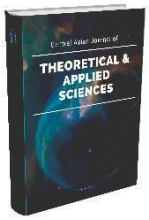

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An Efficient Method for Segmentation of Cerebrospinal Fluid in Hydrocephalus affected T2 weighted MRI images

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Abstract: *The brain is the focal sensory system inundated in cerebrospinal liquid (CSF), which shields it from mechanical pressure and helps support its weight through lightness. Cerebrum hydrocephalus is the condition wherein there is a strange amassing of this cerebrospinal liquid in the ventricles or the pits of the mind. Different calculations have been proposed to resolve this issue. In this paper, an original methodology for the division of CSF from hydrocephalus impacted T2 weighted MRI picture is proposed. The skull stripping strategy embraces a two-venture approach; in the initial step, better deliberate utilization of morphological reproductions tasks is finished the cerebrum picture. In the subsequent advance, a thresholding-based method is utilized to disengage the mind inside the skull. Fixing the limit esteem and by carrying out histogram put together thresholding procedure to the skull stripped picture the CSF segment is separated. This strategy is tested and contrasted and the K-Means calculation. The proposed strategy is ended up being more productive than the K-Means division. The volume of sectioned CSF is determined, which empowers the discovery of hydrocephalus.*

Keywords: *Skull stripping, histogram-based thresholding, K-Means segmentation technique, and T2 weighted MRI brain images.*

I. INTRODUCTION

Hydrocephalus, otherwise called "water on the cerebrum," is an ailment wherein there is a strange aggregation of cerebrospinal liquid (CSF) in the ventricles, or holes, of the mind. This infection is caused to youngsters either previously or after birth. This might cause expanded intracranial tension (ICP) inside the skull and moderate head expansion, spasm, limited focus, and mental incapacity [13]-[16]. Hydrocephalus can likewise cause demise. CSF develops in the focal sensory system in newborn children with hydrocephalus, causing the fontanels (weakness) to swell and the head to be bigger than anticipated [17]-[21].

Hydrocephalus is ordered into three kinds: (1)Non-conveying hydrocephalus-happens when CSF stream is obstructed inside the ventricular framework, (2)Communicating hydrocephalus-happens where there is lacking CSF liquid ingestion, and (3)Normal strain hydrocephalus-an expansion in how much CSF liquid in the mind's ventricles with practically no expansion in the tension inside the head; most frequently found in grown-ups over age 60. Both non-endlessly conveying hydrocephalus can be by the same token "inherent" (exist previously or after birth) or "gained" (creating after birth because of injury or sickness) [22]-[26]. The analysis of typical strain hydrocephalus can be laid out just with the assistance of nonstop intraventricular tension accounts (north of 24 hours or longer) [27].

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As a general rule, moment estimations yield ordinary strain values. Dynamic consistency studies may likewise be useful. Many creators proposed new calculations to recognize the mind hydrocephalus issue [1], [2]. Momani. L and Alkharabshen. A.R [3] proposed another calculation to help foster a timetable that progressively changes according to the patient's ICP esteem. Brandt. M.E and Fletcher. J.M [4] proposed a technique for tracking down the CSF volumes in the back and midline area; however, it isn't relevant for the front district [28]-[31]. Al-Zu'bi. N and Al-Nuaimy. W [5] had an itemized study to improve patient input master framework and gives an appropriate choice to hydrocephalus the board and trick finding [32].

Creators Al-kharabsheh.A and Al-Nuaimy. W [6] propose another way to deal with mechanization and work on the treatment and the board of hydrocephalus [33]-[36]. The anticipation for people determined to have hydrocephalus is hard to foresee, even though there are a few connections between the particular reason for hydrocephalus and the result. Specialists gauge that hydrocephalus influences around 1 in every 500 youngsters. This answer depends on source data from National Disorders and Stroke. 80-90% of babies or newly conceived babies foster hydrocephalus. Jonghyun Oh and Gyuman Kim [7] introduced a clever miniature valve for treating an obsessive condition, i.e., hydrocephalus. Elixmann. I.M and Goffin. C [8] additionally introduced a contextual analysis on the treatment of hydrocephalus [37]-[41]. Lininger. A.A and Xenos.M [9] gave a point-by-point learned about the cerebrospinal liquid stream in the typical and hydrocephalus human cerebrum and experienced a strategy for pulsatile CSF stream estimation, and this might be useful for the prior analysis. Early conclusion and treatment work on the opportunity of a decent recovery from hydrocephalus. Study and examination of cerebrospinal liquid in mind are talked about by many creators [10] [11] and [12]. The original technique proposed in this paper for division of CSF in T2 weighted hydrocephalus impacted cerebrum picture utilizes machine vision. In T2 weighted picture, the CSF segment seems white, white matter shows up in dim shading, and fat tissues seem dim [42]-[51].

II. METHODS AND MEANS

Diagnosing hydrocephalus by machine vision is easy because the volume of CSF in the brain can be used to diagnose [52]-[57]. In the view of machine vision of brain hydrocephalus, it will be easy to detect this problem by finding CSF volume in the brain. The method adopts a two-step approach; in the first step, the skull part is removed from the input image, and the second step uses histogram-based thresholding [58]. The CSF portion can be extracted from the skull-stripped hydrocephalus-affected T2-weighted MRI image by fixing the threshold value. Figure 1 shows the flow chart of the proposed method [59]-[61].

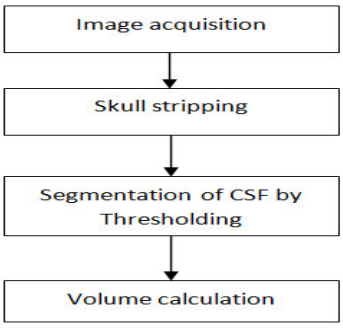

Fig. 1. Flowchart of the proposed methodology

Skull-stripping is the most common way of portioning the mind from non-cerebrum tissues (e.g., skull, scalp, eyes, and neck). Skull stripping is required before handling any calculation on the cerebrum tissue

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[62]-[67]. It is one of the pre-handling progressively works in picture handling. The proposed technique for the skull stripping process is a two-phase process that involves the initial step as morphological remaking to create an essential division and thresholding to get the last skull stripped picture [68]-[73]. Figure 2 shows the info picture.

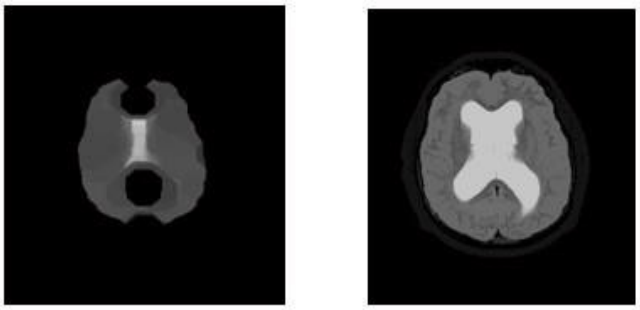
Fig. 2. MRI input brain image

III. EXPERIMENTAL RESULTS

The proposed method is applied on T2 weighted hydrocephalus affected MRI images. The following morphological operations are involved in the proposed method.

Erosion and opening by reconstruction

Disintegration is the most common way of contracting the picture. The counter course of enlargement shows how the organizing component does not entirely settle the picture [74]-[98]. The organizing component is regularly more modest than the picture with a 3x3 size. Figure 3(a) shows the disintegrated mind picture [99-124]. The opening by remaking performs morphological recreation involving the dissolved picture as the marker and the first picture as the veil [125-137]. This smoothes within the article form, breaks limited strips, and wipes out slender segments of the picture, as displayed in Figure 3(b).



(a) (b)

Fig. 3. (a)Eroded image, (b) Reconstruction by opening using an eroded image

Dilation and closing by reconstruction

Expansion is an interaction where the twofold picture is extended from its unique shape. As displayed in Figure 4(a). It checks for covering of pixels; if it exists, the pixels under the middle place of the organizing component will be gone to dark or 1. Then shutting by recreation plays out the supplement of opening by reproduction activity [138-141]. This activity fills the little openings and holes in a solitary pixel object. This cycle is applied after expansion, followed by disintegration [142-156]. The came about the picture is displayed in Figure 4(b).

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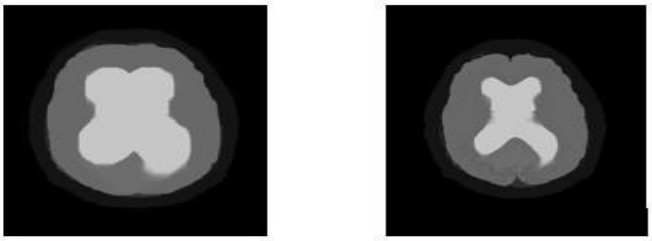

(a) (b)

Fig. 4. (a)Dilated Output, (b)Reconstruction by closing

Thresholding

Thresholding methods produce sections having pixels with comparable forces [157-175]. Thresholding is a helpful method for laying out limits in pictures containing strong items on a differentiating foundation [176-181]. Figure 5 shows the came about the picture.

Fig. 5. Binarized image by thresholding

Skull stripped Output

By setting the thresholding condition with binarized picture and info mind picture, any place, the binarized picture comprises 1 spot force level of information picture as 1 and any place the binarized picture comprises 0 spot 0 [182-189]. The resulting picture comprises just the mind tissues. The stripped picture resembles Figure 6.

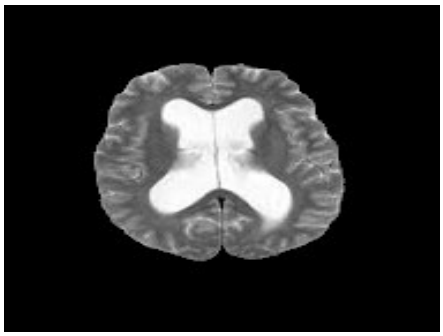

Fig. 6. Skull stripped image

Final Output

The threshold value is fixed as 200 using the histogram thresholding technique; the Cerebrospinal fluid part of the brain is segmented from the skull stripped brain image [190-195]. Figure 7 shows the CSF part segmented image by thresholding.

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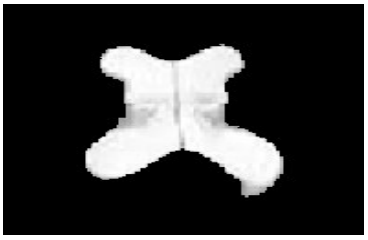


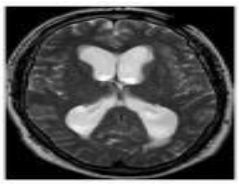
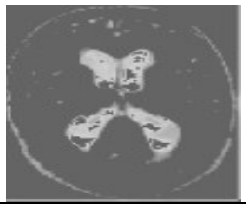
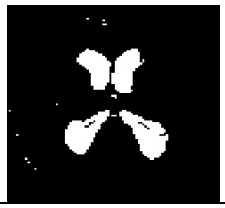
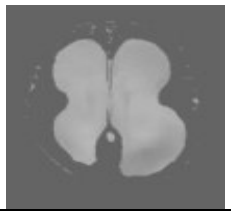
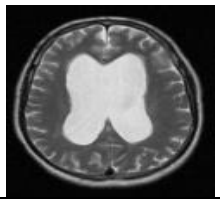
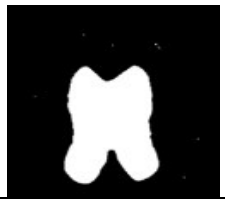
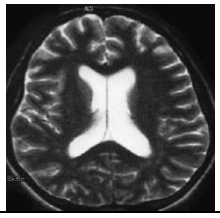
Fig. 7. Final Output of segmented CSF part from brain MRI.

From the extracted CSF portion, the volume of CSF is calculated by counting the non-zero pixel values.

IV. DISCUSSION AND COMPARISON

The above technique is tested for some T2 weighted MRI mind pictures, and the outcomes are contrasted and the K-Means calculation results [196-199]. The outcome examination is given in the accompanying classification (table 1).

Table 1. Comparison of k-means and hard thresholding

Input image	K-Means output image	Hard thresholding output image	Volume (per 40,000 Px) for HT
			25,788
			58,317
			33,102
			20,139

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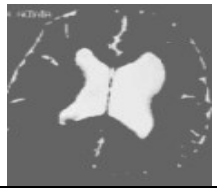
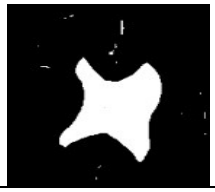
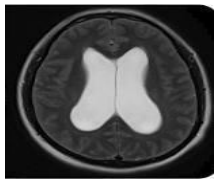
			31,161
			23,544

The volume can be determined by calculating the non-zero pixel values from the CSF segmented images. By manually cropping and calculating the volume of Cerebrospinal Fluid in the normal brain image, the average value is 15,500 Per 40,000 pixels. Thus, by calculating the volume of CSF in the input brain MRI, if it is found to be more than 15,500 pixels per 40,000 pixels, it can be said that there is an abnormality in the CSF that enables the diagnosis of hydrocephalus. And this method is proven to be more efficient than the K-Means segmentation technique.

V. CONCLUSION

This paper proposes a novel method for cerebrospinal fluid segmentation for T2 weighted hydrocephalus affected brain MRI. Though this method is applicable only for T2 weighted MRI brain images, it s found to be very efficient and simple than other methods. The noise present in the K-Means algorithm is reduced in the proposed hard thresholding algorithm. This method is proven to be more efficient than the K-Means segmentation technique. Similar algorithms can also be used to detect the early stage of brain tumours in the future.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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