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MRI Image Segmentation and Classification Using KFCM and Convolution Neural Networks

M.Tech. Scholar Nayan Pure, Asst. Prof. Ashish Tiwari
Department of Computer Science and Engineering,
Vindhya Institute of Technology and Science,
Indore,MP,India
nayanpure09@gmail.com, ashishtiwari205@gmail.com

***Abstract*- The unlimited and uncontrollable growth of cells can cause human brain tumors. Correct treatment and early diagnosis of brain tumors are essential to avoid permanent damage to the brain. In medical image diagnosis, tumor segmentation and classification schemes are used to identify tumor and non-tumor cells in the brain. The automatic classification is a challenging task which utilizes the traditional methods due to its more execution time and ineffective decision making. To overcome this problem, this research proposes an automatic tumour classification method named as Hybrid Kernel based Fuzzy C-Means clustering - Convolution Neural Network (Hybrid KFCM-CNN) method. The algorithm identifies the position of tumor in brain MRI as they are mostly preferred for tumor diagnosis in clinic. The proposed method also crops tumor region from segmented image and way growth of tumor and help in treatment planning. It also provides important information about location, dimension and shape of brain tumor region with no exposing the enduring to a high ionization radiation. The size of tumor is calculated in term of number of pixels. Similarly the primary brain tumor is considered into Benign and malignant type on MRI brain images, based on accuracy, sensitivity, specificity in MATLAB simulation.**

***Keywords*- KFCM, CNN, Feature Extraction, MRI Image, GLCM**

I. INTRODUCTION

Traditionally the segmentation of brain tumor MRI images is done manually by Radiologists. It is time consuming as well as can cause unavoidable mistakes. So proper segmentation of tumor region is required to identify tumor location, tumor size and its surrounding structure of brain for the Radiologist. This information is very essential for appropriate treatment. So, the correct evaluation of brain tumors by means of imaging modalities is one of the key subject of radiology departments Brain tumor can influence people at any age of a person and it is the main cause of cancer death worldwide. Brain tumor is embedded in a brain, which results in development of abnormalities. Due to the overlapped structure of cells in brain and poor quality of MRI due to noise, it's a challenging task for radiologist to diagnose. [1][2]

The identification of exact location of tumor in such kind of images is a challenging task to the Radiologist. Radiologist refers to these images to get detail information about tumor to analyze the disease. There are barrier to separate out tumor region due to Operator supervision and manual thresholding. The segmentation of brain tumor is difficult due to tumor and edema (swelling). Edema appears in white matter regions around tumor and it might hold infiltrative tumor cells. There is gradual change between tumor, edema, and surrounding brain tissue. This results in the uncertainty of the structural boundaries. So it is difficult to select a standard segmentation technique that gives acceptable results in representation dispensation. The intelligence, non-brain rudiments and tissues are main obstacles in segmentation of brain tumor images.

So the Radiologists in adding up to physician face problem during diagnosis. It is really a challenge for researcher to design an algorithm which gives accurate and detail in sequence for accurate analysis of tumor from MRI image. The accuracy of the segmentation and classification of brain CT images depends upon the accuracy with which the region of interests such as gray matter, white matter, cerebrospinal fluid and tumor region are segmented from the CT images.

Segmentation is a necessary image processing technique for easily distinguishing the abnormal tumor regions from normal regions. Most of the texture feature extraction methods are developed to quantify and detect the structural abnormalities in different tissues. The stability of the images shows the variations from one equipment to another and it is also subjective. The same algorithm cannot be run successfully for all the acquired images without human intervention. The selection of features and

human intervention at every slice made to excessive computation time. The selection of features to successfully and efficiently segment and it classify the tumors from all the slices of the axial view is important for the present research work. The proposed work discusses the stable and highly reliable texture feature extraction algorithms. The selected features are used for successful segmentation of tumor, and for accurate classification. [4]

The low soft tissue contrast obtained from scanning the brain CT images, it affects the edges and yields different objects within the same range of intensity. A robust texture feature extraction algorithms taking care of affecting the edges and yielding the different objects within the same range of intensity has been presented in this work. The texture feature extraction algorithms developed in this work performs better segmentation and classification accuracy based on CNN classifiers and makes the computation faster. The gradual evolutions of the algorithm are successful in segmenting the tumor without human intervention and accurately classify the benign and malignant tumors respectively. Benign tumors are self-contained, non-lethal, and grow more slowly than malignant ones.

Glioblastoma multiform is a malignant tumor and represents the most common brain neoplasm. Malignant tumors are cancerous growths which expand quickly and can metastasize, and even spread to other areas of the body. Benign brain tumor has a homogeneous structure and do not contain cancer cells. They can be either simply monitored by radio logically or surgically eradicated and they seldom grow back. Malignant brain tumors have a heterogeneous structure and contain cancer cells.

They can be treated by radiotherapy, chemotherapy or a combination of both. The exact cause of malignant brain tumor development is unknown. Men and women of any age, race or ethnicity can develop a malignant brain tumor. [5]

The clinical manifestation of the disease may be subtle, but early diagnosis is crucial to enable early drug intervention and improved prognosis. The progression of the disease can be degenerated by early treatment and hence it becomes very crucial to detect the on set of benign, malignant tumor early in the patient. The Gradual loss of movement, Double vision and hearing loss are very subtle and goes unnoticed in the early stages of the disease. The disease manifests attention only at a very later stage. This only makes the rationale of the work more significant, to determine the diagnosis of tumor, segment and classify the tumor in a very early stage. The detection of the tumor regions is a challenging task in tumour MRI image because of its low sensitive boundary pixels Non-awareness of patterns of KFCM is solved by extreme learning machine algorithm and artificial bee colony algorithm used for minimizing the membership subspace plane structure KFCM segmentation method is better for segmentation of tumour segmentation region However, the detection and diagnosis of tumour detection still needs more in classifying the tumours. Therefore this research proposes the automatic classification method for classify the brain tumour based on MRI medical image. Initially, the pixels present in the individual modality of the MRI image are applied to Hybrid KFCM to achieve best clustering. The proposed method uses a Hybrid KFCM algorithm to segment the clusters after that the Otsu's threshold value is applied to the segmented image for best clustering selection. After segmentation, the high) and low-level features (mean, standard deviation and variance) are extracted based on GLCM algorithm. The robust information of input, segmented and feature extraction images are given to CNN classifier for obtaining the tumour level of MRI images.

II. RELATED WORK

The researchers have suggested a number of segmentation and classification techniques for brain tumour detection in the medical field. A brief evaluation of a few significant segmentation and classification techniques are presented in this section

Divyamary.D [6] Brain tumor is the most dangerous disease and the detection of brain tumor is very essential to save one's life. The mortality rate of humans caused by the brain tumor was high before the early diagnosis of the brain tumor was identified. After the early diagnosis is found, the mortality rate is significantly decreased. Because of the exact identification of brain tumor at the starting stages, the chances of survival of a patient are increased. The classification accuracy rate is 60% more than existing ones. If the brain tumor is predicted, the position and size of the tumor can be identified and the tumor is removed from the brain. The aim of our project is to develop an efficient method to detect the brain tumor at the early stages. The various steps in the project are noise removal, morphological operation based on segmentation, feature extraction, Naive Bayes classifier initially the brain image is acquired from the patient. The acquired image is subjected to pre-processing and the feature extraction is carried out followed by classification. Therefore, we predict the brain tumor accurately by using Naive Bayes classifier method.

G.Hemanth [7] nowadays, brain tumor detection has turned up as a general causality in the realm of health care. Brain tumor can be denoted as a malformed mass of tissue wherein the cells multiply abruptly and ceaselessly, that is there is no control over the growth of the cells. The process of Image segmentation is adopted for extracting abnormal tumor region within the brain. In the MRI (magnetic resonance image), segmentation of brain tissue holds very significant in order to identify the presence of outlines concerning the brain tumor. There is abundance of

hidden information in stored in the Health care sector. With appropriate use of accurate data mining classification techniques, early prediction of any disease can be effectively performed. In the medical field, the techniques of ML (machine learning) and Data mining holds a significant stand. Majority of which is adopted effectively. The research examines list of risk factors that are being traced out in brain tumor surveillance systems. Also the method proposed assures to be highly efficient and precise for brain tumor detection, classification and segmentation. To achieve this precise automatic or semiautomatic methods are needed. The research proposes an automatic segmentation method that relies upon CNN (Convolution Neural Networks), determining small 3 x 3 kernels. By incorporating this single technique, segmentation and classification is accomplished. CNN (a ML technique) from NN (Neural Networks) wherein it has layer based for results classification.

Various levels involved in the proposed mechanisms are: 1. Data collection, 2. Pre-processing, 3. Average filtering, 4. segmentation, 5. feature extraction, 6. CNN via classification and identification.

By utilizing the DM (data mining) techniques, significant relations and patterns from the data can be extracted. The techniques of ML (machine learning) and Data mining are being effectively employed for brain tumor detection and prevention at an early stage.

T. M. Shahriar Sazzad [8] A tumor cell is a form of cell that develops out of control of the ordinary forces and standardizes growth. Brain tumor is one of the major reasons for human death every year. Around 50% of brain tumor diagnosed patient die with primary brain tumors each year in the United States. Electronic modalities are used to diagnose brain tumors. Among all electronic modalities, Magnetic Resonance Imaging (MRI) is one of the most used and popular for brain tumor diagnosis. In this research study, an automated approach has been proposed where MRI gray-scale images were incorporated for brain tumor detection.

This study proposed an automated approach that includes enhancement at the initial stage to minimize gray-scale color variations. Filter operation was used to remove unwanted noises as much as possible to assist better segmentation. As this study test grayscale images therefore; threshold based OTSU segmentation was used instead of color segmentation.

Finally, pathology experts provided feature information was used to identify the region of interests (brain tumor region). The experimental results showed that the proposed approach was able to perform better results compared to existing available approaches in terms of accuracy while maintaining the pathology experts' acceptable accuracy rate.

Dr Sujan [9] has proposed a new technology for morphological image analysis based on thresholds to identify brain tumors. Initially, the color image is converted to a grayscale image, and then the noise is removed from the grayscale image using a filtering method. The grayscale image was converted to a binary image and a threshold of 0.3 was added to the Otsu threshold to accurately segment the tumor part. Next, perform morphological operations to detect brain tumors made up of the brightest areas on magnetic resonance imaging (MRI). This method only achieved 84.72% accuracy in the process of detecting and segmenting brain tumors from 61 patients. Therefore, it may not be suitable for large data sets.

D. Ravi, H. [10] proposed a new dimensionality reduction scheme for tumor classification maps. The proposed method includes two steps, such as the use of t-distributed random neighbors for dimensionality reduction and the Texton Semantic Forest (STF) for classification. The main advantage of the proposed method is to minimize the risk of recurrence of the disease. The experimental results show that this method is superior to existing methods in terms of specificity and sensitivity. However, the proposed dimensionality minimization method is greatly affected by the number of samples in the training set. When the number of samples is small, the detection rate decreases.

A. Raju [11] proposed a Bayesian Fuzzy Clustering (BFC) technique based on brain tumors, and classified brain tumors using the HCS optimization algorithm based on the SVNN classifier. This classification method uses the characteristics of the segments generated by the BFC algorithm to determine the level of brain tumors. The precision of the proposed automatic classification method is 0.93 and the specificity is 0.99 and 0.93, respectively. Therefore, the proposed classification algorithm is used for efficient decision making by physicians. This work requires preprocessing methods to further improve the accuracy of land cover classification.

K. Usman [12] proposed a segmentation of brain tumors and a classification scheme by multimode MRI. Extract the intensity, local neighborhood, intensity variance and wavelet texture from the preprocessed image. Subsequ ently, the full characteristics are provided to the random forest classifier to predict five categories, such as background, necrosis, edema, unimproved tumor, and enhancement tumor. These category labels are used to stratify 3 different areas based on intact tumor, active tumor, and improved tumor. The proposed method obtained 88% dice overlap throughout the tumor area, 75% in the central tumor area and 95% in the enhanced tumor area. However, this method is less robust in large data sets.

In recent years, K-means clustering has been integrated into the FCM system, and this integrated hybrid clustering

method has been used for the automatic segmentation of brain tumors. This method considerably reduces the computation time of image segmentation by combining K-means clustering and FCM. In order to verify accuracy, we performed experiments on publicly available datasets: Brain (DS1), (DS2) and (DS3).

The proposed method has developed a new clustering system through the morphological pyramid of FCM. Multi-resolution MRI image segmentation. Initially, Wavelet Multi-Resolution (WMR) was used to manage the spatial context between pixels.

Then use the morphological pyramid to merge the resulting multi-resolution image with the original image to maximize sharpness and reduce noise in the processed image. In the last step, FCM is used for image segmentation. The main cause of incorrect segmentation occurs during the processing of noisy images by FCM. KFCM is used to troubleshoot FCM issues. In this study, hybrid KFCM was used to segment tumor regions using MRI images. This hybrid KFCM algorithm uses the heterogeneity of gray in the neighborhood to calculate local context information.

III. PROPOSED WORK

In this work the MRI image is segmented using hybrid KFCM algorithm for detecting mass tumour in the brain. This hybrid KFCM retains the more information of the original image to detect tumour cells accurately. The MRI images are processed and that allows the proposed Hybrid KFCM-CNN method for tumour detection .the main objective of the proposed automatic method is to maximize classification accuracy in brain tumour detection by using Hybrid KFCM-CNN method. The proposed Hybrid KFCM-CNN method has three steps segmentation, feature extraction, and classification.

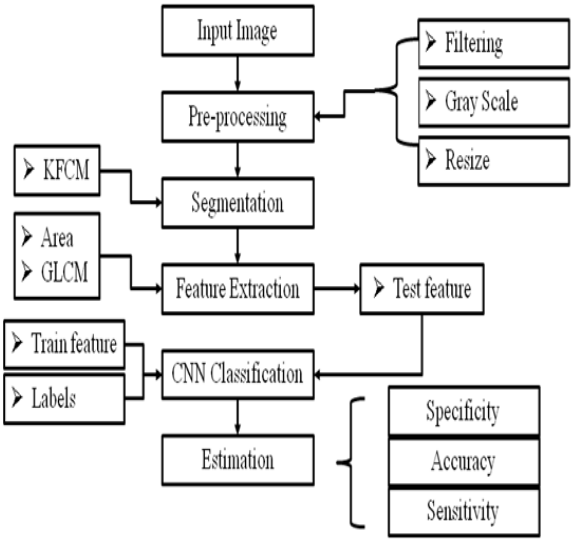

Fig 1. Proposed method Flow diagrams.

Implementation of preprocessing technique Brain MRI images are noisy, inconsistent and incomplete, thus preprocessing phase is needed to improve the image quality and make the segmentation results more accurate. Noise reduction is the process of removing noise from a dataset.

Segmentation KFCM clustering has been proven to provide an easy and convenient way to perform the segmentation. KFCM clustering produced useful result as the abnormal regions (tumor) are not merged with normal regions. So abnormal tumor regions can be easily distinguished from the normal regions.

KFCM clustering a process designed to assign each sample to a cluster based on cluster membership probability. The segmentation of the image into different regions can be defined as the assignment of pixels to different clusters at the same time but in different degrees. This is an important feature of medical diagnostic systems to increase the sensitivity.

Implementation of the classifiers Classification is the process where a given test sample is assigned a class on the basis of knowledge gained by the classifier during training. In this proposed method, an effort has been made to segment and classify the benign and malignant tumors on brain MRI images the CNN classifiers used for recognizing to segment and classify the tumors. Analyze and validate the result. In terms of the classification accuracy the texture feature extraction method GLCM has applied The result shows that Gray Level Co-occurrence feature extraction method has higher classification accuracy The classification performance of the proposed computer aided diagnostic system is compared between the classifiers such as CNN The result shows that the CNN classifier has better classification performance compared with the Other classifiers.

IV. RESULTS AND DISCUSSION

To validate the show of our algorithm,

1. Input Images:

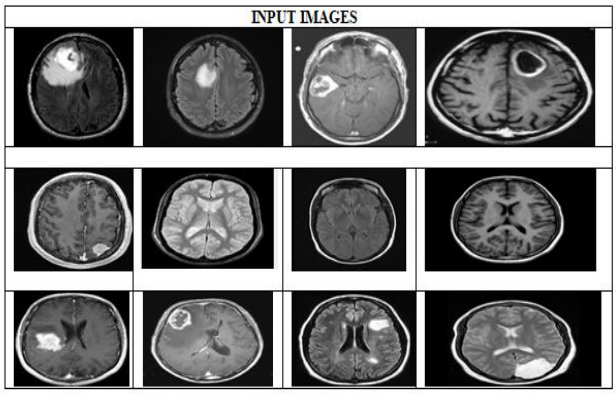

Fig 2. Input of brain MR Image.

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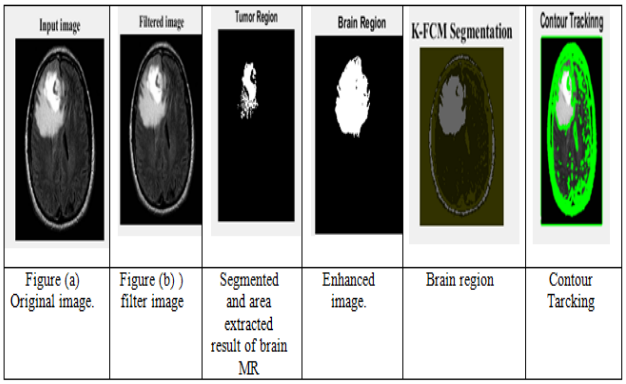

Fig 3. (a) original image (b) filter image (c) Segmented and area extracted result of brain MR(d) Enhanced image (e) Skull-stripped image.

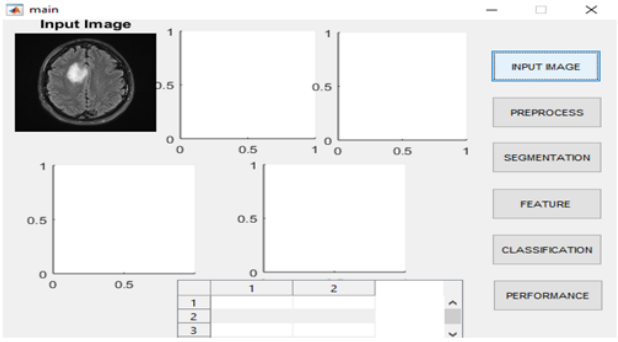

Fig 4. Input Image.

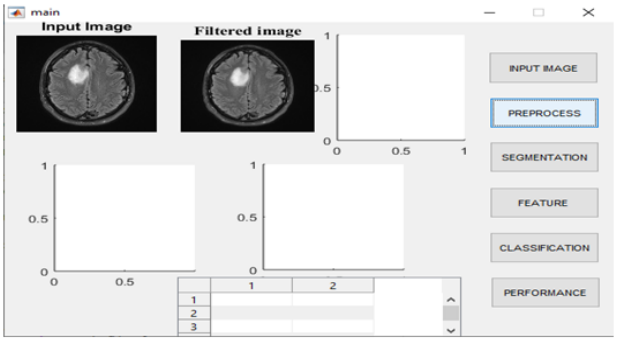

Fig 5. Filtered Image.

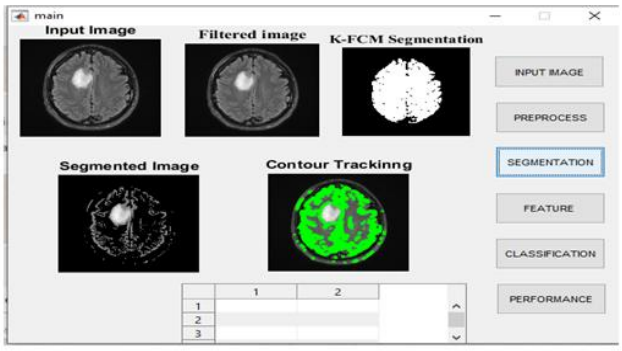

Fig 6. K-FCM Segmentation Image

Segmentation is a necessary image processing technique for easily distinguishing the abnormal tumor regions from normal regions. Most of the texture feature extraction methods are developed to quantify and detect the structural abnormalities in different tissues.

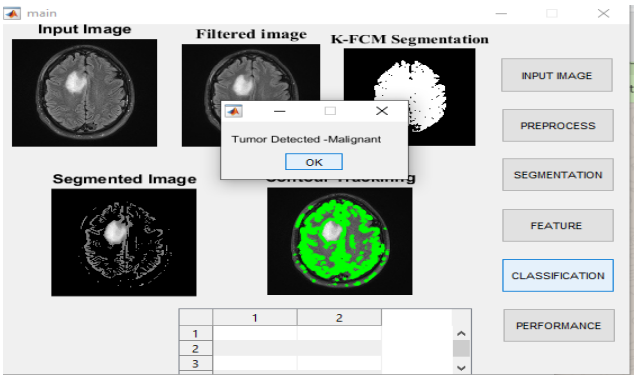

Fig 7. Tumor Classification.

The selected features are used for successful segmentation of tumor, and for accurate classification the texture feature extraction algorithms developed in this work performs better segmentation and classification accuracy based on CNN classifiers and makes the computation faster.

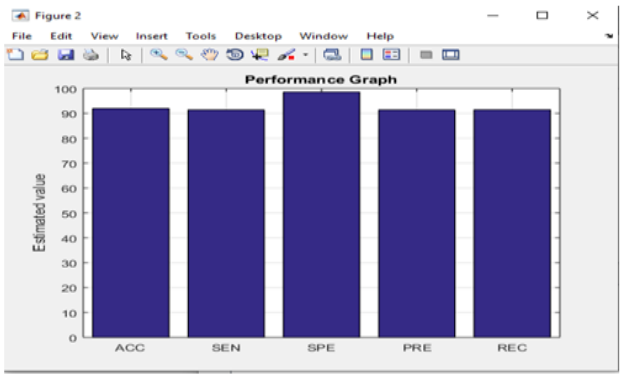

Fig 8. Performance Graph.

2. Performance Evaluation:

The proposed fingerprint representation will be analyzed based on the performance measures: In terms of segmentation accuracy and similarity metric of performance scores, the results will show that the segmentation using CNN classifier has higher classification accuracy compared with the other classification methods. The performance of the process is measured in terms of performance metrics like Accuracy, Sensitivity, Specificity and time consumption.

- **TP** - is the total number of correctly classified foreground (true positives).
- **TN** - is the total number of wrongly classified foreground (true negatives).
- **FN** - is the total number of false negatives, which accounts for the incorrect number of foreground pixels classified as background (false negatives).

- **FP** - is the total number of false positives, which means the pixels are incorrectly classified as foreground (false positives).

Table 1. Comparison on Different Techniques.

Reference	Segmentation	Technique	Accuracy
[1]	Automatic segmentation	SVM	90.0%
Proposed	KFCM	CNN Proposed	92.14%

V. CONCLUSION

Image segmentation and classification plays an important role in medical image. In this research, the abnormal tumors were detected using MRI images .this work is driven by the motive to provide our clinicians or a radiologist is an efficient and cost effective tool for segmenting and classifying the benign and malignant tumors. Brain tumor is any mass that results from abnormal growth of cells in the brain. It may affect any person almost in any age (age between 5 to 80).

Brain tumors can have a variety of shapes and sizes; it can appear at any location in different image intensities. Brain tumors can be benign or malignant. Low grade Gliomas and Malignant are benign tumors which represent the most common type of tumor Here, Hybrid KFCM was used for tumor segmentation. CNN was used for classification technique. By utilizing these techniques an efficient brain classification was constructed with maximum detection accuracy of 92.14 %. Simulation outputs.the KFCM-CNN hybrid is effective for classification at the tumor level.

Therefore, the proposed automatic segmentation and classification method is very suitable for the detection of brain tumors in the field of medical diagnosis. In future work, an efficient biological heuristic method can further improve performance, and more data sets can be used to analyze the performance of the proposed scheme.

REFERENCES

[1] J. Sachdeva, V. Kumar, I. Gupta, N. Khandelwal, and C. K. Ahuja, "Segmentation, feature extraction, and multiclass brain tumor classification," Journal of Digital Imaging, vol. 26, no. 6, pp. 1141-1150, 2013.

[2] D. Haritha, "Comparative study on brain tumourdetection techniques", In: Proc. of International Conference on Signal Processing, Communication, Power and Embedded System, pp. 1387-1392, 2016.

[3] V. Viswa Priya and Shobarani, "An Efficient Segmentation Approach for Brain Tumor Detection in MRI", Indian Journal of Science and Technology, Vol.9, No.19, 2016.

[4] P.B. Kanade1 and P.P. Gumast, "Brain Tumor Detection Using MRI Images", International Journal of Innovative Research In Electrical, Electronics, Instrumentation and Control Engineering, Vol.3, No.2, 2015.

[5] A. Ari and D. Hanbay, "Deep learning based brain tumour classification and detection system", Turkish Journal of Electrical Engineering & Computer Sciences, Vol.26, No.5, pp.2275-2286, 2018.

[6] Divyamary.D Gopika.S Pradeeba.S Brain Tumor Detection from MRI Images using Naive Classifier Brain Tumor Detection from MRI Images using Naive Classifier 978-1-7281-5197-7/20/$31.00 ©2020 IEEE PP-620-622

[7] G.Hemanth , M.Janardhan ,L.Sujihelen Design And Implementing Brain Tumor Detection Using Machine Learning Approach Proceedings of the Third International Conference on Trends in Electronics and Informatics (ICOEI 2019) IEEE Xplore Part Number: CFP19J32-ART; ISBN: 978-1-5386-9439-8 PP 1289-1294

[8] T. M. Shahriar Sazzad Dept K. M. Tanzibul Ahmmed Misbah Ul Hoque Mahmuda Rahman Development of Automated Brain Tumor Identification Using MRI Images 2019 International Conference on Electrical, Computer and Communication Engineering (ECCE), 7-9 February, 2019 978-1-5386-9111-3/19/$31.00 ©2019 IEEE pp

[9] Md. Sujan, N. Alam, S.A. Noman, and M. Jahirul Islam, "A Segmentation based Automated System for Brain Tumor Detection", International Journal of Computer Applications, Vol.153, No.10, pp. 41-49, 2016.

[10] D. Ravi, H. Fabelo, G. M. Callico, and G. Yang, "Manifold Embedding and Semantic Segmentation for Intraoperative Guidance with Hyperspectral Brain Imaging", IEEE Transactions on Medical Imaging, Vol.36, No.9, pp.1845-1857, 2017.

[11] A. Raju, P. Ratna, Suresh, and R. Rajeswara Rao, "Bayesian HCS-based multi-SVNN: A classification approach for brain tumour segmentation and classification using Bayesian fuzzy clustering", Biocybernetics and Biomedical Engineering, Vol.38, No.3, pp.646- 660, 2018.

[12] K. Usman and K. Rajpoot, "Brain tumour classification from multi-modality MRI using wavelets and machine learning", Pattern Analysis and Applications, Vol.20, No.3, pp.871-881, 2017.IEEE