International Journal of Future Generation Communication and Networking
Vol.14, No. 1, (2021), pp. 4302 - 4308

Malaria Parasite Detection and Prediction using Blood Smear and Symptoms

Shweta Tembhurnikar[1], Swati Savkare[2], Shwetanshu Singh[3], Pawan Maher[4]

Department of E&C Engineering, SKNCOE, SPPU, Pune, India

[1]shwetate15@gmail.com

[2]swati.savkare_skncoe@sinhgad.edu

[3]shwetanshu.s27@gmail.com

[4]pawan15maher@gmail.com

Abstract

Malaria stays a big burden on international health, with round two hundred million instances worldwide. Malaria is transmitted through the bites of infected female Anopheles mosquitoes which infects the red blood cells of the human body. The paper is proposing a malaria detection and prediction system. In this system, two modules are used, the input is given as the csv dataset and image dataset. In first module, the image datasets are pre-processed, in preprocessing the image is converted from RGB to Gray scale, then segmentation is done. After segmentation, data is extracted to check the feature of that image and then classified with CNN algorithm and it gives result as whether disease identified or not. The second module is based on symptoms analysis, the symptoms of a patient are given as an input. The prediction is done using SVM algorithm. This system can be used in hospital and test labs to predict and detect the malaria.

Keywords*-Blood smear, Malaria, CNN, SVM*

I. INTRODUCTION

Malaria is a major concern globally because it is the deadliest disease. So, its quick treatment is very necessary. The conventional way of testing the blood smear of the patient is very tedious job and it requires skilled lab workers. The blood smear is stained using chemical and because of this the damaged RBC cell acquires the stain, on the basis of color variation it can be concluded that whether it is infected or not. This paper proposes a system which detects the disease from the blood smear using CNN algorithm and predicts from the symptoms of a person using SVM algorithm.

II. LITERATURE SURVEY

This section gives the knowledge of the previous work done in the field of malaria detection.

Kristofer E. delas Penas et al. [1] suggests a detecting method for malaria parasites in thin blood smears using artificial intelligence. The paper used a Convolutional Neural Network to detect malaria parasites with an accuracy of 92.4 percent and a sensitivity of 95.2%, and to classify the two species Plasmodium falciparum and Plasmodium vivax with an accuracy of 87.9 percent.

Gautham Shekar et al. [2] suggests a convolutional neural network (CNN)-based deep learning algorithm for automatically classifying and predicting contaminated cells in thin blood smears. Standard CNN, VGG-19 Frozen CNN, and VGG-19 Fine Tuned CNN are three different CNN versions that are compared in terms of accuracy to see which is the most precise. Standard CNN gives 94 percent accuracy, VGG-19 Frozen CNN gives 92 percent accuracy and VGG-19 Fine Tuned CNN gives 96 percent accuracy. The Fine-Tuned CNN provided a high accuracy rate compared to the other CNN models.

ISSN: 2233-7853 IJFGCN

All the work done in the past where based on the analysis of the blood smear only. The work proposed in this paper works on the blood smear as well as on the symptoms, this increases the reliability of the system.

III. METHODOLOGY

This paper is proposing a malaria detection system, csv dataset and image dataset are given as an input to two different modules.

A. Detection using blood smear

The first module is of the image processing. It will detect the disease from the image of the blood smear of a patient. The input to the first module is the image of the blood smear. The image is converted to Gray scale from RGB. Then the image is segmented using Otsu thresholding technique. After segmentation, image features are extracted. On the basis of the features, whether there is variation in color of the smear, the disease is detected. For the classification purpose CNN algorithm is used. The CNN algorithm, firstly trained using thousands of the images to classify the images in two categories as: infected by malaria or not infected by malaria. When the image is tested the algorithm accurately classifies whether it is infected or not.

B. Prediction using the symptoms

The second module is for the prediction of the malaria disease on the basis of the symptoms. Various symptoms are being consider which are seen in the patients suffering from malaria. To classify in two classes, in this module, SVM algorithm is used. The SVM algorithm is trained by considering the symptoms of many patients. So, while testing it gives a very good accuracy. By considering symptoms such head ache, metallic taste in mouth, diarrhea etc. The SVM algorithm will predict whether the person is having malaria or not. The second module is acting as a support system to the first module of image.

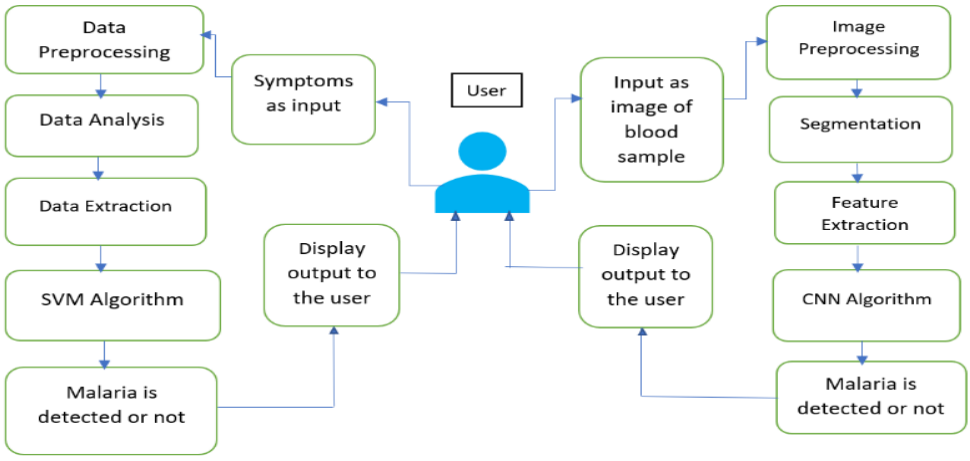

Fig. 1 System Architecture

C. Algorithm of the project

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1) Otsu Thresholding: The thresholding technique is used for segmentation of image. The simple thresholding method replaces the value of each pixel with black pixel if the image intensity is less than the threshold value, or by a white pixel if the value of image intensity is more than the threshold value. In adaptive thresholding, the thresholding value is calculated for smaller areas with different threshold values for different areas.
In Otsu thresholding, the value for the threshold isn't selected but is considered automatically. The histogram generated consists of two peaks. So, a common situation could be to determine for the threshold value chosen from the middle of both the histogram peak values that lies inside the center of every histogram top values.

2) Support Vector Machine (SVM): The SVM algorithm analyze data for classification. The SVM model classify the classes using hyperplane. The hyperplane is going to be generated in an iterative manner by SVM in order that the error are often minimized. SVM divides the datasets into classes to get maximum marginal hyperplane.
• Support Vectors − Data points closest to the hyperplane is named support vectors. Separating line are going to be defined with the assistance of those data points.
• Hyperplane – It is a choice plane or space which is split between a group of objects having different classes.
• Margin – It is going to be defined as the gap between two lines on the closet data points of various classes. It is often calculated as the perpendicular distance from the line to the support vectors. Large margin is taken into account as a good margin and small margin is taken into account as a bad margin.
The main goal of SVM is to divide the datasets into classes to seek out a maximum marginal hyperplane (MMH) and this can be done as follows:
The SVM will first generate hyperplanes repetitively that separates the classes in the best possible way.

After this, the SVM algorithm will choose the hyperplane that best separates the classes.

3) Convolutional Neural Network (CNN): For classification of images CNN can be the great way. CNN is inspired by the biological visual cortex of the brain. The kernel is a filter use to extract features from the input images. The convolution kernels shift over the input features and provide translation equivariant responses. CNNs are versions of multilayer perceptrons. Each neuron in one layer is connected to all or any neurons within the next layer is called multilayer perceptrons. The "full connectivity" of those networks make them susceptible to overfitting data. Typical ways of preventing overfitting, include: Data augmentation, cross validation, reduce the network and adding dropout. CNN have applications in image and video recognition, image classification, image segmentation and medical image analysis.

IV. RESULT AND DISCUSSION

The proposed project will identify whether the person is infected by malaria by analyzing the blood samples and the symptoms of the person.

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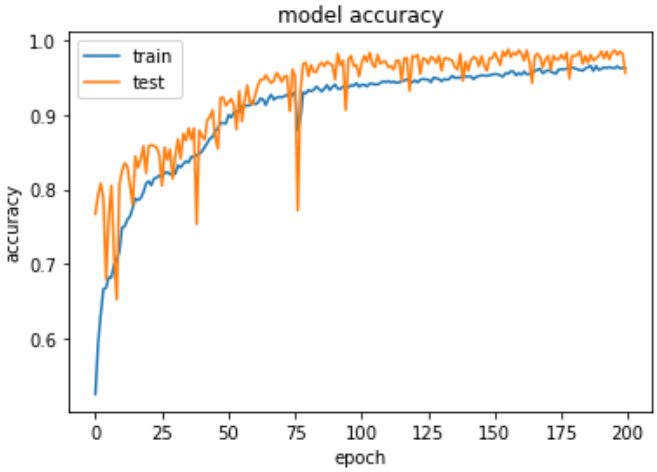

Fig. 2 Accuracy graph of CNN model

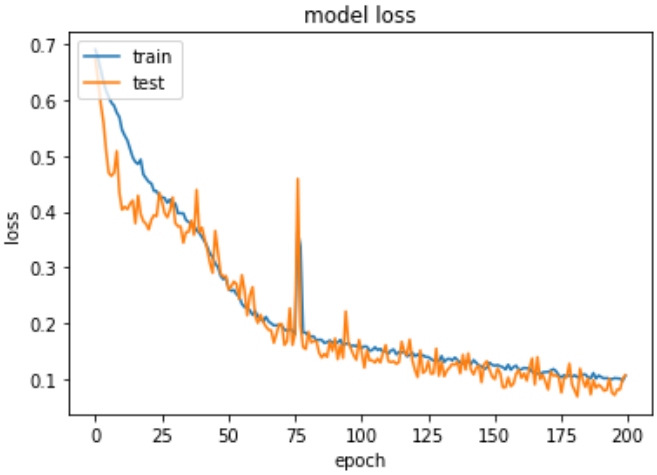

Fig. 3 Loss graph of CNN model

The Fig. 4 is the user interface of the software. It has three buttons which are: 1] To register the patient. During registration, basic details of the patients are asked like gender, age and so on. 2] It is to the detect the disease by blood sample. 3] This is the prediction module, the symptoms of the patients are considered for the prediction of the malaria disease.

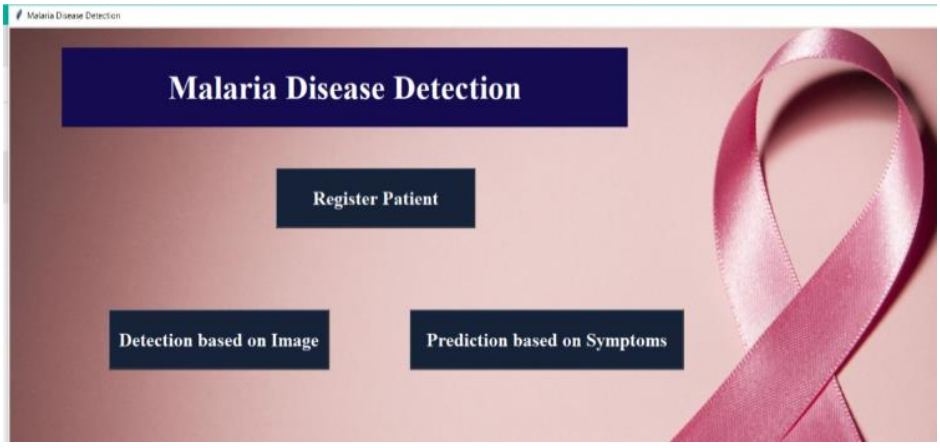

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Fig. 4 Main user interface of the system

A. Detection based on image

The user interface of malaria detection using blood smear is shown in fig. 5. The input image of the blood sample is converted to Gray scale from RGB, the Otsu thresholding is applied to it and then features are extracted from it. CNN algorithm is applied on it for the detection of the disease.

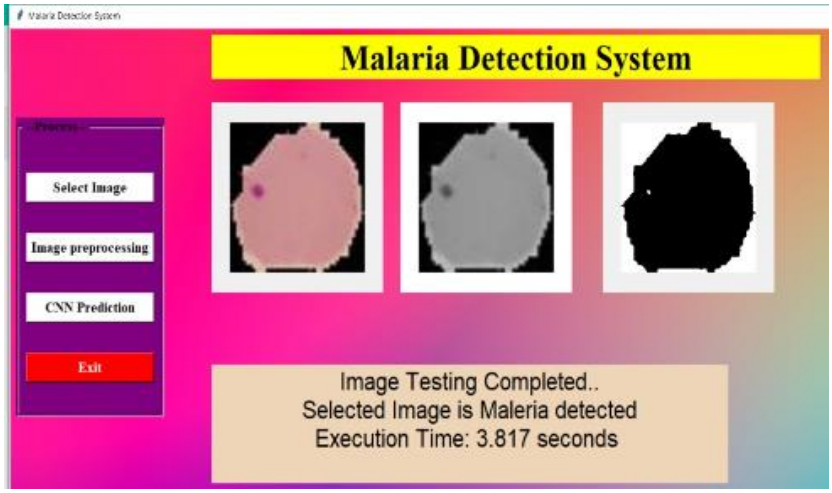

Fig. 5 User interface of the Malaria detection using blood smear

B. Prediction using symptoms

In the below figure, symptoms of a patient are considered for testing it in the second module for the prediction of the malaria disease.

	A	B	C	D	E	F	G	H	I	J	K	L
1	days	current_temp	wbc	servere_headche	pain_behind_the_eyes	metallic_taste_in_the_mouth	appetite_loss	addominal_pain	diarrhoea	hemoglobin	platelet	maleria
2	10	100	5	1	0	1	1	1	1	15	140	1

Fig.6 Symptoms of a patient are considered having malaria

Fig. 7 represents the display screen of the malaria prediction through symptoms. Many symptoms are being considered which are usually seen in the pateint suffering from malaria. The SVM is applied for the prediction purpose. It shows that disease is detected.

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Fig. 7 User interface for the prediction of malaria using symptoms

V. CONCLUSION

The automatic malaria parasite detection and prediction system, helps to detect malaria disease from the blood smear and it predicts from the symptoms of the patient whether he/she is suffering from malaria or not. So, the prediction module acts as a supporting system to the image processing module. The total number of images are 4355 of both the classes, accurately tested images were about 3500. Because of two modules the accuracy of the system has been increased. This system shows reliable performance in the positive and negative prediction of the samples.

REFERENCE

[1] Kristofer E. delas Penas, Pilarita T. Rivera2 and Prospero C. Naval, Jr.1. “Malaria Parasite Detection and Species Identification on Thin Blood Smears using a Convolutional Neural Network”. 2017 IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE), , pp. 1-6, 2017.

[2] Gautham Shekar, S. Revathy, Ediga Karthick Goud, “Malaria Detection using Deep Learning”. Proceedings of the Fourth International Conference on Trends in Electronics and Informatics (ICOEI 2020).

[3] Isabel H.J. Song, Wanzin Yazar, UC Berkeley Austin Tsang, “The self- upgrading mobile application for the automatic malaria detection”.

[4] S. D. Bias, S. K. Reni and I. Kale, "A novel fuzzy logic inspired edge detection technique for analysis of malaria infected microscopic thin blood images," 2017 IEEE Life Sciences Conference (LSC), 2017, pp. 262-265

[5] Hassan Abdelrhman Mohammed, Iman Abuel Maaly Abdelrahman, “Detection and Classification of Malaria in Thin Blood Slide Images”. 2017 International Conference on Communication, Control, Computing and Electronics Engineering (ICCCCEE), Khartoum, Sudan.

[6] Satabdi Nayak, Sanidhya Kumar, Mahesh Jangid, “Malaria Detection Using Multiple Deep Learning Approaches”. 2019 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT) Manipal University Jaipur, Sep 28-29, 2019.

[7] Fig. 7. An image before and after preprocessing

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Fig. 8. Some segmented regions
model using Inception v3 Convolutional Neural Network that goes beyond parasite detection to identify the species in the blood smear as either Plasmodium falciparum or Plasmodium vivax with an accuracy of 87.9%.
As the dataset used is limited to only the trophozoite and gametocyte stages of the malaria parasites, future research may include images of the full schizogony of the parasites to build a more representative and discriminative model for species identification.
Fig. 9. Dataset augmentation by rotation of segmented image by 15 degree increments
Fig. 10. Training accuracy per epoch of the CNN trained to classify trophozoite species

REFERENCES

[1] .
[2] World Health Organization. Malaria Factsheet. 2014.
URL: http://www.who.int/mediacentre/factsheets/fs094/
en/ (visited on 10/01/2014).
[3] Philippines Department of Health. Malaria Control Pro-
gram. 2014. URL: http:// www.doh. gov.ph /node/ 1072.
html (visited on 10/01/2014).
[4]
World Health Organization. Malaria Factsheet. 2014.
URL: http://www.who.int/mediacentre/factsheets/fs094/
en/ (visited on 10/01/2014).

ISSN: 2233-7853 IJFGCN