**A PROJECT REPORT**

**ON**

**”Brain Tumor Detection Using Deep learning” Submitted to**

**UNIVERSITY OF MUMBAI**

**In partial fulfillment of the requirements for the degree of Bachelor of Engineering**

**BY**

**Aryan Sarkar**

**Sarfaraz Haider Ali**

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**UNDER THE GUIDANCE OF**

**(Prof. Salim G.Shaikh)**



**Department of Computer Engineering,**

**Anjuman-I-Islam’s Kalsekar Technical Campus School of**

**Engineering and Technology**

**Plot No. 2 & 3, Sector -16, Near Thana Naka, Khanda Gaon,**

**New Panvel, Navi Mumbai. 410206**

**Academic Year : 2023-2024**

**AFFILIATED TO**

**UNIVERSITY OF MUMBAI**

**A Project II Report**

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**CERTIFICATE**

**This is to certify that the project entitled**

**“Brain Tumor Detection Using Deep Learning”**

**submitted by**

**Aryan Sarkar**

**Sarfaraz Haider Ali**

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**is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Engineering) at Anjuman-I- Islam’s Kalsekar Technical Campus, Navi Mumbai under the University of MUMBAI. This work is done during year 2023-2024, under our guidance.**

**Date: /04 /24.**

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**Project II Approval for Bachelor of Engineering**

**This project entitled Brain Tumor Detection Using Deep Learning by Aryan Sarkar, Sarfaraz Haider Ali , Shaikh Mohammad Danish , Mohammad Suleman , is approved for the degree of Bachelor of Engineering in Department of Computer Engineering.**

**Examiners**

**1. ..............................**

**2. ..............................**

**Supervisors**

**1. ..............................**

**2. ..............................**

**Chairman**



**Declaration**

**We declare that this written submission represents our ideas in our own words and where other ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and in- tegrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or fromwhom proper permission has not been taken when needed.**

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**Abstract**

**Tittle: Brain Tumor Detection Using Deep Learning**

**This project, "Brain Tumor Detection Using Deep Learning," is a significant initiative in the field of medical diagnostics. It leverages the power of machine learning algorithms, specifically Convolutional Neural Networks (CNN) and Artificial Neural Networks (ANN), to predict the presence of brain tumors. The project involves training the models on a large dataset of brain scan images, allowing them to learn and identify the unique patterns and characteristics associated with brain tumors. The CNN model is particularly effective in identifying spatial patterns, making it ideal for image analysis. On the other hand, the ANN model excels at learning complex, non-linear relationships, which is crucial in medical diagnostics.The aim of this project is to provide a reliable, non-invasive method for early-stage brain tumor detection. By accurately identifying the presence of tumors, medical professionals can initiate treatment promptly, leading to improved patient outcomes, including higher survival rates and better quality of life. This project not only underscores the potential of deep learning in healthcare but also highlights the commitment to harnessing technology for societal benefit .It also explores various segmentation techniques, including clustering, edge-based methodology, compression-based methods, region- based strategies, pixel-level approaches, and graph-based algorithms. The study found that CNN- based models achieved the highest accuracy, averaging approximately 96%. However, classical deep learning methods also performed well, suggesting their continued utility in this field.**

**Keywords: Deep Learning, Machine Learning, Convolutional Neural Networks (CNN), Artificial Neural Networks (ANN), Brain Tumor Detection, Medical Diagnostics, Image Analysis, Spatial Patterns, Non-linear Relationships, Early Detection, Healthcare Technology, Survival Rates, Quality of Life.**

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**ABBREVIATION NOTATION AND NOMENCLATURE**

**1) ANN: Artificial Neural Networks**

**2) API: Application Programming Interface**

**3) CNN: Convolutional Neural Networks**

**4) CT: Computed Tomography**

**5) DL: Deep Learning**

**6) MRI: Magnetic Resonance Imaging**

**7) RNN: Recurrent Neural Networks**

**8) FPR: False Positive Rate**

**9) FNR: False Negative Rate**

**10) IoU: Intersection over Union**

**11) K-Fold: K-Fold Cross-Validation**

**12) MRI: Magnetic Resonance Imaging**

**13) NABL: National Accreditation Board for Testing and Calibration Laboratories**

**14) ROC: Receiver Operating Characteristic**

**15) TP: True Positive**

**16) TN: True Negative**

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**Chapter 1**

**Introduction**

**Brain tumors are abnormal growths of cells within the brain or surrounding tissues, which can be life- threatening if left undetected and untreated. Early and accurate detection of brain tumors is crucial for effective treatment planning and improving patient outcomes. Magnetic Resonance Imaging (MRI) is the primary diagnostic tool for brain tumor detection, but manual analysis of MRI scans is time- consuming, subjective, and prone to human error.**

**With the advent of deep learning techniques, particularly Convolutional Neural Networks (CNNs) and Artificial Neural Networks (ANNs), there is a significant opportunity to automate and enhance the process of brain tumor detection and classification from MRI images. These advanced machine learning models can learn to recognize complex patterns and features within the images, enabling accurate identification and localization of brain tumors.**

**The purpose of this project is to develop a deep learning-based system that can automatically detect and classify brain tumors from MRI scans with high accuracy and efficiency. By leveraging the power of CNNs and ANNs, the system aims to assist medical professionals in making more informed and timely decisions, ultimately leading to improved patient outcomes and survival rates.**

**The proposed system will be trained on a large dataset of brain MRI images, including both normal and tumor cases. The CNN models will be responsible for extracting relevant features and identifying spatial patterns within the images, while the ANN models will learn to classify the tumors based on these features. The integration of these two deep learning approaches is expected to provide a robust and reliable solution for brain tumor detection and classification.**

**The successful implementation of this project has the potential to revolutionize the field of brain tumor diagnosis, reducing the time and effort required for manual analysis, minimizing human error, and enabling early detection and intervention. Additionally, the system can be integrated into existing healthcare infrastructure, making it accessible to medical professionals worldwide, including in resource-limited settings.**

**Primary brain tumors originate from the cells within the brain or the surrounding membranes. They can be further categorized as:**

**Gliomas**

**Gliomas arise from glial cells, which are the supportive cells in the brain.**

**Types of gliomas include astrocytomas, oligodendrogliomas, and ependymomas.**

**Glioblastoma multiforme (GBM) is the most aggressive and common type of malignant brain tumor in adults.**

**Meningiomas**

**Meningiomas develop from the meninges, which are the protective membranes covering the brain and**

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**spinal cord.**

**They are usually benign but can become aggressive in some cases.**

**Pituitary Tumors**

**These tumors arise from the pituitary gland, which is located at the base of the brain. They can be non-cancerous (adenomas) or cancerous (carcinomas).**

**1.1 Purpose**

**The purpose of this project is to develop and implement a deep learning-based system for the detection and classification of brain tumors using MRI images. The project aims to leverage the capabilities of Convolutional Neural Networks (CNNs) and Artificial Neural Networks (ANNs) to automate the process of identifying various types of brain tumors, which is a critical step in the diagnosis and treatment planning for patients with brain cancer. By utilizing advanced deep learning models, the project seeks to improve the accuracy, efficiency, and reliability of brain tumor detection compared to traditional manual diagnosis methods.**

**1.2 Project Scope**

**Data Collection: Acquiring a comprehensive dataset of brain MRI images, which may include publicly available datasets such as TCGA-LGG, TCIA, and othersModel Development: Designing and training deep learning models, specifically CNNs and ANNs, to recognize and classify brain tumors from MRI imagesModel Optimization: Fine-tuning the models to achieve high accuracy and generalizability across different types of brain tumors, including glioma, meningioma, and pituitary tumorsValidation and Testing: Evaluating the performance of the models using appropriate metrics such as accuracy, precision, recall, and F1-score on a separate testing datasetImplementation: Developing a user-friendly interface or system that can be used by healthcare professionals to assist in the diagnosis of brain tumors.**

**1.3 Goals**

**Enhance Diagnostic Accuracy: To significantly improve the accuracy of brain tumor detection and classification, thereby aiding radiologists and oncologists in making more informed decisions**

**Reduce Diagnosis Time: To decrease the time required for diagnosing brain tumors by automating the detection process, allowing for quicker treatment initiationIncrease Accessibility: To create a system that can be easily accessed and used by medical professionals, potentially even in resource- limited settings.**

**1.4 Objectives**

**Develop Robust Models: To construct CNN and ANN models that are robust to variations in tumor size, shape, and location within the brain.**

**Achieve High Performance: To reach a target performance metric, such as an accuracy rate above a certain threshold, for the classification of brain tumors**

**Chapter 2**

**Literature Survey**

**[1]Saeedi et al. (2023) provide a comprehensive methodology that integrates deep learning and machine learning methodologies for brain tumor classification. Their 2D Convolutional Neural Network (CNN) delivers great accuracy and recall, making it a feasible solution for healthcare applications and facilitating early tumor diagnosis.[2]Zaw et al. (2019) address the detection of grade- 4 tumor Glioblastoma multiforme (GBM) using Naïve Bayes classification. Their method demonstrates outstanding accuracy and detection rates for both tumor and non-tumor brain tissues, benefiting medical professionals in diagnosing brain cancer, particularly GBM.[3]Kshirsagar et al. (2020) propose an automated brain tumor diagnosis system employing texture information collected from MRI images. Their machine learning-based approach achieves great accuracy, highlighting the promise of automatingthe brain tumor identification procedure.[4]Siar and Teshnehlab (2019) offer a hybrid strategy integrating feature extraction techniques and Convolutional Neural Network (CNN) classifiers. Their approach dramatically enhances tumor detection accuracy, presenting a promising answer for precise diagnosis and treatment planning.[5]Hossain et al. (2019) handle the tough task of brain tumor segmentation using Fuzzy C-Means clustering and Convolutional Neural Networks (CNN). Their suggested CNN-based technique demonstrates excellent accuracy in discriminating between normal and diseased brain areas, boosting the accuracy and efficiency of brain tumor segmentation.[6] The article by Jianyi Wang presents a summary of current achievements in AI-driven brain tumor segmentation andclassification. The study highlights the use of Convolutional Neural Networks (CNN) in reaching above95% accuracy in clinical situations. While many advancements have focussed on network architecture, emerging techniques like Bayesian Neural Networks, Generative GAN, and bidirectional LSTM introduce uncertainty quantification vital for medical applications. The essay addresses restricted utility of reinforcement learning due to overfitting hazards and proposes researching unsupervised and reinforcement learning alternatives. The article underlines the need for breakthroughs beyond supervisedlearning and finishes by providing possibilities for enhancing brain tumor classification accuracy and dependability. (Published in IAES International Journal of Artificial Intelligence, 2023).[7] Dilber Uzun Ozsahin et al. propose a mathematical study of machine learning models for brain tumor diagnosis. The study used the fuzzy PROMETHEE approach to analyze nine machine learning models, finding CNN asthe best accurate. The robustness of the strategy is tested by sensitivity analysis, and potential enhancements are given for model selection. The study demonstrates the reliability of the fuzzy PROMETHEE technique in decision- making procedures. (Published in Diagnostics, 2023).[8] Shahab Wahhab et al. perform a comprehensive survey on brain tumor detection and classification using machine learning. The paper analyzes the impact of several machine learning algorithms in brain tumor diagnosis, emphasizing the need for higher precision in identifying tumor locations and the potential of merging handmade and deep characteristics. The paper underscores the significance of deep learning techniques in brain tumor research and proposes paths for boosting accuracy and efficiency.**

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**(Published in International Journal of Scientific Research in Engineering and Management, 2022).[9] The paper by Shahab Wahhab Kareem et al. gives a comparative evaluation of machine learning methods for brain tumor diagnosis. The research examines the effectiveness of multiple algorithms, offering light on the obstacles and prospects in brain tumor diagnosis using machine learning. The research contributes to theexploration of machine learning's role in enhancing brain tumor detection accuracy. (Published in IAESInternational Journal of Artificial Intelligence, 2023).[10] In a study by Shahab Wahhab et al., the 10comparative evaluation of machine learning algorithms for brain tumor identification is undertaken.Department of Computer Engineering, AIKTC, New Panvel, Navi Mumbail 11Brain tumor using mlSeveral studies have investigated the application of machine learning in the detection and segmentation of brain tumors from MRI images. The conventional method for brain cancer identification primarily involves manual evaluation of MRI images. However, recent advancements in computer-assisted diagnosis, machine learning, and deep learning have transformed this process, providing rapid and accurate results.In one approach, Artificial Neural Networks (ANN) are used to detect brain tumors, and their performance is assessed based on various metrics, offering an efficient means of identifying tumor presence (Brown University, 2022) [13].Recognizing the urgency of early brain tumor detection, as these tumors can be aggressive and life-threatening, Magnetic Resonance Imaging (MRI) is the primary tool for identification. Nevertheless, manual examination is prone to errors. To address this, a Deep Learning-based Depth- wise Separable Convolution Neural Network is employed to detect tumors in MRI images, outperforming traditional methods like Support Vector Machine, K Nearest Neighbor, and Convolutional Neural Network (K J Somaiya Institute of Engineering and Information Technology) [15].Digital image processing plays a pivotal role in brain tumor diagnosis. The segmentation of brain tumors involves the separation of malignant brain tissues from normal ones. Researchers have explored various semi and fully automated segmentation approaches. The adoption of a segmentation method depends on its simplicity and the degree of human supervision required (ICCIDS, 2019) [16].Some studies focus on neural network-based approaches and the utilization of Probabilistic Neural Networks (PNN) with LVQ for automated brain tumor classification, achieving fast and accurate results (Sapra, Singh, and Khurana, 2013) [17]. Others describe a Fully Automatic Heterogeneous Segmentation using Support Vector Machine (FAHS-SVM) that significantly enhances classification accuracy (Ganesh, Kumar, and Kumar, 2021) [18]Additionally, deep learning algorithms have been employed for brain tumor identification and classification, emphasizing their efficiency in achieving accurate results (Jia and Chen, 2017) [19].Image segmentation is a critical aspect of medical image processing. One approach involves the use of the HSom algorithm for picture segmentation in two phases. This approach effectively separates and classifies MRI brain images (Logeswari and Karnan, 2010) [20].**

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**Chapter 3**

**Project Planning**

**The project aims to develop a deep learning model for detecting brain tumors using MRI images. The model will utilize Convolutional Neural Networks (CNN) and Artificial Neural Networks (ANN) to identify unique patterns and characteristics associated with brain tumors.**

**3.1 Members and and Capabilities**

|  |  |
| --- | --- |
| **Aryan Sarkar** | **Model develop of ANN and Testing of Model.** |
| **Sarfaraz Haider Ali** | **Model develop of CNN and Testing of Model.** |
| **Mohammad Suleman** | **Front end and Back-end Connection.** |
| **Shaikh Mohammad Danish** | **Front end and Back-end Connection.** |

**3.2 Roles and Responsibilities**

**Project Manager: Responsible for overall project coordination, task assignment, and ensuring timely completion.**

**Data Acquisition Lead: Responsible for collecting and curating the brain MRI image dataset.**

**Model Development Lead: Responsible for designing, training, and optimizing the deep learning models (CNN and ANN).**

**Testing and Validation Lead: Responsible for evaluating the performance of the models and conducting rigorous testing.**

**Documentation and Reporting Lead: Responsible for maintaining project documentation and preparing reports.**

**3.3 Assumptions and Constraints**

 **The project is based on the following assumptions and constraints:**

 **Availability of a large and diverse dataset of brain MRI images.**

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 **Access to computational resources (GPUs) for training deep learning models.**

 **Adherence to ethical guidelines and data privacy regulations.**

 **Time constraints due to the project's academic nature.**

**3.4 Project Management Approach**

**The project will follow an agile project management approach, with iterative development cycles and regular team meetings to discuss progress, challenges, and necessary adjustments.**

**3.5 Project Timeline**

**i. Data acquisition and preprocessing: January 5, 2024 - January 31, 2024**

**ii. Model development and training: February 1, 2024 - March 15, 2024**

**iii. Testing and validation: March 16, 2024 - March 31, 2024**

**iv. System integration and deployment: April 1, 2024 - April 7, 2024**

**v. Documentation and report preparation: April 1, 2024 - April 10, 2024**

**vi. Project completion: April 10, 2024**

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**Chapter 4**

**Software Requirements Specification**

**Software Requirements Specification (SRS) is a comprehensive description of the intended purpose and environment for software under development. It includes software functionality, user interfaces, performance, security, and any other specifications relevant to the project. It serves as a contractual agreement between the developer and the client, defining what the software will do.**

**4.1 Overall Description**

**4.1.1 Product Perspective**

**The "Brain Tumor Detection Using Deep Learning" system is a medical imaging software application that utilizes deep learning techniques, specifically Convolutional Neural Networks (CNNs) and Artificial Neural Networks (ANNs), to detect and classify brain tumors from MRI scans. The system aims to assist radiologists and healthcare professionals in the early and accurate diagnosis of brain tumors, leading to improved treatment planning and patient outcomes.**

**4.1.2 Product Features**

**- Preprocessing and augmentation of MRI brain scan images**

**- Training of deep learning models (CNNs and ANNs) on the preprocessed dataset**

**- Prediction and classification of brain tumors (glioma, meningioma, pituitary) from input MRI scans**

**- Visualization of prediction results and tumor segmentation**

**- User-friendly interface for seamless interaction**

**4.1.3 Operating Environment**

**The system should be compatible with modern operating systems (Windows, macOS, Linux) and should have the following minimum hardware requirements:**

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**- Processor: Intel Core i5 or equivalent**

**- RAM: 8 GB or higher**

**- GPU: NVIDIA GPU with CUDA support (recommended for efficient training and inference)**

**- Storage: Sufficient storage space for the dataset and trained models**

**4.1.4 Design and Implementation Constraints**

**- The system should be developed using Python and popular deep learning libraries such as TensorFlow, PyTorch, or Keras.**

**- The system should be designed with scalability and extensibility in mind, allowing for future integration of additional deep learning models or techniques.**

**4.2 System Features**

**4.2.1 System Features**

**1. Data Preprocessing and Augmentation: The system should include functionality for preprocessing MRI brain scan images, such as resizing, normalization, and data augmentation techniques (e.g., rotation, flipping, scaling) to increase the diversity of the training dataset.**

**2. Model Training: The system should provide the capability to train deep learning models (CNNs and ANNs) on the preprocessed dataset. This may include features for hyperparameter tuning, model selection, and performance evaluation.**

**3. Prediction and Classification: The trained models should be able to predict the presence of brain tumors and classify them into different types (glioma, meningioma, pituitary) based on input MRI scans.**

**4. Visualization and Reporting: The system should provide visualizations of the prediction results, including segmentation masks highlighting the tumor regions. Additionally, it should generate reports summarizing the prediction results for easy interpretation by healthcare professionals.**

**5. User Interface: The system should have a user-friendly interface that allows users to upload MRI scans, initiate the prediction process, and view the results. The interface should be intuitive and accessible to users with varying levels of technical expertise.**

**4.3 External Interface Requirements**

**4.3.1 User Interfaces**

**The system should have a graphical user interface (GUI) that allows users to interact with the application seamlessly. The GUI should provide options for uploading MRI scans, initiating the prediction process, and viewing the results, including visualizations and reports.**

**4.3.2 Hardware Interfaces**

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**The system should be compatible with standard input devices such as keyboards and mice. Additionally, it should support the integration of medical imaging devices (e.g., MRI scanners) for seamless data transfer and processing.**

**4.3.3 Software Interfaces**

**The system should provide APIs or software interfaces for integration with other medical software systems, such as electronic health record (EHR) systems or picture archiving and communication systems (PACS).**

**4.4 Nonfunctional Requirements**

**4.4.1 Performance Requirements**

**The system should provide real-time or near real-time performance for prediction and classification tasks, ensuring timely diagnosis and treatment planning. The system should also be scalable to handle large volumes of data and concurrent user requests.**

**4.4.2 Safety Requirements**

**The system should implement appropriate measures to ensure the safety and privacy of patient data, such as data encryption, access controls, and audit trails. Additionally, the system should comply with relevant medical device regulations and standards.**

**4.4.3 Security Requirements**

**The system should incorporate robust security measures to protect against unauthorized access, data breaches, and cyber threats. This may include features such as user authentication, role-based access control, and secure communication protocols.**

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**Chapter 5**

**System Design**

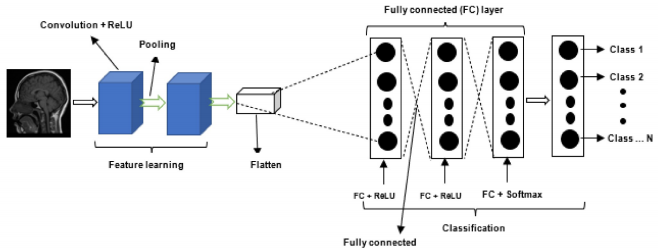
**System design is the process of defining and describing the architecture, modules, interfaces, and data for a system to satisfy specified requirements and constraints. It involves creating a detailed plan for the components of a system, including hardware, software, and network, and how they interact with each other and the external environment. The goal is to ensure the system is efficient, reliable, and meets the needs of the users.**

**5.1 System Requirements Definition**

**5.1.1 Data collecting: Data collecting is the initial step in constructing a machine learningmodelfor applications like brain tumor diagnosis. In the context of brain tumordiagnosis, this includes accumulating a diverse dataset of brain MRI images. Data sources mayinclude medical institutes, hospitals, research facilities, or publicly available datasets like those onKaggle.**

**5.1.2 Data Preprocessing: Data preprocessing involves preparing the acquired data for analysisand model training. For MRI pictures, preprocessing frequently includes scaling images to aconsistent resolution, leveling pixel values, and resolving any artifacts or noise. Proper preprocessingensures thatthe data is in a suitable format for later analysis.**

**5.2 System Architecture Design**



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**CNN Architecture**

**The architecture depicted in the image is a typical Convolutional Neural Network (CNN) used for image classification tasks. Here's a detailed explanation of each component of the architecture:**

**Convolution + ReLU**

**The first stage of the CNN is the feature learning stage, which consists of convolutional layers followed by ReLU (Rectified Linear Unit) activation functions. The convolutional layers use filters (or kernels) to perform convolution operations on the input image, which helps in extracting various features such as edges, textures, and patterns. The ReLU activation function introduces non-linearity to the model, allowing it to learn more complex features by setting all negative values to zero.**

**Pooling**

**After the convolutional layers, the architecture includes pooling layers. Pooling layers reduce the spatial dimensions of the feature maps generated by the convolutional layers. This is typically done using max pooling, which selects the maximum value from a set of values within a predefined window, or average pooling, which calculates the average of the values within the window. Pooling helps to make the feature maps more abstract and invariant to small changes in the input image.**

**Flattening**

**Once the feature maps have been processed through several convolution and pooling layers, they are flattened into a one-dimensional vector. This step is necessary to transition from the spatially structured output of the convolutional and pooling layers to the fully connected layers that follow.**

**Fully Connected (FC) Layer**

**The flattened vector is then fed into a series of fully connected layers. These layers are traditional neural network layers where every input is connected to every output by a learnable weight. The fully connected layers are responsible for mapping the learned features to the final output classes. The image shows three fully connected layers, with the first two followed by ReLU activation functions and the last one followed by a softmax activation function.**

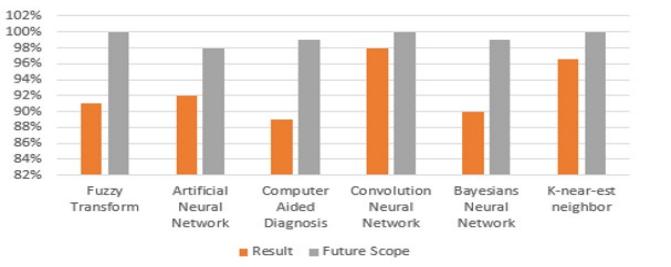
**Classification**

**The final layer in the CNN architecture is the output layer, which typically uses a softmax activation function for multi-class classification tasks. The softmax function converts the logits (the raw output values from the last fully connected layer) into probabilities by exponentiating each logit and then normalizing these values so that they sum up to one. The output of the softmax function is a probability distribution over the classes, indicating the likelihood that the input image belongs to each class.**

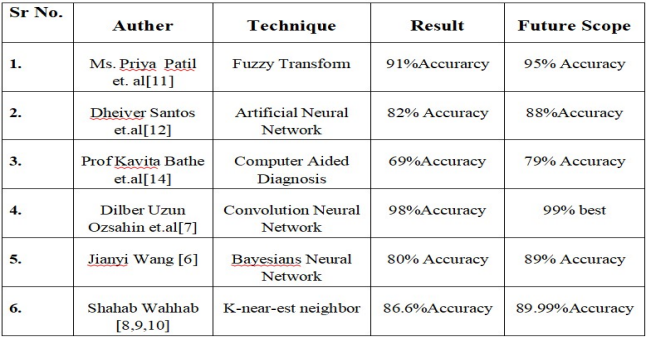
**Chapter 6**

**System Testing**

**6.1 Comparative Analysis of Brain Tumor Detection Methods: Accuracy Assessment and Future Prospects**



**6.2 Comparative Analysis of Different Methods of Brain Tumor Detection Methods**



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**Chapter 7**

**Implementation**

**1. Model code of CNN :**

**import os**

**from flask import Flask, jsonify, request**

**import numpy as np**

**from keras.models import load\_model**

**from keras.preprocessing import image**

**from keras.utils import normalize**

**from flask\_cors import CORS**

**import cv2**

**app = Flask(\_\_name\_\_)**

**CORS(app)**

**model = load\_model('C:\\Users\\aryan\\Desktop\\braintumor\\BrainTumorTypes.keras')**

**print('Model loaded. Check http://** [**127.0.0.1**](127.0.0.1)**:8080/')**

**def get\_className(classNo):**

**if classNo == 0:**

**return "no\_tumor"**

**elif classNo == 1:**

**return "meningioma\_tumor"**

**elif classNo == 2:**

**return "glioma\_tumor"**

**elif classNo == 3:**

**return "pituitary\_tumor"**

**@app.route('/', methods=['GET'])**

**def index():**

**return "<p>Hello, World!</p>"**

**@app.route('/predict', methods=['POST']) # type: ignore**

**def upload():**

**if request.method == 'POST':**

**if 'file' not in request.files:**

**return jsonify({"error": "No file part"})**

**file = request.files['file']**

**if file.filename == '':**

**return jsonify({"error": "No selected file"})**

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**if file:**

**img = cv2.imdecode(np.frombuffer(file.read(), np.uint8), cv2.IMREAD\_COLOR) img = cv2.resize(img, (64, 64))**

**img\_array = np.array(img)**

**img\_array = normalize(img\_array, axis=1)**

**img\_array = np.expand\_dims(img\_array, axis=0)**

**result = model.predict(img\_array) # type: ignore**

**class\_label = np.argmax(result, axis=1)[0]**

**class\_name = get\_className(class\_label)**

**return jsonify({"result": class\_name, "image":file.filename})**

**return "No Prediction"**

**if\_\_name\_\_ == '\_\_main\_\_':**

**app.run(debug=True,port='8080') # type: ignore**

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**2. Model code of ANN :**

**import os**

**import cv2**

**import numpy as np**

**from sklearn.model\_selection import train\_test\_split**

**from keras.utils import to\_categorical**

**from keras.layers import Input**

**from keras.models import Sequential**

**from keras.layers import Dense, Flatten**

**# Define the input size of the images**

**INPUT\_SIZE = 64**

**# Define the directory where the images are stored**

**image\_directory = 'C://Users//aryan//Desktop//braintumor//smallTrain//'**

**# Define the tumor types**

**tumor\_types = ['no\_tumor', 'meningioma\_tumor', 'glioma\_tumor', 'pituitary\_tumor']**

**# Initialize the dataset and labels lists**

**dataset = []**

**labels = []**

**# Loop over the tumor types**

**for tumor\_type\_index, tumor\_type in enumerate(tumor\_types):**

**# Get the list of image file names for the current tumor type**

**images\_path = os.listdir(image\_directory + '/' + tumor\_type)**

**# Loop over the image file names**

**for i, image\_name in enumerate(images\_path):**

**# Check if the image is a JPEG image**

**if image\_name.split('.')[1] == 'jpg':**

**# Load the image**

**image = cv2.imread(image\_directory + '/' + tumor\_type + '/' + image\_name)**

**# Resize the image to the input size**

**image = cv2.resize(image, (INPUT\_SIZE, INPUT\_SIZE))**

**# Convert the image to a numpy array**

**image = np.array(image)**

**# Add the image to the dataset**

**dataset.append(image)**

**# Add the tumor type index to the labels**

**labels.append(tumor\_type\_index)**

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**# Convert the dataset and labels to numpy arrays**

**dataset = np.array(dataset)**

**labels = np.array(labels)**

**# Split the dataset and labels into training and testing sets**

**x\_train, x\_test, y\_train, y\_test = train\_test\_split(dataset, labels, test\_size=0.4, random\_state=0)**

**# Normalize the pixel values of the images**

**x\_train = x\_train / 255.0**

**x\_test = x\_test / 255.0**

**# Convert the labels to categorical labels**

**y\_train = to\_categorical(y\_train, num\_classes=len(tumor\_types))**

**y\_test = to\_categorical(y\_test, num\_classes=len(tumor\_types))**

**# Define the input layer**

**input\_layer = Input(shape=(INPUT\_SIZE, INPUT\_SIZE, 3))**

**# Define the model**

**model = Sequential()**

**model.add(Flatten(input\_shape=input\_layer.shape[1:]))**

**model.add(Dense(64, activation='relu'))**

**model.add(Dense(64, activation='relu'))**

**model.add(Dense(len(tumor\_types), activation='softmax'))**

**# Compile the model**

**model.compile(loss='categorical\_crossentropy', optimizer='adam', metrics=['accuracy'])**

**# Evaluate the model on the testing data**

**score = model.evaluate(x\_test, y\_test, verbose=0)**

**# Print the accuracy of the model on the testing data**

**print('Testing Accuracy:', score[1])**

**# Train the model**

**history = model.fit(x\_train, y\_train,**

**batch\_size=20,**

**verbose=1,**

**epochs=20,**

**validation\_data=(x\_test, y\_test),**

**shuffle=False)**

**# Save the model**

**model.save('BrainTumorTypes\_ANN.keras')**

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**3. Front-End Code :**

**import React, { useState } from "react";**

**import axios from "axios";**

**export default function Home() {**

**const [file, setFile] = useState(null);**

**const [previewSrc, setPreviewSrc] = useState(null);**

**const [prediction, setPrediction] = useState(null);**

**const [selectedModel, setSelectedModel] = useState("braintumorCnn");**

**const [model, setModel] = useState("CNN");**

**const handleFileChange = (e) => {**

**const file = e.target.files[0];**

**setFile(file);**

**const reader = new FileReader();**

**reader.onload = (e) => {**

**// @ts-ignore**

**setPreviewSrc(e.target.result);**

**};**

**reader.readAsDataURL(file);**

**};**

**const handleCnn = async () => {**

**const formData = new FormData();**

**// @ts-ignore**

**formData.append("file", file);**

**try {**

**const response = await axios.post(**

**"http://** [**127.0.0.1**](127.0.0.1)**:8080/predict",**

**formData**

**);**

**setPrediction(response.data.result);**

**console.log(response.data.result, "CNN");**

**} catch (error) {**

**console.error(error);**

**}**

**};**

**const handleAnn = async () => {**

**const formData = new FormData();**

**// @ts-ignore**

**formData.append("file", file);**

**try {**

**const response = await axios.post(**

**"http://** [**127.0.0.1**](127.0.0.1)**:5050/predictann",**

**formData**

**);**

**setPrediction(response.data.result);**

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**setModel("ANN");**

**console.log(response.data.result, "ann");**

**} catch (error) {**

**console.error(error);**

**}**

**};**

**return (**

**<div className="flex flex-col items-center justify-center bg-blue-100 w-full h-screen">**

**<h1 className="text-4xl mb-6 text-center font-extrabold uppercase animate-none underline"> Brain tumor Detection**

**</h1>**

**<label className="bg-blue-50 px-2 rounded-xl mb-4 font-semibold">**

**Select model :{""}**

**<select**

**value={selectedModel}**

**onChange={(e) => {**

**setSelectedModel(e.target.value);**

**}}**

**className=" rounded m-2 bg-gray-500 text-white "**

**>**

**<option value="braintumorCnn">Brain Tumor CNN</option>**

**<option value="braintumorAnn">Brain Tumor ANN</option>**

**</select>**

**</label>**

**<label className="bg-blue-50 px-1 rounded-xl font-semibold">**

**Upload image:**

**<input**

**type="file"**

**accept="image/\*"**

**onChange={handleFileChange}**

**className=" rounded m-2 bg-gray-500 text-white outline-none"**

**/>**

**</label>**

**{previewSrc && !prediction && (**

**<div role="status" className="relative left-32 w-[35%] mt-4 ">**

**<svg**

**aria-hidden="true"**

**className="w-8 h-8 text-gray-200 animate-spin dark:text-gray-600 fill-blue-600" viewBox="0 0 100 101"**

**fill="none"**

**xmlns="**[**http://www.w3.org/2000/svg**](http://www.w3.org/2000/svg)**"**

**>**

**<path**

**d="M100 50.5908C100 78.2051 77.6142 100.591 50 100.591C22.3858 100.591 0 78.2051 0 50.5908C0 22.9766 22.3858 0.59082 50 0.59082C77.6142 0.59082 100 22.9766 100 50.5908ZM9.08144 50.5908C9.08144 73.1895 27.4013 91.5094 50 91.5094C72.5987 91.5094 90.9186 73.1895 90.9186 50.5908C90.9186 27.9921 72.5987 9.67226 50 9.67226C27.4013 9.67226 9.08144 27.9921 9.08144 50.5908Z"**

**fill="currentColor"**

**/>**

**<path**

**d="M93.9676 39.0409C96.393 38.4038 97.8624 35.9116 97.0079 33.5539C95.2932 28.8227 92.871 24.3692 89.8167 20.348C85.8452 15.1192 80.8826 10.7238 75.2124 7.41289C69.5422 4.10194 63.2754 1.94025 56.7698 1.05124C51.7666 0.367541 46.6976 0.446843 41.7345 1.27873C39.2613 1.69328 37.813 4.19778 38.4501 6.62326C39.0873 9.04874 41.5694 10.4717 44.0505 10.1071C47.8511 9.54855 51.7191 9.52689 55.5402 10.0491C60.8642 10.7766 65.9928 12.5457 70.6331 15.2552C75.2735 17.9648 79.3347 21.5619 82.5849 25.841C84.9175 28.9121 86.7997 32.2913 88.1811 35.8758C89.083 38.2158 91.5421 39.6781 93.9676 39.0409Z"**

**fill="currentFill"**

**/>**

**</svg>**

**<span className="absolute top-0 left-10 text-xl animate-pulse">**

**Preprocessing Started...**

**</span>**

**</div>**

**)}**

**{previewSrc && (**

**<div>**

**<img**

**src={previewSrc}**

**alt="preview"**

**width="200"**

**className="mt-8 rounded-xl mr-52"**

**/>**

**{previewSrc && prediction && (**

**<p className="mt-10 text-center text-xl animate-bounce font-semibold text-xl bg-emerald-50 px-[10px] py-[3px] rounded-2xl ">**

**<span className="animate-pulse">Preprocessing Complete </span>**

**</p>**

**)}**

**<button**

**className="py-2 px-4 rounded-full bg-green-200 mt-4 border-2 relative left-[40%] border-green- 400 font-bold"**

**onClick={() =>**

**selectedModel === "braintumorCnn" ?handleCnn() : handleAnn()**

**}**

**>**

**Predict**

**</button>**

**</div>**

**)}**

**{prediction && (**

**<p className="py-2 px-4 rounded bg-sky-200 border-2 relative top-10 border-sky-400 font-bold w- fit uppercase">**

**<span className="font-semibold uppercase">Model :</span>**

**{model}**

**<br />**

**<hr />**

**<span className="font-semibold uppercase">Prediction :</span>**

**{prediction}**

**</p>**

**)}**

**</div>**

**);**

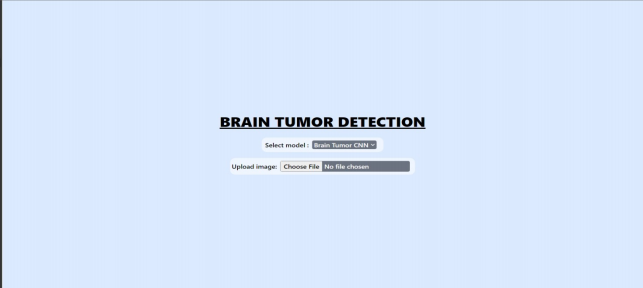
**}**

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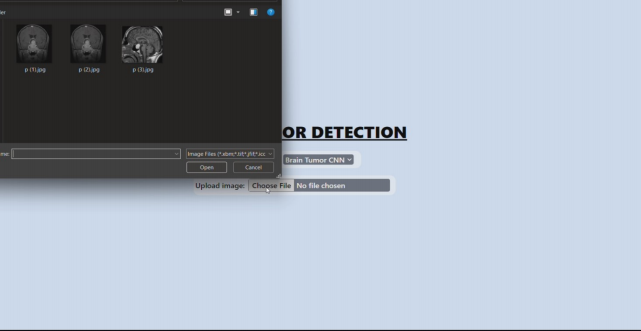
**Chapter 8**

**Screenshots of Project**

**1.Start Screen in which you have choose model.**

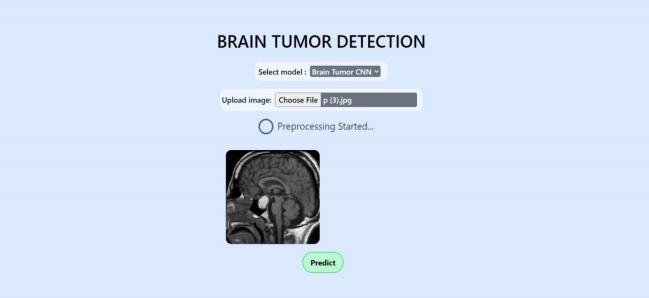


**2. After model selected , then choose image for prediction**

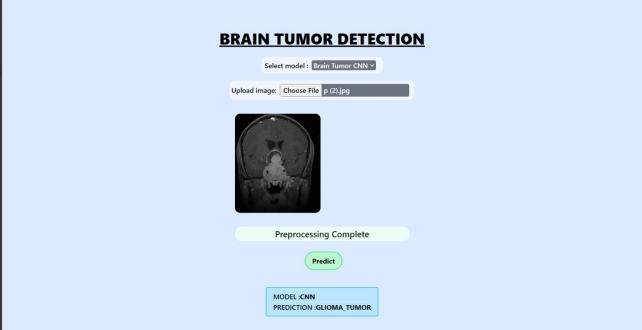


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**3) Preprocessing of image has start , click on predict to get output**

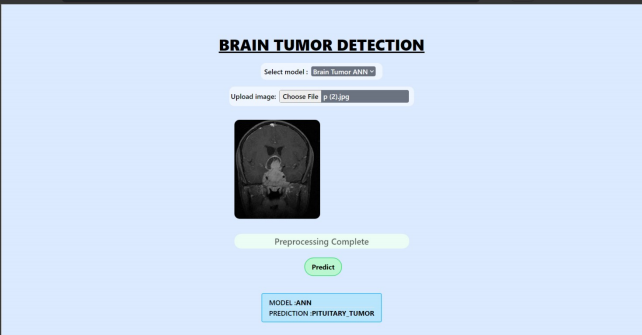


**4) Output : prediction of Model CNN**



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**5) Output : prediction of Model ANN**



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**Chapter 9**

**Conclusion and Future Scope**

**7.1 Conclusion**

**In this project, we tested various machine learning and deep learning algorithms for detecting brain cancers using MRI data. Impressive accuracy levels have been reached utilizing a broad variety of tactics on this challenge. While deep learning techniques now outperform other approaches, classical algorithms still have some promise. Radiologists can profit overall from a "second opinion" supplied by automatic tumor identification and segmentation systems.In conclusion, our study reveals that CNNs , ANNs and Deep learning are successful at detecting and categorizing brain cancers from MRI scans.**

**7.2 Future Scope**

**Brain tumors are abnormal growths of cells within the brain or surrounding tissues that can be life-threatening if left undetected and untreated. Early and accurate detection is crucial for effective treatment planning and improving patient outcomes. This project aims to develop a deep learning-based system using Convolutional Neural Networks (CNNs) and Artificial Neural Networks (ANNs) to automatically detect and classify brain tumors from MRI scans with high accuracy and efficiency. The system will be trained on a large dataset of brain MRI images, with the CNN models extracting relevant features and identifying spatial patterns, while the ANN models will classify the tumors based on these features. The successful implementation of this project has the potential to revolutionize brain tumor diagnosis, reducing time and effort, minimizing human error, enabling early detection and intervention, and ultimately leading to improved patient outcomes and survival rates.**

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**ACKNOWLEDGMENT**

**We would like to take the opportunity to express our sincere thanks to our guide Prof. Salim G. Shaikh, Assistant Professor, Department of Computer Engineering, AIKTC, School of Engi- neering, Panvel for his/her invaluable support and guidance throughout our project research work. Without his/her kind guidance & support this was not possible.**

**We are grateful to his for his timely feedback which helped us track and schedule the process effectively.His time, ideas and encouragement that he gave is help us to complete our project efficiently.**

**We would like to express deepest appreciation towards Dr.Rajendra Magar, Dean, SoET, Navi Mumbai, Prof. Tabrez Khan, Head of Department of Computer Engineering and Prof. Nusrat Jahan, Project Coordinator whose invaluable guidance supported us in completing this project.**

**At last we must express our sincere heartfelt gratitude to all the staff members of Computer Engineering Department who helped us directly or indirectly during this course of work.**

**Aryan Sarkar**

**Sarfaraz Haider**

**Shaikh Mohammad Danish**

**Mohammad Suleman**