1. **REVIEW OF LITERATURE AND RESEARCH PAPERS**

1. **Wang Shitong and Wang Ming** has used a new Detection Algorithm based on Fuzzy Cellular Neural Networks for white blood cell detection and the work involves fuzzification of the features derived from leukocytes. 2006

2. **Farag.A**, had used first time a computer algorithm for blood cancer diagnosis “Computer based Acute leukemia classification”. The segmentation accuracy was poor. 2003


4. **Vincenzo Piuri and Fabio Scotti**, explored the application of artificial neural networks for their paper “Morphological classification of blood leukocytes using Artificial Neural Networks”. 2004


6. **Toha S.F. Ngah**, used similar technique for malarial detection for their paper “Computer Aided Medical Diagnosis for the Identification of Malaria Parasites” and successfully validated the results. 2007
7. F. Boray Tek, Andrew G. Dempster and Izzet Kale, “Malaria Parasite Detection in Peripheral Blood Images”, confined to peripheral blood images using geometrical features of the parasites. 2005

8. Sheikh and Michelle, classified RBC, WBC and platelets using computing techniques using “Blood cell Identification using Neural Networks”. The objective function demanded accurate extraction of features. 1996


11. Egmont Peterson & Schreiner, were able to detect white blood cells picked up from vivo microscope of blood wall vessels for first time using ANN for their paper “Detection of Leukocytes with in contact with vessel wall from In Vivo Microscope recordings using Neural Network,”. 2000


13. Mini puri Jyoti Mana, used image processing technique using spatial and frequency domain techniques for their paper “A cancer detection technique using image processing - A review”. 2015


20. Leticia V. Guimaraes *, Altamiro A. Suzim+ and Junji Maeda were successful in attempting a new circular decomposition algorithm for their research ” A New Automatic Circular Decomposition Algorithm Applied to Blood Cells Image”.2006


24. Guclu Ongun, Ugur Halici, Kemal Leblebicioglu, Volkan Atalay, Meral Bekzac, Sinan Bekzac, translated the same feature extraction technique for differential blood count system and got good results for their paper “Feature extraction and classification of Blood cells for an automated differential Blood count system”. 2001

25. Yunmei Chen, Baba c Vemuri and Li wang,” has alternatively proved nonlinear diffusion as successful method for their research Image denoising and segmentation via Nonlinear diffusion”. 2010

26. Sawsan F. Bikhet, Ahmed M. Darwishh, Hany A. Tolba, Samir I. Shaheenh, also used anew segmentation algorithm using thresholding for their research work Segmentation and classification of white blood cells”. 2000
27. **S. Romani, E. Montseny, P. Sobrevilla.** were too successful in using fuzzy coor histograms for their research with title "Obtaining the Relevant Colors of an image through Stability based Fuzzy Color Histograms". 2003


29. **J. Park and J. Keller,** upgraded the research to fuzzy label patch and flexible models for their research publication “Fuzzy patch label relaxation in bone marrow cell segmentation,”. 2007

30. J. Keller and P. Gader, integrated fuzzy logic and computer vision for their research work titled "Fuzzy Logic and the Principle of Least Commitment in Computer Vision. 2005

**CONCLUSION OF LITERATURE REVIEW**

Interpretations of blood cell images with visual subjective method and image analysis mediated objective methods have their own limitations. Hence medical image processing techniques such as image enhancement and edge detection are done prior to segmentation of white blood cells from blood smear. (14)

Pathological inspection of an infected cell based on the disease, is solely dependent on subjective assessment which usually leads to significant inter-observer variation in grading and subsequently resulting in late diagnosis. However automatic assessment of required cell count still remains a challenging task as many of the cells are clumped in an image and proper segmentation is the primary aspect. segmentation of blood cells had bee done for counting. Auto threshold, Chessboard distance measure and watershed are used for segmentation of blood cells.(15)

Preprocessing methods use a small neighborhood of a pixel in an input image to get a new brightness value in the output image. The concerned research scholar has collected the microscopic blood cell images from blood smear and bone marrow, cells affected
with leukemia and other malarial parasites from radiologist and oncologists and have database of them. Blood cell image acquisition requires 100 x magnifications on the blood smear and preprocessing requires the application of frequency domain filters and edge detection by using cellular automata. The scholar has applied advanced image enhancement techniques and presented them as papers in national and international conferences.

The scholar has implemented de-noising filters such as Gaussian filter & Gabor filter and compared it with conventional filters such as median, laplacian and average filter. Since the image is stored as a collection of discrete pixels it is necessary to produce a discrete approximation to the Gaussian function before the convolution can be performed. It is found that Gaussian filter algorithm is an extremely versatile sharpening tool that improves the definition of fine detail by removing low-frequency spatial information from the original image.

Next step in medical image processing after preprocessing is edge detection which identifies the sudden intensity changes that are observed by the boundaries of object image produced something like a line drawing of an image. Hough transform based edge operator & Sobel edge operator are implemented and compared with conventional edge operators like Prewitt and Canny operators. Hough transform algorithm uses an array called accumulator to detect the existence of a line. Hough transform is also a feature extraction technique concerned with the identification of arbitrary shapes or ellipse and it has performed well compared to Sobel and Canny operators.

Segmentation is done to divide the unique disjoint regions of the image or to partition the image into meaningful regions that corresponds to objects within the scene, distinguishing one element from other is very difficult when occlusion, staining reagent or illumination is inconsistent. The scholar has implemented one new segmentation technique using New Detection Algorithm (NDA) based on fuzzy cellular neural network (FCNN) [1].

The New Detection Algorithm combines the advantages of threshold segmentation mathematical morphology (TSMM) and fuzzy logic method. Binary threshold segmentation is performed as the first step because the gray value of white blood cell nuclei is the smallest in the image. (16)
Then the individual white blood cells are detected quickly according to their shape feature. In this new detection method both gray and homogeneity information are taken into account. However more parameters need to be determined by statistics. K means clustering was used as a segmentation technique using various color models.

Performing differential white blood cell counts in a bone marrow preparation is a crucial step in diagnosing various disease states. It is a tedious task to locate, identify, and count these classes of cells. In an active project, we are investigating the automation of this task. In this paper, we present a cell segmentation approach which utilizes the Principle of Least Commitment. We use the watershed algorithm to perform an over segmentation of the image where each primitive component is assigned memberships in order to obtain more consistent labels for merging into cell objects.

The fuzzy logic method presented in [7] supposes that one microscopic image consists of two regions. One is the interest region, which contains all white blood cells.

This project proposes network architecture for invariant object recognition and rotation angle estimation. The model has four stages. The first stage is a network implementation of the Radon transform, which is used to separate rotation and translation of the input object into translations on the x axis and y axis, respectively. The second stage provides translation-invariant features using correlations and a maximum-pick-up network. The outputs of this stage are used both for object recognition and rotation angle estimation. The recognition stage employs a Rapid transform for rotation invariance and a multilayer feed forward network for recognition.

The watershed algorithm with the help of morphological preprocessing provides useful patch information which helps preserve geometric structures in bone marrow cell images. This patch information is used to build a patch graph and the graph guides the relaxation process by providing context information to the fuzzy rules. It produces highly over segmented results if a image contains noise or texture. The result of taking the maximum of the line openings. So time tasking is high.

The proposed method supposes that the blood cell image consists of two regions. One is the interest region which contains all white cells and the other is of no interest region which contains back round and red blood cells. The idea of this method is to subtract the
back round first and eliminate the red blood cell and small disturbing objects. It was possible to segment almost all the white blood cells and it was found that the running speed was high and the algorithm was comparatively adaptable.

Feature extraction is extraction of a vector in multidimensional space from an image, where each dimension represents the attribute of the image that is believed to carry information that is useful in classification of the image. Features such as nucleus and cytoplasm area, average color co-ordinates and number of pixels in the nuclear perimeter are used. Accurate classification of human blood cells plays a decisive role in the diagnosis and treatment of diseases [8]. Hematological disorders refer to the diseases caused with the changes in blood cells or blood system such as Leukemia, Anemia, Malaria and Azotemia. White blood cell composition of the blood gives valuable information and plays an important role in the diagnosis of different diseases like Leukemia [11]. Leukemia is a rapid proliferation of abnormal white blood cells (leukocytes) [9]. Anemia can be detected the reduction in the morphology of red blood cells (erythrocytes). Thalassemia, a type of malaria is due to the abnormality in red blood cells [6] Azotemia is another type of hematological disorder caused by excessive nitrogen compounds which can be detected by the change in micro morphological features from blood cell.

Proposed research work begins with the segmentation of white blood cells from blood plasma using new advanced computing methods and new segmentation algorithms [1]. New and already done (by the scholar) and some other existing segmentation algorithms will be compared for their accuracies [10], to determine the optimal algorithm finally to be adopted for the next stage of work.

After the segmentation of leukocytes soft computing classifiers are used to classify using the extracted morphological indexes as Neutrophils, Basophils, Eosinophils, Lymphocytes and Monocytes [4]. Fuzzy C means clustering (FCM) will be used for the classification of pixels which is an unsupervised fuzzy classification algorithm. Separation of the classes can be done using three most relevant features such as cell and nucleus area and the gray intensity of the cytoplasm.
Mini puri and Jyoti pana used stem cell regional localization in their research paper for the cancer detection (13).

The malarial parasitic detector can use a Bayesian pixel classifier to mark the stained and unstained classes of pixels using conditional probability density functions. Early identification of leukemia, malarial parasites and other hematological disorders can greatly increase the probability of recovery [13]. Blast cells, for instance are characteristics of a certain type of leukemia and would indicate further tests if found in blood. Features are to be extracted according to an efficiency criterion on the basis of classification or recognition tasks (17). Hough tranforms are used by many researchers to seget brain fissures and mammographic disorders in medical segmentation methods (18).

Being able to automatically able to classify these and flag samples accordingly could be a great boon to hematologists (19). This would of course require leukemic blood with unusual evidence to be available and manual classification by hematologists for the training data set.