and deployment. Since temperature is continuous, the problem is treated as regression. Random Forest Regressor is used due to its robustness and accuracy.

Model Training

The dataset is split into training and testing sets. The Random Forest model is trained on the training data to learn relationships between motor parameters and PM temperature.

Model Deployment

The trained model is saved as model.pkl and deployed using a Flask web application. Users input motor parameters through an HTML interface, and the system predicts the PM temperature.

Technologies Used

Python, Pandas, NumPy, Scikit-learn, Flask, HTML, CSS, JavaScript, Anaconda, and JupyterLab.

Conclusion

This project demonstrates how machine learning can be applied to predictive maintenance problems. The developed system predicts electric motor temperature accurately, helping prevent failures and improve reliability.

Future Enhancements

Future improvements may include IoT integration, real-time monitoring, visualization dashboards, deep learning models, and cloud deployment.