IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 8, Issue 3, Aug - Sep, 2020
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

CELL DETECTION AND SEGMENTATION IN MICROSCOPIC IMAGES USING CONTOUR ANALYSIS

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Abstract: To find out disease, pathologist usually needs to perform some preprocessing (like centrifugal), put it on respective plates, stain it (if necessary), adjust it under microscope and other required instruments (like illumination) and observe various blood elements and parameters, write them down, make necessary calculations and estimations and produce results. These results are usually in form of observed data and calculated diagnostics. These all process requires respective instruments and time of pathologist or specialist, for observing data. Sometimes, it might be tedious to do all things at straight go. They might get stressed with workloads, or have less time. So, with the use of Image Processing and technologies, this task can be lightened up as well as productivity can be boosted. possible disease or categorizations can be drawn based on diagnosed symptoms and structure of cells. Since, image captured from microscope would depend on microscope type, camera resolution etc., we have created a software tuned to particular microscope and microscope camera configuration. Then we apply image processing to quickly analyze the image and display results with probable disease, assisting pathologist in his work with the help of pre calculated results. Our system is designed for diseases which could be identified depending on cells morphological structure and thus the particular general algorithm was devised which could be modified and tuned to identify morphological based diseases found in cells .

Keywords: RBC morphology, 2d shape analysis, Edge detection, Monochrome Image, Binary object extraction

I. INTRODUCTION

In pathology labs, blood samples are analyzed for finding symptoms of possible diseases. The pathologist then, analyzes those blood samples under microscopes for some pattern in the cell, cell shapes etc. for uniquely identifies the disease symptom. This becomes tedious especially when huge amount of blood samples are to be analyzed. To simplify and reducing this work by pre analyzing samples from a computer. Following are some techniques you might think of using.

A. Texture Based Techniques

In texture-based methods, textures of different components of blood samples are considered. One of the drawbacks is it would require more resources like computational power, for performing texture analysis in literal senses. This technique for analyzing blood could be ideal for deep learning. This includes processes like information extraction, pattern observation and research.

B. Morphological Based Techniques

In morphological based methods, structures of blood elements are analyzed to check the presence of diseases. This can be achieved on RGB or other sensors. Staining or illumination can be done for better visibility, precision or just to disclose internal structure, not visible otherwise. For low power systems, conversion to monochrome, Boundary Value Analyses techniques can be in-cooperated for precision.

C. Color Based Techniques

These techniques, more focus is given on color rather than textures of elements or sample as whole. Color or color shade are analyzed in any particular part or as in whole for possible symptoms.

D. Ratio Based Techniques

In this technique, possible symptom of disease are observed by ratio of different interdependent elements. These can be RBC-WBC ratio, Plate-RBC, visible components in cell or their size ratio. This technique is generally used with other technique.

In our system we are incorporating Morphological analysis technique along with ratio-based techniques.

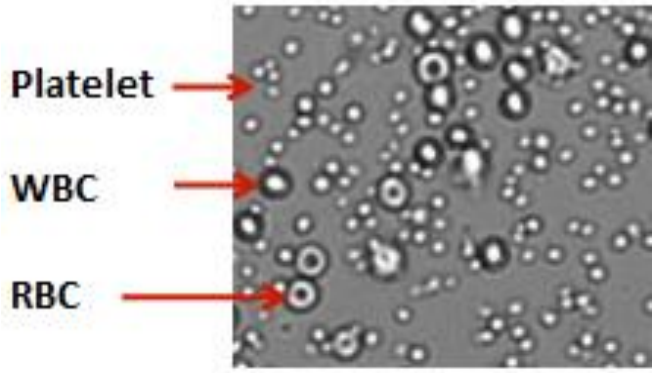

Fig 1. Components of Blood

II. METHODOLOGY

A. RGB2GreyScale

Our system initially accepts the image as input. Conversion of image to grey scale is performed. We aim for quick output and hence converting to grey scale helps in reducing any unnecessary processing. Entire system flow is shown in the figure given Fig. 2.

To convert image from RGB to grey there are 2 methods. First one is Averaging method and second one is Weighted method. Weighted method, results in more vibrant image although treats colors unequally. You could go ahead with any one of the techniques we implemented weighted method. Cropping and angle correction is performed before further preprocessing takes place.

Edge detection algorithms enhances boundaries on objects within image, thus helping estimating boundaries or edges i.e. detect the cells . Here, custom algorithm can be implemented which serves the purpose well or even better. parameters that could be considered to implement such are perimeter, area etc. which could help us distinguish the blood components as WBC, RBCS, platelets.

Hole filling would be required in case, you need to tune the parameters to increase accuracy. Various error correction methods based on aspect ratio, roundness were also implemented to improve the contour (boundary detection) and to eliminate any possible staircase errors and to eliminate objects which are not cells (E.g. a chemical spot on a slide).

C. Monochrome Image

It is straight forward to perform operations on Monochrome image than any other image (since, data is small i.e. white or black) therefore we convert to monochrome image. Binary object extraction can be implemented on these images. To get the total count of object found in the particular slide or image.

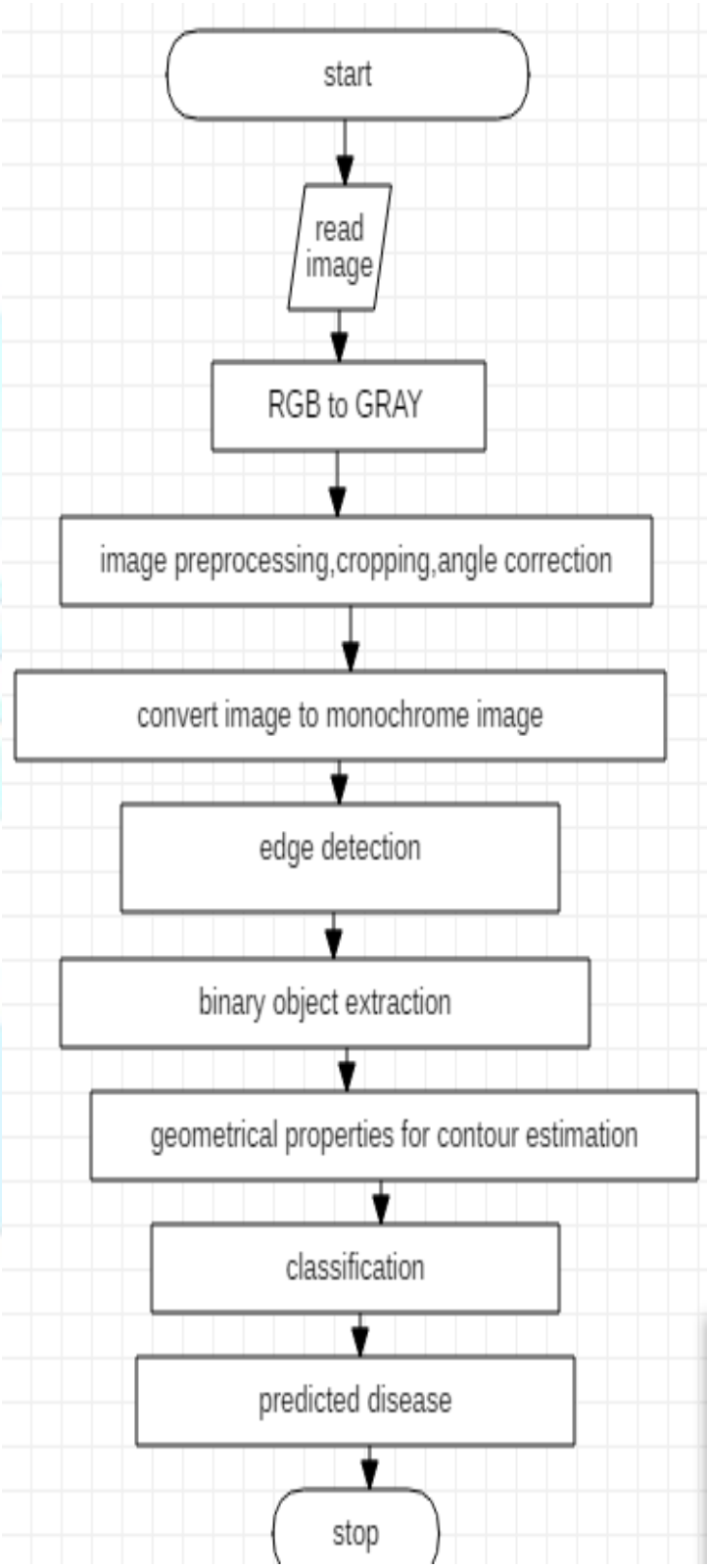

Fig. 2. System Flow

B. Binary Object Extraction

This operation refers filtering objects in monochrome matching our constrains or properties. By this, we filter out objects. Having required constraints. Here we tuned the algorithm such that it focuses on cells which are abnormal and generated the object count which needs to classified further.

E. Classification

Classification includes observing cell shape parameters like size, shape, major axis, minor axis, etc. with some threshold value to properly classify them within classes like macrocyte (larger cell, which may indicate a set of possible diseases) similarly sickle cells which may indicate Amnesia.

Basically, you need to study the cells on various parameters and tune them. Generally, such diseases only effect the RBC's you could even further has customize and eliminate objects using area as tuning parameter. Generally, size of RBC's is 6 to 8 micrometers parameter needs to be tuned according to the resolution of image you are working on.

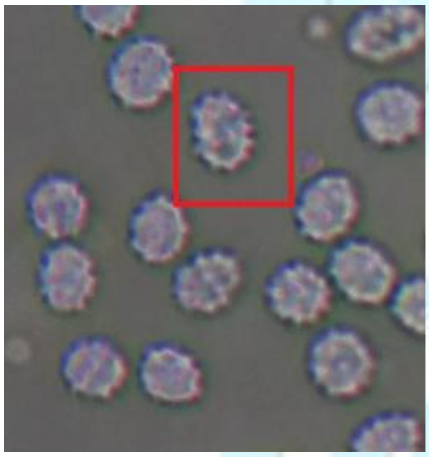

Fig.3 . Infected cells

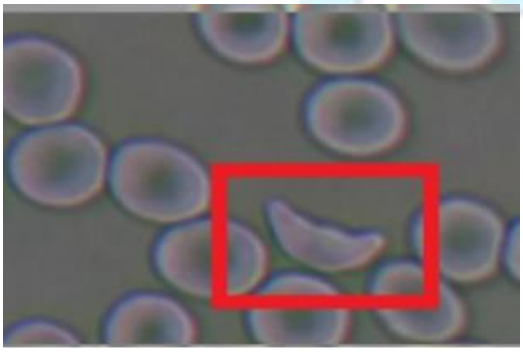

Fig.4. Sickle shaped cell

III. RESULT AND DISCUSSION

After running this software, we came across scenario where objects were improperly converted due to blur, under illuminated images. This caused software to predict weirdly.

To deal with this, set of error correction were introduced error in classification part. Some of them error correction implemented were as mentioned below

A. Size based

Random error minute pixels introduced in image after converting it to monochrome. By introducing a range, such error/object can be filtered out.

B. Aspect ratio based

Other than minute pixels, some curved error shapes got introduced. To filter this out, aspect ratio-based filter was introduced. Some libraries for shape analysis may not calculate. Aspect ratio accurately, so calibration is required. One must make sure that it doesn't overlap with existing disease detection algorithm. For E.g., sickle cell getting filtered out by these filters, where sickle cell detection was the purpose of whole image analysis software.

Our software generates a report in pfd format as its not possible to display every little detail on the screen user has to go through the report to get detailed analysis of the predicted disease

IV. CONCLUSION

The purpose of this project is to assisting pathologist by making use of image processing technologies. Since disease (specific) which we are trying to detect can be detected by using pure geometric structure, we reduce details by converting image to monochrome hence reducing processing overhead. Reducing color information reduces overhead, thus reducing RAM memory required and heat generated.

Speeds can be further increase if GPU is used. This project can be further modified to detect more blood-based diseases like Leukemia, Cancer, Amnesia by adding more geometry-based disease and studying more properties.

For other disease, color or other information should be

retained. Image processing helped us to create a light weight software with good overall accuracy and high speed. which could further be deployed over cloud or create a webapp hence not limiting the access of software to a particular device and still giving good performance without overloading or heating the device

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