**Early Brain Tumor Detection Web-Based System**



Final Year Project Report

By

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In Partial Fulfillment

Of the Requirements for the degree

Bachelor of Science (CS)-2020 to 2024

Sukkur IBA University,

Sukkur, Sindh Pakistan

**DEPARTMENT OF COMPUTER SCIENCE**



**CERTIFICATE**

By signing below, I attest that the project work "**Early Brain Tumor Detection Web Based App)**" that I submitted to the **Sukkur IBA University**

is a record of the original work that I undertook under the guidance of **Mr. Zakriya Jamali**, **Associate Professor** Sukkur IBA University Sindh Pakistan, and **Prof. Dr. Samar Raza Talpur** Professor Computer Science, Sukkur IBA University. The project work that is submitted here partially satisfies the requirements for the Bachelor of Computer Science degree. The findings presented in this study have not been distributed to any other universities or institutes to confer degrees or diplomas.

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**Supervisor** **Co-Supervisor**

A.Prof. Zakriya Jamali Prof. Dr. Samar Raza & Mr. Farhan Ahmed

*Date:*

**DECLARATION**

I hereby declare that this project report entitled “**Early Brain Tumor Detection Web Based System)**” submitted to the “**DEPARTMENT OF COMPUTER SCIENCE”**, is a record of original work done by me under the guidance of Supervisor Zakriya Jamali and that no part has been plagiarized without citations. Also, this project work is submitted in partial fulfillment of the requirements for the degree of Bachelor of Computer Science.

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| --- | --- |
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| **Place:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

**DEDICATION**

I dedicate this to Allah almighty, who has been my strength throughout the project. I also dedicate this to my mentor, motivation Sir Zakriya Jamali who tried hard to provide me with the best education and resources, without their belief, it would not have been possible.

*“Don’t complain the darkness, Light a candle” I dedicate this work to the Vice Chancellor of Sukkur IBA University who lit the candle of education for millions of people by establishing this meritorious institute, Sukkur IBA University. My work is dedicated to*

**Mr. Nisar Ahmad Siddiqui - A Beacon of Light Founder of - Sukkur IBA University**

I also dedicate this piece of work to my co-supervisor Sir Farhan Ahmed. It was his unwavering support that led to the completion of the project.

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**– Dilbar Hussain –**

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# Abstract:

Brain tumors represent a significant health concern worldwide, with its diverse and complex nature necessitating advance detection, prevention, and doctor recommendation strategies.

This project investigates the multidimensional aspects of brain tumors, focusing on its early detection, and the essential role of physician recommendations.

The early detection of brain tumors is a critical task that enables accurate diagnosis and targeted treatment. This project examines the evolving landscape of brain tumor early detection techniques, ranging from traditional histopathological methods to cutting-edge molecular profiling. Furthermore, it explores the integration of Artificial Intelligence and Machine Learning in refining early detection accuracy, enabling personalized treatment plans and predicting patient outcomes. Prevention strategies for early brain tumors encompass a range of lifestyle modifications and risk factor management. It also emphasizes the significance of public health campaigns in raising awareness about risk reduction through measures like healthy dietary choices, minimizing radiation exposure, and fostering a tobacco-free environment. Effective doctor recommendation systems play a pivotal role in facilitating timely diagnosis and appropriate treatment.

Doctor recommendation and patients’ communication can be addressed by utilizing emerging technologies tools such as Telemedicine and Decision Support Systems (DSS) that not only enhance but also streamline the referral process.

In conclusion, the intricate landscape of early brain tumor detection, prevention, and doctor recommendation strategies. By embracing advancements in detection methodologies, adopting preventive measures, and optimizing doctor-patient interactions, the medical community can collectively enhance brain tumor management and patient outcomes. This project can further be extended for prevention, design for mobile applications and chatbot.

Keywords: brain tumors, detection, prevention, doctor recommendation, molecular profiling, artificial intelligence, risk factors, telemedicine, decision support systems.

# CHAPTER-1 INTRODUCTION

## -Background

Artificial intelligence (AI) has emerged as a transformative force across numerous domains, revolutionizing the way we approach complex problems and make decisions. This technology leverages computational power and machine learning algorithms to analyze vast datasets and make predictions or classifications. One area where AI has shown remarkable promise is in healthcare, particularly in the early detection and diagnosis of life-threatening diseases. This thesis project focuses on the application of AI in the crucial domain of early brain tumor detection.

The adoption of AI in healthcare has covered the way for more efficient, accurate, and cost-effective solutions to long-standing medical challenges. From image analysis to predictive analytics, AI has proven its worth in revolutionizing patient care. In diagnostic medicine, AI systems have exhibited the ability to augment the skills of healthcare professionals, providing more precise and timely assessments of various conditions, from diabetes to cardiovascular diseases.

Brain tumors can occur at any age, and their effects are far-reaching. According to the American Brain Tumor Association (ABTA), approximately 90,000 primary brain tumors are diagnosed in the United States in every year. Globally, brain tumors are a significant cause of cancer-related morbidity and mortality. [1]Recent research in 2021 suggests that among 24,530 adults in the United States, about 13,840 men and 10,690 women will be diagnosed with cancerous brain and spinal cord tumors. The likelihood of developing this type of tumor in one's lifetime is less than 1%, accounting for 85% to 90% of all primary central nervous system tumors. Additionally, approximately 3,460 children under 15 will also be diagnosed with brain or CNS tumors. Brain cancer ranks as the tenth leading cause of death for both men and women, with an estimated 18,600 adults expected to die from these tumors in 2021. Therefore, there's a crucial need to improve the accuracy of existing methods in medical imaging research. Our proposed CNN-based algorithm, with an accuracy of 82.74%, aims to assist medical professionals by automating the analysis of MRI images, thereby potentially enhancing treatment efficiency. These tumors can be malignant or benign, and their clinical presentation can range from subtle symptoms to life-threatening neurological deficits. Consequently, early detection of brain tumors is paramount in improving patient outcomes, enhancing the quality of life, and reducing the economic burden of treating advanced-stage diseases.

The Proposed Solution Early Brain Tumor Detection Web Application is structured in a way that at the backend it has a machine learning model deployed. This model will take the image but before that preprocessing of the image will be done over the image. The image given to the model would present the detection results to the end users within seconds.

In Pakistan, when a patient goes to the hospital for a normal test and fees are charged up to 15000 to 18000 per, and all the tests for brain tumors are very costly, how a normal family will pay? I am developing such a system in which he needs only the CT scan and MRI images, after that they can find whether he has a brain tumor or not, and my system will suggest it best workouts and eating suggestions and precautions and preventions by following that one can recover yourself from the brain tumor. My system will recommend to the best doctors who give treatment to the normal family up to 40% off. My project will minimize human error like sometimes doctors fails to identify the tumor when it is in early stages but the system can find very easily and having good accuracy.

## -Project Goals

**Accessibility:** A common people can have access of the application using which he/she can classify Brain Tumor and also professional people like doctors and physicians can use this for the better results and for accuracy purposes. Now a days, even children’s know how to use web applications, they can detect yourself very well with good accurate results. World is going to technology very fast, we have to keep yourself updated will technology, now a days people take most of the answers from the google and treatment yourself. Early Brain tumor detection web-based systems helps them to detect early the Tumor by using smart phones and systems.

**Time Saving:** Brain tumor detection using web-based will consumes less time and it is an autonomous Web-based system for Brain tumor detection. Now a days, everyone working to do any task in very less time. People wants to shift yourself on technologies, technologies gives more accurate results than human and take very less time, time consumption less and accuracy very high.

**Rapid Results:** The Proposed idea can provide rapid results to the end user unlike the traditional methods. For that reason, this idea has much weightage. Now a day, everyone wants rapid results, with high accuracy. In traditional methods, we are not sure about the accurate results within less time. Human can’t detect as accurately as a machine or model can detect.

**Training on a variety of datasets:** While training, one dataset brain-tumor-detection 2020 is used for detection. This dataset contains various types of brain tumor images. From different aspects, it shows tumor and model is using 80% of the percentage data for training and 20% for testing of the data. My model is working perfectly on the above dataset. I tried for the latest datasets on Kagle but I couldn’t find the latest one, so I used this one.

## -Project Scope

As a minimum viable product, I have passed presented a product that would detect the Brain Tumor from CT scan or MRI image. For that user will have to get himself registered, then the user will be redirected to the login page. From the login page, the user will get redirected to the dashboard once the credentials get verified. From the dashboard, the user can upload the image and submit the response. At submitting the user response, the user gets the results of Brain Tumor detection. After that user can logout yourself.

## -Not In Scope

This project will not store the detected images results to the database. This project doesn’t allow to capturing image at runtime, it requires the user to have images in device using which he accesses the web interface.

## -Project Objectives

I am over to developing a system that provides accessibility to users for detecting Brain Tumor and talking about the model used. The main objective is to get images as input and apply different techniques for image processing and machine learning models to detect brain tumors. The system would be thoroughly tested throughout the development cycle.

# Chapter Summary:

This chapter mainly discussed the background of the project, the scope and objectives of the project, and the goal that must be achieved. And finally, the benefits achieved by the users through the web application.

# Chapter 2

# Literature Review

The brain, being the most complex organ in our body, consists of around 100 billion neurons. It plays a crucial role in processing sensory information, controlling fast responses, and facilitating learning. Together with the spinal column, it forms the Central Nervous System (CNS), which governs essential bodily functions like thinking, speaking, and movement. A brain tumor arises from abnormal cell growth, disrupting normal brain function and potentially impacting speech, movement, and cognitive processes. There are two main types: primary tumors, which originate in the brain and can be categorized as low or high grade based on their growth rate; and secondary tumors, which spread to the brain from elsewhere in the body and are usually cancer cells. In this paper, we are focusing on providing a solution in which the end users can detect the brain tumor easily without any wait for the doctor/expert. The research will cover the many things that consume a lot of time and, have doubts about whether the results are accurate right or not because a human can make mistakes but if the machines are first trained carefully then there is not any chance of the error. Nowadays, people don’t have a lot of time to wait for the doctors he checks the reports and after checking the results they will provide consultations to the patients. Testing centers also face a shortage of healthcare professionals available to diagnose and offer consultation for test results. So, there should be a system in place for patients and doctors to detect brain tumors. This could be achieved using the latest machine learning and deep learning techniques, such as Support Vector Machines (SVM) and Convolutional Neural Networks (CNN) for extracting features. So, I looked up research papers on Google Scholar and IEEE Xplore to find relevant studies for my final year project. After reviewing several papers, I focused on ones related to Artificial Neural Network (ANN) and Convolutional Neural Network (CNN) based detection. In these studies, ANN is used to categorize features extracted from the data. The number of hidden layers in an ANN depends on the input photos. The input layer of the dataset is connected to the ANN through the hidden layers. Depending on whether the dataset is labeled or unlabeled, supervised, or unsupervised learning methods are used. In a neural network, weights at each connection are learned using either backpropagation or feed-forward architecture. The underlying dataset is utilized differently by both systems. Feed-forward neural networks only transmit data in one direction, from the input layer to the output layer. Medical imaging includes various non-encroaching methods to see inside the body. It's mainly used for diagnosing and treating medical conditions, playing a crucial role in improving healthcare and patient treatment. [1]Medical imaging also helps experts/doctors to notify the diseases clearly and suggest the patient accurate treatment and precautions. [2] Indeed, many human diseases, including COVID-19, Parkinson's disease, breast cancer, diabetes, medical image segmentation, and heart disease, can be detected and classified using machine learning and deep learning techniques. Nowadays medical imaging is going to be so advanced and detects the results clearly within a very short period. No one wants the traditional methods of checkups of doctors they touch the vain of the patient and tell them you have this problem or that problem. Nowadays everything is available on the internet, you can check your serious disease results on the internet, and it also helps you to take precautions about diseases and suggests good doctors. In medical imaging, we take help from the machine learning, computer vision, image processing, and the well-known algorithms of the machine learning and computer vision that help to detect the disease very accurately and suggest the best precautions for the diseases. Convolutional Neural Network is one of them, a well-known algorithm in machine learning that helps in many medical problems. [3]In recent years, CNN has emerged as a powerful tool in medical image segmentation, significantly enhancing diagnostic capabilities. Compared to traditional methods, CNN algorithms help in learning complex features from images, making them the preferred choice in computer vision. Convolutional Neural Network has the power to extract features from the images and use them with different layers that help to predict accurate results and there could be very low error chances due to their hidden layers. Their effectiveness in detecting significant features is particularly evident in medical imaging tasks, where processing intricate images with numerous details is essential. CNN-based approaches consistently perform well in various image understanding challenges, such as Brain Tumor Segmentation (BRATS) and other biomedical competitions, in this context, proposing a machine learning algorithm based on convolutional neural networks for detecting and classifying brain tumors is highly promising[3]. These advanced methods facilitate the accurate identification and categorization of various health conditions, aiding in early diagnosis and treatment planning. The brain contains various structures, including cerebrospinal fluid, grey matter, white matter, and skull tissues, in addition to the tumor. Experts are researching day and night to find the best and easiest way to find/detect/classify the meaning and types of the above-mentioned builds in the brain. The experts are making machines that work without depending on others and predict accurate results much better the human predictions. [2]Although there are some benefits to using machines, the main issue with manual methods of brain tumor checking is that they often fail to accurately predict brain tumors. Machines have been trained on huge data it couldn’t be a problem for the machine to detect or classify these diseases. [4]Automatic detection of abnormalities in MRI scans utilizes advanced algorithms trained on large datasets to identify irregularities of tumors quickly and accurately. This technology enhances diagnostic efficiency and aids in early detection and treatment planning for various medical conditions. [5]Machine Learning (ML) algorithms learn from examples in training data to predict the category of new, unseen data. They're widely employed in health informatics to analyze medical data and make predictions about various health-related aspects. [3]One technique in artificial neural networks is transfer learning, which is quite straightforward. Instead of creating a new CNN model and training it entirely from the beginning, pre-existing architectures that have been well-trained on large datasets and have proven effective are utilized. This approach allows each transfer learning model to be adjusted and customized based on the specific requirements of the task and the features to be identified or classified. [5]This aims to investigate how different image processing methods are used on MRI images to find brain tumors. Additionally, it seeks to compare how well these various techniques perform in detecting brain tumors on MRI scans. [6]The goal of image segmentation is to divide a picture into similar parts, helping to identify the shapes within those regions. MRI (Magnetic Resonance Imaging) or CT (Computed Tomography) scans are commonly used to study the structure of the brain. MRI scans are preferred over CT scans as they don't involve radiation exposure, making them safer for patients. [6]A new automated system is introduced to detect brain tumor image levels, specifically tested on MRI scans. MRI is preferred for tumor detection due to its safety (low radiation), clear contrast, and detailed resolution. While MR images provide valuable data on tumor location and size, they may not accurately categorize the grade of the tumor. [1]In the domain of machine learning for brain tumor segmentation, a vast dataset comprising MRI scans with verified tumor annotations is essential for effective training. Brain tumor tissues are segmented on magnetic resonance visuals of the brain using a convolutional neural network model. This approach enhances learning by extracting the attributes of tumor from complete images, eliminating patchwork selection, and improving calculations at adjacent intersections. However, this abundance of data often introduces challenges such as intensity bias and various forms of image noise. Addressing these issues becomes crucial to ensure the accuracy and reliability of the segmentation model, enabling precise identification and delineation of tumor boundaries in MRI images. [7]Brain tumors exhibit a wide range of appearances, making them challenging to distinguish from normal tissue. This similarity between tumor and healthy tissue complicates the process of extracting tumor regions from images. The convolutional neural network tends to analyze it very well due to their hidden and computational layers which identify the very small tissues if they are looking different from the other tissues. [8]The usual way we detect objects in images, which involves picking out important features, doesn't always work well in wealthy areas. Even experts in this field struggle to come up with methods that consistently give accurate results in different situations, and the Convolutional Neural Network is marked as one of the successful models for their hidden layers. That's where model training comes in. Instead of relying on predefined features, we teach the computer to recognize the right features for each specific task, like analyzing images. Brain tumors show abnormal and uncontrolled cell growth in the brain, with two main types: malignant, containing cancer cells, and benign, no cancer cells. Convolutional Neural Networks (CNNs) are comprised of layers that respond to specific features. Brain tumor segmentation relies on CNNs, which use small 3x3 kernels to identify features. This approach allows for a detailed architecture and helps prevent overfitting, enhancing the network's accuracy even with minimal data. In this study,[8] we used a dataset called BraTS2020, which we got from a website called Kaggle. This dataset has a total of 369 MRI images of patients with brain tumors. We used 125 of these images to train our model and 169 images to test it with an accuracy of 72%. Additionally, we also used another dataset called Br35H2020, which has 3000 images of brain tumor patients. From this dataset, we used 2400 images for training our model and 400 images for testing it with an accuracy of 81% to 82.78%. Early detection and prompt treatment of brain tumors significantly improve a person's chances of survival. By using advanced data analysis techniques, we can examine large amounts of data from different perspectives to gather valuable insights. [9]This research aims to develop a system for diagnosing and predicting brain tumors by incorporating predictive analytics. Brain tumors can be linked to various medical conditions affecting the heart, and these abnormal symptoms have a direct impact on the brain. Currently, brain tumors are a major health concern, underscoring the importance of proactive detection and treatment. Researchers and experts are working to make it a solvable disease because it attacks suddenly, and till the infected person goes to treatment he/she is at the point of death, researchers are working to make a system that can detect the tumor early from the MRI images because nowadays, many times of diseases doctors are engaged with patients a whole day so if there is any system which can detect the tumor it could help the patients to take precautions and step towards the doctors for the treatments and I am making such a system which can detect the tumor but also recommend the best doctors and it could help to the patients to take precautions through the web-based page in which chatbot will be added in Future. Researchers[10] have requested specialists like neurologists and radiologists to provide structured reports to assist in further research. A common issue is the imbalance of tumor types, which is often addressed by using techniques like data augmentation to modify existing images. Currently, most machine learning methods focus on detecting tumor areas by considering the specific location within the brain. Future research could aim to incorporate this information into neural networks, perhaps by providing the entire image to the network. However, brain tumor images are typically high-resolution and gigapixels in size, making it possible to train networks on them due to memory and computational limitations. Our approach[11] stands out from existing methods, particularly in terms of how we handle features and segmentation. We use optimal features during the classification phase, which boosts accuracy and reduces processing time. Unlike many other studies that rely on complex algorithms to select optimal features, we employ a feature extraction technique that achieves the same goal more efficiently. As a result, our method yields superior accuracy and requires less processing time compared to others. Our system can be effectively deployed in real-time settings, offering significant performance improvements, and taking help from the previous researchers' work.

# Chapter 3

# Problem Statement with Definition

In today's rapidly evolving world, where digitalization has permeated every sector, including engineering, agriculture, academia, and medicine, the need for innovation in medical diagnostics, particularly for severe conditions like brain tumors. With robots now assisting in surgeries under the guidance of specialists, it's clear that traditional methods alone are insufficient.

The absence of an efficient brain tumor detection system means patients often wait 4 to 7 days for test results because doctors have many more appointments, enduring both physical and emotional strain. Moreover, the cost of these tests and treatments is often high, further increasing the burden on patients and healthcare systems. By taking this issue is the global shortage of healthcare professionals, as highlighted by the World Health Organization, which underscores the urgent need for technological solutions.

I am developing a product in the medical domain, especially one related to brain tumor cancer, which demands significant and efficient research efforts. Lives are at stake, necessitating thorough training of backend models on extensive datasets to ensure accurate and reliable detection of brain tumors.

To address these challenges, there is a need for innovative solutions that hold advancements in technology, data analytics, and medical imaging to enable early detection of brain tumors. By using the power of artificial intelligence, machine learning algorithms, and predictive modeling, we can develop cost-effective, and widely accessible tools for early brain tumor detection.

# Chapter 4

# Methodology

The methodology used in the project “Early Brain Tumor Detection” is Agile development. The main reason for the Agile methodology is project can be broken into parts and easily can be implemented with understanding. Along with that, different tools and techniques were required to plan, design, analyze implement and test the project by following steps:

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