RMSE Computation and Detection of Ring P. Falciparum

Rinki Tyagi, Geetanjali

Raj Kumar Goel Institute of Technology, Ghaziabad, Uttar Pradesh, India

Corresponding author: Geetanjali, Email: geetanjali.cs@gmail.com

Malaria is a disease that is threat to our life and it is caused by a parasite named protozoan. As we all studied that there are five species of malaria falciparum, p.vivax, p. malaria, p. ovale, and p. knowlesi. Some of the common symptoms of malaria are fever, fatigue, headache, cough, abdominal pain, nausea. Some of the causes of malaria are blood transfusion, maternal foetal transmission, by infected needle because of bite of female anopheles mosquito. Earlier number of method were used like malaria microscopy, RDT (Rapid Diagnostic Test). These tests were very costly so after their failure computer vision techniques came into limelight like image processing. Here microscopic images of blood samples were taken and using various techniques of image processing like preprocessing of an image, feature extraction, segmentation were used and were very popular in last few years but nowadays may machine learning classification models are used such as Naïve Bayesian classifier, Support vector machine classifier, K-nearest neighbor and many more and are very successful in predicting accuracy of detection of malaria parasite. In this paper we are going to detect malaria parasite and also which parasite it is with the help of a pre-processed image using region filling and then using canny edge detection for smoothening of edges in combination with watershed segmentation using distance transform and at last we will predict RMSE (Root Mean Square Error) using SVM classifier. Basically, in this paper we are trying to decrease the RMSE while detecting malaria parasite and we will predict the error using SVM classifier and also with Ensemble classifier and we will compare which one is better using regression analysis.

Keywords: Region filling, Watershed Segmentation using Distance Transform, Regression Analysis.

2023. In Saroj Hiranwal & Garima Mathur (eds.), *Artificial Intelligence and Communication Technologies*, 815–821. Computing & Intelligent Systems, SCRS, India. https://doi.org/10.52458/978-81-955020-5-9-76

1 Introduction

Malaria is a disease that is caused because of the bite of female anopheles mosquito or culex mosquito. Malaria is always caused because of the bite of female mosquito because it consumes blood. Male mosquito never consumes blood because they lives onto the nectar of a flower. There are many areas that are prone to malaria like Africa. His is the area where large number of people died because of malaria. Most of the children got infected and if they do not died then they suffer from brain damage. Severe malaria occur because of organ damage. Malaria is mostly found in under developing countries. In Africa, there is lack of diagnosis of malaria because of lack of diagnosing equipment and most of the cases occur only because of this problem. There were many techniques used that we will explain further in literature survey [1].

1.1 Life Cycle of Malaria

The diagram given below shows the various stages of malaria through which human being suffers. Firstly female anopheles mosquito transmits sporozoites to human beings. Sporozoites are infective form that a female anopheles mosquito inculcates into the human being. After that sporozoites travels through the blood vessel to the liver of human beings and infects the liver and after infecting it converts into merozoites by reproducing asexually. Now schizont breaks down suddenly and releases merozoites into the RBCs of a human being. Then infected RBCs multiplies until they get burst and then begins a new cycle and releases immature trophozoite. It is the nourishment stage and then they get converted to mature trophozoite and gametocytes. Gametocytes is the sexual stage where gamete are produced sexually and mature trophozoite gets converted to schizont and then breaks down suddenly into the blood of a human being. This cycle is repeated again and again and then gametocytes are taken as a meal by the mosquito from the person infected by malaria and then the whole cycle begins again. Male and female gametocytes fuses together and form ookinets. Ookinets gets developed and gets converted into sporozoites and then these sporozoites travels into the salivary gland of mosquito and they inject it into new host.

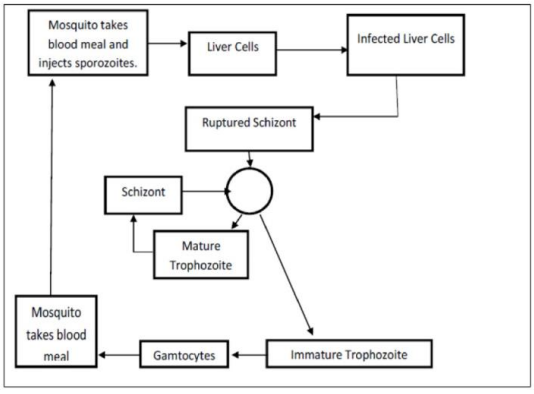

Fig. 1. Life Cycle of Malaria

2 Literature Survey

Many Scientist and researchers and many other engineers are trying to find the accurate results, cost effective results of diagnosis of malaria In this section we will describe work that has been already done or i.e. the previous work done. Rapid diagnostic tests are available in the area where there is lack of infrastructure for detection of malaria parasites. These kits are basically used to find antigens of malaria in human blood. Tomari et al. proposed that for automatic detection and identification of RBC's a computer aided system is used for extracting number of RBC's, threshold and also morphological operations used for labeling of cells and also for removing noise [2]. For classification artificial neural network is used and average accuracy obtained is 83%. Chapre et al. find out that main problem in diagnosing malaria is the segmentation part. If segmentation is not properly then we will not get efficient results while diagnosing malaria. Feature extraction is also used by chapre and for classification purpose SVM classifier is used and results obtained are accuracy 97%, sensitivity 97.4%, specificity 97.7% [3]. Savarkare et al. proposed the concept of binary classifiers to detect infected and non-infected RBC's and also feature extraction is used with SVM classifier and accuracy obtained is 99.43% [4]. Anuja vane et al. proposed an image processing method for classification of RBC's. Here RBC's are counted using morphological operations [5]. Narote et al. proposed an automatic method of identifying the number of plasmodium parasites. He uses Otsu's threshold method on a gray scale image [5]. Purnima et al. proposed the concept of ANN (Artificial Neural Network) for the diagnosis of malaria in RBC's [6]. Sinha et al. uses watershed transform using distance transform for segmenting images using Laplacian of Gaussian edge detector to avoid over-segmentation problem. Maini et al. compares different edge detection methods with the help of MATLAB 7.0. When all the edge detection operators are compared then canny edge detection gives best output but it is an expensive operator. If there is a sudden change into the intensity of pixels from which boundaries are categorized then edge detectors are used. Various types of edge detectors are already available, each type of operators have certain characteristics for the edges. Edges can be diagonal, horizontal, vertical and edge detector operators have to optimize them. If the frequency content is high or an image consists of noise then in that situation using edge detector is very difficult [7].

3 Proposed Model

Here, we will see the flowchart that is the solution of my problem. Here step by step solution is prepared and we will study the detail study of the methods used here. Here firstly we will upload an image using MATLAB@R2020b software. Image can be of low quality or not good in contrast, intensity can be low, resolution can be bad, can consist of noise because of atmospheric changes, change in temperature etc.

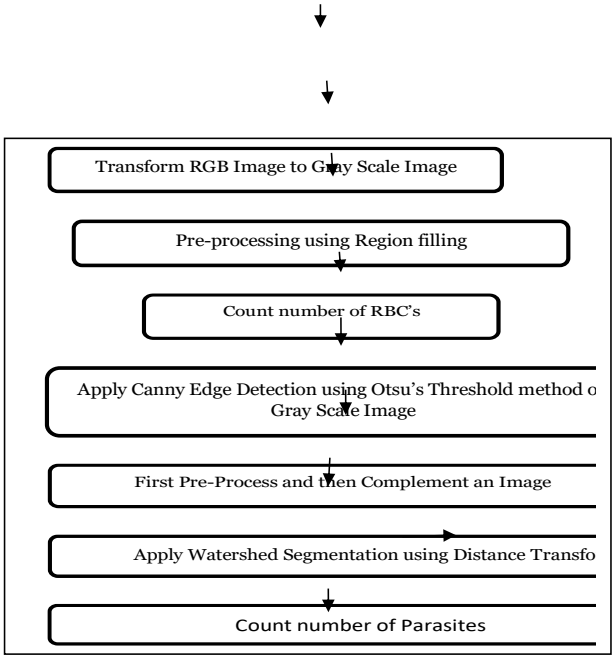

Fig. 2. Proposed Model

So, we need to pre-process an image. After that segmentation task is performed and then feature extraction is done in which we will calculate number of parasites and then the ratio is calculated. After that regression is performed using SVM.

4 Results Obtained

Using MATLAB R@2020b software we will first implement ring parasite. Fig.3 represents the original microscopic image of malaria parasite of ring falciparum, fig.4 represents gray scale image of malaria parasite, fig.3 represents segmented image of malaria parasite using watershed segmentation using distance transform in combination with canny edge detection algorithm. In our work we are now going to calculate root mean square error, lowest the error better will be the model. We implemented our model using SVM classifier. Let us see the results:

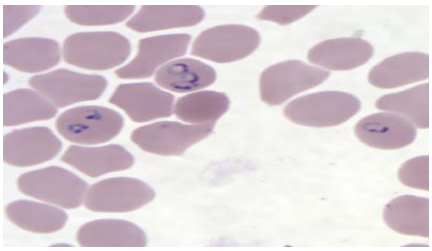

Fig. 3. Microscopic Image of Malaria Parasite

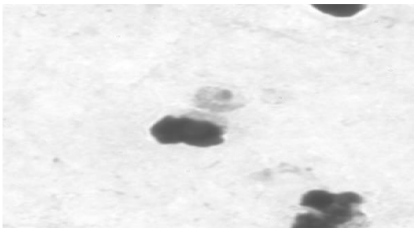

Fig. 4. Gray Scale Image of Malaria Parasite

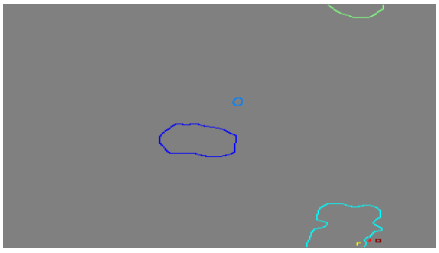

Fig. 5. Segmented Image

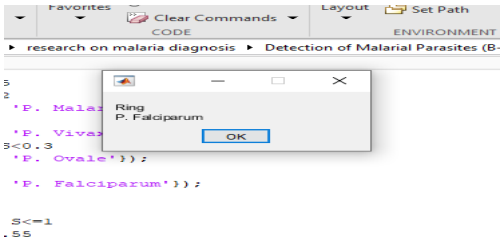

Fig. 6. Detection of Ring P. Falciparum

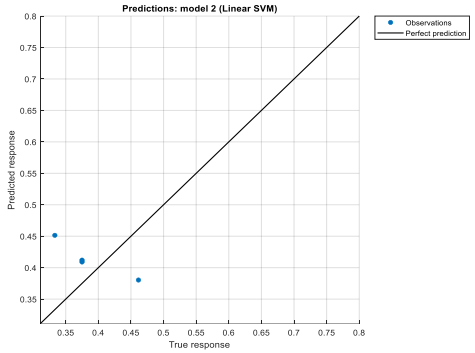

Fig. 7. Prediction Model of Ring P. Falciparum using Linear SVM

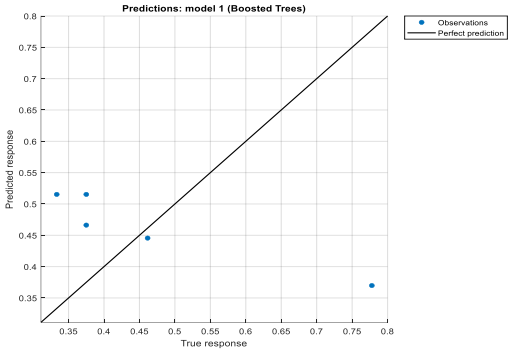

Fig. 8. Prediction Model Using Boosted Trees

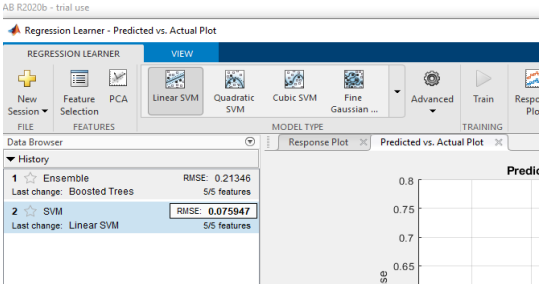

Fig. 9. Comparison of Ensemble Classifier and Boosted Trees

Here when we compare the results we came to know that using Linear SVM regression analysis we get less root mean square i.e. 0.075947, whereas using Ensemble regression analysis we get 0.21346 root mean square error. Lesser the error better will be the result. So, using. Fig, 9 we can say that our model is better and in fig. 6 we successfully detected the type of malaria parasite i.e. ring P. falciparum

5 Future Work

In future we can improve our work using large data set, as data set will be large result will be more accurate. We can also work on its specificity and also on sensitivity

References

[1] Raviraju, S. et al. (2015). The Classification and Recognition of Plasmodium Parasite in Prediction of Malaria Infected Blood Smears using Artificial Intelligence Technique. *International Journal of Advanced Research in Computer Science and Software* Engineering, 5(7).

[2] Tomari, R. et al. (2014). Computer-Aided System for RBCs Classification in Blood Smear Image. *Procedia Computer Science*, 42: 206-213.

[3] Bairagi, V. K. and Charpe, K. C. (2016). Comparison of Texture Features used for Classification of Life Stages of Malaria. *International Journal of Biomedical Imaging*, 2016: 7214156.

[4] Savkare, S. S. and Narote, S. P. (2015). Automated System for Malaria Parasite Identification. In *International Conference on Communication, Information and Computing Technology*.

[5] Vane, A. et al. (2016). Classification of RBCs using Image Processing to Detect Malaria Parasites. *International Research Journal of Engineering and Technology*, 3(4).

[6] Pandit, P. and Anand, A. Artificial Neural Network for Detection of Malaria in RBCs. https://arxiv.org/ftp/arxiv/papers/1608/1608.06627.pdf

[7] Acharjya, P. P. et al. (2013). A New Approach of Watershed Algorithm using Distance Transform applied to Image Segmentation. *The International Journal of Innovative Research in Computer and Communication Engineering*, 1(2).