A Novel Segmentation Technique to Extract Amygalada of Brain to Detect Insomnia Disorder Using Graph Cut Method

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Abstract— Insomnia is one of the most dangerous sleepless disorders and can continue through the teenage years and lifelong of human being. This research work focuses on one of the major problems of this disorder happen in human brain called amygalada abnormality. The size and growth of the amygalada will decide the insomnia disorder. Various existing research works to extract the amygalada (Head and body) are surveyed in this thesis and an automatic diagnosis technique is proposed to extract the amygalada in MRI brain images. In the proposed method, Graph Cut Method is used to make it suitable for segmenting small, low contrast structure such as the amygalada to predicting the Insomnia Disorder. The results show accurate and very fast performances in external amygalada segmentation in a real data set.

Keywords— Insomnia, Amygalada, Graph Cut, MRI, Segmentation.

I. INTRODUCTION

Insomnia is defined as difficulty initiating, or maintaining sleep at least 3 nights per week, in addition to complaints of sleep-related daytime impairment. Sufficient and restful sleep is a human necessity. The average adult needs slightly more than 8 hours of sleep a day, but only 35% of American adults consistently get this amount of rest.

Insomnia increases the risk of substance abuse, motor vehicle accidents, headaches, and depression. Recent surveys indicate that 50% of people suffer from sleep difficulties, and 20 – 36% of them struggle with such difficulties for at least 1 year. Other studies show that one person out of three in the United States has insomnia, but only 20% tell their health care providers about it [1].

Insomnia is more common in women and older adults. People who are divorced, widowed, or separated are more likely to have the problem than those who are married, and it is more frequently reported by those with lower socioeconomic status. Short-term, or transient, insomnia is a common occurrence and usually lasts only a few days. Long-term or chronic insomnia lasts more than three weeks and increases the risk for injuries in the home, at the workplace, and while driving because of daytime sleepiness and decreased concentration. Chronic insomnia can also lead to mood disorders like depression [2].

➢ **Stress.** Concerns about work, school, health or family can keep your mind active at night, making it difficult to sleep. Stressful life events — such as the death or illness of a loved one, divorce, or a job loss — may lead to insomnia.

➢ **Anxiety.** Everyday anxieties as well as more-serious anxiety disorders, such as post-traumatic stress disorder, may disrupt your asleep. Worry about being able to go to sleep can make it harder to fall asleep [3].

➢ **Caffeine, nicotine and alcohol.** Coffee, tea, cola and other caffeine-containing drinks are well-known stimulants Alcohol is a sedative that may help you fall asleep, but it prevents deeper stages of sleep and often causes you to awaken in the middle of the night.

Sleep problems may be a concern for children and teenagers as well. However, some children and teens simply have trouble getting to sleep or resist a regular bedtime because their internal clocks are more delayed. They want to go to bed later and sleep later in the morning [4].

Insomnia is the inability to obtain an adequate amount or quality of sleep. The difficulty can be in falling asleep, remaining asleep, or both. People with insomnia do not feel refreshed when they wake up. Insomnia is a common symptom affecting millions of people that may be caused by many conditions, diseases, or circumstances. The brain regions affected by insomnia are Abnormal growth of amygalada and reduction of gray matter in frontal lobe which are involved in sleeping disorder activity, which is an only problem area for insomnia[4].

II. SEGMENTATION APPROACH

In this section briefly described about the segmentation approach such as graph cut technique. Here each and every step of this algorithm explained briefly.

➢ *Graph Cut Technique*

In the graph cut technique it represents the image in the form of graphs. That means Containing nodes and vertices like a graph. So here represent the each pixel as a node and the distance between those nodes as the edges. It can calculate the distance between the nodes by using the attributes of the color model.

. In graph theory, a cut is a partition of the nodes that divides the graph into two disjoint subsets. The set of cuts of the cut is the set of edges whose ending points are in different subsets of the divided region. If edges are in its cut-set then they are said to be crossing the cut. In an un-weighted undirected graph, the weight or size of a cut is the number of edges that are crossing the image. And in the case of a weighted graph, it is defined as the sum of the weights of all the edges crossing the cut. The working mechanism of Graph cut Algorithm is shown in Figure 1.
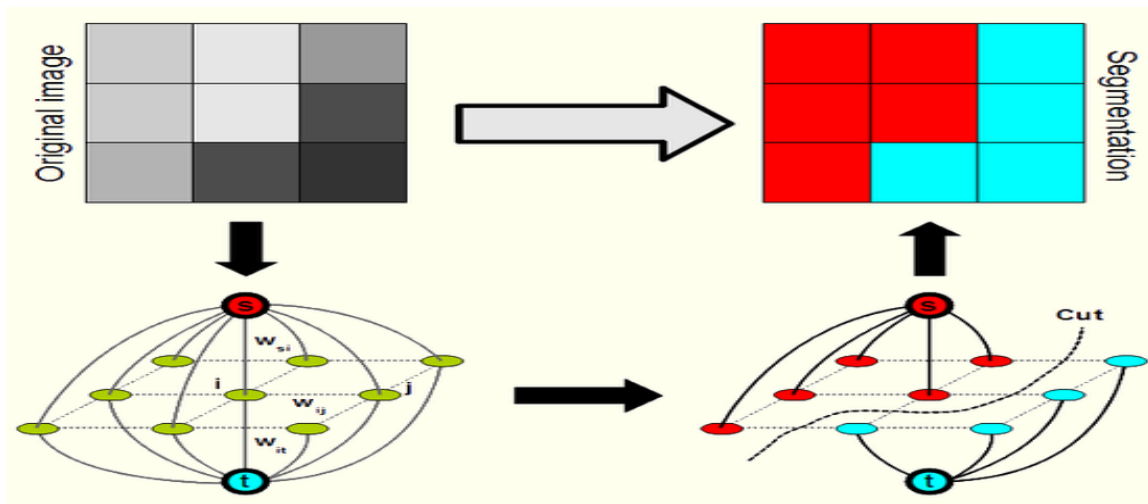

Figure 1.Working Mechanism of Graph Cut Algorithm

III.METHODOLOGY

The proposed method contains three phases and the schematic diagram is shown in Figure 2.

➢ *Brain image Acquisition*
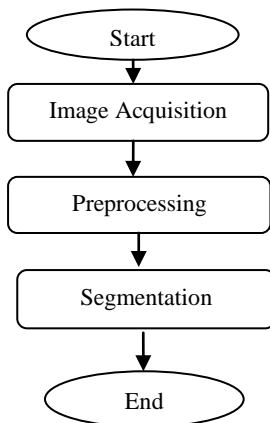➢ *Preprocessing*
➢ *Segmentation*

Figure 2. Schematic Diagrams of the Proposed Algorithms

IV.DESCRIPTION

➢ *Image Acquisition*

   To Access the real medical images like MRI, PET or CT scan and to take up a research is a very complex because of privacy issues and heavy technical hurdles. The first stage in any vision system is the image acquisition stage. In this stage, images can be acquired from digital camera, scanner, or other desirable digital input device. Magnetic resonance imaging (MRI) is a non-invasive medical test that helps physicians diagnose and treat medical conditions. MRI uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of organs

➢ *Image Preprocessing*

   During image formation, the original image may be corrupted with some undesired impulsive noises. In this step, to remove the impulsive noises Gaussian filtering technique is used. The goal of Gaussian filtering techniques is to increase the accuracy and the clarity of the brain images during the image preprocessing phase.

> *Segmentation*

The external segmentation is takes place by using graph cut algorithm to extracting the small, low contrast structure such as the amygalada to predicting the ADH Disorder.

V. PROPOSED METHOD

In this section, introduce the GC framework for extracting the Amygalada from MRI brain Images. Let us define $Z = z1, ..., zp, ..., z|P|$ as the set of pixels for a given grayscale image I; $P = 1, ..., p, ..., |P|$ as the set of indexes for I; N as the set of unordered pairs {p, q} of neighboring pixels of P under a 4-(8-) neighborhood system, and $L = L1, ..., Lp, ..., L|P|$ as a binary vector whose components Lp specify assignments to pixels $p \in P$. Each Lp can be "foreground" or "background", or equivalently "caudate" or "back" for our problem

```
      ┌───────────────┐
      (    Start      )
      └───────┬───────┘
              │
              ▼
    ┌─────────────────────┐
    │ Seed Initialization │
    └──────────┬──────────┘
               │
               ▼
    ┌─────────────────────┐
    │ Declare Supervised  │
    │ &Unsupervised terms │
    └──────────┬──────────┘
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               ▼
    ┌─────────────────────┐
    │ Manipulate Supervised│
    │ &Unsupervised terms │
    └──────────┬──────────┘
               │
               ▼
    ┌─────────────────────┐
    │ Calculate Energy    │
    │ optimization        │
    └──────────┬──────────┘
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               ▼
      ┌───────────────┐
      (     End       )
      └───────────────┘
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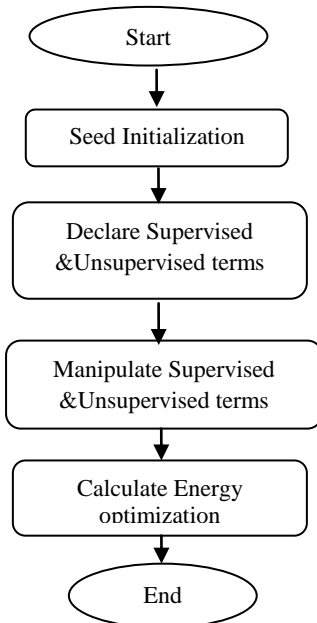
Figure 3. Flowchart of the Graph Cut Algorithm

(Abbreviations for caudate and background), indicating whether pixel p belongs to the caudate or background, respectively. Thus, the array L defines a segmentation of image I. The frame work of graph cut algorithm is shown as flowchart figure 3.

> *Seed Initialization*

In this step, Amygalada and background seeds are defined by performing morphological operations on the ROI obtained R0, as follows: a caudate seed denotes 'C'

$$C = \text{Erode } ke (R0),$$

Where Erode ke denotes an erosion with a structural element of ke pixels; and background seed denotes 'B'.

$$B = P \setminus \text{Dilate } kd (R0),$$

where Dilate kd denotes a dilatation with a structural element of kd pixels. The output of the Seed Initialization is shown in figure 4.
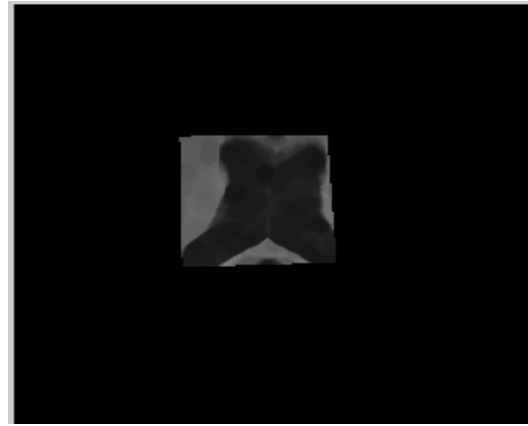

Figure 4. Seed Initialization

> *Supervised &Unsupervised Terms*

In this step the unary term is defined as the addition of two parts (unsupervised and supervised terms) as follows: unsupervised terms denotes "Up", supervised terms denotes "Sup" and Unary term denotes "USp"

USp ("caudate") = Up ("caudate") + Sup ("caudate")
USp ("back") = Up ("back") + Sup ("back")

The unsupervised unary term is denoted using caudate and background models based on gray level information pertaining to the seeds. The unary potentials at each pixel *p* are initialized as:

Up ("cau") = −ln (Pi (Lp ="caudate")
Up ("back") = −ln (Pi (Lp ="back")

Next the probability of unary term denotes "Pi". Pi (Lp ="caudate") is computed using the histogram of gray levels of caudate seeds and the probability

Pi (Lp ="back") = 1 − Pi (Lp ="cau"),

since background seeds contain many different tissues and it is difficult to extract a model directly from them. C Amygalada and background seed is shown in figure 5.
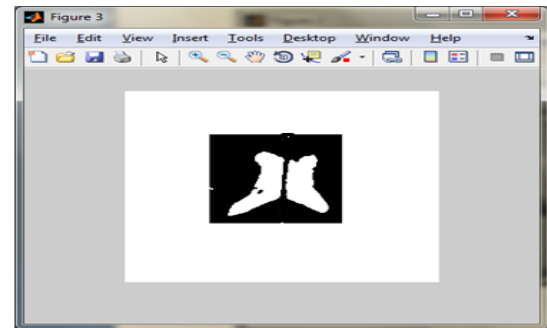

Figure 5. Amygalada and Background Seed

> *Energy Optimization*

The GC formulation defines the cost function e(L) which describes soft constraints imposed on boundary and region properties of L

$$e(L) = un(L) + \delta\ bo(L),$$

Where U(L) is the unary term (or region properties term),

$$un\ (L) = \quad Up\ (Lp),\ p \in P$$

and B(L) is the boundary property term,

$$B\ (L) = B\ \{p,q\} - \quad Lp,\ Lq\ \ ,\{p,q\} \in N$$

Where $\quad \Omega\ (Lp;\ Lq) = \{1;\ if\ Lp \not= L_q$

$$\{0;\ otherwise:$$

The goal of GC is to compute the global minimum from all segmentations L satisfying the hard constraints $\forall p \in C;\ Lp$ ="caudate", $\forall p \in B;\ Lp$ ="back", where $C \subset P;\ B \subset P;\ C \cap B = \emptyset$ denote the subsets of caudate and background seeds, respectively.
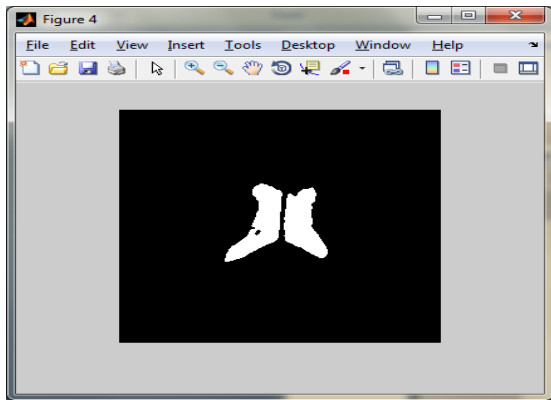
Figure 6. Extraction of the Amygalada

Finally, energy optimization gives an exact pixel value for extracting the amygalada from the brain images shown in figure 1.6. Based on a graph cut algorithm the amygalada is extracted from the brain images very fastly and accurately.

VI. EXPERIMENTAL RESULT

Various samples of amygalada images are taken and the regions are segmented and extracted by the proposed algorithm and the results are compared with the existing techniques. The complete procedure applied to one sample amygalada image is shown below
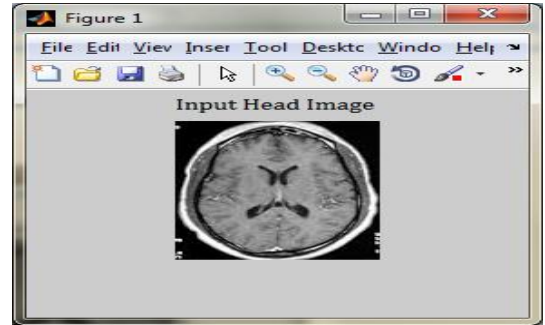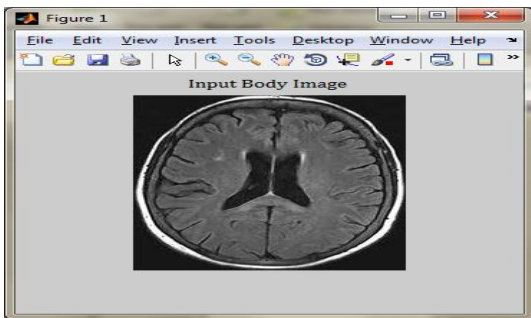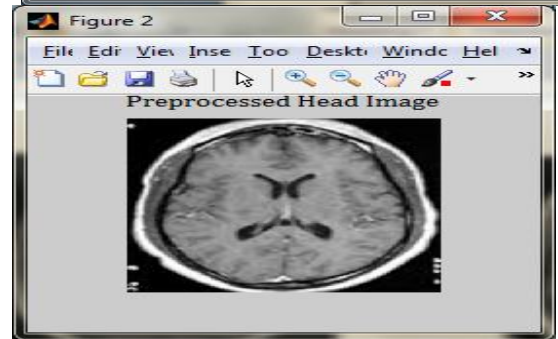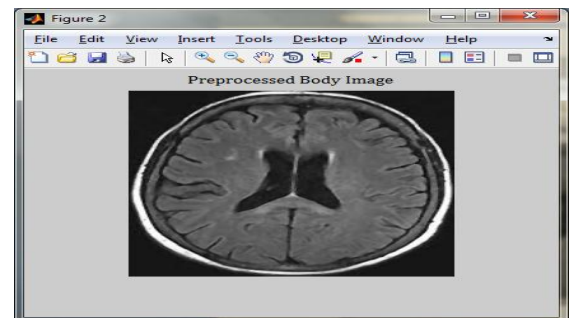

Figure 7. Input Images of the Amygalada

The input images of the amygalada are shown in figure 6.1. Here applying Gaussian filter to remove the noise from the amygalada. The output image is shown in figure 7.
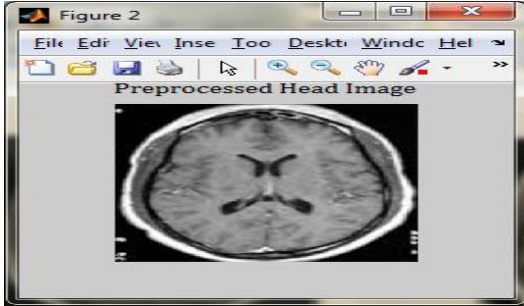

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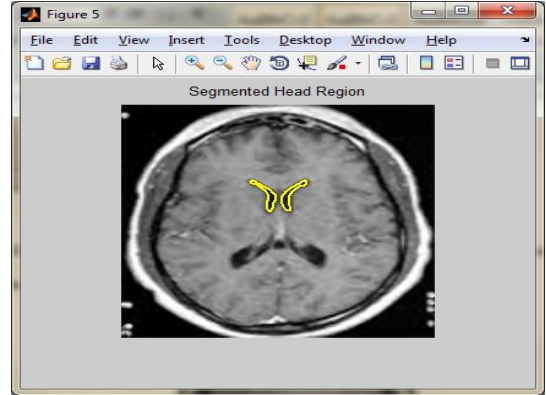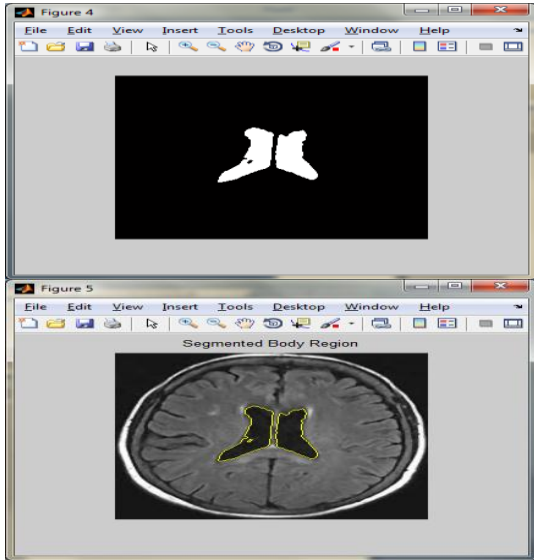**41**
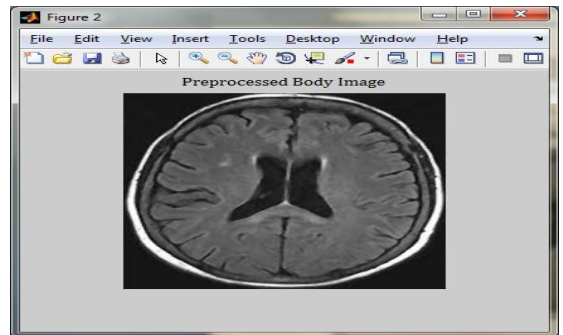
Figure 8.Amygalada Preprocessed

Figure 9. Body of the amygalada

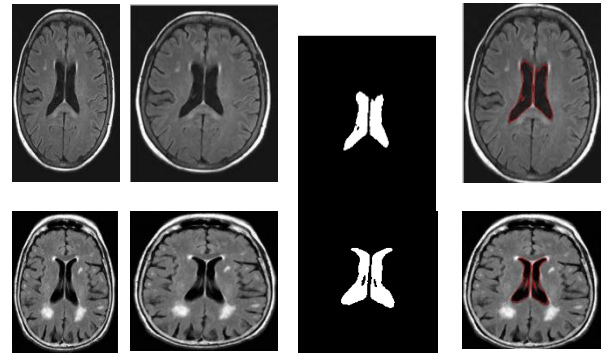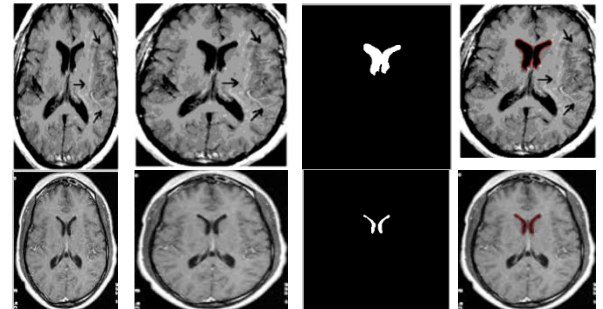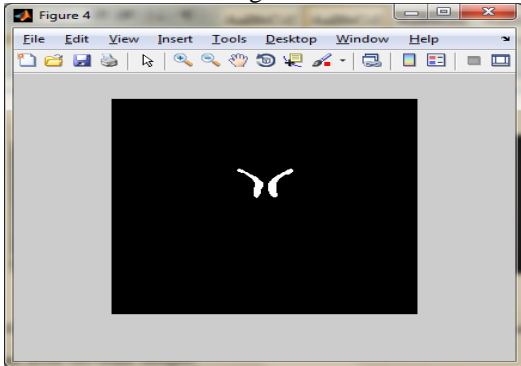The above figure 9 shows the body of the amygalada extracted by using the Graph cut algorithm from the brain images.

Figure 10 Head of the amygalada

Figure 11. Sample images and their outputs

VII.CONCLUSION

In this research work, an automatic diagnostic model to segment and extract the amygalada of the brain using Graph cut method is proposed .The border of the amygalada is clearly found out by using this proposed method. The proposed external segmentation, segment the small and low-contrast amygalada structure to predicting Insomnia Disorder. Finally, the automatic segmentation method was completely validated on a dataset which shows accurate and fast performances

In future this research work may be extended to identify the stage of amygalada problem which may extend an

alarm/sign of warning to the neurologists to learn more about this disorder and hence take preventive measures to diagnose this problem.

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