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DIAGNOSIS OF COMPLETE BLOOD SAMPLE ANALYSIS USING IMAGE PROCESSING

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Abstract: In this work we propose an approach to select the classification method and features, based on the state-of-the-art, with best performance for diagnostic support through peripheral blood smear images of red blood cells. In our case we have used samples of patients with sickle-cell disease which can be generalized for other study cases. To trust the behaviour of the proposed system, we have also the overlapped cells into a single cell, one can get the exact blood count and all the relevant blood statistics like RBC and WBC etc. analyzed the interpretability. We have pre-processed and segmented microscopic images, to ensure high feature quality. We have applied the methods used in the literature to extract the features from blood cells and the Deep learning methods to classify their morphology. Finally, comparing the best performing classification methods with the state-of-the-art, we obtained better results even with interpretable model classifiers.

Key Word: Red blood cells, RBC and WBC, Morphology

I. INTRODUCTION

1.1 Over View of Researchers

The steps of segmentation in medical images plays a very vital role. While segmenting an image, it partitions the image into foreground and background regions. Proper diagnosis of the disease is not possible without appropriate segmentation technique. Image thresholding is an easy and efficient way of image analysis technique for segmenting an image. Thresholding is labelling of pixel as belonging to one or two (or more) classes. In broad sense, the thresholding methods are of two types namely global and adaptive (or local) thresholding. The thresholding technique which chooses only one threshold value to the whole image for segmentation is called as global thresholding.

This technique is computationally easy and fast. But, in case of noisy image or low contrast between the foreground and background, this technique fails. In many applications, a single threshold value is not sufficient and do not give appropriate results of segmentation for the whole image. Local or adaptive thresholding is very useful for such applications which uses different values of threshold for different areas of the image. In local thresholding, local characteristics of any region of the image are used for threshold value. In case of selection of local thresholds for each pixel (or groups of pixels) independently by splitting an image into sub images, the technique is called dynamic or adaptive thresholding

1.2 Red Blood Cells

Red blood cells carry fresh oxygen throughout the body. This is important to your health. Red blood cells are round with a flattish, indented center, like doughnuts without a hole. Our healthcare provider can check on the size, shape, and health of your red blood cells using a blood test.

Hemoglobin is the protein inside red blood cells. It carries oxygen. Red blood cells also remove carbon dioxide from your body, transporting it to the lungs for you to exhale.

Red blood cells are made in the bone marrow. They typically live for about 120 days, and then they die.

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1.3 Nutrition and red blood cells

Foods rich in iron help us to maintain healthy red blood cells. Vitamins are also needed to build healthy red blood cells. These include vitamins B-2, B-12, and B-3, found in foods such as eggs, whole grains, and bananas. Folate is found in fortified cereals, dried beans and lentils, orange juice, and green leafy vegetables.

1.4 Illnesses of the red blood cells

Most people don't think about their red blood cells unless they have a disease that affects these cells. Problems with red blood cells can be caused by illnesses or a lack of iron or vitamins in our diet. Some diseases of the red blood cells are inherited.

Diseases of the red blood cells include many types of anemia. This is a condition in which there are too few red blood cells to carry enough oxygen throughout the body. People with anemia may have red blood cells that have an unusual shape or that look normal, larger than normal, or smaller than normal.

Symptoms of anemia include tiredness, rapid heart rate, pale skin, feeling cold, and, in severe cases, heart failure. Children who don't have enough healthy red blood cells grow and develop more slowly than other children. These symptoms show how important red blood cells are to your daily life.

1.5 These are common types of anemia

Iron-deficiency anemia: If you don't have enough iron in your body, your body won't be able to make enough red blood cells. Iron-deficiency anemia is the most common form of anemia. Among the causes of iron deficiency are a diet low in iron, a sudden loss of blood, a chronic loss of blood (such as from heavy menstrual periods), or the inability to absorb enough iron from food.

Sickle cell anemia: In this inherited disease, the red blood cells are shaped like half moon rather than the normal indented circles. This change in shape can make the cells "sticky" and unable to flow smoothly through blood vessels. This causes a blockage in blood flow. This may cause acute or chronic pain. It can also lead to infection or organ damage. Sickle cells die much more quickly than normal blood cells—in about 10 to 20 days instead of 120 days. This causes a shortage of red blood cells.

Normocytic anemia: This type of anemia happens when your red blood cells are normal in shape and size, but you don't have enough of them to meet your body's needs. Diseases that cause this type of anemia are usually long-term conditions, like kidney disease, cancer, or rheumatoid arthritis.

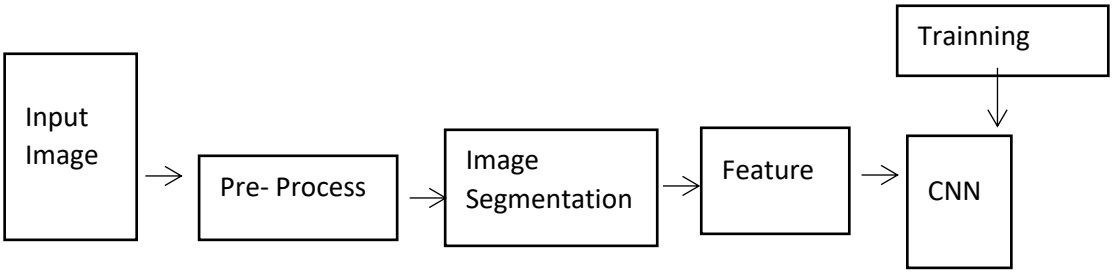
1.6. Challenges

The precise classification of sickle cell anemia in erythrocytes is a hard task in automatic medical diagnosis due to many challenges such as:
•Overlapping of cells
•Lack of training data
• Low contrast between cells and background
• Complex shapes and sizes of cells
• Required effective deep learning models for classification.
• Various staining processes.

II. SYSTEM DESCRIPTION

2.1 System Architecture

This figure shows the input image and preprocessed image, the input image is affected by some disease and the preprocess image is little brighter than input image in order to make the system better understanding.



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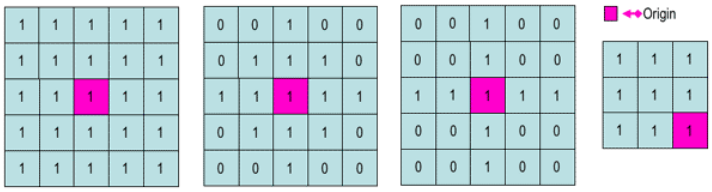
2.1.1 Image acquisition

First step in image acquisition is to capture the leaves using microscopic blood images of sickle cell aneamic. This stored images of the data base are load by specifying the path.

2.1.2 Image preprocessing

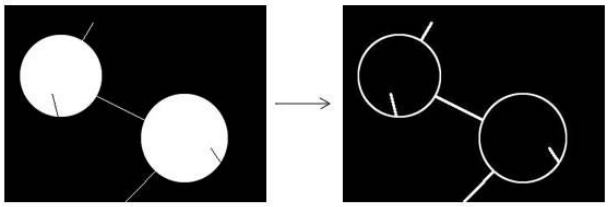
Preprocessing improves the quality of the image by removing unsought distortions. Clipping the images based on the region of interest (ROI), image smoothing and contrast enhancement are done here.



Examples of simple structuring elements.

2.1.3 Image segmentation

Image segmentation is the method of dividing an image into different sub images.here we use K- mean segmentation technique which uses hue estimation method for dividing and clustering the image. Since the green colour of the leaves is normal, abnormal sickle cells.



Morphological Gradient

2.1.4 Feature extraction

Interesting part of an image from where the required informations are extracted is called as feature extraction. The dimensions of the region of interest will be smaller than the original image. Gray level co-occurrence matrix(GLCM) is one of the best method for texture analysis. It uses second order statistics methods for estimating the image properties. GLCM calculates the pixel with a particular intensity or gray value occurs in the image. Resultant will be the sum of occurrence of the pixel with specific intensity in the spatial domain. Size of the GLCM will be based on the number of gray levels.

2.1.5 Classification

Classification used for image segmentation. Training our proposed models (explained in the next section) on dataset2, which has images that are in the same domain of the target dataset. Loading the pre-trained models. The first layers learned low-level features such as colors and edges, while last layers learned task-specific features. Replacing the final layers with new layers to learn features specific to the target task. Training the fine-tuned models with the target dataset, which is Dataset 1 Predicting and evaluating the model accuracy. Deploying the results. Each convolutional layer in the model is followed by batch normalization and Rectified Linear Unit (ReLU) to speed up the training process and to prevent vanishing gradient problem.

2.2 Data Flow Diagram

The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.

1. The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
2. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

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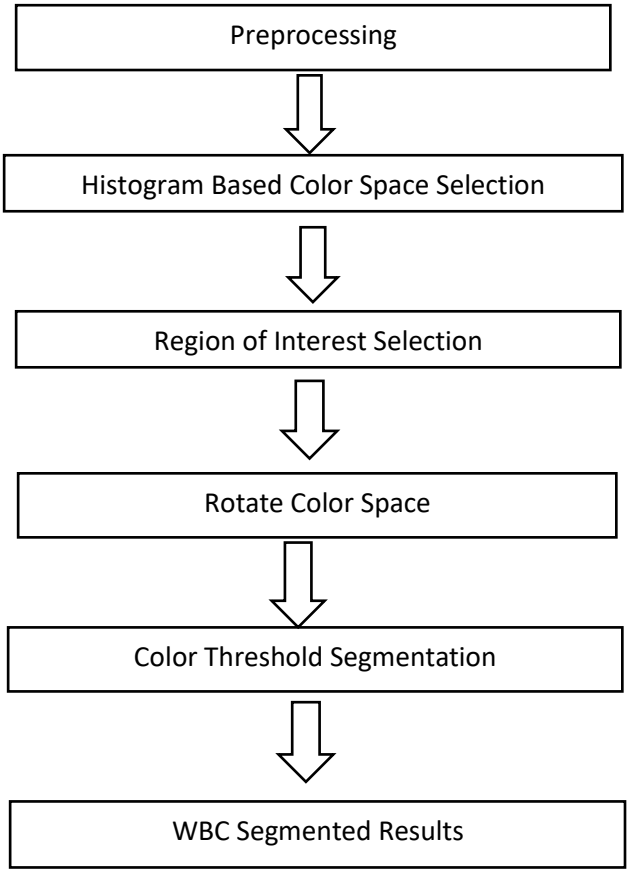
3. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.



2.3 UML Diagrams

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group.

The goal is for UML to become a common language for creating models of object oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems.

The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems and it is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

2.4 Goals

The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
2. Provide extendibility and specialization mechanisms to extend the core concepts.
3. Be independent of particular programming languages and development process.

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2.5 Use Case Diagram

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.

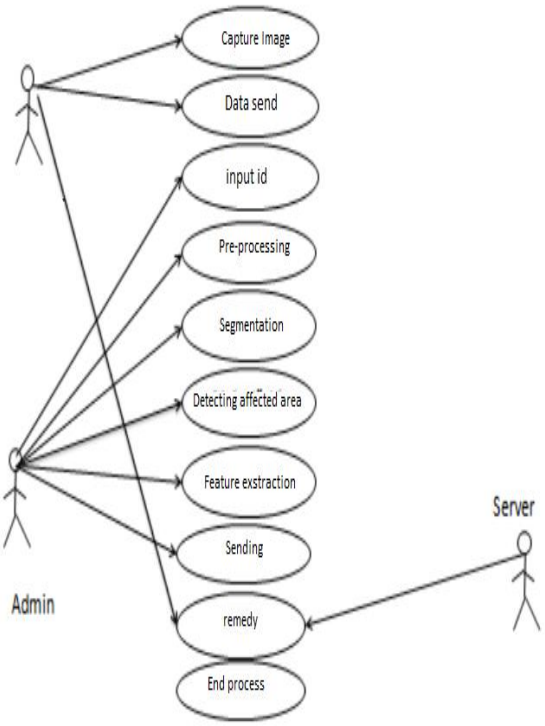

Figure:5.5 Use Case Diagram

2.6 Class Diagram

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

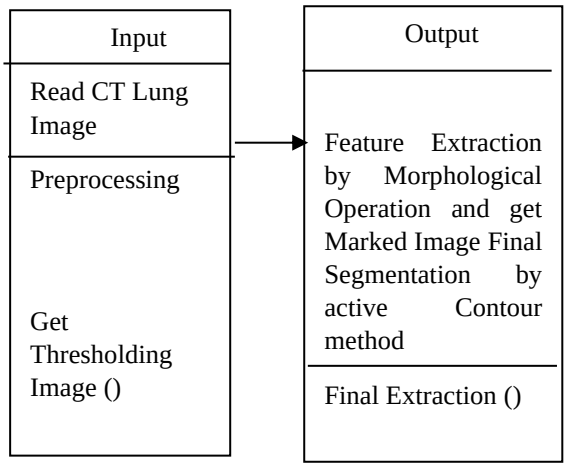

Figure:5.6 Class Diagram

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2.7 Sequence Diagram

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

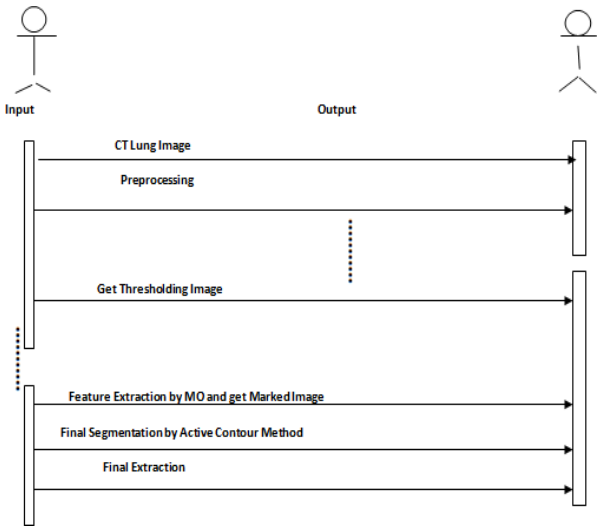

*Figure:5.7 Sequence Diagram

2.8 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control. Every image in the database stores a device URL against it which is used for sending notification to the corresponding the farmer who posted the image for suggestions

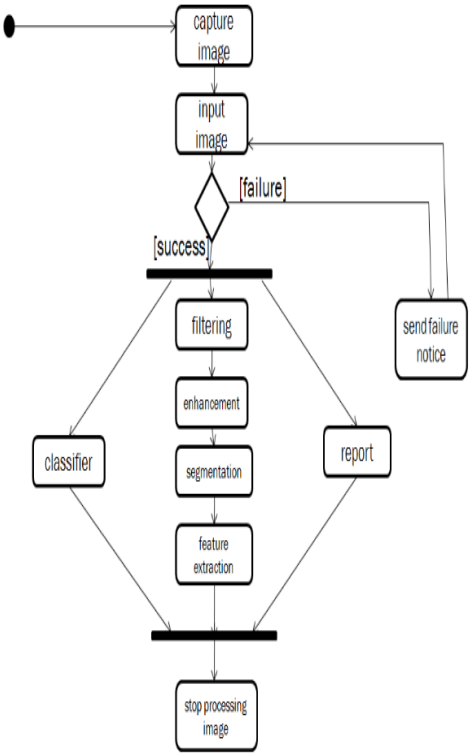

Figure:5.8 Activity Diagram

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III. SOFTWARE DESCRIPTION

3.1 Hardware Requirements

System	: i3 processor
Hard disk	: 500 GB
Monitor	: 15 VGA Colour
Mouse	: Logitech
RAM	: 4 GB

3.2 Software Requirements

Coding Language	: MATLAB
Tool	: MATLAB R2017A

IV. APPLICATION AREAS

4.1 Application Areas Of Project

Agricultural applications, such as detection of leaf diseases, fruits diseases etc. In all these techniques, digital images are collected using a digital camera and image processing techniques are applied on these images to extract useful information that are necessary for further analysis.

Digital Image processing is used for the implementation which will take the image as input and then perform some operation on it and then give us the required or expected output. Application of computer vision and image processing techniques certainly assist farmers in all the areas of agriculture activities

- Detecting leaves with disease.
- Quantify area that is affected.
- Finding the shape of affected area.
- Determine color of the affected area.
- Texture analysis by determining size and shape of leaf.

V. CONCLUSION

The adaptive techniques have been used for segmentation purpose, which focuses mainly on applying these tools for detection of Sickled RBCs. From the result, we can say that out of all four thresholding methods, CNN technique gives highest accuracy of 97% for sickle cell detection. Again from computational time point of view, CNN technique performs in the lowest time of 1.73 seconds.

VI. FUTURE ENHANCEMENT

In future work, the hybrid techniques are those techniques of the image segmentation that uses the concepts of both above techniques i.e. use of discrete pixel and structural information together.

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