AN AUTOMATED MALARIA DIAGNOSIS SYSTEM FOR DETECTING INFECTION SEVERITY FROM THICK BLOOD SMEAR IMAGES

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AUGUST, 2024

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FUFILMENT OF THE REQUIREMENT OF THE (M.SC) DEGREE IN BIOINFORMATICS, DEPARTMENT OF COMPUTER AND INFORMATION SCIENCES, COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA

AUGUST, 2024

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Sciences in Bioinformatics in the Department of Computer and Information Sciences, College of Sciences and Technology, Covenant University, Ota, Nigeria.

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(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 **IBITOYE, OLAJUMOKE GRACE (22PBF02394),** carried out this research entitled "An Automated Malaria Diagnosis System for Detecting Infection Severity from Thick Blood Smear Images". It was carried out under the supervision of Dr. Itunuoluwa Isewon. Concepts of this research project are the results of the research carried out by Ibitoye, Olajumoke Grace and ideas of other researchers have been fully recognised.

IBITOYE, OLAJUMOKE GRACE

Signature and Date

CERTIFICATION

This is to certify that this dissertation titled **"AN AUTOMATED MALARIA DIAGNOSIS SYSTEM FOR DETECTING INFECTION SEVERITY FROM THICK BLOOD SMEAR IMAGES"** is original research carried out by **IBITOYE, OLAJUMOKE GRACE (22PBF02394)** in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Itunuoluwa Isewon. We have examined and found this work acceptable as part of the requirements for the award of Master of Science (M.Sc.) in Bioinformatics.

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Prof. Olusegun Folorunso
(External Examiner) **Signature and Date**

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

DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding

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ABSTRACT

Malaria is a significant and life-threatening disease that poses a threat to global health and the economy. Accurate diagnosis is crucial in combating this disease. Microscopy is considered the gold standard for diagnosing malaria parasites and requires a skilled slide reader to examine blood slides for the presence of parasites and careful quantification. Therefore, automating the process would be beneficial. The accessibility and availability of large curated datasets for quantifying malaria parasite images in thick blood smears have posed a significant challenge. The absence of an accessible, fully automated, and fully functional web-based system for multiclass classification is also a notable gap. This study aims to develop an automated system for quantifying malaria parasites in routine blood films. Blood samples collected from Covenant University Medical Centre and AceMedicare clinic were used to generate a dataset of 1518 labeled thick blood smear images. The annotations were recorded from the health facilities and used to correctly label the images. The dataset includes 458 uninfected, 427 mild, and 633 severe thick blood smear images. The images were digitized using the Olympus CX33 trinocular microscope. Data processing techniques such as resizing, rescaling, and data augmentation were used to prepare the dataset for training. Five transfer models - VGG16, VGG19, ResNet50, InceptionV3, and DenseNet201 - were trained and evaluated on the newly generated images. The models' accuracies were VGG16- 81.2%, VGG19- 82.5%, InceptionV3- 81.0%, DenseNet201- 81.8%, and ResNet- 68.3%. The best predictive model across all performance metrics was VGG19 with an accuracy of 82.5%, precision of 82.0%, recall of 82.0%, F1-score of 81.0%, and 0.38 loss. The best-performing predictive model was deployed as a web-based application. The study proffers deep learning model capable of classifying malaria thick blood smear images into multi class classification based on their level of severity.

Keywords: Malaria, Thick Blood Smear Image, Deep Learning, Transfer Learning, Multiclass Classification, Malaria Severity