J. Sci. Trans. Environ. Technov. 2023, 17 (1) : 10 - 17

ARTIFICIAL INTELLIGENCE RECOMMENDATION SYSTEM FOR CANCER REHABILITATION SCHEME

Kavitha A[1*], Kiruthika C[2], Srilekha M[3], Adit P J[4]

[1]Assistant Professor, Department of Computer Science (UG&PG), Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, TN, India. kavithaa@dgvaishnavcollege.edu.in
[2]M.Sc. Computer Science 2nd year, Department of Computer Science (UG&PG), Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, TN, India, kiruthikaaji2603@gmail.com.
[3]M.Sc. Computer Science 2nd year, Department of Computer Science (UG&PG), Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, TN, India, srilekham217@gmail.com.
[4] M.Sc. Computer Science 2nd year, Department of Computer Science (UG&PG), Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, TN, India, pjadit1802@gmail.com.

Article History
Received: **05.07.2023**
Revised and Accepted: **08.08.2023**
Published: **15.09.2023**

https://doi.org/10.56343/STET.116.017.001.002
www.stetjournals.com

ABSTRACT

Cancer is the most difficult problem in the field of medicine, and its postoperative recovery has become the most concerning problem for cancer patient. MRI is widely used for imaging technique to assess brain tumours, but the large amount of data produced by MRI needs manual segmentation in reasonable time, limiting the use of precise quantitative measurements in the clinical practice. So, automatic and reliable segmentation methods are required. Automatic segmentation is an challenging problem in which manual detection and segmentation of brain tumors using brain MRI scan forms a large part of human arbitration for detection and segmentation taken per patient, is both tedious and has huge internal and external observer detection and segmentation variability. Hence there is high demand for an efficient and automatic brain tumour detection and segmentation using brain MR images to be overcome errors in manual segmentation. In Practice, the system uses HSI (Hyper Spectral Imaging) to detect cancer cells. It is difficult to eliminate the ambiguities in MRI Brain samples. To overcome this difficulty, we are developing a system which detects the location of cancer cells into and out of MR Images and also suggests effective treatment like medications, vaccines, chemotherapy, etc. to physicians.

Keywords --- Automatic Segmentation, Cancer, HSI, MRI, Post Operative recovery.

Kavitha A

Assistant Professor, Department of Computer Science(UG & PG), Dwaraka Doss Goverdhan Doss Vaishnav College, Ch-106

email : kavithaa@dgvaishnavcollege.edu.in

P-ISSN 0973-9157
E-ISSN 2393-9249

INTRODUCTION

Cancer is one of the most dangerous challenges in the field of medicine, affecting millions of lives worldwide. Among the numerous complexities associated with cancer treatment, postoperative recovery is a particularly concerning issue for cancer patients. In the context of brain tumors, Magnetic Resonance Imaging (MRI) has emerged as a vital diagnostic tool, providing valuable insights into tumor localization and characteristics. However, the vast amount of data generated by MRI scans necessitates manual segmentation for accurate

analysis, which limits the practical application of precise quantitative measurements in clinical practice. Therefore, the development of automatic and reliable segmentation methods is imperative to enhance the diagnosis and treatment of brain tumors. This research endeavors to address this critical need by proposing a novel approach that leverages Hyper Spectral Imaging (HSI) for cancer cell detection, aiming to reduce the inherent ambiguities in MRI brain samples. The ultimate goal of this study is to create a system that not only identifies cancer cells within and beyond MR images but also provides valuable treatment recommendations to healthcare professionals.

Need of the Study

The need for this study arises from the multifaceted challenges posed by brain tumor diagnosis and treatment. Manual segmentation of brain tumors in MRI images is labor-intensive, time-consuming, and susceptible to significant observer variability, both internally and externally. This manual process not only hinders the efficiency of clinical workflows but also care. Furthermore, ambiguities in MRI brain samples present additional hurdles in the accurate localization and characterization of cancer cells. Therefore, there is an urgent need for an automated solution that can enhance the precision, speed, and consistency of brain tumor detection and segmentation while minimizing the risk of errors. Additionally, the integration of HSI technology offers the potential to overcome the challenges associated with MRI, thus elevating the quality of cancer care.

Objectives of the Study

The objectives of this research study are as follows: Develop an Automatic Segmentation Method: Create an advanced algorithm for the automatic segmentation of brain tumors in MRI images, aiming to reduce the reliance on manual intervention and enhance the accuracy of tumor delineation. Leverage Hyper Spectral Imaging investigate the application of Hyper Spectral Imaging (HSI) technology to improve cancer cell detection within MRI samples, mitigating the ambiguities inherent in traditional MRI scans. Enhanced Localization and Characterization helps to improve the localization and characterization of cancer cells both within and outside MR images, enabling a more comprehensive understanding of tumor extent. Recommend Effective Treatment Strategies develop a system that not only identifies cancer cells but also suggests tailored treatment options such as medications, vaccines, chemotherapy, and more to assist physicians in optimizing patient care plans. Reduced Diagnostic Errors can minimize the risk of errors in manual segmentation, thus increasing the reliability and consistency of brain tumor detection and segmentation.

MACHINE LEARNING

Machine learning (ML) is the study of algorithms in computer that improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence. Machine learning algorithms are built on a model based on sample data, known as "training data", in order to make decisions without being explicitly programmed to do so. Machine learning algorithms are used in various applications, such as email filtering and computer vision, where it is unfeasible to develop conventional algorithms to perform the needed task

The types of machine learning algorithms are mainly divided into four categories:

- Supervised learning,
- Unsupervised learning,
- Semi-supervised learning,
- Reinforcement learning.

Supervised Learning

Supervised learning algorithms build a mathematical model of a set of data that have the inputs and the desired outputs. These data is known as training data, and consists of a set of training examples each training example has one or more inputs and the desired output, also known as a supervisory signal. In the mathematical model, each training data set example is represented as an array or vector, sometimes called a feature vector, and the training data is represented by a matrix. Insistent ideal of an objective function are used to predict the output associated with new inputs. An optimal function will allow the algorithm to correctly

resolve the output for inputs that were not a part of the training data.

Unsupervised Learning

Unsupervised learning algorithms is a set of data that contains only inputs, and find structure in the data, like clustering of data points. These algorithms learn from testing the data that has not been classified. In place of responding to unsupervised learning algorithms, it is used to identify commonalities between the data and react based on the presence or absence of commonalities in data. An unsupervised learning is a term which is used in the field for measuring the density and making estimation in statistics, such as finding the probability density function. Unsupervised learning also enclose other domains involving summarizing.

Semi-supervised Learning

Semi-supervised learning is in between unsupervised learning and supervised learning. Some of the training examples are mislaid training labels, far many machine-learning researchers have found that unlabeled data, when used in association with a small amount of labeled data, and have a considerable improvement in learning accuracy.

Reinforcement Learning

Reinforcement learning is one of type of machine learning concerned. However software agents would take actions in an environment so we want to maximize the notion of cumulative reward. Due to its observation, this method is used in field, such as game theory, control theory, operations research, information theory, simulation-based optimization, etc. In machine learning, the environment is represented as a Markov Decision Process (MDP). There are many reinforcement learning algorithms using dynamic programming techniques.

MAGNETIC RESONANCE IMAGING (MRI)

Magnetic Resonance Imaging (MRI) is technique which uses the radio frequency signals to get the image of brain. This imaging technique is our focusing technique. MRI scans play an essential role in the screening and diagnosis of brain tumor. The wide adoption of Brain tumor screening is expected to benefit millions of people. This can provide an opportunity to study the robustness of medical machine learning models and analyze the performance of various strategies for classifying MR images at scale. Due to the highly advanced performance of machine learning algorithms for radiology diagnosis, some developers have commercialization of their models.

Magnetic Resonance Imaging (MRI) is an indispensable tool in the medical field, with a wide range of applications:

- **Brain Imaging:** MRI is extensively used to visualize and diagnose various neurological conditions, including brain tumors, stroke, multiple sclerosis, and traumatic brain injuries. It provides detailed images of brain structures and abnormalities.
- **Musculoskeletal Imaging:** Orthopedic specialists rely on MRI to assess injuries to bones, joints, ligaments, and tendons. It aids in the diagnosis of conditions such as torn ligaments, herniated discs, and arthritis.
- **Cardiac Imaging:** Cardiologists use MRI to examine the heart's structure and function. It's valuable for assessing congenital heart defects, myocardial infarctions, and cardiac function.
- **Abdominal Imaging:** MRI helps in the evaluation of abdominal organs like the liver, kidneys, pancreas, and gastrointestinal tract. It can detect tumors, inflammation, and other abnormalities.
- **Breast Imaging:** MRI is used alongside mammography in breast cancer screening, especially for women at high risk. It provides additional information for breast cancer detection and staging.

BRAIN TUMOR

A brain tumor is an abnormal growth of cells within the brain or the central spinal cord. These tumors can be benign (non-cancerous) or malignant (cancerous) and may originate from brain tissue or spread to the brain from other parts of the body (metastatic tumors). Here are some basic details about brain tumors and their analysis
A brain tumor is an abnormal growth of cells within the brain or the central spinal cord. These tumors can be benign (non-cancerous) or malignant (cancerous) and may originate from

brain tissue or spread to the brain from other parts of the body (metastatic tumors). Here are some basic details about brain tumors and their analysis:

Types of Brain Tumors

- **Primary Brain Tumors**: These tumors originate in the brain itself. They are categorized as benign (slow-growing and non-cancerous)
- **Metastatic Brain Tumors**: These are secondary tumors that have spread to the brain from other parts of the body, often from lung, breast, or skin cancer.

Symptoms

Symptoms of brain tumors can vary widely but may include headaches, seizures, changes in vision, difficulty speaking or understanding speech, weakness or numbness in limbs, and personality changes.

CONVOLUTION NEURAL NETWORK (CNN) – ALGORITHM

Our program design language is the Algorithm type. Here the used algorithm is CNN (Convolution Neural Network). The purpose of using CNN is that it is the best for image recognition.

● Convolution Neural Network (CNN) is a class of Deep learning algorithms.
● CNN is an algorithm that can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other.
● CNN works by extracting features from the image and CNN consists of the following:

a. The input layer which is a gray scale image.

b. The output layer may be binary or multi-class labels.

c. Hidden layers consisting of convolution layers, RELU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network.

WORKING ARCHITECTURE

Working Architecture is the conceptual model that defines the structures, behaviours, and more views of a system. An architectures description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviour of the system. MRI Brain Image is the input image which is taken from the dataset (database) for image processing. The image processing has three major steps:

- Data pre-processing
- Segmentation
- Classification

The first step of image processing is Data pre-processing. Data pre-processing is the process of taking only the necessary data from the input MRI by removing unwanted data present in the MRI and image and data pre-processing involves the functions like converting into grayscale image, apply different filtering methods to remove noise, image enhancement to improve the image quality.

This will be converted into a suitable form on which further work can be performed. Next move is the segmentation process. This process will separate out the tumour region from the MRI image and segmentation involves the function of threshold-based segmentation. The threshold-based segmentation is the technique used by the segmentation process. This technique will detect and highlight the tumor region based on pixel intensity (high impressions). And then moves to the feature extraction process. This process will extract the features of segmented part like size, shape, tissue texture and location. After the basic operations of image processing on MRI image, the CNN algorithm will perform on processed image to classify into normal healthy brain or tumour brain. This classification is done by using the algorithm called CNN (Convolution Neural Network). The purpose of using CNN is that it is the best for image recognition. And finally, treatment suggestions will be given to the physician if the tumour is identified in brain.

Data pre-processing

- Collecting the data is one task and making that data useful is an another vital task.
- Data collected from various means will be in an unorganized format and there may be lot of null values, in-valid data values and unwanted data.
- Cleaning all these datas and replacing them with appropriate datas and removing null and missing datas and replacing them with some fixed alternate values are the basic steps in pre-processing of datas.

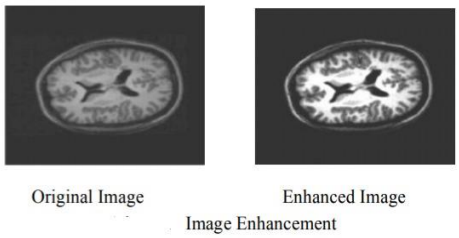


Figure 1. DATA PREPROCESSING

Segmentation

- Segmentation technique is to separate out tumor region from MRI image. Using segmentation, it is possible to identify objects, boundaries, location in an image.
- A lot of research has been carried out in the area of segmentation.
- It is used to achieve the goal to obtain the more meaningful and easier to analyze a image as it simply or change the image representation.

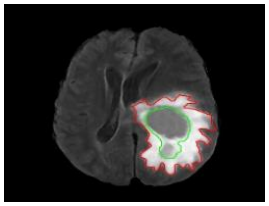


Figure 2. SEGMENTED IMAGE

Classification

Image classification is a process of classifying the items according to its type and pattern from image and the dataset performs on image using CNN algorithm. This CNN algorithm is used to classify it into normal brain or tumor brain. For example, if we have a MRI brain image and we want to train our CNN on that image to classify it into "normal brain" or "tumor brain".

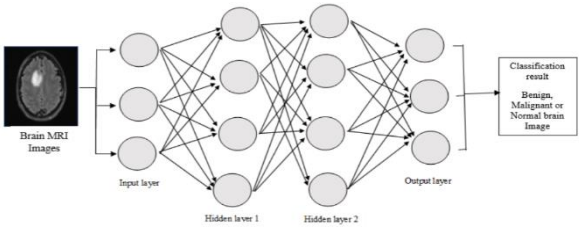


Figure 3. CLASSIFICATION

TRAINING AND TESTING

- Finally after processing of datas and training and the very next task is obviously testing. This is where performance of algorithm, quality of datas, and required output all appears out.
- From the huge data set collected 90 percent of the data is utilized for training and 10 percent of the data is reserved for testing.
- Training is the process of making the machine to learn and giving it the capability to make further predictions based on the training it took.
- Whereas testing is already having a predefined data set with output also previously labeled and the model is tested which is working properly or not and giving the right prediction or not. If the maximum number of predictions are right then model will have a good accuracy percentage and is reliable to continue with otherwise better to change the model.

TREATMENT SUGGESTION

- Treatment suggestions include types of treatments that are the standard of care for a brain tumor. "Standard of Care" means best treatments known.

- Treatment for a brain tumor depends on size, type and location of the tumor cells.
- Treatment includes surgery,radiation and chemotherapy.
- Surgery - If the tumor is located in a place that makes it accessible for an operation, the surgeon will work to remove the tumor cells as much as possible.

Radiation Therapy
This therapy uses high energy beams like X-rays or protons to kill tumor cells. It may cause many side effects also.

Chemotherapy
Under this therapy, doctors use medications like drug called temozolomide (temodar) which is taken as a pill, vaccines etc.

Rehabilitation After Treatment
There is a need for rehabilitation because brain tumors can develop in parts of the brain that control motor skills, speech, vision and thinking

Physical Therapy
To help you regain lost motor skills, muscle strength, etc.

Occupational Therapy
To help you to come back your normal daily activities, including work, after a brain tumor or other illness.

Speech Therapy
With specialists in speech difficulties (speech pathologists) to help if you have difficulty speaking.

Tutoring for school-age children
To help kids cope with changes in their memory and thinking after a brain tumor.

TESTING TECHNIQUES
Testing is a process of executing a program with the object of finding an error. A good test case is one that is high probability of finding a error. A successful test is one that uncovers an so far undiscovered error. System testing is to aimed at ensuring the system works accurately and efficiently as expected before live operation commences. It verifies whole set of programs that hangs together. System testing consists of several key activities and steps for run program, string, system. It is important in adopting a successful new system. This is the last chance to detect and correct errors.

White Box Testing
This testing is also called as Glass box testing. In this testing, the specific functions has been design to perform test can be conducted that demonstrates that each function is fully operational at the same time searching for errors in each function. It is a test case design method which is used as a control structure of the procedural design to derive test cases.

Black Box Testing
In this type of testing the internal operation of a product can be conducted to ensure that "all gears mesh", that makes internal operation according to specification and all internal components which are adequately exercised. It is fundamentally focused on the functional requirements of the software.

RESULTS AND DISCUSSION

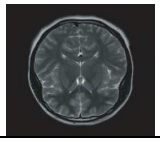
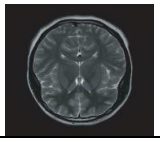
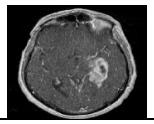
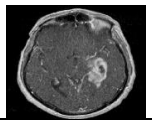
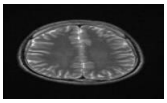
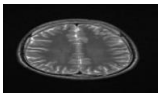
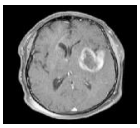
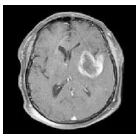
INPUT IMAGE	DETECTION OF TUMOR	RESULT/ OUTPUT
		No Tumor Detected
		Tumor Detected
		No Tumor Detected
		Tumor Detected

Figure 4. AUTOMATED SEGMENTATION OF BRAIN TUMOR BY THE PROPOSED ALGORITHM

By automating the segmentation of brain tumors in MRI scans has the potential to significantly improve clinical practice. By reducing reliance on manual segmentation, errors and variability can be minimized, leading to more accurate and consistent results.The integration of Hyper Spectral Imaging augments the precision of cancer cell detection. By capturing spectral information, HSI can distinguish cancerous tissues from healthy ones more effectively, contributing to earlier and more accurate diagnoses. The inherent ambiguities in MRI brain samples pose a persistent challenge. However, by combining HSI with advanced machine learning algorithms, it is possible to address these ambiguities to a considerable extent, increasing the reliability of tumor localization. The proposed system's ability to suggest tailored treatment options to physicians is a significant step forward in personalized medicine. This feature has the potential to improve patient outcomes and reduce the burden of decision-making on medical professionals.

CONCLUSION AND FUTURE SCOPE

In conclusion, we have proposed a recommender system which helps physicians to detect the presence and location of tumour. In this recommender system, a deep learning algorithm have been used called CNN which is the best algorithm for image recognition, since this system takes input in image format i.e JPEG or jpg . Initially, image processing techniques are done by taking input MR image for enhancement of image quality and to detect and classify MR image into benign and malignant using a proposed CNN algorithm for accurate detection of brain tumor and giving treatment suggestions based on needs. By using this methodology, we improve the efficiency of detection and classification of brain tumors via MR Images. For physicians, it works like an add on, which reduces their work and time.

In future, further additional functionalities as per requirements will be added which includes automated expert system by using a advanced algorithms based on future developing technologies to excavate the deep information of brain in the process of brain abnormal detection in more accuracy upto 100% based on upcoming algorithms in future so that a better pre-planning treatment also can be suggested to prevent growing other abnormal tissues in brain at early stage itself if any abnormal tissues are likely seems to grow in brain. Our proposed system will suggest treatments only after detecting tumors in the brain based on needs and also our project is designed only to detect a tumor in the brain and giving treatment suggestions after the detection of tumor in brain.

REFERENCES

Cho G., J. H. Huh, J. Cho, S. Oh, Y. Song, and H. Kim, Syspal:System-guided pattern locks for Android, in Proc. *IEEE Symp. Security Privacy (SP)*, pp. 338–356.

He W., T. Meng, S. Zhang, Q. Ge, and C. Sun.2017. Trajectory tracking control for the flexible wings of a micro aerial vehicle, *IEEE Trans. Syst., Man, Cybern., Syst.*, vol. 99, pp. 1–14, Jul. 2017.

He W. and S. Zhang. 2017. Control design for nonlinear flexible wings of a robotic aircraft, *IEEE Trans. Control Syst. Technol.,* 25(1): 351–357.

He, W. Z. Yan, C. Sun, and Y. Chen.2017. Adaptive neural network control of a flapping wing micro aerial vehicle with disturbance observer, *IEEE Trans. Cybern.,* 47(10):3452–3465.

Liu X., Z. Zhou, W. Diao, Z. Li, and K. Zhang.2015. When good becomes evil: Keystroke inference with smartwatch, In: Proc. 22nd ACM SIGSAC Conf. Comput. Commun. Secur., Denver, CO, USA, Oct. 2015,pp. 1273–1285.

Nakada Y., M. Wakahara, and T. Matsumoto.2014. Online Bayesian learning with natural sequential prior distribution, *IEEE Trans. Neural Netw.Learn. Syst.,* 25(1), 40–54.

Shen, Y. Zhang, X. Guan, and R. A. Maxion.2016. Performance analysis of touchinteraction behavior for active smartphone authentication, *IEEE Trans. Inf. Forensics Security*, 11(3), 498–513.

Song R., Y. Song, Q. Dong, A. Hu, and S. Gao.2017. WebLogger: Stealing your personal PINs via mobile Web application, In Proc. 9th Int. Conf. Wireless Commun. Signal Process. (WCSP), Oct. 2017, pp. 1–6.

Vijayalakshmi P., K. Selvamani and M. Geetha. 2011. Segmentation Of Brain MRI Using K-Means Clustering Algorithm, Int. J. of Eng. Trends Technol., 3, 113-115.

Wang H., T. T.-T. Lai, and R. Roy Choudhury.2015. Mole: Motion leaks through smartwatch sensors, in Proc. 21st Annu. Int. Conf. Mobile Comput. Netw., Paris, France, Sep. 2015, pp. 155–166.