



Colloid Cyst Detection through MRI and CT Scan Images

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Abstract

A Colloid Cyst is a tumor which has gelatinous material in the human brain. Basically it starts and mostly exists in the anterior parts of the third ventricle of human brain. The occurrence or the presence these tumors or the cysts can reduce the flow of blood to the major parts of the brain. As a result of this, the functioning of the brain affected at various parts as result the intracranial pressure, blood pressure of the patient's increases. This sudden increase of pressure might cause the death of the patients too. In the present paper, a new algorithm has been proposed to work with Mean filter to reduce the Noise on the image borders and can be achieved by the usage of Sobel Edge Detector. The working of the present model in three phases and those phases are pre-processing, segmentation and feature extraction. The results of the method show some improvement in the accuracy of identification of cysts in comparison with the existing model of median filters with Gaussian Blur models.

Keywords: Tumor, Cysts, Cyst detection, Segmentation, Mean Filtering, Gaussian Blur filtering, Region of Interest.

1. Introduction

Brain is the main organ of any human being for performing any task or to perform or to take any decision. It plays the key role in the entire body and controls almost all parts of the body. It also controls the central nervous system of any human being. This brain controls the nervous system and almost all parts and their day to day activities are controlled. A group of cells in brain are known as cysts [1]. The combination of such cells can form cysts. In general, these cysts will contain some amount of semi solid materials, fluids, blood or some cerebrospinal fluids or some tissue or tumors cells. In general, the presence of tumors in human brain will cause some serious issues to human beings. The functioning or the decision taking strengths of the human brain are reduced by the presence of these cysts or tumors' in the human brain. The presence or the occurrence of these tumors will have the impact on the functioning of the human brains [2,3]. In general, various types of cysts can occur at various scenarios. Some of them are, Colloid Cyst, Arachnoid Cyst, Dermoid cyst, Pineal Cyst, Epidermoid cyst and other tumor related cysts. These cysts can occur at various ages of the people and the reasons for the occurrence of such cysts may vary from one type of the cyst to the other set of cysts. The symptoms of various cysts and their impact on the human beings or the patients were based on various symptoms like the size of the cyst, location of the cyst and type of the cyst.

In the present paper, we mainly focused on the identification or the detection of colloid cysts in brain from CT scan and MRI images. In general, the general suggestion from the doctors or the general review of time or the reason from the forming of cysts will be formed during the embryonic occurrence of the nervous system. These cysts will contain some gel type of substance inside the body of the cyst and it will increase its size gradually. If the size is getting more and more, the chances of patient going to serious stages are coming early. In general, these cysts will contain some thick and gelatinous substance known as colloid which came from the Greek word. Other than these liquid materials, the cyst also contains blood, spinal fluid, minerals, cholesterols etc. These cysts in general will exist in the central parts of the human brain. When these cysts will occur at the central ventricle side, these cysts will try to stop the blood flow to the major parts of the human brain. When the passage of blood to those parts is reduced, the blood pressure of the brain and other parts increases to large levels. As a result, the patients can observe some important symptoms for these diseases are like vomiting, serious headaches, vertigo, loss of memory, insomnia etc. The size of these cysts may vary from 3 to 44 mm. As the presence of these cysts are becoming the life risk of patients, the identification of these cysts at right time and accurately is needed such that to save the life of some individuals [4].

In recent days and years, the research on medical image processing was growing in a rapid manner. Some of the latest technologies had been developed such that to identify the various critical parts of the

human body without going for any internal surgery or some other thing. Some of those technologies are like CT scanner, digital mammography and the magnetic Resonance Imaging. By using any of these three technologies, the doctors or even the patients can see the inner parts of the body or the critical parts of a patient's body in 3D view. The images or the scan reports or the digital images which were generating from these laboratory tests can be analyzed deeper and deeper and can be viewed in a detailed manner by applying some digital techniques such that the objects on these images can be analyzed more accurately. By the utilization of such techniques, the risks linked with the doctors or the radiologists who were working on these areas can take the better decisions based on the results of these mechanisms. At the same time, these technologies are somehow cost effective and can reduce the risk of manual risks and can reduce the operating costs of these techniques [5,6].

The current techniques or the technologies includes various set of filters or the advanced filters such that to filter the noise presence on these scan images and can find the needed data more clearly and accurately. The improvement of quality of the image is also another important point to be considered for the better outputs from these sorts of images. A new algorithm have been proposed here such that to reduce the noise and tries to improve the accuracy more in identifying the cysts. Some advanced techniques are used in the current methods such that to identify the cysts present on these images. The results shown that the considered model and the technique successful in detecting the presence of cysts and at last the comparison with the current with the older systems were also presented.

2. Proposed Methodology

In the present paper, an algorithm had been proposed. With the current algorithm, Mean filter was used such that to reduce the noise on the images and to get the edges of the images by edge detector. The processing of this algorithm can be seen in the following figure as follows,

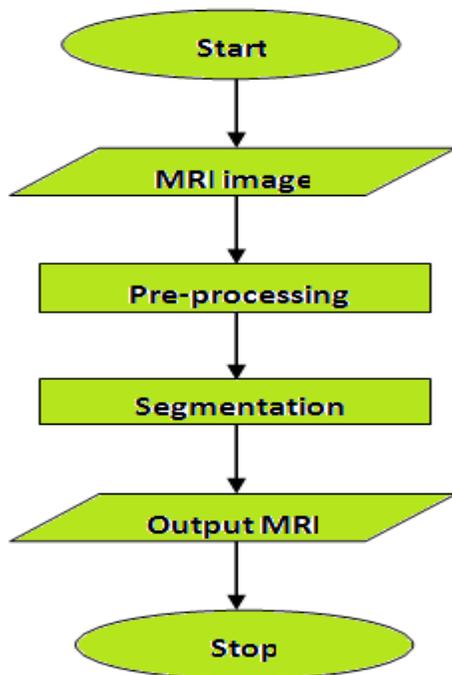


Fig. 1. Flow chart of proposed methodology

The proposed System has three phases:

1. Pre-processing of images
2. Segmentation of pixels on the images
3. Extraction of features from the images

In the starting step of the current mechanism, the noise present on the images needs to be removed and this process can be completed by the Mean filter. The resulting image from the current phase of the process was the image with reduced amount of noise on the images or some little noise on the images. In the second phase of the process, the segmentation process was started and the required portions on the images were identified and the areas where the cyst had been present will be identified based on these segmented results. In the next phase, the representation of features and their statistical features of the cysts were done. The new algorithm proposed in the current work was to identify the cyst with better accuracy and better results [7]. This process can be completed by the images that were acquiring from the CT scans and MRI scans.

3. Algorithm to Detect Colloid Cyst

- Step 1: Start of the method
- Step 2: Read Input MRI/CT scanned Brain image
- Step 3: Conversion of input image into Gray Scale image
- Step 4: Apply Mean filter on Gray scale image to remove noise
- Step 5: Pass the filter image through Gaussian Blur filter
- Step 6: Implement multilevel Thresholding on the filtered image
- Step 7: Implement Segmentation using threshold value
- Step 8: Define region of interested & crop that portion
- Step 9: If cyst present in that location
 - Step 9.1: Trace the Region boundaries and plot the shape and part trace the region boundaries and plot the shape and location of the cyst in the actual image.
 - Step9.1.1: Display the actual image with colloid cyst super imposed with red color boundary.
 - Step 9.1.2: Calculate the size of the colloid cyst in mm^2
 - Step9.1.3: Display a message box with the message box with "colloid cyst detected and approximate size of the colloid cyst is mm^2 ," else
 - Step 9.2: Display actual image with the message "No colloid cyst present"
- Step 10: Stop

The proposed algorithm takes minimal amount of time to detect the presence or absence of Colloid Cyst, irrespective of the size of the image. Average time taken is between 8 sec to 10 sec and the accuracy rate is 98.3%. It can detect very small size Colloid Cyst as well. The exact shape of the cyst can be identified easily by using the current method. Hence, as a result of the calculation for the size of the Colloid Cyst almost accurate.

4. Implementation of Algorithm

4.1. Conversion of Input Image and Gray Scale Image

In order to convert a color image to black and white image, the first step was to collect the input images from various sources. In our paper, we need to check the images or the scan images which existed from MRI or CT scan or scan images. These images will be considered for our work to convert to gray scale from color images and can be used to identify the presence of cysts in the images. By using the MATLAB functions, the conversion of image was processed in detail. Any format of images can be taken such that to

division of image in to several pieces in the form of pixels or regions which have some common characteristics was done here. By applying the segmentation process, the processing of the images becomes more and more easy and the processing of images becomes easier by analyzing the data on images. Some of the famous methods used for this process are region growing method, clustering method, histogram dependant method and compression based method etc. Multilevel threshold method was used such that to minimize or maximize the method. Some multiple thresholds $\{P_1, P_2, \dots, P_n\}$ in the image histogram may be as $h(x, y)$ to deal with pixels of similar attributes of the images.

$$S(h(x, y)) = \begin{cases} G_0 & \text{if } h(x, y) \leq P_1 \\ G_1 & \text{if } T_1 < f(x, y) \leq P_2 \\ P_2 & \text{if } T_1 < f(x, y) \leq [2] \\ \dots & \dots \\ G_N & \text{if } h(x, y) > P_N \end{cases}$$

Where $S(h(x, y))$ is the Segmented image and G_L is the gray-level assigned to the pixel in region L.

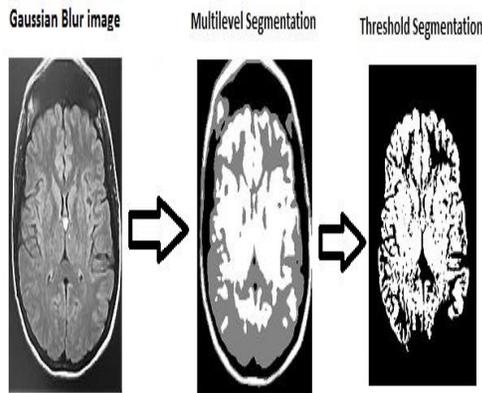


Fig.7. Multilevel Thresholding and Threshold Segmentation

If Colloid Cyst is present then we have traced the exterior boundaries of the cyst using *bwboundaries* (cyst, 'noholes') and then plotted the points shown in Figure 8.

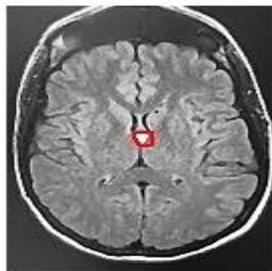


Fig.8. Identifying the Boundaries

Now we have calculated the approximate size of the Colloid Cyst, considering that the image contains only two values, black and white. The maximum image size is taken as 256 x 256 and the binary image can be represented as

$$\text{Img, BI} = \sum_{255} \sum_{255} [f(0)+f(1)]$$

WT=0 HT=0

Where $f(0)$ is white pixel, $f(1)$ is black pixel, WT is width and HT is height. [16]

$$\text{Pixel} = \text{Width (WT)} \times \text{Height (HT)} = 256 \times 256$$

As we have extracted and marked the Colloid Cyst in white pixels. Therefore, no_of_WhitePixel

$$W = \sum_{255} \sum_{255} [f(0)]$$

$$WT=0 \quad HT=0$$

We have calculated the approximate size of the Colloid Cyst in mm^2 .

$$1 \text{ Pixel} = 0.214\text{mm}$$

$$(\text{Number of White Pixel}) W = \text{width} \times \text{height}$$

4.4. Approximate Size of Colloid Cyst = $[(\sqrt{W}) \times 0.214] \text{mm}^2$

A message box like in Figure 9 is used to display whether Colloid cyst is present or not. If it is present, the approximate size of the Colloid cyst is also mentioned.

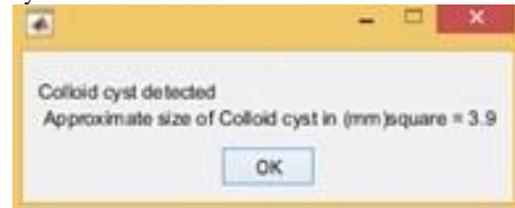


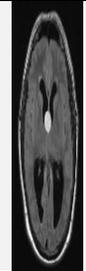
Fig. 9. Output display of the size of the cyst

5. Result Analysis

Considering the high risk of sudden death due to Colloid Cyst, we effectively use Image processing techniques in MATLAB for the automation of detecting Colloid cyst process in Brain from MRI or CT scanned images. In Table 1, we have analyzed the results of our proposed algorithm to demonstrate what sets it aside from other existing algorithms and to measure its effectiveness and accuracy by testing different cases. As we can see in Table 1, the proposed algorithm takes minimal amount of time to detect the Colloid Cyst, irrespective of the size of the image. Average time taken is between 5sec to 12 sec and the accuracy rate is 98%. It can detect very small size Colloid Cyst as well. It extracts and marks the exact shape of the cyst, therefore making the calculation for the size of the Colloid Cyst almost accurate.

Table1. Comparison of Current method with earlier methods

CASE	IMAGE	DESCRIPTION	DETECTION TIME	Accuracy
Case 1. Colloid Cyst detected with Median Filter and Gaussian High pass filter		Size of Colloid Cyst : 3.9 mm^2	5s 57ms	98%
Case 1.				

Colloid Cyst detected with Mean Filter and Gaussian Blur method		Size of Colloid Cyst : 6.24 mm ²	5s 2ms	98.3%
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6. Conclusion

The identification of cyst in MRI and CT scan images was one of the important concerns such that to treat the problems earlier and can get avoid of the serious problems for the patients. If the observations were done manually, some irregularities may happen or some mistakes might take place. So, to avoid this situation we tried to develop an automated system such that to process the images and to identify the cyst on the scan images with more accuracy. In the proposed work, the accuracy and the performance time of the system was reduced and the accuracy had increased from 98% to 98.3% and execution time was reduced. Hence, the identification of the cyst on the MRI and CT scan images was given some good and impressive results with the proposed algorithm.

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