Real-Time Image Processing for Biological Applications Through Morphological Operations using LabVIEW

Ajay P. Dhawale
Department of electronics
Government college of engineering Aurangabad.

Prof. S. R. Hirekhan
Department of electronics
Government college of engineering Aurangabad.

***Abstract* - This investigation develops a multiple diagnosis for the anemia using Microscopic Images of RBC (Red blood corpuscles). This system can identify, analyse and save records of microscopic images. Real –Time analysis of RBC (erythrocytes), the most common type of blood cell has been implemented. Microscopic analysis of cell plays a vital role in diagnosis and treatment. Real-Time Image Processing for Biomedical Image Analysis, RBC Analysis is the basis to perform higher level tasks such as automatic differential counting which play an vital role in diagnosis of various diseases. To prepare and Interpret Peripheral Blood Smear examination, Researchers have developed various effective methods such as A Hematology Analyzer for blood smear . However , they always depend on special and expensive instruments.**

Keywords: Biomedical Image Processing, Pattern Matching, Analysis of RBC counting, Possible analysis of image samples.

I. INTRODUCTION

Images are the main source of acquiring information from the real world. Images are captured in various ways hence it needs the preprocessing for unwanted data of images. The System is implemented by using USB – 800X Magnification Digital microscope and a software tool *Laboratory Virtual Instrumentation Engineering Workbench* (LabVIEW). The algorithm for processing of the images and detection of cells which is anemic or not using LabVIEW.

The importance of being able to quickly and accurately identify and count the particles in a blood sample of a patient. Previously, this crucial but tedious work has been carried out manually by lab technicians. This introduces a component of subjectivity and human error into the results that can sometimes cause problems. However, advances in microscopy and computing technology can now allow scientists to write software that can perform this job automatically, thus removing the risk of human error.

There are several different approaches that can be taken to write the type of software that would be necessary for such an application. The one taken in this report involved the use of LabVIEW and National Instruments Vision Assistant software. Using knowledge of the characteristics of the particles found in the blood, with particular attention to white and red blood cells and the differences between them, one can allow design a program that can distinguish specific particles of interest. Gathering data this way could be done far more efficiently than it is now and could prove invaluable for doctors and patients. If a system could be developed to pattern matching to the numerous targets simultaneously, then experiments would take less time, require less human effort and fewer other resources, such as microorganism being and medicinal resources.

II. METHODS

A] The Image is capture through the Microscopic USB camera and take as a input.

In this study, a pattern matching system for RBC's was developed. It includes the following subsystems:

1. For observing a panoramic and snap view of the anemia completely, an ingenious circular experimental pool is self-made on a microscope slide.
2. A Digital biological microscope with a 5X digital zoom target lens 40X-800X which is used to magnify the RBC's. images and enable the RBC's to be observed by the naked eye.
3. A computerized image shape matching system which was designed to help observe and record the shape match and particle analysis of each RBC's.
4. A man-machine interface which was programmed using LabVIEW software to enable the pattern matching system be used to locate and identify the abnormal RBC's and analysis of anemia.

5. An image processing procedures which includes color Plane extraction, thresholding, background subtraction, and morphology.
6. A pattern matching algorithm which can match N number of normal and abnormal RBC's and Anemia.

The block diagram of the multi-target tracking system is shown in Figure 1.

B. Image Processing And Pattern Matching

In feature extraction, digital image processing is adopted to recognize the shape of the Anemia. The image is analyzed by

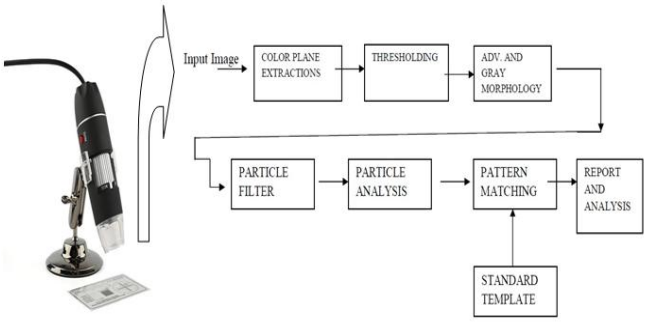


Figure: 1 Block Diagram Of pattern matching system

a software developed in LabVIEW-2013 (National Instruments, USA), a graphical programming development tool, which can be used to pattern match, analyze, and particle filter of an image. In this study, the system is divided into the two parts that are shown in Fig.1 pre-processing, and image analysis. In the pre-processing stage, the system processes of snap images that record the behavior of the RBC's as JPG, JPEJ file in LabVIEW. Increasing the effectiveness of data processing, reducing the required human resources and time. The proposed image processing algorithm consists of the following Six procedures. In the color space extraction, the system converts the HIS or HSL images from the JPEG, JPG file to the images with a uniform grayscale. The threshold algorithm is applied to compute the local thresholds for each pixel based on its local statistics and seek the dark objects to make the intended target stand out against the complex background and convert to the binary image. In Advance. (Adv.) Morphology the binary image operation removing the border touching objects and fill hole of object and in gray morphology the remove small object, erosion and dilation functions to finishing the image.
The adv. morphology filter the particle which was unwanted. The system particle analysis gives the particle report to the display which contain the number of particle and size in pixels. The pattern matching algorithm match the shape of particle from the standard template and gives the final shape matching report which is number of matches found of a iron deficiency anemia (IDA) and sickle cell anemia when gives that template to it.
The input image and processing image was developed in this system. The input image after processing and the background correction and count the number of object in the input image and gives for the next processing. The step by step image process is shown in the Figure 2. The process automation algorithm was developed for minimize the human errors and time and save the result data automatically.

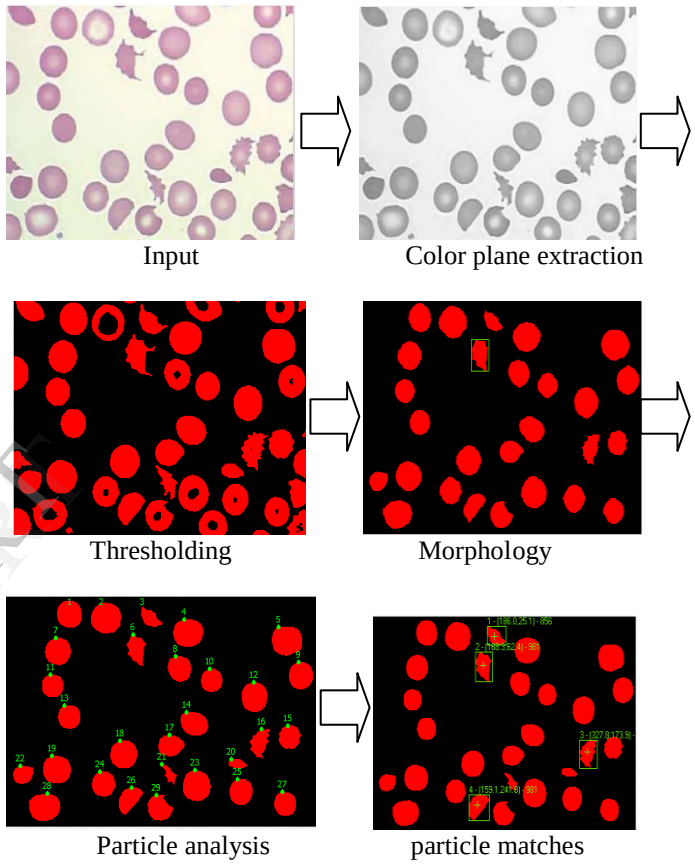


Figure: 2 The image processing and RBC's counting procedures for IDA

C. Algorithm

To verify the accuracy of shape matching, analysis IDA Pattern match algorithm was developed.

Algorithm

1. Give the input image
2. Color plane extraction-HSL or HSI
3. Thresholding
4. Adv. Morphology - Remove Border object
   - Fill Holes
   - Remove Small objects
5. Gray Morphology – erode

6. Particle filter – center of mass x
7. Particle analysis
8. Shape matching

The algorithm describes the procedure for carrying out the system work. In this investigations used the simple algorithm which was automated only gives the input image and run the system. The particle analysis, particle shape match and selected particle report display on front panel of LabVIEW window.

III. EXPERIMENTS AND RESULTS

To confirm that the developed system can match the shape of Iron deficiency anemia accurately using the above-mentioned positioning algorithm for the image analysis of the system.

Object #	Center of Mass X	Center of Mass Y	First Pixel X	First Pixel Y
1	81.57814	20.51939	82	4
2	129.06908	25.20121	123	7
3	185.97917	25.1224	176	12
4	235.14995	42.88634	230	27
5	362.89311	52.16254	352	36
6	168.27627	62.4339	164	45
7	66.84633	64.93693	64	49
8	224.12332	85.54692	219	71
9	381.0703	93.93212	378	78
10	265.57074	99.66881	263	86
11	59.90924	106.23177	57	93
12	320.94416	119.59049	320	102
13	81.35768	143.2772	75	130
14	242.94335	151.35591	233	138
15	366.41548	167.53081	364	154
16	327.81416	173.92743	330	158
17	212.5156	177.59733	211	165
18	151.96825	188.13122	147	172
19	65.26707	206.27625	59	190
20	298.60952	199.20952	291	194
21	211.03286	211.8216	201	200
22	21.55991	212.15904	18	202
23	246.04034	225.70356	244	207
24	125.74627	223.51289	121	209
25	303.60662	232.88477	299	218
26	159.06843	241.8367	162	228
27	360.65356	247.22995	357	233
28	49.37034	251.12966	53	235
29	197.80874	252.43852	194	237

Table: 1 Total number of particles in image

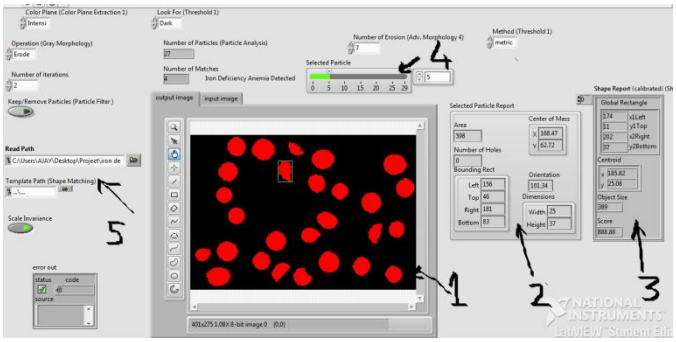


Figure 3: Analysis of Image

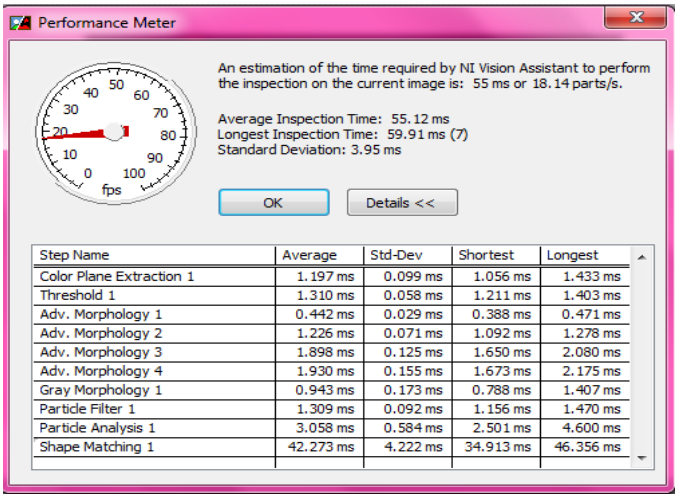
Figure 3: presents the proposed man-machine interface, which was developed using LabVIEW software. Through this interface, the center of Mass X and center of Mass Y adopted to detect Object position. The table:1 shows the total number of object in image. In red highlighted objects was the IDA which was the pattern matched by algorithm and equivalent result shown in table: 2.

Results ...	1	2	3	4
Center X	186	168	328	159
Center Y	25	62	174	242
Score	856	981	929	981

Table 2: Number of Matches of IDA and position in pixels

Figure 3: presents five display windows as shown in the following.

1. Morphology and Pattern Match (image) Display Window: This window presents the results of image processing.
2. Selected particle analysis window which display the area, center of Mass X Center of Mass Y *etc.*
3. The shape report which matched the pattern, display on third window.
4. In this window Selected particle numbers (0 to n-1) If 29 object is detected then display (0 to 29-1) the numbers 0 to 28.
5. The fifth window for standard template file path from which template path can be selected.



Step Name	Average	Std-Dev	Shortest	Longest
Color Plane Extraction 1	1.197 ms	0.099 ms	1.056 ms	1.433 ms
Threshold 1	1.310 ms	0.058 ms	1.211 ms	1.403 ms
Adv. Morphology 1	0.442 ms	0.029 ms	0.388 ms	0.471 ms
Adv. Morphology 2	1.226 ms	0.071 ms	1.092 ms	1.278 ms
Adv. Morphology 3	1.898 ms	0.125 ms	1.650 ms	2.080 ms
Adv. Morphology 4	1.930 ms	0.155 ms	1.673 ms	2.175 ms
Gray Morphology 1	0.943 ms	0.173 ms	0.788 ms	1.407 ms
Particle Filter 1	1.309 ms	0.092 ms	1.156 ms	1.470 ms
Particle Analysis 1	3.058 ms	0.584 ms	2.501 ms	4.600 ms
Shape Matching 1	42.273 ms	4.222 ms	34.913 ms	46.356 ms

Figure 4: Performance Meter For Algorithm

IV. DISCUSSION

This study utilizes LabVIEW software to implement the proposed pattern matching algorithm. And the analysis of the Iron Deficiency Anemia depends on their standard template shape matched. The proposed computerized pattern matching system not only can save significant time and manpower for the researchers, while still produces optimal results, but also gather numerous meaningful data simultaneously. Experimental results reveal the effectiveness of the pattern matched system, which maintains pattern. In the future, methods for processing RBC's images covered by obstacles, which will includes Optical Flow method as well as an algorithm for automatically adjusting the number of eroding time to suit different body shapes and sizes for microorganisms match pattern shall be developed.

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