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Automated Disease Diagnosis Using Image Microscopy

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***Abstract*:** The finding of sicknesses utilizing microscopy is basic for medicinal services, and exact forecast. The count of WBC and RBC Cells are very important for the doctor to diagnose various diseases such as anemia, leukemia etc. At present, it requires a tremendous measure of human and financial assets. Hardware solutions like Automated Hematology Counter exits, they are very expensive machines and unaffordable in every hospital laboratory. To overcome these problems, this paper proposes an image processing technique to count the number of red blood & white blood cells in the blood sample image. Our methodology has been to consolidate the all-around created field of advanced imaging, image handling, and manual microscopy to acquire a powerful and minimal effort gadget. We utilize a low cost optical microscope retrofitted with computer controlled imaging and stage positioning modules, and perform MATLAB based image processing on the microscopic images to accomplish the wanted results. The blood cell count that is RBC & WBC count is then used to diagnose the patient as well as detection of abnormalities like leukemia.

The "Automated Disease Diagnosis Using Image Microscopy" puts to utilize different parts of Electronics and Telecommunication, essentially Circuit Design and Image Processing for the execution of the undertaking.

Keywords: Disease Diagnosis; Blood tests; Blood Cell Counting; Malaria Detection; Digital Microscopy; Image Analysis; Malady; RBC; WBC

I. INTRODUCTION

The impact and effect of advanced images on present day society is huge, and image preparing is currently a basic part in science and innovation. The fast advance in automated restorative image recreation, and the related improvements in examination strategies and PC helped finding, has pushed medicinal imaging into a standout amongst the most essential sub-fields in experimental imaging.

The current framework for counting platelets and identification of maladies is at medicinal lab or clinical research center. Setting up research center is immoderate issue and it is not cost productive to set it up in provincial and undeveloped zone of the nation. A restorative research center or clinical lab is a lab where tests are typically done on clinical examples so as to get data about the strength of a patient as relating to the analysis, treatment, and counteractive action of malady.

Considering the current framework, the malady identification is exorbitant issue and since pathology labs are not accessible at remote spots it additionally requires investment for illness discovery. Thus the undertaking planned to outline a minimal effort gadget for performing conclusive analytic tests for the vigorous location of basic therapeutic conditions, by utilizing image investigation systems on microscopic images of blood smears [2].

II. RELATED WORK

A. *Digital Microscope*

An optical microscope might suffice the requirement for basic investigation of test smears in research centers. Be that as it may, with regards to change over one into a uniquely crafted Microscope that can catch images digitally, endeavors should be put into [1]. Computerized extensions can be brought readymade, however they have a tendency to be either costly or of poor optical quality. A creative system would be utilizing a webcam since it can helpfully exchange images to a PC by means of USB. A microscope is intended to center the image on the back of your eye when one looks through the eyepiece. One can't simply stick a webcam straightforwardly onto the eyepiece, on the grounds that the webcam is likewise attempting to bring a image into spotlight on the sensor inside the camera, bringing about a sort of optical twofold inconvenience. In any case, if the lens is expelled from the webcam and held at the right separation from the microscope eyepiece, it can come about into a superbly framed image [3]. After evacuation of the lens and supplanting the ring, the appropriate measure of space is acquired between the camera and the item to bring the image into impeccable spotlight on the sensor. It is like planning a completely mechanized computerized Microscope so that the images can be straightforwardly seen on the PC screen instead of adjusting the concentrate unfailingly. This method has been made utilization of in the task in order to marginally adjust

the webcam with a specific end goal to enhance the nature of images acquired utilizing the same.

B. Blood Count Using Image Processing

Paper on Image-Based Red Cell Counting for Wild Animals' Blood, Claudio R.M.Mauricio presents an image based red platelet (RBC) programmed numbering framework for wild creatures' blood investigation. Images with 2048x1536-pixel determination gained on an optical microscope utilizing neubauer loads are utilized to assess RBC meaning three creature species (Leopardus pardalis,Cebus apella and Nasua) and the blunder discovered utilizing the proposed strategy is like that got for entomb spectator visual tallying technique, i.e., around 10%. Littler blunders (e.g. 3%) can be gotten in locales with less matrix ancient rarities. These promising results permit the utilization of the proposed strategy either as a complete programmed including apparatus research centers for wild creature's blood investigation or as a first including stage a self-loader checking device. This works can be stretched out to different species including people, who have comparative blood structure and characterizations.

G.P.M. Priyankara has proposed a quick and practical creation of platelet number reports is of central significance in the medicinal services industry. The customary technique for manual tally under the microscope yields off base results and put a grievous measure of weight on the Medical Laboratory Technicians. Despite the fact that there are equipment arrangements, for example, the Automated Hematology Counter, creating nations like India, Sri Lanka, Bangladesh and Pakistan are not equipped for conveying such restrictively costly machines in each doctor's facility research center in the nation. The paper titled An Extensible Computer Vision Application for Blood Cell Recognition And Analysis by Priyankara et al tosses light on the same and as an answer for this issue, this examination venture intends to give a product based financially savvy and an effective option in perceiving and breaking down platelets.

In this work, the cost viability is just while considering the product viewpoints. The precision of white blood include, particularly, differential check is low. The images were taken from microscope that uses Koehler light and lower end form of these, extents from 30,000 INR - 1,00,000 INR. There is part of degree for cost lessening.

C. Malarial Parasite Detection

Identify Malaria Parasite Using Pattern Recognition Technique by Isha Suwalka et al is an examination paper which proposes a remarkable strategy to consequently analyze the parasite's vicinity utilizing the calculation said which expends less time and labor as contrast with traditional strategies. Moving with the mechanical progression in the field of bio imaging handling this paper exhibits an imaginative advanced method distinguishing parasitic protozoa of the sort Plasmodium. Customarily, in clinical research centers the direct infinitesimal forecast of the parasite on the thick and/or flimsy blood smears are utilized for the finding of jungle fever. It includes accumulation of a blood spread, its recoloring with Romanowsky stains and examination of the Red Blood Cells for intracellular malarial parasites [6]. In blood tests, if the red corpuscles of vertebrates are contaminated by malarial parasites, they will have a particular shape which can recognize their vicinity. Late research has proposed that the state of the influenced red platelets can be identified utilizing the 2D snippets of the image of the contaminated cell. In this paper a calculation is executed to recognize the sort of parasite through their shading and shape. This strategy can identify the presence of intestinal sickness parasite inside of seconds and along these lines can supplant the ordinary techniques for recognition of jungle fever in biomedical applications and therapeutic science.

A paper titled Segmentation of Blood Smear Images utilizing Normalized Cuts for Detection of Malarial Parasites by Subhamoy Mandal et al introduces an upgraded standardized cut strategy for division of RBCs contaminated with malarial parasites utilizing fringe blood smears. The calculation is connected over different shading spaces to locate its ideal execution for minute blood smear images. The work is valuable in tele-pathology applications and can robotize the screening of intestinal sickness in rustic ranges where medicinal services labor is constrained.

III. SYSTEM DESIGN

The project aimed to design a low cost device for performing decisive diagnostic tests for the robust detection of critical medical conditions, by employing image analysis techniques on microscopic images of blood smears.

A. Objectives

The venture goes for accomplishing the accompanying objectives:

- Real Time Digital Microscopy
- Automatic Counting of:
  - Red Blood Cells
  - White Blood Cells
  - Platelets
- Automatic Detection of Malaria
- Above functionalities in a minimal effort plan

B. System Architecture

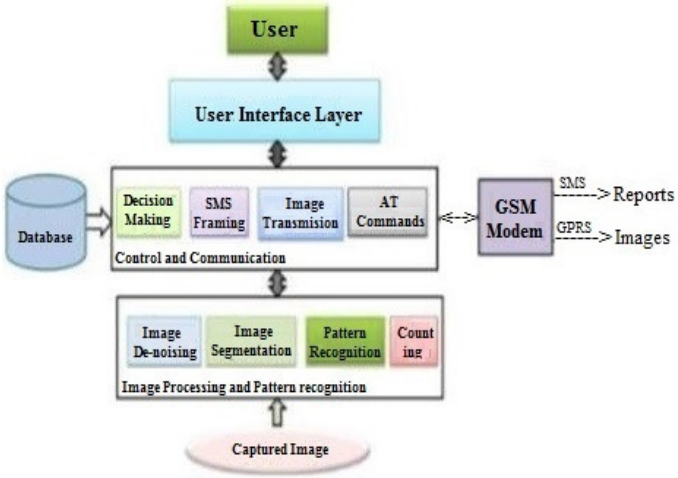

Figure 1: System Architecture

C. Hardware Architecture

To accomplish our ventures goal we require following:

- Real time digital microscopic imaging
- Automated slide positioning
- Robustness and Inherently low cost design

Taking a gander at the above prerequisites the accompanying equipment engineering was proposed:

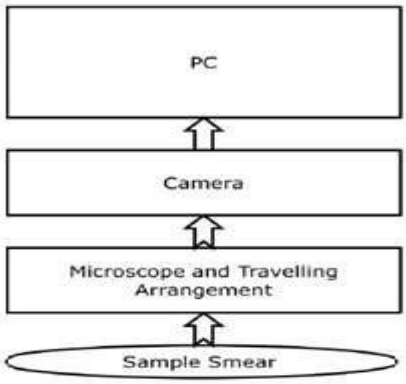

Figure 2: Hardware Architecture

Since digital microscopes are costly, it was decided to retrofit a low cost optical microscope. The following components is to be used,

- Optical Microscope: To obtain microscopic view of the slide
- Travelling Arrangement: For automated slide positioning
- Camera arrangement: To obtain digitized image on the PC.

D. Software Requirements

We use Mathwork's MATLAB Version 'R2011' for image processing.

IV. IMPLEMENTATION

A. Reading the Image of Blood Smear in MATLAB

This is the initial move towards the programmed estimation of RBCs in the given blood test smear. The stride includes taking a Human Blood Smear Image as the info, under a standard magnification of the Microscope. It reads a grayscale or color image from the file specified by the string filename. Second step includes transformation of a RGB image into its grayscale image [9]. Grayscale image needs contrast improvement. Contrast-limited adaptive histogram equalization is performed wherein bilinear interpolation is used to eliminate artificially induced boundaries. Background detection is performed by morphological opening of the grayscale image. Background is subtracted. After converting the image to Gray, for ease in processing during steps of noise removal, boundary extraction etc. the gray bits are converted to 1's and 0's (binary image) using thresholding [9]. The objects of interest (RBCs and WBCs) should be in white for purpose of counting.

In some cases cells are connected to each another, however for appropriate checking we require each and every cell to be totally disengaged from alternate cells. To defeat this issue we perform morphological opening followed by erosion of the image [8]. As output the associated cells are cut at different angles. The fringe touching cells are not to be considered as they are not totally inside of the image. Now, the image has RBCs as well as WBCs.

B. Counting RBCs and WBCs

Blood consists of three types of cells viz. RBC, WBC and Platelets. The size of RBCs is usually in the range of 7.5-8 µm in diameter. The WBC blood cells can be classified into five type's viz. lymphocytes, eosinophils, monocyte, neutrophils, basinophils. WBCs are biggest among the RBCs and platelets. The size of an average WBC varies in the range of 7-14 µm in diameter. The platelets are the smallest constituents in the blood. The average size of platelets varies in the range 2.65 to 2.9 µm in diameter. The image processing algorithm primarily exploits the sizes of the RBCs, WBCs and platelets and based on the sizes we separate the constituents and count them. The image processing algorithm needs to be robust enough to tackle the problem of cell clumping. If these issues are overlooked, the algorithm yields false results and it significantly affects the physician's diagnosis.

The very basic idea to overcome this problem is apply iterative erosion techniques to the clumped cells [8]. However the problem with applying iterative erosion technique is that it erodes cell objects of small dimensions

such as platelets. There is also a possibility that iterative erosion may reduce the dimensions of WBCs till that extent, where it may be comparable with the dimensions of RBCs. There are several robust techniques for overcoming the cell clumping. These methods are based on convexity analysis based on the geometry of the cell and are very complex. The image processing algorithm uses a novel technique to overcome the problem of cell clumping called selective erosion, i.e. applying erosion only to the most clumped cells instead of entire image. This greatly overcomes the problems associated with the iterative erosion technique.
The flowchart of the algorithm is demonstrated to read blood smear and counting RBCs & WBCs as follows:

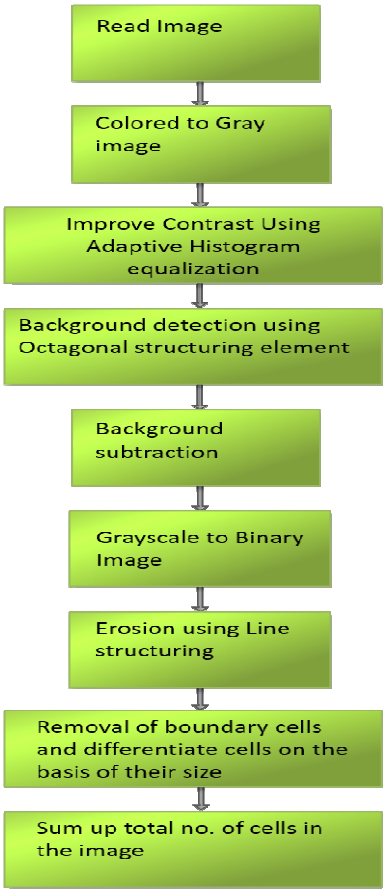

Figure 3: Flowchart to Read Blood Smear and Count RBCs &WBCs

C. Malaria Parasite Detection

Malaria parasite belongs to the family called plasmodium. It is an infectious disease which is mainly diagnosed by visual microscopic evaluation of stained blood smears [6]. As it poses a serious global health problem, automation of the evaluation process is of high importance. Here, we formulated a novel image processing algorithm to perform automatic malaria detection.
For testing malaria, giesma stain is utilized which stains the malaria parasite and WBCs [6]. Our algorithm exploits the stained portion and detects malaria. The WBCs and malaria parasite are distinguished based on their sizes. The original image which is in RGB format is converted into HSV planes. The stained portion's hue, saturation and intensity values are computed and this value is set as thresholds. Since WBC and malarial sites are stained, WBC and malarial sites are separated based on the size. After thresholding, only the malaria parasite sites are detected. The flowchart of the algorithm is demonstrated as follows:

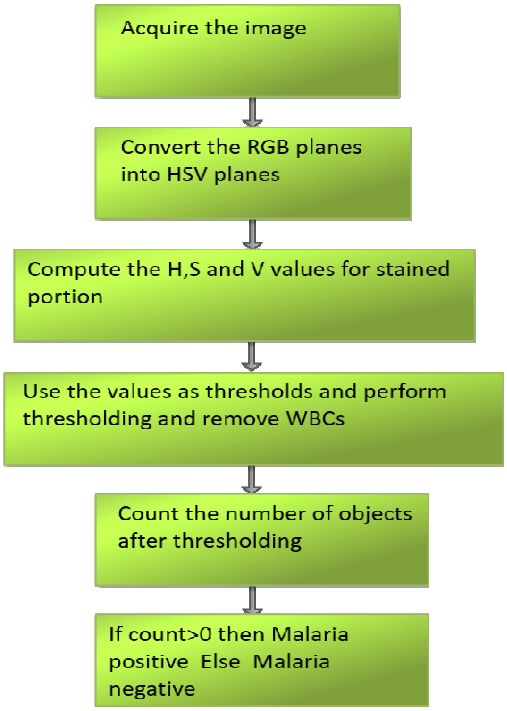

Figure 4: Flowchart Malaria Parasite Detection

V. CONCLUSION

After a point by point investigation of the present situation relating to the accessibility of a feasible low cost solution at the grass root level for detecting critical medical conditions, an appropriate problem statement was defined which aimed at developing a prototype that could conduct automated, fast and highly accurate blood tests. The device incorporates a unique image acquisition component along with a platform developed for further processing and tabulation of results. The Selective erosion greatly overcomes the problems associated with Cell clumping of RBCs and WBCs for counting of RBCs and WBCs.
The issue of staining of the malaria parasite and WBCs was resolved by thresholding the WBC and malaria parasite based on their sizes by the algorithm for Malaria Detection. After creating a database of about 600 images, we could accomplish the usual RBC, WBC and platelet count for each of these images with high accuracy and reliability. Also, as an added feature, detection of the malarial parasite was undertaken and an algorithm was devised for the same using MATLAB.

VI. FUTURE WORK

The system is solely and specifically designed to diagnose critical health complications at the grass root level and provide for associated medical / nutritional reference. The device prototype can be developed further to include the following functionalities, which shall add to its feasibility and render it tailor made to suit practical situations.
More diseases detection algorithm can be formulate for diseases like Anemia, Thalassemia, etc.

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