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A Hybrid Approach to Detect Dengue Virus Present in Blood Cell Images

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ABSTRACT

Huge number of implementation has been carried out to earnestly and quickly identify the disease in a blood cell image. The proposed system is focused on detecting the Dengue disease in which white blood cells are used as hosts. Nevertheless, owing to exceeding challenges and issues, WBC classification using decision tree is a flourishing area of analysis. Canny edge detector and Multi-level thresholding is used to have an enhanced image and the effected WBC's are extracted depending on the number of lymphocytes and phagocytes present in it. Then, morphological operations are carried out, after which the extracted WBC are tested for the presence of dengue by using Decision Tree Classifier.

Key words: Multi-level thresholding, Decision Tree Classfier

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1. INTRODUCTION

Huge amount of information will be embedded in a blood stained images. Recent studies have shown immense interest in extracting data from images. Content can be in many different forms such as, objects, colour, texture, shape and relationship between them. Image gives us the semantic information that can be used for content based image retrieval and will be also helpful in indexing and classification. The diagnosing of blood illnesses assumes a vital part in the proper location and curing of ailments in the medicinal field and subsequently ensuring and sparing the human life.

Dengue is the hazardous illness, caused by the mosquito degree in the body of human and prompts mortality. Dengue is otherwise called bone breaking sickness. Dengue contamination has imperilled almost two billion populaces all through the world. Dengue is separated into two kinds as sort 1 and sort 2 to be specific Dengue Fever (DF) and Dengue Hemorrhagic Fever (DHF) by the World Health Organization. It causes stomach torment, drain, circulatory crumple, intense platelet inadequacy. The indications of dengue incorporate dying, low levels of blood platelets, low circulatory strain and metallic taste in mouth, migraine, joint torment and rashes. It is hard to separate dengue fever and dengue hemorrhagic fever. The ailment transmission happens when AedesAegypti mosquito nibbles a solid individual; the infection goes into the body liquids of that individual. At that point it begins recreating inside the white platelets and starts the dengue infection cycle.

Dengue fever is a viral ailment and also a noteworthy issue in numerous creating nations, including India. The fundamental target is to recognize and tally platelet in order to analyze Dengue Haemorrhagic Fever. Division methodologies and morphological undertaking are associated with look at the amount of platelets which is used to break down dengue using the minor picture of blood spread. The platelet check is assessed using distinctive Segmentation techniques and morphological exercises and with the help of the platelets count dengue fever sullying is perceived. One of the morphological assignments called surge fill is utilized to distinguish platelet with platelet measure. In various basic restorative administrations centers platelet counting is regularly performed physically, which is amazingly troublesome and requires ace lab pro. This strategy needs a mechanized camera attached with regular opening up amplifying instrument where the moved camera is connected with PC. The cost of the proposed equipment is taken a toll productive.

In this paper, the main two components of WBC namely lymphocytes and phagocytes are identified and some of the morphological operations are applied in order to detect the virus affected cell from it.

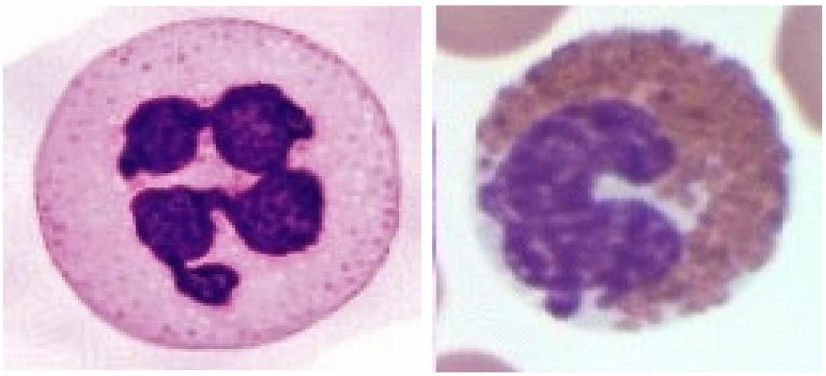

Fig. 1 Samples of phagocytes images

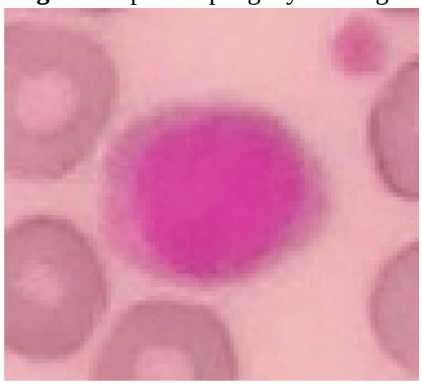

Fig. 2 Sample of lymphocyte image

Here in this paper, we have used median filter for pre-processing. In order to obtain edge features from the image, some of the morphological technique is adopted. These features are used to train decision tree classifier. For testing, some of the features are measured and database are created and dilation is applied on the transformed image. Then, connected component analysis is carried out and then affected dengue virus cells are detected.

The rest of the paper is organized as follows. We discuss related work in Section II. Section III explains proposed method. Section IV describes experiments and results. We finally conclude by using percent accuracy to measure the effectiveness of our work.

2. LITERATURE SURVEY

Many algorithms have been proposed for recognizing disease affected cell in a blood image. Each method gives robust results for specified set of images.

Tantikitti *et al* [1] proposed a system that focuses on detecting the Dengue disease in which white blood cells are used as hosts. Canny edge detector and Multi-level thresholding is used to have an enhanced image and the effected WBC's are extracted depending on the number of lymphocytes and phagocytes present in it. Then, morphological operations are carried out, after which the extracted WBC are tested for the presence of dengue by using Decision Tree Classifier.

Alfred R. J. Katz [2] plans to demonstrate that the discovery and order of white platelets can be completely computerized. Multi step process is built, comprising of the extraction of a district of enthusiasm from a bigger picture around thresholded cell cores, the division of that picture into cell and non-cell locales utilizing Canny edge location took after by a circle ID calculation, extraction of a list of capabilities in view of cell shading, estimate and atomic morphological data, and utilization of a classifier. The execution of various classifiers was contrasted utilizing the separated list of capabilities with figure out which could accomplish the most minimal mistake rate on a typical informational collection removed from 206 pictures of white platelets.

Subitha and Padmapriya [3] explored that mining learning from a lot of spatial information is known as spatial information mining. It turns into an exceptionally requesting field on the grounds that immense measures of spatial information have been gathered in different applications extending from geo-spatial information to bio-restorative learning. The database can be grouped from multiple points of view contingent upon the bunching calculation utilized, parameter settings utilized, and different components. An effective thickness based kmedoids grouping calculation has been proposed to defeat the disadvantages of DBSCAN and kmedoids bunching calculations. The outcome will be an enhanced variant of kmedoids bunching calculation. This calculation will perform superior to anything DBSCAN while taking care of groups of circularly appropriated information focuses and marginally covered bunch.

Poornima and Krishnaveni [4] proposed work in view of morphological activities and division strategies. Blob preparing (method went for recognizing objects in a computerized picture) is utilized to distinguish and check platelets. The calculation used is coded as a piece of c-sharp using visual studio. The accuracy of result made as 91.7%. Low precision

result involvement in low determination picture. The framework Offered distinctive structure for distinguishing and checking RBC, WBC, and Platelets. Change of picture is through histogram adjustment.
The novel philosophy called Circular Hough Transform technique (CHT) is used to recognize and to check RBC and platelets. To perceive WBC division draw in with morphological techniques are used. Naming calculation is useful in tallying WBC. The exactness in light of picture determination is utilized in division procedures to distinguish sickle platelet. Round hough change used to recognize and check typical platelet. Morphological tasks are utilized to separate RBC and WBC. The device that utilized shows 92% exactness.
Joshi *et al* [5] enhanced the understanding of conclusion to different picture handling programming which are produced to extricate valuable data from restorative pictures. Hematologist makes the tiny investigation of human blood which prompted a need of techniques, including magnifying instrument shading imaging, division, grouping, and bunching that can permit the recognizable proof of patients experiencing leukemia. Leukemia is connected with impact white platelet (WBC). The nonspecific nature of the signs and indications of ALL frequently prompts wrong analysis so hematologist additionally discover trouble for impact cell grouping consequently manual order of platelets is tedious and powerless to blunder. Thusly quick, exact and programmed distinguishing proof of various platelets is required. Otsu's limit platelet division strategy is proposed alongside picture improvement and number juggling for WBC division. kNN classifier has been used to arrange shoot cells from typical lymphocyte cells. The framework is connected for 108 pictures accessible out in the open picture dataset for the investigation of leukemia.

3. PROPOSED SYSTEM

This section describes the modules of the proposed system which includes pre-processing of the image, detection of edges and noise removal, calculating features for training the dataset, morphological operations and thresholding, connected component analysis and extracting accurate part from the image.
The proposed method is developed to extract the effected WBC from complex background and also from image that is affected by uneven lighting conditions. This method has two phases: training and testing phase. In training phase, pre-processing is done to the input image. Canny edge detection algorithm is used at the training phase to locate strong edges. Next step is to extract features from the image which includes Area, Roundness and HCT. Along with these three features, one of the statistical feature i.e., standard deviation is also computed. In testing phase, Decision Tree Algorithm is applied on the obtained edge detected image that gives us the components of WBC. Morphological operations are applied on those components. Connected components analysis is carried out based on the geometrical properties. Then potential content regions are detected with the help of trained Decision tree classifier. The overall architecture of the system is depicted in Fig. 3.

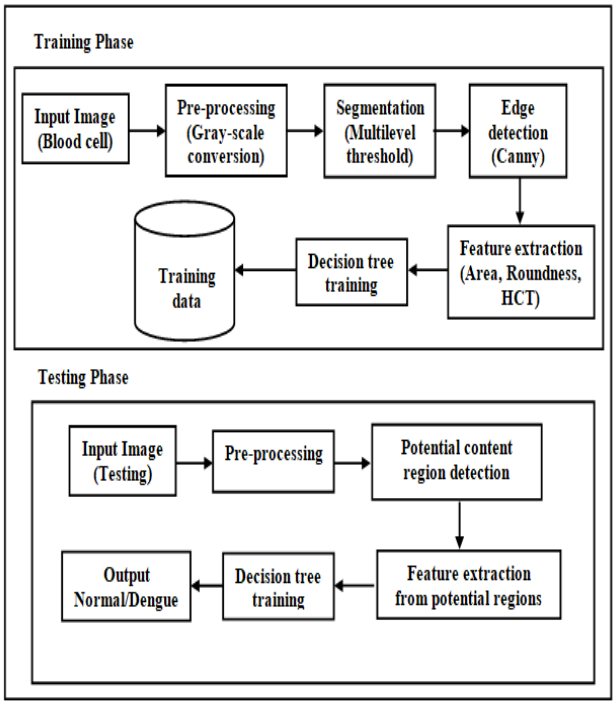

Fig. 3 System architecture

3.1. Pre-processing

In pre-processing stage, input colour image which is used for training the decision tree will be the input to the training phase of the system. The main goal in pre-processing is to enhance the image quality. Then, this input image will be

transformed into gray scale image which will decrease memory requirements. This conversion is carried out because inherent complexity of gray scale image is less than the colour image. Multi-level thresholding is applied on the gray scale image for noise removal and for preserving sharp edges. These pre-processing steps will help in easier text detection. The robustness of the approach can be improved and fluctuations can be removed by applying a histogram equalization function. Correlation between the color channels can be reduced. The converted image can be calculated with separate H, S and V values. As they treated as separate channels they are not correlated. The HSV can be expanded as H as hue S as saturation and Vas intensity. Saturation represents tit in color. This is human perception of lightness. In the software the color is considered as hue and saturation.

3.2. Segmentation

Image segmentation is used to divide the images into meaningful structures. It is one of the steps in image processing. Otsu's Global Threshold is used for segmentation. Using thresholding method binary images can be created from the gray scale image. It is an iterative process where possible threshold values are considered and the degrees of the pixel values are computed. The pixel values are computed in such a way that it either follows in the foreground or background. The objective is to get the threshold value as a minimum spread by considering the sum of foreground and back ground spread of pixels [6].

3.3. Edge Detection

Next stage in the training phase of the project is to detect edges. This technique efficiently identifies the points in the image that causes sharp changes in it. These changes can be because of brightness or any other uneven lighting conditions. This method arranges the identified points with the set of bended line portions which are called as edges. Step detection discovers the discontinuities in single dimension whereas change detection discovers over time. It determines some properties of the image. Different types of edge detection techniques are available. Here in this project, canny operator is used. Compared with other edge detection method, Canny edge detector is efficient because, Canny edge method will detect every edge.

3.4. Feature Extraction

In order to train the Decision Tree, potential features are extracted from the blood cell images. These extracted components are classified as dengue or normal based on these features. It is one of the important characteristics that are used to identify the region of interest in the image. It is the statistical method of extracting content features. From this matrix, different content features can be extracted. Here in this project, four important features are extracted namely, Area, perimeter centroid and circularity in order to train the Decision Tree classifier.

Area, perimeter centroid, circularity are the characteristics of lymphocyte cells that is used to differentiate the blasts. Area of the WBC is calculated first and then the area of the WBC nucleus is considered. The number of pixels in the WBC nucleus is calculated.

3.5. Potential Region Detection and Decision Tree Classification

In testing phase, image to be tested will be pre-processed initially. Input test image will be converted from colour image to gray scale image. Then, Canny edge operator is applied on the edge map. Decision Tree algorithm is used for classification Decision Tree is powerful and robust algorithm based on Vapnik–Chervonenkis theory. Decision Tree classifier is used to make predictions on unknown samples. It uses supervised learning. Known class labels are used to indicate the performance of the system. Decision Tree is trained on various streams of input images and then it is validated [7].

3.6. Dengue Classification

In the proposed system, there are two types of classification involved. They are WBC classification and Dengue Classification. In WBC classification, lymphocytes and phagocytes are taken as input to be classified. These two main components of WBC are classified based on some of its important features such as height, width, area and roundness. WBC region that is extracted from connected component analysis method will be the image that is cropped from the original input image. Feature extraction process will then be carried out for these cropped images.

In Dengue classification, the numerical values of all the cells present in the blood smears play an important role. Calculation is done for the number of phagocytes, lymphocytes, presence of these two components in percentage along with HCT. Then the trained Decision Tree classifier will group them as normal or Dengue based on the training given to the system.

4. RESULTS AND ANALYSIS

The experiment is carried on different types of images having different types of disease affected blood cell images.

4.1. Results for Input Image

Input to the system is RGB image. Input image is depicted in Fig. 4.

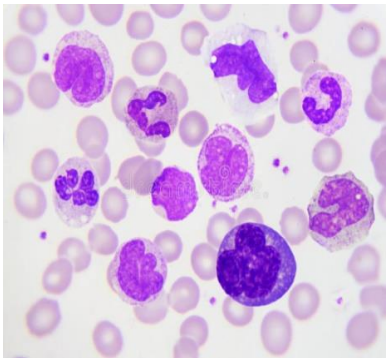

Fig. 4 Input RGB image

Input RGB image selected for testing will be pre-processed i.e., converted to gray scale image and Then, this image undergoes many pre-processing techniques, where it is enhanced in order to improve the quality of picture. The enhanced image is shown in the Figure 5.

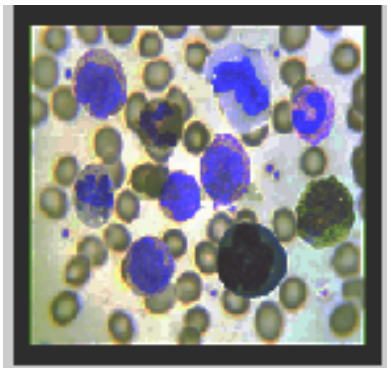

Fig. 5 Enhanced image

Then RGB image will be resized and then converted to HSV image. HSV image of the given input image is shown in Fig. 6

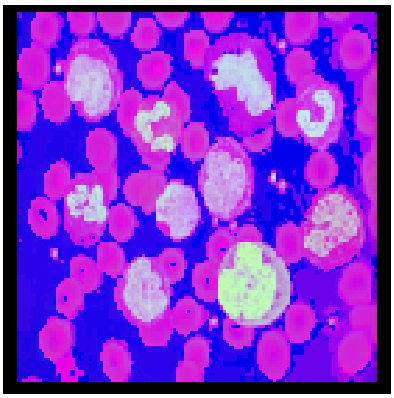

Fig. 6 HSV image

After obtaining HSV image, Image segmentation is used to divide the images into meaningful structures. It is one of the steps in image processing. Otsu's Global Threshold is used for segmentation. Segmented image of the input image is shown in the Fig. 7.

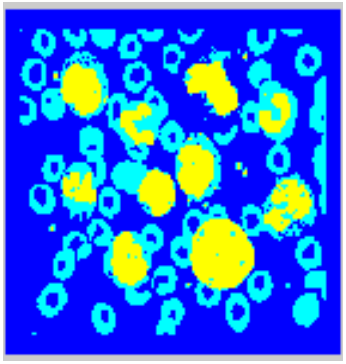

Fig. 7 Segmented image

From segmented image, White blood cells are extracted in order to detect the presence of disease in it. Canny edge detection method will be applied on it. Gray-scale image will be given to median filter. This is done to remove noise from the image to obtain better results. Input image after applying Canny edge detection method is shown in Fig. 8

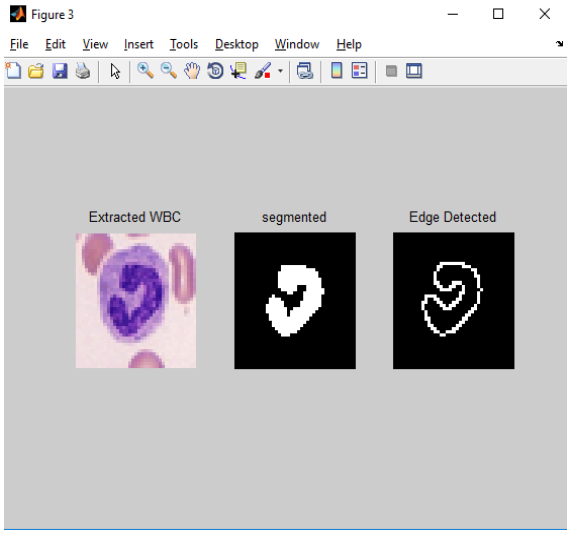

Fig. 8 Canny Edge Image

Once all the process gets completed, the final output is obtained by using Decision tree classifier. The output is displayed in the message box either as 'positive' or 'negative'.

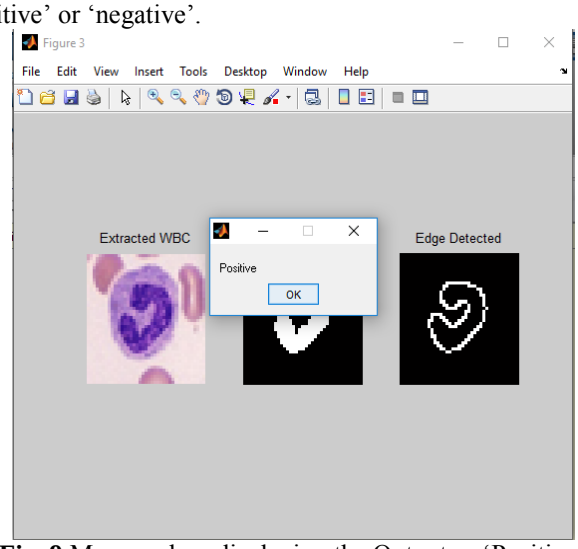

Fig. 9 Message box displaying the Output as 'Positive'

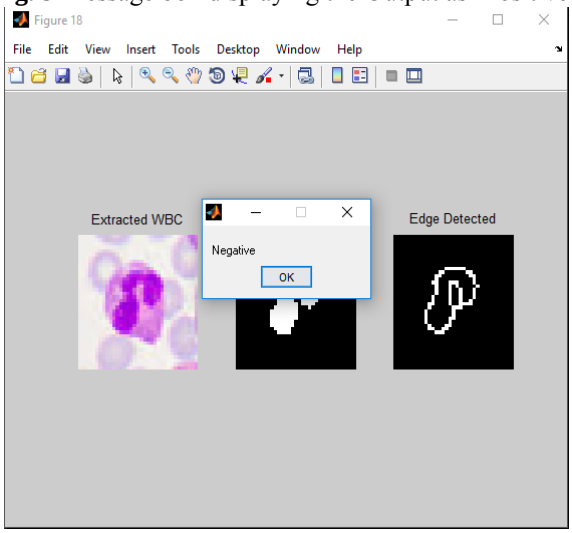

Fig. 10 Message box displaying the Output as 'Negative'

5. CONCLUSION

Detection of disease in a blood cell image with many other thousands of cells attached to the effected cell is a difficult, challenging and important problem. Here, a novel method is approached for the process of dengue affected WBC detection. For this purpose, canny edge detector is used to identify strong edges. For testing purpose, Decision tree classifier is applied. Dilation is carried out for the components that are obtained from Haar wavelet. After Dilation, WBC classification and Dengue Classification is done by using trained data. Then, connected components analysis is done and are filtered based on the set criteria to obtain effected WBC Cells. The proposed technique came out to be 92.4% of accuracy in WBC classification and 89.2% of accuracy in Dengue Classification, tested from 264 images of blood cell.

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