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Deep Convoluational Neural Networks for Malaria Cell Identification

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Abstract
Malaria is one of the deadliest diseases across the globe. This is caused by the bite of female Anopheles mosquito that transmits the Plasmodium parasites. Some current malaria detection techniques include manual microscopic examination and RDT. These approaches are vulnerable to human mistakes. Early detection of malaria can help in reducing the death rates across the globe. Deep Learning can emerge as a highly beneficial solution in the diagnosis of disease. This model gives a faster and cheaper method for detecting plasmodium parasites. The custom convoluational neural network is primarily designed to distinguish between healthy and infected blood samples. The proposed model consists of three convoluational layers and fully connected layers each. The neural network presented is a cascade of several convoluational layers having multiple filters present in layers, which yields the exceptionally good accuracy as per the available resources. The model is trained and later several blood sample images are fed to test the accuracy of the designed system. The CNN classifier has perform exceptionally well under limited computational resources giving best accuracy. Blood smear sample analysis can also aid in the detection of certain other illnesses and the application of deep learning models will help in the greater good of humankind.
Keywords: *Malaria Erythrocyte, Peripheral blood smear, Digital image processing, Deep learning Convoluational neural networks.* .

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I. Introduction

Malaria is a disease caused by the bite of female Anopheles mosquito. Plasmodium parasite gets injected in the body due to the sting of a mosquito. There are several types of parasites out of which the two, P. falciparum and P. vivax carry the greatest risk; however, the most prevalent effect is of P. falciparum. According to the survey of the World Health Organization (WHO) in 2019, the globe had 228 million occurrences of the disease all over the world [1].

There are about 300-500 million cases reported annually caused due to plasmodium parasites. WHO reported that around 405,000 people died of it, most of them children from sub-Saharan Africa [1]. Malaria causes ailment and death in large numbers causing drastic effects on the national economy of a country. Malaria is a genuine purpose of worry for the poor countries as they are caught in the endless loop of ailment and destitution.

The blood sample examination is conducted for disease diagnosis and yields a reliable result. Thin blood smears help with recognizing the types of parasites inflicting the infection and thick blood smears assist in detecting the presence of parasites [2].

In pathology labs, the blood samples are collected and the diagnosis of malaria infection is done by identifying the parasites in blood slides through a microscope by the experts. A chemical process is used in the detection of malaria parasites called Giemsa staining. In this process, the parasite in the blood sample is recognized and detected.

To avoid false results, these stained objects are analyzed further to determine whether they are parasitized or healthy. As per the WHO protocol, there are various techniques used in the detection of malaria that involve an intensive examination.

II. Literature Survey

Numerous research projects around the world have been undertaken to implant deep learning models for clinical use. Some of the research conducted on this work is, a CNN based Deep Learning model Alex Net designed by Alex Krizhevsky in 2012 that subsequently increased the performance of CNN in categorizing natural images.Many CNNs like Google Net, VGGNet, and ResNet established considerable improvements in attaining ILSVRC annual challenges.

[1].A. Acevedo, S. Alf´erez, A. Merino, L. Puigví, J. Rodellar,The main objective of this paper is to improve the accuracy, speed and accessibility of malaria diagnosis using Deep convoluational neural networks and algorithms is crucial for achieving the desired objectives in malaria cell identification.Research on malaria cell identification using DCNNs continues to make significant strides, trackling data limitations, interpretablity, and fariness concerns.
[2].S. Revathy Associate Professor The authors proposed system reduces the possibilities of human error in the detection of malaria parasites using image processing and deep learning methods..The scope of this document is to significant potential to improve diagnosis and Informatics and combat the diseases with high accuracy, Automation , integration beyond images.
[3].Mahendra Kumar Gourisaria Assistant Professor, Deep Convoluational Neural Networks (DCNN) is the complex neural network architecture widely used in the industry to solve complex real world problems.
The author proposed that they have used dataset from the official website of NIH. We have used a balanced dataset of blood cells. There are total number of 27560 images which are equally divided into two classes that are Parasitized and Uninfected cells. We have divided the dataset into 3 categories known as training sets, test set and validation sets.

III. METHODOLOGY

ConvolutionalNeural Networks, a part of deep learning have proved to be of immense use in image recognition, identification and categorization. CNNs outperform traditional deep learning methods in terms of accuracy and efficiency in disease recognition studies. Convoluational Neural Network consists of several types of layers, each performing a particular operation.

System Architecture

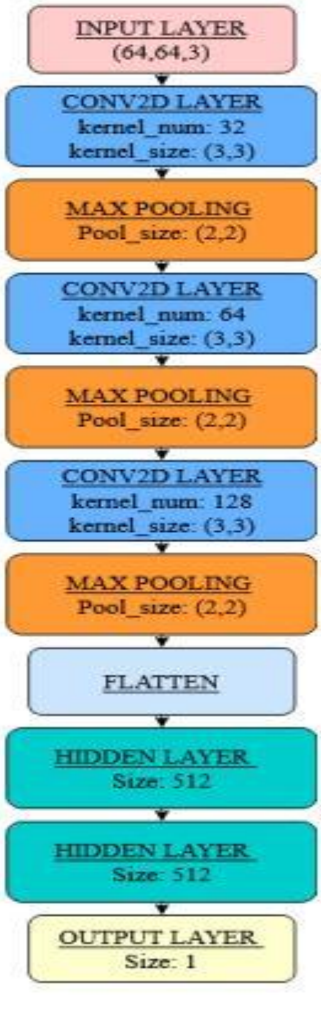

Figure 1 .System Architecture

Data Flow Diagram

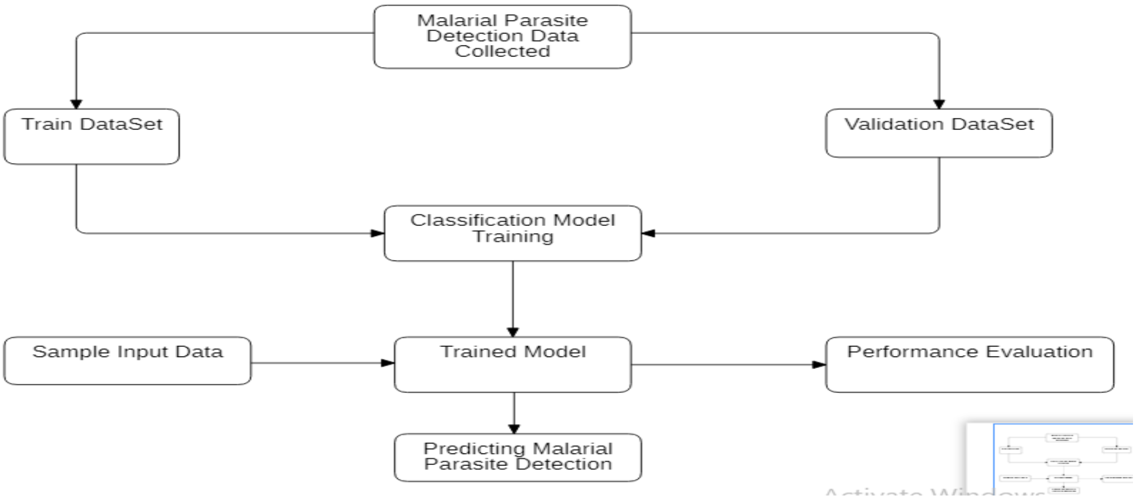

Figure 2. Data-Flow diagram

IV. Module description

Image Acquisition:

The first step of the Malaria Parasite Classification is image acquisition. High-quality Malaria Parasite dataset used which are obtained from open Github repository. The entire sample set is divided into three parts: training samples and validation samples in the training phase and testing samples in the testing phase. Moreover, the sample set is divided into positive and negative samples—a positive sample is an image showing patient behaviors, whereas a negative sample is a background image.

Image Processing:

The obtained images that will be engaged in a preprocessing step are further enhanced specifically for image features during processing. The segmentation process divides the images into several segments and utilized in the extraction of Malaria Parasite from dataset.

Feature-Extraction:

This section involves the convolutionary layers that obtain image features from the resize images and is also joined after each convolution with the ReLU. Max and average pooling of the feature extraction decreases the size. Ultimately, both the convolutional and the pooling layers act as purifiers to generate those image characteristics.

Classification:

The final step is to classify images, to train deep learning models along with the labeled images to be trained on how to recognize and classify images according to learned visual patterns. The authors used an open-source implementation via the TensorFlow module, using Python and OpenCV including the Faster R-CNN model.

Deployment:

The last step of machine learning life cycle is deployment, where we deploy the model in the real-world system. If the above-prepared model is producing an accurate result as per our requirement with acceptable speed, then we deploy the model in the real system. But before deploying the project, we will check whether it is improving its performance using available data or not. The deployment phase is similar to making the final report for a project.

V. RESULT

Malaria parasite detection was performed using a custom CNN model. As the model was trained, it showed growth in the accuracy rate and after 6 epochs, it gave constant accuracy rate of around 95%. As mentioned in Table 1, the network had an error rate of 4.74% and 5.72% for parasitized and uninfected images respectively.

Home Page:

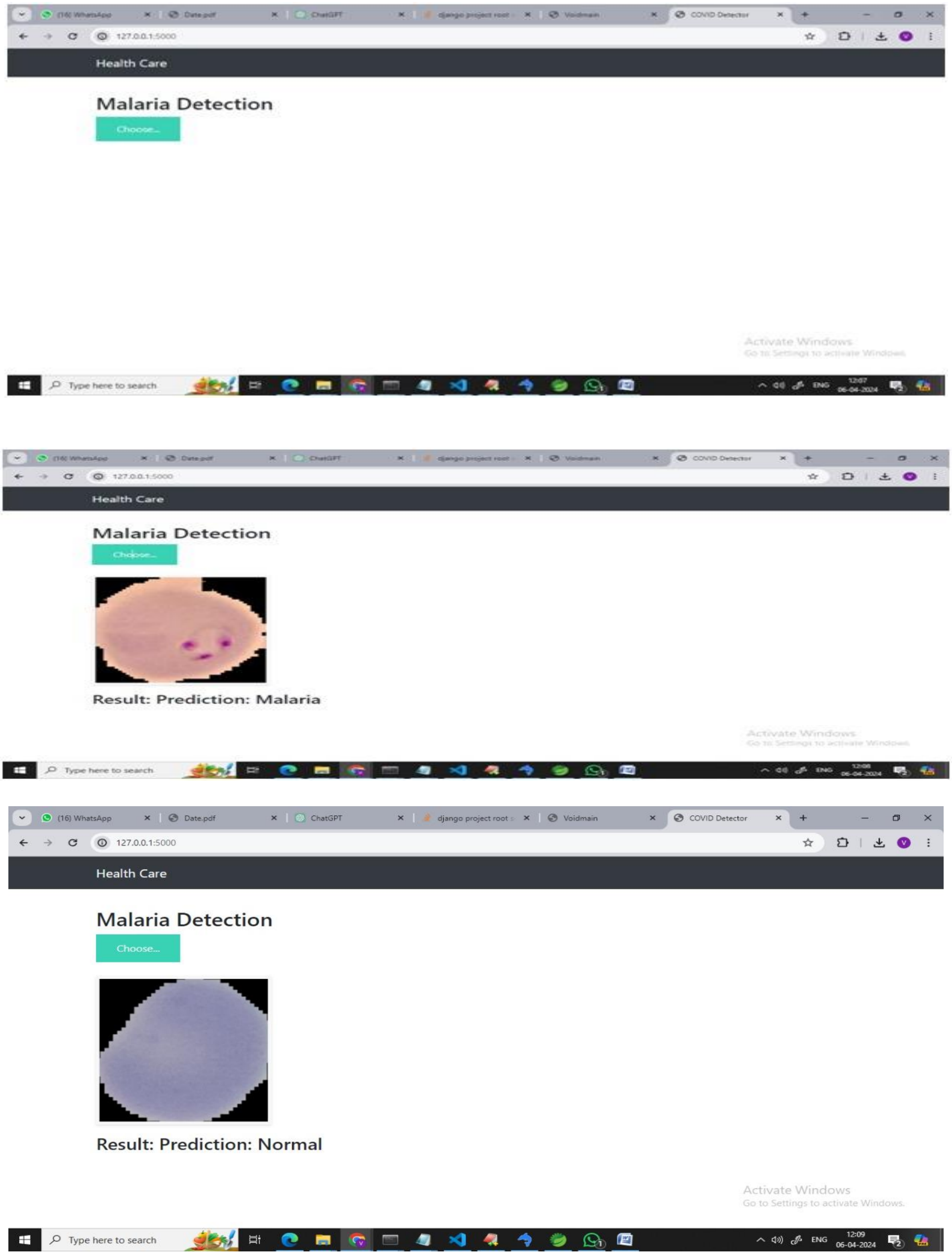

Figure 3 . Detection of Malaria

VI. Conclusion

As pathologists manually do the detection of malaria parasites using microscopes, there are chances of human errors and false detection of parasites that can cause further issues in the treatment of the patient. This system reduces the possibilities of human error in the detection of malaria parasites using image processing and deep learning methods.

We developed an image classification model by using convolutional neural networks and labeled datasets. The proposed model yields an accuracy. The system is robust, and other factors do not affect it. We believe with more computing power the model can perform better than the present results. The model can further be expanded to diagnose other diseases from the blood samples.

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