**Cascaded feature extraction of Covid-19 Chest X-Ray images Using Histogram of Oriented Gradient HOG and Local binary Pattern LBP**

**CHAPTER ONE**

**INTRODUCTION**

* 1. **Background of Study**

Considering the outbreak of any word health crisis, the medical sectors will be constantly seeking for new technologies to contain, control, detect the spread of a deadly sickness. Artificial intelligent is a modern way or approach that can be easily adopted in keeping track of the spread of infectious diseases or virus. In real time artificial intelligent can be use in controlling disease outbreak and diagnose by identify a high risk patient (Vaishya et al., 2020). Considering health crisis such as the Coronavirus outbreak, artificial intelligent can be used in prediction the mortality risk by diligently analysis existing data of confirmed cases. Population screening, medical help, suggestion nothing and prediction of infectious cases can be achieved by Artificial Intelligent. In addition, AI as the capability or technology on planning, treating and prepare report outcome of and infected Covid19 patient.

AI is a widely user term for the science of Artificial Intelligent. It’s the science that uses computers to mimic or simulate the intelligent behavior of humans, and computers are trained by learning human behavior such as; learning, decision making, judgement and the likes. Artificial Intelligent is a knowledge-based project that acquire knowledge as object, analyze the object, study the knowledge expression and adopt those approaches to actualize the aim of mimicking the intelligent of human activities. Artificial intelligent is a combination of various field which include computer science, logic, biology, psychology, philosophy and many other disciplines (Zhang & Lu, 2021).

Furthermore, Deep learning mimic the biological neurons by it way of receiving impulse as signal and perform or fire a respond only if a threshold is meet, mathematically it adapts a multiplayer approach to hidden layers of the artificial neural form of networks. Traditionally for of machine learning approach features are specify and they are manually extracted. While that of deep learning models, the features are automatically learned and extracted, this enable high achievement in both accuracy and performance. Generally, the hyperparameters of those classifier models are automatically measured. The artificial neural networks and the deep learning algorithm has provided the best solution to varieties of computational problems in the field of natural language processing, speed and image recognition. Popular deep learning algorithm includes; Deep Neural Network, Convolutional Neural Networks, and Recurrent Neural Network (Dang *et al*., 2020).

A Convolutional Neural Network (CNN) is a specially created type of feed-forward neural network which is specifically employ in fields such as recommender system, computer vision and natural language processing. It’s a deep neural network that consist of convolutional layer, pooling or subsampling layers to create input that are fully connected to the classification layer. The convolutional neural network performs filtering on the input in order to extract features; and the output of this multiple filter are combined. The Pooling layer or subsampling layer are within the network in order to create a reduce resolution version of features, in order to increase the robustness, noise, and distortion of the convolution neural networks (Dang *et al.*, 2020).

The Coronavirus (Covid-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus strain. This disease had its first strike in Wuhan (a city in China) in the year 2019 and subsequently began to spread globally to become the fifth documented pandemic since 1918 flu pandemic which claimed many lives. The main symptoms shown include respiratory distress, fever and cough, the severity of the infection may be visible as pneumonia, acute respiratory syndrome, septic shock, multi-organ failure and, finally, death (Ohata *et al*., 2021).

In the city of Wuhan in China’s Hubei Province, the coronavirus came in guise of pneumonia and several cases were detected on December 31, 2019. Whereas, the causative agent was later identified as a new coronavirus (2019-nCoV) on January 7, 2020 and the disease was named as COVID-19 (Zhan *et al*., 2020) According to the World Health Organization (WHO), as of December 22, 2021, the total number of worldwide confirmed cases of coronavirus is 275,233,892 including 5,364,996 deaths.

The disease is contagious, and the virus gets spread amongst human via respiratory droplets, physical contact, and also through fecal-oral transmission. Specialists depend on radiological studies, either by chest X-ray (CXR) or computer tomography (CT) to follow the break out of the disease. The use of CT as a diagnostic method for covid-19 has several disadvantages. In many hospitals the necessary equipment to acquire the image is not available and the cost of a tomographic study is high (López-Cabrera *et al*., 2021).

The rate of human to human transmission of this disease is high and is a matter of concern for the regulatory authorities globally. At large, the control depends on early diagnosis at the right time. The method available for diagnosis is laboratory tests like Reverse-Transcription Polymerase Chain Reaction (RT-PCR) requires testing kits which have limited availability in the supply chain and the test takes time due to laboratory processes involved (Singh & Singh, 2021).

On the other hand, CXR images have some benefits compared to CT, which makes this modality a more extended way to patients. There is a minimal possibility of spreading the virus and exposing the patient to a lower dose of ionizing radiation. The chest radiography (X-ray) is a method adopted by many worldwide because it is less expensive, fast and common clinical method (Narin *et al*., 2021).

The World Health Organization (WHO), with the support of the Strategic Advisory Group of Experts (SAGE) on immunization and its COVID-19 Vaccines Working Group, continues to review the emerging evidence on the need for and timing of a booster dose for the currently available COVID-19 vaccine which have received Emergency Use Listing (EUL). This statement reflects the current understanding of vaccine performance and supply as presented to SAGE on December 7, 2021. It summarizes and contextualizes current evidence on booster vaccination. In recent weeks, the SARS-Cov2 Omicron variant has emerged. Data are currently insufficient to access the impact of this new variant of concern in vaccine effectiveness, in particular against severe disease.(He *et al*., 2021)

The WHO has said that the omicron variant is reported to be causing infections in people that are already vaccinated or who have recovered from the covid-19 disease as they could be re-infected. This is as it said that there is now consistent evidence that the omicron variant is spreading significantly faster than the Delta variant as covid-19 continues to account for about 50,000 deaths globally every week.(Eyre *et al*., 2022).

Feature Extraction is the process of transforming raw data into numerical features that can be processed while preserving the information in the original dataset (Jogin, 2018). It yields better results than applying machine learning directly to the raw data. Deep Learning technique is a type of machine learning based on Artificial Neural Network in which multiple layers of processing are used to extract progressively higher level features from data (Duran-Lopez *et al*., 2020). Classification is a supervised learning that refers to a predictive modeling problem where a class label is predicted for a given example of input data(Asif *et al*., 2020).

**1.2 Problem Statement**

There are several machine learning models developed to detect the severity and alertness for necessary precaution against covid-19, but these models are plagued with non-substantial chest x-ray images, non-deployment on handheld devices, problem of overfitting and high memory requirements and computational cost of the model are challenges faced. (Abbas *et al*., 2021). Also, to improve the classification accuracy parameter optimization can be used on chest x-ray images of covid-19 patients and other related diseases affecting the lungs. (Ismael & Şengür, 2021). Based on the research paper of (Jumani et al., 2019) in other to extract important features from an image its recommended to combine LBP techniques with HOG Operator using Deep learning models. Consequently, robust extraction feature technique that will enhance the classification of CXR will be employed. In this research work, histogram of oriented gradient (HOG) and local Binary Pattern (LBP) is proposed classify chest x-ray images to make detection more accurate using convolution neural network (CNN) as classification algorithm.

**1.3 Aim and Objectives of the Study**

The aim of this research is to employ cascaded feature extraction using Histogram of Oriented Gradient (HOG) and Local Binary Pattern (LBP) techniques and CNN for classification of Covid-19 Chest X-ray images.

The aim of this research work will be achieved with the following objectives:

1. To identify the challenges of the existing models in the detection of chest x-ray images (CXR) for Covid-19
2. To employ HOG and LBP for feature extraction and CNN for classification to address the existing problem in (i).
3. To evaluate the performance of the (ii) above using metrics: Accuracy, F1-score, Recall and Precision.

**1.4 Significance of the Study**

The significance of this study will be of great importance to all health sectors and nations battling with this very deadly virus. The designed model will be use in analysis, diagnosing, and prediction if an individual is affected by the virus or no with just an x ray image sample. It’s going to be of great important to a security agency who monitor, contain, diagnose and predict if an immigrant moving in and out of the country as the virus or not. Other includes;

1. The proposed COVID-19 prediction method can improve the diagnosis accuracy and performance.
2. It will be useful to health practitioners in the diagnosis of COVID-19 disease.

**1.5 Scope and Limitation of the Study**

The scope of the study span across chest x-ray images for covid-19 infection detection. Hence, the scope can be widened to other related diseases, such as hepatitis, cancer and the likes.

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