PREDICTION OF INDUCTION MOTOR FAULTS USING MACHINE LEARNING

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING DEGREE (M.Eng.) IN ELECTRICAL AND ELECTRONICS ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE

JULY, 2023

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfillment of the requirements for the award of the degree of Master of Engineering in Electrical and Electronics Engineering, Department of Electrical and Information Engineering, College of Engineering, Covenant University Ota Nigeria.

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Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, **ANYIM, JUSTUS TOCHUKWU (21PCK02297)**, declare that this research was carried out by me under the supervision of Dr. Ademola Abdulkareem of the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria. I attest that the dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

ANYIM, JUSTUS TOCHUKWU

Signature and Date

CERTIFICATION

We certify that this dissertation titled "**PREDICTION OF INDUCTION MOTOR FAULTS USING MACHINE LEARNING**" is an original research work carried out by **ANYIM, JUSTUS TOCHUKWU (21PCK02297),** in the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Ademola Abdulkareem. We have examined and found this work acceptable as part of the requirements for the award of Master of Electrical and Electronics Engineering.

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(Head of Department) **Signature and Date**

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Prof. Akan B. Williams
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DEDICATION

This dissertation is dedicated, first and foremost, to the Almighty God for His mercies, grace, wisdom, and grace throughout the Masters' program. It is especially dedicated to my parents Chief and Mrs. Stanley Anyim, and my lovely siblings Dozie, Excel, Ijeoma, Ifunanya, Ikechukwu and Kelechi.

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LIST OF ABBREVIATIONS

ML	Machine Learning
AI	Artificial Intelligence
ANN	Artificial Neural Network
RF	Random Forest
DT	Decision tree
k-NN	K-Nearest Neighbors
AC	Alternating Current
r.p.m	Rotation per Minute
MCSA	Motor Current Signature Analysis
TP	True Positives
TN	True Negative
FP	False Positive
FN	False Negative
LDA	Linear Discriminant Analysis
PCA	Principal Component Analysis

ABSTRACT

Unplanned downtime in industries poses significant challenges, affecting production efficiency and profitability. To address this issue, companies strive to optimize operations and minimize disruptions that hinder meeting customer demands and financial targets. Predictive maintenance, utilizing advanced technologies such as data analytics, machine learning, and IoT devices, enables real-time monitoring and analysis of equipment data. This study focuses on training an adaptable machine-learning model for predicting faults in induction motors in industrial settings. By implementing such a model, proactive maintenance can be facilitated, leading to reduced downtime in industrial operations. A dataset containing healthy and faulty conditions of four 3 phase induction motors, along with relevant features for fault prediction, was obtained. Multiple machine learning algorithms were trained using this dataset, and they demonstrated promising performance. The RF model achieved the highest accuracy of 0.91, followed by the Ann and k-NN models with an accuracy of 0.9. The DT model achieved the lowest accuracy of 0.89. Further evaluation of the models was conducted using a confusion matrix, which provided a detailed breakdown of the model's performance for each class, indicating the number of correctly and incorrectly classified induction motor conditions. The outcome of the confusion matrix demonstrated that the models successfully classified the different states or conditions of the induction motors. To enhance the performance of the models, future work should involve refining the ANN and RF models, exploring transfer learning or ensemble methods, and incorporating diverse datasets to improve generalization.

KEYWORDS: ANN (Artificial Neural Network) classifier, DT (Decision Tree) classifier, RF (Random Forest) classifier, k-NN (k Nearest Neighbor) classifier, Bearing fault, Induction motors, Predictive maintenance.