A Mini Project Synopsis on

BrainScan AI

T.E. – Computer Science and Engineering- Data Science

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CERTIFICATE

This to certify that the Mini Project report on "BrainScan AI" has been submitted by Sakshi Jamdhade(21107042), Tanvi Mirgal(21107028), Harsh Mulik(21107044), Meghraj Padwal(21107025) who are a bonafide students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfilment of the requirement for the degree in **CSE(DATA SCIENCE)**, during the academic year **2023-2024** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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Chapter 1

Introduction

The brain is the most important organ in the human body which controls the entire functionality of other organs and helps in decision making. It is primarily the control center of the central nervous system and is responsible for performing the daily voluntary and involuntary activities in the human body. The tumor is a fibrous mesh of unwanted tissue growth inside our brain that proliferates in an unconstrained way. This year at the age of 15 about 3,540 children were diagnosed with a brain tumor. The right way of understanding of brain tumor and its stages is an important task to prevent and to carry out the steps in curing the illness. To do so, magnetic resonance imaging (MRI) is widely used by radiologists to analyze brain tumors. The result of the analysis carried out in this paper reveals whether the brain is normal one or diseased one by applying deep learning techniques. In this paper ANN and CNN are used in the classification of normal and tumor brain. Artificial Neural Network works like a human brain nervous system, on this basis a digital computer relates to large number of interconnections and networking which makes neural network to train with the use of simple processing units applied on the training set and stores the experiential knowledge. It has different layers of neurons which are connected. The neural network can acquire knowledge by using data set applied on learning process. There will be one input and output layer whereas there may be any number of hidden layers. In the learning process, the weight and bias are added to neurons of each layer depending upon the input features and on the previous layers (for hidden layers and output layers). A model is trained based on the activation function applied on the input features and on the hidden layers where more learning happens to achieve the expected output.

1.1 Purpose

Brain tumors are a significant health concern, and early detection can significantly improve patient outcomes. The project can contribute to advancements in healthcare by developing a tool that aids in the early detection of brain tumors, potentially saving lives and improving the quality of life for affected individuals. Brain tumor detection projects can provide valuable data for medical research. The data collected and analyzed during the project can be used to better understand the characteristics of brain tumors, their prevalence, and

potential trends or patterns in their occurrence. Developing a brain tumor detection system often involves the use of cutting-edge technologies, such as machine learning, computer vision, and medical imaging. These projects can drive technological innovation and potentially lead to the development of more accurate and efficient diagnostic tools.

1.2 Objectives

Create a machine learning model that can accurately detect brain tumors in medical images, such as MRI or CT scans. Improve the accuracy of brain tumor detection compared to existing methods or baseline models. Aim to detect brain tumors at an earlier stage, increasing the chances of successful treatment and better patient outcomes. Develop an automated system that can analyze medical images and provide rapid and consistent results, reducing the reliance on manual interpretation. Minimize the number of false-positive results to prevent unnecessary patient anxiety and follow-up procedures. Enhance the speed of the detection process to ensure timely diagnosis and intervention.

1.3 Scope

Collect and preprocess a diverse dataset of brain MRI images, including cases with and without tumors, to train and test the detection model. Develop a machine learning or deep learning model capable of accurately classifying brain MRI scans as tumor or non-tumor cases. Create a user-friendly interface for uploading medical images and obtaining detection results. Implement validation and testing procedures, collaborating with healthcare professionals to ensure the system's reliability and accuracy. Address ethical considerations, including patient consent and data privacy, in the development and deployment of the system.

Chapter 2

Problem definition

To develop an accurate and efficient brain tumor detection system that utilizes machine learning techniques to analyze medical imaging data, specifically MRI (Magnetic Resonance Imaging) scans. The primary goal of this project is to create a software tool that can assist healthcare professionals in the early and reliable detection of brain tumors, ultimately improving patient outcomes. Brain tumors are a significant health concern, with a wide range of tumor types, sizes, and locations within the brain. Early detection of these tumors is critical for timely intervention and optimal treatment. While medical imaging, such as MRI scans, plays a vital role in diagnosing brain tumors, the process often relies on manual interpretation by radiologists, which can be time-consuming and subject to human error. The development of an automated brain tumor detection system can enhance the speed and accuracy of diagnosis, enabling healthcare professionals to make informed decisions promptly. The brain tumor detection project outlined herein represents a significant endeavor with far-reaching implications for healthcare, patient outcomes, and scientific progress. By developing an accurate, automated, and ethically responsible brain tumor detection system, we aim to address a critical healthcare challenge and provide healthcare professionals with a powerful tool to improve patient care. The project aligns with the broader goals of enhancing healthcare accessibility, optimizing resource utilization, and contributing to medical research. Furthermore, it exemplifies the responsible use of medical data and sets a benchmark for ethical data handling in AI-driven healthcare applications. Ultimately, the successful realization of this project has the potential to save lives, reduce the burden of brain tumors on patients and their families, and advance the field of medical imaging and AI in healthcare.

Chapter 3

Proposed system

Brain tumors are a critical health concern, and their early detection is crucial for timely intervention and improved patient outcomes. This proposal outlines the development of an advanced Brain Tumor Detection System that leverages cutting-edge technology, including artificial intelligence (AI) and machine learning (ML), to enhance the accuracy and efficiency of brain tumor diagnosis. The BrainScan AI aims to automate the detection process, reduce the reliance on manual interpretation, and provide healthcare professionals with a reliable and rapid tool for brain tumor detection and characterization.

3.1 Features and Functionalities

- The system will be capable of ingesting MRI scans from various sources, including healthcare institutions, research databases, and digital archives. Data preprocessing techniques will be applied to standardize image formats and ensure data quality.

- The BrainScan AI will feature a user-friendly web-based interface that enables healthcare professionals to upload medical images easily. The interface will provide seamless interaction, allowing users to submit images, initiate analysis, and view results.

- The detection engine is responsible for processing uploaded MRI scans through the trained ML model. It will generate comprehensive reports detailing the presence, location, size, and characteristics of any detected brain tumors.

- Users, typically healthcare professionals, can easily upload brain MRI scans through the user interface. The system will support various image formats, ensuring compatibility with different acquisition devices.

- The system will provide real-time results, displaying the presence or absence of brain tumors on the uploaded image. Detected tumors will be outlined, and their characteristics, such as size and location, will be highlighted.

Chapter 4

Project outcomes

Image Pre-Processing: Image Pre-Processing: Our pre-processing includes rescaling, noise removal to enhance the image, applying Binary Thresholding and morphological operations like erosion and dilation, contour forming. In the first step of pre-processing, the memory space of the image is reduced by scaling the gray-level of the pixels in the range 0-255. We used Gaussian blur filter for noise removal as it is known to give better results than Median filter since the outline of brain is not segmented as tumor here.

Transfer Learning: Transfer learning allows neural networks to use significantly less data. With transfer learning, we are in effect transferring the knowledge 'that a model has learned from a previous task, to our current one. The idea is that the two tasks are not totally disjoint, as such we can leverage whatever network parameters that model has learned through its extensive training, without having to do that training ourselves. Transfer learning has been consistently proven to boost model accuracy and reduce required training time, less data, less time, more accuracy.

Segmentation: Brain tumor segmentation involves the process of separating the tumor tissues from normal brain tissues and solid brain tumor with the help of MRI images or other imaging modalities. Its mechanism is based on identifying similar type of subjects inside an image and forms a group of such by either finding the similarity measure between the objects and group the objects having most similarity or finding the dissimilarity measure among the objects and separate the most dissimilar objects in the space. Segmentation algorithms can be of two types which are bi-clusters (2 sub-parts) or multi-clustered algorithms. Segmentation can be done by using Edge Detection, Region Growing, Watershed, Clustering via FCM, Spatial Clustering, Split and Merge Segmentation and Neural Network.

Feature Extraction: Feature Extraction is identifying abnormalities. We need to extract some features from images as we need to do classification of the images using a classifier which needs these features to get trained on. We chose to extract GLCM (texture-based features). Gray Level Co-occurrence Matrix (GLCM) features are based on probability density function and frequency of occurrence of similar pixels. GLCM is a statistical method of examining texture that considers the spatial relationship of pixels.

Machine Learning Training and Testing: After training the model, we need to validate and fine-tune the parameters and finally test the model on unknown samples where the data undergoes feature extraction based on which the model can predict the class by matching corresponding labels. Pattern/Sequential/Incremental mode where the whole sequence of forward and backward computation is performed resulting in weight adjustment for each pattern.It again starts from the first pattern till errors are minimized, within acceptable levels.

Chapter 5

Software Requirements

Software requirements for the "BrainScan AI" system:

Operating System (OS): The system should be compatible with common OS platforms such as Windows, macOS, and Linux to ensure widespread accessibility.

Development Environment: Choose a suitable integrated development environment (IDE) for software development. Common choices include Visual Studio Code, PyCharm, or Eclipse.

Programming Languages: Utilized programming languages for various components: Python for ASR and NLP components. HTML, CSS, and JavaScript for the user interface (web-based application).

Database Management System: MySQL, PostgreSQL, or SQLite.

Version Control: Implemented version control using Git and host the repository on platforms like GitHub, GitLab, or Bitbucket for collaborative development.

Web Development Tools: Used web development tools like HTML/CSS preprocessors (e.g., SASS/SCSS), JavaScript frameworks (e.g., React, Angular, or Vue.js), and web development extensions for browsers (e.g., React DevTools).

User Interface (UI) Design Tools: Used design software like Flutter , Android Studio, Figma, or similar tools for UI/UX design.

Text Editors (for Documentation): Utilized text editors such as Microsoft Word, Google Docs, or Markdown editors for documentation and user guides.

Testing and Quality Assurance Tools: Employ testing frameworks (e.g., PyTest for Python) and continuous integration tools (e.g., Jenkins, Travis CI) to ensure software quality.

Security Tools: Implemented security tools like SSL certificates (for web-based applications), firewall configurations, and intrusion detection systems to protect user data.

Containerization and Deployment Tools: Used containerization tools like Docker and deployment platforms like AWS, Heroku, or Google Cloud Platform for hosting and scaling the system.

Collaboration and Communication Tools: Utilized communication and collaboration tools such as Slack, Microsoft Teams, or email for team coordination and communication.

Documentation and Knowledge Management: Used documentation tools like Confluence, DokuWiki, or Markdown-based documentation systems for documenting the project's progress and knowledge sharing.

User Feedback and Issue Tracking: Used Set up tools like Bugzilla, Jira, or GitHub Issues to collect and manage user feedback and track system issues.

Analytics and User Behavior Tracking: Implemented analytics tools like Google Analytics or Matomo for tracking user behavior and system usage.

Chapter 6

Project design

Fig 6.1: Login page

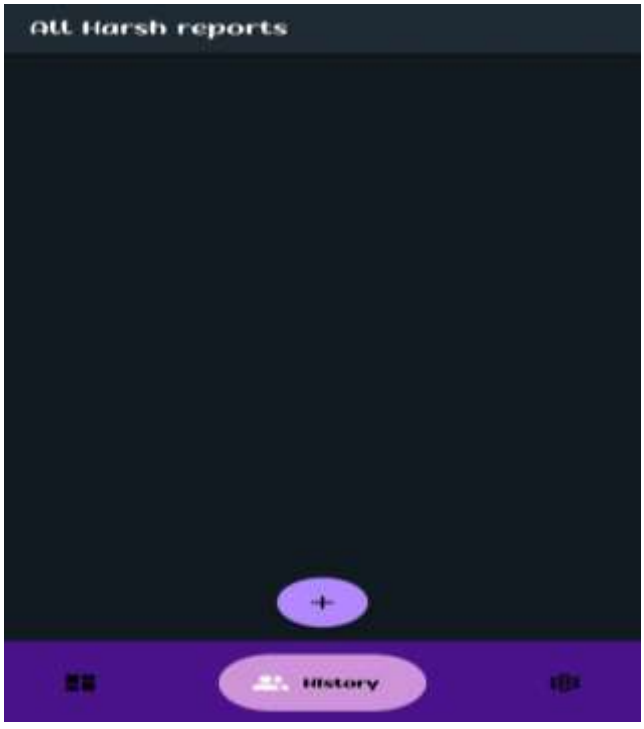

Fig 6.2: Patient's history

Fig 6.3: Patient's dashboard

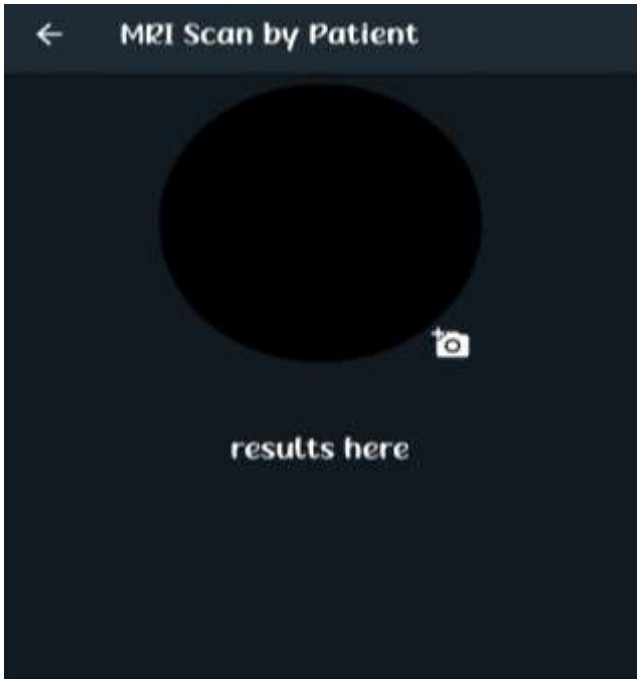

Fig 6.4: MRI scanning

Fig 6.5: Patient's account

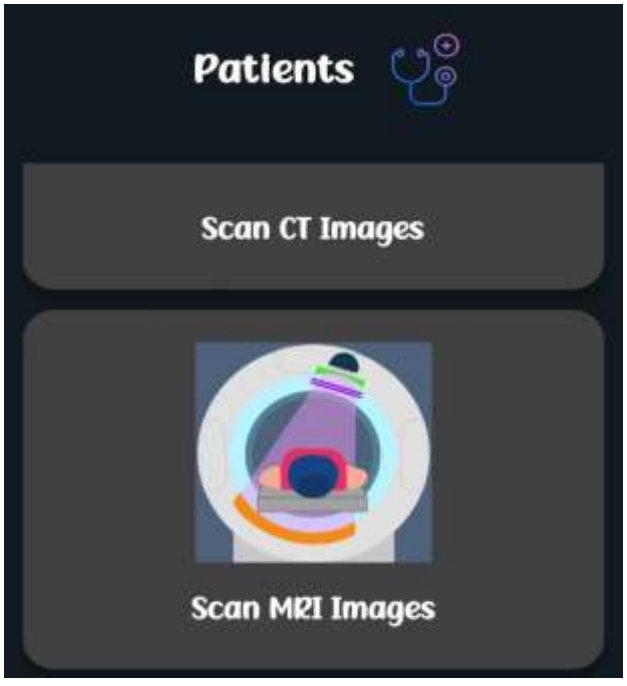

Fig 6.6: Options for CT scan

Chapter 7

Project scheduling

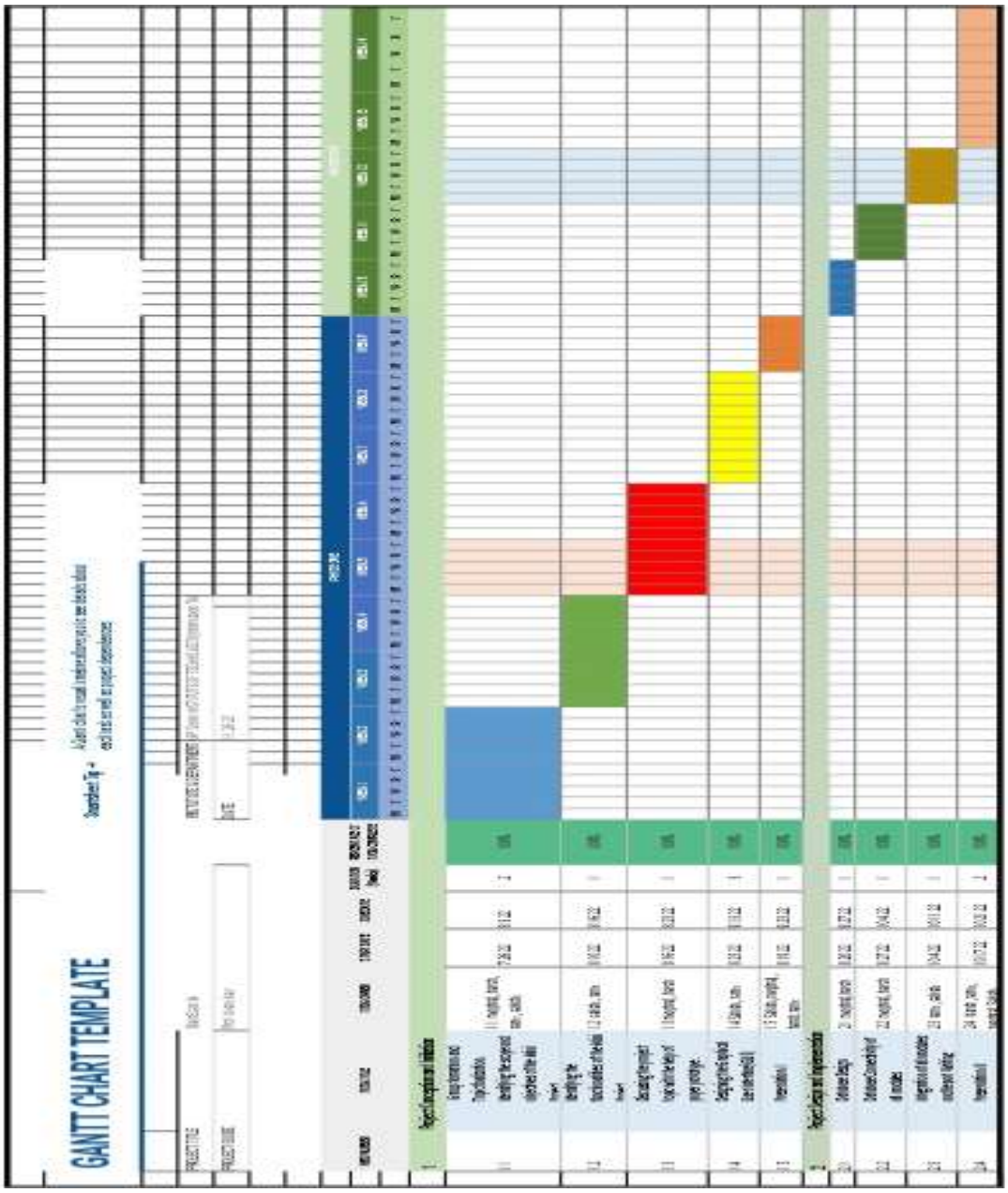

Fig7.1 Gantt chart

Here in the above figure, the rows of the chart contain the task titles such as the project conception and initialization as well as the project design and implementation which in subdivision contains the group formation, topic finalizing, prototype, GUI designing, backend implementation etc. The columns contain the duration of the task completed, the percentage of work completed, the number of weeks required to complete a particular task, the specific dates, and the team members who contributed towards the completion of tasks The detailed explanation of the Gantt chart is explained below: The project conception and initiation task were executed by the July month end around 29/07/23. The task of initiation included many more sub-tasks such as group formation and topic finalization which was performed during the 1 week of project initialization. The group formed included 4 members meghraj padwal, harsh mulik, tanvi mirgal and sakshi jamdhade, and the finalized topic was BrainScan AI: Tumour detection with the help of artificial intelligence. Further, the upcoming week led to the task of identifying the scope and objectives of the mini projects. This was during the time interval of 29/07/23 to 04/08/23. The next sub-task was to identify the functionalities of the project, which was done by the two members sakshi jamdhade, and tanvi mirgal in a span of one week from 29/07/23 to 14/08/23. The discussion of the project topic with the help of a paper prototype was completed by meghraj padwal, harsh mulik within one week from 14/08/23 to 21/08/23. The next main task of Graphical User Interface (GUI) designing was completed by sakshi jamdhade and tanvi mirgal within 2 weeks from 24/08/23 to 02/09/23. The next week from 24/08/23 to 07/09/23 the members worked on the preparation of Presentation I. The next major task was database design and implementation. It took 5 weeks to complete the final implementation. The database Design and connectivity of all modules were done by meghraj padwal and harsh mulik during the course time of 2 weeks from 07/09/23 to 23/09/23. The integration of all modules and report writing was completed by sakshi jamdhade and tanvi mirgal members from 23/09/23 to 15/10/23. The preparation of final presentation II work was equally shared by all the group members in the time of 2 weeks from 15/10/23 to 20/10/23.

Chapter 8

Conclusion

In summary, the development of a BrainScan AI represents a remarkable leap forward in the field of medical diagnostics. This project has aimed to address a pressing healthcare challenge by harnessing the power of cutting-edge technology, specifically machine learning and artificial intelligence (AI), to improve the early detection of brain tumors. Throughout the project's journey, we have meticulously defined the problem, established objectives, and meticulously outlined the system's architecture and functionalities. As proposed, it promises to revolutionize the process of identifying and characterizing brain tumors, offering numerous benefits to healthcare professionals, patients, and the broader medical community. The BrainScan AI represents a powerful marriage of technology and medicine, a testament to human innovation and a dedication to enhancing patient care. By improving the early detection of brain tumors, this system stands poised to save lives, reduce the burden of disease, and advance the field of medical imaging and AI in healthcare. It is a testament to the transformative potential of technology to address some of the most pressing challenges in medicine and improve the well-being of individuals and communities around the world.

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