SIMULATION OF A FEDERATED DEEP LEARNING APPROACH FOR PREDICTING COVID-19 SEVERITY OF A PATIENT

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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 SCIENCE (M.Sc.) DEGREE IN COMPUTER SCIENCE IN THE DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE, COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY.

SEPTEMBER, 2021

ACCEPTANCE

This is to attest that this dissertation was accepted in partial fulfillment of the requirements for the award of Master of Science (M.Sc) degree in Computer Science in the Department of Computer and Information Science, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria.

Mr. John A. Philips
(Secretary, School of Postgraduate Studies) **Signature and Date**

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

DECLARATION

I hereby declare that this dissertation titled **SIMULATION OF A FEDERATED DEEP LEARNING APPROACH FOR PREDICTING COVID-19 SEVERITY IN PATIENTS** was carried out by **JUWE, JESSE IKECHUKWU** with matriculation number **19PCG02029**. This work is centered on an original study in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, under the supervision of Prof. Olufunke O. Oladipupo. The concepts for this research project are the outcome of my own research. Other scholars' ideas have also been completely acknowledged.

JUWE, JESSE IKECHUKWU **Signature and Date**

CERTIFICATION

This is to certify that this dissertation titled **SIMULATION OF A FEDERATED DEEP LEARNING APPROACH FOR PREDICTING COVID-19 SEVERITY OF A PATIENT** was carried out by **JUWE, JESSE IKECHUKWU** and was supervised by and submitted to the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Ogun State.

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Dr. Victor T. Odumuyiwa **Signature and Date**

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

DEDICATION

I dedicate this project to God Almighty, who has provided me with abundant grace, wisdom, and knowledge throughout the completion of my Master's Degree program.

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ABSTRACT

The new SARS-COV-2, also known as the Coronavirus or COVID-19, is a contagious virus that causes respiratory issues and symptoms such as cough, shortness of breath, fever, pain, weariness, and parosmia (loss or altering of sense of smell and taste). This virus was responsible for the COVID-19 pandemic outbreak in 2019 and since then several methods have been suggested to prevent the re-occurrence of the outbreak. Predicting COVID-19 severity of patient is an important aspect of the solutions suggested for providing better health care and diagnosis. One limitation of the predictive solutions is the data availability because, for security and personal reason not every data can be collected. However, most predictive algorithms do not perform optimally with small training dataset which in turn affect the accuracy of the deployed predictive model. In bridging this gap, a number of federated deep learning approaches for battling COVID-19 in various aspects do exist in literature with medical images like chest CT scans and blood works but yet not on predicting COVID-19 patient severity using dataset. Hence, this study aims at investigating the performance of federated deep learning approach for building machine learning predictive model for determining COVID-19 severity in patients with non image datasets spread across several endpoints or institutions so as to handle scarcity of data, without compromising the security of private data. For this study, data repositories like Kaggle, was beneficial in getting public dataset for building the initialized model. Computations using the TensorFlow Federated (TFF) framework was used to implement the dispersion of the initialized model to the participants for training the model, and client computations was done using Stochastic Gradient Descent SGD). A Federated Averaging Algorithm (FedAVG) was used on the server to aggregate and average the individual updates received from clients. For evaluation, the global model was benchmarked against a deep learning model (ANN) and a traditional machine learning model (RandomForest) using evaluation metrics such as: Accuracy, AUC, Precision, Recall, F-Measure. The Deep Learning Model (ANN) had a good accuracy of 90% which performed better than the RandomForest algorithm, having an accuracy of 87%. This just goes to show how well Deep Learning models handle complex datasets better than regular machine learning models. Also, the Deep Learning model spent less time during computation than the traditional machine learning algorithm, RandomForest. The TFF model had an accuracy of 91%, which was slightly higher than the Deep Learning model, according to the results of the training done on all three models.

Keywords: *COVID-19, Federated Learning, TensorFlow Federated, Deep Learning*