Project Report

on

An Effective Brain Tumor Detection System Using Deep Learning

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For the Degree of

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2022-23

SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,
SHEGAON–444 203 (M.S.)
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that **Ms. Palak Agrawal, Ms. Mayuri Patil, Ms. Dolly Solanke, Ms. Mayuri Heda and Ms. Kanchan Raut,** students of final year B.E. in the year 2022-23 of Computer Science and Engineering Department of this institute has completed the project work entitled **“An Effective Brain Tumor Detection System Using Deep Learning”** based on syllabus and has submitted a satisfactory account of her work in this report which is recommended for the partial fulfillment of degree of Bachelor of Engineering in Computer Science and Engineering.

Prof. Ms. P. V. Deshmukh
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Internal Examiner	**External Examiner**
Date:	**Date:**

Abstract

A brain tumor is an abnormal growth or mass of cells in the brain. Human brain is enclosed by a very rigid skull. Any development inside such a limited space can create some issues. This tends to compromise life and can harm the mind. However, you can receive neurological treatment as soon as possible if you are aware of the symptoms of a brain tumor. It's terrifying to think that you might have tumor in your brain, but early detection can help you survive and thrive. The brain tumor is diagnosed using a variety of algorithms, including SVM, VGG, K-means, and others. The CNN algorithm, which uses MRI images of brain tumor to determine whether a brain tumor is present or not in a human brain, is described in this paper. Image Pre-processing, normalization, feature extraction, Image analysis and image classification are all components of the algorithm. CNN algorithm contains various layers such as, Convolution layer, pooling layer, various hidden layers etc. In this we added one extra hidden layer to gain the better accuracy of model and detect brain tumor more accurately.

Acknowledgement

The real spirit of achieving a goal is through the way of excellence and lustrous discipline. I would have never succeeded in completing my task without the cooperation, encouragement and help provided to me by various personalities.

I would like to take this opportunity to express my heartfelt thanks to my guide ***Prof. Ms. P. V. Deshmukh****, for her esteemed guidance and encouragement, especially through difficult times. Her suggestions broaden my vision and guided me to succeed in this work. I am also very grateful for her guidance and comments while studying part of my seminar and learnt many things under her leadership.*

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Abbreviations

CNN	Convolutional Neural Network
MRI	Magnetic Resonance Imaging
ML	Machine Learning
DL	Deep Learning

CHAPTER 1: INTRODUCTION

Brain the mass of nerve tissue in the anterior end of an organism. The brain integrates sensory information and directs motor responses; in higher vertebrates it is also the centre of learning. The human brain weighs approximately 1.4 kg (3 pounds) and is made up of billions of cells called neurons. Junctions between neurons, known as synapses, enable electrical and chemical messages to be transmitted from one neuron to the next in the brain, a process that underlies basic sensory functions and that is critical to learning, memory and thought formation, and other cognitive activities.

In lower vertebrates the brain is tubular and resembles an early developmental stage of the brain in higher vertebrates. It consists of three distinct regions: the hindbrain, the midbrain, and the forebrain. Although the brain of higher vertebrates undergoes considerable modification during embryonic development, these three regions are still discernible.

The hindbrain is composed of the medulla oblongata and the pons. The medulla transmits signals between the spinal cord and the higher parts of the brain; it also controls such autonomic functions as heartbeat and respiration.

The midbrain, the upper portion of which evolved from the optic lobes, is the main centre of sensory integration in fish and amphibians. It also is involved with integration in reptiles and birds. In mammals the midbrain is greatly reduced, serving primarily as a connecting link between the hindbrain and the forebrain.

The forebrain includes the cerebral hemispheres and, under these, the brainstem, which contains the thalamus and hypothalamus. The thalamus is the main relay centre between the medulla and the cerebrum; the hypothalamus is an important control centre for sex drive, pleasure, pain, hunger, thirst, blood pressure, body temperature, and other visceral functions. The hypothalamus produces hormones that control the secretions of the anterior pituitary gland, and it also produces oxytocin and antidiuretic hormone, which are stored in and released by the posterior pituitary gland.

A brain tumor is a growth of cells in the brain or near it. Brain tumors can happen in the brain tissue. Brain tumors also can happen near the brain tissue. Nearby locations include nerves, the pituitary gland, the pineal gland, and the membranes that cover the surface of the brain.

Brain tumors can begin in the brain. These are called primary brain tumors. Sometimes, cancer spreads to the brain from other parts of the body. These tumors are secondary brain tumors, also called metastatic brain tumors.

Many different types of primary brain tumors exist. Some brain tumors aren't cancerous. These are called noncancerous brain tumors or benign brain tumors. Noncancerous brain tumors may grow over time and press on the brain tissue. Other brain tumors are brain cancers, also called malignant brain tumors. Brain cancers may grow quickly. The cancer cells can invade and destroy the brain tissue.

Brain tumors range in size from very small to very large. Some brain tumors are found when they are very small because they cause symptoms that you notice right away. Other brain tumors grow very large before they're found. Some parts of the brain are less active than others. If a brain tumor starts in a part of the brain that's less active, it might not cause symptoms right away. The brain tumor size could become quite large before the tumor is detected.

Brain tumor treatment options depend on the type of brain tumor you have, as well as its size and location. Common treatments include surgery and radiation therapy.A brain tumor is an unnatural growth of cells in the brain. The symptoms of brain tumor can vary depending on its size, location and type. Cerebrum growths can be harmless (non-destructive) or threatening (malignant). Headaches, seizures, issues with vision or hearing, difficulty speaking, limb weakness or numbness, and shifts in mood or behavior are all possible signs.

However, it is essential to keep in mind that a person with these symptoms does not necessarily have a brain tumor, and that many of these symptoms can also be brought on by other conditions.

A brain tumor diagnosis typically requires a biopsy, in which a small portion of the tumor is removed and examined under a microscope to determine whether it is cancerous.

Brain tumor patients may benefit from earlier diagnosis and treatment. Using medical imaging like MRI or CT scans, deep learning algorithms can aid in the process of finding and diagnosing brain tumors.

Train a convolutional neural network (CNN) on a large dataset of brain images with and without tumors is one common strategy. The CNN figures out how to perceive examples and highlights that are related with the presence of a growth, and can then be utilized to characterize new pictures as one or the other positive or negative for a cancer.

It is vital to note, in any case, that while profound learning can be a significant device in helping with cerebrum growth identification, it ought not be utilized as a trade for a prepared clinical expert. A trained medical professional should always be consulted before making any decisions regarding diagnosis or treatment.

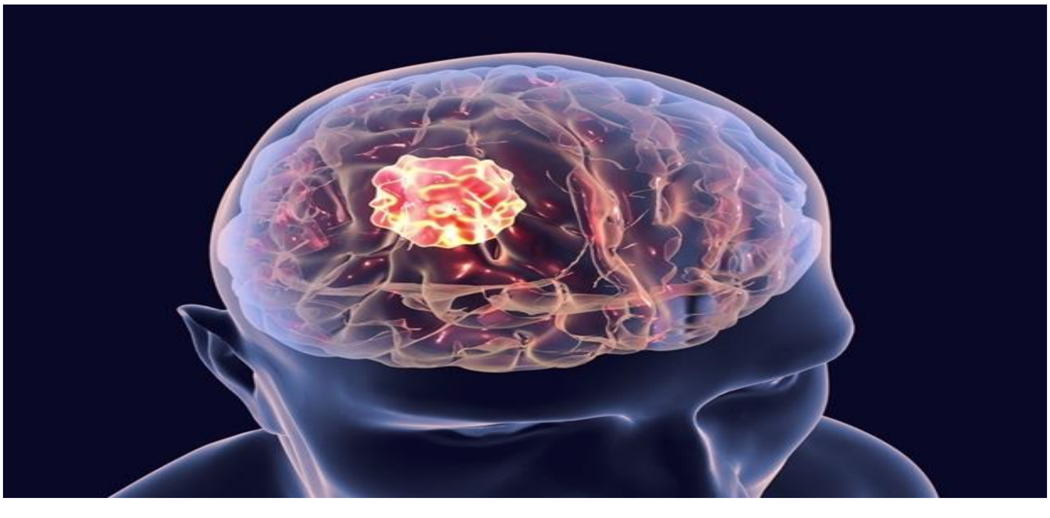


Figure 1.1 Brain Tumor Image

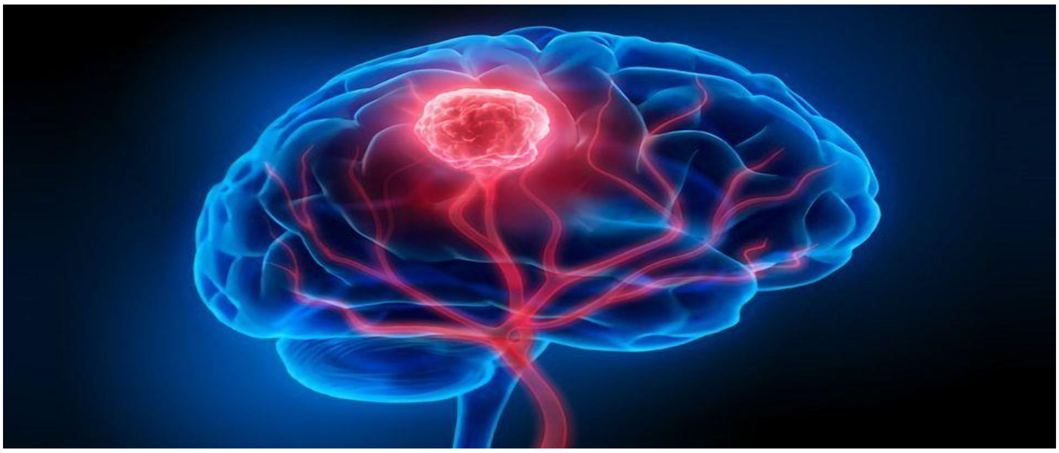


Figure 1.2 Brain Tumor Image

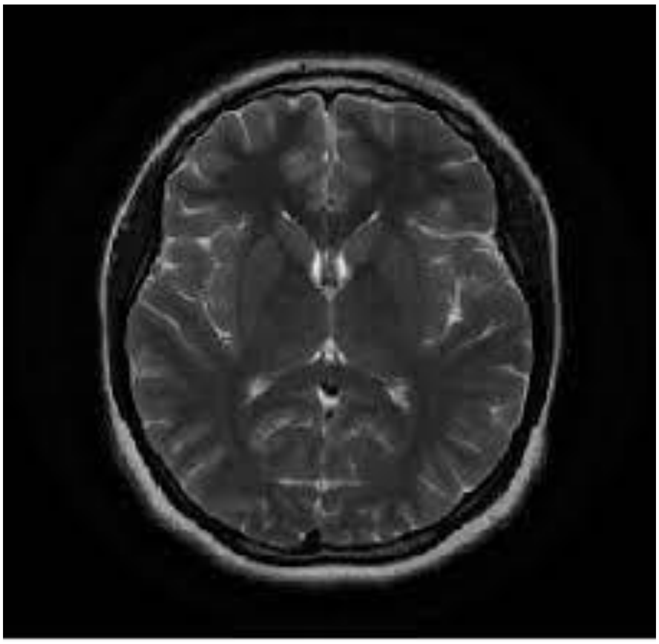


Figure 1.3 Non Tumor Image

1.1 MOTIVATION

- The main motivation of the proposed system is to detect brain tumor in early stage by using deep learning algorithm.
- Medical imaging seeks to disclose internal structures hidden by skin and bones and also to diagnose and treat disease.
- Brain tumor is a serious life frightening disease. So which not detected in earlier stage, can take away person’s life.

1.2 PROBLEM DEFINITION

a) To detect the brain tumor on the bases of image dataset and if the tumor is present then it detect tumor in the brain.

b) Previously stage of tumor is used to be detected manually with the help of observation of image by doctors and sometimes it takes more time and results may be inaccurate.

c) Today many computers added tool is used in a medical field. These tools have a property of quick and accurate result.

1.3 PROJECT SCOPE

The purpose of the Brain Tumor Detection system is to provide a appropriate detection which can be used in medical situation. The system is based on dataset related to MRI based images. We will use the MRI image dataset for our system, to make it more specified based on the images in the dataset. Above all, we hope to achieve a system which will be useful in different scenarios provided relevant data.

Our aim is to develop an automated system for enhancement, segmentation and classification of brain tumors. The system can be used by neurosurgeons and healthcare specialists. The system incorporates image processing, pattern analysis, and computer vision techniques and is expected to improve the sensitivity, specificity, and efficiency of brain tumor screening. The primary goal of medical imaging projects is to extract meaningful and accurate information from these images with the least error possible. The proper combination and parameterization of the phases enables the development of adjunct tools that can help on the early diagnosis or the monitoring of the tumor identification and locations

1.4 OBJECTIVES

The objectives of an effective brain tumor detection system using deep learning include:

1. **Accurate detection:** The primary objective of a brain tumor detection system using deep learning is to accurately identify the presence of a brain tumor in medical images such as MRI or CT scans.
2. **Early detection:** Early detection of brain tumors can significantly improve the chances of successful treatment. An effective brain tumor detection system should be able to detect tumors at an early stage.
3. **Differentiation between tumor types:** Brain tumors can be of different types, and each type requires a specific treatment approach. An effective system should be able to differentiate between different tumor types accurately.
4. **Reduced human error:** Medical professionals can make errors while interpreting medical images. An automated system can significantly reduce the risk of error and improve the accuracy of diagnosis.
5. **Speed:** The system should be able to analyze medical images quickly and provide results promptly to aid in timely treatment.
6. **Scalability:** As the number of medical images generated daily increases, the system should be able to handle the volume of images and still provide accurate results.
7. **Accessibility:** The system should be accessible to medical professionals globally to improve the diagnosis and treatment of brain tumors, especially in areas where there is a shortage of trained medical professionals.

1.5 DEEP LEARNING

A subfield of machine learning known as deep learning is entirely based on artificial neural networks. Since brain networks are intended to copy the human mind, deep learning is likewise a kind of mirroring the human cerebrum. Deep learning models can consequently gain highlights from the information, which makes them appropriate for errands like picture acknowledgment, discourse acknowledgment, and regular language handling. Feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) are the architectures in deep learning that are utilized the most frequently. Deep learning achieves immense strength and adaptability by learning. A lot of named information and a lot of processing power are needed to create Deep Learning models. Deep learning has had the opportunity to advance in a wide range of applications due to the increasing accessibility of a lot of information and computational resources.

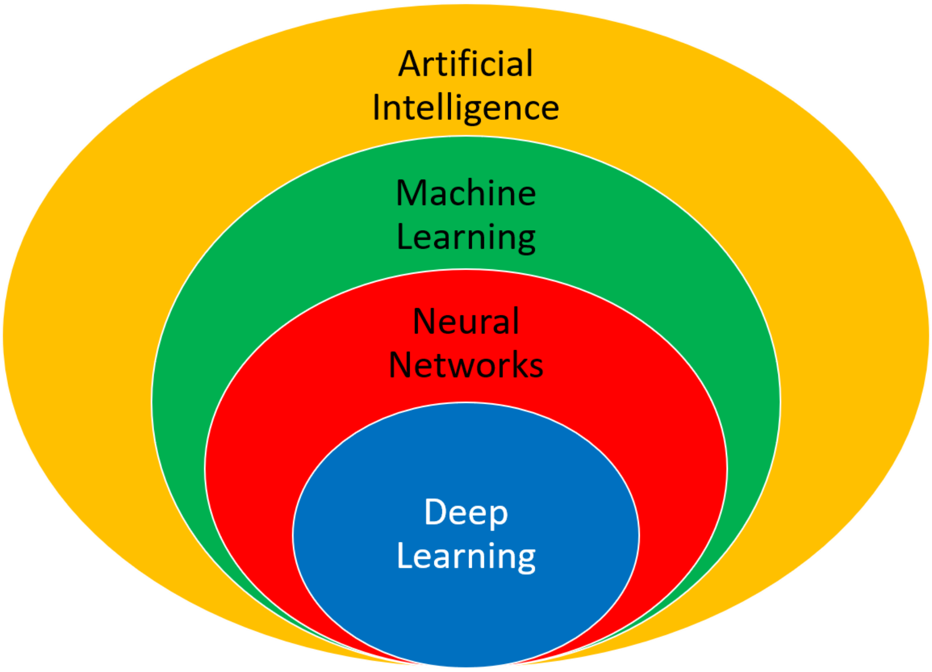


Figure 1.4 Deep Learning

1.5.1 SUPERVISED LEARNING

In Supervised learning machines are prepared utilizing great "marked" preparing information, and on premise of that information, machines anticipate the result. Some input data already carries the appropriate output tag, as indicated by the labelled data.

In supervised learning, the machines preparation information go about as a manager to show them how to foresee the result accurately. Similar to how a student learns under a teacher's supervision, it applies.

The process of providing the machine learning model with both accurate input data and output data is referred to as supervised learning. Finding a planning capability to coordinate the info variable (x) with the result variable (y) is the goal of a supervised learning calculation.

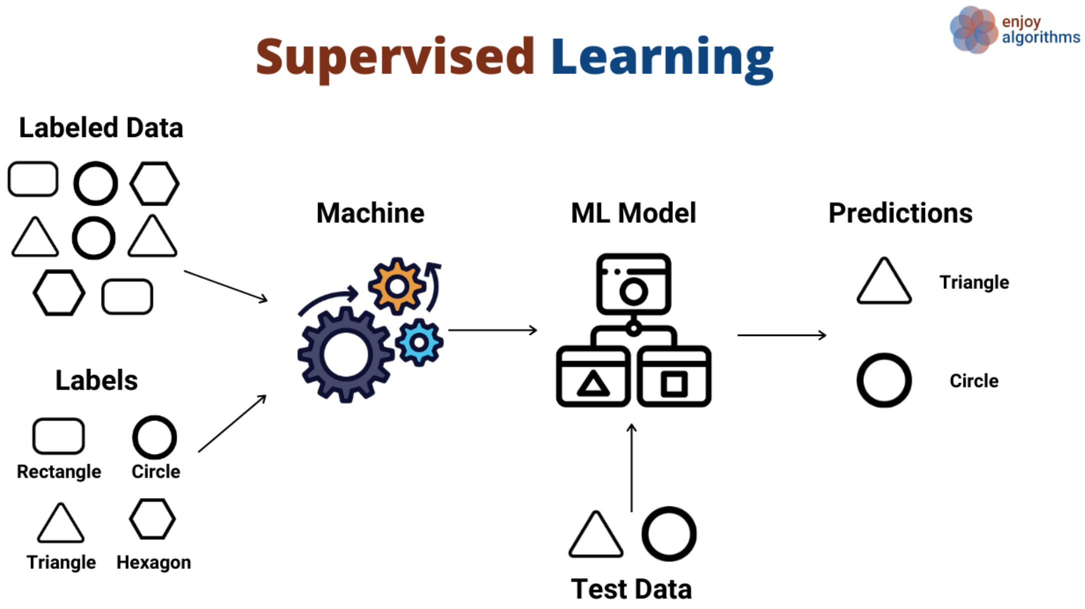


Figure 1.5 Supervised Learning

1.6 PYTHON

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy: a bug or bad input will never cause a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace. A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to

Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective.

1.6.1 FEATURES OF PYTHON

Python provides lots of features that are listed below.

a) **Easy to Learn and Use**

   Python is easy to learn and use compared with other programming languages. It is developer-friendly and high-level programming language.

b) **Interpreted Language**

   Python is an interpreted language because no need of compilation. This makes debugging easy and thus suitable for beginners.

c) **Cross-platform Language**

   Python can run equally on different platforms such as Windows, Linux, Unix and Macintosh etc. So, we can say that Python is a portable language.

d) **Free and Open Source**

   The Python interpreter is developed under an open-source license, making it free to install, use, and distribute.

e) **Object-Oriented Language**

   Python supports object-oriented language and concepts of classes and objects come into existence.

f) **GUI Programming Support**

   Graphical user interfaces can be developed using Python.

g) **Integrated**

   It can be easily integrated with languages like C, C++, and JAVA etc.

1.6.2 PYTHON APPLICATIONS

Python is a general-purpose programming language that makes it applicable in almost all domains of software development. Python can be used to develop any type of applications.

Here, we are providing some specific application areas where python can be applied.

- Web Applications
- Desktop GUI Applications

- Software Development
- Scientific and Numeric
- Business Applications
- Console Based Application
- Audio or Video based Applications

1.6.3 PYTHON LIBRARIES

While there are a lot of languages to pick from, Python is among the most developer-friendly Machine Learning and Deep Learning programming language, and it comes with the support of a broad set of libraries catering to your every use-case and project. TensorFlow is a fast, flexible, and scalable open-source machine learning library for research and production. TensorFlow is one of the best libraries available for working with Machine Learning on Python. Offered by Google, TensorFlow makes ML model building easy for beginners and professionals alike. Using TensorFlow, you can create and train ML models on not just computers but also mobile devices and servers by using TensorFlow Lite and TensorFlow Serving that offers the same benefits but for mobile platforms and high-performance servers.

Some of the essential areas in ML and DL where TensorFlow shines are:

- Handling deep neural networks
- Natural Language Processing
- Partial Differential Equation
- Abstraction capabilities
- Image, Text, and Speech recognition
- Effortless collaboration of ideas and code

Core Task: Build Deep Learning models

Keras

Keras is one of the most popular and open-source neural network libraries for Python. Initially designed by a Google engineer for ONEIROS, short for Open-Ended Neuro Electronic Intelligent Robot Operating System, Keras was soon supported in TensorFlow’s core library making it accessible on top of TensorFlow. Keras features several of the building blocks and tools necessary for creating a neural network such as:

- Neural layers
- Activation and cost functions
- Objectives
- Batch normalization
- Dropout
- Pooling

Keras extends the usability of TensorFlow with these additional features for ML and DL programming. Support for the convolutional and recurrent neural network also exists along with standard neural networks.

Pandas

Pandas is a Python data analysis library and is used primarily for data manipulation and analysis. It comes into play before the dataset is prepared for training. Pandas make working with time series and structured multidimensional data effortless for machine-learning programmers. Some of the great features of Pandas when it comes to handling data are:

- Dataset reshaping and pivoting
- Merging and joining of datasets
- Handling of missing data and data alignment
- Various indexing options such as Hierarchical axis indexing, Fancy indexing
- Data filtration options

Pandas make use of Data Frames, which is just a technical term for a two-dimensional representation of data by offering programmers with Data Frame objects.

Core task: Data manipulation and analysis

NumPy

The NumPy library for Python concentrates on handling extensive multi-dimensional data and the intricate mathematical functions operating on the data. NumPy offers speedy computation and execution of complicated functions working on arrays. Few of the points in favor of NumPy are:

- Support for mathematical and logical operations
- Shape manipulation
- Sorting and Selecting capabilities
- Discrete Fourier transformations
- Basic linear algebra and statistical operations
- Random simulations
- Support for n-dimensional arrays

NumPy works on an object-oriented approach and has tools for integrating C, C++, and Fortran code, and this makes NumPy highly popular amongst the scientific community.

Core task: Data cleaning and manipulation

1.7 FLASK

Flask is a web micro-framework developed by Armin Ronacher.Flask is written in Python programming language.Flask is made for Python applications.Flask helps in implementing a machine learning application in Python that can be easily plugged, extended and deployed as a web application.Flask is based on two key components: WSGI toolkit and Jinja2 template engine. WSGI is a specification for web applications and Jinja2 renders web pages. Linkedin, Pinterest use the Flask framework. Flask is a small and powerful web framework for Python. It's easy to learn and simple to use, enabling you to build your web app in a short amount of time. Flask is a web structure. This implies flask gives you devices, libraries and innovations that permit you to fabricate a web application. This web application can be some pages, a blog, a wiki or go as large as an online schedule application or a business site

Flask is the best Python microframework Flask is a creation prepared framework 'The' as particular from 'an' isn't precise right now, there are a lot of other Python web frameworks utilized underway constantly. Flask is the best Python microframework.

Flask Extensions

Flask offers a range of extensions for:

- Object relation mapping
- Uploading files
- Authentication
- Forms validation
- Mail, SQLAlchemy, jquery integration.

Advantages of using Flask framework are:

- There is a built-in development server and a fast debugger provided.
- Lightweight
- Secure cookies are supported.
- Templating using Jinja2.
- Request dispatching using REST.
- Support for unit testing is built-in.

1.8 IMAGE PREPROCESSING

Image preprocessing is the steps taken to format images before they are used by model training and inference. This includes, but is not limited to, resizing, orienting, and color corrections.

Image preprocessing may also decrease model training time and increase model inference speed. If input images are particularly large, reducing the size of these images will dramatically improve model training time without significantly reducing model performance. For example, the standard size of images on iPhone 11 are 3024×4032. The machine learning model Apple uses to create masks and apply Portrait Mode performs on images half this size before its output is rescaled back to full size.

Preprocessing is an essential step to clean image data before it is ready to be used in a computer vision model. There are both technical and performance reasons why preprocessing is essential.

Fully connected layers in convolutional neural networks, a common architecture in computer vision, require that all images are the same sized arrays. If your images are not in the same size, your model may not perform as expected. If you are building a model in code using a library like Tensorflow, you are likely to encounter an error if your image is not the same size.

Image Preprocessing Steps

Identifying the correct preprocessing steps most useful for increasing model performance requires a firm understanding of the problem, data collected, and production environment. What may work well in one situation is not appropriate in all others. This is also the case in image augmentation.

Thus, considering techniques and why each may be valuable enables informed decisions. In this post, we’ll surface considerations and provide recommendations that are generally best. Again, there is no free lunch, so even “generally best” tips can be disproven.

Let's start with image preprocessing steps that you should keep in mind when you are ready to start training your computer vision model.

Orientation:

When a picture is taken, its metadata informs our computers how to show the input image in relation to how it is stored on disk. Its EXIF orientation is the name given to that metadata, and incorrect EXIF data handling has long been a source of frustration for developers everywhere. This also holds true for models: if we've established annotated bound boxes on how we viewed an image to be orientated but our model is "seeing" the picture in a different orientation, we're utterly mistraining the model.

Resize:

Although altering an image's size may seem simple, there are things to keep in mind. Few devices capture exactly square images, despite the fact that many model topologies require square input images. Stretching an image's dimensions to make it square is one option, as is maintaining the image's aspect ratio while adding additional pixels to fill in the newly formed "dead space."

Random Flips:

Our model must acknowledge that an object need not always be read from left to right or up to down by randomly reflecting it about its x- or y-axis. In order-dependent circumstances, such as when deciphering text, flipping may be irrational.

Grayscale:

One type of image transformation that can be applied to all images (train and test) is a change in color. Random changes can also be made to images only during training as augmentations. Every image is often subjected to grayscaling, which alters the color. While we may believe that "more signal is always better, we may actually observe more timely model performance when images are rendered in grayscale.

Different Exposure:

If a model might be expected to operate in a range of lighting conditions, changing image brightness to be randomly brighter and darker is most appropriate. The maximum and minimum levels of brightness in the space must be taken into account.

Normalization

Normalization is a scaling technique in Machine Learning applied during data preparation to change the values of numeric columns in the dataset to use a common scale. It is not necessary for all datasets in a model. It is required only when features of machine learning models have different ranges.

Normalization techniques in Machine Learning

Although there are so many feature normalization techniques in Machine Learning, few of them are most frequently used. These are as follows:

- Min-Max Scaling:

  This technique is also referred to as scaling. As we have already discussed above, the Min-Max scaling method helps the dataset to shift and rescale the values of their attributes, so they end up ranging between 0 and 1.

- Standardization scaling:

Standardization scaling is also known as **Z-score** normalization, in which values are centered around the mean with a unit standard deviation, which means the attribute becomes zero and the resultant distribution has a unit standard deviation. Mathematically, we can calculate the standardization by subtracting the feature value from the mean and dividing it by standard deviation.

Hence, standardization can be expressed as follows:

$$X' = \frac{X - \mu}{\sigma}$$

Here, **μ** represents the mean of feature value, and **σ** represents the standard deviation of feature values.

However, unlike Min-Max scaling technique, feature values are not restricted to a specific range in the standardization technique.

This technique is helpful for various machine learning algorithms that use distance measures such as KNN, K-means clustering, and Principal component analysis, etc. Further, it is also important that the model is built on assumptions and data is normally distributed.

CHAPTER 2: LITERATURE SURVEY

Li Qiang, Ayesha Younis, and others [1] proposed the diagnosis of brain tumors is essential in clinical treatments. It is critical to interpret medical images because medical images vary greatly. The automatic brain tumor detection approach makes detection easier, but it also significantly increases the patient's chances of survival. Convolutional networks for brain tumor categorization have helped pave the way for better tumor detection and accuracy. MRI is most commonly used to detect and classify brain cancers. Due to the apparent efficient feature extraction capacity of DL-based techniques, they have recently gained greater attention and efficiency when compared to standard classification techniques for medical imaging. If cancer is diagnosed, many lives can be spared, and the appropriate grade is determined using quick and low-cost diagnostic tools. As a result, there is an urgent need to create rapid, non-invasive, and cost-effective diagnostic tools. This study made an attempt to meet such needs by bringing a novel solution for the detection of brain tumors in MRI images with greater precision. The proposed model integrated deep learning and transfer learning models to achieve a remarkable accuracy rate. As compared to similar techniques from past literature, in this study, the optimization of training models was increased to reduce the need for high computational power.

In this study, a CNN was built to detect brain tumors using MRI scans of the brain automatically. The network could be trained for faster and more convenient training using a pre-trained VGG 16 model. VGG 16 has sixteen layers and is a critical CNN model to evaluate if employing a commercial model for a task. This paper aimed to discover a brain tumor using the VGG 16, CNN model architecture, and weights to training data. The precision of the outcome was evaluated. Brain MRI images for tumor identification are the type of data we aimed to acquire for our study. Compared to conventional methods, the results showed that the proposed network architecture was appealing and performed exceptionally well in detecting tumors. Various processing operations were also carried out to enhance the model's efficiency. The proposed approach for brain t proposed two deep learning techniques, CNN and VGG-16, were applied to MRI scans, with VGG-16 achieving better accuracy (98.5%) than CNN (96%) in accuracy.

Arkapravo Chattopadhyay, et al. [2] put forward a CNN-based method for segmenting brain tumors from 2D MRI, next conventional classification and deep learning techniques. CNN outperformed other traditional classifiers in this study. CNN have the advantage of automatically learning representative complex features for both healthy brain tissues and tumour tissues directly from the multi-modal MRI images, so they decided to improve its accuracy. First they tried to implement SVM on CNN, but they got low accuracy of only 20.83%. Then they tried different parameters. Changed the final layer parameter to softmax and optimizer to AdaMax. Then they got 98.10% accuracy. But need more, so they decided to change the optimizer to RMSProp, and finally got the output accuracy to 99 %. By using 2473 numbers of image as training data and 273 images for testing in 9:1 ratio with 11 epoch procedure we ultimately got our final result. Our model has 9 layer CNN model with 14 stages. Most importantly we also deleted some images to overcome overfitting.

Prof. Kavita Bathe and Others [3] presented that brain tumor is considered as one of the aggressive diseases, among children and adults. Brain tumors grow very fast and if not treated well, the survival chances of the patient are very less. Early detection of brain tumors is very important. Proper treatment planning and accurate diagnostics is at the topmost priority to improve life expectancy of the patients. The best technique to detect brain tumor is Magnetic Resonance Imaging. The MRI images are examined by the radiologist. Manual examination can be error prone due to the level of complexities involved in brain tumors and their properties. Hence an automated brain tumor detection system is required to detect tumors at its early stage. This paper uses deep learning based Depth wise Separable Convolution Neural Network to detect the tumor based on the MRI images. Experiments are done on the public dataset available at kaggle. Experimental Results have shown that Depth wise Separable Convolution Neural Network gives better accuracy as compared Support Vector Machine, K Nearest Neighbour and Convolution Neural Network. On the MRI dataset, two deep learning methods that are CNN and Depth Wise CNN and they were tested. The results showed that CNN had an accuracy of 95.7 percent, while Depth Wise CNN had an accuracy of 97%, which was higher than CNN.

Aryan Sagar, Methil, and Others, [4] In this paper, image preprocessing was the first step. The Convolutional Neural Network (CNN) is then used to classify images of tumors and non-tumors. As brain tumors arise from different types of cells and the cells can suggest things like the nature, severity, and rarity of the tumor. tumors can occur in different locations and the location of tumors can suggest something about the type of cells causing the tumor which can aid further diagnosis. the task of brain tumor detection can become aggravating by the problems which are present in almost all digital images eg. illumination problems. Tumor and non-tumor images can have overlapping image intensities which makes it difficult for any model to make good predictions from raw images. this paper proposes a novel method to detect brain tumors from various brain images by first carrying out different image preprocessing methods ie. histogram equalization and opening which was followed by a convolutional neural network. the paper also discusses other image preprocessing techniques apart from the ones that are finalized for training and their impact on our dataset. The experimental study was carried on a dataset with different tumor shapes, sizes, textures, and locations. convolutional neural network (CNN) was employed for the task of classification. In our work, CNN achieved a recall of 98% on the training set, 99% on the validation set which is very compelling

Ahmed Bakhtyar Mohammed et al.[5] suggested processing 1258 MRI images from 2015 to 2020 using MATLAB software and their database. The study found that the proposed deep CNN-based approach had an accuracy level of 96%.

The study indicates that the brain tumor diagnosis is the hardest diagnosis situation in Radiology so more than all of the other processes need auto-diagnose system. The results reveal that some factors have the most influences on decision making, these factors have effective role to get correct predictions. The factors consist of the dataset which represents as the feature bank, deep CNN method which involves feature extraction and classification processes together, training options which include the optimizer and number of epochs. The performance of Deep CNN in terms of its feature learning accuracy and sensitivity is highly dependent on the number of utilized epochs, which set to 15 in the present study. The whole automate system runtime did not subtend more than five minutes, representing real-time diagnosis. Accurate diagnosis of brain tumor MRI images is highly useful in clinical diagnosis, in turn rising the patient’s lifetime. In this regard, deep

CNN is one of the most significant and effective models that can be employed in automated tumor diagnosis, with the classification capacity of hundreds of images per second. Therefore, radiologists are highly recommended to have working knowledge of deep CNN in order to be able to utilize these tools for clinical purposes.

Manika Gupta and others[6] presented Brain tumor classification assumes a significant part in clinical diagnosis and compelling treatment. With the improvement in today's technology, deep learning which the subset of machine learning is has recently showed striking performance, particularly in classification and segmentation related problems. An advanced computational technique has achieved substantial outcome in the classification of brain tumor using Convolutional Neural Network (CNN). In this paper, we present a completely programmed brain tumor classification uutilizing Deep Convolutional Neural Network. The proposed neural model can examinee MRI images consisting of following types of tumors: meningioma, glioma pituitary and no tumor. This paper aims to build three different classifications of brain tumors using three different CNN models. Brain tumor detection is attained with 91.29% accuracy using the first CNN model. The second CNN model classifies the brain tumor with padding, dropout and data augmentation with an accuracy of 79.79%. The third CNN model that is VGG16 can group the brain tumors with an accuracy of 87.27%.

Ankita Parmar and others,[7] In this paper, survey on various techniques for brain tumor detection is done. Different techniques are used by various researchers to detect the brain tumor from MRI images are discussed. This paper talks about overview of the brain, braintumor and also about MRI images. Some segmentation techniques and conventional method are also discussed. According to this review we find that automation of brain tumor detection and segmentation using CNN from MRI images is most effective and helpful research area. In this paper, they proposed an algorithm to segment brain tumours from 2D Magnetic Resonance brain Images (MRI) by a convolutional neural network which is followed by traditional classifiers and deep learning methods. We have taken various MRI images with diverse Tumour sizes, locations, shapes, and different image intensities to train the model well. Furthermore, we have applied SVM classifier and other activation algorithms (softmax, RMSProp, sigmoid, etc) to cross-check our work. We implement our proposed method using “TensorFlow” and “Keras” in “Python” as it is an efficient programming language to perform fast work.

CHAPTER 3: SYSTEM REQUIREMENT

The introduction of the term Software Requirements Specification (SRS) which provides brief overview of the whole SRS with some of the terms such as purpose, the scope, references, definitions, overview of the SRS, acronyms and the abbreviations. The intention of this document is to collect and analyze and provide an in depth understanding of the entire system by elaborating the problem statement. It also points on the capabilities needed by stakeholders as well as their requirement while explaining high-level of the product features. This specifies the software requirement for the Brain Tumor Detection Using Deep Learning.

3.1 OVERALL DESCRIPTION

Product Introduction Image processing is a process of analyzing, manipulating an image in order to perform some operation to extract the information from it. Medical imaging seeks to disclose internal structures hidden by skin and bones and also to diagnose and treat disease. And it also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. In today’s world, one of the reasons in the rise of mortality among the people is brain tumor. Abnormal or uncontrolled growth of cell developed inside the human body is called brain tumor. This group of tumor grows within the skull, due to which normal brain activity is disturbed. Brain tumor is a serious life frightening disease. If not detected in earlier stage, can take away person’s life. Previously stage of tumor is used to be detected manually with the help of observation of image by doctors and sometimes it takes more time and results may be inaccurate. There are many types of brain tumour and only expert doctor can able to give the accurate result. Today many computers added tool is used in a medical field. These tools have a property of quick and accurate result. MRI is the most commonly used imaging technique for inspecting internal structure of human body. Proper detection of tumor is the solution for the proper treatment. Also require accurate diagnosis tool for proper treatment. Detection involves finding the presence of tumor. Detecting brain tumor using image processing techniques involves four stages. Image pre-processing, normalization, applying CNN algorithm, and classification.

3.1.1 SOFTWARE REQUIREMENTS

- System : Intel i3 Processor
- Hard Disk : 500 GB
- RAM : 4 GB

3.1.2 HARDWARE REQUIREMENTS

- Operating System : Windows 10
- Platform : Google Colab
- IDE : Visual Studio Code
- Web Framework : Flask
- Coding Language : Python

3.2 ANALYSIS MODELS :

The system being based on Deep Learning does not particularly have the traditional Brain Tumor Detection using Deep Learning SSGMCE, Shegaon 12 predictive approach. Analysis uses an adaptive approach as there is no detailed plan of the tasks. The adaptiveness of the analysis model is most suited for building this system. Analysis model being a combination of incremental and iterative approach helps in building the system incrementally in multiple iterations. As the system consists different modules of features which all require incremental development, this approach fits well. Each module of the system together completes the system and provides results. The iteration of each module is developed with incremental improvements to form the whole system. The main advantage of this approach is that minimum planning is required and is flexible enough to make changes and improvements to the system.

CHAPTER 4: METHODOLOGY

In the past, numerous deep learning methods were utilized for brain tumor detection. Right now we have creating cerebrum tumor discovery by utilizing CNN algorithm. Our method predicts that deep learning CNN algorithms outperform other algorithms in terms of accuracy.

4.1 BLOCK DIAGRAM

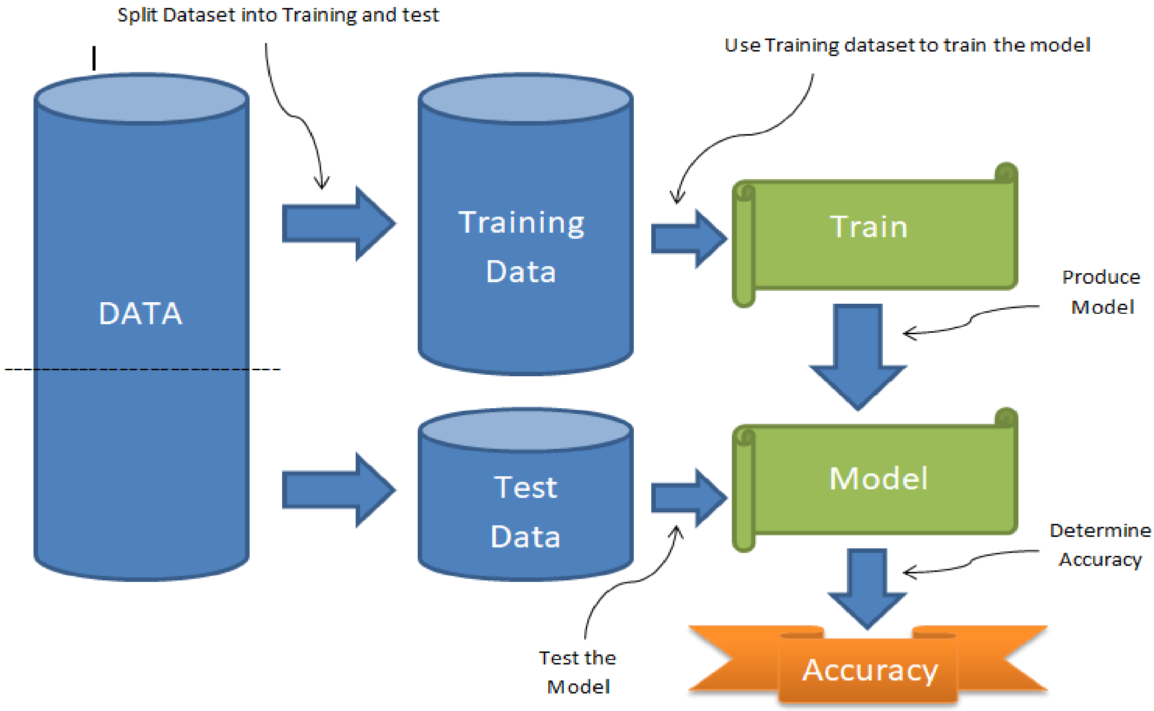


Figure 4.1 Block Diagram

Steps to split data and produce model :

a) Identify the kind of training dataset first.

b) Collect the training data with labels.

c) Divide the training dataset into test, validation, and training datasets.

d) Determine the info highlights of the preparation dataset, which ought to have sufficient information with the goal that the model can precisely foresee the result.

e) Selecting an appropriate algorithm for the model.

f) Put the algorithm into action using the training dataset.

g) Use the validation set to determine accuracy of the model . If the model gives expected results and correctly predicts the output then our model is accurate.

4. 2 FLOW CHART

The project implementation flow, which includes image dataset, preprocessing of image, normalization, CNN algorithm implementation, then testing of model and output, is depicted in the following figure.

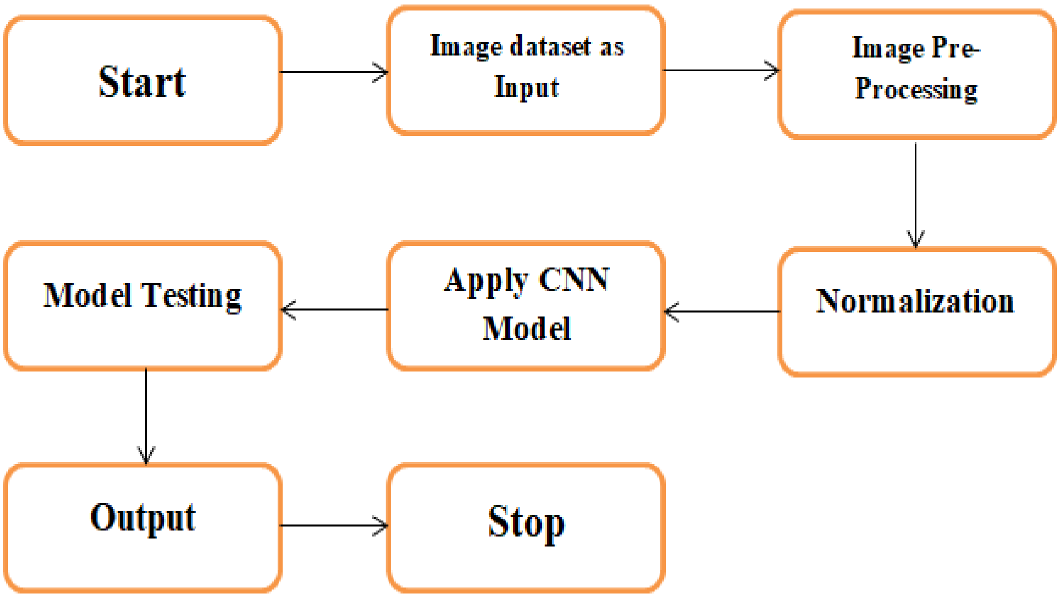


Figure 4.2 Flowchart

a) **Image Dataset:**

We obtained this dataset from the websites of Kaggle. There are a various datasets to choose from. There are 3,000 images of brain tumors in the dataset, which have been divided into two groups: yes and no. There are 1500 images with a tumor, and there are 1500 images without a tumor.

b) Image preprocessing:

The goal of preprocessing is to improve the quality of the image so that we can better analyze it. Preprocessing enables us to improve specific qualities that are crucial to the application we are working on and eliminate unwanted distortions. In this firstly we read the image then convert it into array. Resizing of image and applying label to it is also performed in this.

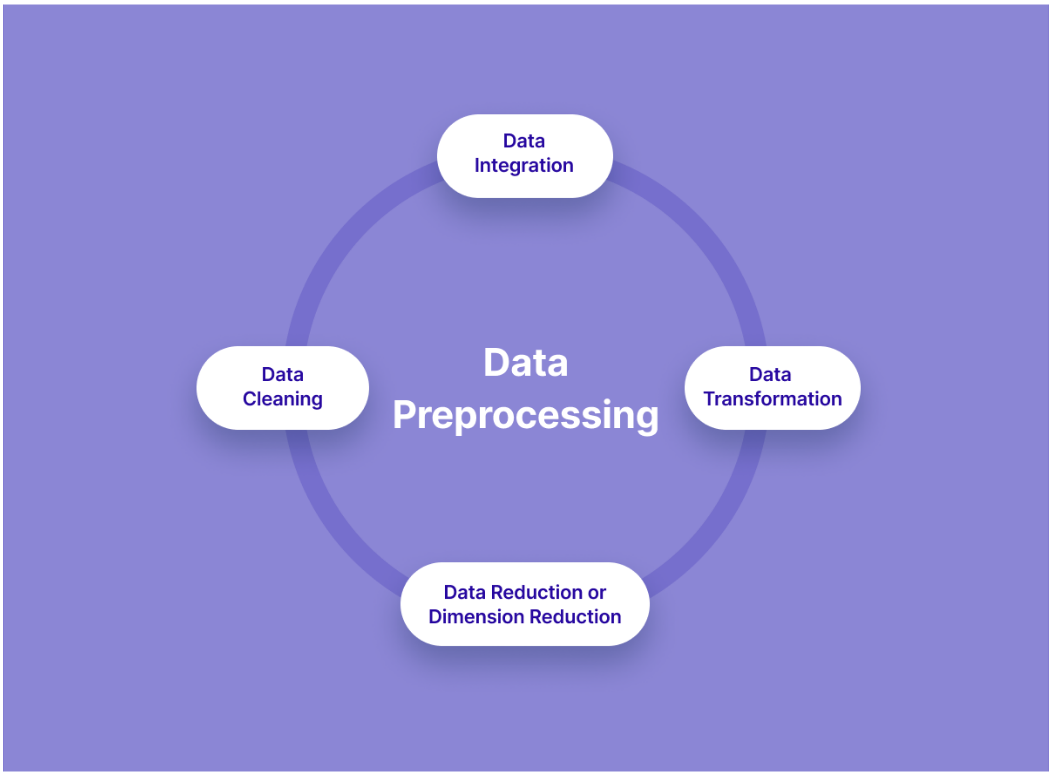


Figure 4.3 Image Pre-processing

c) Normalization:

A set of data undergoes scale transformation when it is normalized. For deep learning models, our objective is generally to recenter and rescale our information to such an extent that is somewhere in the range of 0 and 1 or - 1 and 1, contingent upon the actual information. Because the different features are on the same scale, normalization can help our neural networks train better because it stabilizes the gradient descent step. This allows us to utilize higher learning rates or assist models with meeting quicker for a given learning rate.

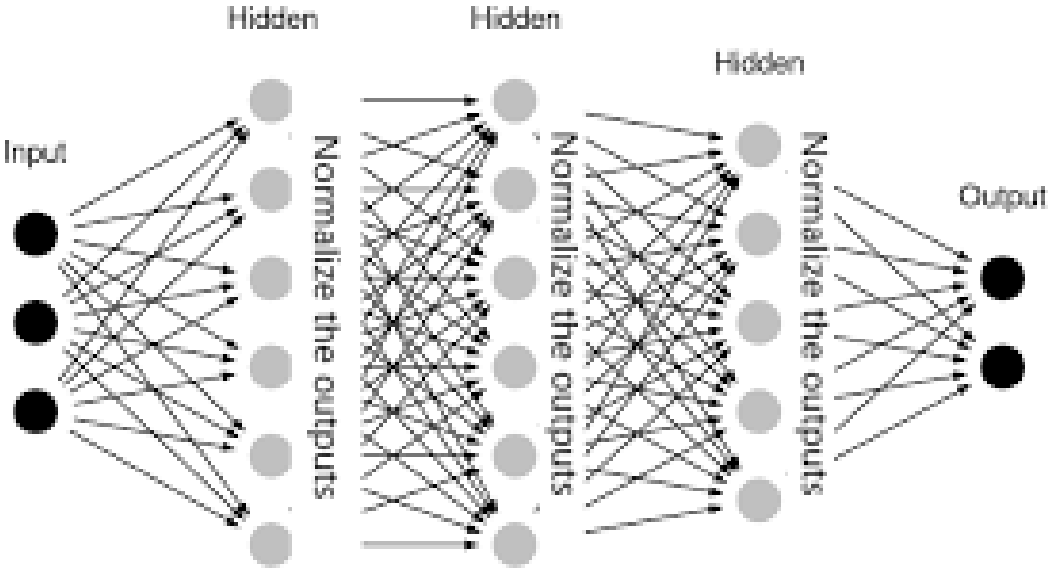


Figure 4.4 Normalization

d) Apply CNN Model :

In this we apply CNN model to prepare machines/PCs with the goal that they can gain for a fact, order and perceive information/pictures very much like a human cerebrum does. It is used to recognize and classify images and objects. In this Different CNN layers such as, Convolution layer, pooling layer, and various hidden layers etc. are applied and used sequential model.

e) Model Testing:

We test our trained model to make sure that the learned model will behave consistently and produce the expected results.

4.3 ALGORITHM

4.3.1 MODEL BUILDING

1. Start
2. Install and Import required Libraries.
3. Fetch image dataset from directory.
4. Assign dataset path to variable.

5. Create lists to store image and label.
6. Image Pre-processing

```
Iterate loop through no_tumor_images:
        If img_name[1]== ‘.jpg’:
            Read image
            Convert img into array
            Resize img
            Append array of img into list
            Append label as ‘0’ into list
    Iterate loop through yes_tumor_images:
        If img_name[1]==’.jpg’:
            Read image
            Convert img into array
            Resize img
            Append array of img into list
            Append label as ‘1’ into list
```

7. Store numpy array of image into variable.
8. Store numpy array of label into variable.
9. Split Dataset into Train and Test.
10. Normalize the data.
11. Apply CNN Model.
12. Compile the model with ‘accuracy’ metrics.
13. Fit the model.
14. Save model with ‘.h5’ extension.

4.3.2 MODEL TESTING

1. Install and Import required libraries.
2. Load model.
3. Read image from dataset for prediction.
4. Convert image into array.
5. Resize image.
6. Convert image into numpy array
7. Expand dimensions of numpy array
8. Predict model.

9. Print result.
10. Connect it with Web using Flask framework.
11. Run and display it on Web.

CHAPTER 5: IMPLEMENTATION

5.1 ALGORITHM DETAILS

Convolutional Neural Networks also known as CNNs or ConvNets, are a type of feed-forward artificial neural network whose connectivity structure is inspired by the organization of the animal visual cortex**.** Small clusters of cells in the visual cortex are sensitive to certain areas of the visual field. Individual neuronal cells in the brain respond or fire only when certain orientations of edges are present. Some neurons activate when shown vertical edges, while others fire when shown horizontal or diagonal edges. A convolutional neural network is a type of artificial neural network used in deep learning to evaluate visual information.

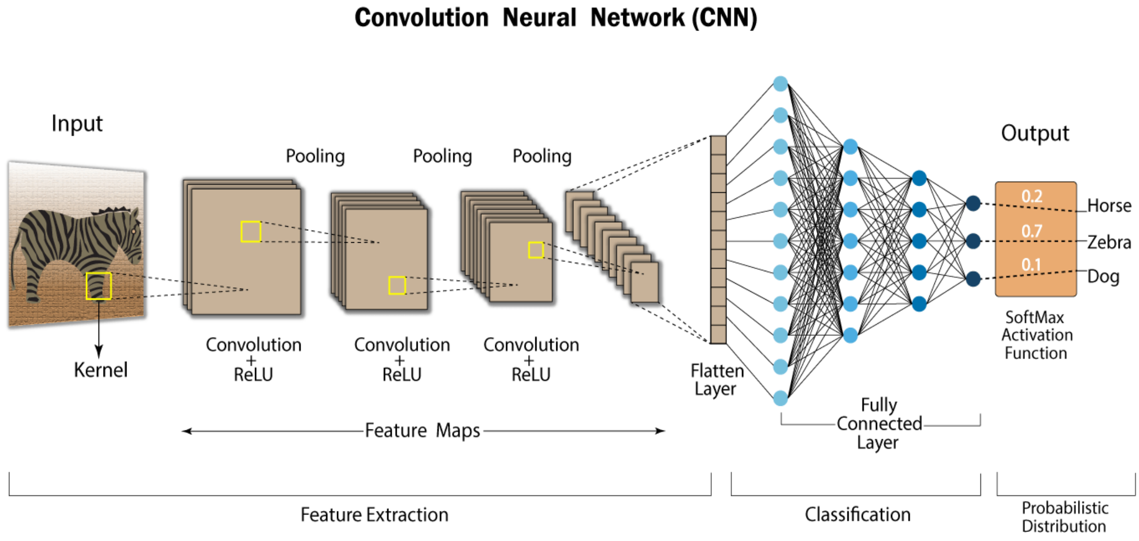


Figure 5.1 CNN

Convolutional Neural Networks (CNNs) have an input layer, an output layer, numerous hidden layers, and millions of parameters, allowing them to learn complicated objects and patterns.

CNN uses convolution and pooling processes to sub-sample the given input before applying an activation function, where all of them are hidden layers that are partially connected, with the completely connected layer at the end resulting in the output layer. The output shape is similar to the size of the input image.

Convolution is the process of combining two functions to produce the output of the other function. The input image is convoluted with the application of filters in CNNs, resulting in a Feature map. Filters are weights and biases that are randomly generated vectors in the network. Instead of having individual weights and biases for each neuron, CNN uses the same weights and biases for all neurons. Many filters can be created, each of which catches a different aspect from the input. Kernels are another name for filters.

Layer of Convolution:

An activation map is created by scanning the images several pixels at a time with a filter in the convolution layer. The internal workings of the convolution layer are shown in the following figure.

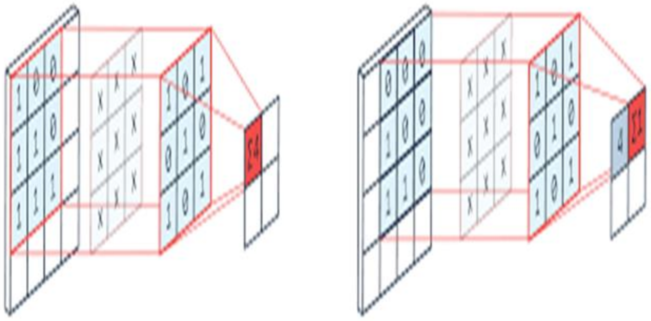
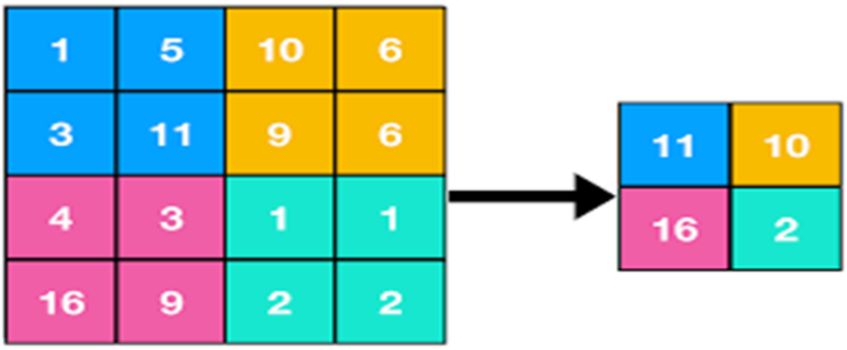


Figure 5.2 Convolution Layer

Layer of Pooling:

Layer of Pooling diminishes how much information made by the convolutional layer so it is put away more productively. The pooling layer's internal workings are depicted in the following Figure.



1	5	10	6
3	11	9	6
4	3	1	1
16	9	2	2

11	10
16	2

Figure 5.3 Pooling Layer

Layer with Full Connectivity:

A layer whose output is "flattened" into a single vector and used as an input for the subsequent stage is referred to as a layer with Full Connectivity. In order to anticipate the appropriate label, the first fully connected layer adds weights to the feature analysis inputs. The probability for each label is provided by the fully connected output layer at the end. The internal workings of a fully connected layer are depicted in the following figure.

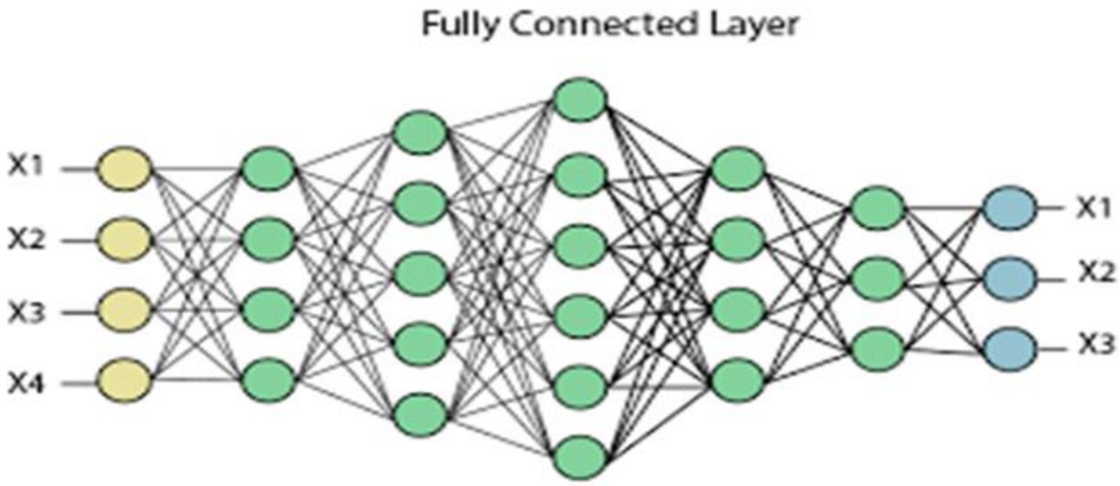


Figure 5.4 Fully Connected Layer

5.2 ACTIVATION FUNCTIONS

5.2.1 WHAT IS ACTIVATION FUNCTION?

It's just a thing function that you use to get the output of node. It is also known as Transfer Function**.**

5.2.2 WHY WE USE ACTIVATION FUNCTIONS WITH NEURAL NETWORKS?

It is used to determine the output of neural network like yes or no. It maps the resulting values in between 0 to 1 or -1 to 1 etc. (depending upon the function).

The Activation Functions can be basically divided into 2 types-

1. Linear Activation Function
2. Non-linear Activation Functions

The Nonlinear Activation Functions are mainly divided on the basis of their range or curves-

Sigmoid or Logistic Activation Function

The Sigmoid Function curve looks like a S-shape.

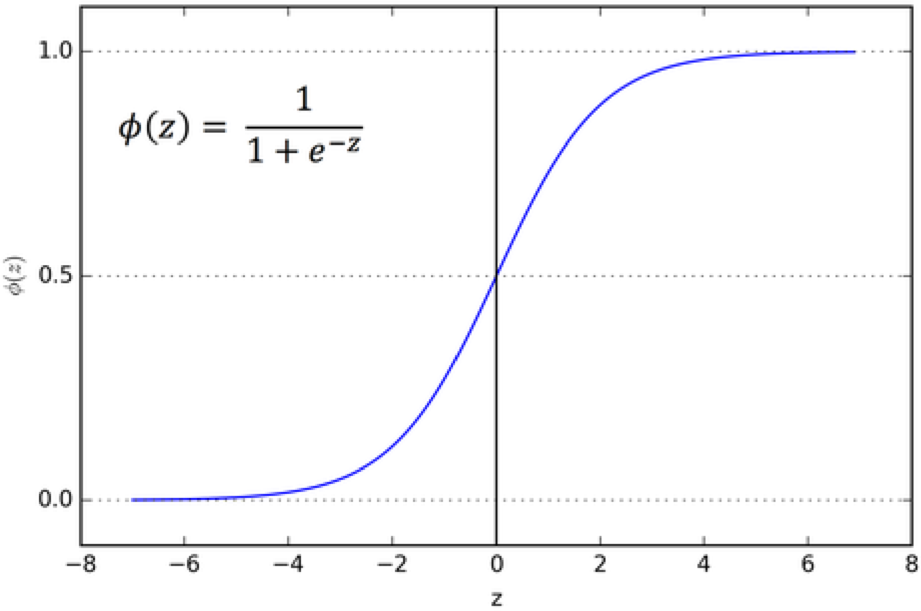


Figure 5.5 Sigmoid Activation Function

The main reason why we use sigmoid function is because it exists between (0 to 1). Therefore, it is especially used for models where we have to predict the probability as an output. Since probability of anything exists only between the range of 0 and 1, sigmoid is the right choice.

The function is differentiable. That means, we can find the slope of the sigmoid curve at any two points.

The function is monotonic but function’s derivative is not.

The logistic sigmoid function can cause a neural network to get stuck at the training time.

ReLU (Rectified Linear Unit) Activation Function

The ReLU is the most used activation function in the world right now. Since, it is used in almost all the convolutional neural networks or deep learning.

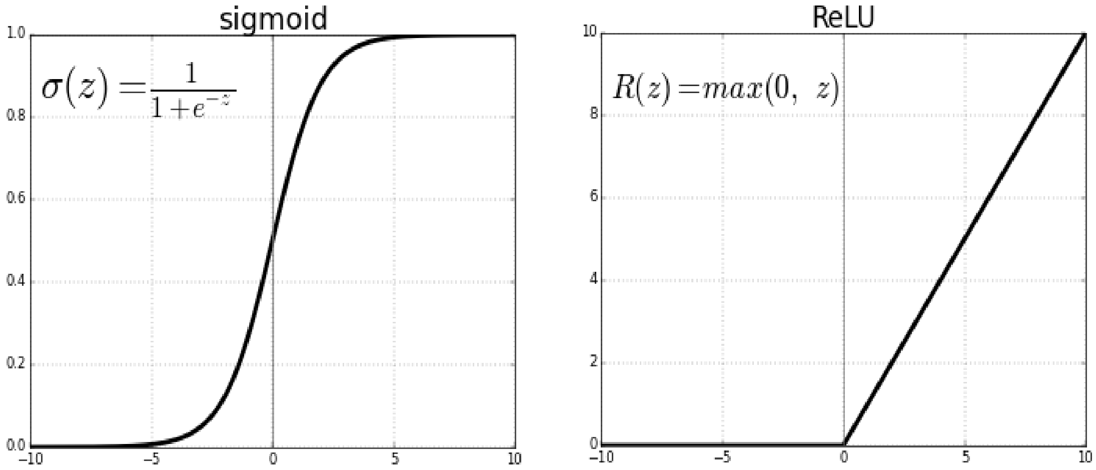


Figure 5.6 Relu Activation Function

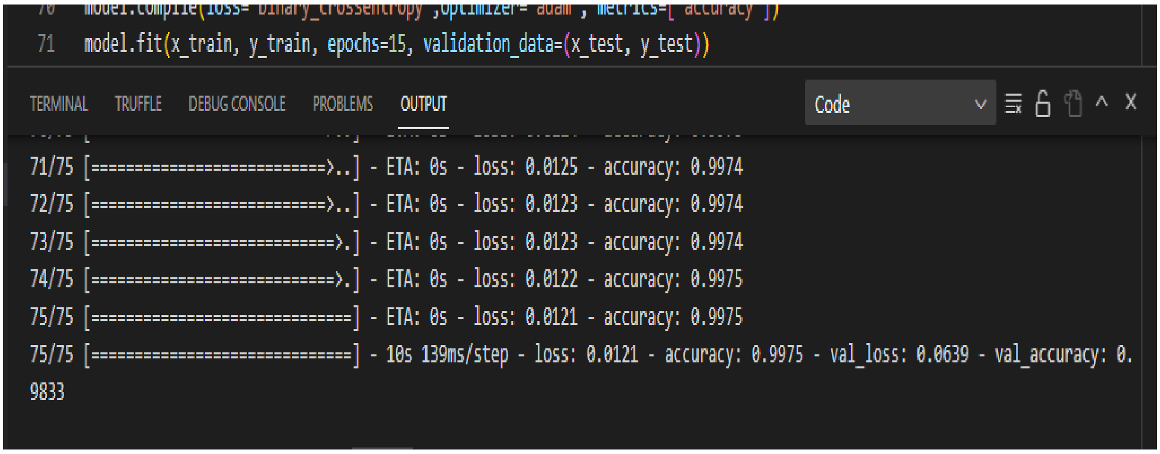
As you can see, the ReLU is half rectified (from bottom). f(z) is zero when z is less than zero and f(z) is equal to z when z is above or equal to zero.

B (0 to infinity)

The function and its derivative both are monotonic**.**

But the issue is that all the negative values become zero immediately which decreases the ability of the model to fit or train from the data properly. That means any negative input given to the ReLU activation function turns the value into zero immediately in the graph, which in turns affects the resulting graph by not mapping the negative values appropriately.

CHAPTER 6: RESULT AND DISCUSSION

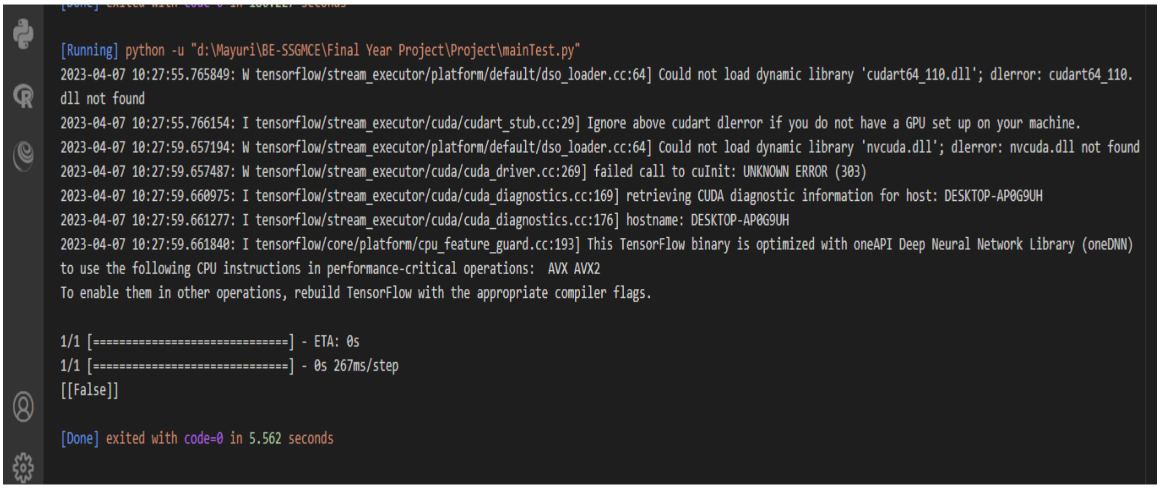


```
model.compile(loss='binary_crossentropy',optimizer='adam', metrics=['accuracy'])
model.fit(x_train, y_train, epochs=15, validation_data=(x_test, y_test))
```

```
71/75 [==========================>..] - ETA: 0s - loss: 0.0125 - accuracy: 0.9974
72/75 [==========================>..] - ETA: 0s - loss: 0.0123 - accuracy: 0.9974
73/75 [===========================>.] - ETA: 0s - loss: 0.0123 - accuracy: 0.9974
74/75 [===========================>.] - ETA: 0s - loss: 0.0122 - accuracy: 0.9975
75/75 [==============================] - ETA: 0s - loss: 0.0121 - accuracy: 0.9975
75/75 [==============================] - 10s 139ms/step - loss: 0.0121 - accuracy: 0.9975 - val_loss: 0.0639 - val_accuracy: 0.
9833
```

Figure 6.1. Accuracy after model building

In the above figure i.e. Fig 6.1, the model is trained with the number of epochs which helps in better training of model for giving best and more accurate results.



```
[Running] python -u "d:\Mayuri\BE-SSGMCE\Final Year Project\Project\mainTest.py"
2023-04-07 10:27:55.765849: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cudart64_110.dll'; dlerror: cudart64_110.
dll not found
2023-04-07 10:27:55.766154: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.
2023-04-07 10:27:59.657194: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'nvcuda.dll'; dlerror: nvcuda.dll not found
2023-04-07 10:27:59.657487: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (303)
2023-04-07 10:27:59.660975: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:169] retrieving CUDA diagnostic information for host: DESKTOP-AP0G9UH
2023-04-07 10:27:59.661277: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:176] hostname: DESKTOP-AP0G9UH
2023-04-07 10:27:59.661840: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN)
to use the following CPU instructions in performance-critical operations:  AVX AVX2
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.

1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 267ms/step
[[False]]

[Done] exited with code=0 in 5.562 seconds
```

Figure 6.2. Model Testing result

In Fig 6.2, the model is tested and checked whether it is working properly or not by providing it various sample images as input and result is checked.

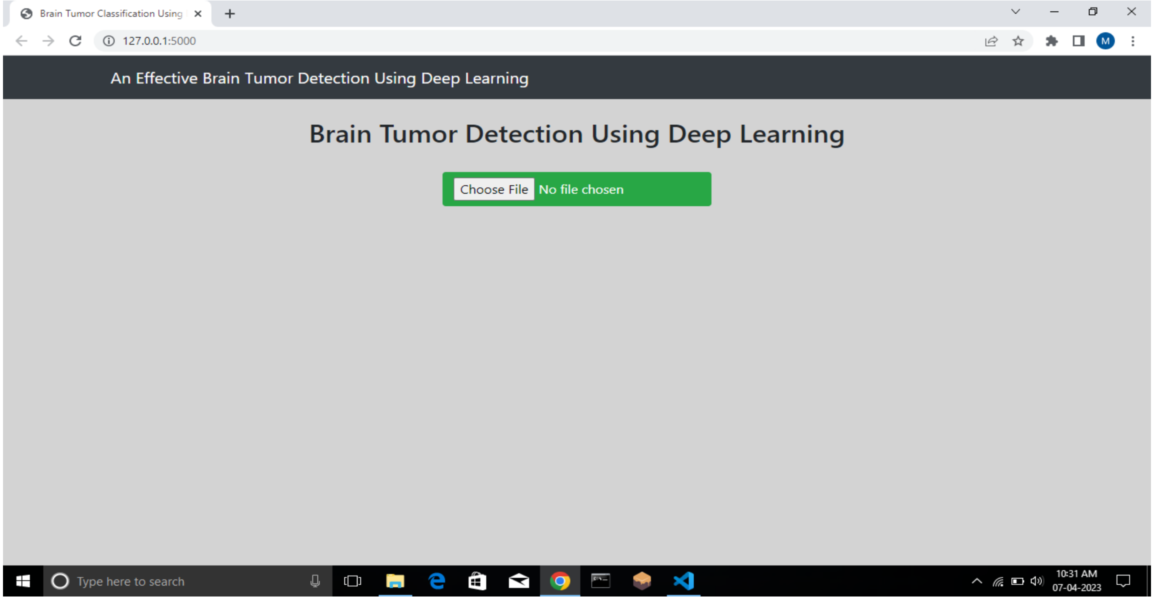

Brain Tumor Classification Using
127.0.0.1:5000
An Effective Brain Tumor Detection Using Deep Learning
Brain Tumor Detection Using Deep Learning
Choose File
No file chosen
Type here to search
10:31 AM
07-04-2023

Figure 6.3. Model on Webpage

In Fig 6.3, the project is displayed on web as front end by connecting the DL models to web using flask and thus deployed the model on web.

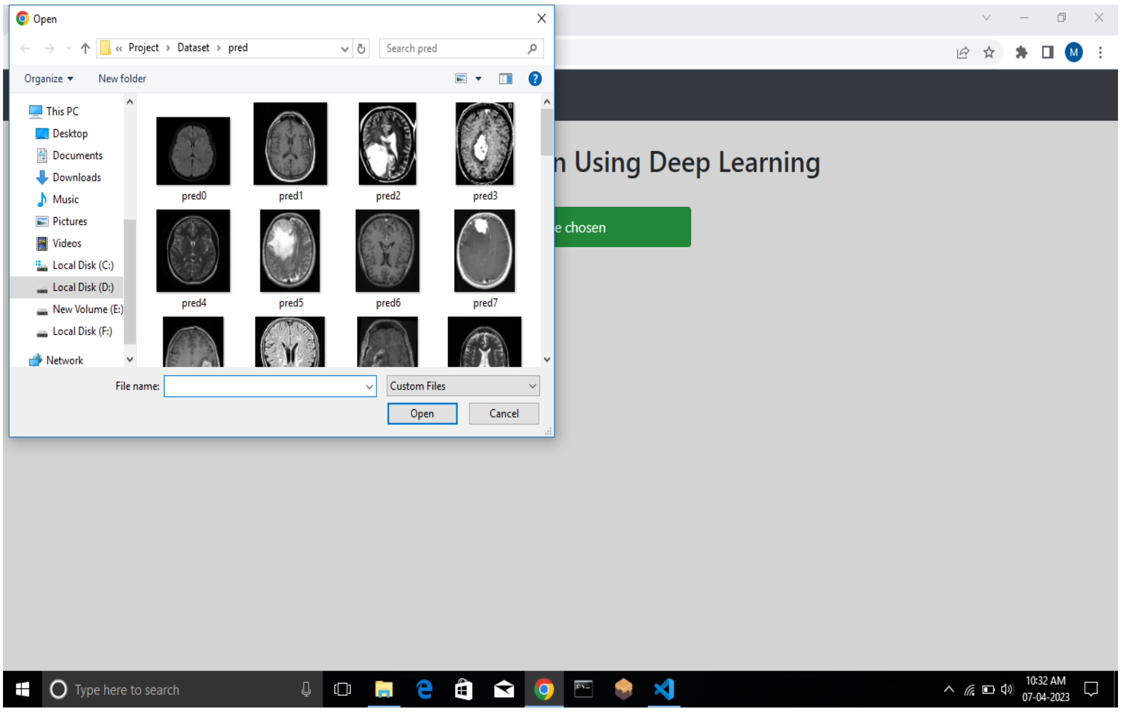


Figure 6.4. Image Choosing

In Fig 6.4, the image is choosen from dataset which we want to check that whether the brain tumor is present or not.

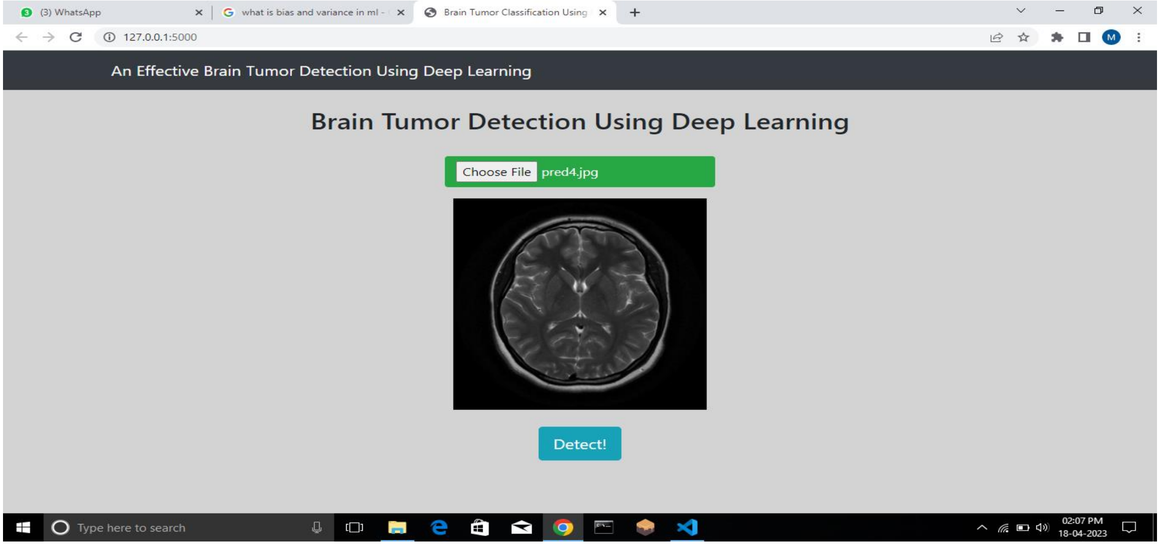
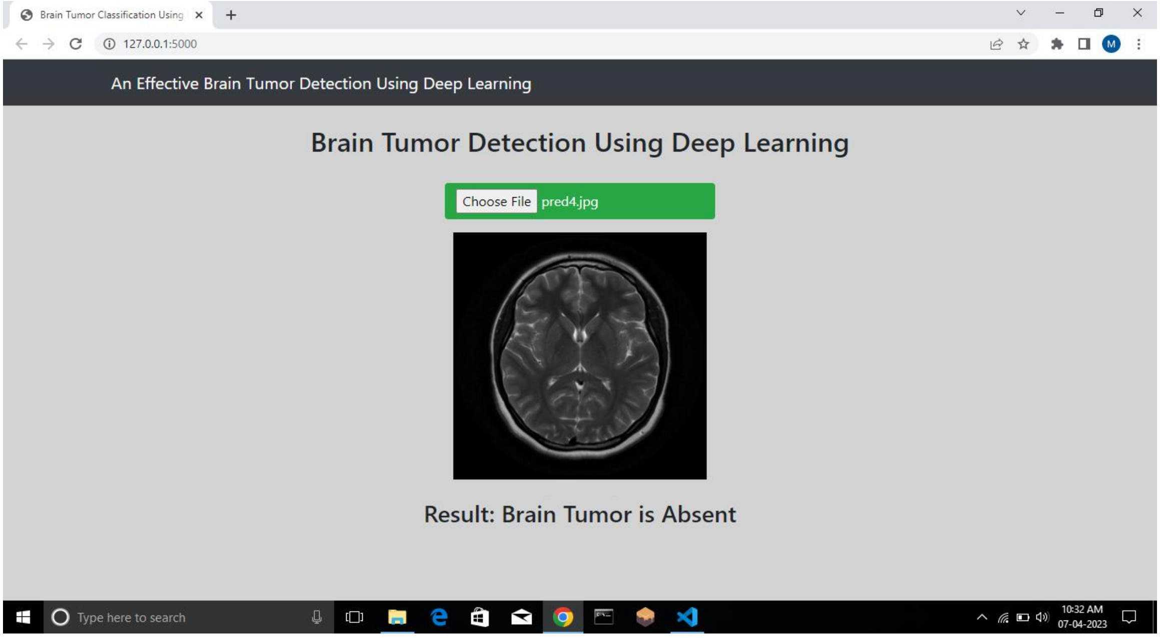

(3) WhatsApp
what is bias and variance in ml -
Brain Tumor Classification Using
127.0.0.1:5000
An Effective Brain Tumor Detection Using Deep Learning
Brain Tumor Detection Using Deep Learning
Choose File
pred4.jpg
Detect!
Type here to search
02:07 PM
18-04-2023

Figure 6.5. Selected Image Display

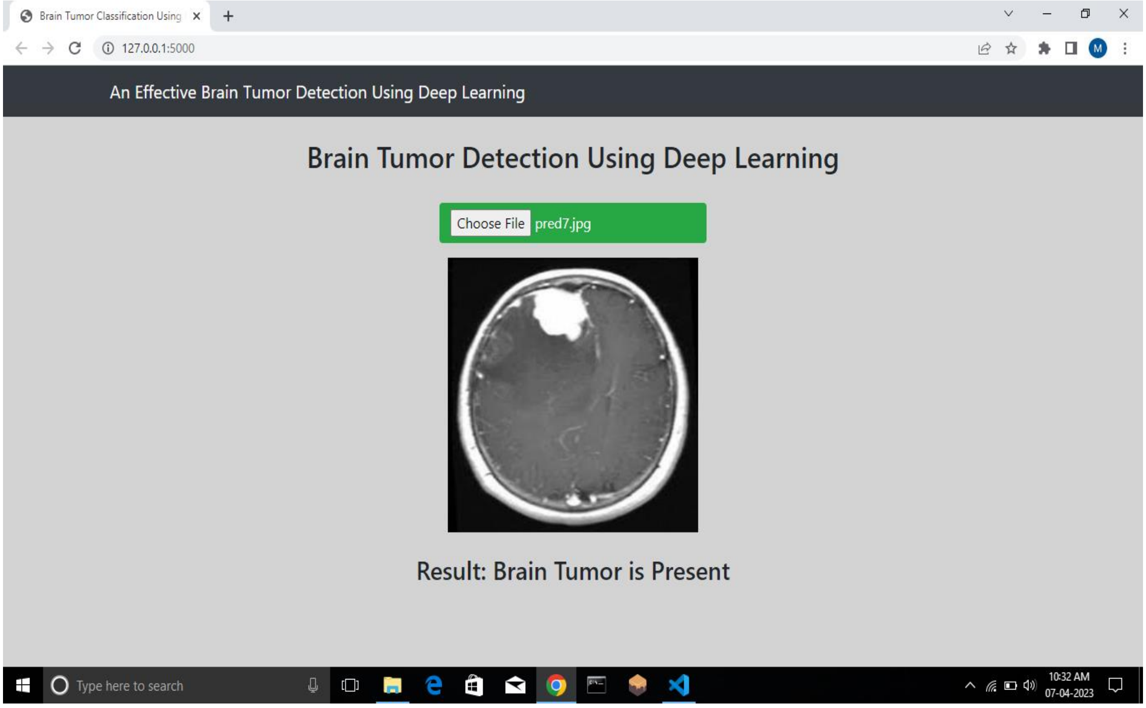
In Fig 6.5, the selected image input from dataset is displayed on the front end to check the proper result.


Brain Tumor Classification Using
127.0.0.1:5000
An Effective Brain Tumor Detection Using Deep Learning
Brain Tumor Detection Using Deep Learning
Choose File
pred4.jpg
Type here to search
10:32 AM
07-04-2023

Result: Brain Tumor is Absent

Figure 6.6. Brain Tumor detection

In Fig 6.6, after clicking on the “Detect” button shown in Fig 6.5, the proper result is displayed on the web that the image is non tumorous.


Brain Tumor Classification Using
127.0.0.1:5000
An Effective Brain Tumor Detection Using Deep Learning
Choose File
Type here to search
10:32 AM
07-04-2023

Brain Tumor Detection Using Deep Learning

pred7.jpg

Result: Brain Tumor is Present

Figure 6.7. Brain Tumor Detection

In Fig 6.7, after clicking on the “Detect” button shown in Fig 6.5, the proper result is displayed on the web that the image is non tumorous.

CHAPTER 7: ADVANTAGES, APPLICATIONS AND LIMITATIONS

7.1 ADVANTAGES

1. **Early detection:** Early detection of brain tumors can significantly improve the chances of successful treatment. Deep learning algorithms can quickly analyze large amounts of medical images and identify potential tumors that might be missed by human observers.

2. **Accuracy:** Deep learning algorithms are highly accurate in identifying tumors. They can analyze medical images with great precision and detect even small tumors that might be difficult to spot with the human eye.

3. **Efficiency:** Automated brain tumor detection using deep learning can save a lot of time and effort for radiologists and other medical professionals. They can quickly scan through large amounts of data and focus on the cases that need their attention the most.

4. **Personalized treatment:** Deep learning algorithms can also help in developing personalized treatment plans for patients. By analyzing medical images and other data, they can provide valuable insights into the size, location, and nature of the tumor, which can help in developing an effective treatment plan.

7.2 APPLICATIONS

1. **Early Detection:** An effective brain tumor detection system can help doctors detect brain tumors at an early stage, which can improve patient outcomes and survival rates.

2. **Accurate Diagnosis:** Deep learning algorithms can help doctors accurately diagnose brain tumors by analyzing medical images, such as MRI or CT scans, with greater precision and speed than human doctors.

3. **Treatment Planning:** An effective brain tumor detection system can help doctors plan the best course of treatment for each patient based on the size and location of the tumor. This can lead to more personalized and effective treatment plans.

4. **Monitoring Tumor Growth:** By using deep learning algorithms to analyze medical images over time, doctors can monitor the growth and progression of brain tumors. This can help them adjust treatment plans as needed to maximize patient outcomes.

5. **Research:** An effective brain tumor detection system can also be used to analyze large amounts of medical imaging data to identify patterns and trends in brain tumors. This can help researchers develop new treatments and improve our understanding of brain tumors.

7.3 LIMITATIONS

Despite the many benefits of deep learning for brain tumor detection, there are some limitations to its effectiveness. Some of these limitations include:

1. **Lack of interpretability:** Deep learning models can be very complex and difficult to interpret, making it challenging to understand how the model arrived at a particular decision or diagnosis. This lack of interpretability can make it challenging for doctors to trust the model's outputs and may lead to less adoption of the technology.

2. **Limited data availability:** Deep learning models require large amounts of data to train effectively. However, obtaining large amounts of high-quality brain imaging data for training a brain tumor detection system can be challenging. This is especially true for rare tumor types or patients with uncommon characteristics.

3. **False positives and false negatives:** Deep learning models can produce false positives (incorrectly identifying a tumor where there isn't one) or false negatives (failing to identify a tumor that is present). These errors can lead to misdiagnosis or delayed diagnosis, potentially leading to poorer patient outcomes.

4. **Dependence on high-quality imaging:** The accuracy of deep learning models for brain tumor detection is highly dependent on the quality of the imaging data used for training and testing. Poor quality imaging can lead to inaccuracies in the model's outputs.

5. **Limited generalizability:** Deep learning models trained on one set of data may not generalize well to new data from different imaging modalities or populations. This can limit the usefulness of the model in a clinical setting where patients may have diverse characteristics and imaging data.

CHAPTER 8: CONCLUSION

Magnetic Resonance Imaging (MRI) has become an effective tool for clinical research in recent years and has found itself in applications such as brain tumour detection. Deep learning techniques when applied on these MRI images helps to detect the tumor. The study and implementation of CNN algorithms clearly demonstrates that it aids in the effective and more accurate detection of brain tumors. Since diagnosing a brain tumor is difficult due to its complexity and sensitivity, accuracy is essential when determining whether or not a tumor is present in a patient's brain and how frequently it occurred. We have done practical implementation by adding one extra hidden layer in CNN algorithm which gives better accuracy than simple CNN algorithm. Through the proposed method is able to detect if a tumor exists or not. However, in future the system can be further enhanced to detect a particular type of tumor and suggest the treatment accordingly. We will need to use a variety of deep learning algorithms in the future to develop model which will provide severity and location of tumor with faster, more effective and more dependable methods for early brain tumor classification and detection.

REFERENCES

[1] Ayesha Younis, Li Qiang, Charles Okanda Nyatega, Mohammed Jajere Adamu, H. B. Kawuwa, Brain Tumor Analysis Using Deep Learning & VGG-16 Enessembling Learing Approaches, Journal of Applied Science, 2022.

[2] Arkapravo Chattopadhyay, Mausumi Maitra, MRI-based Brain Tumor Image Detection Using CNN based Deep Learning Method. Elsevier Masson SAS 2022.

[3] Prof. Kavita Bathe, Varun Rana, Sanjay Singh, Vijay Singh, Brain Tumor Detection using Deep Learning Techniques, Proceedings of 4th International Conference on Advances in Science & Technology (ICAST 2021).

[4] Aryan Sagar Methil, Brain Tumor Detection Using Deep Learning and Image Processing, International Conference on Artificial Intelligence and Smart Systems (ICAIS), March 2021

[5] Bakhtyar Ahmed Mohammed, Muzhir Shaban AI-Ani, “An efficient approach to diagnose brain tumors through deep CNN”, International Conference on Artificial Intelligence and Smart Systems (ICAIS) January 2021.

[6] Manika Gupta , Sanjeev Kumar Prasad, Deependra Rastogi , Prashant Johri, “Brain Tumor Classification using Advanced Computational Techniques” 3rd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN) 2021.

[7] Ankita Parmar, Dr. Mefuza s. holia , Pranay s. patel, A survey on Brain Tumor Detection Using Deep Learning, International Journal of Advance Engineering and Research Development at Vallabh Vidhyanagar, Anand, Gujarat, India On 4 April 2020.

[8] W. Zhang, Y. Wu, B. Yang, S. Hu, L. Wu, S. Dhelim, Overview of multi-modal brain tumour MR image segmentation, Healthcare 9 (2021).

[9] D. Nanware, S. Taras, and S. Navale, ‘Brain Tumor Detection Using Deep Learning’, Int. J. Sci. Res. Eng. Dev, 2020.

[10] T. Kalaiselvi, S. T. Padmapriya, P. Sriramakrishnan, and K. Somasundaram, ‘Deriving tumor detection models using convolutional neural networks from MRI of human brain scans’, Int. J. Inf. Technol.

[11] R. V. Kurup, V. Sowmya, and K. P. Soman, Effect of Data Pre-processing on Brain Tumor Classification Using Capsulenet. Singapore: Springer Singapore, 2020.

[12] M. Toğaçar, Z. Cömert, and B. Ergen, ‘Classification of brain MRI using hyper column technique with convolutional neural network and feature selection method’, Expert Syst. Appl., vol. 149, p. 113274, Jul. 2020.

[13] M. I. Sharif, J. P. Li, M. A. Khan, and M. A. Saleem, ‘Active deep neural network features selection for segmentation and recognition of brain tumors using MRI images’, Pattern Recognit. Lett., vol. 129, pp. 181–189, 2020, doi: 10.1016/j.patrec.2019.11.019.

[14] Fatemeh Derikvand,Hassan Khotanlou,”Brain Tumor Segmentation in Magnetic resonance imaging Images Using a Hybrid Deep Network Based on Patch and Pixel”, 2020 International Conference on Machine Vision and Image Processing (MVIP), ISBN: 978-1-7281-6832-6.

[15] Hein Tun Zaw, Noppadol Maneerat, Khin Yadanar Win, “Brain tumour detection based on Naïve Bayes Classification”, 2019 5th International Conference on Engineering, Applied Sciences and Technology (ICEAST), ISBN:978-1-7281-0067-8.

[16] Tonmoy Hossain, Fairuz Shadmani Shishir, Mohsena Ashraf, MD Abdullah Al Nasim, Faisal Muhammad Shah, Brain tumour detection using Convolution Neural Network (2019), 1st International Conference on Advances in Science, Engineering and Robotics Technology 2019 (ICASERT 2019)

[17] Tamjid Imtiaz, Shahriar Rifat, Shaikh Anowarul, “Automated Brain Tumor Segmentation from Magnetic resonance imaging Data Based on Local Region Analysis”, 2019 IEEE International Conference on Biomedical Engineering, Computer and Information Technology for Health (BECITHCON) 28-30 November 2019, Dhaka, Bangladesh.

[18] Annisa Wulandari, Riyanto Sigit, Mochamad Mobed Bachtiar,” Brain Tumor Segmentation to Calculate Percentage Tumor Using Magnetic resonance imaging”, 2018 International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC).

[19] Hein Tun Zaw, Noppadol Maneerat, Khin Yadanar Win, “Brain tumour detection based on Naïve Bayes Classification”, 2019 5th International Conference on Engineering, Applied Sciences and Technology (ICEAST).

[20] Bhavana Ghotekar, K. J. Mahajan, Brain Tumour Detection and classification using SVM, National Conference on Innovative Trends in Science and Engineering.

[21] Seetha J, Raja S. S. Brain Tumor Classification Using Convolutional Neural Networks. Biomed Pharmacol J 2018;11(3).

An Effective Brain Tumor Detection System Using Deep Learning

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ABSTRACT - A brain tumor is an abnormal growth or mass of cells in the brain. Human brain is enclosed by a very rigid skull. Any development inside such a limited space can create some issues. This tends to compromise life and can harm the mind. However, you can receive neurological treatment as soon as possible if you are aware of the symptoms of a brain tumor. It's terrifying to think that you might have tumor in your brain, but early detection can help you survive and thrive. The brain tumor is diagnosed using a variety of algorithms, including SVM, VGG, K-means, and others. The CNN algorithm, which uses MRI images of brain tumor to determine whether a brain tumor is present or not in a human brain, is described in this paper. Image Pre-processing, normalization, feature extraction, Image analysis and image classification are all components of the algorithm. CNN algorithm contains various layers such as, Convolution layer, pooling layer, various hidden layers etc. In this we added one extra hidden layer to gain the better accuracy of model and detect brain tumor more accurately.

KEYWORDS - Brain Tumor, Deep Learning, Classification, Accuracy, MRI (Magnetic Resonance Imaging), CNN (Convolutional Neural Network).

I. INTRODUCTION

A brain tumor is an unnatural growth of cells in the brain. The symptoms of brain tumor can vary depending on its size, location and type. Cerebrum growths can be harmless (non-destructive) or threatening (malignant). Headaches, seizures, issues with vision or hearing, difficulty speaking, limb weakness or numbness, and shifts in mood or behavior are all possible signs. However, it is essential to keep in mind that a person with these symptoms does not necessarily have a brain tumor, and that many of these symptoms can also be brought on by other conditions. A brain tumor diagnosis typically requires a biopsy, in which a small portion of the tumor is removed and examined under a microscope to determine whether it is cancerous. Brain tumor patients may benefit from earlier diagnosis and treatment.

Using medical imaging like MRI or CT scans, deep learning algorithms can aid in the process of finding and diagnosing brain tumors. Train a convolutional neural network (CNN) on a large dataset of brain images with and without tumors is one common strategy. The CNN figures out how to perceive examples and highlights that are related with the presence of a growth, and can then be utilized to characterize new pictures as one or the other positive or negative for a cancer. It is vital to note, in any case, that while profound learning can be a significant device in helping with cerebrum growth identification, it ought not be utilized as a trade for a prepared clinical expert. A trained medical professional should always be consulted before making any decisions regarding diagnosis or treatment.

A. Deep learning

A subfield of machine learning known as deep learning is entirely based on artificial neural networks. Since brain networks are intended to copy the human mind, deep learning is likewise a kind of mirroring the human cerebrum. Deep learning models can consequently gain highlights from the information, which makes them appropriate for errands like picture acknowledgment, discourse acknowledgment, and regular language handling. Feed forward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs) are the architectures in deep learning that are utilized the most frequently. Deep learning achieves immense strength and adaptability by learning. A lot of named information and a lot of processing power are needed to create Deep Learning models. Deep learning has had the opportunity to advance in a wide range of applications due to the increasing accessibility of a lot of information and computational resources.

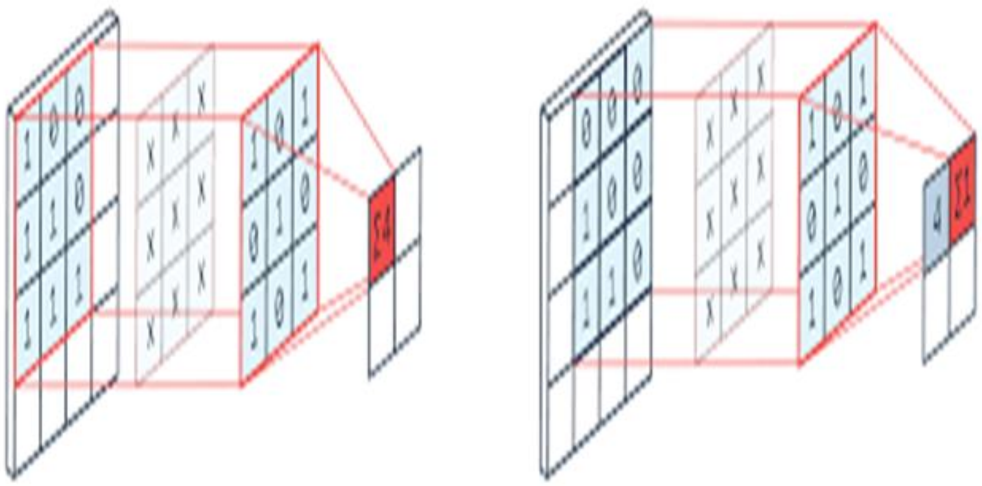
B. Supervised learning

In Supervised learning machines are prepared utilizing great "marked" preparing information, and on premise of that information, machines anticipate the result. Some input data already carries the appropriate output tag, as indicated by the labelled data. In supervised learning, the machines preparation information go about as a manager to show them how to foresee the result accurately. Similar to how a student learns under a teacher's supervision, it applies. The process of providing the machine learning model with both accurate input data and output data is referred to as supervised learning. Finding a planning capability to coordinate the info variable (x) with the result variable (y) is the goal of a supervised learning calculation.

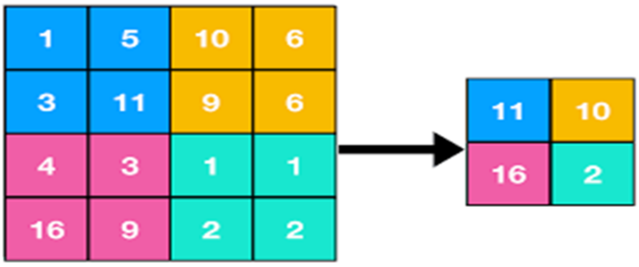
C. CNN

Deep learning architectures like the CNN (Convolutional Neural Network) are often used for tasks like image classification and recognition. Some of its many layers include pooling, fully connected, and convolutional ones. To remove highlights from the info picture, the Convolutional layer applies channels, the Pooling layer down samples the picture to eliminate calculation, and the completely associated layer makes the last forecast. The network uses back propagation and gradient descent to learn the best filters. Layers that make up a Convolutional Neural Network are a fully connected pooling layer and a convolutional layer. The following diagrams depict all layers.

Layer of Convolution: An activation map is created by scanning the images several pixels at a time with a filter in the convolution layer. The internal workings of the convolution layer are shown in the following figure.



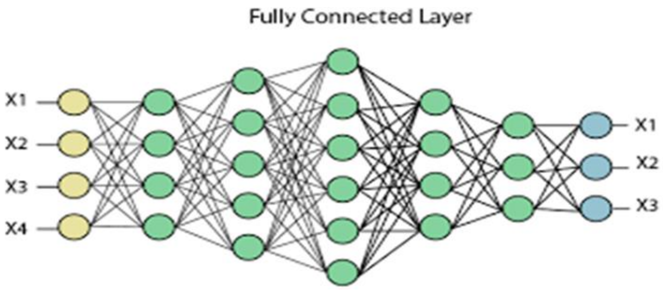
Layer of Pooling: Layer of Pooling diminishes how much information made by the convolutional layer so it is put away more productively. The pooling layer's internal workings are depicted in the following Figure.



1	5	10	6
3	11	9	6
4	3	1	1
16	9	2	2

11	10
16	2

Layer with Full Connectivity: A layer whose output is "flattened" into a single vector and used as an input for the subsequent stage is referred to as a layer with Full Connectivity. In order to anticipate the appropriate label, the first fully connected layer adds weights to the feature analysis inputs. The probability for each label is provided by the fully connected output layer at the end. The internal workings of a fully connected layer are depicted in the following figure.



II. LITERATURE SURVEY

Li Qiang, Ayesha Younis,[1] and others proposed two deep learning techniques, CNN and VGG-16, were applied to MRI scans, with VGG-16 achieving better accuracy (98.5%) than CNN (96%) in accuracy.

Arkapravo Chattopadhyay et al.,[2] put forward a CNN-based method for segmenting brain tumors from 2D MRI, next conventional classification and deep learning techniques. CNN outperformed other traditional classifiers in this study. In order to successfully train the model, they used a SVM classification and other activation algorithms to verify the model. Additionally, they took MRI images of a variety of tumor sizes, locations, shapes, and intensities.

Prof. Kavita Bathe and Others.[3] On the MRI dataset, two deep learning methods—CNN and Depth Wise CNN—were tested. The results showed that CNN had an accuracy of 95.7 percent, while Depth Wise CNN had an accuracy of 97%, which was higher than CNN.

Aryan Sagar, Methil, and Others.[4] In this paper, image preprocessing was the first step. The Convolutional Neural Network (CNN) is then used to classify images of tumors and non-tumors. On the training set, CNN had a recall of 98.55%, and on the validation set, it had a recall of 99.73%.

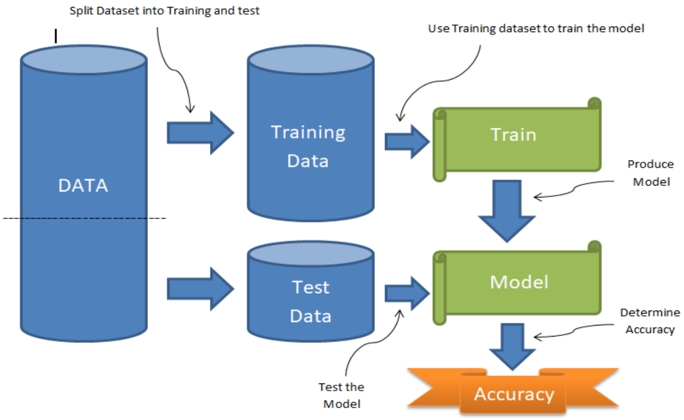
Ahmed Bakhtyar Mohammed et al.,[5] suggested processing 1258 MRI images from 2015 to 2020 using MATLAB software and their database. The study found that the proposed deep CNN-based approach had an accuracy level of 96%.

Manika Gupta and others[6] paper aims to use three distinct CNN models to create three distinct classifications of brain tumors. Mind growth recognition is accomplished with 91.29% precision utilizing the main CNN model. With padding, dropout, and data augmentation, the second CNN model which correctly performs classification of brain tumor with an accuracy of 79.79 percent. The brain tumors can be grouped with an accuracy of 87.27 percent by utilizing the third CNN model, VGG16.

Ankita Parmar and others.[7] An examination of various methods for detecting brain tumors is carried out. An overview of the brain, a brain tumor, and MRI images are discussed in this paper. The conventional method and a few segmentation techniques are also discussed. According to this review, the most efficient and useful research area is automated brain tumor detection using CNN from magnetic resonance images.

III. PROPOSED SYSTEM

In the past, numerous deep learning methods were utilized for brain tumor detection. Right now we have creating cerebrum tumor discovery by utilizing CNN algorithm. Our method predicts that deep learning CNN algorithms outperform other algorithms in terms of accuracy.

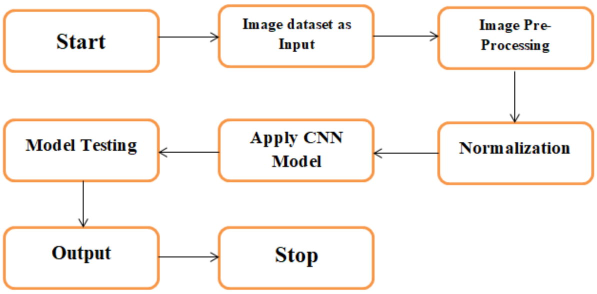


Steps to split data and produce model :

a) Identify the kind of training dataset first.
b) Collect the training data with labels.
c) Divide the training dataset into test, validation, and training datasets.
d) Determine the info highlights of the preparation dataset, which ought to have sufficient information with the goal that the model can precisely foresee the result.
e) Selecting an appropriate algorithm for the model.
f) Put the algorithm into action using the training dataset.
g) Use the validation set to determine accuracy of the model . If the model gives expected results and correctly predicts the output then our model is accurate.

IV. METHODOLOGY

The project implementation flow, which includes image dataset, preprocessing of image, normalization, CNN algorithm implementation, then testing of model and output, is depicted in the following figure.



A. Image Dataset:

We obtained this dataset from the websites of Kaggle. There are a various datasets to choose from. There are 3,000 images of brain tumors in the dataset, which have been divided into two groups: yes and no. There are 1500 images with a tumor, and there are 1500 images without a tumor.

B. Image preprocessing:

The goal of preprocessing is to improve the quality of the image so that we can better analyze it. Preprocessing enables us to improve specific qualities that are crucial to the application we are working on and eliminate unwanted distortions. In this firstly we read the image then convert it into array. Resizing of image and applying label to it is also performed in this.

C. Normalization :

A set of data undergoes scale transformation when it is normalized. For deep learning models, our objective is generally to recenter and rescale our information to such an extent that is somewhere in the range of 0 and 1 or - 1 and 1, contingent upon the actual information. Because the different features are on the same scale, normalization can help our neural networks train better because it stabilizes the gradient descent step. This allows us to utilize higher learning rates or assist models with meeting quicker for a given learning rate.

D. Apply CNN Model :

In this we apply CNN model to prepare machines/PCs with the goal that they can gain for a fact, order and perceive information/pictures very much like a human cerebrum does. It is used to recognize and classify images and objects. In this Different CNN layers such as, Convolution layer, pooling layer, and various hidden layers etc. are applied and used sequential model.

E. Model Testing:

We test our trained model to make sure that the learned model will behave consistently and produce the expected results.

V. ALGORITHM

i. Model Building

```
1. Start
2. Install and Import required Libraries.
3. Fetch image dataset from directory.
4. Assign dataset path to variable.
5. Create lists to store image and label.
6. Image Pre-processing
        Iterate loop through no_tumor_images:
            If img_name[1]== '.jpg':
                Read image
                Convert img into array
                Resize img
                Append array of img into list
                Append label as '0' into list
        Iterate loop through yes_tumor_images:
            If img_name[1]==’.jpg’:
                Read image
                Convert img into array
```

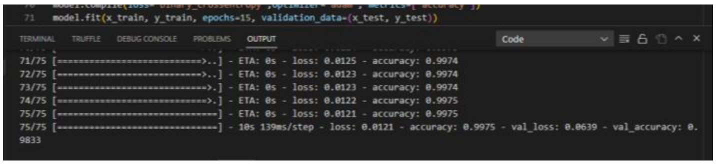
    Resize img
    Append array of img into list
    Append label as ‘1’ into list

7. Store numpy array of image into variable.
8. Store numpy array of label into variable.
9. Split Dataset into Train and Test.
10. Normalize the data.
11. Apply CNN Model.
12. Compile the model with ‘accuracy’ metrics.
13. Fit the model.
14. Save model with ‘.h5’ extension.

ii. <u>Model Testing</u>

1. Install and Import required libraries.
2. Load model.
3. Read image from dataset for prediction.
4. Convert image into array.
5. Resize image.
6. Convert image into numpy array
7. Expand dimensions of numpy array
8. Predict model.
9. Print result.
10. Connect it with Web using Flask framework.
11. Run and display it on Web.

VI. RESULT AND DISCUSSION

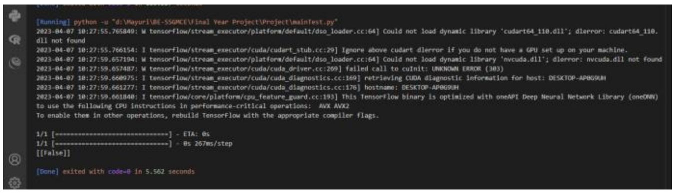


```
model.compile(loss='binary_crossentropy',optimizer='adam', metrics=['accuracy'])
model.fit(x_train, y_train, epochs=15, validation_data=(x_test, y_test))
```

```
71/75 [==========================>..] - ETA: 0s - loss: 0.0125 - accuracy: 0.9974
72/75 [==========================>..] - ETA: 0s - loss: 0.0123 - accuracy: 0.9974
73/75 [============================>.] - ETA: 0s - loss: 0.0123 - accuracy: 0.9974
74/75 [============================>.] - ETA: 0s - loss: 0.0122 - accuracy: 0.9975
75/75 [==============================] - ETA: 0s - loss: 0.0121 - accuracy: 0.9975
75/75 [==============================] - 10s 139ms/step - loss: 0.0121 - accuracy: 0.9975 - val_loss: 0.0639 - val_accuracy: 0.
9833
```

Fig 1. Accuracy after model building

The accuracy of this proposed model, which is higher than that of a straightforward CNN algorithm, is 99.75 percent.

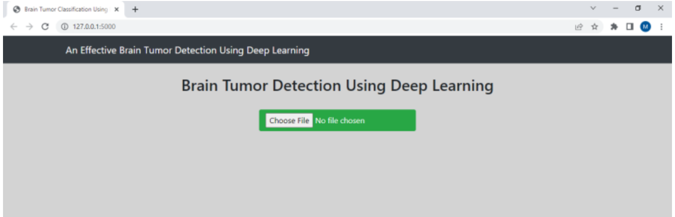


```
[Running] python -u "d:\Mayuri\BE-SSGMCE\Final Year Project\Project\mainTest.py"
2023-04-07 10:27:55.765849: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cudart64_110.dll'; dlerror: cudart64_110.
dll not found
2023-04-07 10:27:55.766154: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.
2023-04-07 10:27:59.657194: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'nvcuda.dll'; dlerror: nvcuda.dll not found
2023-04-07 10:27:59.657487: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (303)
2023-04-07 10:27:59.660975: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:169] retrieving CUDA diagnostic information for host: DESKTOP-AP0G9UH
2023-04-07 10:27:59.661277: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:176] hostname: DESKTOP-AP0G9UH
2023-04-07 10:27:59.661840: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN)
to use the following CPU instructions in performance-critical operations:  AVX AVX2
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.

1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 267ms/step
[[False]]

[Done] exited with code=0 in 5.562 seconds
```

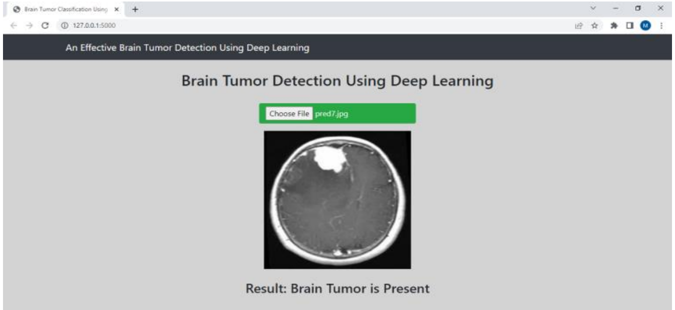
Fig 2. Model Testing result



An Effective Brain Tumor Detection Using Deep Learning

Brain Tumor Detection Using Deep Learning

Fig 3. Model on Webpage



An Effective Brain Tumor Detection Using Deep Learning

Brain Tumor Detection Using Deep Learning

Result: Brain Tumor is Present

Fig 4. Brain tumor prediction on web

VII. CONCLUSION

The study and implementation of CNN algorithms clearly demonstrates that it aids in the effective and more accurate detection of brain tumors. Since diagnosing a brain tumor is difficult due to its complexity and sensitivity, accuracy is essential when determining whether or not a tumor is present in a patient's brain and how frequently it occurred. We have done practical implementation by adding one extra hidden layer in CNN algorithm which gives better accuracy than simple CNN algorithm. We will need to use a variety of deep learning algorithms in the future to develop model which will provide severity and location of tumor with faster, more effective and more dependable methods for early brain tumor classification and detection.

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[1] Ayesha Younis, Li Qiang, Charles Okanda Nyatega, Mohammed Jajere Adamu, H. B. Kawuwa, Brain Tumor Analysis Using Deep Learning & VGG-16 Enessembling Learing Approaches, Journal of Applied Science, 2022.

[2] Arkapravo Chattopadhyay, Mausumi Maitra, MRI-based Brain Tumor Image Detection Using CNN based Deep Learning Method. Elsevier Masson SAS 2022.

[3] Prof. Kavita Bathe, Varun Rana, Sanjay Singh, Vijay Singh, Brain Tumor Detection using Deep Learning Techniques, Proceedings of 4th International Conference on Advances in Science & Technology (ICAST 2021).

[4] Aryan Sagar Methil, Brain Tumor Detection Using Deep Learning and Image Processing, International Conference on Artificial Intelligence and Smart Systems (ICAIS), March 2021

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[6] Manika Gupta , Sanjeev Kumar Prasad, Deependra Rastogi , Prashant Johri, “Brain Tumor Classification using Advanced Computational Techniques” 3rd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN) 2021.

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[8] W. Zhang, Y. Wu, B. Yang, S. Hu, L. Wu, S. Dhelim, Overview of multi-modal brain tumour MR image segmentation, Healthcare 9 (2021) 1051, https://doi. org/10.3390/healthcare9081051.

[9] D. Nanware, S. Taras, and S. Navale, ‘Brain Tumor Detection Using Deep Learning’, Int. J. Sci. Res. Eng. Dev., vol. 3, pp. 391–395, 2020.

[10] T. Kalaiselvi, S. T. Padmapriya, P. Sriramakrishnan, and K. Somasundaram, ‘Deriving tumor detection models using convolutional neural networks from MRI of human brain scans’, Int. J. Inf. Technol., pp. 2–7, 2020, doi: 10.1007/s41870-020-00438-4.

[11] R. V. Kurup, V. Sowmya, and K. P. Soman, Effect of Data Pre-processing on Brain Tumor Classification Using Capsulenet. Singapore: Springer Singapore, 2020.

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[13] M. I. Sharif, J. P. Li, M. A. Khan, and M. A. Saleem, ‘Active deep neural network features selection for segmentation and recognition of brain tumors using MRI images’, Pattern Recognit. Lett., vol. 129, pp. 181–189, 2020, doi: 10.1016/j.patrec.2019.11.019.

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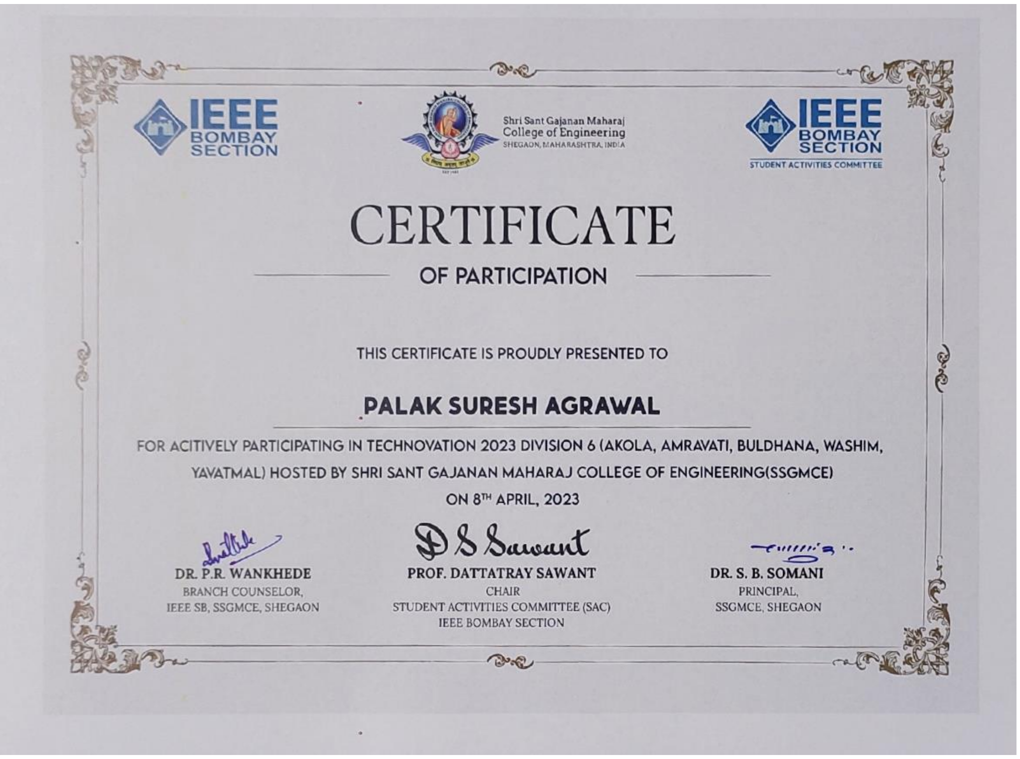

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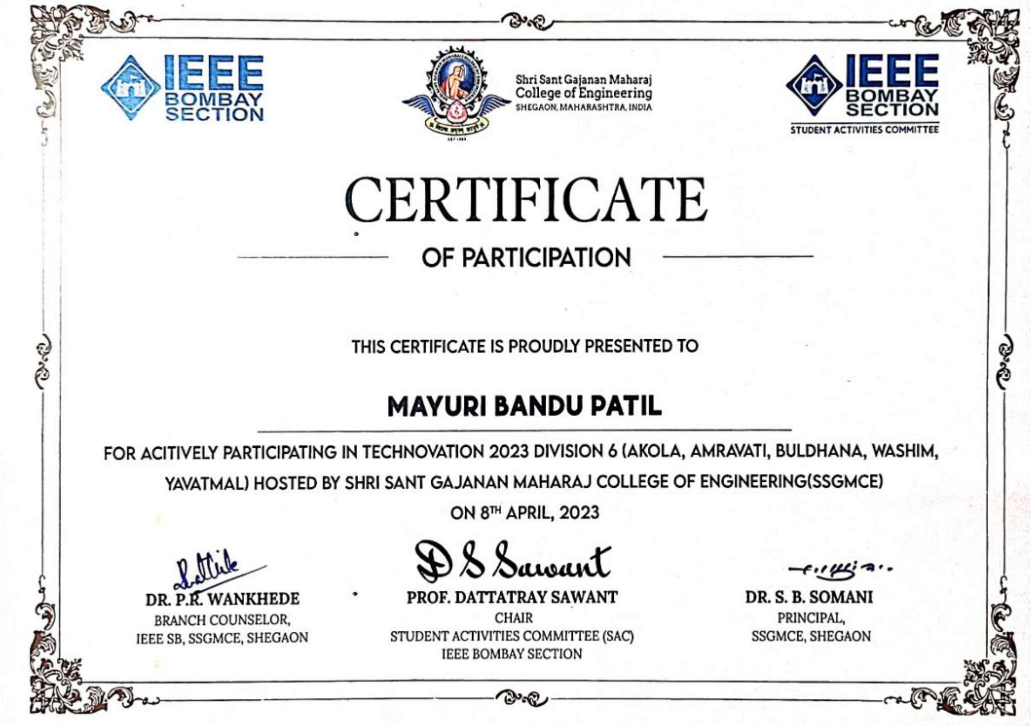

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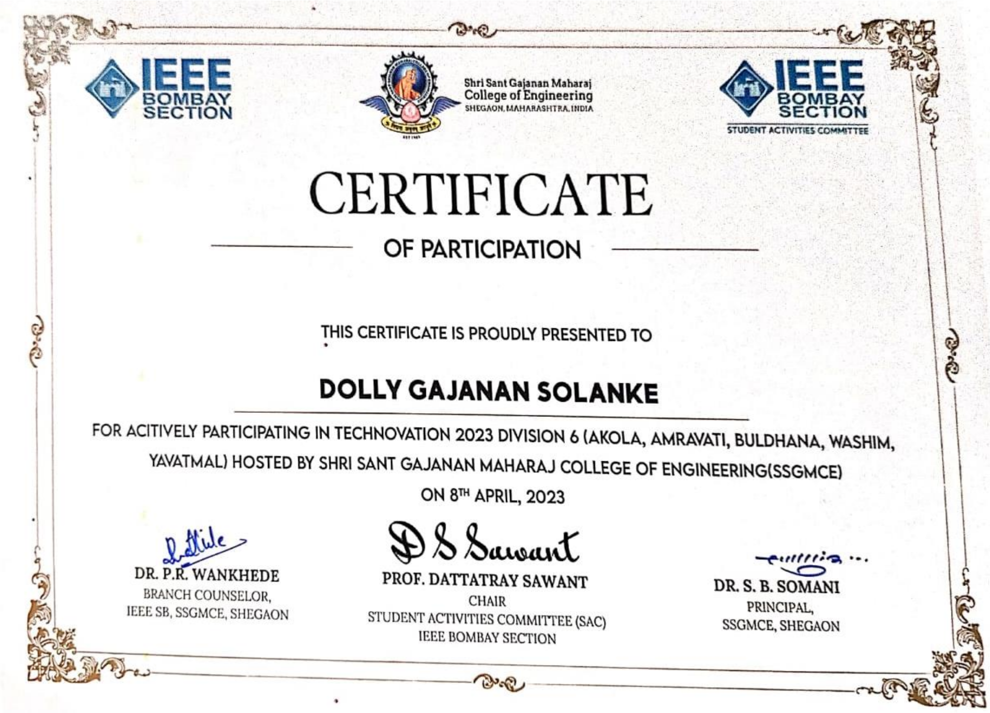

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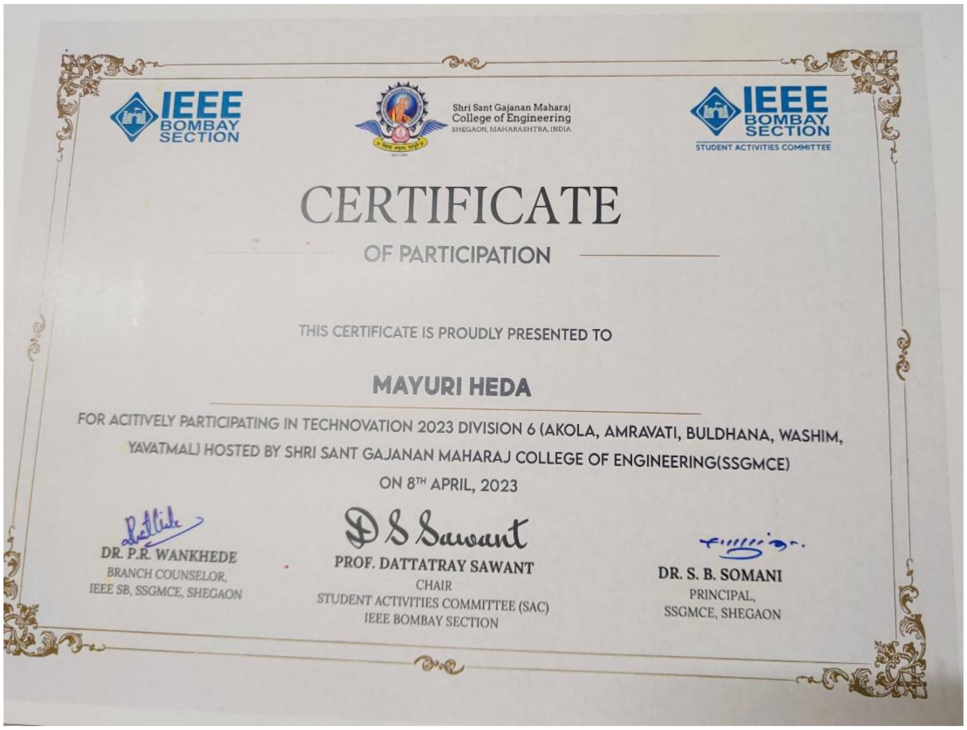

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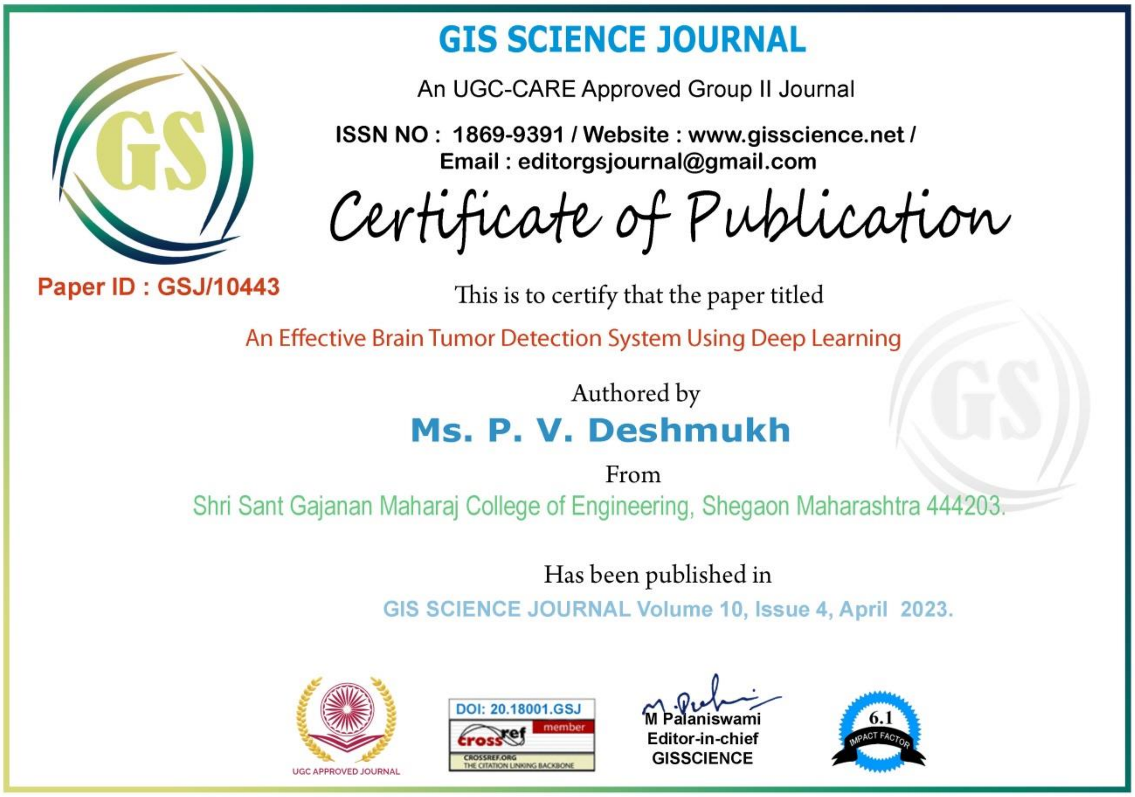

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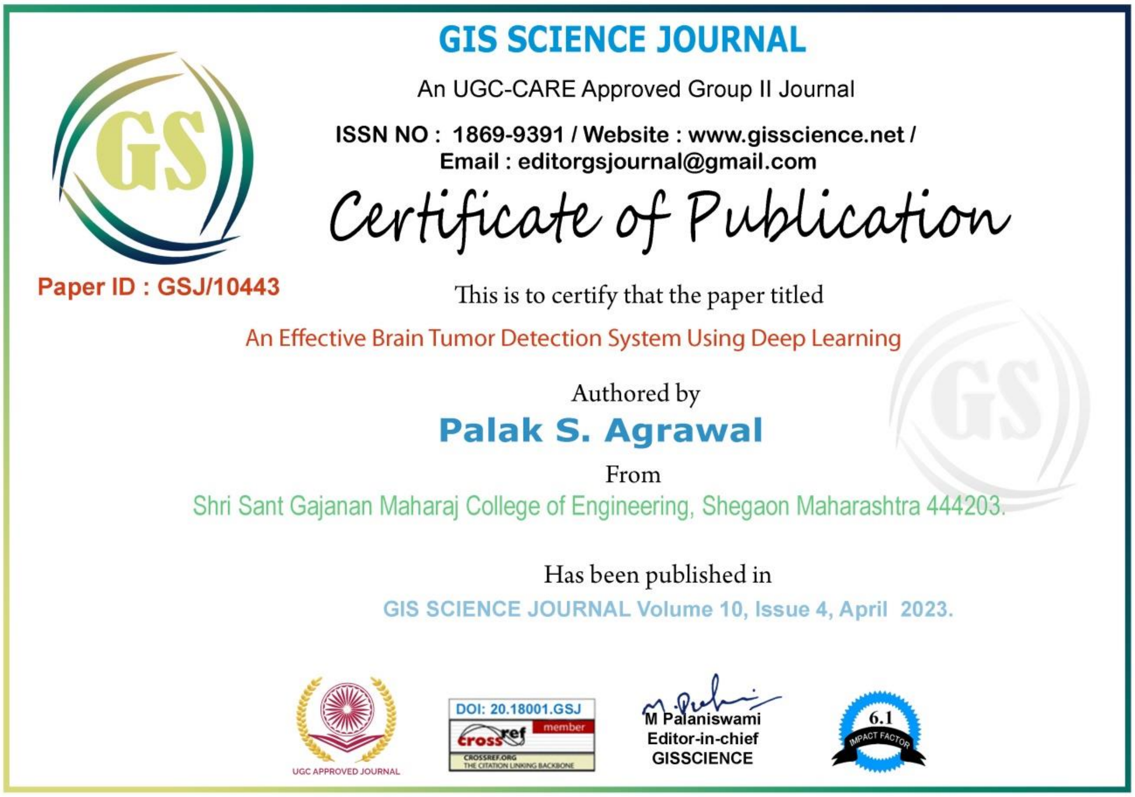

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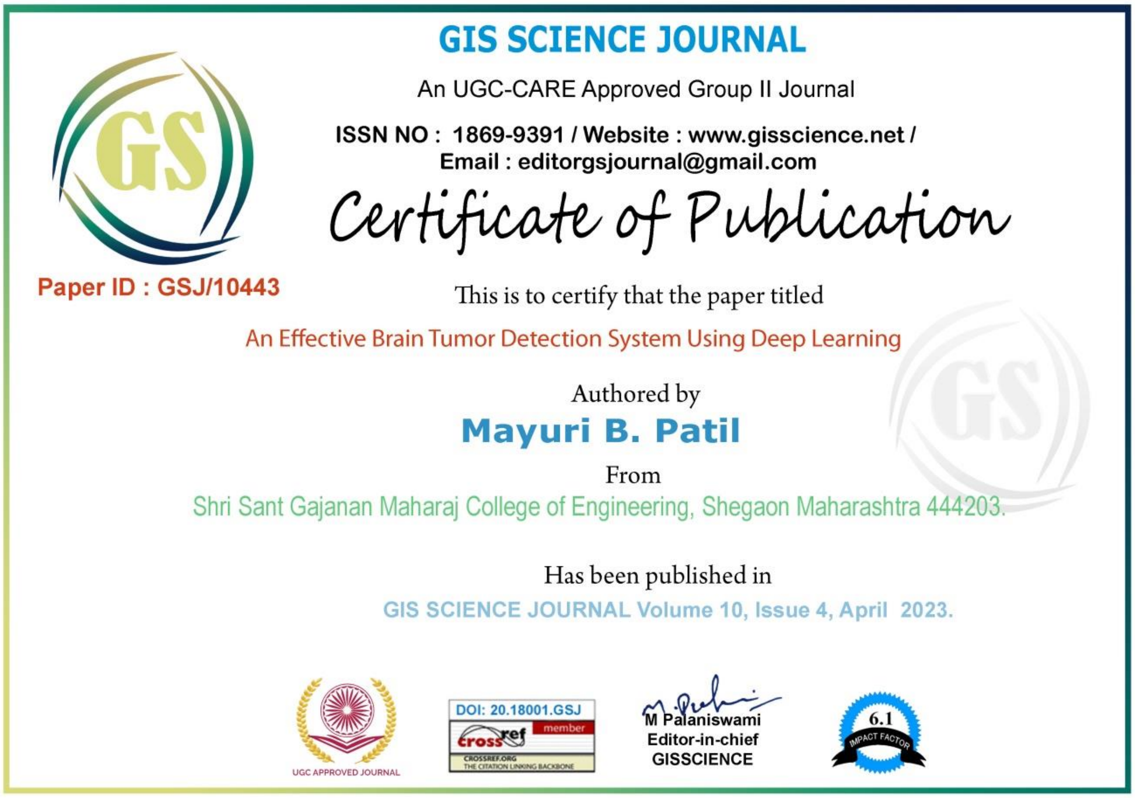

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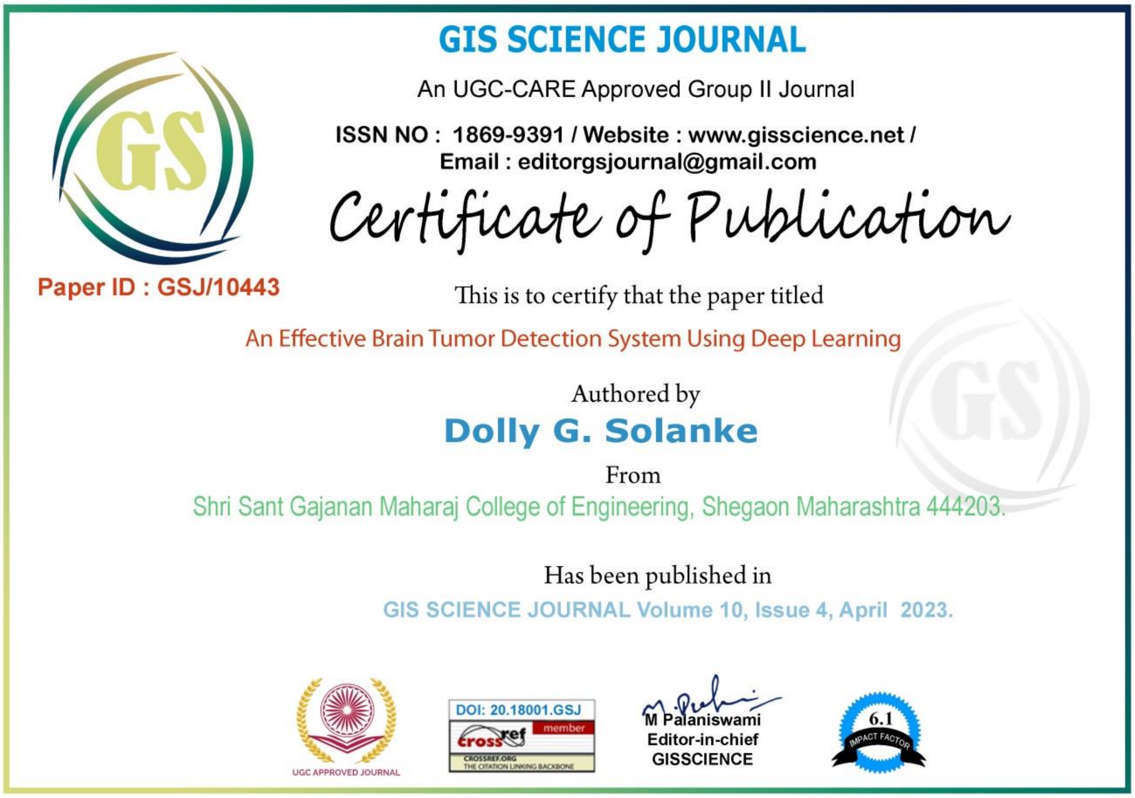

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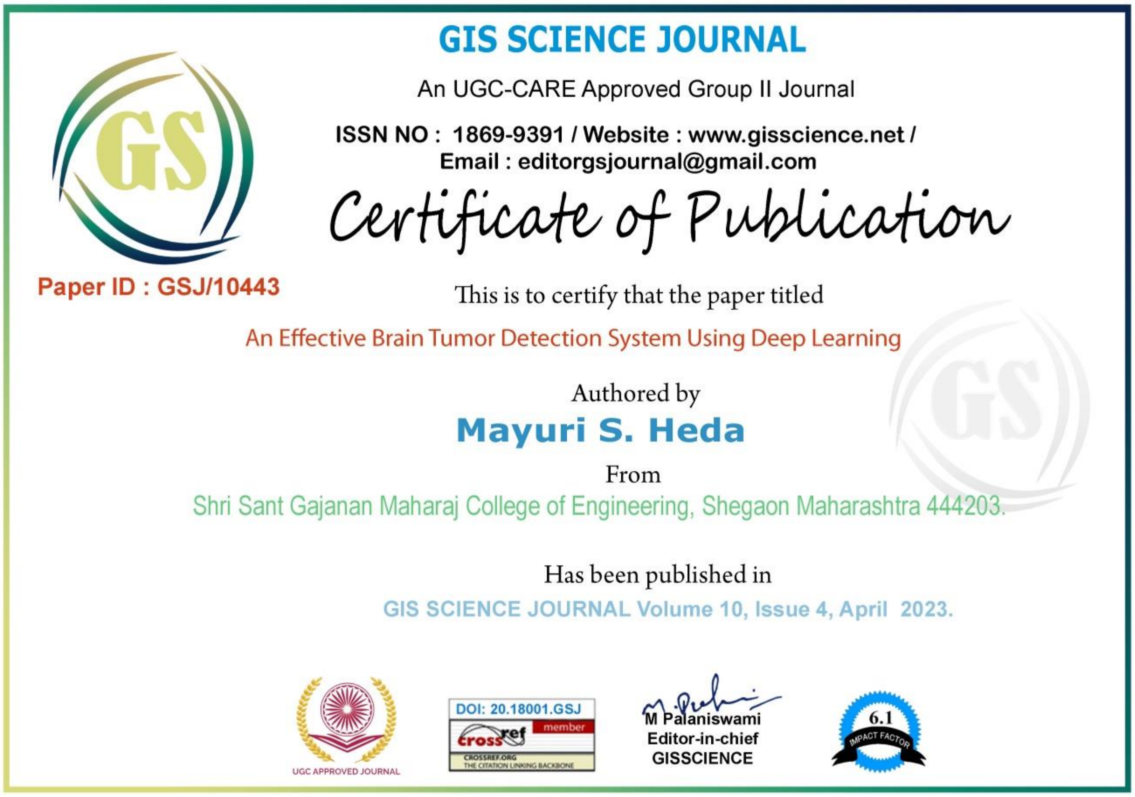

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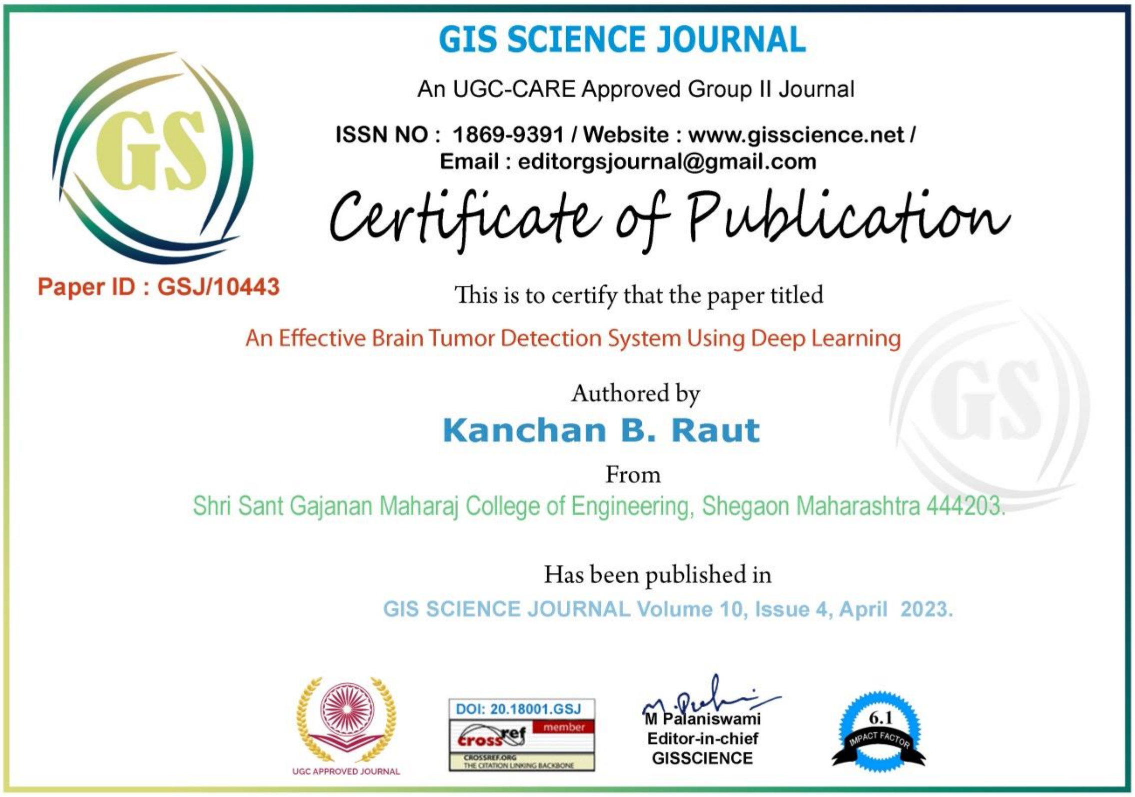

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