Morphological Technique in Medical Imaging for Human Brain Image Segmentation

Asheesh Kumar, Naresh Pimplikar, Apurva Mohan Gupta, Natarajan P.
SCSE, VIT University, Vellore INDIA

Abstract: *Watershed Algorithm is proposed for the Image Segmentation analysis using the morphological technique. According to morphological analysis technique, removal of the over segmented portion can be merge and removal of false portion are possible. The purpose of including the watershed algorithm is to remove the non important regions and noise, which is part of the image and creates the greater, extends region analysis of the watershed segmented images. After the computation of the segmentation function of regions, Compute of the nearest view of the image and persistent low level image background, then make the changes in the existing old segmentation function, then watershed transformation are calculated on the new function.*

Keywords: *Morphological Modeling, Watershed Algorithm, Region Merging, Image Segmentation.*

1. Introduction

Image Segmentation is part of study to divide and analysis of image into various clusters or regions, and each region has some particular characteristics. After the segmentation of an image the every segment stand with group of pixels. As soon as segmentation is performed, each region can be extent some degree of calculation and the connected properties between the two clusters can be make or enquired. So the segmentation of an image is the important technique for the explaining about the image. Morphology is a mathematics technique for the image value analysis for the bio science and medical imaging [6].

In medical science images are playing a important role, that why segmentation are used for processing the human body parts such as lungs skin etc. so after the segmentation the output of the image shows the real view of that organ. But in real world images have lots of the noise and other non boundary properties that make difficult to analyze the image. Morphology is a method that gives the mathematical aspects of processing images. It gives another possibility that use the shape concept stands on the set theory, where no early models are used for analysis. Morphology is a system of idea where images are analyze as a sets, and transformations that are processed from the addition and subtraction are state to show features of an image [1]. This Paper the watershed transformation morphology technique is considered. This method gives the best results with the low quality and contrast pictures, where the other methods such as gradient and boundary methods are not efficient due to noise consideration in image. This is efficient method for the edge detection, filtering and analysis the noise present in image [8].

2. Research Method

Real world images are full of the noise and also have unexpected shape and boundaries. So it is much difficult to analyze and make segment of noisy and low contrast image. In this paper a watershed morphology technique is adopted for the segmentation of an image. In segmentation of image objects inside the image detected based on the property of the image e.g. pixel value or intensity of color, edges of the objects in image, boundary value detection etc.

3. Marker Controlled Watershed Algorithm

Terrain values are used for image for showing the description in algorithm where the gray properties values of an image f(x, y), that have almost similar to the terrain elevation property. Let's say N_1 N_2 …. N_R are the co-ordinates that are used to denote the local minima of an image f (x, y), C (N_i) denotes the co-ordinates grouping of the selected points, and these grouping of the points are resides in the local minima, that is linked with the reservoir area. T (n) is used for the notation of grouped co-ordinates (s, t),
Where f(s, t) < n,

$$T(n) = \{(s, t) | f(s, t) < n\}$$

Here T (n) is used to denote the midpoint of the stand co-ordinates f(x, y), and above T (n) equation describe that the midpoint of the grouped co-ordinate is situated under the plane f(x, y) = n.

If the value of (x, y) is the subset of C (N_i) and (x, y) is also subset of the T (n) C_n (N_i) = 1 resides (x, y) otherwise C_n (N_i) = 0.

Now consider f(x, y) image before the apply segmentation, g(x, y) denotes the gradient and C (M_i) denotes the set of pixel in area and n denotes the gray scale threshold. The pixel set (u, v) where g (u, v) < n

$$T[n] = \{(u, v) | g(u, v)\} \quad (1)$$

And in the binary image:

$$Cn(Mi) = C(Mi) \cap T[n] \quad (2)$$

When the threshold of the gray scale image equal to n, then C_n denotes the image pixels

$$C[n] = \bigcup_{i=1}^{R} C(Mi) \quad (3)$$

For the calculation of the union of all pixels set, it is denoted by C [max+1]:

$$C[\max+1] = \bigcup_{i=1}^{R} C\max+1(Mi) \quad (4)$$

In equation one the gradient pixel values are always less than gray scale threshold pixels in the input image. Gradient image contains the pixels values that are less at the inside portion of object and higher pixel values at the boundary portion. In equation two the binary image pixel value calculation is done that means it is the intersection of the collection of pixel in an area and threshold pixels. Image gradient in input image depends on the density of pixel values of the objects inside image. Gradient magnitude of the image, the value always greater at the boundary region or overlapping area of objects and always less at the object inside portion. So the gradient magnitude calculation gives the better pixel values density at the objects in image.

3.1 Marker Creation

Marker controlled watershed algorithm have a strong membership in the segmentation analysis when objects in an image have strong enough pixels closeness to each other. Objects in the image use the watershed algorithm as the single or double marker inside the objects for same interest. The intensity labelling is done locally by using the thresholding method. On behalf of the thresholding, creation of binary image is done by removal of pixels that assign the value zero and pixels with the values one are remains in the image. So by this way the boundaries of images are constructed. By applying recursively all small pixels removed and gaps are filled by morphological technique that is not accessed by the neighbours. Gaps with the no intersection values are taken as the marker of the image objects. Closings of the values are performed and markers are taken that are close to the boundaries and it is repeated until desired value not get. Marker with the boundaries are selected for the applying the watershed algorithm for further analysis of binary image of input image.

4. Steps in Algorithm

1- Take off the noise present in the image by using the filters.
2- Read the new image that is produced in filtering process, and now our intention is to convert this new image in the gray scale image.
3- Establish a calculation for the segmentation function, for that purpose we use the gradient magnitude.
4- Establish outside limitation or restrictions of the entire image, or foreground objects of the image and background objects of the image.
5- Now we need to calculate the watershed transform of the segmented function that we had already calculated in step 3 of the algorithm.
6- Output image is generated.

This Algorithm can be apply various kind of images but it gives better result at the image which have less over segmented regions or boundary regions are less overlapped. This algorithm states that input image first converted in gray scale image after that segmentation function is apply by using gradient magnitude function on input image. Most important step in the algorithm is calculation of the segmentation function that provides the object dark that need to be segmentation.
After calculation of the gradient, foreground and background objects of the image are calculated that's gives the individual objects orientation about the objects presents in image. Foreground objects identification is done by the opening and closing reconstruction and background image objects are identified by isolating the area which is not part of objects. Now applying the watershed algorithm it provide the regions with the segmentation in the image, now easily segmented image can superimposed on the input image. So now super imposed image is the output image, which contain the segmentation of the objects in image.

5. Algorithm Implementation

Analysis of an image is very difficult when objects in image touching or overlapping. In this paper Watershed algorithm is used for the make the segment of each object based on the transformation and gradient calculation. Watershed algorithm uses the intensity of pixel in image surface. Watershed transformation identifies the foreground object and background positions.
In this paper the human body brain is considered as input image and based on the algorithm output image superimposed with segments.

5.1. Proposed Method for Implementation

Pre-processing of an image is important step in segmentation analysis because realms images contains lots of noise and overlapped regions. So local pre processing is a method that used for the pre processing of the image. Using the smoothing in image noise and other unwanted fluctuations can be removed. The gradient magnitude is derivative function that shows the pixel values are high at boundary regions and lower derivative value inside the objects of the image. Watershed algorithm implements after the pre-processing and produce the result images. Now the post processing is the important step in segmentation that apply for the correcting the base regions in the image and boundary regions in the image. After the post processing out image is produced as the result.

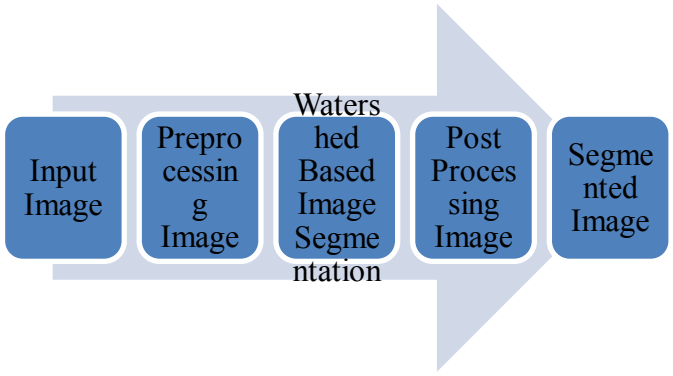

Figure 1. Projected steps in Implementation

Segmentation is a better way to perform the analysis objects present in an image. Watershed algorithms provide a better way to segment the image objects and representation of segmented objects provide the close look of that particular object. Projected steps in sequence diagram of watershed algorithm are discussed in the figure 1.

6. Results and Discussion

In this paper, human Brain MRI image is taken as an input image. MRI brain image contains number of objects in input image. Watershed algorithm implementation with the MRI image provides the segments analysis based on segmentation superimpose on Input image. First step in algorithm implementation is converting color image into grey images. Gray scale image used for the gradient magnitude calculation of the image. See Figure 2 and 3. Segmentation function calculation on the gray scale image provides the objects that need to be calculated. Dark pixels regions are mapped based on the segmentation function and mark as the objects inside the image.

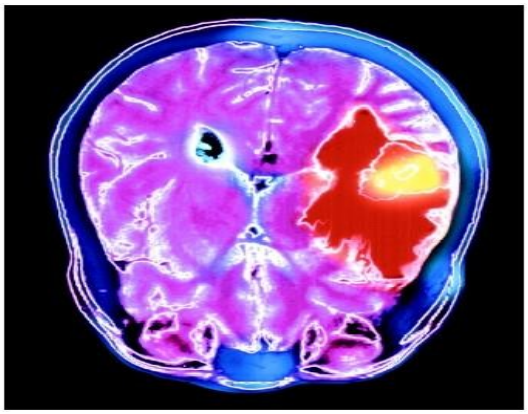

Figure 2. Input Image

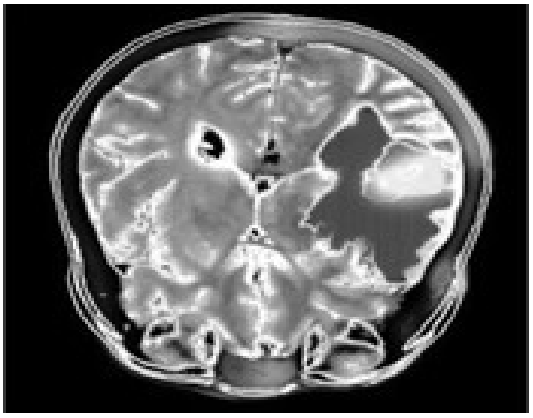

Figure 3. Gray Scale Image

Now calculate the gradient magnitude of the gray scale image that identify the border of the object with very high slope and inside the object gradient slope is very low, as shown in Figure 4.
Calculation of the segmentation function by morphological operation gives the objects identification. The segmentation function of the image calculates the dark pixels of the image as the objects and removes light pixels for differentiate between objects and background regions. And computation of foreground and background objects, are done after the segmentation function computation. Morphological technique uses various methods for identifying the foreground object in an image. This paper uses opening by reconstruction and closing by reconstruction shown in Figure 5.

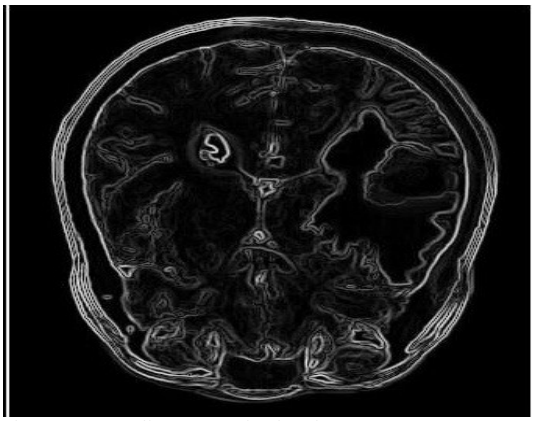

Figure 4. Gradient Magnitude of Image

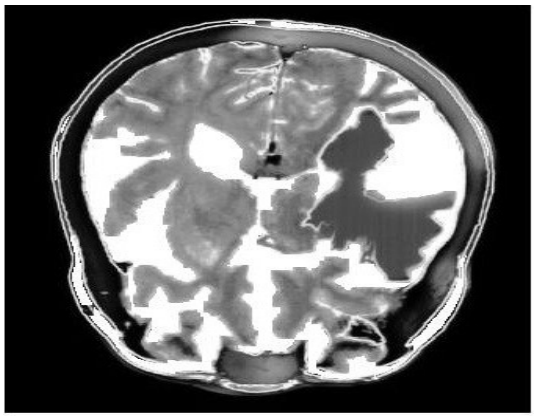

Figure 5. Identifying Foreground Objects

Background identification of image; identify the dark pixel in image. By Morphological technique thresh holding can be applied to identify dark pixel, calculation of the watershed transformation now performed on the gray scale image. Now it is possible to superimpose of the computed image foreground objects, segmented portion of image and background portion on the original gray scale image, shown in Figure 6. and Figure 7.

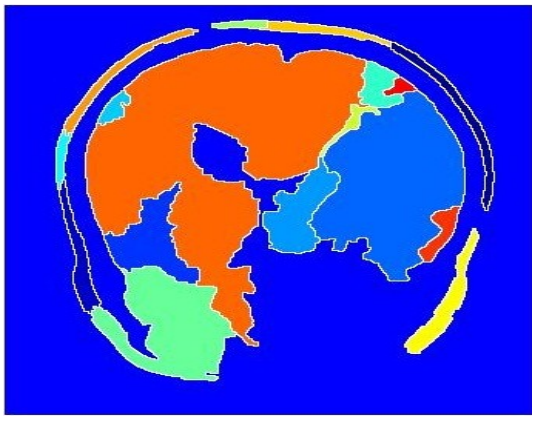

Figure 6. Segmentation Superimpose on color image

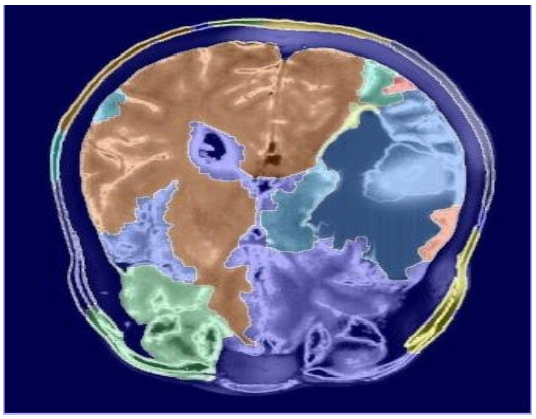

Figure 7. Superimpose transparently on color image

MRI images are realms images that contain the fluctuation in the form of noise, so the after the pre-processing apply the watershed algorithm. Watershed algorithm generates output image with segmentation that is given in figure 6. In output image, figure 7 the segmented objects of the image are clearly shown by different colours. Different objects in an image segmented and each segment is shown in output image by different color.

7. Conclusion

Segmentation of an image can do by different approach where watershed algorithm also provides high quality results that are shows it is strong member for segmentation analysis. Watershed algorithm computes the segments present in the image properly. In this paper the brain contains the objects that are detects based on the segmentation algorithm. Segmentation analysis discuss in this paper gives the segments of MRI image, that segments can further analyze for study and medical purpose. Segmentation becomes more important; in brain image when it contains the tumour segmentation of tumour provide extra information for study and research. This method can be used for the medical imaging segmentation and also in deferent kind of images. This algorithm superimposes the segmented part of image at original image. The watershed algorithm provides the segmentation for individual object inside the image. Now in segmented image particular objects can analyze and study for further research. Overlapped area of objects is not accurately defined by this algorithm. So, future work is to improve the algorithm for computation of the overlapping objects in an image.

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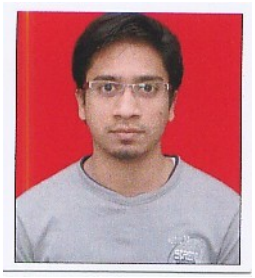
Asheesh Kumar is M. Tech (CSE) Student at VIT University Vellore TamilNadu India. He did his B.Tech (IT) from IIMT Engineering College, Meerut, UP. His area of Interest is Algorithms Analysis, Theory of Computation and Computer Graphics.

Apurva Mohan Gupta is M. Tech (CSE) Student at VIT University Vellore TamilNadu India. He did his BE (CSE) from Global Institute of Technology, Jaipur, Rajasthan. His area of Interest is Data Structure, Computer Architecture and Computer Graphics.



Naresh Rameshrao Pimplikar is M. Tech (CSE) Student at VIT University Vellore TamilNadu India. He did his BE (IT) from Priyadarshini College of Engineering, Nagpur, Maharashtra. His area of Interest is Database Management System, Operating System, and Computer Graphics.

Prof. Natarajan P. is Assistant Professor (Senior) in SCSE in VIT University Vellore Tamil Nadu INDIA.

Prof Natarajan P. Has experience inclusive in Computer Graphics, Image Processing, and Animation Technologies. Prof. Natarajan P. supervises Master Degree students in Computer Graphics, Image processing. He also leads and teaches modules at both B.Tech and M.Tech levels in computer science and Engineering.

