PROJECT REPORT

On

AUTOMATIC DETECTION AND CLASSIFICATION OF WHITE BLOOD CANCER FROM MICROSCOPIC IMAGES USING MATLAB

Submitted for partial fulfillment for the award of the degree

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

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BONAFIDE CERTIFICATE

Certified that this project report titled "**AUTOMATIC DETECTION AND CLASSIFICATION OF WHITE BLOOD CANCER FROM MICROSCOPIC IMAGES USING MATLAB**" is the Bonafide work of **Mr. Deepak S(Reg. No. RA1911004040004)** and **Mr. Deepak Kumar K(Reg. No. RA1911004040015)** who carried out the Minor Project (**18ECP107L**) work under my supervision as a batch. Certified further, that to the best of my knowledge the work reported herein does not form any other project report on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

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Date: Internal Examiner-I Internal Examiner-II

ACKNOWLEDGEMENT

It has been an enjoyable journey over our cherished years at the SRM Institute of Science and Technology. This work would not have been completed without motivation and help from our **SRM IST MANAGEMENT**.

We would like to express our sincere gratitude to Founder and Chancellor **Dr T.R Pachamuthu**, Chairman **Mr. Ravi Pachamuthu**, Vice chancellor of SRM IST **Dr.C.Muthamizhchelvan**, Dean **Dr. C.V.Jayakumar** and Head of the Department, Electronics and Communication Engineering **Dr. A. Shirly Edward**, for her support and constant encouragement throughout the project.

We would like to have a special mention of our guide **Mr. S Balaji** for his guidance.

We could not have finished this work without support from our family. They are dearest in heart and great source of motivation. Our hearty appreciation and thanks to our friends whose support and encouragement made all this possible.

ABSTRACT

Leukemia may be a white blood cell (WBC) malignancy that alters the structure of bone marrow and blood. If not diagnosed at an early stage, the sickness may be fatal. To manually identify the types of malignant illness cells, full blood count (CBC) or morphological analysis are frequently used. These methods take time, and there are fewer fixes that can be made. Using microscopic blood image analysis, they have planned an automatic method for the detection of chronic scholastic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myeloid leukemia (CML). This method first separates the different types of cells from the image, such as platelets, red blood cells, and white blood cells. Afterward White blood cells are divided from lymphocytes. The lymphocytes' form and color options are then retrieved and provided to an SVM classifier, which divides the cells into conventional and blast categories. The counting of WBC cells is then determined for a precise diagnosis. In comparison to manual identification methods, an automated technique for detecting malignant neoplastic disease was proven to be more useful, quick, and accurate.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The phrase "digital image" describes how a digital computer transforms a two-dimensional image. It denotes digital processing of any two-dimensional data in a larger context. An array of real or complex integers represented by a finite number of bits makes up a digital image. An image that has been provided as a transparency, slide, photograph, or X-ray is first digitized and stored in computer memory as a matrix of binary numbers. A high-definition television monitor can then be used to process and/or display this digitized image. To provide a visually continuous display, the image is kept in a rapid-access buffer memory for display, which refreshes the monitor at a rate of 25 frames per second.

1.1.1 THE IMAGE PROCESSING SYSTEM

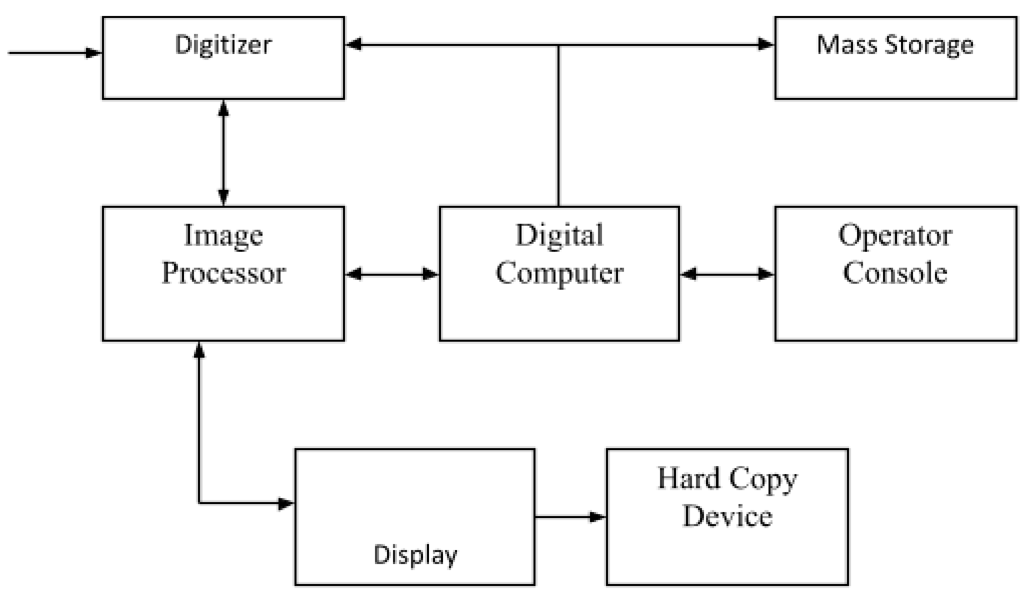


FIG 1.1 BLOCK DIAGRAM FOR IMAGE PROCESSING SYSTEM

DIGITIZER:

A picture is transformed by a digitizer into a numerical representation that can be entered into a digital computer. Typical digitizers include

1. Microdensitometer
2. Flying spot scanner
3. Image dissector
4. Videocon camera
5. Photosensitive solid- state arrays.

IMAGE PROCESSOR:

The tasks of picture collecting, storage, preprocessing, segmentation, representation, recognition, and interpretation are completed by an image processor, which then displays or records the finished image. The basic steps of an image processing system are shown in the block diagram below.

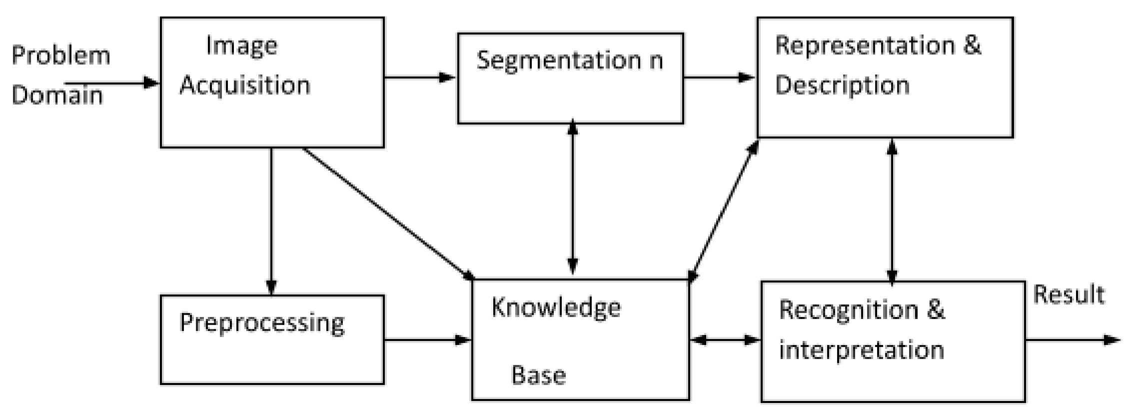


FIG 1.2 BLOCK DIAGRAM OF FUNDAMENTAL SEQUENCE INVOLVED IN AN IMAGE PROCESSING SYSTEM

The process begins with picture acquisition, which is done using an imaging sensor and a digitizer to digitize the image, as shown in the diagram. The following phase is preprocessing, when the image is enhanced and fed into the other processes as an input. Preprocessing frequently involves improving, eliminating noise, isolating regions, etc. Segmentation divides an image into its individual objects or components. The result of segmentation is often raw pixel data, which either includes the region's perimeter or the region's individual pixels. The process of representation involves converting the raw pixel data into a format that can be used by the computer for further processing.The task of description is to identify key characteristics that distinguish one class of items from another.

DIGITAL COMPUTER:

The computer performs mathematical operations on the digitized image, such as convolution, averaging, addition, subtraction, etc.

MASS STORAGE:

Floppy discs, CD ROMs, and other supplementary storage media are frequently used.

HARD COPY DEVICE:

The hard copy device is used to create a copy of the image that will last forever and to store the relevant software.

1.1.2 IMAGE PROCESSING FUNDAMENTAL:

Image processing in digital form is referred to as "digital image processing." Although some modern cameras may capture a picture immediately in digital form, most photos start out in optical form. They are digitized after being recorded on camera. Sampling and quantization are both parts of the digitization process. The five essential processes are then used to process these images, if not all of them, then at least one of them.

IMAGE PROCESSING TECHNIQUES:

This section gives various image processing techniques.

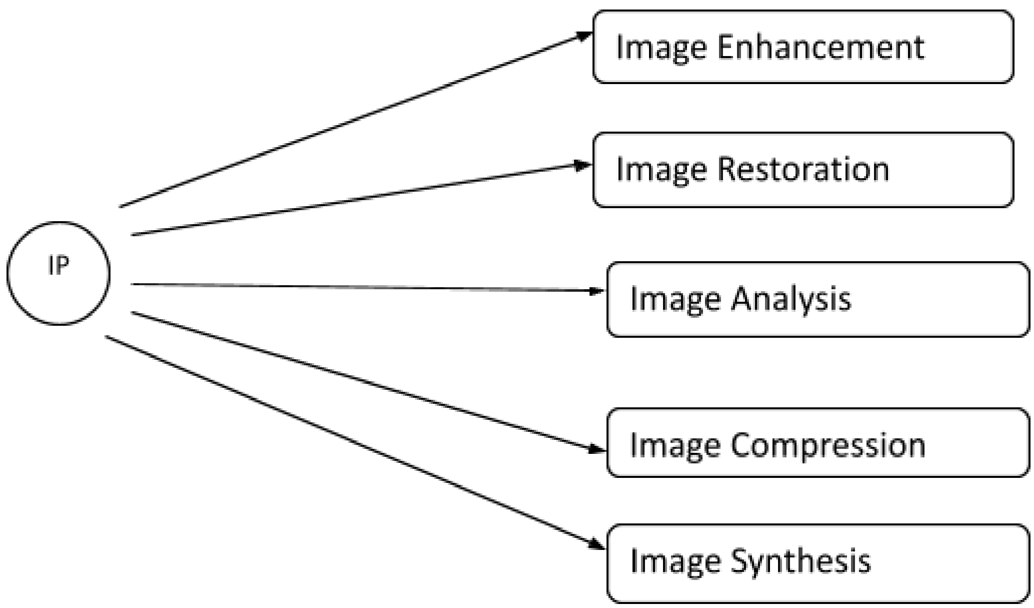


FIG1.3: IMAGE PROCESSING TECHNIQUES

IMAGE ENHANCEMENT:

The properties of an image are improved via image enhancement processes, which may include enhancing the image's contrast and brightness characteristics, lowering its noise content, or sharpening the details. Simply put, this improves the picture and makes the same information easier to interpret. It doesn't provide any new details.

IMAGE RESTORATION:

Similar to image enhancement, image restoration enhances the quality of the image, however all procedures are mostly based on known, measurable, or original image degradations. Images with issues including geometric distortion, poor focus, repeated noise, and camera motion can be fixed using image restoration techniques. It is used to fix known image degradations.

IMAGE ANALYSIS:

Based on the qualities of the original image, image analysis techniques generate numerical or graphical information. They separate them into objects before classifying them. The image statistics affect them. Automated measurements, object classification, and the extraction and description of scene and image features are common procedures. The majority of machine vision applications involve image analysis.

IMAGE COMPRESSION:

The amount of data required to describe an image is reduced through compression and decompression of the image. Compression eliminates all the unnecessary information that is present in the majority of photos. Compression reduces the size, allowing for more effective storage or transportation. When a picture is displayed, it is decompressed. While lossy compression offers excellent compression, it does not represent the original image in any way. Lossless compression keeps the exact data in the original image.

IMAGE SYNTHESIS:

Images are produced via image synthesis processes using non-image or other image data. In general, image synthesis techniques produce images that are either impossible to capture physically or that are impractical to get.

APPLICATIONS OF DIGITAL IMAGE PROCESSING:

Remote sensing using satellites and other spacecraft, image transmission and storage for business purposes, medical processing, radar, sonar, and acoustic image processing, robotics, and automated industrial item inspection are just a few of the many uses for digital image processing.

MEDICAL APPLICATIONS:

One is concerned with processing chest X-rays, cineangiograms, transaxial tomography projection images, and other medical images that occur in radiology, nuclear magnetic resonance (NMR), and ultrasonic scanning in medical applications. These photos might be used to screen and monitor patients, find cancers or other diseases in patients, or even just to keep an eye on them.

COMMUNICATION:

Applications for image transmission and storage can be found in military communications, broadcast television, teleconferencing, and facsimile image transfer for office automation, computer network communication, and closed-circuit television-based security monitoring systems.

RADAR IMAGING SYSTEMS:

Radar and sonar images are used for detection and recognition of various types of targets or in guidance and maneuvering of aircraft or missile systems.

DOCUMENT PROCESSING:

It is used to scan and transmit paper documents in order to turn them into digital images, compress the images, and store them on magnetic tape. It is also used to automatically detect and recognise printed properties when reading documents.

DEFENSE/INTELLIGENCE:

It is utilised in target acquisition and guidance for identifying and following targets in real-time smart-bomb and missile-guidance systems as well as reconnaissance photo-interpretation for automatic interpretation of earth satellite data to look for sensitive targets or military threats.

1.2 OBJECTIVE

1.2.1 This project's primary goal is the identification and quantification of blood cell cancer cells in microscopic blood smear images. One of the most crucial systems in the human body is the circulatory system of the blood. This system's job is to circulate blood throughout the body. The heart, which serves as the system's pump, blood, which serves as the system's medium, and blood vessels, which include arteries, veins, and capillaries, make up this system. Transporting blood is crucial for providing our bodies with oxygen, carrying carbon dioxide for gaseous exchange, minerals, nutrients, and ensuring health.

1.3 EXISTING SYSTEM

According to this study, blood images should be pre-processed using median filtering and histogram equalization. Fuzzy c-means were then used to segment white blood cells. After features were recovered using the Gabor texture extraction method in order to differentiate between normal and blast cells, support vector machine (SVM) was utilized for classification.

1.3.1 DISADVANTAGES OF EXISTING SYSTEM

- The WBC cells are not segmented solely by the fuzzy c-means method.
- Because only the WBC cells' size and shape can distinguish between healthy and cancerous cells,When compared to the suggested system, the output accuracy of this method is lower.
- The number of WBC cells is not estimated in this instance. Considering that counting is another crucial element for medical diagnosis referrals.

1.3 PROPOSED METHOD

In this article, we suggest that efforts have been made to use image processing techniques to detect acute lymphoblastic leukemia, acute myeloid leukemia, chronic lymphocytic leukemia, and chronic myeloid leukemia using microscopic blood pictures. The photos were subjected to preprocessing to remove any noise, and segmentation was then carried out to identify lymphocytes in the image. After extracting shape and color data, Watershed is used to separate the clustered lymphocytes for cell counting; SVM is used to distinguish normal and blast cells.

SCOPE OF THE PROJECT

One of the most crucial systems in the human body is the circulatory system of the blood. This system's job is to circulate blood throughout the body. The heart, which serves as the system's pump, blood, which serves as the system's medium, and blood vessels, which include arteries, veins, and capillaries, make up this system. Transporting blood is crucial for providing our bodies with oxygen, carrying carbon dioxide for gaseous exchange, minerals, nutrients, and ensuring health. White blood cells (WBCs), red blood cells (RBCs), platelets, and plasma make up blood cells. Monocyte, Lymphocyte, Neutrophil, Basophil, and Eosinophil are the five different forms of WBC. Each component of blood cells contributes in a unique way to the maintenance of health and life. To ensure health, the quantity of each component is crucial.

BLOCK DIAGRAM:

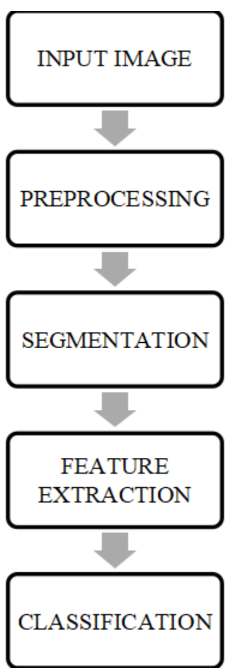


FIG 1.4: BLOCK DIAGRAM OF PROPOSED SYSTEM

1.4.1 PROPOSED SYSTEM ADVANTAGES

1. In order to more correctly segment the size and shape of the WBC cells, we apply color space conversion and the WATERSHED segmentation algorithm in this method.

2. We must distinguish between healthy and cancerous cells utilizing the precise size and form of the WBC cells.

3.We will count the quantity of WBC cells in addition to looking for cancer cells so that a doctor can diagnose you. In this procedure, as compared to the current system, the output accuracy is higher.

CHAPTER 2

PROJECT DESCRIPTION

2.1 INTRODUCTION

A kind of blood cancer called acute lymphoblastic leukemia is characterized by aberrant leukocyte (WBC) growth. The immune system of the human body is exposed when these aberrant cells affect the blood and bone marrow. Additionally, it inhibits the synthesis of healthy platelets and red blood cells, which results in anemia, a blood shortage. Furthermore, these aberrant leukocytes quickly invade human circulation and can target several organs, including the kidney, liver, spleen, brain, and lymph nodes. Depending on the type of white blood cells that are contaminated, leukemia is either classed as lymphoblastic or myelogenous. When lymphocytes or granulocytes are the infected cells, the leukemia is categorized as myelogenous (AML), and when lymphocytes are the infected cells, it is categorized as lymphoblastic (ALL). In accordance with the French American British (FAB) classification, ALL is further divided into the L1, L2, and L3 subtypes. L1 type cells typically have a small size, are homogeneous, and have little cytoplasm. They have a discoid, well-structured nucleus. Compared to L1 type cells, L2 type cells are larger and have a different morphology.L3 type cells have round or oval nuclei and are uniform in size, shape, and shape. Vacuoles and sufficient amounts of cytoplasm are present in them. Typically, they are larger than L1.

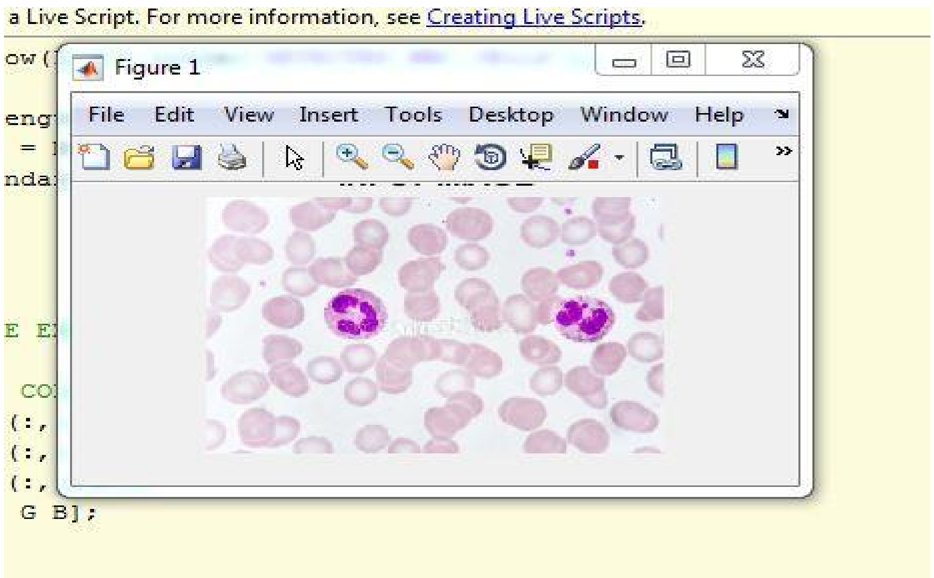
2.1.1 RGB COLOR IMAGE:

Red, green, and blue light are combined in different ways to create the RGB color model, an additive color scheme that can recreate a wide range of hues. The initials of the three additive fundamental colors—red, green, and blue—were used to create the model's name.

Although it has been employed in conventional photography, the RGB color model is mostly utilized for the sensing, representation, and display of pictures in electronic devices like televisions and computers. The RGB color model already had a sound theory supporting it that was based on how people see color before the advent of electronics.

Since the color components (such as phosphors or dyes) and their responses to the specific R, G, and B levels vary from manufacturer to manufacturer, or even within the same device over time, various devices detect or reproduce a particular RGB value differently. Therefore, without some sort of color management, an RGB value does not define the same color across devices.

Fig 2.1.1.(a) Example of RGB color image is given below

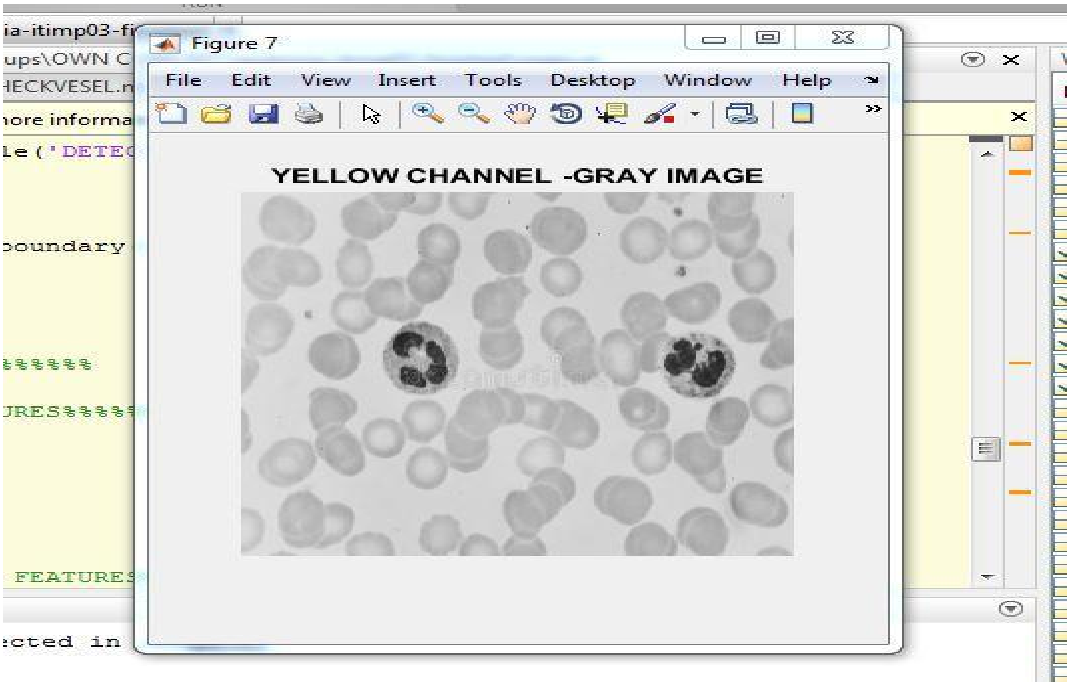


2.1.2 GRAYSCALE:

A grayscale or greyscale digital image is one in which each pixel's value is a single sample, carrying only intensity information, and is used in both photography and computers.

When only a specific frequency is recorded, grayscale images are considered to be monochromatic proper. Grayscale images are frequently created by measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (such as infrared, visible light, ultraviolet, etc.). However, they can also be created artificially from full-color images; see the grayscale conversion section for more information.

Fig 2.1.2(a)Example of gray scale image is given below

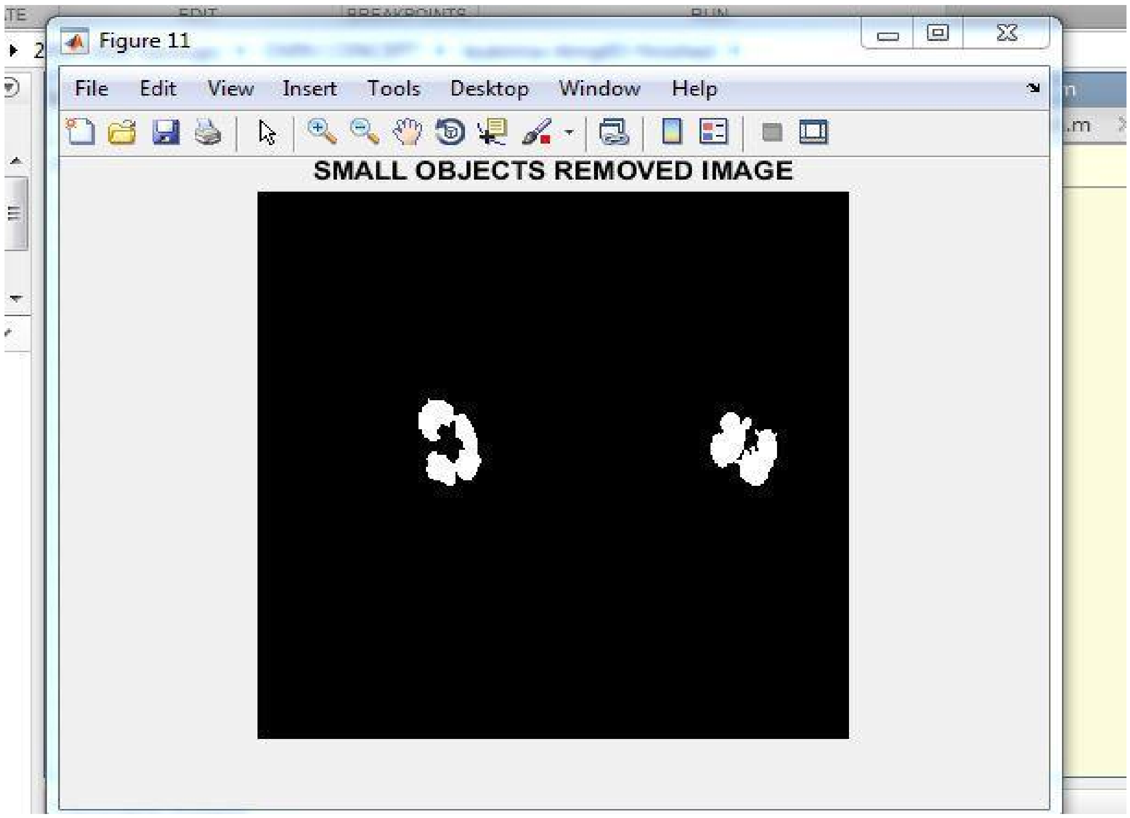


2.1.3 BORDER CORRECTED MASK:

The mask is made in order to identify the precise processes in an image. in order to recognise the issues or aspects that we must search for in an image.

The margins of the border corrected mask are closed to reveal all of the details of an image.

Example of border corrected mask is given below



2.1.4 SEGMENTATION:

Image segmentation in computer vision is the division of a digital image into several segments (sets of pixels, also known as superpixels).

A set of segments that together encompass the full image, or a set of contours taken from the image, are the products of image segmentation (see edge detection). Regarding a characteristic or computed feature, such as color, intensity, or texture, every pixel in a region is comparable. The same attribute is dramatically variable in adjacent places (s). With the aid of interpolation methods like marching cubes, the contours produced after picture segmentation can be utilized to produce 3D reconstructions when applied to a stack of images, which is usual in medical imaging.

2.1.5 CONNECTED COMPONENT ANALYSIS (CCA) AND OBJECTS EXTRACTION:

Using pixel connection, the well-known image processing method CCA examines a picture and divides pixels into named components. To locate all the items inside the binary image generated by the previous step, an eight-point CCA stage is carried out. This stage's output is an array of N objects that serves as an illustration of both its input and output.

2.2 APPLICATIONS:

- To encourage early detection, accurate diagnosis, and effective treatment.
- Several medical applications depend heavily on image segmentation.
- Its automation is difficult due to low SNR conditions and a variety of artifacts.
- To accomplish a reliable and precise segmentation.
- Additionally, the checking process is sped up.
- Therefore, we need to develop a better method of detecting blood cell malignancy.

2.3 METHODOLOGIES:

2.3.1 MODULE DESCRIPTION: (IMPLEMENTATION)

1. INPUT IMAGE:

A read-in image is displayed. The imread command can be used to read an image into the workspace. It is referred to as the action of obtaining an image from a source, typically a hardware-based source, for processing in image processing. It is the first step in the workflow sequence because processing cannot take place without an image. The captured image is entirely unprocessed.

2. PREPROCESSING.

The term "pre-processing" refers to operations on images at their most basic level; the input and output are both intensity images. Pre-processing aims to improve the image data by reducing undesirable distortions or enhancing certain elements that are crucial for subsequent processing. Image pre-processing techniques make extensive use of redundant images. In actual photographs, adjacent pixels referring to the same item have brightness values that are essentially the same or similar. As a result, distorted pixels can frequently be recovered as the average value of nearby pixels.

1. RESIZING THE INPUT IMAGE:

The dimensions of every input image are standardized. The output image will be deformed if the given size does not create the same aspect ratio as the input image.

2. CONVERTING COLOR FORMAT:

Color information is useless for many image processing applications. One justification for converting RGB images to B&W, GRAYSCALE, or RGB images to HSV formats in images is if you start trying to tell colors apart from one another.

3. SEGMENTATION

Image A method called segmentation divides a picture into non-intersecting sections so that each region is homogeneous and no two adjacent regions combined are homogeneous. To locate and recognise objects and boundaries (lines, curves, etc.) in an image, homogeneity criteria, such as color, intensity, or texture, can be used to compare pixels in a region. The final success or failure of a computerized analytic technique is determined by the segmentation accuracy.

1. COLOR SPACE CONVERSIONS:

The translation of a color's representation from one basis to another is known as color space conversion. This usually happens when translating a picture from one color space to another, with the intention of making the translated image look as much like the original as possible. Here, we convert the rgb color space to the ycbcr color space to segment white blood cells.

2. MORPHOLOGICAL OPERATIONS:

A group of non-linear processes focused on the morphology or shape of features in an image make up morphological image processing. A wide range of image processing techniques known as morphology process images based on forms. A structuring element is added by morphological processes to an input image to produce an output image of the same size.

Some segmentation techniques are,

A) ROI (Region of Interest)

B) WATERSHED SEGMENTATION

4. FEATURE EXTRACTION

Feature extraction is a process used in machine learning, pattern recognition, and image processing that starts with a set of measured data and creates derived values (features) meant to be informative and non-redundant. This process speeds up the learning and generalization processes and, in some cases, improves human interpretations. Dimensionality reduction and feature extraction are connected. When an algorithm's input data is too extensive to process and is thought to be redundant (such as when the same measurement is given in feet and meters or when pixels are used to represent images), it can be reduced to a smaller collection of characteristics (also named a feature vector). The process of selecting a portion of the first characteristics is known as feature selection. In order to do the intended task using this reduced representation rather than the whole starting data, it is expected that the selected features will contain the pertinent information from the input data.

a) Shape features
b) Color features
c) Geometrical features
d) Texture features

A) SHAPE FEATURES:

The form qualities or visual features of an object are their visual characteristics. For instance, the diameter of the border, the perimeter of an object's boundary, or other shapes like circles, triangles, or other shapes. All of the visually shown intuitive elements are form features.

B) **COLOR FEATURES**:

Histograms of color and texture as well as the overall image's color scheme are examples of global characteristics. Local attributes for subimages, segmented regions, and interest spots include color, texture, and shape features. Then, picture matching and retrieval are done using these features that were retrieved from the images.

C) **GEOMETRICAL FEATURES**:

The characteristics of an object that are made up of geometric elements like points, lines, curves, or surfaces are known as geometric features. These features, which can be found using feature detection techniques, can be anything from corner features to edge features, Blobs, Ridges, prominent point's picture texture, and so forth. Here, we use features like area, diameter, and density to calculate.

D) **TEXTURE FEATURES**:

An image's perceived texture can be measured using a set of metrics calculated during image processing. Image texture provides details on the spatial distribution of colors or intensities inside an image or particular area within an image. Here, we analyze the texture features using the GLCM (Grey Level Co-occurrence Matrix).

Some feature extraction methods are,

A) GLCM (Grey level co-occurrence matrix)

B) LBP (Local Binary Pattern)

C) PCA (Principal Component Analysis)

5. CLASSIFICATION:

The process of extracting information classes from a multiband raster image is referred to as image classification. Thematic maps can be made using the raster that is produced after picture categorization. The Image Classification toolbar is the suggested method for performing classification and multivariate analysis.

CHAPTER 3
SOFTWARE SPECIFICATION

3.1 GENERAL

The numerical computing environment and fourth-generation programming language is called MATLAB (matrix laboratory). Matrix manipulation, function and data visualization, algorithm implementation, user interface design, and interface interaction with programmes written in other languages, such as C, C++, Java, and Fortran, are all possible with MATLAB, a tool created by MathWorks.

The MuPADsymbolic engine is used by an optional toolbox in MATLAB, which is primarily designed for numerical computing but also has access to symbolic computing capabilities. Graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems are added by an additional programme called Simulink.

A variety of tools are available in MATLAB for recording and sharing your work. You can distribute your MATLAB algorithms and applications as well as combine your MATLAB code with other languages and software.

3.2 FEATURES OF MATLAB

High-level language for technical computing.

Development environment for managing code, files, and data.

Interactive tools for iterative exploration, design, and problem solving.

Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.

2-D and 3-D graphics functions for visualizing data.

Tools for building custom graphical user interfaces.

Functions for integrating MATLAB based algorithms with external applications and languages, such as C, C++, Fortran, Java™, COM, and Microsoft Excel.

Signal and image processing, communications, control design, test and measurement, financial modeling and analysis, and computing are just a few of the many fields in which MATLAB is employed. The MATLAB environment is extended with add-on tool boxes (collections of specialized MATLAB functions) to address specific types of issues in certain application areas.

Personal PCs, sophisticated server systems, and the Cheaha computing cluster can all run MATLAB. The language may be expanded with parallel implementations for common computational operations, such as for-loop unrolling, with the inclusion of the Parallel Computing Toolbox. This toolkit also enables the offloading of computationally demanding jobs to the campus computing cluster Cheaha. One of the few programming languages where each variable is a matrix (in the broadest sense) and "knows" how large it is is MATLAB. Additionally, where necessary, the basic operators (such as addition and multiplication) have been coded to cope with matrices. And much of the tedious housekeeping that makes all this possible is handled by the MATLAB environment. Since matrices are used in so many of the Macro-Investment Analysis techniques, MATLAB is a very effective language for both communication and execution.

MATLAB may be linked to Maple or Mathematica as an alternative to the MathWorks' MuPAD-based Symbolic Math Toolbox.

Libraries also exist to import and export MathML.

Development Environment

Startup Accelerator for faster MATLAB startup on Windows, especially on Windows XP, and for network installations.

Spreadsheet Import Tool that provides more options for selecting and loading mixed textual and numeric data.

Readability and navigation improvements to warning and error messages in the MATLAB command window.

Automatic variable and function renaming in the MATLAB Editor.

Developing Algorithms and Applications

MATLAB provides a high-level language and development tools that let you quickly develop and analyze your algorithms and applications.

The MATLAB Language

Vector and matrix operations, which are essential to solving engineering and scientific issues, are supported by the MATLAB language. It makes quick development and execution possible. You can programme and create algorithms more quickly using the MATLAB language than with other languages because you don't have to deal with low-level administrative activities like declaring variables, defining data types, and allocating memory. MATLAB often does away with the necessity for "for" loops. As a consequence, numerous lines of C or C++ code may often be replaced by a single line of MATLAB code.

The characteristics of a conventional programming language, such as arithmetic operators, flow control, data structures, data types, object-oriented programming (OOP), and debugging capabilities, are all available in MATLAB at the same time.

This technology, which is available on most platforms, provides execution speeds that rival those of traditional programming languages.

Development Tools

MATLAB includes development tools that help you implement your algorithm efficiently. These include the following:

MATLAB Editor

Provides standard editing and debugging features, such as setting breakpoints and single stepping

Code Analyzer

Checks your code for problems and recommends modifications to maximize performance and maintainability

MATLAB Profiler

Records the time spent executing each line of code

Directory Reports

Scan all the files in a directory and report on code efficiency, file differences, file dependencies, and code coverage

Designing Graphical User Interfaces

Layouting, designing, and editing user interfaces using the interactive GUIDE (Graphical User Interface Development Environment) tool With GUIDE, you may add MATLAB plots, Microsoft ActiveX® controls, list boxes, pull-down menus, push buttons, radio buttons, and sliders. As an alternative, you may use MATLAB routines to programmatically generate GUIs.

3.2.1 ANALYZING AND ACCESSING DATA

From gathering data from external devices and databases, through preprocessing, visualization, and numerical analysis, to providing output that is suitable for presentations, MATLAB covers the full data analysis process.

Data Analysis

MATLAB provides interactive tools and command-line functions for data analysis operations, including:

- Interpolating and decimating
- Extracting sections of data, scaling, and averaging
- Thresholding and smoothing
- Correlation, Fourier analysis, and filtering
- 1-D peak, valley, and zero finding

- Basic statistics and curve fitting
- Matrix analysis

Data Access

Accessing data from files, other programmes, databases, and external devices is simple and effective using MATLAB. You can read data from common file types including Microsoft Excel, ASCII text or binary files, picture, music, and video files, as well as HDF and HDF5 scientific file types. You can operate with data files in any format thanks to low-level binary file I/O'Functions. Additional features enable you to read data from XML and Web sites.

Visualizing Data

In MATLAB, you may access every graphic element needed to visualize engineering and scientific data. These comprise tools for interactively building plots, 2-D and 3-D graphing, 3-D volume visualization, and the ability to export outcomes in all widely used graphics formats. Plots may be altered by adding additional axes, altering line and marker colors, adding commentary, Latex equations, and legends, as well as by sketching shapes and multiple axes.

2-D Plotting

Visualizing vectors of data with 2-D plotting functions that create:

- Line, area, bar, and pie charts.
- Direction and velocity plots.
- Histograms.
- Polygons and surfaces.
- Scatter/bubble plots.
- Animations.

3-D Plotting and Volume Visualization

3-D scalar and 3-D vector data, as well as 2-D matrices, may all be shown using MATLAB tools. These features may be used to display and comprehend vast, frequently complicated, multidimensional datasets. describing the plot's elements, such as the camera's perspective, the lighting effect, the placement of the light sources, and transparency.

3-D plotting functions include:

- Surface, contour, and mesh.
- Image plots.
- Cone, slice, stream, and isosurface.

3.2.2 PERFORMING NUMERIC COMPUTATION

Mathematical, statistical, and engineering functions are available in MATLAB to enable all typical engineering and scientific processes. The MATLAB language is built on these mathematically sophisticated functions. The LAPACK and BLAS libraries for linear algebra subroutines as well as the FFTW Discrete Fourier Transform library are used for the basic mathematical operations. These processor-dependent libraries run quicker than similar C or C++ applications because they are tailored to the many systems that MATLAB supports.

MATLAB provides the following types of functions for performing mathematical operations and analyzing data:

- Matrix manipulation and linear algebra.
- Polynomials and interpolation.
- Fourier analysis and filtering.
- Data analysis and statistics.
- Optimization and numerical integration.
- Ordinary differential equations (ODEs).
- Partial differential equations (PDEs).

CHAPTER 4

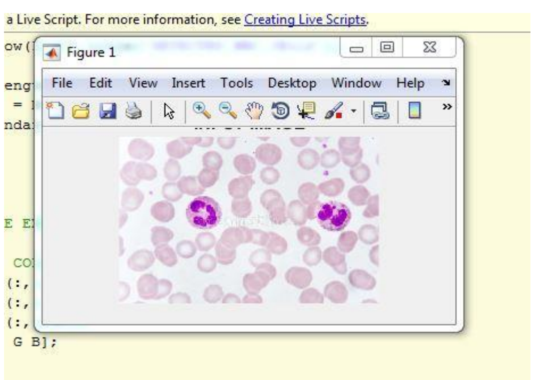
IMPLEMENTATION

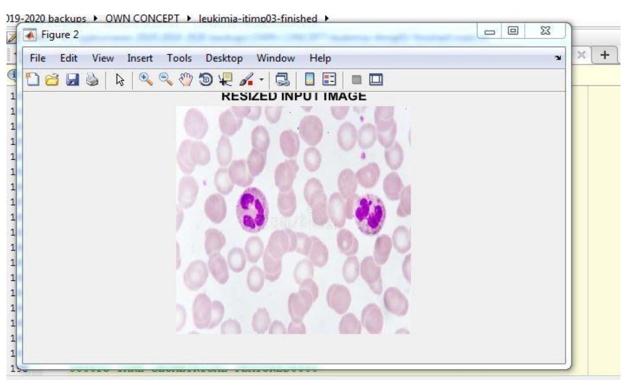
4.1 GENERAL

Matlab is a program that was originally designed to simplify the implementation of numerical linear algebra routines. It has since grown into something much bigger, and it is used to implement numerical algorithms for a wide range of applications. The basic language used is very similar to standard linear algebra notation, but there are a few extensions that will likely cause you some problems at first.

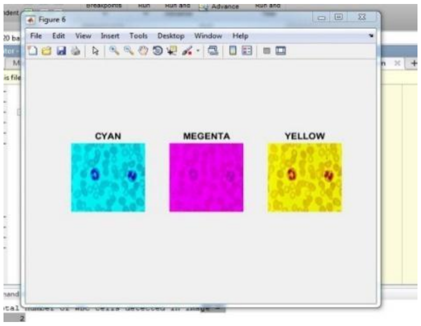
4.2 SNAPSHOT:
<u>FOR HEALTHY BLOOD CELL</u>

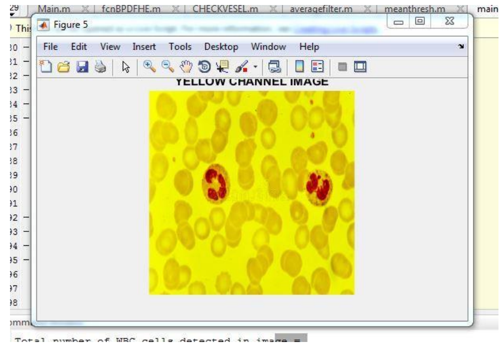
1.INPUT IMAGE **2.RESIZED IMAGE**



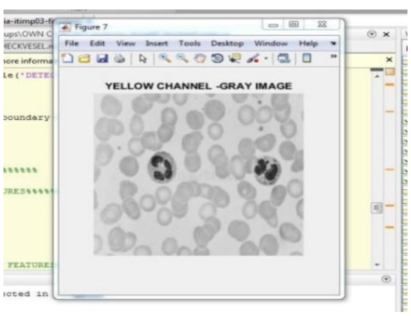


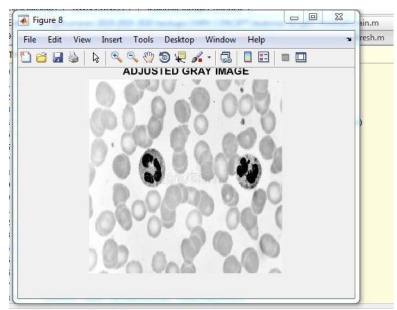
3.RGB CMYK COLOR IMAGE **4.SELECTED Y- COLOR IMAGE**



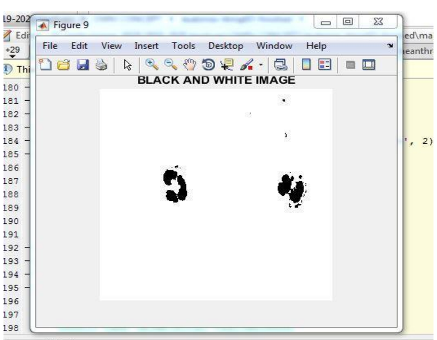


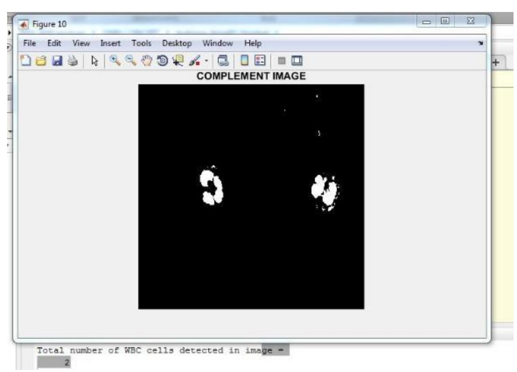
5.GRAY CONVERTED Y- COLOR IMAGE **6.ADJUSTED GRAY Y- COLOR IMAGE**



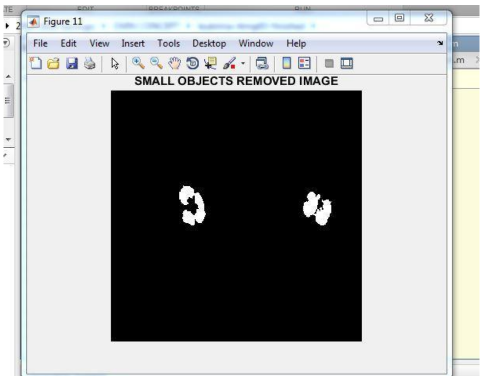


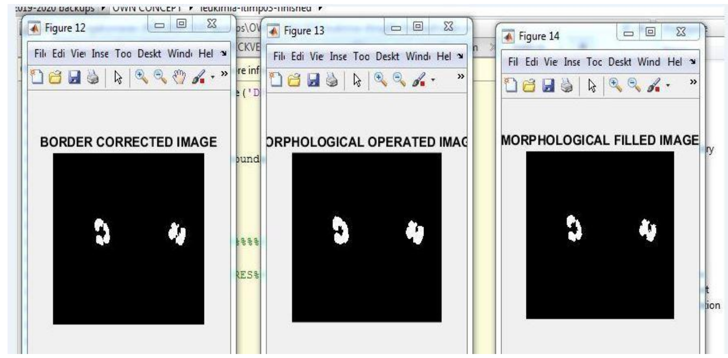
7.BLACK AND WHITE IMAGE **8. COMPLEMENT IMAGE**



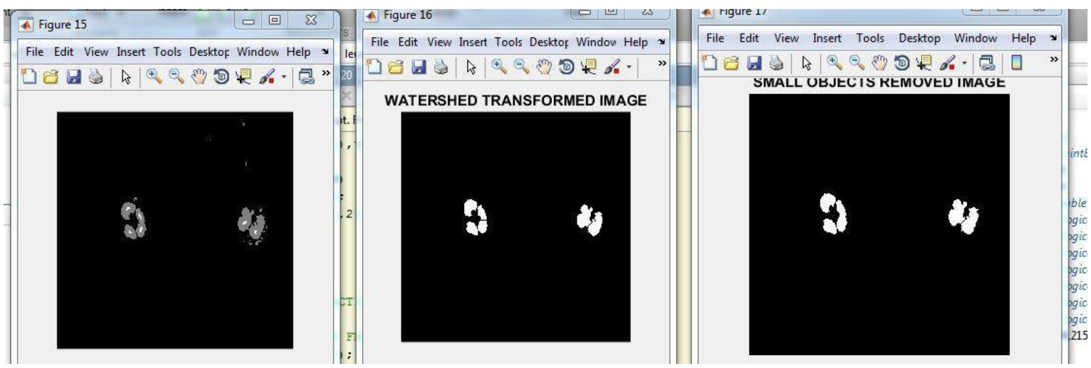


9.SMALL OBJECT REMOVED IMAGE   10.MORPHOLOGY OPERATED IMAGE

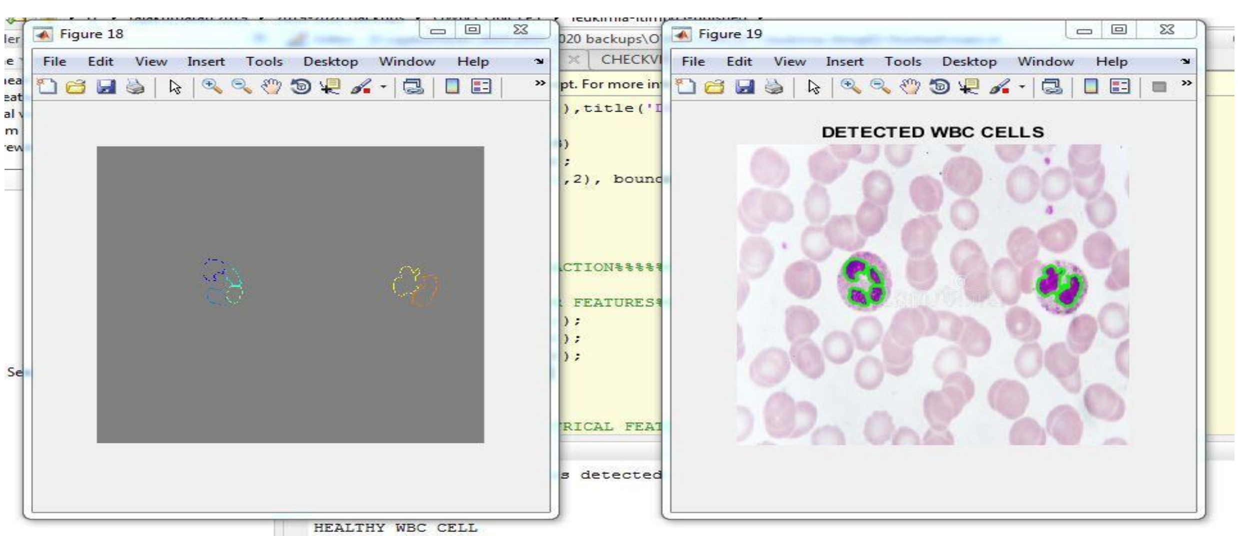




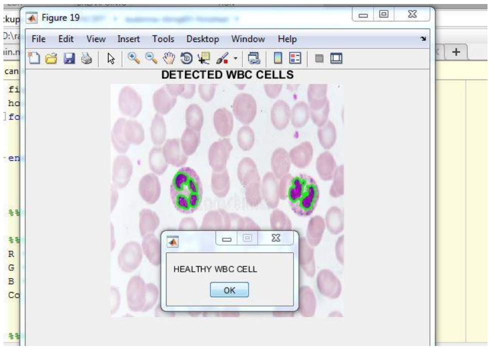
11. WATERSHED TRANSFORMED IMAGE



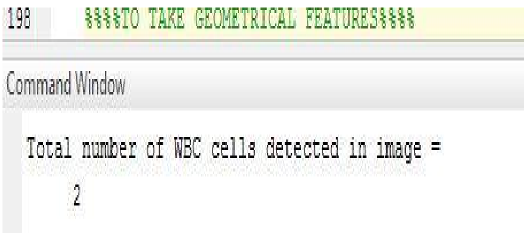
12. FINAL SEGMENTED IMAGE



13. FINAL OUTPUT IMAGE

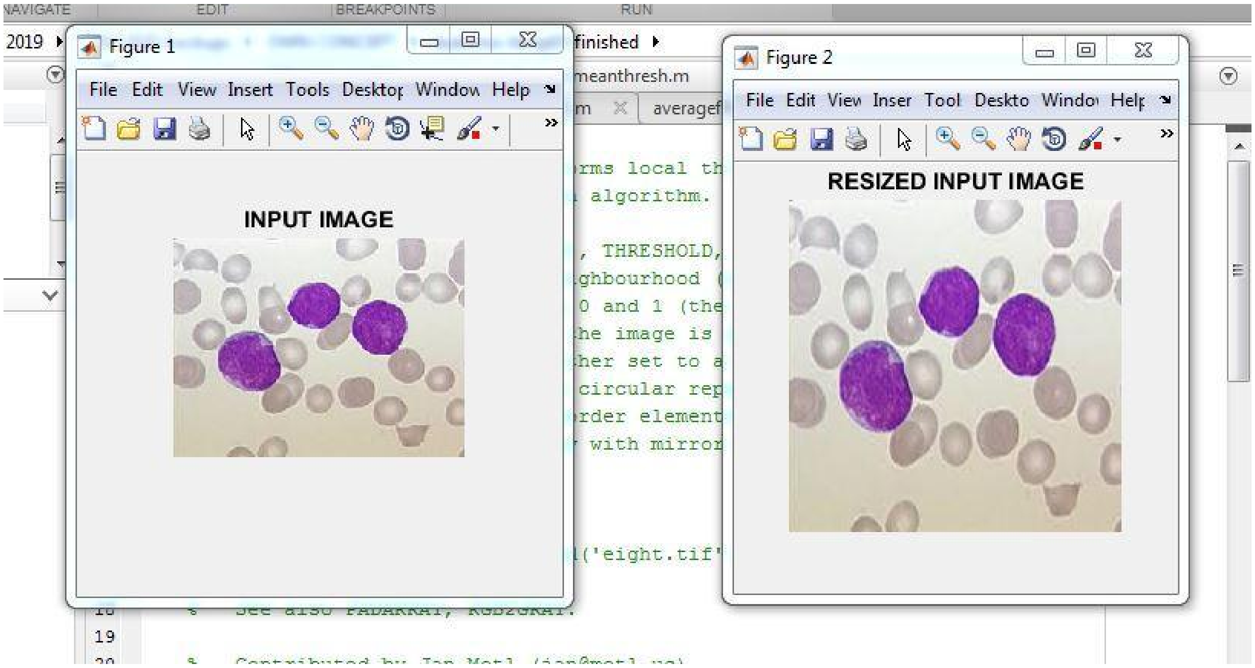


14. TOTAL NUMBER OF CANCER CELLS;

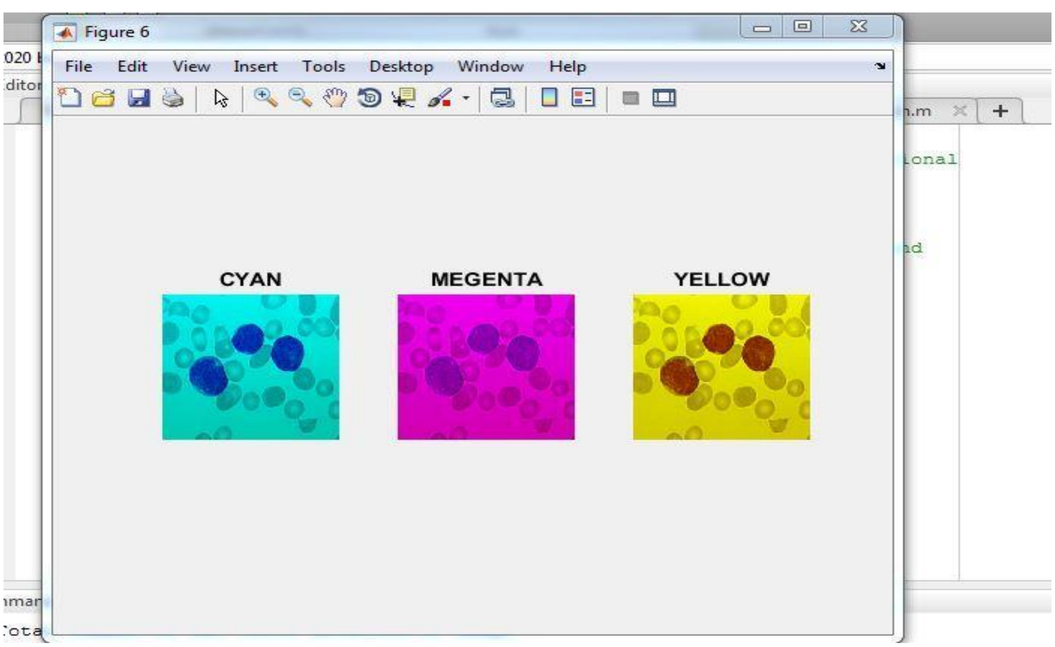


FOR CANCER BLOOD CELL

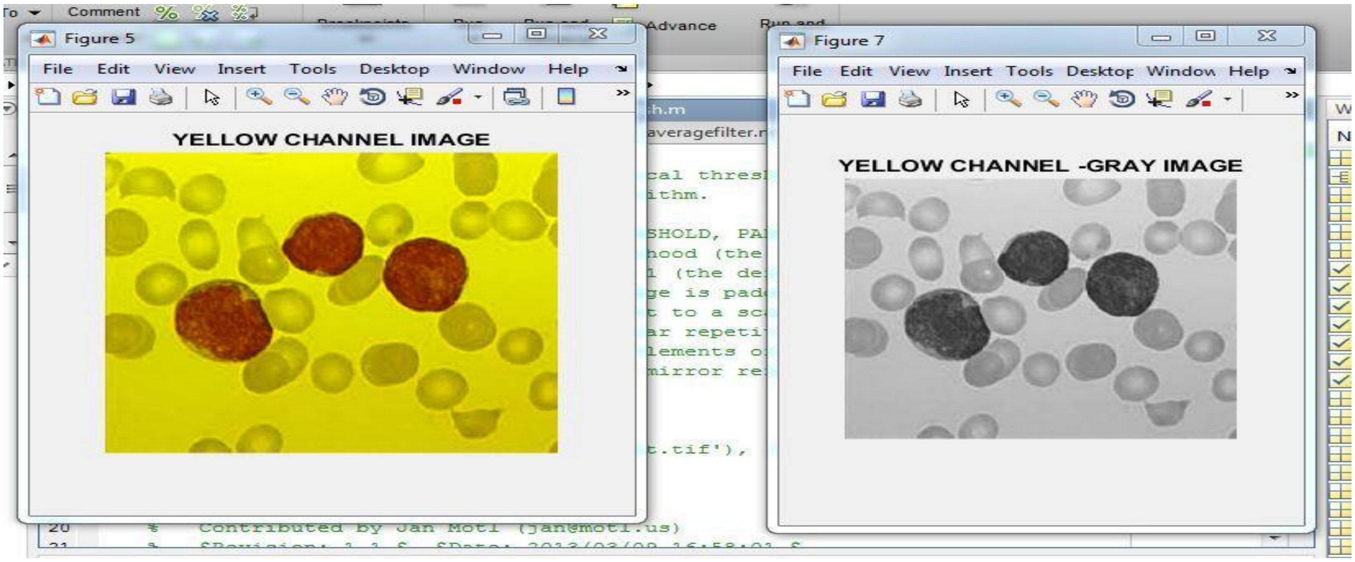
1. INPUT IMAGE 2.RESIZED IMAGE



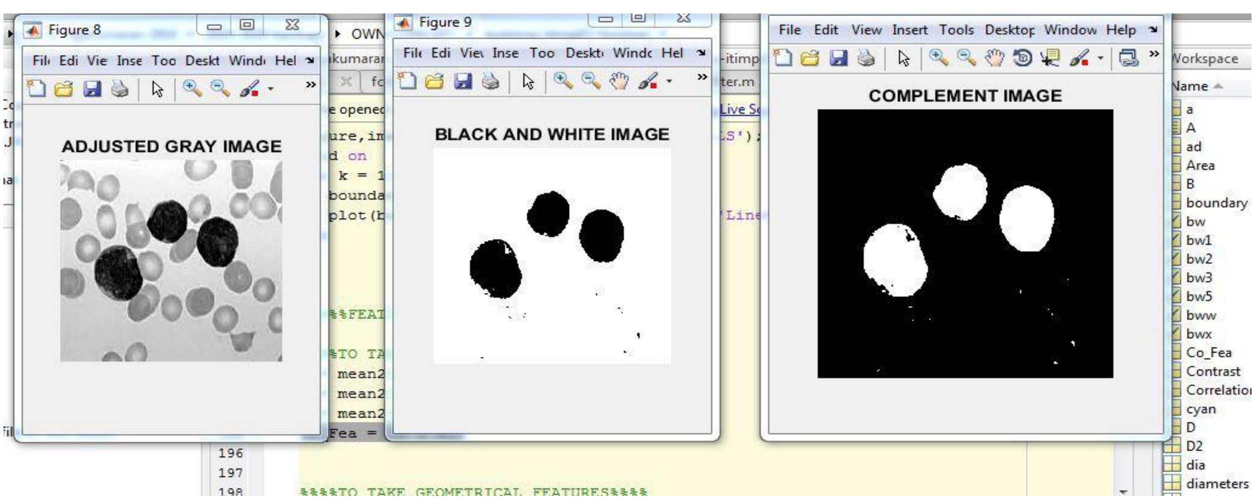
3.RGB TO YCBCR COLOR SPACE IMAGE



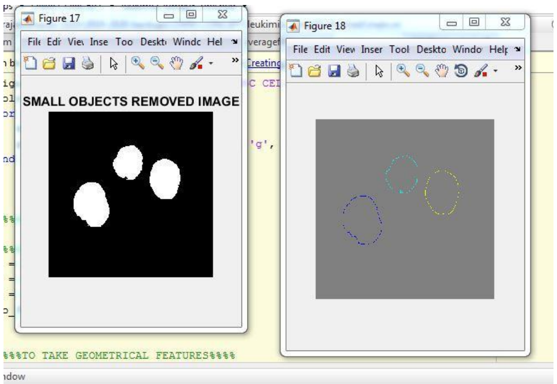
4.SELECTED Y-CHANNEL & GRAY CONVERTED Y-CHANNEL

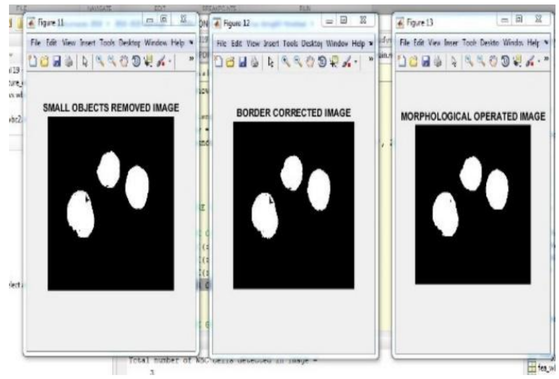


5.ADJUST &BW & COMPLEMENT IMAGES

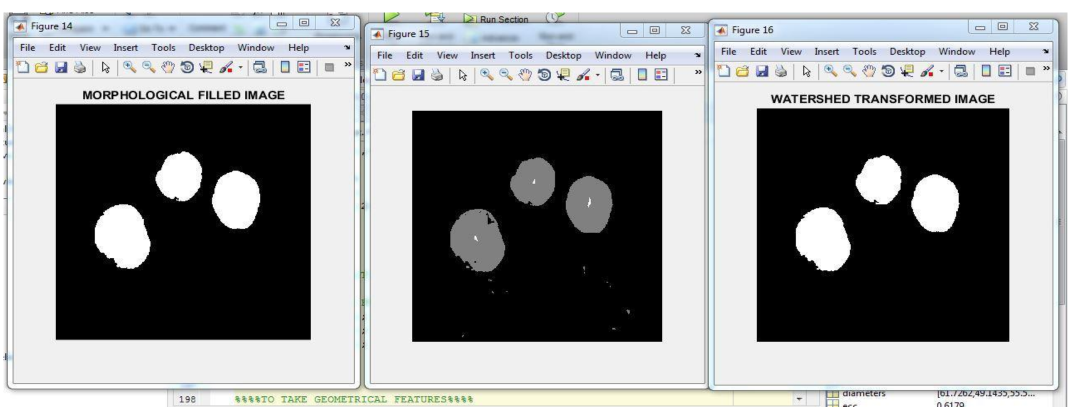


6.SMALL OBJECT REMOVED IMAGES 7.MORPHOLOGY OPERATED IMAGE

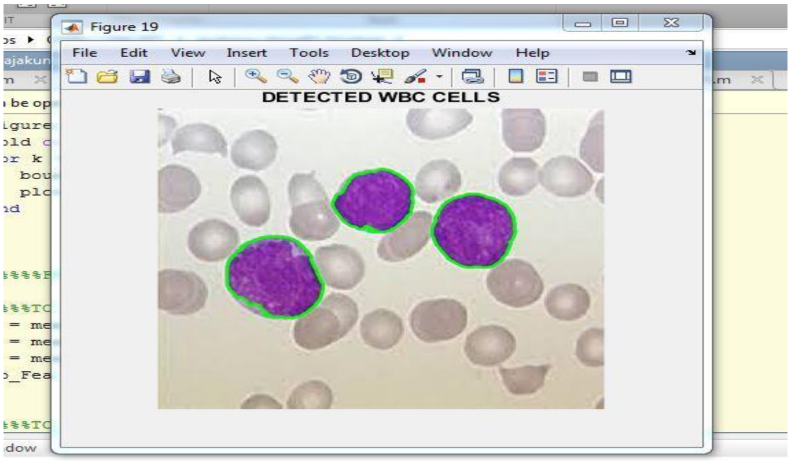




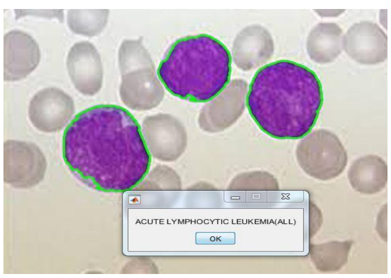
8. WATER SHED TRANSFORMED IMAGE

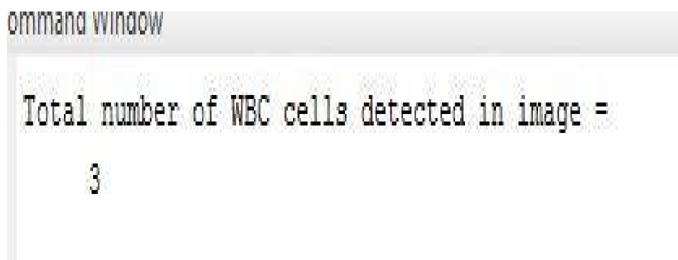


9.SEGMENTED IMAGE

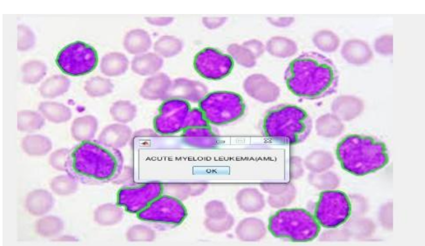


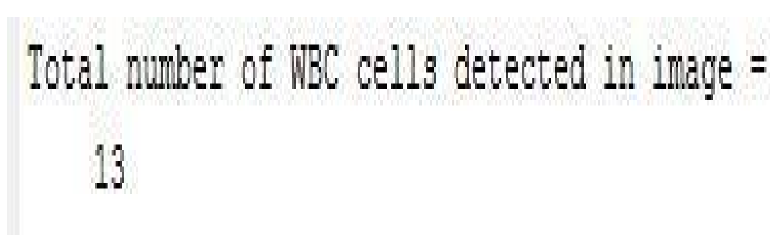
10. FINAL OUTPUT IMAGE

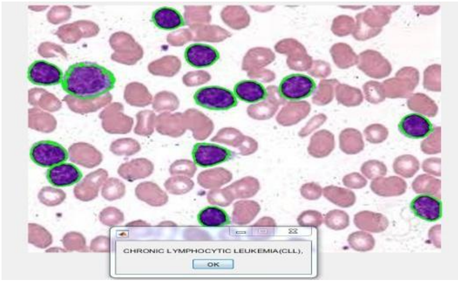




11. TOTAL NUMBER OF WBC CELLS

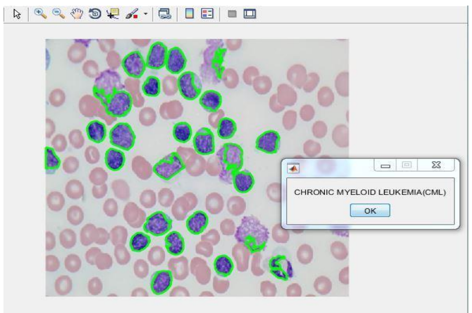






Total number of WBC cells detected in image =

13



Total number of WBC cells detected in image =

28

CHAPTER 5

CONCLUSION AND REFERENCES

5.1 CONCLUSION

In this study, efforts have been made to use image processing techniques to count and detect acute lymphoblastic leukemia from microscopic blood pictures. The photos were subjected to preprocessing to remove any noise, and segmentation was then carried out to identify lymphocytes in the image. After extracting shape and color information, the clustered lymphocytes are separated using Watershed, and normal and blast cells are classified using SVM. This technique can be further enhanced in the future to detect various leukemia types and other blood-related disorders.

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AUTOMATIC DETECTION AND CLASSIFICATION OF WHITE BLOOD CANCER FROM MICROSCOPIC IMAGES USING MATLAB

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