Comparative Analysis of Gaussian Filter and Median filter in Liver Cancer detection

Dr. Pushpa Ravikumarr[1], Savera Kulsum[2], Sangareddy B Kurtakoti[3] ,Chaithra I.V[4]

[1] *HOD & Professor, Computer Science and Engineering, Adichunchanagiri Institute of Technology, Chikmagalur, Karnataka, India,*
[2] *4th Sem M.tech Computer Science and Engineering Adichunchanagiri Institute of Technology Chikmagalur, Karnataka, India*
[3] *Assistant Professor, Computer Science and Engineering, Adichunchanagiri Institute of Technology, Chikmagalur, Karnataka, India.*
[4] *Assistant Professor, Computer Science and Engineering Adichunchanagiri Institute of Technology, Chikmagalur, Karnataka, India.*

Abstract - *Heptocellular carcinoma, also known as liver cancer belongs to themalignant tumors which is derived from the Hepatocytes or their precursors, which is more common among males with various risk factors. If untreated it might lead to multiple complications.The treatment ranges from chemotheraphy to surgery both of which demands segmentation of tumor region.As liver is placed in between complications of tissuessourrounding. Many techniques in image processing havebeen used including CNNbut promising results were shown by U Net.The image can neither be segemented nor be classified accuratly without removing the noises present in it. These steps are prior to the classfication and segmentation. In this paper we are detailing about the pre-processing techniques like median filter and Gaussian filter used before that.*

***Key Words*: Gaussian filter, medianfilter, Pre-processing, Liver tumor, comparision**

1.INTRODUCTION

Medical imaging has been an active and beneficial field when it comes to image processing. Uncontrollable growth of the cells within the liver region is called Liver cancer. There can be beginning growth of the cells or the malignant growth. Hepta cellular carcinoma is one of the most common type of malignant tumor. Majority of the tumors are formed because of the damage or the injury to DNA, cells will be considered as the cancer cells, when compared to the regular cell, the cell will keep the damage and the cell dies if the DNA is damaged. It will results in making unnecessary new cells if the damaged DNA is not repaired.

The Liver cancer is referred as metastasis when the Liver cancer cells spread and when it moves to other parts of the body, so that it will begins to become tumours which will be positions in the tissues of the human body. Metastasis occurs when the cells of cancer spread from one part of the body to otherareas like which may include the bones, lungs . colon cancer or rectum cancer tend to spread to liver. This metastasis Liver cancerhave symptoms like abdomen pain and weakness of other forms of Liver cancer, it also causes weight loss, fatigue and yellowed skin.

1.1 Growth of Tumors

The neoplastic growth of tissue in liveris a liver tumor. It can be benign that is non-cancerous or it can also be malignant which is cancerous due to the redundant growth found in the liver. The cancer is classified into two types “primary tumours” which will occur in the liver cells or tissues and the second type of cancer is “secondary tumours” which occurs in other sites and spread to the tissues of the body. The cancer which occurs in the liver itself is called as primary tumours and the cancer which have been travelled from other parts of the body is called as secondary tumours. Primary tumours are again divided into benign tumours and malignant cancers.

1.2 Causes

The primary liver cancer is caused due tothe heredity growth of cancer cells, this will start from the liver parts only. The Heptacellularcarcinoma are the true or primary liver cancers. This HCC will move into the blood vessels of the nerves, muscles, bones, fat tissue present in the body andit can also spreadto anywhere in the body. These primary tumours can also be called as benign tumours which may have abnormal tissue growth results in traumatic infections or inflammation caused into the liver. Metastasis liver canceris calledas secondary liver cancer. Thecancer cells in the liverdue to which there will be a refashion of the liver. If the non-cancerous liver region is affected by the liver cancer it will make the changes to the

structure of the liver, or it will be broken and need to rebuild it. The entire liver will be affected by the cancer cells by the growth of new cells in the body, so liver cancer is a deadly and dangerous disease. To detect the liver cancer if the cancer cells are in the liver then there will be a difference in the texture of the liver it can result in the broken texture which will be at a maximum rate if it is observed.

2. Methodology

Figure 1depicts block diagramof detection of liver cancer using CNN and SVM

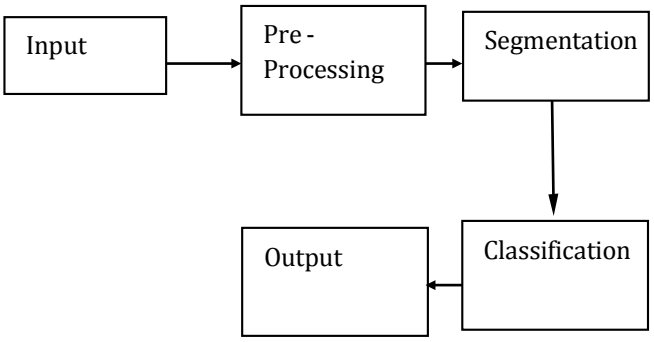

Figure -1: Methodology of Proposed System

The input here is CT scan images. It is very obvious to have noises in the CT scan images which is the reason of detoriation in the image and makes it difficult to extract the vital information Hence, the pre-processing steps becomes essential. This paper deals with two filters and comparison accuracy between them.

3. Pre-processing

As elemental, the origioanl RGB imageis converetd to a gray scale image. The process continues further by application of gaussian filter which helps in removing the gaussian noise. The high frequency content of image is sujected to median filter. Ostu thresholdingis applied to further to seprate foreground image and backgrond image.

The pre-processing steps are detailed below:

1. Conversion of RGB to greyscale.
2. Application of Gaussian filter
3. Application of median filter
4. Ostu thresholding

If we choose a window in the image whoseimagepixels are 0, 0, 0, 0,179,243,0,65,159.The following two steps are applied.

Conversion of RGB too greyscale.

The process of converting the RGB to greyscale is carried out by using the below equation

$$G' = ((0.3 * R) + (0.59 * G) + (0.11 * B))$$

Where , G = green pixel intensities.
R = Red pixel intensities.
B = Blue pixel intensities.
G' = grey pixel intensities.

The motive behind this conversion is to minimize the amount of data in RGB image. RGB has 3 channels and each channel has 8 bits of information in it, when converted to Grey scale, 3 channels is reduced to 1 channel. As we needonly theimage andnot the color of it,this is not considered to be a loss of data.

Application of Gaussian filter

The obtained greyscale image cannot be used directly as there might be some random variations in the intensities of the pixel values which can be termed as noise. These noises can be gaussian noise, salt and pepper noise, impulse noise or other any other forms. The obtained greyscale image cannot be used directly as there might be some random variations in the intensities of the pixel values which can be termed as noise. These noises can be gaussian noise, salt and pepper noise, impulse noise or other any other forms.

The below equation is 2 dimension gaussain smooting filter.

$$g[i,j] = e^{\frac{-(i^2+j^2)}{2\sigma^2}}$$

Where σ = $paramter\ of\ gaussian\ filter$, when σ is wider then greater is the smoothning. i and j are width and height of the kernel respectvely.

Application of median filter

Median filter, which is helpful in removing noises such as salt and pepper nose, implusivenoise presentin the image. Median filter does not work on the concept of weighted sum, rather its computing the median of of the pixels in each window centered around [i,j].

The two steps are followed in median filtering. a. To sort the pixels into the ascending orderby grey level b. Select the middle value of the pixel as the newvalue of pixel[i,j].

The first step would be arranging in ascending order. 0,0,0,0,65,159,170,243. In which themedian value is 0. Hence replaced by 170 in the first pixel. This is done to the entire image with thestrideof 1. The zeros around are padded to retain theboundary pixels . The equation is shown below

$$Median\ Filter = \frac{a\left(\frac{N}{2}\right) + a\left(\frac{N}{2}+1\right)}{2}$$

Ostu thresholding.

In ostu thresholding, the number of repeataton of each pixel value are computed according to which a graph of values of pixels and number of their repeated values are drawn against each other and divides the image into 0's and 1's assisting binarization

This kind of thresholding is done to binarize and to seprate foreground and baground image. If considered, t0 to be complete one region then it can be given as {0, ...t} and t1 will be {t, t+1,l.....l-1,l}. where, t is the threshold value. Which is derived from the probablity value :

$$p(i) = \frac{number\ \{(r,c), image\ (r,c) = i\}}{R, C}$$

Where, r and c are index of rows and columns respectively. R and C are numberof rows and colums respectively. And value of i will be 1..l

4. Results and Analysis

CT scanned images of Abdomen of stage 1, stage2and stage 3 of liver tumor are used here as input to conduct experimental results. Stage 1 means first stage of liver cancer and Stage 2 means second stage of liver cancer and same goes for stage 3. An comparative analysis graph is being depicted at the end of the results. To show the perfomance comparision between gussian filter and the median filter.

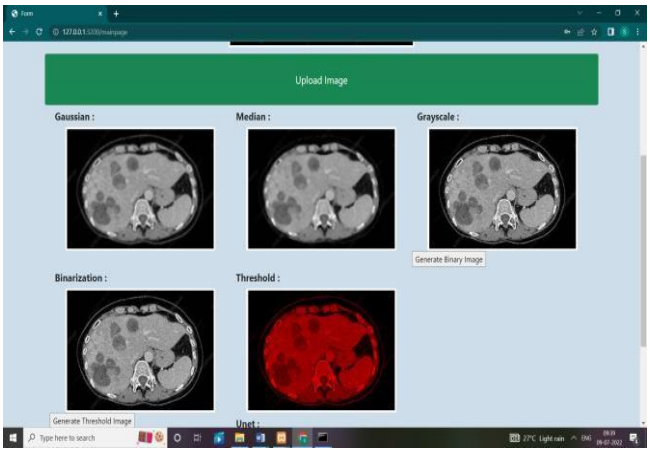

Figure 2 : Pre- processing steps for stage1 liver tumor

Figure 2 illustrates thepre-processing stepsfor liver tumor detection for stage 1. The steps includes the image upload, gaussian filtering, Median filtering, Greyscaling and the binarized image which is done through thresholding, whose image is also shown beside the binarization at the end.

Figure 3: Input abdomen Image

Figure 3 illustrates the CT scanimage of abdomen. To pre-process, initially the data must beselected. By clicking on choose file as shown in home page snapshot, the CT scan image is selected. The bone cancer image data is collected from the liver dataset option in which the database is stored in the folder.

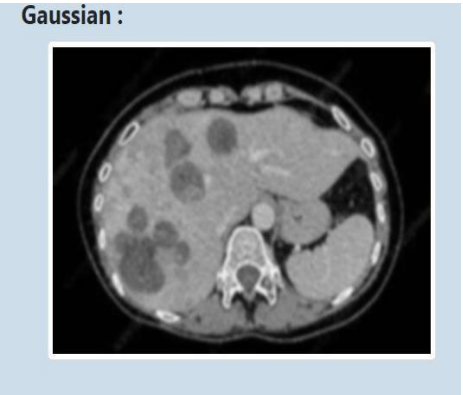

Figure 4 : Application of gaussian filter

Figure 4 shows the filtered image by using gaussian filter. This noise in the image is produced if the image is not captured properly. In the case, CT scan image of patient is not taken properly due to some movements, there will be a noise in the image and a unwanted distortions in the original image which cannot be used for the further processes as it does not produce the proper result. So, it is important to remove the noise if there is a noise else not necessary. In gaussianfilter a gaussian kernel of 3x3 matrix is convouled with the input image.

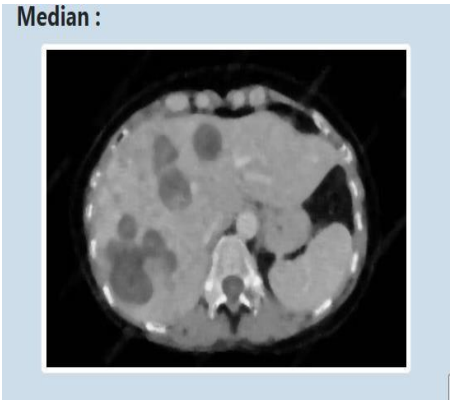

Figure 5 : Application of median filter

Figure 5 shows the filtered image by using median filter. The other kind of filters like salt pepper noise is removed using the median filter, where as the gaussian noise is removed using the gaussian filter.

Figure 6 : Binarization of the image

Figure 6 shows the Binarized image which is the result of thresholding. The threshold sets the value, below which the pixel intensities willbe 0's and above it the pixel intensites will be 1.

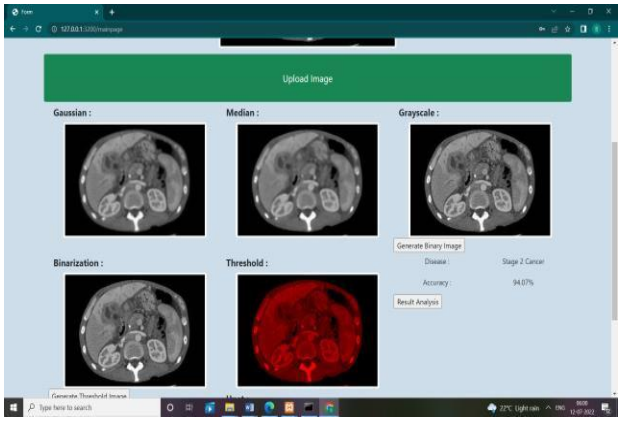

Figure 7 : Pre – Processing steps for stage 2 liver tumor.

Figure 7 illustrates the processing steps for liver tumor detection for stage 2. Initially the image is greyscaled, furthermore the filters are added for the removel of noises. Eventually binarization is done by applying ostu thresholding method which divides the image into foreground and background.

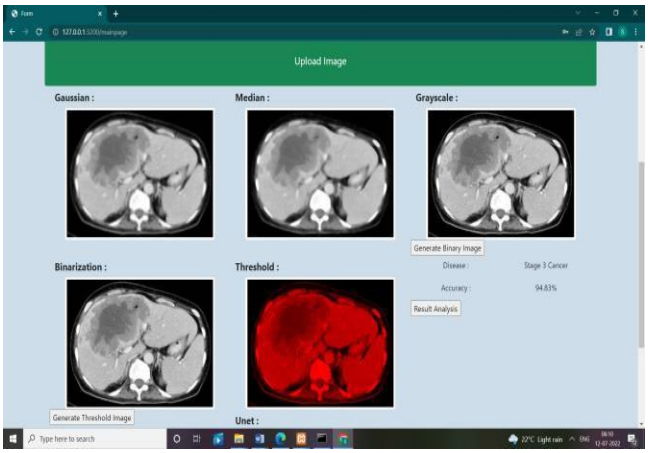

Figure 8 : Pre – Processing steps for stage 3 liver tumor.

Figure 8 illustrates the pre-processing steps for liver tumor detection for stage 3. The first step includes the image being greyscaled, nextto removenoise filters are added. At the end thresholding is incoperated to binarize the image andsimplify thefurther calculation. A analysis graph for the comparasion between two filtering techniques will give the breif idea about the performance accuracy.

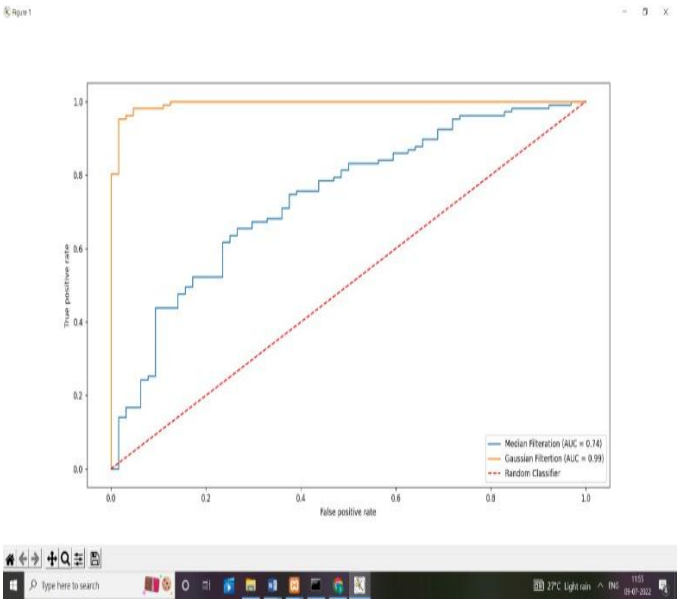

Figure-9: ROC curve showing comparative analysis between median filter and Gaussian filter

Figure 9 shows the comparaive analysis of Median filter and Gaussian Filterthrough an ROC (reciver operating characteristic curve) graph. The curve depicts whichamongthemodels performwell in the field of classification. AUC of both the filters are shown above. The graph is plotted with FPR (False postive rate) at X – axis and TPR (True Positive rate) at Y- axis. The greater AUC (area under curve) , the higher is the accuracy, andlower the AUC (Area uner curve)lesser the accuracy. As shown Gaussian filter has the AUC with 0.99 and hence the better one comparatively

5. Conclusion

Noises in the image whichcan make image blurry and unclear, can cause multipleobstcales in futherimage processing techniques which needs to be removedby using some filters.

Here, we havediscussedby taking dataset of abdomen images and applying two kinds of filters i.e.,gaussian filter and the medianfilter.By experiments, Gaussian filters shows better performance level than the median filter by giving 99 % accuracy level

REFERENCES

[1] S. Gunasundari, M. Suganya Ananthi, “Comparison nd Evaluation of Methods for Liver Tumor Classification from CT Datasets ”International Journal of Computer Applications , Vol. 39 – No. 18, 2012.

[2] Xing Zhang, Jie Tian*, Dehui Xiang, Xiuli Li and Kexin Deng,“ Interactive Liver Tumr Segmentation from CT Scans using Support Vector Classification using Watershed,” 33rd Annual International Conference of IEEE EMBS Boston, Massachusetts USA, August 30 – September 3, 2014

[3] E-Liang Chen, Pau-Choo chung, Ching- Liang Chen, ong – Ming Tsai and Chein-I Chang, “An Automatic Diagnostic System for CT Liver Image Classification,” IEEE transactions on Biomedical Engineering, Vol. 45, No 6, June 1998.

[4] Xuechen Li, Suhuai Luo, Jiaming Li, “ Liver Segmentation from CT Image Using Fuzzy Clustering and Level Set”, Journal of Signal Infromation Processing, 2013.

[5] Nadja Gruber, Stephan Antholzer, Werner Jaschke, Christian Kremser, Markus Haltmeier, "A Joint Deep Learning Approach for Automated Liver and Tumor Segmentation”, Computer Vision and Pattern Recognition, 2019. arxiv:1902.07971

[6] Olaf Ronneberger, Philipp Fischer, and Thomas Brox “ U-Net: Convolution Nnetworks for Biomedical Image Segmentation”, spring International Publishing Switzerland 2015

[7] Chartrand, G., Cresson, T., Chav, R., Gotra, A., Tang, A., & DeGuise, J. (2014, April). Semiautomated liver CT segmentation using Laplacian meshes. In Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on (pp. 641-644). IEEE

[8] Chen, Bin, et al."Segmentation of liver tumor via nonlocal active counters."Image Processing (ICIP), 2015 IEEE International Conference on. IEEE, 2015