Tumor Size Processing using Smart Phone

Divya Patil¹, Sangeetha D R², Dr. Andhe Pallavi³, Madhura Gangaiah⁴
¹,² PG Student, ³ Prof. & HOD, ⁴ Asst. Prof.
IT Dept., RNSIT, Bangalore, India.

Abstract - This paper presents the tumor processing from MRI images using the computational features available on a mobile device (smart phones). The MRI images are pre-processed using dithering and median filtering and then transmitted to the mobile computing device. Dithering which converts gray scale image to black and white image but with gray scale visual rendition leads to the reduction in the size of the image being transmitted. The dithered images are filtered using median filter to improve the PSNR. From these transmitted images the Region of Interest (ROI) is selected using image measurement application present(in built) in mobile device. Tumor size is so computed is compared with that of obtained from existing automated algorithms.

Keywords: Dithering, PSNR, Median filtering

I. INTRODUCTION

Processing of MRI images are currently carried out with high end automated software (with different algorithms). This processing requires a desktop loaded with the software and the oncologists should use this particular desktop or he should have a hard copy (film) of the MRI images required for the diagnosis. The measurement of tumor from the hard copy is a difficult proposal. In this paper we are presenting a scheme where in the MRI images to be diagnosed are transmitted to the smart phones of the oncologists (experts). The processing of the tumor is carried out in the smart phone instead of desktop. The advantage of transmission is that experts can view the MRI images (same as that of hard copy) and at the same time perform measurement on tumor using the built in processing capacity of the device.

Generally images are corrupted by noises. The most frequently referred type of noise is impulsive noise. Few impulsive noisy pixels have arbitrary value which smudges the resulting images. These noisy pixels cannot be removed by using linear filter, hence a non-linear filter such as median filter is used. It is an edge preserving smoothing filter which preserves the useful data of the image. It does a better job than the mean filter of preserving useful detail in the image [1]. Although median filter is a useful non-linear image smoothing and enhancement technique, it has some disadvantages. The median filter is used to remove both the noise and the fine detail since it can't tell the difference between the two. If the noise intensity of the image is more than 10-20% (approximate), then a slight reduction in the performance of the median filter is observed as shown in fig. 1. The filter performance is affected by window size of the filter. When the order of the filter window is changed from 3x3 to 15x15 the image is smoothened but edge details are lost as seen from fig.1b.

To overcome this disadvantage adaptive median filter is used. Adaptive Median Filter performs spatial processing to determine which pixels in an image have been affected by impulse noise, it preserves the details and smoothens the non-impulsive noise. The advantage of this filter is, it modifies only the corrupted pixels [2].

Generally PSNR (peak signal to noise ratio) indicates the filter performance. From fig.2 has justifies that higher the PSNR value better the filter performance [4]. Adaptive median filter with filtering window 7x7 exhibits a very good performance/cost ratio in comparison to standard median filters [2] which is shown in fig.2. The images produced by adaptive median filter take more space for storage and transmission so this can be overcome by using dithering technique. Dither is a method of compressing images to make more efficient use of storage and transmission capacity while preserving the edge and other details of the images[6]. As the size of these images is reduced, they can be easily transmitted through phone. By using the smart phone application the oncologists can measure the tumor area in a much simpler way.

Fig. a.original image  
Fig. b.3x3  
Fig.c. 15x15  
Fig 1. Simulink results

Fig 2. Plot of PSNR vs Noise intensity for Adaptive median filtering with different window sizes
II. CASE FLOW

Fig. 3. Paper scheme

Fig. 3. shows the complete flow of tumor image processing scheme proposed and implemented in this paper. The smartphone used in implementation is Samsung. Images of breast cancer patients are obtained by MRI technique. These images are pre-processed by using dithering and median filtering. The processed images are transmitted using smartphone.

A. DITHERING

Dither is a method of compressing images to make more efficient use of storage and transmission capacity while preserving the edge and other details of the images[6]. Dithering can be applied to gray scale and colored images by different dithering algorithms. It is used in processing of digital audio and video also.

![Gray Scale Image](image1.png) ![Dithered Image](image2.png)

Fig. 4. Gray scale and Dithered image

When the gray scale image is converted into black and white images there is loss of more information and creates false contours and black and white conversion using dithering will not only render gray image visualization for the user, it will also preserve the area information and prevents the creation of false contours. The tumor area computed from gray scale image, black and white image and dithered image using MATLAB is shown in table.1. The area computed for dithered image is nearly same as that obtained from original gray scale image.

<table>
<thead>
<tr>
<th>IMAGE TYPE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAY SCALE</td>
<td></td>
</tr>
<tr>
<td>BLACK AND WHITE</td>
<td></td>
</tr>
<tr>
<td>DITHERED</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Area plot using MATLAB

B. MEDIAN FILTERING

The dithered images can be transmitted to the consultant oncologists. The transfer of these images can be made faster and easier by removing the dither noise and reducing the size of the image. This can be implemented by using median filter [7]. Median filter will effectively remove the dither noise and enhanced images are obtained by varying the window size and we get better image rendition and also a reduction in computation.

![Filtered images](image3.png)

Fig. 5. Filtered images with different window size

We can observe from fig. 5, image obtained from window 7x7 has less noise compared to that of with 3x3 from median filter.
The images after median filtering are saved in Portable Network Graphics (PNG) format. As compared to other formats like JPG and GIF etc PNG does lossless compression preserving the image data and reduces the size of the image [10].

![Fig.6. Images in PNG(left) and JPG(right) format](image)

The image in JPG format is 51.1kb in size where as the same image in PNG format is 10.2kb in size. The size of the image for transmission can be reduced further by using the same Tiny PNG. It uses smart lossy compression techniques to reduce the size of the image. By reducing the number of colors in the images, few bytes are required for the storage of data. The effect is negligible but it makes a very large difference in file size. The images with reduced size is shown in fig.7.

![Fig.7. Images with reduced size](image)

The PNG images shown in Fig.5. are of size 10.2, 7.48, 5.45, 4.4 kb which after application of Tiny PNG is reduced to sizes of 4.1, 3.3, 2.3, 1.6kb respectively as shown in fig.7. Now this image can be used for transmission through phones easily.

C. Image measurement

On the dithered image we cannot apply automated area measurement of tumor region so we use the mobile’s inbuilt application. The general computing algorithms for automatically finding area of the tumor as reported requires high end software tools as elaborated next such as MATLAB software, open CV etc which are found in desktop/laptop systems which occupies more space, are time consuming and are currently unavailable in handheld mobile phones. By using these smart phones application such as image measurement the area of the tumor region can be measured. In this application the region of interest(ROI) to be measured is selected by using markers and the results are displayed instantly. The results of image measurement are shown in fig.10. Here fig.a and fig.b indicates the tumor area after 72 days and 42 days of treatment. It can be clearly observed that the tumor has been reduced after treatment.

KLONK image measurement is an application (version 0.22) is of size 1.25MB that simply and quickly helps us to measure areas, perimeters and length of the objects on selected surfaces in the images, it gives you user-friendly solution. Within a few minutes we can fully become familiar with the basics, and we can quickly and effortlessly start to form the conclusions based on the measurements. This application can be downloaded in any smart phone from play store.

![Fig.8. Screenshot of mobile app](image)

With KLOCK image measurements application we can:
1. Capture an image from the phones camera or choose an image from the gallery or from the drop box.
2. Enter the length and the unit of scale object in order to calibrate the image.
3. Define the scale ruler.
4. Measure the length, perimeter or area of an object in the image.
5. Share the images with measurement.

![Fig.9. Steps for image measurement appplication](image)

![Fig.10. Screen shots of tumor area measurement using smart phone](image)
The advantages of using this smart phone application is that it is a hand held device which can be used anytime anywhere, requires limited computing power and storage capacity and has better display options. So the images can be easily transmitted to the consultant oncologist smart phone. Since the image size is less this is much faster but the dithering will ensure that all the intensities of colors are displayed.

III. CONCLUSION

In our paper, the visualization of MRI images on smart phones is presented. The dithering and median filtering are used to pre-processing the image before transmission. The diagnosis done by the expert oncologists will carry more weightage than that obtained from automated software, as the automated results once again should be validated by the expert.

REFERENCES


[4] “Comparison of Filters used for Underwater Image Pre-Processing” Dr. G. Padmanathi, Dr. P. Subashini, Mr. M. Muthu Kumar and Suresh Kumar Thakur Department of Computer Science, Avinashilingam University for Women, Coimbatore, TN, India, IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.1, January 2010


