International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET

# An Investigation of Various Medical Image Segmentation Techniques

**S. Raghu[1], Prof. T. Adi Lakshmi[2]**
[1]Research Scholar, Department of CSE, Osmania University, Hyderabad, Telangana, India
[2]Professor and Head, Department of CSE, Vasavi College of Engineering, Hyderabad, Telangana, India

**Article Info**
Volume 9, Issue 1
Page Number : 292-301

**Publication Issue :**
January-February-2022

**Article History**
Accepted : 20 Feb 2022
Published: 28 Feb 2022

**ABSTRACT**
Medical pictures have found wide uses in healthcare in recent years for diagnosing disease, therapy planning, and monitoring disease development, which include the collection of images of the afflicted organ utilizing various modalities. Picture segmentation is the technique of dividing an image into numerous segments, which is utilized in a variety of medical imaging applications. Aside from other organs, precise segmentation of MRI brain pictures aids physicians in the effective and early identification and detection of brain tumors. The abnormal development of cells within the brain structure is known as a brain tumor, also known as an intracranial neoplasm. This article attempts to examine several segmentation methods and determine the best appropriate approach to segment MRI brain pictures impacted by malignant tumors and assess the tumor's growth pattern, representing it as a binary image output to aid the physician in early diagnosis.
**Keywords :** Image Preprocessing, Feature Extraction Image Segmentation, Image Classification, MRI images, Tumors.

## I. INTRODUCTION

A brain tumor [1] is an abnormal development of cells in the skull that originates from brain, blood vessel, and nerve cells. Brain tumors can arise at any age, and the specific etiology of brain tumors is still being researched thoroughly. The general cause of malignant tumor development, particularly in brain cells, is ionizing radiation exposure and some hereditary variables. The symptoms of this terrible disease vary according to the size of the tumor cells, the grade or kind of tumor, and their location. Headache, numbness, convulsions, nausea, and other symptoms are frequent. The brain is a vital element of the human body that consists of many components such as Grey Matter (GM), White Matter (WM), Cerebrospinal Fluid (CSF), and backdrop. In general, the cells in the human body have the ability to multiply; as a result of this ability, the overall functions of the brain are governed. When the cell multiplicity becomes out of control, the growing cells become aberrant and are referred to as a brain tumor. In which the cells proliferate and replicate uncontrolled while controlling the regular cells. Then it is divided into the following groups.
A benign tumor [2] is one that does not develop rapidly and does not harm the healthy tissues around it. Malignant is a highly serious stage that worsens over time and culminates in a person's death. MRI is

frequently utilized in brain tumor identification despite the fact that there are other imaging modalities for acquiring anatomical features of brain pictures, including Computed Tomography (CT), Positron Emission Tomography (PET), and Magnetic Resonance Imaging (MRI). This is due to the fact that the MR imaging approach is based on an imaging principle that is dependent on the spatial intensity resolution.

MRI is a well-known medical imaging technique for detecting and seeing features in the interior structure of the brain. Furthermore, it contains extensive information regarding brain architecture, vascular supply, and cellular structure. As a result, it is a critical tool for successful tumor surveillance, diagnosis, and therapy [3]. It is a non-invasive medical diagnostic that produces a comprehensive image of organs, soft tissues, and bone by using a strong magnetic field, radio frequency pulses, and a computer. It does not utilize ionizing radiation and allows doctors to assess different regions of the body to identify the presence of a tumor. It is also used to detect issues including bleeding, damage, and blood vessel infection. In the realm of medical imaging, segmenting tumor parts in MRI has been an intriguing and developing study topic.

Medical pictures are commonly utilized in healthcare for illness diagnosis and therapeutic planning. Images of the afflicted organs are captured and compared with an image atlas in any medical imaging program to evaluate and gather the necessary data for clinical analysis [4]. Images of the afflicted organs may be taken at multiple time intervals or with different sensors and compared to one another to determine the amount of pathogenesis. This study will also help with the integration of constructive data from clinical analysis and therapy. The computerized methods in imaging techniques of visualization minimize the complexity in the alignment and analysis of these pictures, but the complexity comes in the process of segmenting and registering the needed content of the image data.

Image segmentation is the process of separating a given image into areas that are homogeneous in terms of particular characteristics and, ideally, correspond to genuine objects in the actual scene. The segmentation process is arguably the most essential stage in image analysis since its success has a direct impact on the performance of the succeeding image processing processes. Despite its relevance, segmentation remains an unresolved issue in general since there is no general mathematical theory. The two fundamental challenges of the segmentation problem are the limited nature of the segmentation procedure and the absence of definition of the "correct" segmentation. As a result, determining the validity and consistency of a segmentation result from a particular scene becomes possible only in specialized tasks, such as knowledge-based and ground truth [5].

Brain picture segmentation from MRI images is hard and difficult, yet it is required for tumor identification and classification, edema, hemorrhage detection, and necrotic tissues. MRI imaging is the most effective imaging tool for detecting abnormalities in brain regions early. MRI image acquisition settings, unlike computed Tomography (CT), may be modified to generate high contrast images with varying gray levels for diverse instances of neuropathology.

## II. Literature Survey

### 2.1 Pre-Processing of MRI Images

Pre-processing is the basic and most essential image processing technology that assists medical image analysis in effectively diagnosing disease or planning therapy. The MR brain pictures are acquired with different degrading variables such as Gaussian noise, speckle noise, and non-uniform intensity distribution. The thorough study of known pre-processing approaches from the literature that aids in the development of the innovative segmentation methodology is provided below.

The quality of MR images may be improved by pre-processing them with a variety of filtering techniques such as the average filter, median filter, and wiener filter [7] . Following noise reduction and picture enhancement, the procedure of segmentation and brain tumor identification was undertaken. The k-means clustering approach is used to segment the MR brain picture and locate tumor cells [8]. A hybrid clustering approach is tested by merging the k means and fuzzy c means algorithms, which demonstrated superior efficiency in tumor segmentation (Abdel et al. 2015). This approach involves several phases of image processing, beginning with filtering and progressing through clustering, feature extraction, contouring, and eventually segmenting. In this study, the median filter is used to reduce noise and enhance picture quality, as well as to remove the skull in order to use hybrid segmentation with less iterations and execution time. However, due to the difficulties in removing the backdrop and contouring further, this approach reported with less accuracy.

The use of deep learning algorithms to pre-process MR brain to segment gliomas was also considered as a first procedure for effective outcomes. This task entails converting all of the pictures to the same size, subtracting the mean value of the entire image from the intensity value of each pixel, and then normalizing the intensity using histogram normalization [9]. The pre-processing is improved by transforming the RGB or greyscale picture to binary images and then setting a suitable threshold to assess the change in the intensity scale throughout the image [10].

## 2.2 Feature extraction methods for MRI images

Only by selecting and extracting the characteristics that must be segmented will image segmentation be more efficient and precise. This decreases the complexity, and therefore the segmentation computational time. The following is a comprehensive overview of feature selection and extraction approaches. The 3D voxels were generated from the input MRI brain picture using a simple linear iterative clustering approach built from the information theory discriminative segmentation method [11]. However, it was shown that this technique needs the least amount of time since feature extraction assisted in getting valuable information prior to performing segmentation [12]. In order to detect tumors, a new technique integrating wrapper methods and embedding methods was used in feature selection of brain MR images [13]. The support vector machine was utilized in this direct iterative method to prioritize the collected features based on the statistical analysis's supplied weights. Using Gabor wavelet and statistical feature extraction techniques, a completely automated segmentation approach was created [14]. The goal of this study was to decrease the complexities and problems of computing in a totally automated way. However, in tumor analysis, this approach solely employed single spectrum MR brain pictures. A multifractal feature-based method was used to segment MR brain images for tumor detection. The adaboost ensemble classifier was employed in this approach to identify the tumor affected and non-tumor affected areas of the MR image. This method resulted in lower accuracy in complicated tumor areas. The Grey level Co-occurrence matrix, which is based on a statistical analysis approach that analyzes the relationship among the pixels in any input MR brain picture, may also be used for feature extraction [15]. The extraction of features from MR brain pictures is extremely useful in neuroscience and neuroimaging. When features are extracted effectively, the accuracy of diagnosis or therapy planning improves. Principal component analysis-based extraction is one such method for increasing the accuracy of MR brain image feature extraction by classifying the axial slices as normal or abnormal tumour affected images [16].

## 2.3 Segmentation of MRI images

The extraction and categorization of the areas as normal and abnormal is the primary issue in brain tumor detection. The segmentation accuracy was improved by experimenting with region selection and edge detection based brain tumor categorization. For greyscale pictures, enhanced fuzzy filtering-based noise reduction is performed [17]. In MR brain image segmentation, an unsupervised segmentation technique based on extended fuzzy C means segmentation was also tried. The adoption of a nonlocal framework proved helpful in overcoming the intensity in homogeneity and artifacts in brain tissue imaging. A patch driven level set using sparse representation approaches is used in the segmentation of a newborn MR brain picture, resulting in enhanced accuracy in segmenting grey and white matter. To attain spatial regularity and overcome the difficulties of image capture noise, automated segmentation of lesions from MR images was also attempted. Brain tumor cells were retrieved using an artificial bee colony method that was based on fuzzy C means, fuzzy K means, and a genetic algorithm.

The FCM technique is used to execute an automated approach to brain image segmentation, with the goal of enhancing resilience and accuracy [18]. However, it was unable to overcome the difficulties of high computational complexity, making it unsuitable for flawless brain picture segmentation. To address problems such as significant fluctuations in the edges of tumor cells as well as ambiguous borders, a new technique based on local independent projection dependent classification was explored. Another thresholding-based segmentation technique, known as real coded genetic algorithm with simulated binary cross over multilayer thresholding, claimed great efficiency and accuracy. Multiple transfer classifiers outperformed current supervised classifier-based methods in terms of classification errors.

The non parametric model distribution approach is used to identify normal areas, whereas the graph cut distribution method is utilized to find tumors [19]. This strategy assisted in assessing the global similarity of distributions in a limited region by experimenting with and evaluating the performance of the MICCAI data set. However, the main disadvantage of this approach is that higher image quality is required to minimize artifacts. The Fuzzy C Means (FCM) segmentation approach was utilized to detect and categorize tumor stages from MR brain images. FCM methods were shown to be superior to neural network-based classification, which required significant monitoring and training in order to detect tumor cells. FCM technique-based segmentation of brain tumor cells was shown to be more efficient than neural network-based segmentation approaches.

Mesh to volume based segmentation was tested in the segmentation of brain tumor cells with enhanced accuracy, high robustness, and high sensitivity in distinguishing the morphologies of healthy and afflicted cells [20]. However, this approach was believed to be more complicated. The Non-Negative Matrix Factorization (NMF) approach is also used to identify brain tumors using image segmentation by imparting histogram equalization, median and high pass filtering, and threshold based segmentation, morphological procedures, and image subtraction. For identifying brain tumors, a novel graph cut distribution matching approach based segmentation was explored. A non parametric model is used to characterize the normal pixel from the input data, in addition to removing the isolated parts of the picture and assessing the global similarity metric between the distribution functions. For clustering the super voxels in the brain, an Information Theoretic Discriminative Segmentation (ITDS) approach was used [11], in which the informative characteristics were picked concurrently and the uncertainties of super voxel assignment were removed. A novel robust mixture model for outlier identification is presented to improve robustness by choosing outliers based on each component's confidence level. It was also demonstrated that transfer learning-based segmentation approaches enhanced the overall efficiency of supervised brain image segmentation algorithms. To separate tumor cells from an MR brain picture, the Self-Organizing Map (SOM) was used in conjunction with the fuzzy k-means method [21]. Because SOM lowers the dimensionality of the collected features and groups them appropriately, this was able to produce correct segmentation results. However, this model was unable to evaluate vast amounts of data. The histogram equalization technique and the discrete wavelet transform are used to improve the image's quality. Particle swarm optimization (PSO) was used to choose the best solutions, while SVM was used for segmentation. The method's main weakness is that it failed to analyze multiple performance metrics for huge volumes of data. A new vector quantization-based segmentation technique can detect brain tumor cells [22]. It is a classic quantization approach in which the probability density functions are represented by the protype vectors distribution. This may also be used to compress a huge volume of data by splitting it into a large collection of points.

**Table 1 Summary of literature review**

| Segmentation techniques from literature | Merits | Limitations |
|---|---|---|
| Threshold technique | The most Simplest method | Introduction of noise, blurred edges or outliers due to non involvement of the spatial information. |
| Hierarchical clustering | Simple method that produces an output that has a characteristic correlation with original image. | Large computational time is required and not suitable for large images. |
| Partitional clustering (K-means algorithm) | Simple, Fast speed with fixed number of clusters. | To identify the number of clusters, different results due to different initial centroids, unable to display the characteristic of the database. |

| Segmentation techniques from literature | Merits | Limitations |
|---|---|---|
| Region growing | Increased accuracy for the images with clear edges, simple, excellent shape matching, easy in finding the seed points, multiple criteria can be chosen simultaneously. | High computational time and unable to differentiate fine variation of the images. |
| Region merging and splitting | Capable of splitting the image until required accuracy level is achieved with different criteria adopted for splitting and merging. | Blocky segmentation with high computational time. |
| Mean shift | Can separate the face and shoulders easily. | High computational time and cannot be applied other than face and shoulders |
| ▵ Watershed | Fast computational time with high reliability | Over-segmentation. |

## III. Literature Review Findings

The comprehensive literature review provided an accurate overview of the existing segmentation techniques and their limitations. Furthermore, knowing the picture better is more essential than selecting the best segmentation method since pre-processing resolves many difficulties related to segmentation accuracy. The intensity of each pixel may fluctuate depending on the noise level influencing each pixel, increasing the difficulty in precisely recognizing the position of the tumor cells. The inhomogeneous intensities in the MR brain picture are caused by the high degree of impulse noise and the biasing field of the image collecting equipment.

One of the primary challenges of present segmentation approaches is their reliance on picture intensity uniformity, which has a direct impact on segmentation accuracy (Ahmed et al. 2016). The following interpretations were found in the included literature survey on several available brain image segmentation methods.

1. Unsuitability for varying or multimodalities in MR brain images.
2. Less efficient for complex tumour stages including Stage III and IV
3. Increased complexity of computation

Given the limitations of existing MR brain image segmentation, a novel segmentation process that overcomes the shortcomings of all existing techniques is required. Furthermore, a review of the literature found that no standard algorithm has been created to cater to the various levels of tumor growth based on the harmful implications. This study intends to create a series of algorithms that will only be used for medullablastoma and astrocytoma, the two most common kinds of tumors that arise in the cerebellum and cerebrum, respectively.

## IV. Future Research Directions

The inhomogeneous intensity noise in MR brain pictures always influences the pixel intensity. This, in turn, has an impact on the exact spotting of tumor cells, resulting in incorrect segmentation findings. According to the literature, present segmentation algorithms are typically dependent on the uniformity of the image intensities and hence fail to provide reliable segmentation findings in MR brain pictures, commonly leading to erroneous localization of tumor cells. There is a need to create algorithms for sequential segmentation of MRI brain images in order to overcome the obstacles in identifying brain tumors.

The goal of this study is to create an appropriate segmentation method for segmenting MR brain images impacted by tumors with enhanced segmentation accuracy. The created algorithms have the ability to achieve optimal solutions for developing a solution approach for segmenting real-time MR brain pictures impacted by medulablastoma. The performance analysis is based on the many factors in the segmentation issue.

Combining the benefits of threshold-based and region-based segmentation approaches to aid in the efficient segmentation of MR brain images impacted by medullablastoma.

To demonstrate, that there is a possibility of combinational method of particle swarm optimization and fuzzy K means to eliminate the redundant information in real time MR brain images affected with medullablastoma.

To increase and improve segmentation accuracy, the skull structure was removed and the MR brain images were registered before segmentation to detect astrocytoma using a texture-based pixel connection approach.

To address the improvement of segmentation accuracy and reduction in segmentation complexity, parameters such as variance, mean square error, true positive, true negative, false positive, false negative, sensitivity, specificity, and accuracy are simulated and compared with other existing segmentation algorithms that suit real-time MR brain images affected by cancer.

## V. CONCLUSION

Image processing is used to increase image quality for better human comprehension. MRI pictures are the greatest tool for detecting aberrant tissue development in the brain, whereas CT scans are excellent for bone issues. Soft tissue abnormalities will be best shown by an MRI scan. The image's quality is degraded due to noise. There is a chance that the physician will incorrectly identify an MRI picture due to noise. Image segmentation attempts to divide the input image into smaller images for further processing. Combining segmentation with threshold-based particle swarm optimization with fuzzy k means improves segmentation accuracy. Thresholding is a traditional method of segmentation based on intensity levels that does not work well with multichannel images. This article attempts to examine several segmentation methods and determine the best appropriate approach to segment MRI brain pictures impacted by malignant tumors and assess the tumor's growth pattern, representing it as a binary image output to aid the physician in early diagnosis. A critical examination of the existing approach is given. This will aid in the development of a more efficient hybrid technique for MRI picture segmentation.

## VI. REFERENCES

[1] Ku A. Goswami and M. Dixit, "An Analysis of Image Segmentation Methods for Brain Tumour Detection on MRI Images," 2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT), 2020, pp. 318-322, doi: 10.1109/CSNT48778.2020.9115791.

[2] N. Feng, X. Geng and L. Qin, "Study on MRI Medical Image Segmentation Technology Based on CNN-CRF Model," in IEEE Access, vol. 8, pp. 60505-60514, 2020, doi: 10.1109/ACCESS.2020.2982197.

[3] A. Hussain and A. Khunteta, "Semantic Segmentation of Brain Tumor from MRI Images and SVM Classification using GLCM Features," 2020 Second

International Conference on Inventive Research in Computing Applications (ICIRCA), 2020, pp. 38-43, doi: 10.1109/ICIRCA48905.2020.9183385.

[4] M. Ali, S. O. Gilani, A. Waris, K. Zafar and M. Jamil, "Brain Tumour Image Segmentation Using Deep Networks," in IEEE Access, vol. 8, pp. 153589-153598, 2020, doi: 10.1109/ACCESS.2020.3018160.

[5] Z. Jia and D. Chen, "Brain Tumor Identification and Classification of MRI images using deep learning techniques," in IEEE Access, doi: 10.1109/ACCESS.2020.3016319.

[6] Rajeshwari, S & Sharmila, TS 2013, "Efficient quality analysis of MRI image using preprocessing techniques," in IEEE Conference on Information & Communication Technologies, vol. 3, pp. 391-396.

[7] Malathi, R 2015, "Brain Tumour Detection and Identification Using K-Means Clustering Technique," in Proceedings of the UGC Sponsored National Conference on Advanced Networking and Applications, pp. 354.

[8] Abdel E Maksoud, Mohammed Elmogy Rashid & Awadi, A 2015, "Brain tumour segmentation based on a hybrid clustering technique," Egyptian Informatics Journal, vol. 16, pp. 71-81.

[9] Poornachandra, S & Naveena, C 2017, "Pre-processing of MR Images for Efficient Quantitative Image Analysis using Deep Learning Techniques", IEEE- International Conference on Recent Advances in Electronics and Communication Technology, 978-1-5090-6701-5/17 IEEE DOI 10.1109/ICRAECT.2017.43

[10] Priya Verma, Nitin Naiyar, Shrikant, B & Burje, 2017, "Detection of Brain Tumor in MR Images using Multi-objective Particle Swarm Optimization with Support Vector Machine Classifier with RBF kernel", International Research Journal of Engineering and Technology (IRJET), vol. 4, no. 5, pp. 1346-1352.

[11] Kong, Y, Deng, Y & Dai, Q 2015, 'Discriminative clustering and feature selection for brain MRI segmentation', IEEE Signal Process Letter, vol. 22, no. 5, pp. 573-577.

[12] Hancer, E, Ozturk, C & Karaboga, D 2013 "Extraction of brain tumors from MRI images with artificial bee colony based segmentation methodology", 8th International Conference Electrical Electronics Engineer (ELECO) IEEE, vol. 24, no. 4, pp. 235-28.

[13] Bron, EE, Marion, S, Niessen, WJ & Stefan, K 2015, 'Feature selection based on the SVM weight vector for classification of dementia', IEEE Journal of Biomedical and Health Informatics, vol. 19, pp. 1617-1626.

[14] Nabizadeh, N & Kubat, M 2015, "Brain tumours detection and segmentation in MR images: Gabor wavelet vs. statistical features," Computers & Electrical Engineering, vol. 45, pp. 286-301.

[15] Amulya, ER, Soumya Varma & Vince Paul 2017, "Classification of Brain MR Images using Texture Feature Extraction", International Journal of Computer Science and Engineering Communications, vol. 5, no. 5, pp. 1722-1729.

[16] Gupta, Tanvi Gandhi, Tapan K & Panigrahi, BK 2017, "Multi-sequential MR brain image classification for tumour detection", Recent advancements in computer, communication and computational sciences, Journal of Intelligent & Fuzzy Systems, vol. 32, no. 5, pp. 3575-3583.

[17] Manglem Singh, 2011, "Fuzzy Rule based Median Filter for Gray-scale Images", Journal of Information Hiding and Multimedia Signal Processing, vol. 2, no. 2, pp. 108-122.

[18] Preetha, R & Suresh, GR 2014 "Performance Analysis of Fuzzy C Means Algorithm in Automated Detection of Brain Tumour," in World Congress on Computing and Communication Technologies, pp. 30-33.

[19] Njeh, I, Lamia Sallemi, Ismail, BenAyed, Stephane Lehericy, Damien Galanaud Ahmed & BenHamida 2015, "3D multimodal MRI brain glioma tumour and edema segmentation: a graph cut distribution matching approach," Computerized Medical Imaging and Graphics, vol. 40, pp. 108-119.

[20] Kim, J, Valdes, Hernandez Mdel, C, Royle, NA & Park, J 2015, "Hippocampal shape modeling based on a progressive template surface deformation and its verification," IEEE transactions on medical imaging, vol. 34, pp. 1242-1261

[21] Vishnuvarthanan, G, Pallikonda Rajasekaran, M, Subbaraj, P & Anitha Vishnuvarthanan, 2016, "An unsupervised learning method with a clustering

approach for tumour identification and tissue segmentation in magnetic resonance brain images," Applied Soft Computing, vol. 38, pp. 190-212.

[22] Sayan Nag , 2017, " Vector Quantization using the Improved Differential Evolution Algorithm for Image Compression", Computer Vision and Pattern Recognition, DOI. 10.17605/OSF.IO/M9RNZ

[23] J.Nageswara Rao ,Veeraiah D , Dr Joel Sunny Deol G , Dr. Rajendra Kumar Ganiya, SA , Suneetha Bulla , Assefa Alene, Energetic And Valuable Path Compendium Routing Using Frustration Free Communication Dimension Extension Algorithm In Manet, Wireless Communications and Mobile Computing, Science Citation Index Expanded (SCIE)-accepted-2022

[24] J. Nageswara Rao ,Ranga Swamy Sirisati, C. Srinivasa Kumar, A. Gautami Latha, Kanusu Srinivasa Rao ,B. J. D. Kalyani , A framework for effective utilization of cloud resource and optimal scheduling strategy with complex cloud resource using whale genetic optimization, Soft Computing https://doi.org/10.1007/s00500-021-06642-z,Science Citation Index Expanded (SCIE)-accepted-2022.

[25] J.Nageswara Rao, Rajendra Kumar G, Veeraiah Duggineni, Suneetha Bulla, , J. Sunny Deol . G,Efficiency Evaluation of HRF mechanism on EDoS attacks in Cloud Computing Services, International Journal of Ad Hoc and Ubiquitous Computing, DOI: 10.1504/IJAHUC.2022.10041784, Science Citation Index Expanded (SCIE),2022.

[26] J.Nageswara Rao, Babu Rao Markapudi, Kavitha Chaduvula,Indira DNVSLS3 , Joel Sunny Deol Gosu, An improved deep convolutional neural network for classification of breast cancer images using artificial fish school algorithm, Soft Computing, DOI: 10.1007/s00500-021-06684-3, Science Citation Index Expanded (SCIE)-accepted-2022.

[27] J. Nageswara Rao, P. Satyanarayana, T. Mahalakshmi, P. Rama Koteswara Rao, AdlinSheeba, JampaniRaviand, "Enhancement of Energy Efficiency and Network Lifetime Using Modified MPCT Algorithm in Wireless Sensor Networks", Journal of Interconnection Networks (2022)

[28] J Nageswara Rao, S Sai Kumar, AnumalaReethika Reddy, B Sivarama Krishna, Ajmeera Kiran, "Privacy Preserving with Modified Grey Wolf Optimization Over Big Data Using Optimal K Anonymization Approach", Journal of Interconnection Networks, Pages 2141039 (2022)

[29] J.Nageswara Rao, BhupalNaik, G Sai Lakshmi, V Ramakrishna Sajja, D Venkatesulu,"Driver's Seat Belt Detection Using CNN", Turkish Journal of Computer and Mathematics Education,Vol.12 No.5 (2021), 776-785

[30] J Nageswara Rao, Dr R Satya Prasad, "An Enhanced Novel Dynamic Data Processing (ENDDP) Algorithm for Predicting Heart Disease in Machine Learning", International Journal of Scientific Research in Computer ScienceEngineering, and Information Technology (IJSRCSEIT), ISSN, Pages 2456-3307 (2021)

[31] J Nageswara Rao, Dr R Satya Prasad, "An Ensemble Deep Dynamic Algorithm (EDDA) to Predict the Heart Disease", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN, Pages 2394-4099 (2021)

[32] J Nageswara Rao,Dr KattaSubba Rao, ChMadhuBabu, GovinduSurla,"SOFTWARE DEFECT PREDICTION TO IMPROVE SOFTWARE QUALITY USING MACHINE LEARNING APPROACH", Turkish Journal of Physiotherapy and Rehabilitation, Volume- 32, Issue- 3, Pages 6916-6922 (2021)

[33] J Nageswara Rao,Avantika Tiwari, SundeepSaradhiKanthety, DNVSLS Indira, "AN ENHANCED USAGE PATTERN HYBRID METHOD FOR MINING HUI SETS FROM LARGE DATASETS", Turkish Journal of Physiotherapy and Rehabilitation, Volume- 32, Issue-3, Pages 6505-6509 (2021)

[34] J Nageswara Rao,ChintalapudiSowndaryaLahari, B Sivarama Krishna,PERSONALIZED MEDICINE PREDICTION USING DEEP LEARNING APPROACH", Turkish Journal of Physiotherapy and Rehabilitation, Volume- 32, Issue-3, Pages 6492-6496 (2021)

[35] J Nageswara Rao,AnumalaReethika Reddy, NV Naik, "AN IMPROVED K-MEANS ADAPTIVE

CLUSTERING METHOD ON LARGE DATASETS", Turkish Journal of Physiotherapy and Rehabilitation, Volume- 32, Issue-3, Pages 6497-6504 (2021)

[36]J Nageswara Rao, "CARDIOVASCULAR DISEASE PREDICTION USING MACHINE LEARNING TECHNIQUES", Turkish Journal of Physiotherapy and Rehabilitation, Volume- 32, Issue-3, Pages 6875-6880 (2021)

[37]J. Nageswara Rao, Dr.RambabuBusi, Dr. G Rajendra Kumar, U. Surya Kameswari, Contentimage Retrieval Based on using open Computer Vision and Deep Learning Techniques", International Journal of Advanced Science and Technology,Volume29Issue03Pages5926 - 593 9, (2020)

[38]J. Nageswara Rao, and D. Veeraiah "An Efficient Data Duplication System based on Hadoop Distributed File System", 2020 International Conference on Inventive Computation Technologies (ICICT), 2020, pp. 197-200, doi:10.1109/ICICT48043.2020.9112567, Scopus/Web of Science.

[39]J. Nageswara Rao,RadhaMothukuriSuneetha Bulla, "Analysis of Unsupervised Dicretization Methods Impact on C4.5 Classification", International Journal of Advance d Science and Technology, Volume-29, Issue-5, Pages 802 – 815 (2020)

[40]J. Nageswara Rao, B. ShyamalaBhanu Prakash Doppala, M. Gargi, A. Nalini, "Prognosis of Cardiovascular Disease Using Machine Learning Algorithms", International Journal of Future Generation Communication and Networking, Volume- 13, Isssue-3, Pages 709 – 716 (2020)

[41]J. Nageswara Rao,KalamSwathi, M. Gargi, KhadriLalitha Vani Sri, B. Shyamala, "Human Activities Recognition Using OpenCV and Deep Learning Techniques", International Journal of Future Generation Communication and Networking, Volume-13, Issue- No. 3, Pages 717 – 724 (2020)

[42]J. Nageswara Rao, D. Veeraiah, "A Review on Coronavirus (COVID-19) Impact on the Public", International Journal of Future Generation Communication and Networking, Volume-13, Issue-3, Pages 314 – 318 (2020)

[43]J Nageswara Rao, Y DurgaMalleswari, K Teja Krishna, CH Vishnu Sai, Y Ramya Sri, "Twitter Sentiment Analysis for Different Business Applications", Journal of Advanced Research in Dynamical and Control Systems,Vol. 12, Issue-02, (2020)

[44]J.Nageswara Rao, H.SudhakarRambabuBusi, G Rajendra Kumar, "A New Analysis on Assessment of Sentiments Using EEG Signals and BCI", Journal of Advanced Research in Dynamical and Control Systems, Volume-12, Issue 2, Pages 1044-1047 (2020)

[45]J Nageswara Rao, BSivarama Krishna, Bhanu Prakash Doppala, S Phani Praveen, G Joel Sunny Deol, B Shyamala, "Advanced Adaptive Pattern Approach to Mine High Utility Item Sets from Large Transaction Databases", International Journal of Advanced Science and Technology,Vol. 29, No. 5, (2020), pp. 9435-9440

[46]J Nageswara Rao, KhadriLalithaVaniSri, B Shyamala, M Gargi, KudaravalliDeepika, "A Modern Optimized Fuzzy C-Means Clustering Using Machine Learning for Data Clustering",International Journal of Advanced Science and Technology, Vol. 29, No. 5, (2020), pp. 9417-9428

[47]J. Nageswara Rao, K Ruth Ramya, B Manjula Josephine, VenkataVara Prasad Padyala, KhadriLalithaVaniSri, "An Efficient and Secured Biometric Authentication for IOT Using Face Recognition", Journal of Critical Reviews, Volume-7, Issue-18, Pages 1016-1028 (2020)

[48]J.Nageswara Rao,KhadriLalithaVaniSri, B. Shyamala,M.Gargi, KudaravalliDeepika, "A Modern Optimized Fuzzy C-Means Clustering Using Machine Learning For Data Clustering", International Journal of Advanced Science and Technology,Volume 29, Issue-5, Pages 9417-9428 (2020)

[49]J. Nageswara Rao,D. Veeraiah"Use of Clustering Sentiments for Opinion Mining: An Experimental Analysis", Conference-Advances in Intelligent Systems and Computing 933, Pages 625-632 (2020)

[50]J Nageswara Rao, Mr V KanthaRao, Mr VenkataNareshMandhala, SGLS Ratna, Y Nagateja, K Hoshitha "Stock Market Prediction and Analysis using Machine Learning Algorithm-Random Forest

Classifier (RFC)",International Journal of Advanced Science and Technology,Vol. 29, No. 7, (2020), pp. 1095 – 1103

[51]J. Nageswara Rao, "A Review on Data Mining & Big Data, Machine Learning Techniques", International Journal of Recent Technology and Engineering, Volume-7, Issue-6S, Pages914-916, (2019)

[52]J.NageswaraRao ,S.Govindu, K.SundeepSaradhi, A.Sudhakar, Ch.SrinivasaRao, "Advanced Ensemble ACGCTechnique using Image Segmentation Model", International Journal of Recent Technology and Engineering (IJRTE), Volume 7, Issue-6S2, Pages 796-799 (2019)

[53]J.Nageswara Rao,Dr.M.Babu Reddy Dr.P.Ashok Reddy, "Design of Internet of Things (IoT) Sensors and Cloud Computing for Health Care Applications", Journal of Advanced Research in Dynamical and Control Systems – JARDCS, Volume 10, Issue-10, Pages 239-244 (2018)

[54]J Nageswara Rao, Mr Aryan Chandrapal Singh, "A Novel Encryption System Using Layered Cellular Automata", International Journal of Engineering Research and Applications, Vol. 2, Issue 6, November- December 2012, pp.912-917

[55] J Nageswara Rao, Mrs P Balaramudu M Tech, "Fingerprint Identification and Verification System using Minutiae Matching" (2012)

**Cite this article as :**

S. Raghu, Prof. T. Adi Lakshmi, "An Investigation of Various Medical Image Segmentation Techniques", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 9 Issue 1, pp. 292-301, January-February 2022.
Journal URL : https://ijsrset.com/IJSRSET22922