DEVELOPMENT OF A MACHINE LEARNING BASED FAULT DETECTION MODEL FOR RECEIVED SIGNAL LEVEL IN TELECOMMUNICATION ENTERPRISE INFRASTRUCTURE

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APRIL 2023

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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 (M.Eng.) DEGREE IN INFORMATION AND COMMUNICATION ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE

APRIL 2023

ACCEPTANCE

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

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(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I**, NWOKOLO, INNOCENT OZULONYE (20PCK02095)** declare that this dissertation is a representation of my work and is written and implemented by me under the supervision of Dr. Kennedy O. Okokpujie of the Department of Electrical and Information Engineering, Covenant University, Ota, Nigeria. I attest that this dissertation has in no way been submitted either wholly or partially to any other university or institution of higher learning for the award of a masters' degree. All information cited from published and unpublished literature has been duly referenced.

NWOKOLO, INNOCENT OZULONYE

Signature and Date

CERTIFICATION

This is to certify that the research work "**DEVELOPMENT OF A MACHINE LEARNING BASED FAULT DETECTION MODEL FOR RECEIVED SIGNAL LEVEL IN TELECOMMUNICATION ENTERPRISE INFRASTRUCTURE**" is an original research work carried out by **NWOKOLO, INNOCENT OZULONYE (20PCK02095)**, meets the requirements and regulations governing the award of Master of Engineering (M.Eng.) degree in Information and Communication Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, and is approved for its contribution to knowledge and literary presentation.

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(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

I dedicate this dissertation to God almighty for giving me knowledge and understanding throughout this research. His grace was sufficiently available for me.

ACKNOWLEDGMENTS

My heartfelt appreciation goes to the Almighty God for his immeasurable Grace and strength to begin and complete this program.

I would also like to thank the Chancellor of Covenant University, Dr. David Oyedepo for this great vision. Thank you, Sir, for the supportive structures and enabling environment, and I pray that God replenishes you with His abundance. I also want to extend my appreciation to the Vice Chancellor, Prof. Abiodun H., Adebayo, the Dean School of Postgraduate Studies, Prof. Akan B. Williams, the Dean College of Engineering, Professor David O. Olukanni, the Head of the Department Electrical and Information Engineering, Prof. Emmanuel Adetiba and all my course lecturers.

In addition, I would like to express my sincere gratitude to my supervisor, Dr. Kennedy O. Okokpujie, for the knowledge, time and efforts he provided throughout the course of this project. His useful advice and suggestions were really helpful. May God bless and give him more grace and wisdom for a higher position.

I would also like to thank my spouse, Mrs. Kendra Nwokolo, for her support in keeping the home front while I embarked on this program. Her understanding and patience during this time has been invaluable and I pray Almighty God to reward her immensely. I also want to thank my parents, Mr. and Mrs. Nwokolo for impacting me with godly training and also for their foundational investment in my educational pursuits.

Finally, I would also appreciate my siblings and friends who played a significant role in helping me to accomplish this dissertation. I pray that God blesses you for the moral and financial supports in helping me to accomplish this project.

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ABSTRACT

Wireless telecommunication infrastructure can fail without notice for maintenance action. However, these failures may not always result in a complete downtime, but rather degraded performance that can be difficult to pinpoint without specialized tools. Received signal level (RSL) is an important metrics of the quality of a wireless connection and can be used to determine the strength of the signal from the transmitting to the receiving device. It is important to regularly monitor the RSL to ensure that the network is operating at peak performance and to proactively address any issues that may arise. This research aims to develop a machine learning based fault detection model for received signal level in telecommunication enterprise infrastructure. The research methodology involves the modeling of an enterprise point to multipoint wireless communication network using pathloss 5.0 software. Data was extracted from the vector images of the simulated wireless network containing the free space pathloss, transmit power output, transmit antenna gain, transmitter loss, miscellaneous loss and receiver loss. The dataset obtained was then used to train the gradient boosting regression (GBR), random forest regression (RFR) and K-Nearest Neighbor (KNN) regression model. The algorithm compares a threshold value with the received signal levels (RSL) of new and unseen dataset and then trigger a “Fault” or “No-fault” condition. A Fault condition signifies a deviation in the received signal level which then prompt the field support team to perform maintenance on the wireless link. Whereas a No-Fault condition signifies that the RSL is within the accepted range, hence no maintenance is required on the wireless link. In order to choose an optimal machine learning model to achieve the objectives of this project, the performance evaluation metrics of mean absolute error (MAE), mean square error (MSE), R-squared and Root mean square error (RMSE) were compared and experimental results shows that the RFR model is better than the GBR and KNN with 'MAE': 0.007101, 'MSE': 0.000610, 'R-squared': 0.999992, and 'RMSE': 0.024697. By leveraging on the developed machine learning-based fault detection models, service providers can quickly optimize network performance, reduce downtime and increase customer satisfaction.

Keywords: Machine learning, Enterprise Wireless, Telecommunication, Received Signal Levels (RSL)