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Identifying Dengue Virus in Blood using Image Processing Technology

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Abstract: ***Dengue fever is an endemic in Asia and East of the Mediterranean and Western Pacific. According to the World Health Organization (WHO), it is one of the diseases of greatest impact on health, affecting millions of people each year world wide, knowing that most of the world's population living in risky areas, in order to diagnose and treat the disease high skilled experts and human resources are needed. The main objective is to count platelets to diagnose Dengue Hemorrhagic fever using Digital Image Processing.***

Keywords: Image Processing, MATLAB, Preprocessing, Image Segmentation, Edge Detection, Green plane Extraction

I. INTRODUCTION

Dengue is a viral infection spread by mosquitoes. It's widespread in many parts of the world where as in most of people the infection is mild and passes in about a week without causing any lasting problems. But in rare cases it can be very serious and potentially life threatening. Symptoms of dengue usually develop suddenly 4 to 10 days after becoming infected like; a high temperature(fever), severe headaches, pain behind the eyes, etc. the symptoms normally pass in about a week, although patients may feel tired and slightly unwell for several weeks afterwards. In rare cases dengue can be very serious and potentially life threatening. This is known as severe dengue or dengue haemorrhagic fever. People who've had dengue before are thought to be most at risk of severe dengue if they become infected again. The word "Dengue" was derived from the Swahili expression Ka-dinga pepo that portrays the disease as being brought on by an evil spirit. The Swahili word dinga have its source from Spanish word dengue which means fastidious or cautious. Dengue virus appeared in early nineteenth century and was found common to all tropics and subtropics regions. There are five serotypes of dengue viruses DEN-1, DEN-2, DEN-3, DEN-4, DEN-5, with similar characters however genetic variations still exist within these serotypes. Dengue fever is the most common arthropod borne viral disease. It is one of the most important emerging disease of the tropical and sub-tropical regions, affecting urban and pre urban areas. For dengue patient monitoring, platelet count is vital to ensure early treatment in order to prevent disease complications. Therefore, the image processing and segmentation techniques are extensively applied to estimate the platelet count from the given blood slides, which ultimately lead to the accurate results.

Image processing applications can make it possible for machines to act more self -sufficient and ensure the quality of the products. The processing systems work faster than humans, it can give accurate results which is required. Image processing technology extracts information from the images and integrates it for the further process of the application. An image processing technique is the usage of computer to manipulate the digital image. These techniques have many benefits such as adaptability, data storing and communication. The image processing became quicker, inexpensive, and simpler to get the accurate results which are required.

II. PROPOSED SYSTEM

A. Objective and Methodology

The main objectives of the proposed system are to capture images of blood infected with dengue virus. In this Images of the blood smears infected with dengue virus are collected and examined under a digital microscope. The Leishman's stain characterizes the lymphocytes by a purple colour and the cytoplasm as a thin blue film surrounding it, To improve the quality of images using enhancement technique. Here By using image enhancement techniques like Green Plane Extraction and Contrast Adjustment the image obtained can be enhanced to improve the quality of the image, To detect virus in blood, segmentation technique is utilized. Using K-Means Clustering- segmentation of microscopic image is done to remove the other blood components and isolate the major component of interest, which are platelets. The K-means algorithm is a clustering method the separates a given set of data into various regions known as clusters based on a common characteristic, Automated platelet counting, Counting cells manually is a tiresome process for humans if given a large data set of microscopy images. This task can be achieved much faster by means of labelling techniques.

B. Design

A novel image processing technique to detect and count the platelets is proposed here. It is an efficient and simple technique to identify whether the patient is affected with dengue or not. The process done to extract platelets is displayed in the Fig. 1.

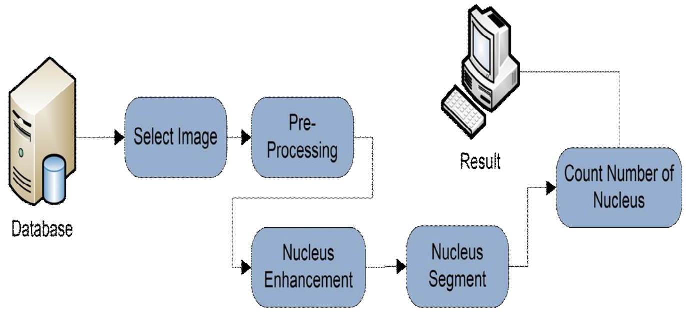

Fig. 1 Process Model

C. Flowchart

Fig. 2 shows the procedures to identify how dengue virus in blood by selecting the image of the blood samples where it undergoes with the preprocessing, enhancement, segmentation and finally the platelets are counted.

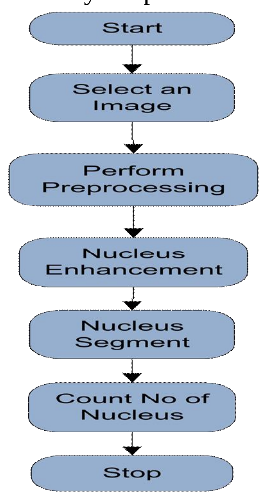

Fig. 2 Basic Flowchart

Fig 3. shows preprocessing flowchart. Poisson noise or Shot noise is a type of electronic noise which can be modelled by a Poisson process. Shot noise results from discrete nature of electric charge. Shot noise may be dominant when the finite number of particles that carry energy is sufficiently small so that uncertainties due to the Poisson distribution, which describes the occurrence of dependent random events.

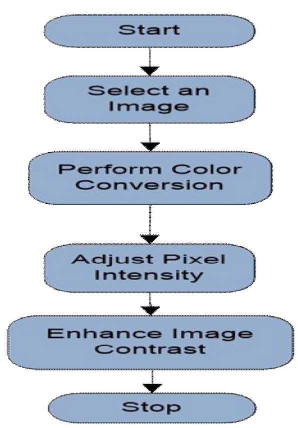

Fig. 3 Preprocessing

Fig 4. shows the flowchart for Nucleus Enhancement. The image is enhanced to improve the quality. Before segmentation the RGB color image is split into three planes such as red, green and blue. The green plane so extracted is clear with feature that we need to split platelets. So, the green plane of the imported image is taken for further process. The formula G = Img (:,:,2) is used to split green plane. The other two plane such as red and blue are not suitable for analysis with clear feature. The image may lack contrast when there are no sharp differences between black and white. To change the contrast or brightness of an image we make use of Contrast-limited adaptive histogram equalization (CLAHE). CLAHE works on little areas in the image, called tiles, as opposed to the whole image.

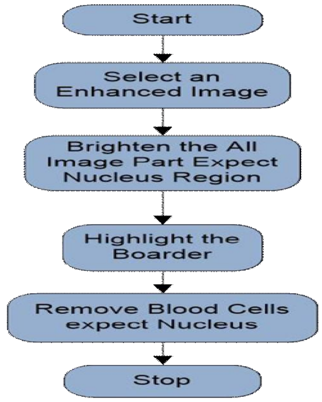

Fig. 4 Nucleus Enhancement

Fig 5. shows the flowchart for Nucleus Segmentation. The term image segmentation refers to the partition of an image into an arrangement of areas that cover it. The fundamental objective is to extract significant information the digital image. A global threshold (limit) can be utilized to change over the image intensity of a binary image. Binary images are typically obtained by thresholding a Gray level image. Pixels with a Gray level above the threshold are set to 1 and the rest are set to 0.

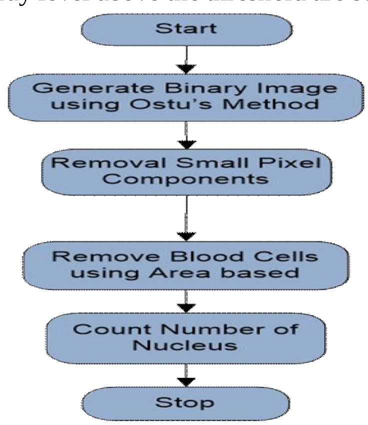

Fig. 5 Nucleus Segmentation

III. EXPERIMENTS AND RESULTS

Fig 6. is the original image of the blood sample where there are RBC, WBC, lymphocytes, cytoplasm, platelets and so on.

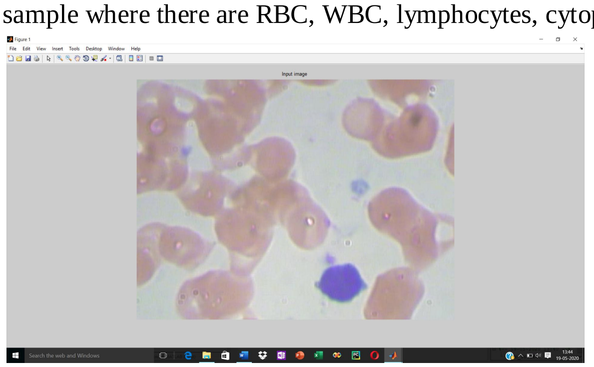

Fig. 6 Input Image

Fig 7 is the original image of the blood sample is converted into gray scale image from RGB color.

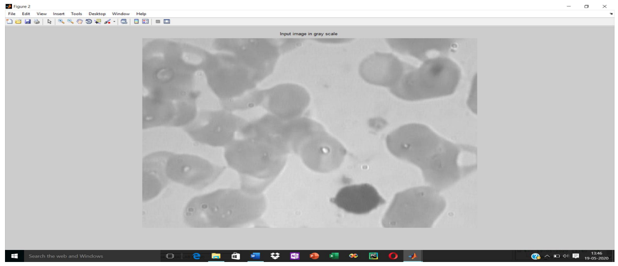

Fig. 7 Gray Scale Image

Fig 8 shows where intensity adjustment is done only because in the input image there will be multiple objects but it is mostly considered with only purple color of WBC.

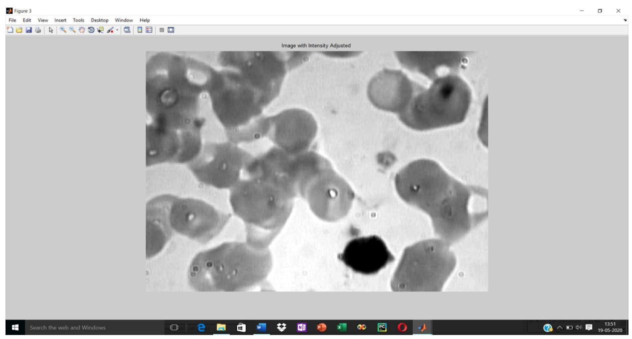

Fig. 8 Intensity Adjustment Image

Fig. 9 shows only brightening only with the nucleus part is done. Then trying to find the boundaries of the objects and then trying to obtain only the nucleus part of the image.

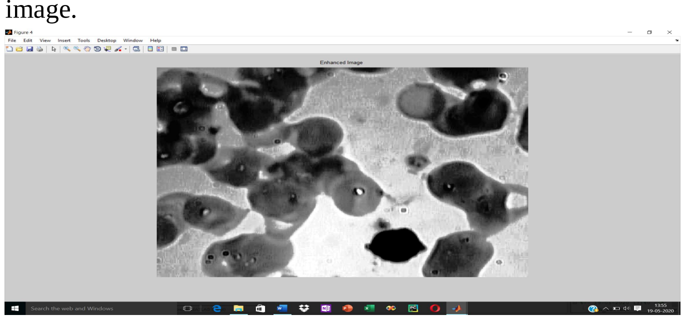

Fig. 9 Enhanced Image

In Fig 10 brightness of the image is done because it is given more importance with the nucleus of WBC and only that part can be easily identified.

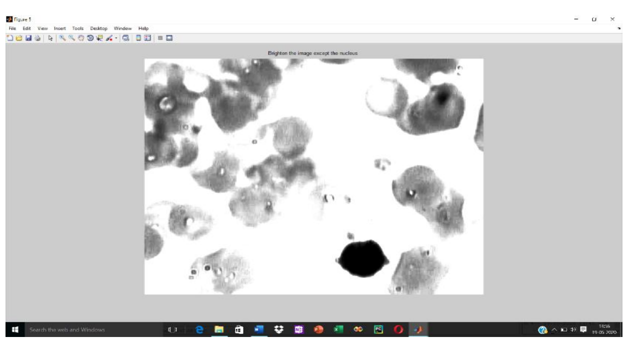

Fig. 10 Brightening the Image except nucleus

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In Fig 11 it shows the final segmented image of the blood sample in which only the nucleus of the WBC is obtained to count the platelets.

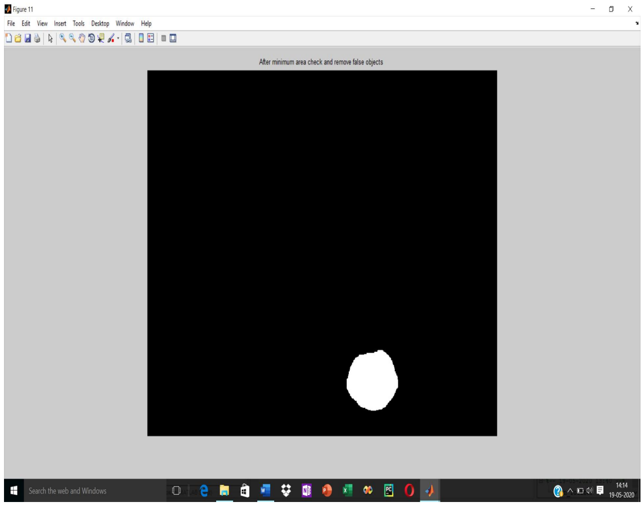

Fig. 11 Segmented Image

In Fig 12 it shows the result is obtained by passing the dataset as an input with obtaining the nucleus boundary and borders of all the objects and finally obtaining with the nucleus part of the WBC to count the platelets.

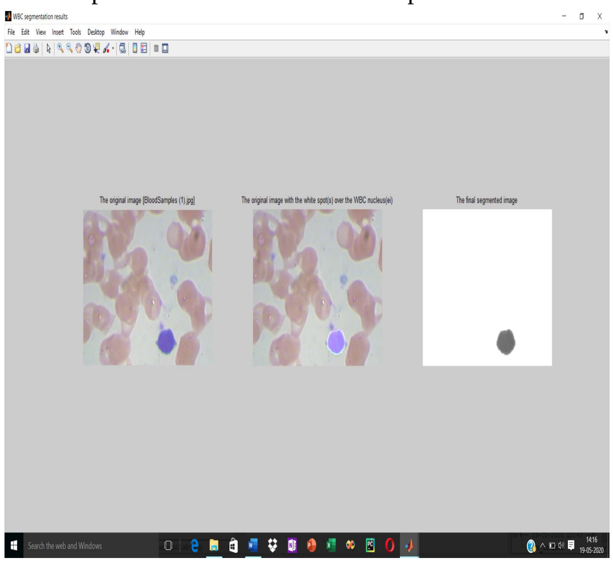

Fig. 12 WBC segmented results

IV. CONCLUSIONS

The survey of various image processing techniques are reviewed and that have been used to diagnose dengue. It is helpful to estimate the count of platelet using image processing techniques successfully. Compared with the manual counting of platelets the system has taken less time. Compared with the automatic analyser this system is cost efficient.

Through the use of various Image Processing Techniques, the platelet count of microscopic blood smear images is obtained and combined with an analysis of the symptoms present in the patient. The samples are then classified into three classes which is High probability of dengue, Moderate probability of dengue and Low probability of dengue.

The process is based on white blood cells and it avoids complexity and reduces errors. The steps involved are pre-processing, segmentation, feature extraction and classification. The microscopic blood images contain noise and it can be removed by low pass or high pass filter. The segmentation is followed by thresholding in which white blood cells is extracted. The nucleus is extracted by feature extraction technique.

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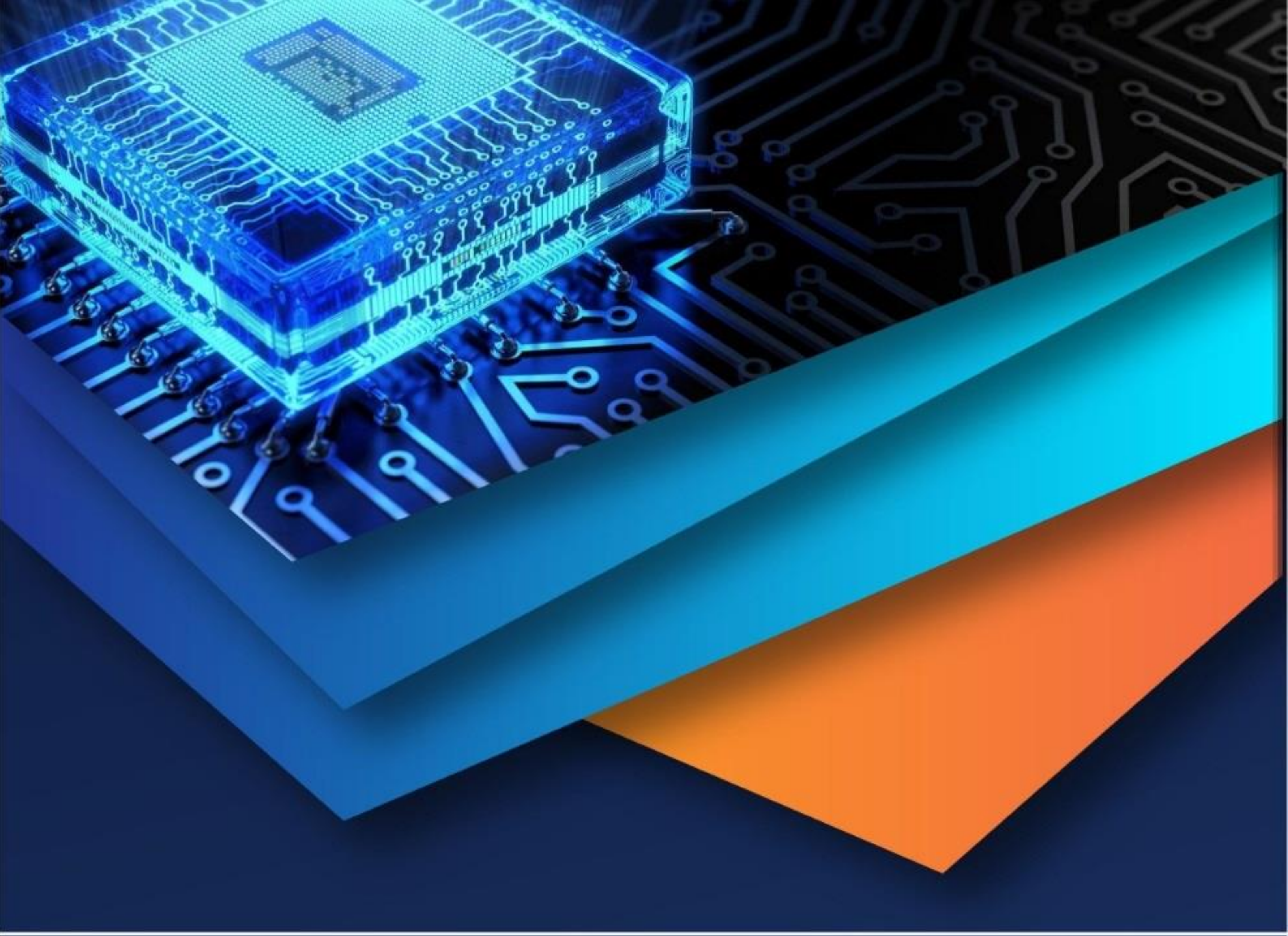

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