Solution Architecture: Electric Motor Temperature Prediction Using Machine Learning

Electric motors are critical components in industrial systems. Overheating can lead to failures, reduced efficiency, and expensive downtime. Machine Learning (ML) can predict motor temperature in advance using sensor data, enabling predictive maintenance and improved reliability.

1. Problem Objective

Predict the internal temperature of an electric motor using sensor data so that overheating can be detected early and preventive actions can be taken.

2. Data Sources

- Motor voltage
- Motor current
- Ambient temperature
- Torque
- Speed (RPM)
- Cooling system status
- Vibration data
- Historical temperature sensor readings

3. Data Ingestion Layer

Sensor data from motors is collected using IoT sensors and transmitted through industrial gateways. Data is streamed in real-time to a data platform using protocols such as MQTT or HTTP.

4. Data Storage Layer

Incoming data is stored in scalable storage systems such as cloud data lakes or time-series databases. Historical data is used for training machine learning models.

5. Data Processing & Feature Engineering

- Normalization and cleaning of sensor data
- Handling missing values
- Time-series feature extraction
- Rolling averages and lag features
- Correlation analysis between variables

6. Machine Learning Model

- Linear Regression

- Random Forest Regressor

- Gradient Boosting

- Neural Networks (LSTM for time-series data)

7. Model Training Pipeline

Historical sensor data is split into training and testing datasets. The model is trained to predict motor temperature based on input variables such as voltage, current, torque, and ambient conditions.

8. Model Deployment

- Deploy model as REST API

- Edge deployment on industrial gateway

- Cloud deployment for centralized monitoring

9. Prediction & Monitoring

Real-time sensor data is passed to the deployed model which predicts the motor temperature. If predicted temperature exceeds safe thresholds, alerts are triggered.

10. Business Benefits

- Predictive maintenance

- Reduced downtime

- Improved equipment lifespan

- Energy efficiency

- Lower maintenance costs