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Automatic Detection of Dengue Fever with Platelets Count Using Image Processing

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***Abstract*: Dengue fever is a one of the viral disease and it is an issue in many developing countries, including India. The main objective is to count platelets and also to check for certain symptoms in patients to diagnose Dengue Hemorrhagic Fever. Digital image processing is helpful to face this challenge. Segmentation techniques and image labelling are applied to investigate the number of platelets in microscopic image of blood smear. The platelet count is estimated using Segmentation and labelling techniques and also some major symptoms are identified to decide patient is having dengue or not. It replaces manual counting performed in primary health care centers and it does not require any experts.**

***Keywords*: Dengue haemorrhagic fever, Digital image processing; Morphological operation, Platelets count, Segmentation techniques.**

1. Introduction

Dengue has been predicted as one of the world’s major viral disease. Dengue is spread by Aedesaegypti mosquito. Dengue can affect independent of the age and sexual basis. Identifying dengue fever by manual methods in laboratories is time consuming. Many people are dying due to this DHF (Dengue Hemorrhagic Fever). Dengue has become a global problem since the Second World War and is common in more than 110 countries. Between 50 and 528 million people are infected and approximately 10,000 to 20,000 die each year. Its cause and spread were understood by the early 20th century.

Patients who have dengue can be treated effectively, if the fever is identified in the earlier stage. Platelets are the smallest of the three major types of blood cells. Platelets size is between 1-15 microns. An important function of platelets is clotting of blood. The ordinary platelet count is 150,000-350,000 for each microliter of blood. Scatters with low platelet checks are called thrombocytopenia, which is caused by viral disease. Estimated that the platelets size is under 30 pixels. In Dengue affected patient due to low platelet count clotting of blood does not happen. By the platelet count of the patient and with identifying some major symptoms of dengue, the dengue infection can be identified. The count goes low when illness becomes severe, and it becomes normal when the patient recovers from the infection. As a results our system aims to detect the dengue affected patient using microscopic image of patient’s blood smear. The infection can be distinguished using the blood image in just three to five days. In a small cases, the disease may cause life threatening DHF, leads to bleeding. The proposed framework makes utilization of morphological operations and also makes utilization of Otsu’s thresholding technique to split platelet and applies holes filling strategy to enhance picture for segmentation. Morphological operation is an arrangement of non-linear operations connected with the shape and elements in a picture. Blood smear contains diverse shape and size of cells. To identify such components, we require morphological operation. Morphology has a capacity to safeguard structure of cells.

Low levels of blood platelets and blood plasma leakage, or into dengue shock syndrome, where dangerously low blood pressure occurs. Ancient methods used for evaluating platelet count are by manual counting or by the use of Advia Hematology analyser. Manual counting entirely depends upon the technician’s skill that’s why it doesn’t give error-free results whereas Hematology analyser is very expensive device so it is not easy to install in underdeveloped or rural areas. To overcome these drawbacks, we have introduced an image processing technique which is highly cost-effective and reliable.

2. Literature review

White blood cell counting of the role of cell differentiation as a new feature that can classify dengue viral infections of patients via decision tree methods is done which is a tie consuming process [1].

SVM and two-layer feed forward network to detect dengue [2]. But the accuracy obtained is 70% and the system implementation is complex compared to our system. Only platelet counts are used to predict the dengue detection and the system has a limitation that the loss of a few platelets in segmentation process takes place [3]. Counting of platelets using Circular Hough Transform technique in which the system is dependent only platelets count [4]. The system detects RBC and WBC in blood to detect diseases like anaemia, leukaemia. But not platelet counts for detecting dengue disease [5].

3. Proposed system

An image processing technique to detect and count the

platelets is proposed in this paper. It is an efficient and simple technique to identify whether the patient is affected with dengue or not. The flow diagram of proposed system is displayed in block diagram in figure 1.

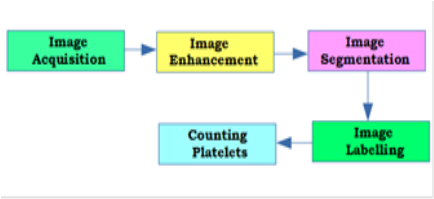

Fig. 1. Block diagram

A. Image acquisition

In this phase a digital image of blood smear is captured using a digital camera. A drop of blood is taken in a slide and monolayer of blood is prepared where the cells are divided sufficiently. Place a drop of immersion oil onto slide to be seen ensuring it is totally air dried subsequent to recoloring. Blend the Wright-Giemsa Stain and buffer blend to get ready with blood smears. The advanced camera is associated with a magnifying lens which catches tiny computerized picture of blood smear [6]. Caught picture is annexed to PC for examination.

B. Image Enhancement

In this phase captured image is enhanced to improve quality. It involves two processes.

1) Green Plane Extraction:

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.

2) Contrast Adjustment:

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. Every tile's contrast is upgraded using formula CA=adapthisteq(G).

C. Image segmentation

The fundamental objective of this phase is to extract significant information of 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 thresh holding a gray level image [7]. Pixels with a gray level above the threshold are set to 1 and the rest are set to 0.

1) Global Image Threshold using Otsu's Method

The contrast adjusted image is converted to binary image based on threshold. The gray thresh() function uses Otsu's strategy to produced image with black and white pixels. The binary image obtained is inverted i.e. background representing black and cells in it representing white.

2) Filling of Holes

One of the morphological operations called flood fill operation is performed on binary image. This operation repair gaps in the binary image. Flood fill in binary image changes connected background pixels (0s) to foreground pixels (1s), ceasing when it achieves object limits. Little openings and substantial gaps are isolated utilizing fill holes operator. Here the platelets are considered as little gap and it effectively extracted from other blood cells.

D. Image labelling

In this phase image labelling is done. Image labelling is one of the image analysis techniques which can name the connected region in a binary image. Labelling checks the imported image and groups its pixels into components based on pixel availability.

E. Counting platelets

In this phase platelets are counted. Counting the cells manually 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.

4. Implementation

We implemented the system using MATLAB. GUI tool in MATLAB is used for designing the GUI.

A. MATLAB

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Image Processing Toolbox provided in MATLAB provides a comprehensive set of reference-standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development.

B. GUIDE tool

GUIDE, the MATLAB Graphical User Interface development environment, provides a set of tools for creating graphical user interfaces (GUIs). Guide tool is also used to Layout the GUI and also Program the GUI. The GUIDE tool provides various options including Push Button, Radio Button, Check box, Slider, List Box, Pop-up menu, Toggle button and panel.

5. Results

On blood smears blend with Wright-Giemsa stain, platelets become visible as purple color staining cells. The number of platelet counted will be used as input for calculation of total number of platelets present in per micro litre of blood smear. The platelet count calculation is done using following formula:

$$\text{Platelet count}/\mu L = \text{average count} * 15{,}000 \quad (1)$$

The platelet count obtained must be in the range of 150,000 to 350,000 for a normal person. If the person is dengue affected

then he have platelet count less than 150,000. Considering the platelet count and also from some major symptoms the system will give the result as positive. If some minor symptoms are present with less platelet count, the result will be given as the person is most likely to have dengue.

The blood smear images follow every steps of image processing techniques, which are given below.

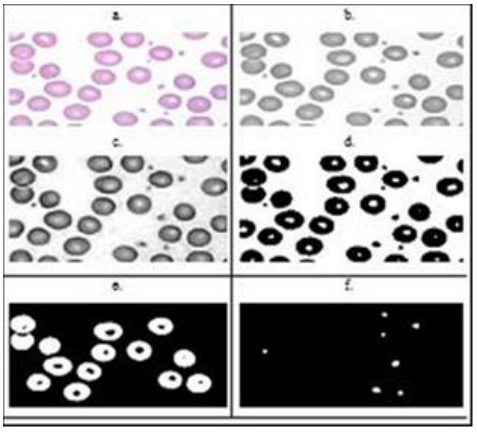

Fig. 2. a) Original image, b) Green plane, c) Contrast adjustment, d) Binary image using Otsu thresholding, e) Except platelets, f) 7--Platelet count

According to Figure 2, the blood smear contains 7 plate¬lets count which is normal (Figure 2.f); The patient is not affected by dengue.

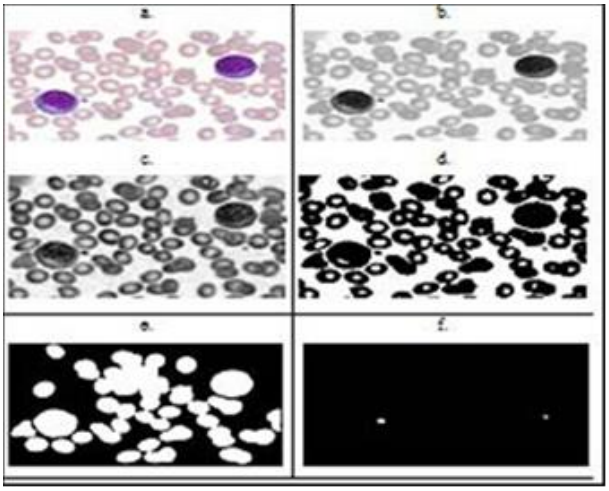

Fig. 3. a) Original image, b) Green plane, c) Contrast adjustment, d) Binary image using Otsu thresholding, e) Except platelets, f) 2--Platelet count.

Fig. 3.f Shows that the blood smear contains two platelets in that case the patient is affected by dengue.

6. Conclusion

The system is helpful in estimating the platelets count using image processing techniques. Compared with the manual counting of platelets the proposed system takes less time. Compared with automatic analyzer this system is cost efficient. The number of platelets count in blood sample of the patient alone is not used to identify the DHF in our system, some major symptoms of DHF are also considered to give the result whether is patient is affected by Dengue Hemorrhagic Fever or not. The final result will be positive or negative.

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