ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

A Proficient System For Brain Lesion Escalation Detection and Classification in MR Images

R. Manju[#1], Dr C. Balasubramanian[*2], P. Subbalakshmi[*3]

PG Scholar, Department of CSE, P S R Rengasamy College of Engineering for Women, Sivakasi, India[#1]

HOD, Department of CSE, P S R Rengasamy College of Engineering for Women, Sivakasi, India[*2]

Assistant Professor, Department of CSE, P S R Rengasamy College of Engineering for Women, Sivakasi, India[*3]

ABSTRACT: a brain tumor is a disease that arises due to abnormal growth of cells that have proliferated in an uninhibited manner. In the field of medical image processing detection of brain tumor from MRI scan has become one of the active researches. To avoid manual errors in this paper proposed an efficient morphological segmentation and K-NN classification technique to recognize normal and abnormal MRI images. Using this segmentation and classification technique tumor region is extracted from MR Image and depending upon the type of the tumor, the brain lesion growth is represented in time series manner.

KEYWORDS*:* brain lesion, braintumor, K-NN classification, morphological segmentation, MRI.

I. INTRODUCTION

A brain tumoris defined as an abnormal growth of cells within the brain or the central spinal canal, which can disrupt proper brain function, usually in the brain itself, but also in lymphatic tissue, in blood vessels, in the cranial nerves, skull, pituitary gland, or pineal gland.

A. *TYPES OF BRAIN TUMOR*

There are two main types of tumor: benign tumor and malignant tumor. The malignant tumor is known as cancerous tumor that is separated into primary tumor that originate within the brain, and secondary tumor that spread from somewhere else known as brain metastasis tumor.

1)Primary brain tumor

Primary brain tumor can be benign or cancerous and originate in our brain. They can develop from our:

- Brain cells
- The membranes that surround our brain, which are called meninges
- Nerve cells
- Glands

2)Secondary brain tumor

Secondary brain tumors make up the majority of brain cancers. They start in one part of the body and spread, or metastasize to the brain.Secondary brain tumors are always malignant but benign tumors don't spread from one part of your body to another.

The primary objective of image enhancement is to clear all types of noise, distortion, degradation from image and make it more appropriate for a given task and a particular observer. Image enhancement is basically improving the interpretability or perception of information in images for human and giving betterinput for other automated image processing techniques. Image enhancement techniques can be alienated into two wide categories:

1. Spatial domain techniques, which workstraight on pixels.
2. Frequency domain techniques, which work on the Fourier transform of an image.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

In spatial domain techniques we directly deal with the image pixels [1]. The pixel values are manipulated to attainpreferred enhancement.In frequency domain techniques, the image is first transferred into frequency domain [2]. All the imageimprovement operations are done by first converting the image into the Fourier transform and then to obtain the resultant image the Inverse Fourier transform is applied. Image segmentation is the process used for partitioning the digital image into multiple segments. The objective of segmentation is to simplify and modify the illustration of an image into something that is more meaningful and easier to analyse. Image segmentation is normally used to place objects and borders in images. More precisely, image segmentation is used for assigning a label to each and every pixel in an image using this pixels with the same label share their image characteristics.Feature extraction is the process of transforming the input data into the set of features (intensity, texture, shape, etc). Feature set is used to take outimportant information from the input data in order to perform the preferred task using condensed representation instead of full size of input data.Image classification operation is done byanalysing the numerical properties of an image features and organizes thisinformation into categories.

II. RELATED WORK

In this section we briefly consider some of the correlated works that is most appropriate to our approach. BrojenH.Menzeetal, [3] have proposed a generative probabilistic model for segmentation of brain lesions in multidimensional images that generalizes the Expectation Maximization (EM) algorithm. In this process they extend the atlas based EM-segmenter by a latent atlas class that represents the possibility of changeover from any of the 'healthy' tissues to 'lesion' class. In this method the process is iterative as an automaton labels the image user can observe the segmentation evaluation and guide the algorithm with human input where the segmentation is difficult to compute. This approach is tested using two image sets BRATS set of glioma patient scans and multimodal images with acute and sub acute ischemic stroke. Time is the major problem of this method.

Y.Tarabalka, G.Charpiat, L.Brucker and H.Menze [4] have proposed a method for joint segmentation of monotonously growing or shrinking shapes in a time series of noisy images. In this work they addressed the problem of shape segmentation in 2D and 3D sequences of very noise or low contrast images. Where shapes monotonously grow or shrink in time. In this paper they proposed a new graph-cut based method for computing the globally optimal spatio-temporal segmentation satisfying the constraints. The limitation of this approach is that it can be applied only to a time series of images on the same scale.

A.Gooyaetal, [5] have proposed the EM algorithm to iteratively refine the estimates of tissue label posteriors. Deformable registration of the atlas is jointly estimated with segmentation, to construct a statistical atlas of the glioma. The application of GLISTR to a large number of data sets reveal that the method can produce promising segmentation and atlas registration results, even in the presence of large mass-effect, necrosis and edema. Accuracy of this method is similar to existing method, so it is less frequently used.

N.K.Batmanghelich, B.Taskar, and C.Davatzikos [6] have proposed a novel dimensionality reduction method for classification in medical images. The goal of this method is to transform very high dimensional input to a low dimensional representation that preserves discriminative signal and is clinically interpretable. Voxel Based Morphometry (VBM) is a neuro imaging analysis technique that allows investigation of focal differences in brain anatomy using the statistical approach of statistical parametric mapping. Limitation of this method is that overlapping groups imposes a challenge to the optimization problem.

III. PROPOSED SYSTEM

The major components of the system architecture are image pre-processing, skull stripping, tumor region detection, classification, tumor growth identification. The skull stripping is a process of eliminating all non-brain tissues from brain image,it is also one of image pre-processing step. Tumor region detection is a process in which affected tumor lesion from skull stripped image is detected. Classification technique is used to identify the type of tumor that is the

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

tumor is cancerous or not, after classification the tumor growth identification is used to represent the time series extension of tumor region.

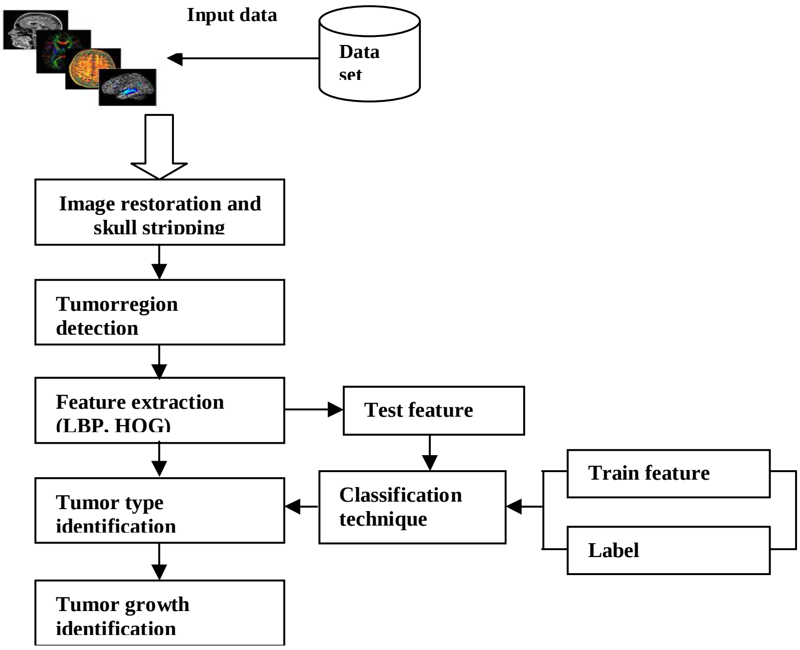


Fig 1 System Architecture

A. ***PREPROCESSING***

Image preprocessing, also called image restoration, involves the rectification of distortion, degradation, and noise introduced during the imaging process.In electronics and signal processing, a Gaussian filter is a filter it generates the impulse response as a Gaussian function (or an approximation to it). It is considered the ideal time domain filter, just as the sin-c is the ideal frequency domain filter.In this process radiometric and geometric errors are encountered from the remotely sensed image.

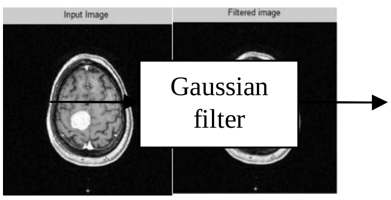


Fig.1.

B. ***SKULLSTRIPPING***

Skull stripping is one of the important processes in biomedical image analysis.It is needed only in brain images not needed in images such as heart, lungs etc,It is the process of eliminating all non-brain tissues from brain image.In skull stripping removes extra cerebral tissues such as skull, fat, skin etc.In this proposed method skull stripping based on histogram analysis is used.

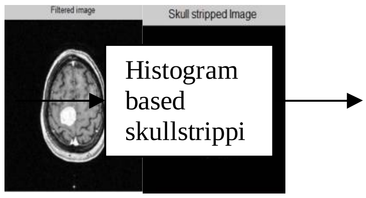
ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

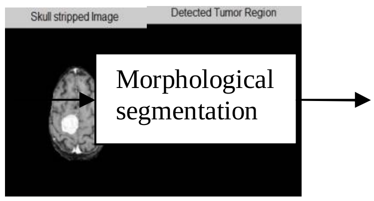
Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017



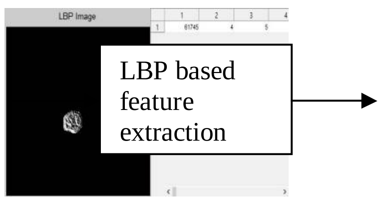
C. ***TUMOR REGION DETECTION***

Tumor region detection is a process of separating the individual rudiments of an image into a set of groups, so that all rudiments in a group have a common property.Medical images contain a lot of information, segmentation allows visualization of the structures of interest by removing unnecessary information from the image.Morphological segmentation algorithm is used for brain lesion segmentation using morphological operations.



D. ***FEATURE EXTRACTION***

Feature extraction is a process of transforming the input data into the set of features (intensity, texture, shape, etc). Features said to be the properties that describe the whole image.Feature set is used to extract relevant information from the input data in order to perform the desired task using reduced representation instead of full size of input data.



E. ***CLASSIFICATION***

Image classification evaluate the numerical properties of various image features and classify data into categories.Classification algorithms commonlyapply in two phases of processing:

- *Training phase*
- *Testing phase*

In this classification module k nearest neighbour based approach is used to reduce time required for classification of image and increase accuracy.

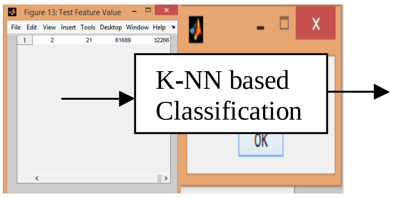
ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017



V. IMPLEMENTATION

The implementation of this paper work is first to extract the input image from the data set and partitioning the tumor region from the skull stripped image.

1. Image restoration using Gaussian filter
2. Skull stripping the filtered image
3. Tumor region detection
4. LBP based Feature extraction
5. Tumor type identification
6. Tumor growth identification

1) Image restoration using Gaussian filter

Image restoration, also known as image pre-processing, involves the correction of distortion, degradation, and noise introduced during the imaging process [7]. This process generates a corrected image that is used to remove both geometric and radio metric, errors and also preserves the radiant energy characteristics ofthe original scene.

A. BINARIZATION

- The binary image pixel values are applied to the delay register type model and to store the pixel values.
- Then to set the minimum threshold value between the two pixels variations limits a mask is generated. Mask is a filter. That is applied on whole image in filtration process.
- Mask is a small matrix useful for blurring, sharpening, embossing, edge-detection, and more. This is accomplished by means of convolution between a kernel and an image.

B. GAUSSIAN FILTER

The Gaussian filter is a non-uniform low pass filter.Gaussian kernel coefficients are sampled from the 2D Gaussian function.

$$G(X,Y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

- Where σ is the standard deviation of the distribution.
- The allocation is assumed to have a mean of zero.
- The continuous Gaussian function is discredited to store it as discrete pixels.
- Central pixels value has higher weight than those on the periphery.
- Larger values of σ generate a wider peak (greater blurring).
- Kernel size is increasing with increase in the value of σ using this Gaussian nature of the filter is maintained.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

- Gaussian filter kernel coefficients value depends on σ.
- The coefficientsvalue must be close to 0, at the edge.
- The kernel is rotationally symmetric with no directional bias.
- Gaussian kernel is discrete which allows fast computation
- The disadvantage of Gaussian filters is it might not maintain image brightness.

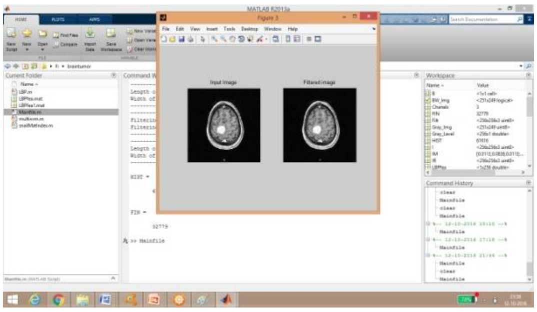


Fig 2 Image restoration

2) Skull stripping the filtered image

- In quantitative morphometric studies of magnetic resonance (MR) images often require a preliminary step to isolate brain from extra-cranial or “non-brain” tissues [8]. This preliminary step, commonly referred to as “***skull-stripping***,” facilitates image processing such as surface representation, cortical destruction, image listing, de-identification, and lesion segmentation.
- It must be possible for large-scale, multisite studies, such as the projects supported by the Biomedical Informatics Research Network (BIRN), skull-stripping methods should be correct and fairly automated.
- The results showed promising use of double *thresholding* as a robust threshold value in handling intensity in-homogeneities compared to *Otsu'sthresholding*.

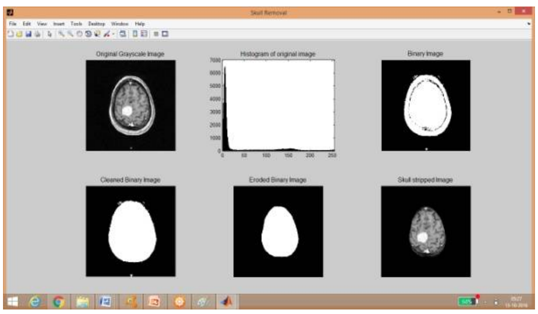


Fig 3 Skull Stripping

3) Tumor region detection

Tumor region detection is the process of dividing the individual elements of an image or volume into a set of groups, so that all elements in a group have a common property [9]. Segmentation of anatomical structures is a key enabling

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

technology for medical applications such as diagnostics, planning and guidance. The region detection process allows visualization of the region of interest, by removing unnecessary information.

- Morphological techniques typically probe an image with a small shape that is known as a structuring element.
- The structuring element is located at all possible locations in the image and it is compared with the equivalentneighbourhood of pixels.
- Morphological operations differ in how they carry out this comparison.
- *Dilation* causes object to dilate or grow in size;*erosion* causes objects to shrink in size.
- The amount and the mannerthey dilate or shrink depend upon the selection of the structuring element.
- Dilating or eroding without specifying the structural element makes no more sense than trying to low pass filter an image without specifying the filter.
- Commands used for morphing
    - Strel – used for creating morphological structuring element.
    - Imerode() – used to erode or shrink an image.
    - Imdilate () – used for dilating or expanding an image.

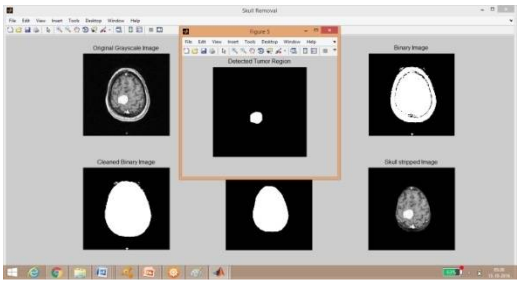


Fig 4 Detected TumorRegion

4) LBP based Feature extraction

The LBP feature vector is created in the following manner:

- In the first step the examined window is divided into cells (e.g. 16x16 pixels for each cell).
- Then for each pixel in a cell, each pixel is compared with its 8 neighbours (on its left-top, left-middle, left-bottom, right-top, etc.).
- The pixel comparison done in circular manner, i.e. clockwise or counter-clockwise. When the centre pixel value is larger than the neighbour’s value, write "0". Otherwise, write "1".
- Then the 8-digit binary number generated (which is usually converted to decimal for convenience).
- The histogram is computed for each cell, of the frequency of each "number" occurring.
- This histogram is 256-dimensional feature vector. Then normalize the histogram. Concatenate histograms of all cells. This gives a feature vector for the entire window [10].

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

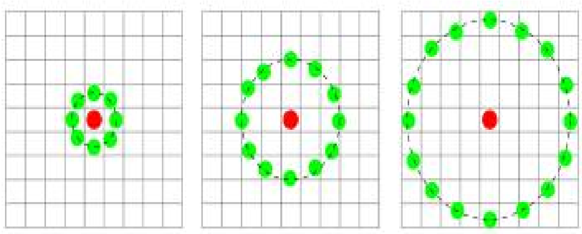


Fig5 LBP based Feature Extraction

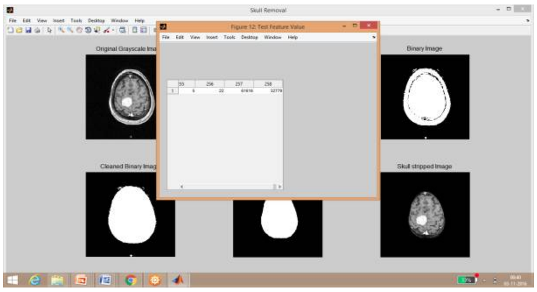


Fig 6 Test Feature Values

5) Tumor type identification

Image classification analyzes the numerical properties of various image features and organizes data into categories.

A. ***K-NN BASED CLASSIFICATION***

- In pattern recognition, the k-Nearest Neighbours algorithm is a non-parametric method used for both classification and regression operations. In both cases, the input consists of the k neighbouring training dataset in the feature space [11].
- In k-NN classification, the yield is a class membership. An entity is classified by a majority vote of its neighbours, with the entity being assigned to the class most common among its k nearest neighbours. If k = 1, then the object is simply assigned to the class of that single nearest neighbour.

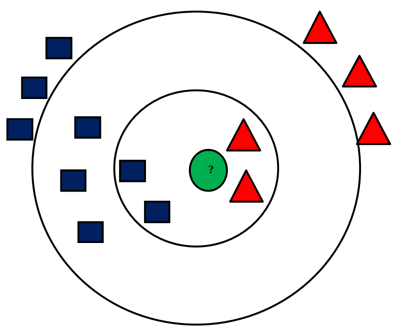


Fig 7 K-NN Classification

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

B. ***K-NN CLASSIFICATION PSEUDO CODE:***

Function knn

Input: A finite set C of points to be classified

A finite set T of points

A function f: T -> {1,...,n}

A natural number k

Output: A function s: C -> {1,...,n}

Begin

Foreach y in Cdo

Let V<- {}

Foreach t in T add the pair (d(y,t) , f(t)) to V

Sort the pairs in V using the first components

Count the class labels from the first k elements from V

Let s(x) be the class with the maximum number of occurrence

End Foreach

Return s

End

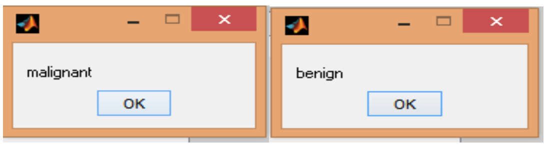


Fig 8 Classification outputs

6) Tumor Growth Identification

Tumor growth identification is a process in which depending upon the tumor type identified using K-NN classifier the tumor growth is represented [12].Tumor growth of each lesion is identified by comparing the areas of present and already calculated lesion area.

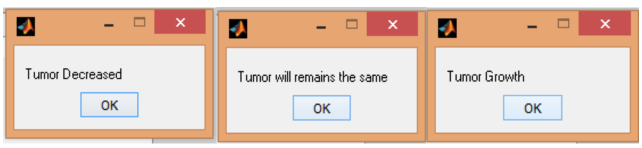


Fig 9Tumor growth level representation

7) Performance Analysis

In performance analysis phase the existing and proposed systems performance values as accuracy, error rate, sensitivity and specificity are compared and graph is generated.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

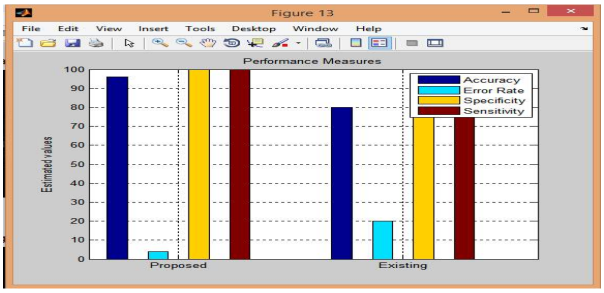


Fig 10 Performance Analysis

TABLE I. PERFORMANCE ANALYSIS

Performance Analysis (%)	**Performance comparison**			
	Existing system		***Proposed system***	
	Image 1	***Image 2***	***Image 3***	***Image 4***
Accuracy	80	82	94	95
Error Rate	20	18	6	5
Specificity	90	92	100	100
Sensitivity	79	80	99	100
Time (sec)	55	60	27	25

VI. CONCLUSION AND FUTURE WORK

In this proposed method an efficient morphological segmentation and K-NN classification technique is yielding the better result while comparing with existing methods, which reduces time complexity, computational complexity and increases accuracy. Using this both segmentation and classification approaches tumor region is detected, classified and tumor growth level is identified.

Future work is extended for longitudinal representation of tumor growth and tumor growth identification after and before therapeutic.

REFERENCES

[1] B. M. Menzeetal., “The multimodal brain tumor image segmentation benchmark (BRATS),” IEEE Trans. Med. Imag., vol. 33, no. 10, pp. 1993–2024, Oct. 2014.
[2] S. Bauer, R. Wiest, L.P. Nolte, and M. Reyes, “A survey of MRI-based medical image analysis for brain tumor studies,” Phys. Med. Biol., vol. 58, no. 13, pp. R97–R129, Jul. 2013.
[3] BjoernH.Menze*, A Generative Probabilistic Model and Discriminative Extensions for Brain Lesion Segmentation— With Application to Tumor and Stroke, *IEEE Transaction on Medical Imaging*, vol. 35, apr. 2016.
[4] Y. Tarabalka, G. Charpiat, L. Brucker, and B. H. Menze, “Enforcing monotonous shape growth or shrinkage in video segmentation,” in Proc. Brit. Mach. Vis. Conf., 2013.
[5] A. Gooya et al., “GLISTR: Glioma image segmentation and registration,” IEEE Trans. Med. Imag., vol. 31, no. 10, pp. 1941–1954, Oct. 2012.
[6] N. K. Batmanghelich, B. Taskar, and C. Davatzikos, “Generative-discriminative basis learning for medical imaging,” IEEE Trans Med. Imag. vol. 31, no. 1, pp. 51–69, Jan. 2012.
[7] B. H. Menzeetal., “A generative approach for image-based modeling of tumor growth,” in Proc. IPMI, 2011.
[8] A. Gooya, G. Biros, and C. Davatzikos, “Deformable registration of glioma images using EM algorithm and diffusion reaction modeling,” IEEE Trans. Med. Imag., vol.30, no.2,pp.375–390,Feb.2011.
[9] S. Bauer, J. Tessier, O. Krieter, L. Nolte, and M. Reyes, “Integrated spatio-temporal segmentation of longitudinal brain tumor imaging studies,” in Proc MICCAI-MCV. New York: Springer, 2013, LNCS.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Special Issue 1, March 2017

[10] Y. Tarabalka, G. Charpiat, L. Brucker, and B. H. Menze, “Spatio-temporal video segmentation with shape growth or shrinkage constraint,” IEEE Trans. Image Process., vol. 23, no. 9, pp. 3829–3840, Sep. 2014.
[11] S. Parisot, H. Duffau, S. Chemouny, and N. Paragios, “Joint tumor segmentation and dense deformable registration of brain MR images,” in Proc. MICCAI, 2012, pp. 651–658.
[12] E. Alberts, G. Charpiat, Y. Tarabalka, M. A. Weber, C. Zimmer, and M. B. H. Youdim, “A nonparametric growth model for estimating tumor growth in longitudinal image sequences,” in Proc MICCAI Brain Lesions Workshop (BrainLes). New York: Springer, 2015, LNCS.