SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

A Project Report

MARIAL PARASITE DETECTION SYSTEM

Under the Guidance of

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By

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May,2021

DECLARATION BY THE CANDIDATE

We hereby declare that the project report entitled "MARIAL PARASITE DETECTION SYSTEM" submitted by us to Vellore Institute of Technology, Vellore in partial fulfilment of the requirement for the award of the degree of B. Tech (CSE) is a record of J component of project work carried out by us under the guidance of Dr. MOHANASUNDARAM R. We further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.
Place : Vellore Institute of Technology, Vellore.

Date :10-5-21

ABSTRACT-

This paper reviews image analysis studies aiming automated diagnosis or screening of malaria infection in microscope images of thin blood film smears. Nowadays as we see that Malaria is a major cause of death in tropical and sub-tropical countries, killing each year over 1 million people globally; 90% of fatalities occur in African children. Although effective ways to manage malaria now exist, the number of malaria cases is still increasing, due to several factors. Hence the purpose of the project is to implementation a solution for easy and malaria diagnosis with high accuracy.

INTRODUCTION

Malaria management is a challenging problem all over the globe particularly in Asian and African continents. Presently, even 110 years after the Nobel Prize of Ronald Ross for his work on malaria, people in the European region are also at risk from diseases carried by vectors both within the region and when traveling abroad. While treatment of malaria itself is a challenging problem its quick detection is also a problem with no less significance. There are mainly four species of malaria parasites infecting human beings namely, Plasmodium falciparum, Plasmodium vivax, Plasmodium oval and Plasmodium malaria. Plasmodium vivax, is found mainly in tropical and subtropical areas and has a severe clinical manifestation. Rapid detection of presence of the parasite in human blood and early institution of antimalarial drugs are the mainstay of management of the disease. WHO recommends that all cases of suspected malaria be confirmed using parasite-based diagnostic testing (either microscopy or rapid diagnostic test) before administering treatment. In the malaria detection test, microscopy-based diagnosis has the central importance for species differentiation, parasite quantification, management of severe disease. Additionally, the method may be amenable to larger section of society because of its scalability and low running cost. Two types of blood smears, thick and thin, are prepared from the blood of patients, who are clinically suspected to be suffering from malaria. The thick smear is more useful for parasite detection whereas the thin smear is particularly used for identification of malaria species. When the parasite load is low, malaria may be detected about 20 times more rapidly in thick smear than in thin smear.

Overview and Planning

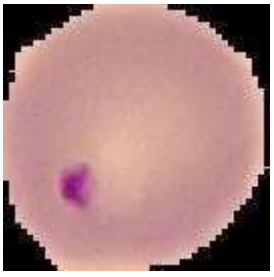
Proposed Work-

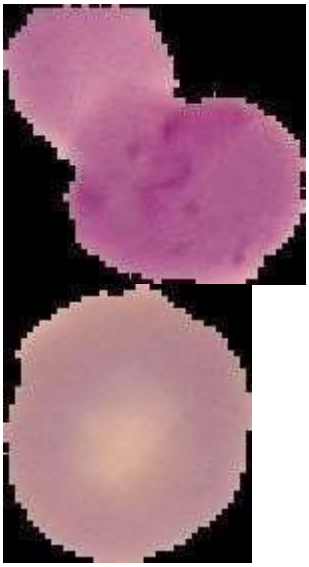
The objective of the project is to develop a fully automated image classification system to positively identify malaria parasites present in thin blood smears, and differentiate the species. In this project we proposed a system of using Deep learning with Pytorch –it is python dependency used for the image processing. As using Deep learning with Pytorch has shown great results with good accuracy.

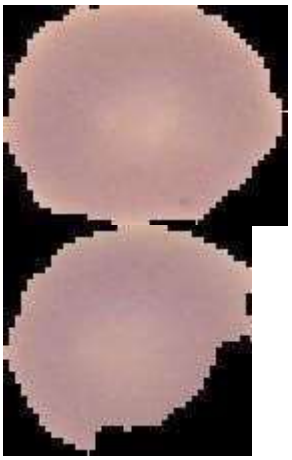
We have taken dataset of this project from the official NIH website- https://ceb.nlm.nih.gov/repositories/malariadatasets/

Our dataset consists of about 27,500 images of uninfected and parasitized cells of humans which they are going to fit in our trained data

Some input cells of our datasets are-







Hardware Requirements

RAM: 2GB
Hard Disk: 10GB
Speed: 1.2 GHz+

Software Requirements

Operating System : Windows or Mac
Software required :Anaconda
Dependencies required: Pytorch, NumPy, matplotlib

Literature Review

In 2010, Frean [1] build a morphologic based analysis system to count parasites from individual microscopic images. But there was some inconsistency of detecting the parasite which is in primary state.
In 2011, Somasekar [2] proposed a linear programming based Image segmentation and morphological operations for detection of malarial parasites. But there was no complete system for detecting different parasites.
In 2011, Prescott WR, Jordan [3] proposed Shape and colour pattern of parasite and RBC (Red Blood Cells) for Detection of malaria parasite from thick and thin smear image. But there some difference of colour pattern between the resultant value and WHT value.
In 2011, Edison M, Jeeva J, Singh M [4] proposed Image filtering and edge detection to analyze the changes of Plasmodium vivax in thin smear erythrocytes images.
In 2013, Pallavi T. Suradkar [5] proposed flood fill algorithm and the colour range of RBC and parasite to detect parasite from the blood sample. But there was no system for detecting the P. falciparum parasite.
In 2013, Prof VV Dixit[6] presented enhanced technique for Malaria Parasite Detection, where cell segmentation process consists of various steps such as image binarization using Poisson's distribution based Minimum Error Thresholding, followed by Morphological Opening for the purpose of refinement and compared classification technique of SVM and Euclidean Distance classifier.
In 2018, Kishor Roy [7] developed a model by using color based pixel discrimination technique and Segmentation operation to identify malaria parasites from thin smear blood images.But hoped for better classification techniques for detection.
In 2017,Ahmedel mubarak Bashir, Zeinab A.Mustafa, Islah Abdelhameid, Rimaz Ibrahem[8] used Artificial neural network

(ANN) This method would be helpful for an educated person but might be hard for students. It uses Less time consuming, improves consistency in diagnosis. Need good technical knowledge to implement.

In 2018,Andrea Loddo, Cecilia Di Ruberto and Michel Kocher. D Rub[9] used Automatic thresholding and morphological operates, typical pipeline of a computer-aided image analysis process Very effective but need a big time frame as it is time consuming A Morphological approach to cell segmentation which is more effective was proposed. More time is consumed due to Microscopic activities.

In 2018,Kishor Roy, Shayla Sharmin, Rahma Bintey Mufiz Mukta, Anik Sen[10] used An unsupervised approach in which color and segmentation based algorithms are put together to formulate an algorithm for Plasmodium parasite detection from thin smear slide. For images contains intensity of light at a standard and equal value, it gives best possible results. Comparative higher predictability and lower false positive rate. Chances of false detection due to human error, false detection due to changes in light intensity.

In 2017,Hassan Abdelrhman Mohammed, Iman Abuel Maaly Abdelrahman[11] developed algorithm picks the suspicious regions and detects the parasites in the images including the overlapped cells. Accordingly, the RBCs are classified into infected and non-infected cells and the number of RBCs in each image is calculated. The second part of the system uses the Normalized Cross-Correlation function to classify the parasite into one of the four species namely, Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale. Compared to manual results, the system achieved 95 % accuracy for detection and counting of RBCs and 100% for detection and classifying the parasite into one of its four types.

In 2016,Naveed Abbas, Tanzila Saba, Dzulkifli Mohamad, Amjad Rehman, Abdulaziz S. Almazyad & Jarallah Saleh Al- Ghamdi[12] examine the microscopic images of stained thin

blood smears using a variety of computer vision techniques, grading malaria parasitemia on independent factors (RBC's morphology). The proposed methodology was based on inductive approach, color segmentation of malaria parasites through adaptive algorithm of Gaussian mixture model (GMM).

In 2019, Neha C Poojari, Pallavi K, Prapthi P Rai, Rahil Abdullah and Mrs. Ankitha K[13] developed a model that uses image processing techniques and algorithms that are definite, rapid and cost- effective detection of malaria by training and testing over the acquired stained thin blood smear images. Datasets consisting of images of affected and unaffected erythrocytes are collected, preprocessed, closely connected features are extracted from the acquired images and finally, it is confirmed whether the sample image is infected or not based on the features that are extracted from them. A set of characteristics depending on the features are suggested, and the performance from the created database of the features on the erythrocytes samples is classified using a SVM and MSVM.

In 2018, Soumya Das, Sony P, Jyothi R L[14] in this image processing techniques are used for detection of malaria from microscopic images of Giemsa stained thin blood smear. Here, blood smear images are analyzed based on extracting SIFT features from preprocessed images and lead to the classifier for recognition.A comparative analysis of SVM (Support Vector Machine) and ANN (Artificial Neural Network) is carried out for recognition of extracted SIFT features.

In 2015,Kshipra C. Charpe [15], proposed automated malarial parasite and their stage detection, which proceeds in steps like image acquisition, segmentation, feature extraction and then classification. The features: color, shape, size, intensity, texture will be extracted and classification is done using SVM. In this work, the parasite infected RBC and their count is also found.

In 2012, S.S. Savkare [16] developed a fully automatic system for counting and classification of Malaria parasite infected erythrocytes and detection of life stage of parasites. Here, Otsu threshold erythrocytes are segmented form preprocessed images, watershed

algorithm is used to separate overlapped cells, statistical and colour features are extracted and given to the SVM binary classifier which classifies malaria infected erythrocytes and SVM multi classifier is used for detection of parasite life stages.

In 2019, Saiprasath G[17] proposed a methodology determines the malarial infection with the help of captured images of patients without staining the blood or need of experts. with the intention of singling out the parasite blood smears for malaria detection, shallow machine learning algorithms are used against the traditional method, which has some snags related to sensitivity and specificity.

In 2016, Adam Wax [18] presents an automated analysis method for detection and staging of red blood cells infected by the malaria parasite *Plasmodium falciparum* at trophozoite or schizont stage. Unlike previous efforts in this area, this study uses quantitative phase images of unstained cells. To improve the diagnostic capacity, they applied various machine learning techniques, including linear discriminant classification (LDC), logistic regression (LR), and *k*-nearest neighbor classification (NNC), to formulate algorithms that combine all of the calculated physical parameters to distinguish cells more effectively.

In 2015 Soumya [19], proposed method, we applied sparse banded highpass filter row-wise and column-wise to extract the vertical and the horizontal edges of the image respectively.

There has been a great deal of developing new methodologies in last few years for malaria diagnosis, which includes rapid antigen, fluorescent microscopy detection method, and PCR(Polymerase Chain Reaction) method that detect the specific sequences of nucleic acid [20].

Literature Survey

After reviewing several papers, we came to an understanding that accuracy of malarial parasite classifier can be increased by using a different approach known as residual network architecture as a model for our data. As Image Recognition is an interaction of extricating significant data, like the substance of a picture, from a given picture. In picture acknowledgment, it is fundamental to arrange the significant substance in a given picture, so it doesn't include deciding the position and posture of the perceived substance. The expression "Picture Recognition" is presented for PC innovations which perceive the specific creature, items, individuals, or other focused on subjects with the assistance of calculations and AI ideas. Picture acknowledgment is associated with PC vision, which is a far-reaching mark to see like people for the way toward preparing PCs and picture handling.

After we get some input data for images and get them trained by machine learning models, then we use our main residual networks. A residual neural organization (ResNet) is a fake neural organization (ANN) of a sort that expands on develops known from pyramidal cells in the cerebral cortex. Remaining neural organizations do this by using skip associations, or alternate routes to hop over certain layers. Run of the mill ResNet models are carried out with twofold or triple-layer avoids that contain nonlinearities (ReLU) and cluster standardization in the middle. An extra weight framework might be utilized to gain proficiency with the skip loads; these models are known as Highway Nets Models with a few equal skips are alluded to as Dense Nets. With regards to remaining neural organizations, a non-leftover organization might be portrayed as a plain organization.

Finally, after testing the images it will give its final accuracy for the image, whether it is malarial parasitic or not. And then we bring in more images to be input using scikit library to check whether the image is malarial positive or not which would be the main aim of our project. i.e., improving the accuracy of prediction from previous different research paper’s models published.

Reference	Methods Used	Evaluation	Merits and Demerits
1) Detection of Malaria Parasites Using Digital Image Processing by Ahmedelmubar ak Bashir, Zeinab A.Mustafa, Islah Abdelhameid, Rimaz Ibrahem [8]	Artificial neural network (ANN)	This method would be helpful for an educated person but might be hard for students.	Less time consuming, improves consistency in diagnosis. Need good technical knowledge to implement.
2) Recent Advances of Malaria Parasites Detection Systems Based on Mathematical Morphology by Andrea Loddo, Cecilia Di Ruberto and Michel Kocher. D Ruberto [9]	Automatic thresholding and morphological operates, typical pipeline of a computer- aided image analysis process	Very effective but need a big time frame as it is time consuming	A Morphological approach to cell segmentation which is more effective was proposed. More time is consumed due to Microscopic activities
3) Detection of Malaria Parasites in giemsa blood sample using image processing by Kishor Roy, Shayla Sharmin, Rahma Bintey Mufiz Mukta, Anik Sen. [10]	An unsupervised approach in which color and segmentation based algorithms are put together to formulate an algorithm for Plasmodium parasite detection from thin smear slide.	For images contains intensity of light at a standard and equal value, it gives best possible results.	Comparative higher predictability and lower false positive rate. Chances of false detection due to human error, false detection due to changes in light intensity

Methodology

Method Used-In this project we have used a python dependency called Pytorch which is used commonly used library in image processing and in this project, we have used the concepts of Deep learning by implementing with Pytorch

1. Firstly we take the input images and fit it in our training model
2. then after training our model our model is finally trained and ready for predicting the outputs
3. In this project we have used Residual networks as our neural networks architecture
3. After training the testing of the model is done and it will give us the testing accuracy
4. finally, we load our input image from dataset and we use scikit image library in our code to import our image
5. Our model is ready to predict the images that the blood cell is malaria positive or not

Applications

As our model is predicting that patient is malaria positive or not by seeing the microscopic image of the patient blood cell so it will ease the humans jobs and give the output with more correct accuracy so it will save time and money and also it will reduce the human work

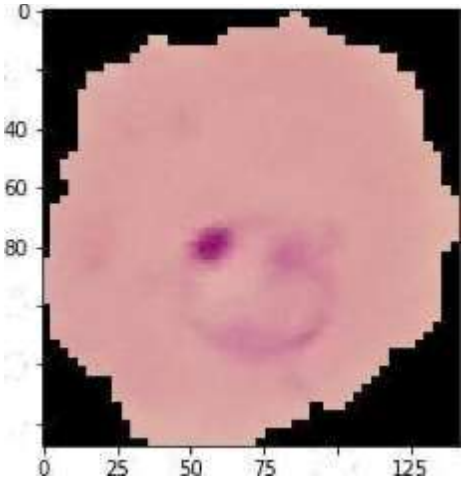
System Implementation

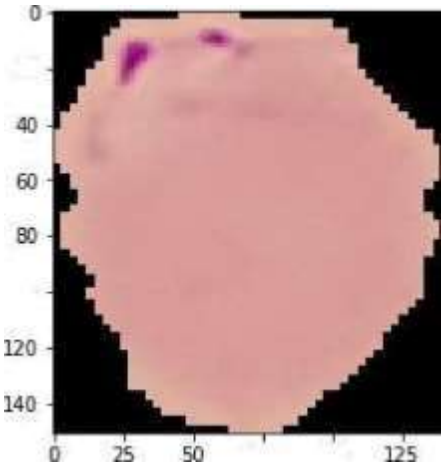
Code

Image project code colab Hyperlink

RESULTS-

Parasitized





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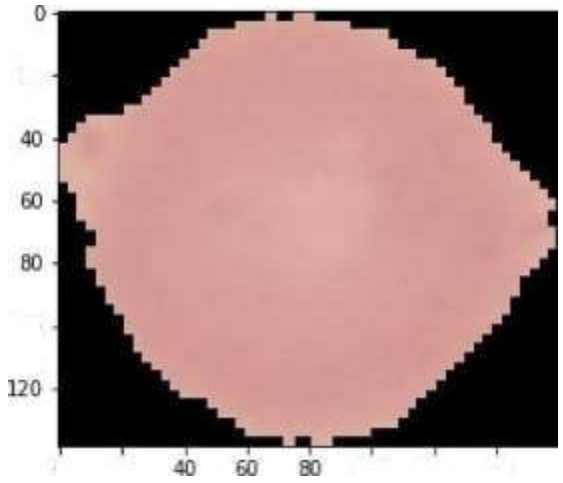
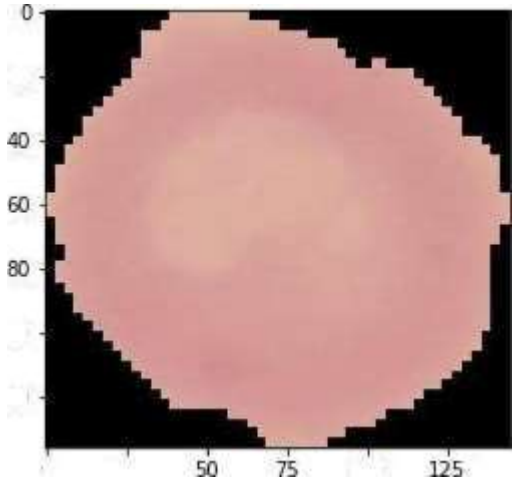
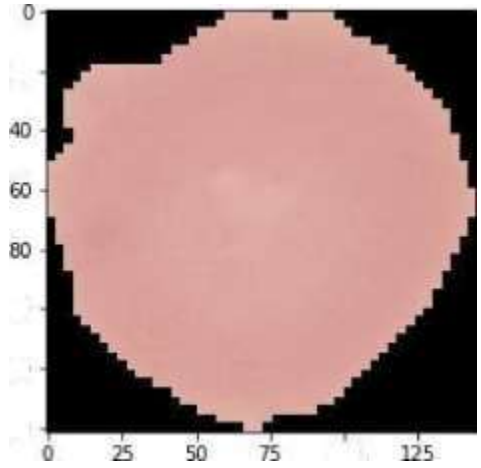
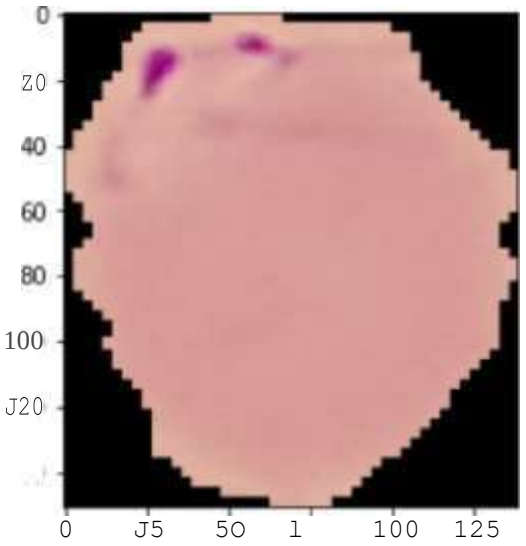


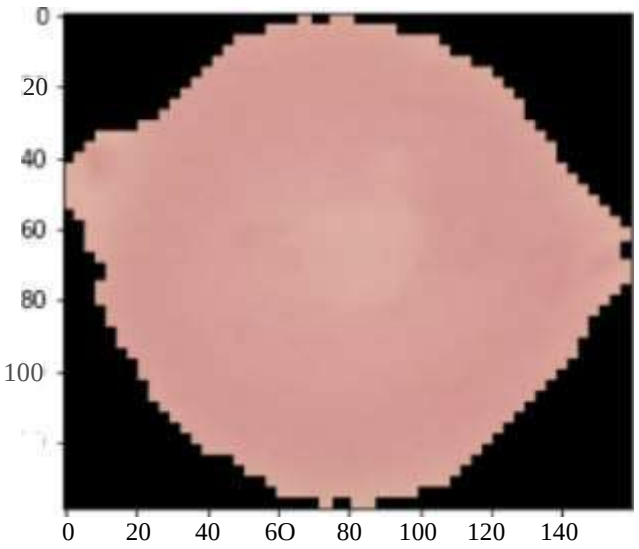




Parasitized



Uninfected



CONCLUSION-

The detection of malaria parasites is done by pathologists manually using microscopes. so, the chances of false detection due to human error are high, which in turn can result into fatal condition. this seminar curbs the human error while detecting the presence of malaria parasites in the blood sample by using image processing and automation. we achieved this goal using image processing through deep learning techniques and we have trained our input images to detect malaria parasites in images acquired from giemsa stained peripheral blood samples. the system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, positive prediction and negative prediction values. and the extraction of red blood cells achieves a reliable performance and the actual classification of infected cells. The detection of malaria parasites is done by pathologists manually using microscopes. so, the chances of false detection due to human error are high, which in turn can result into fatal condition. this seminar curbs the human error while detecting the presence of malaria parasites in the blood sample by using image processing and automation. we achieved this goal using image segmentation smoothing processing techniques to detect malaria parasites in images acquired from giemsa stained peripheral blood samples. the system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, positive prediction and negative prediction values. and the extraction of red blood cells achieves a reliable performance and the actual classification of infected cells.

FUTURE ENHANCEMENTS-

Our project focuses on detection of malaria detected cells, future work can be carried out to predict different stages of infected cells, different kinds of diseases like H1N1,Dengue etc. using machine learning techniques.

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Publisher Information: Multidisciplinary Digital Publishing Institute

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