International Journal of Computer Sciences and Engineering Open Access
Case Study Vol. 8, Issue.10, October 2020 E-ISSN: 2347-2693

A Study on Lymphoblastic Leukemia Using Image Processing

Afsheen Firdous[1*], Kompella Venkata Ramana[2]

[1]Computer Science and Technology, Department of Computer Science and System Engineering, Andhra University College of Engineering, Visakhapatnam, India
[2]Department of Computer Science and System Engineering, Andhra University College of Engineering, Vizag, India

**Corresponding Author: afirdous501@gmail.com, Tel.: 8978914952*

DOI: https://doi.org/10.26438/ijcse/v8i10.147157 | Available online at: www.ijcseonline.org

Received: 20/Oct/2020, Accepted: 25/Oct/2020, Published: 31/Oct/2020

***Abstract*-**Blood cancer is one of the types of cancer. Leukemia is one among them. Which was caused due to the abnormal growth of the white blood cells in the bone marrow in the blood. This also affects the functionality of the white blood cells and the red blood cells, platelets. The leukaemia is further divided into four types. In this paper, we are going to discuss and examine the results of the acute lymphoblastic leukemia. In the phase of segmentation procedure, we have taken the edge-based segmentation. Here we will see the results by applying the median filter once and twice with different masks along with different operators. For the process, we have done it in processing tool like Pycharm with python, Opencv package. We have observed the difference between the operators with its functionality, changing the mask values for filtration. The good segmentation leads to the accuracy in classification.

***Keywords*-**Blood cancer, ALL (Acute Lymphoblastic Leukemia), Image Segmentation, Pycharm

I. INTRODUCTION

Blood cancer is of three types leukemia, lymphoma and myeloma. Leukemia starts in blood and bone marrow because of abnormal WBC cells the damage will occur to RBC and platelets. Lymphoma again divided into two 1.Non-hodgkin lymphoma, 2.Hodgkin lymphoma. Non-hodgkin lymphoma develops in the lymphatic system from cells called lymphocytes, a type of WBC that helps to fight infections. Hodgkin lymphoma is the same as non-hodgkin but the difference is the presence of an abnormal lymphocyte called the "red-Sternberg cell." Multiple myeloma it develops in blood plasma cells a type of WBC made in the bone marrow. In this paper, we are going to discuss leukemia. In leukemia, we are going to deal with one of the types that is acute lymphoblastic leukemia. It is common in children. It damages the DNA. If it is not treated, it will become a deadly disease within months. Immature cells grow at a rapid rate. Therefore, it is called leukemia blasts. If it affects adults then there are very less chances to cure. This will spread to other parts like liver, spleen and lymph nodes. However, it does not make a tumor. The leukemia cells will decrease the efficiency of WBC to kill the infections and virus. The treatments to treat the cancer are stem-cell transplant, chemotherapy, radiation therapy. To do this here we have to examine the infected cancer cells. For that purpose, we will apply image-processing techniques. For the detection, we will employ the segmentation process to recognize the cancerous cells. This segmentation process based on the edge-based method. In the edge based method we have sobel, canny, prewitt, Robert, fuzzy logic methods.

II. RELATED WORK

Under the image processing and specially image segmentation much work has done. Very good amount of research work is also taking place with available and new techniques for the best results. Many people worked on it and still work is going on for better results. Some of the works we are going to discuss where they applied different techniques and logical ideas for the automatic and better analysis for the detection of affected cells. A Survey on Detection of Blood Cancer Cell Segmentation. Many techniques and classification of WBC are present. However, they presented that the segmentation techniques on cytoplasm and nucleus from each WBC and feature extraction follows the remaining procedure of detection [1]. They have stated that the segmentation can also be done with the color based clustering; the clustering techniques used are k-means, k-medoid, FCM, GK and FPCM for microscopic image segmentation. The Hausdorff dimension was used for the analysis of the lymphoblast detection [2]. These people presented a paper based on a study and overview on the segmentation and feature extraction and accuracy techniques. We have to choose correct segmentation techniques even though we have many problems related to the staining of cells, noise reduction, robust and fully automated systems, which can be efficient [3]. Another proposed a method for automated detection of leukemia. At the image segmentation stage, they have taken the k-means and fuzzy k-means clustering. The classification was by SVM (Support Vector Machine). The accuracy was achieved with these logics [4]. This method is to detect acute leukemia based on Otsu's segmentation method and features extraction by contour signature [5]. They have stated that for the automated

detection of leukemia and finding out the intended object as early as possible many of them are using SVM as a classifier and K-means as a segmentation algorithm. The automated accuracy was dependent on the type of segmentation [6]. The good work was done and presented a two-phase methodology to analyze white blood cancer cells using image processing and data mining techniques. A novel method used for segmenting color and texture information was proposed using Markov random fields. CIE L*a*b* color spaces were employed for color features, instance based classifier, decision trees were used for classification [7]. They stated that the primary purpose of the paper is cellular segmentation, which is continued by feature extraction, the outcomes display the K-means approach is applied for first-rate segmentation functionality [8]. Here in this paper the segmentation is done with a matrix of pixels. Every detail of the primary matrix is introduced to the further similar details in the secondary image matrix. Later the image undergoes the Otsu's threshold for the binary image with black and white. For the reduction of the intra variance values [9]. They had proposed a method in their work they do segmentation with the k-means clustering for detection. They applied histogram equalization and then they applied the zack algorithm for grouping the lymphocytes and myelocytes.By threshold the detected the nucleus [10]. They have done segmentation of nuclei using MATLAB. Otsu's threshold has been used for the binary image creation.

The sobel operator detects edges. The feature extraction is with the Statistical, geometrical, textural analysis [11]. The paper is on "Detection of Leukemia in Microscope Images Using Image Processing", They defined that after performing the linear contrast enhancement and histogram equalization apply Otsu's threshold and then Sobel edge detection is for removal of the small particles [12].

III. METHODOLOGY

In this paper, we have worked on acute lymphocytic leukemia. The detection of the cells is done by the edge detection methods.

Many edge detection methods are there from which we have taken two methods such as sobel and canny operators. For the better understanding of the difference between the edge based methods and threshold values it is going to explain with the algorithm and block diagram.

Algorithm:

Step 1: Images taken with the light microscope this process comes under image acquisition.

Step 2: They will take into the grayscale then for the next process.

Step 3: The grayscale image taken then the once, twice median filters with different mask values will be applied for the sharp boundaries and for the reduced noise.

Step 4: Here in this paper we took the sobel and canny operator to see the resultant outputs for the efficient detection.

Step 5: Sobel operator was applied on gray value filtered image then we applied on the X-axis and then Y-axis finally we combined them. It gives output with some reduced noise and edges of the object in the image were detected.

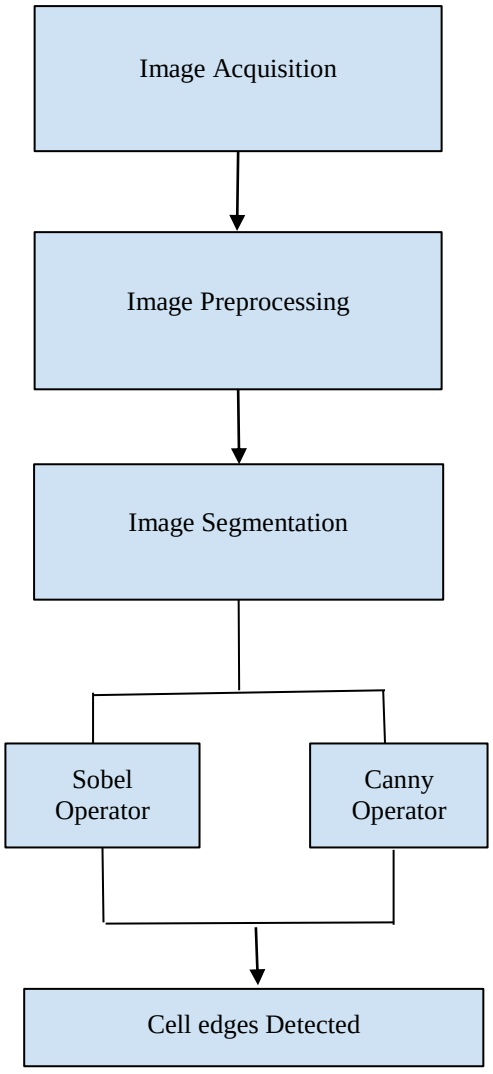
Step 6: On the other hand, we applied a canny operator on the gray value image. The canny operator itself is having a Gaussian filter as one of its features and by applying the hysteresis threshold; we get the image with least amount of noise and with better edges was detected.

Step 7: By changing the threshold values and to get a good threshold value that edge segmented image can be used for the next process of the detection.

Step 8: From step 5 and step 6, we can distinguish which process was with the least noise, better segmented.

Step 9: From step 7 and step 8, we can say that the canny operator will give the efficient result.

Block Diagram:



We have used the filter with the 3*3, 5*5, 7*7, 9*9 masks. For the better filtration, we applied the filter twice on the image. The filter we used was median filter. The median filter will give images with less noise and sharp edges. Segmentation is a process where the image is divided into small segments, the operations will take place according to the operator, and we get a segmented image. The edge based segmentation method we used is sobel and canny.

Sobel operator: It is used to detect the edges vertical and horizontal direction. In vertical direction, it simply works as a first order derivative and calculates the intensities in an edge region.

The horizontal direction also works with the same principle but as the center row is zero it will not include the above and below rows of the particular edge. This sudden change makes the edge more visible.

Canny operator: It is also a one of the edge based segmentation methods. Which is more efficient on the texture based analysis. It is good for the signal to noise ratio is high that is it gives an image with the least noise. The application area is the medical field for the x-ray diagnosis and object recognition. The canny operator itself compressed of four features they are

1. Noise Reduction
2. Finding Intensity of the Image
3. Non-maximum Suppression
4. Hysteresis Threshold

The noise reduction is going to do with the Gaussian filter. So here we no need to put a extra filters for pre-processing, for the hysteresis threshold, it is having threshold value 1 and threshold value 2. The value 1 is for the first threshold value, which will apply on the grayscale-filtered image after that again it goes under segmentation with the other threshold value so that we get the filtered image without incomplete edges at the corners and least noise. Due to having less noise and with more efficient detection of edges of the cells we can get better segmentation results.

IV. RESULT AND DISCUSSION

The image was taken and that will be converted to the grayscale image on which we have applied two operators one is sobel and other is canny. When we compare these two operators on the bases of least noise and good edges detection. We get a result that canny has given a good result. Because of Canny's features. Later on, we examine by applying the threshold values. We figured out the points of threshold values where we can get a good-segmented image with least noise. So that it can be used for further image processing. Because the classification depends on the segmentation.

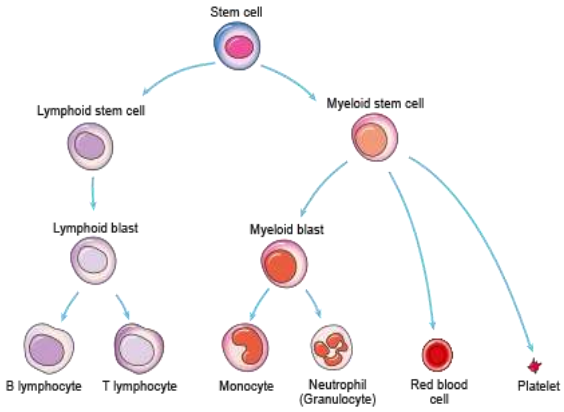


Figure 1. Image of Acute Lymphoblastic Leukemia

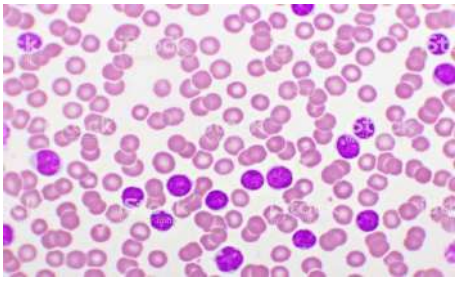


Figure 2. Image taken for the processing

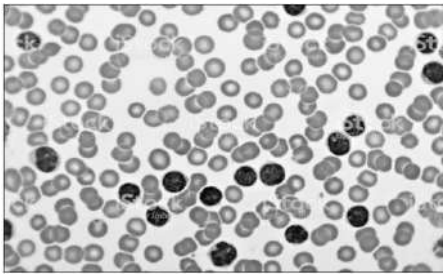


Figure 3. Grayscale image

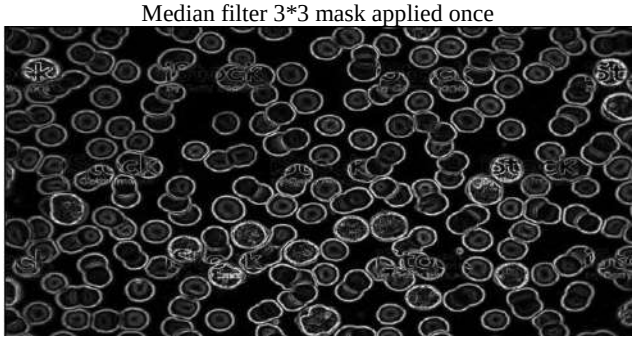
When the image is converted to the grayscale then the step in the image processing is applying the filters. As we took a median filter for the elimination of noise to some extent and sharpening of edges. We also examined that median filter with different masks twice. We took mask values those are 3*3, 5*5, 7*7, 9*9. After this section, the image undergoes segmentation with the sobel and canny operator. We have applied the sobel operator with the different masks with twice the median filter. We observed the output with respect to the different masks with different changes. To eliminate the noise from the image we have to combine it with the Otsu's threshold value or clustering techniques. Which means the process is a bit complex. On the other hand canny is having a Gaussian filter for the noise reduction to get a more filtered image. We applied the median filter twice with different masks along with the canny operator. Canny is also having the low and high threshold values(hysteresis threshold). We have checked that having mask value basic 3*3 and the minimum threshold value with the canny operator giving

the result with unwanted noise. That may lead to undesirable results. We also observed the changes taking place while increasing the threshold value with 50 as interval between the values up to maximum 400, the minimum is 100. We have taken the masks up to 9*9 and threshold value up to 400 to study where we are getting the good-segmented image with sharp edges and least amount of noise. We observed that if we are increasing the mask value more than 5*5 with twice median filter along with canny operator it will lose information from the image. If we increase the threshold value, more than 350 then the edges will be incomplete. Those incomplete edges may not give the accurate result in the classification. When It Undergoes morphological analysis those important information may be eroded. The outputs, which are below, will give the visualization of the sobel operator with median applied once, twice with different mask values. In addition, we see the canny operator with the median applied once, twice with different masks with the threshold values.

Table 1. For the sobel operator median filter applied with different masks:

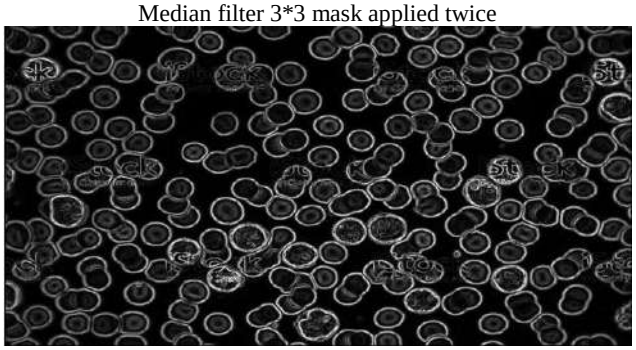
Masks	**Median filter applied once**	**Median filter applied twice**
3*3	output1.0	output1.1
5*5	output2.0	output2.1
7*7	output3.0	output3.1
9*9	output4.0	output4.1

Median filter 3*3 mask applied once



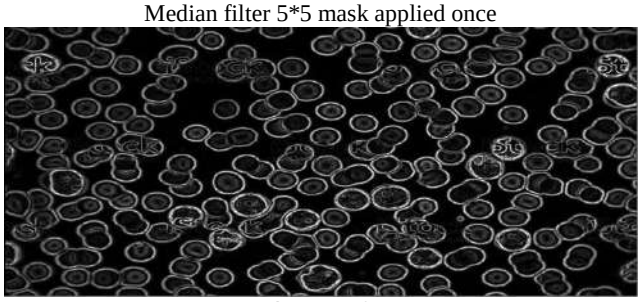
Output 1.0

Median filter 3*3 mask applied twice



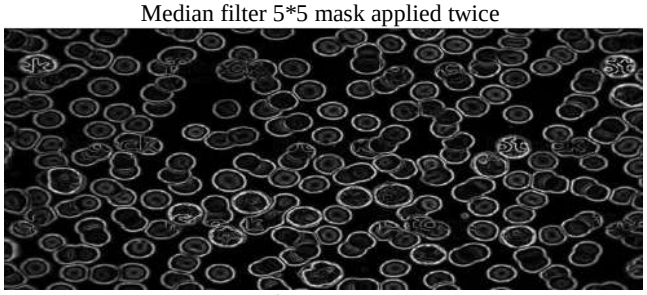
Output 1.1

Median filter 5*5 mask applied once



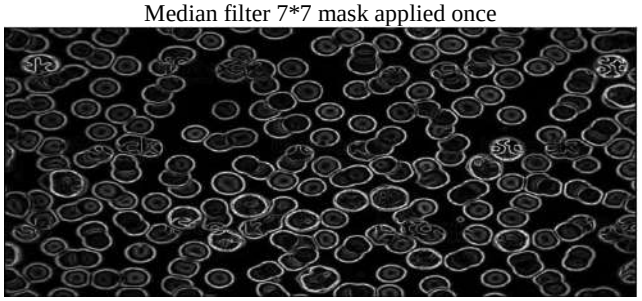
Output 2.0

Median filter 5*5 mask applied twice



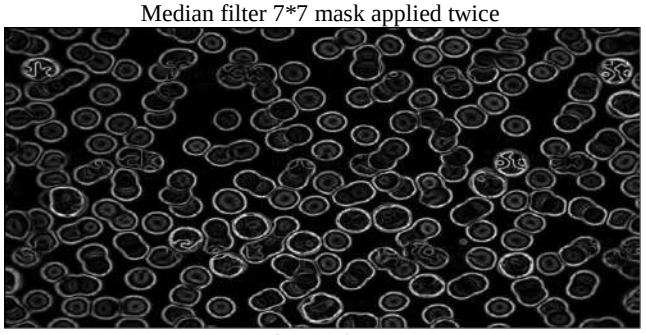
Output 2.1

Median filter 7*7 mask applied once



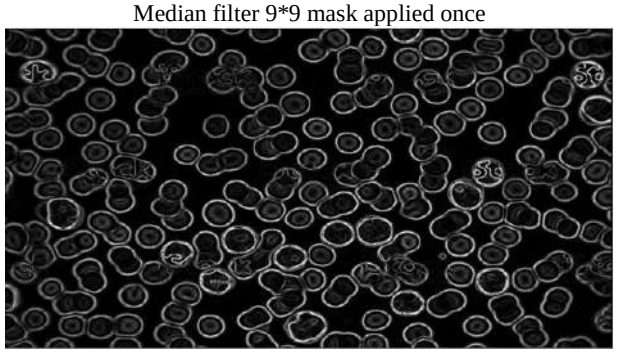
Output 3.0

Median filter 7*7 mask applied twice



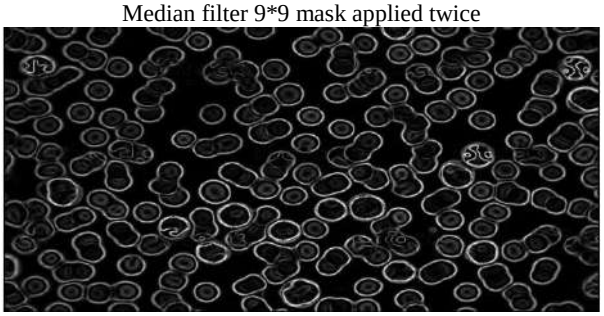
Output 3.1

Median filter 9*9 mask applied once



Output 4.0

Median filter 9*9 mask applied twice

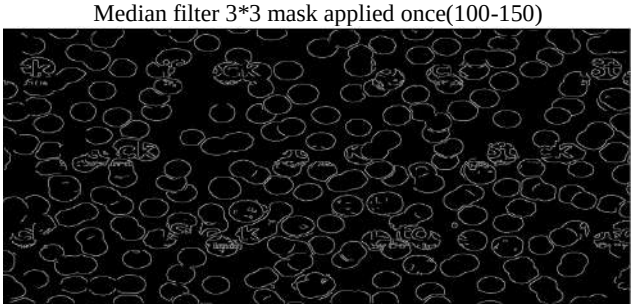


Output 4.1

Table 2. For the canny operator median filter applied with different mask and threshold values(100-150):

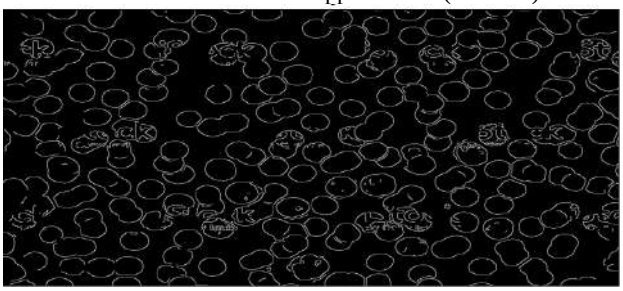
Masks	**Median filter applied once (100-150)**	**Median filter applied twice (100-150)**
3*3	output5.0	output5.1
5*5	output6.0	output6.1
7*7	output7.0	output7.1
9*9	output8.0	output8.1

Median filter 3*3 mask applied once(100-150)



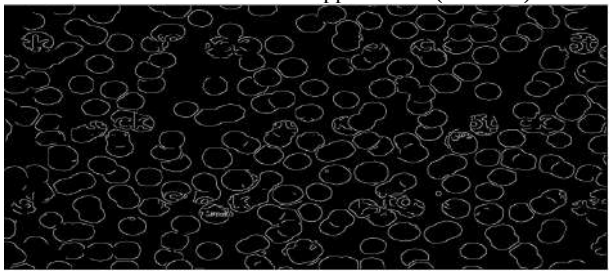
Output 5.0

Median filter 3*3 mask applied twice(100-150)



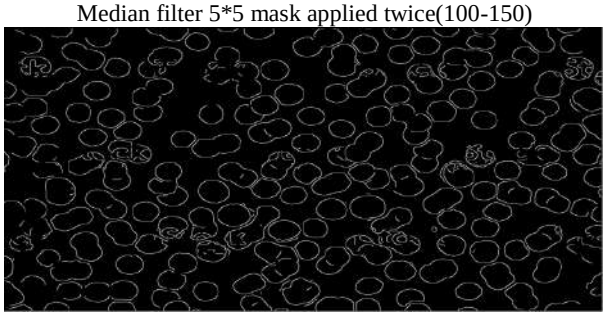
Output 5.1

Median filter 5*5 mask applied once(100-150)



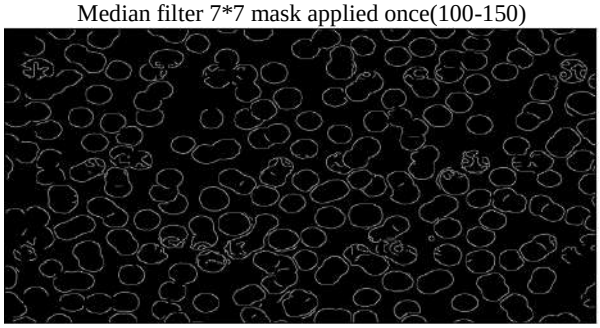
Output 6.0

Median filter 5*5 mask applied twice(100-150)



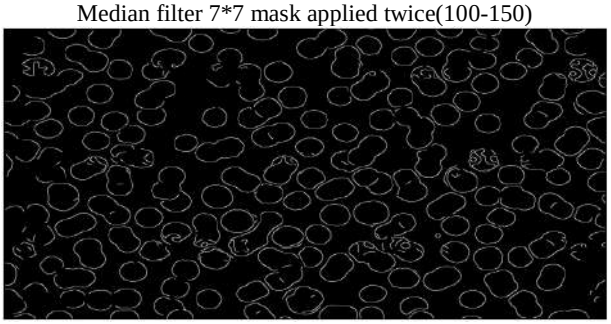
Output 6.1

Median filter 7*7 mask applied once(100-150)



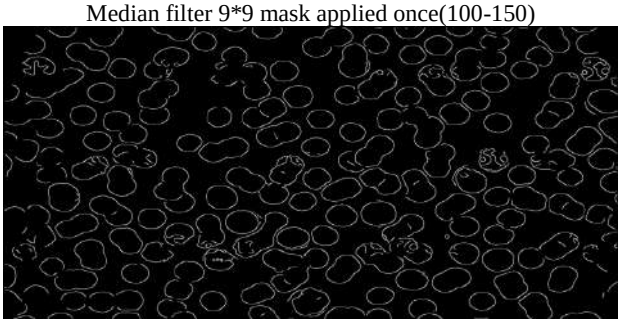
Output 7.0

Median filter 7*7 mask applied twice(100-150)



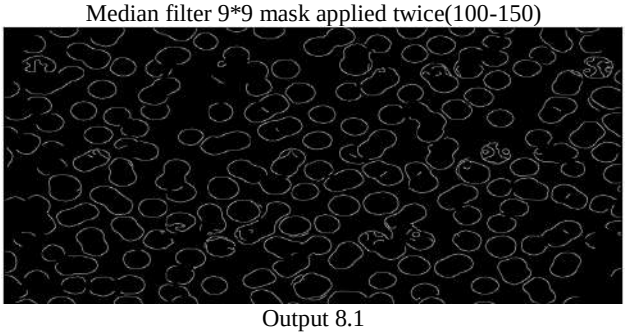
Output 7.1

Median filter 9*9 mask applied once(100-150)



Output 8.0

Median filter 9*9 mask applied twice(100-150)

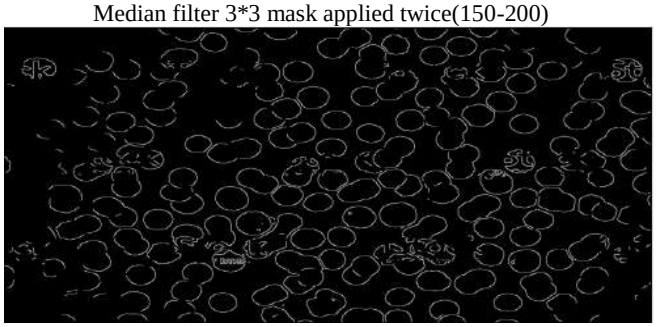


Output 8.1

Table3. For the canny operator median filter applied with different mask and threshold values(150-200)

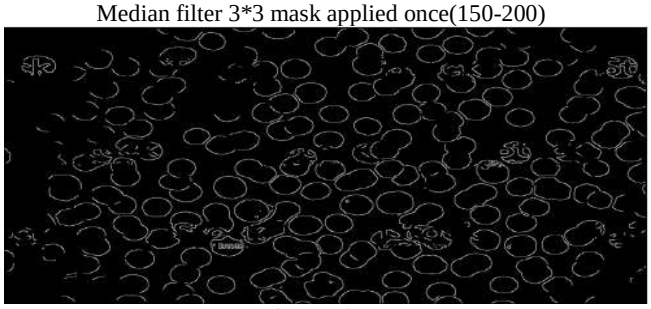
Masks	Median filter applied once(150-200)	Median filter applied twice(150-200)
3*3	output9.0	output9.1
5*5	output10.0	output10.1
7*7	output11.0	output11.1
9*9	output12.0	output12.1

Median filter 3*3 mask applied twice(150-200)



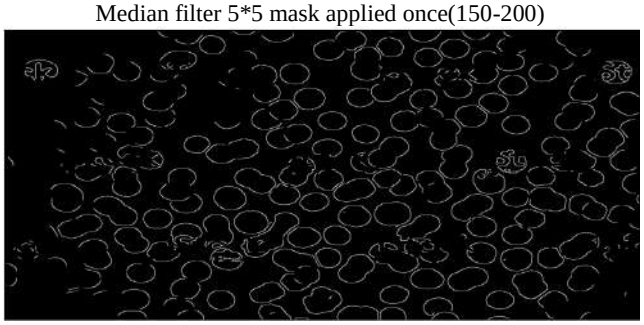
Output 9.0

Median filter 3*3 mask applied once(150-200)



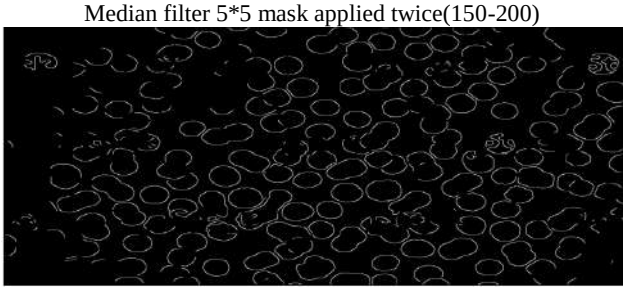
Output 9.1

Median filter 5*5 mask applied once(150-200)



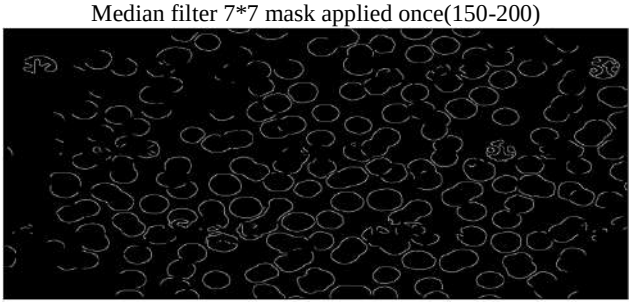
output10.0

Median filter 5*5 mask applied twice(150-200)



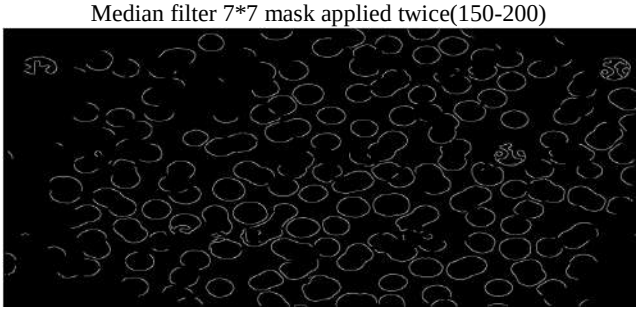
Output 10.1

Median filter 7*7 mask applied once(150-200)



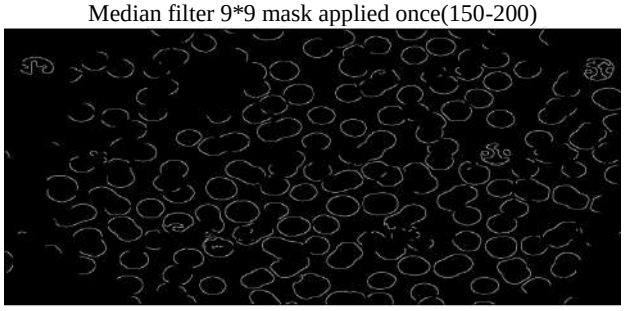
Output 11.0

Median filter 7*7 mask applied twice(150-200)



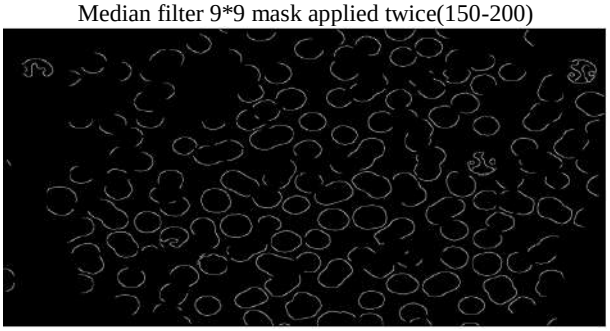
Output 11.1

Median filter 9*9 mask applied once(150-200)



Output 12.0

Median filter 9*9 mask applied twice(150-200)

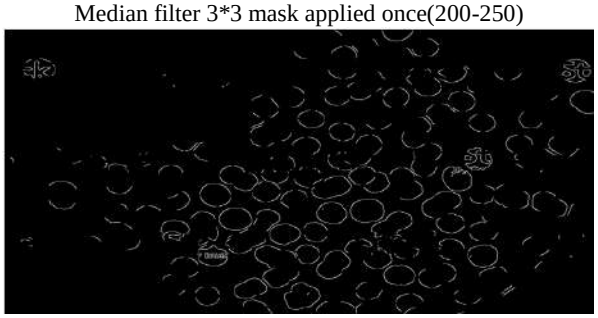


Output 12.1

Table 4. For the canny operator median filter applied with different mask and threshold values(200-250)

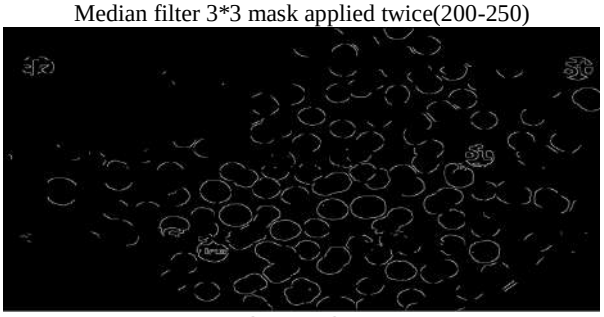
Masks	Median filter applied once(200-250)	Median filter applied twice(200-250)
3*3	output13.0	output13.1
5*5	output14.0	output14.1
7*7	output15.0	output15.1
9*9	output16.0	output16.1

Median filter 3*3 mask applied once(200-250)



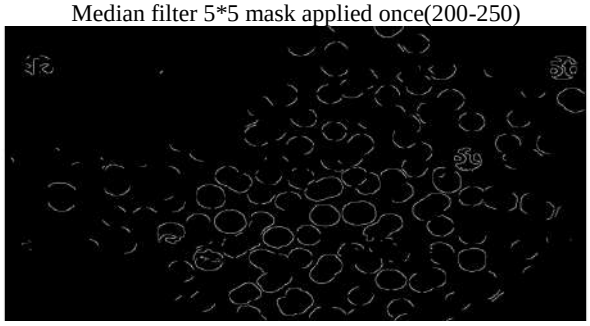
Output 13.0

Median filter 3*3 mask applied twice(200-250)



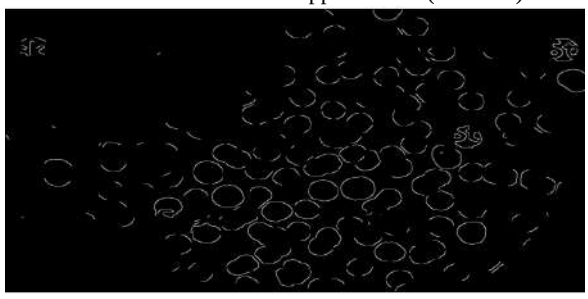
Output 13.1

Median filter 5*5 mask applied once(200-250)



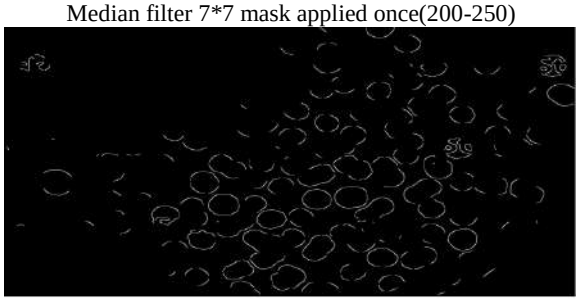
Output 14.0

Median filter 5*5 mask applied twice(200-250)



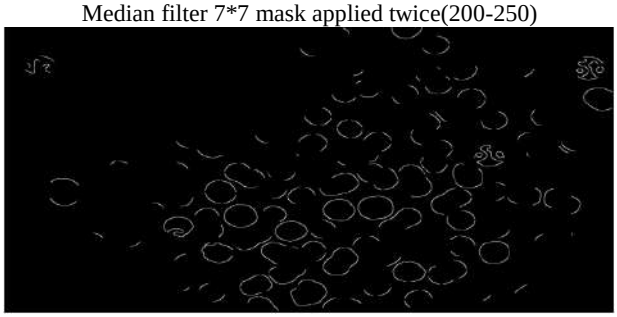
Output 14.1

Median filter 7*7 mask applied once(200-250)



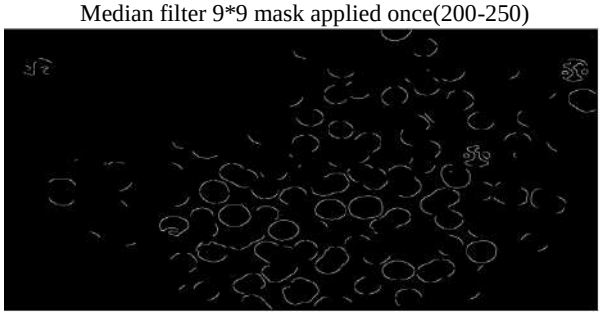
Output 15.0

Median filter 7*7 mask applied twice(200-250)



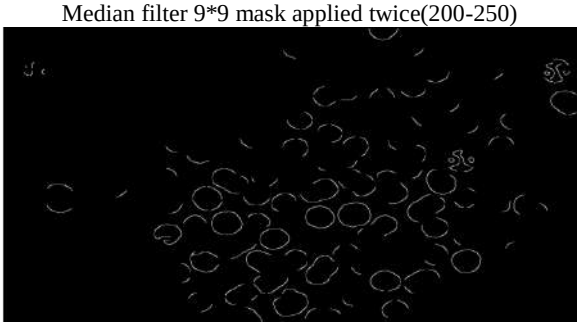
Output 15.1

Median filter 9*9 mask applied once(200-250)



Output 16.0

Median filter 9*9 mask applied twice(200-250)

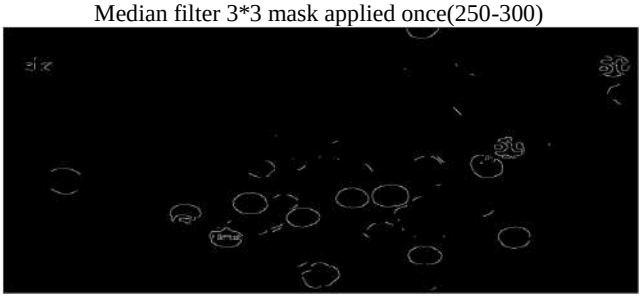


Output 16.1

Table 5. For the canny operator median filter applied with different mask and threshold values(250-300)

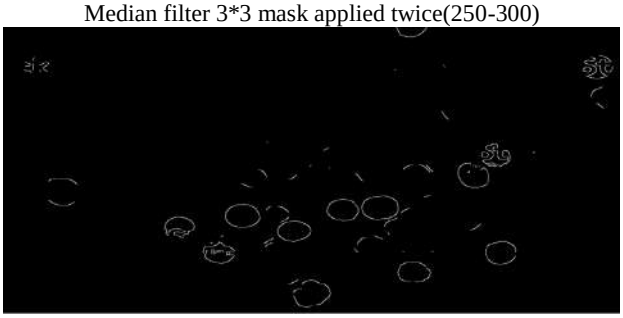
Mask	**Median filter applied once(250-300)**	**Median filter applied twice(250-300)**
3*3	output17.0	output17.1
5*5	output18.0	output18.1
7*7	output19.0	output19.1
9*9	output20.0	output20.1

Median filter 3*3 mask applied once(250-300)



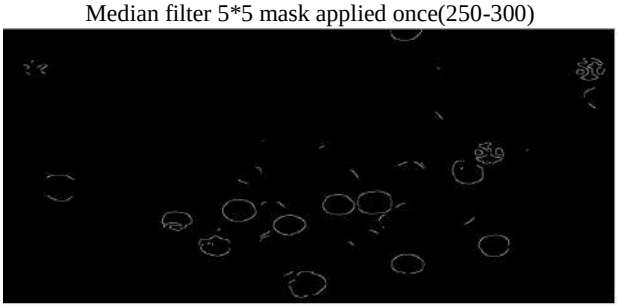
Output 17.0

Median filter 3*3 mask applied twice(250-300)



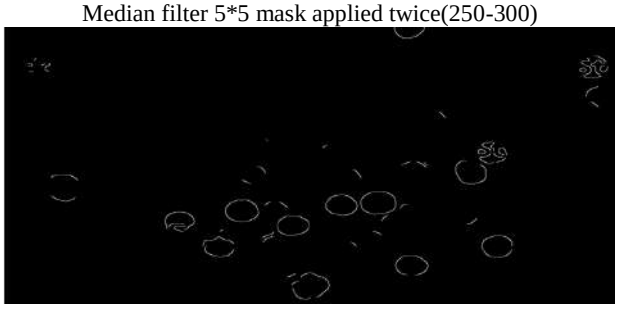
Output 17.1

Median filter 5*5 mask applied once(250-300)



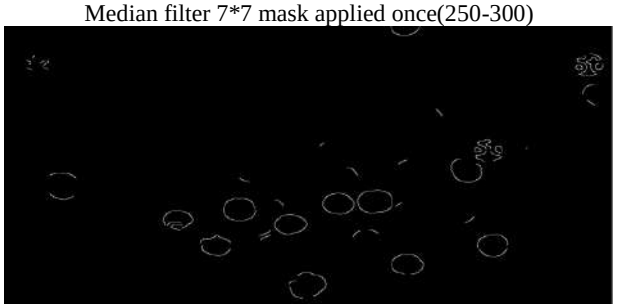
Output 18.0

Median filter 5*5 mask applied twice(250-300)



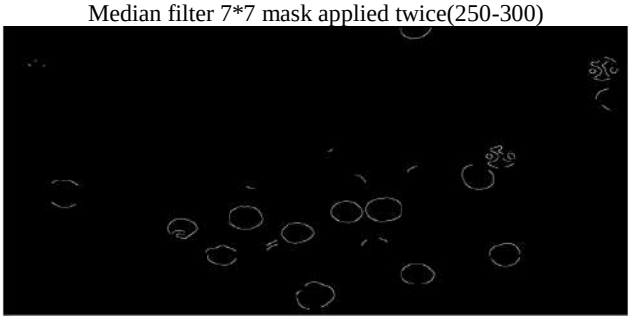
Output 18.1

Median filter 7*7 mask applied once(250-300)



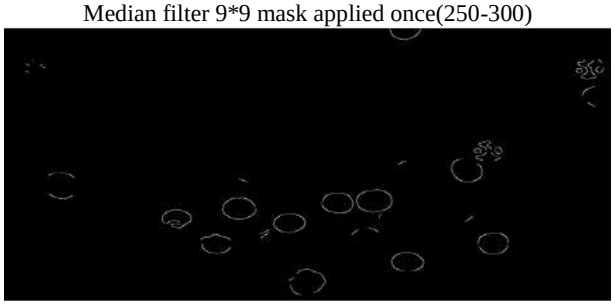
Output 19.0

Median filter 7*7 mask applied twice(250-300)



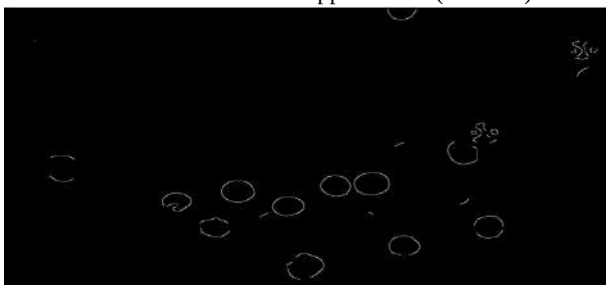
Output 19.1

Median filter 9*9 mask applied once(250-300)



Output 20.0

Median filter 9*9 mask applied twice(250-300)

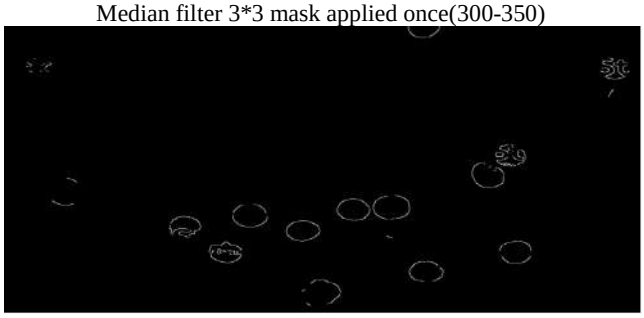


Output 20.1

Table 6. For the canny operator median filter applied with different mask and threshold values(300-350)

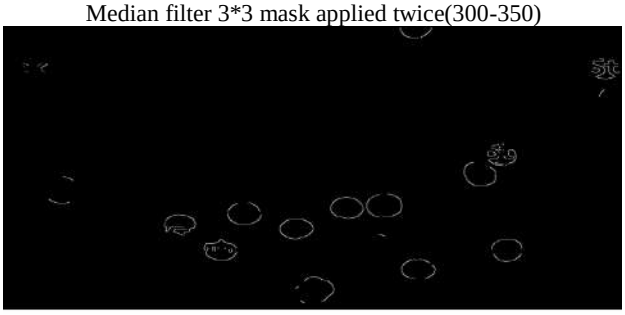
Mask	**Median filter applied once(300-350)**	**Median filter applied twice(300-350)**
3*3	output21.0	output21.1
5*5	output22.0	output22.1
7*7	output23.0	output23.1
9*9	output24.0	output24.1

Median filter 3*3 mask applied once(300-350)



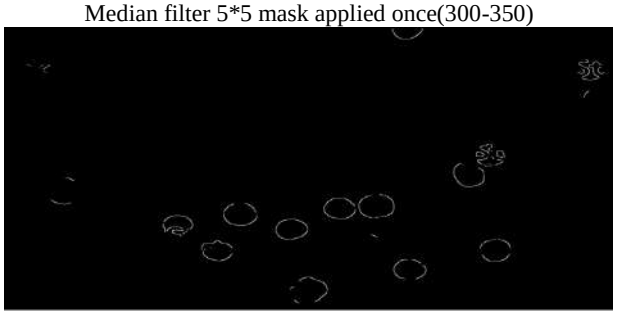
Output 21.0

Median filter 3*3 mask applied twice(300-350)



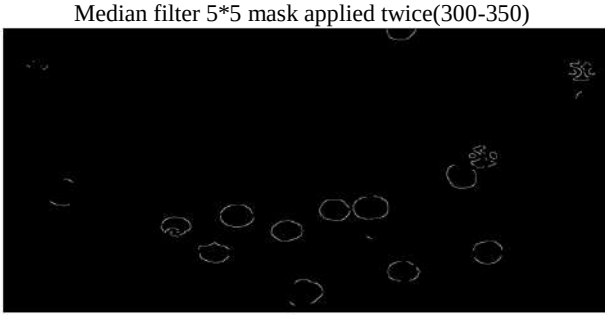
Output 21.1

Median filter 5*5 mask applied once(300-350)



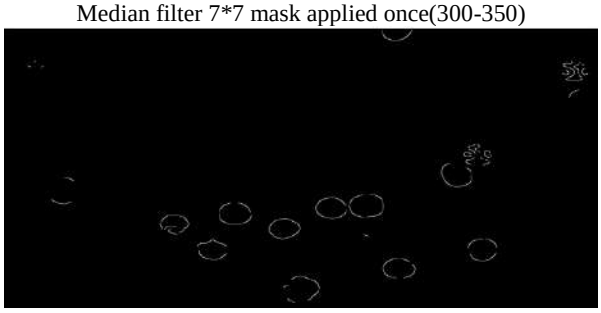
Output 22.0

Median filter 5*5 mask applied twice(300-350)



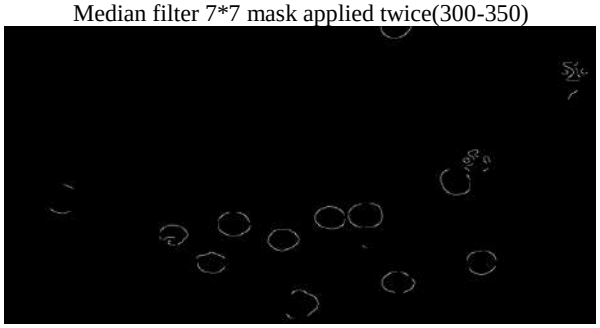
Output 22.1

Median filter 7*7 mask applied once(300-350)



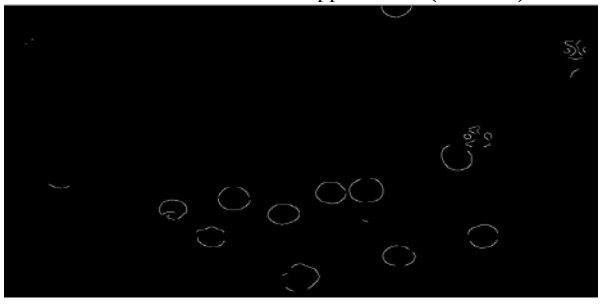
Output 23.0

Median filter 7*7 mask applied twice(300-350)



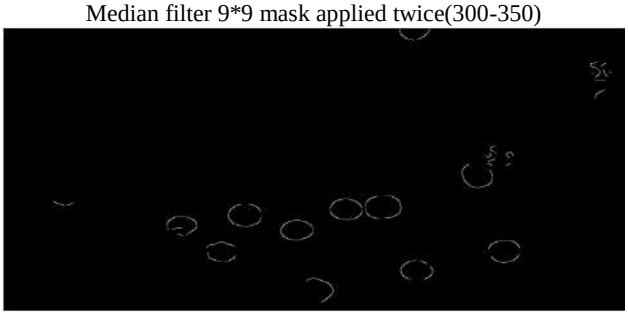
Output 23.1

Median filter 9*9 mask applied once(300-350)



Output 24.0

Median filter 9*9 mask applied twice(300-350)

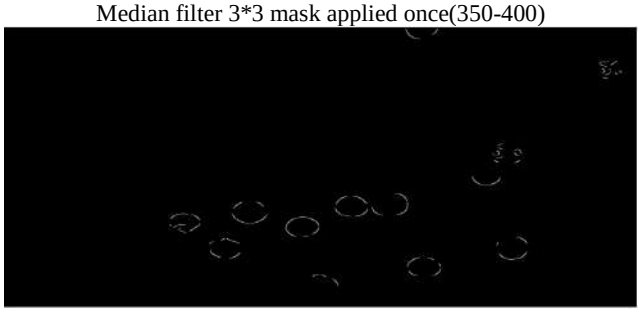


Output 24.1

Table 7. For the canny operator median filter applied with different mask and threshold values(350-400)

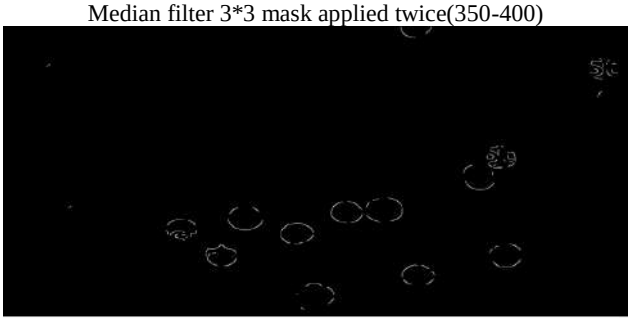
Mask	**Median filter applied once(350-400)**	**Median filter applied twice(350-400)**
3*3	output25.0	output25.1
5*5	output26.0	output26.1
7*7	output27.0	output27.1
9*9	output28.0	output28.1

Median filter 3*3 mask applied once(350-400)



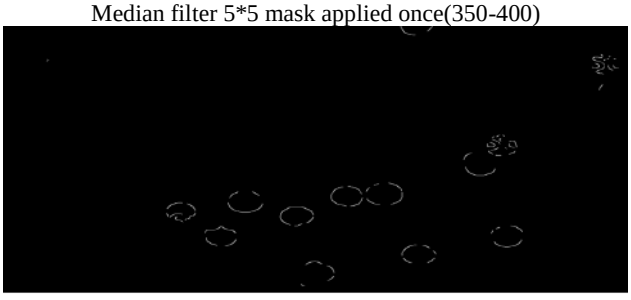
Output 25.0

Median filter 3*3 mask applied twice(350-400)



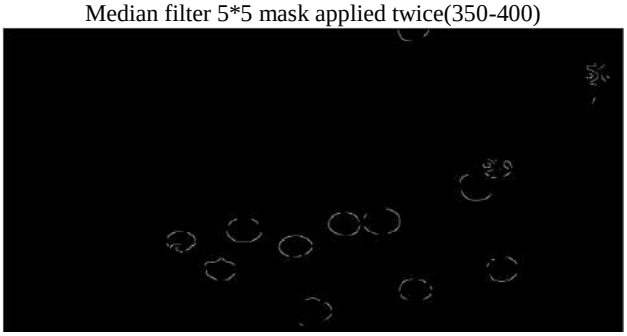
Output 25.1

Median filter 5*5 mask applied once(350-400)



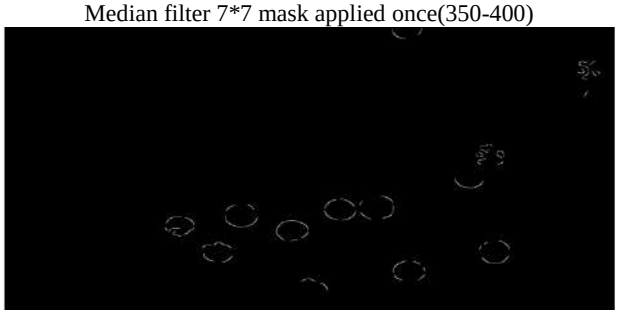
Output 26.0

Median filter 5*5 mask applied twice(350-400)



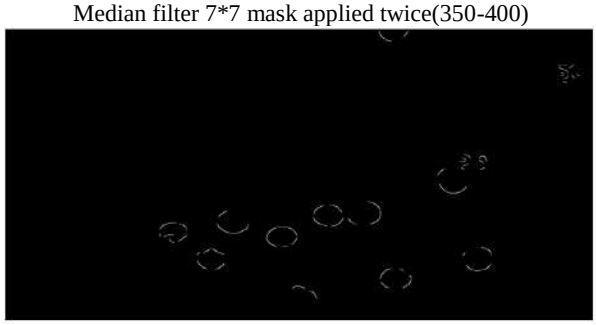
Output 26.1

Median filter 7*7 mask applied once(350-400)



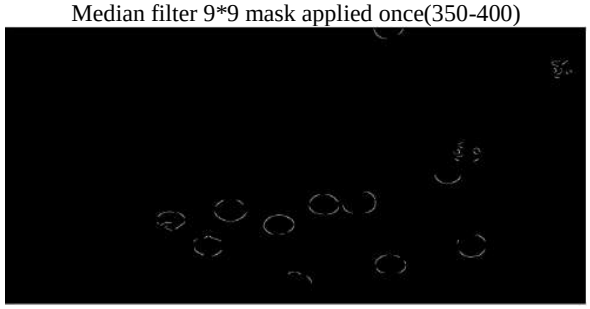
Output 27.0

Median filter 7*7 mask applied twice(350-400)



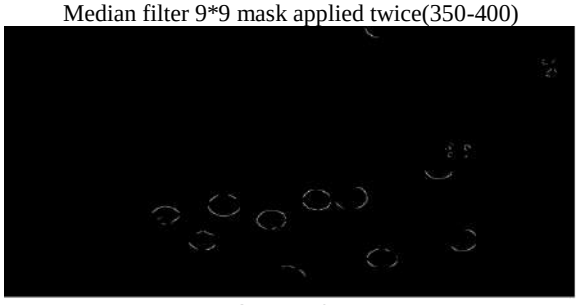
Output 27.1

Median filter 9*9 mask applied once(350-400)



Output 28.0

Median filter 9*9 mask applied twice(350-400)



Output 28.1

V. CONCLUSION

As we discussed, much work took place for the efficient detection of leukemia cells for example by applying Otsu's threshold, K-means, CNN, and other region based segmentation, and other techniques in edge detection. Many used sobel operator and upon applied threshold value to get a least noise and cells get distinguished. From this paper work, we can say that edge detection which is good for images having better contrast between objects. Instead of applying sobel along with threshold, value the canny operator can give the efficient results because it is having a Gaussian filter, two threshold values and we applied median filter along with it. We have shown the results of applying filter once and twice with different threshold values with different masks. Due to this we can get the mask, the threshold value for least noise elimination. By this way the detection of the cells with its features. Which can be helpful for the good classification results.

VI. FUTURE WORK

The research work is going on different aspects and at same time on detection of objects with the edges also. The further work may be done by basing this paper. As it is a study how the good segmentation can be done. In the same way by applying other segmentation methods, we can show the efficient one or by applying the different masks or by applying different clustering techniques with canny segmentation methods we may examine a good result. The future work may be extended by feature extraction and other detection techniques. Calculating the accuracy of how well the detection is happening or how much percent affected cells are present by using the classifiers.

REFERENCES

[1] Pooja Deshmukh, prof. C. R. Jadhav, "A Survey on Detection of Blood Cancer Using White Blood Cells Segmentation", International Journal of Modern Trends in Engineering And Research(IJMTER), volume02, Issue12, ISSN (print):2393-8161.

[2] Subrajeet Mohapatra, Dipi Patra, Sanghamitra Satpathy, "Unsupervised Blood Microscopic Image Segmentation and Leukemia Detection Using Color Based Clustering", International journal of Computer information system and industrial Management Application, Vol 4, 2012, pp. 477-485.

[3] Vasundhara Sharma, Sonu Elsa Jacob, Praveen Kumar Sharma, "A Comparative Study of Techniques For Leukemia Detection", International Journal of Advance Research in Science and Engineering IJARSE, vol.No.4, Special Issue (01), March2015, ISSN-2319-8354(E).

[4] T. Karthikeyan, N. Poornima, Microscopic image segmentation using fuzzy c means for leukemia diagnosis, Leukemia 4(1).

[5] Tejashri G. Patil, V.B. Raskar, "Blood microscopic Image Segmentation & acute leukemia detection" (IJERMT) ISSN: 2278-9359(volume-4, Issue-9).

[6] Manisha, Dr. T. Sethukarasi "Automated Detection of White Blood Cell Cancer Disease Using Classification Techniques-A Survey", (IRJET), Vol.No:06, Issue 02, FEB 2019. E-ISSN: 2395-0056.

[7] Carolina Reta, Leopoldo Altamirano, Jesus A. Gonzalez, Ranquel Diaz and Jose S. Guichard (2015), "segmentation of bone marrow cells images for morphological classification of acute leukemia". Twenty-Third International Florida Artificial Intelligence Research Society Conference (FLAIRS 2010).
[8] Rejintal, A., Aswini, N. 2016. "Image processing based leukemia cancer cell detection". IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), pages 471–474.
[9] Meghana M.R, Akshatha Prabhu "An Efficient Technique for Identification of Leukemia in Microscopic Blood Samples Using Image Processing",(IJRPS),ISSN:0975-7538, year-2019.
[10] Nimesh Patel, Ashutosh Mishra "Automated Leukemia Detection Using Microscopic Images", procedia computer science 58(2015)635-642.
[11] Shiv Kumar chatarwad, Pratik Bansode, Amar Burade, prof. T.S Chaware, "Blood Cancer Detection Using Image Processing", (IJARECE)vol.no:7,Issue:5 May 2018, ISSN: 2278-909X.
[12] Chaitali Raje, Jyoti Rangole "Detection of Leukemia in Microscopic Image Using Image Processing", conference paper. April 2014, ICCSP.2014.6949840.

AUTHORS PROFILE

Afsheen firdous is pursuing second year M.Tech in Computer Science and Technology at Andhra University College of Engineering, Visakhapatnam, Andhra Pradesh. She is interested in Image Processing and Data Mining.

Kompella Venkata Ramana has done his B.E (E.C.E) and M.E (COMPUTER ENGINEERING) and PhD from ANDHRA UNIVERSITY, VISAKHAPATNAM, INDIA. He has started his carrier as LECTURER in N.I.T. (W). Later he shifted to ANDHRA UNIVERSITY. At present, he is working as ASSOCIATE PROFESSOR in the department of computer science &systems engineering in ANDHRA UNIVERSITY. His areas of interest are Image Processing, Formal languages and Automata theory, compiler design and Systems Programming. He has written books on the above areas. He has experience of more than twenty five years in teaching and guided more than one hundred Thesis in M.Tech. Level, majority of them are in image processing. He has done his PhD in computer engineering (image processing…mathematical soft morphology.)

