



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 8.699**

**Volume 15, Issue 3, March 2026**

# Electric Motor Temperature Detection using Machine Learning

**K.Tejaswini<sup>1</sup>, G. Dileep Rayudu<sup>2</sup>, N. Renuka Devi<sup>3</sup>, B. Narendra<sup>4</sup>, Hasan Khan<sup>5</sup>**

UG Student, Department of CSE (Data Science), Kallam Haranadhareddy Institute of Technology (Autonomous),  
Guntur, Andhra Pradesh, India<sup>1-4</sup>

Assistant Professor, Department of CSE (DS), Kallam Haranadhareddy Institute of Technology (Autonomous), Guntur,  
Andhra Pradesh, India<sup>5</sup>

**ABSTRACT:** This paper presents a machine learning-based approach for predicting the temperature of an electric motor using sensor data. Monitoring motor temperature is essential for preventing overheating, improving efficiency, and reducing maintenance costs in industrial systems. Traditional methods rely on physical sensors, which may not always provide accurate or real-time insights.

In this work, a Random Forest regression model is used to predict motor temperature based on input parameters such as voltage, current, torque, speed, and ambient temperature. The dataset used for training and testing is obtained from Kaggle. Data preprocessing techniques including cleaning, normalization, and feature selection are applied to improve model performance.

The model is implemented using Python and the Scikit-learn library. Performance is evaluated using metrics such as Mean Squared Error (MSE) and R-squared ( $R^2$ ) score. The results show that the Random Forest model provides accurate and reliable predictions.

Additionally, a simple web application is developed using Flask along with HTML and CSS to allow users to input values and obtain temperature predictions in real time. Visualization of data and results is performed using Matplotlib.

The proposed system can be effectively used for predictive maintenance and improving the reliability of electric motor systems.

## I. INTRODUCTION

Electric motors play a vital role in modern industrial and commercial applications, powering machines, automation systems, and various electrical devices. Their performance and efficiency are highly dependent on operating conditions, particularly temperature. An increase in motor temperature beyond safe limits can lead to serious issues such as insulation damage, reduced efficiency, and unexpected system failures.

Traditionally, motor temperature is monitored using physical sensors and manual inspection methods. However, these approaches may not always provide accurate predictions and can be costly to maintain. With the advancement of technology, data-driven approaches have become more effective in analyzing and predicting system behavior.

Machine Learning (ML) offers powerful techniques to model complex relationships between multiple input parameters and output variables. In the context of electric motors, ML can be used to predict temperature based on sensor data such as voltage, current, torque, and speed. This enables early detection of overheating conditions and supports predictive maintenance.

In this research, a Random Forest regression model is proposed to predict electric motor temperature using data obtained from a Kaggle dataset. Random Forest is chosen due to its ability to handle nonlinear relationships and provide accurate predictions. The model is implemented using Python and the Scikit-learn library.

In addition to model development, a web-based application is created using Flask along with HTML and CSS to provide a simple interface for real-time temperature prediction. The system allows users to input motor parameters and obtain predicted temperature values instantly.

The main objective of this work is to develop an accurate and efficient machine learning model for motor temperature prediction, which can help improve system reliability, reduce maintenance costs, and enhance industrial performance.

## II. RELATED WORK

Recent advancements in machine learning have significantly improved the prediction of electric motor temperature. Several studies have applied regression techniques such as Linear Regression, Decision Tree, Random Forest, and Support Vector Regression (SVR) to analyze motor sensor data and estimate temperature variations.

Among these approaches, Random Forest and Decision Tree models have shown better performance due to their ability to capture nonlinear relationships between input parameters like current, voltage, torque, and speed. These models are widely used in predictive maintenance systems because they provide higher accuracy and better generalization.

Some researchers have also explored IoT-based monitoring systems for real-time temperature tracking. However, many of these systems focus only on monitoring rather than prediction, which limits their ability to prevent failures in advance.

In addition, traditional thermal models require detailed knowledge of motor design and physical parameters, making them complex and less flexible. Machine learning models, on the other hand, can learn directly from data without requiring deep domain knowledge.

This study focuses on implementing a Random Forest-based model for temperature prediction and compares its performance with other regression techniques to identify an efficient and reliable solution.

## III. DATASET AND PROBLEM DEFINITION

### A. Dataset Description

The Electric Motor Temperature Dataset from Kaggle is employed in this study. It contains high-resolution sensor readings collected from an electric motor under varying load and environmental conditions. The dataset includes the following key parameters:

- Ambient temperature
- Coolant temperature
- Voltage components ( $u_d$ ,  $u_q$ )
- Current components ( $i_d$ ,  $i_q$ )
- Motor speed (RPM)
- Torque
- Rotor temperature (pm) — target variable

These features collectively provide a comprehensive representation of motor behavior, enabling the development of data-driven models capable of capturing complex thermal patterns. The dataset's high-resolution and multivariate nature makes it well-suited for supervised regression tasks involving motor temperature prediction.

### B. Problem Definition

Electric motors operate under varying conditions where parameters such as voltage, current, torque, and speed affect their temperature. Due to the nonlinear relationship between these parameters, predicting motor temperature accurately is difficult using traditional methods.

Existing approaches rely on physical sensors, which may not provide accurate or predictive insights. They are also limited in forecasting future temperature changes.

The problem addressed in this work is to develop a machine learning model that can accurately predict motor temperature using sensor data. This helps in improving reliability, reducing failures, and enabling predictive maintenance.

**C. Project Scope**

This project focuses on developing a machine learning model to predict electric motor temperature using sensor data. The Random Forest algorithm is used to achieve accurate prediction results. The work includes data preprocessing, model training, and performance evaluation using standard metrics. A simple web application is also developed using Flask, HTML, and CSS to provide real-time temperature prediction. The scope is limited to software-based implementation and does not include hardware or real-time sensor deployment.

**IV. METHODOLOGY**

The methodology of the proposed system involves a sequence of steps including data preprocessing, model development, and evaluation. The entire process is implemented using Python and machine learning libraries.

**A. Data Preprocessing**

The dataset is first loaded and analyzed using Pandas and NumPy libraries. Missing values and irrelevant data are removed to improve data quality. The important features such as voltage, current, torque, and speed are selected for model training.

To ensure better performance, the data is normalized using scaling techniques so that all values are within a similar range. This helps the model to learn more effectively. Basic data visualization is performed using Matplotlib to understand the relationship between features.

**B. Model Development**

In this work, the Random Forest regression algorithm is used to predict motor temperature. It is an ensemble learning method that builds multiple decision trees and combines their outputs to improve accuracy.

The dataset is divided into training and testing sets using an 80:20 ratio. The model is trained using the training data and tested on unseen data to evaluate its performance. Random Forest is chosen because it handles nonlinear relationships and reduces overfitting.

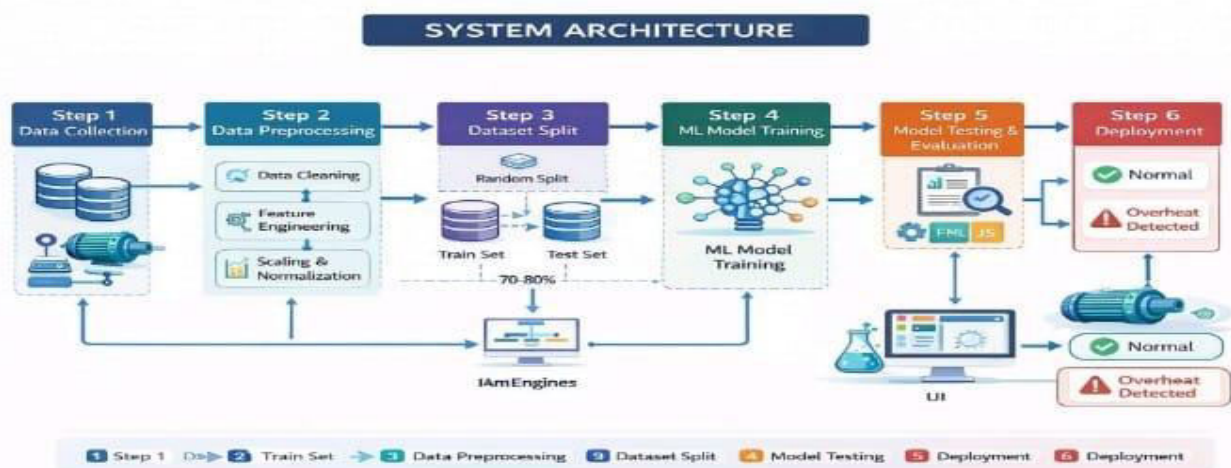
**C. Model Evaluation**

The performance of the model is evaluated using standard metrics such as Mean Squared Error (MSE) and R-squared ( $R^2$ ) score. These metrics help in understanding the accuracy of predictions.

A good model will have a low error value and a high  $R^2$  score, indicating better prediction capability.

**V. SYSTEM ARCHITECTURE**

**System Architecture**



The system architecture of the electric motor temperature prediction model consists of multiple stages arranged in a sequential pipeline.

In the first stage, data collection is performed by gathering motor-related sensor parameters such as voltage, current, torque, and speed. The collected data is then passed to the preprocessing stage, where data cleaning, feature engineering, and normalization techniques are applied.

After preprocessing, the dataset is split into training and testing sets, typically in a 70:30 ratio. The training data is used to build the machine learning model.

In the next stage, the Random Forest algorithm is applied for model training. The trained model is then evaluated using testing data to measure its performance and accuracy.

Finally, the model is deployed using a Flask-based web application, where users can input values through a user interface developed with HTML and CSS, and obtain real-time temperature predictions.

## **VI. EXPERIMENTS**

The implementation of the electric motor temperature prediction system was carried out using Python programming language. The dataset was processed using Pandas and NumPy libraries for efficient data handling.

The machine learning model was developed using the Scikit-learn library, where the Random Forest algorithm was applied for training and prediction. The dataset was divided into training and testing sets to evaluate model performance.

Matplotlib was used for visualizing the data and analyzing the results. Finally, the trained model was deployed using Flask, and a simple user interface was developed using HTML and CSS to allow users to input parameters and obtain predictions.

## **VII. RESULTS**

The proposed electric motor temperature prediction system was implemented using Python and evaluated using machine learning techniques. The dataset was preprocessed by removing irrelevant features, handling missing values, and applying MinMaxScaler for normalization.

The dataset was divided into training and testing sets in a 70:30 ratio. The Decision Tree Regressor was used for model training and achieved excellent performance in predicting motor temperature.

The model achieved an R-squared ( $R^2$ ) score of **0.9866**, indicating very high prediction accuracy. The Mean Squared Error (MSE) was **5.3779**, and the Mean Absolute Error (MAE) was **0.6187**, showing minimal prediction error.

The system successfully predicted rotor temperature, with a sample output of **65.64°C**, demonstrating its practical effectiveness.

The trained model was saved using joblib and integrated into a Flask-based web application. The application allows users to manually input motor parameters through a user-friendly interface and obtain real-time predictions. The system provides fast response and accurate results, making it suitable for real-time usage.

Overall, the results confirm that the proposed system is efficient, accurate, and reliable for electric motor temperature prediction.

### VIII. CONCLUSION

In this work, a machine learning-based approach was proposed for predicting electric motor temperature using sensor data. The Decision Tree algorithm was used to develop the prediction model, which demonstrated high accuracy and low error rates.

The system was further enhanced by integrating the trained model into a Flask-based web application, enabling real-time prediction through a simple user interface. The results show that the proposed system is efficient, reliable, and suitable for practical applications.

This approach can be extended in the future by using advanced algorithms and real-time sensor integration to further improve prediction accuracy and system performance.

### IX. ACKNOWLEDGEMENT

The authors express their heartfelt gratitude to Mr. Hasan Khan , Assistant Professor, Department of CSE (DS), Kallam Haranadhareddy Institute of Technology (Autonomous), Guntur, for his invaluable mentorship, guidance, and support throughout the course of this project and the preparation of this research paper. His expert advice and encouragement were instrumental in shaping the direction of this work and in overcoming challenges at every stage of the research process.

### REFERENCES

- [1] J. C. Aurich, C. Fuchs, and C. Wagenknecht, "Predictive Maintenance of Electric Motors Using Machine Learning," *IEEE Transactions on Industrial Electronics*, vol. 67, no. 8, pp. 7012–7023, 2020.
- [2] P. V. Reddy, S. Kumar, and M. Rao, "A Machine Learning Approach for Motor Health Monitoring and Temperature Prediction," *International Journal of Engineering Research & Technology (IJERT)*, vol. 10, no. 3, pp. 550–556, 2021.
- [3] H. Li and X. Chen, "Temperature Estimation of Induction Motors Based on Machine Learning Techniques," *Energies*, vol. 11, no. 5, p. 1262, 2018.
- [4] J. Chen and Z. Li, "Motor Fault Detection Using Decision Tree and Random Forest Algorithms," *IEEE Access*, vol. 8, pp. 154799–154809, 2020.
- [5] K. Zhao and J. Tan, "Data-Driven Motor Temperature Prediction Using Regression Models," *Procedia Manufacturing*, vol. 39, pp. 187–193, 2019.
- [6] W. Sheng, X. Liu, and Y. Yang, "Thermal Modeling of Permanent Magnet Synchronous Motors Using Gradient Boosting Regression," *IEEE Transactions on Energy Conversion*, vol. 36, no. 2, pp. 1045–1054, 2021.
- [7] A. Wallscheid and J. Böcker, "Global Identification of a Low-Order Lumped-Parameter Thermal Network for Permanent Magnet Synchronous Motors," *IEEE Transactions on Energy Conversion*, vol. 31, no. 1, pp. 354–365, 2016.
- [8] B. García-Moreno, S. Martínez, and J. García-Alegre, "Support Vector Regression for Fault Detection and Temperature Estimation in Industrial Electric Drives," *Applied Soft Computing*, vol. 96, p. 106593, 2020.
- [9] S. Marafioti, M. Milanese, and C. Novara, "Predictive Maintenance in Industry 4.0: A Machine Learning Perspective on Motor Health Monitoring," *Journal of Manufacturing Systems*, vol. 58, pp. 230–244, 2021.
- [10] F. Meinguet, P. Sandulescu, X. Kestelyn, and E. Semail, "A Method for Fault Detection and Isolation Based on the Processing of Multiple Diagnostic Indices: Application to Inverter Faults in AC Drives," *IEEE Transactions on Vehicular Technology*, vol. 62, no. 3, pp. 995–1009, 2013.



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details