A

PROJECT REPORT

ON

"BRAIN TUMOR DETECTION"

SUBMITTED TO

SHIVAJI UNIVERSITY, KOLHAPUR

IN THE PARTIAL FULFILMENT OF REQUIREMENT FOR THE AWARD OF DEGREE BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING

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UNDER THE GUIDANCE OF

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DKTE SOCIETY'S TEXTILE AND ENGINEERING INSTITUTE,

ICHALKARANJI

2021-2022

D.K.T.E.SOCIETY'S

TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI
(AN AUTONOMOUS INSTITUTE)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that, project work entitled

"BRAIN TUMOR DETECTION"

is a bonafide record of project work carried out in this college by

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is in the partial fulfillment of the award of degree Bachelor in Technology in Computer Science & Engineering prescribed by Shivaji University, Kolhapur for the academic year 2021-2022.

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EXAMINER: _____

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DECLARATION

We hereby declare that, the project work report entitled “Brain Tumor Detection” which is being submitted to D.K.T.E. Society’s Textile and Engineering Institute Ichalkaranji, affiliated to Shivaji University, Kolhapur is in partial fulfilment of degree B.Tech.(CSE). It is a bonafide report of the work carried out by us. The material contained in this report has not been submitted to any university or institution for the award of any degree. Further, we declare that we have not violated any of the provisions under Copyright and Piracy / Cyber / IPR Act amended from time to time.

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ACKNOWLEDGEMENT

With great pleasure we wish to express our deep sense of gratitude to **Mr. T. I. Baghban** for his valuable guidance, support and encouragement in completion of this project report.

Also, we would like to take the opportunity to thank our head of department Dr. D. V. Kodavade for his co-operation in preparing this project report.

We feel gratified to record our cordial thanks to other staff members of the Computer Science and Engineering Department for their support, help and assistance which they extended as and when required.

Thank you,

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ABSTRACT

In today's world, there is tremendous growth in the use of computer science techniques in the medical field. Medical world is taking help of computer science in order to ease their work and develop new methodologies for carrying out different tasks. Use of technology has shown useful results in some areas in the medical domain like surgery and therapy of different diseases. Even researchers are trying to experiment with the detection of different diseases like cancer in the lungs and kidneys. Brain Tumor detection is one of the most crucial and difficult tasks in medical image processing as a human-assisted manual classification can result in inaccurate prediction and diagnosis. When there is a large amount of data present, it is difficult to work with this data manually. Brain tumors have high diversity in appearance and there is a similarity between tumor and normal tissues and thus the extraction of tumor regions from images becomes unyielding.

In this project, we will input the symptoms faced by the patient and build a classification model that would take MRI images of the patient and compute if there is a tumor in the brain or not. We will be using a dataset consisting of brain images that we have collected from Kaggle. We have used CNN model for the training of the image dataset available. By testing the trained model, prediction is made whether a tumor is present or not. In our work, CNN gained an accuracy of 93%, which is very compelling.

INDEX

INTRODUCTION

Brain is an important organ of the human body. It is a vital part of humans. Brain is a complex organ. It controls thought, memory, emotions, touch, hunger and every process that regulates our body.

The brain is made up of three main parts, which are the cerebrum, cerebellum, and brain stem**.** The average brain weight of the adult male was 1336 gr; for the adult female 1198 gr. With increasing age, brain weight decreases by 2.7 gr in males, and by 2.2 gr in females per year. Per centimetre body height brain weight increases independent of sex by an average of about 3.7 gr**.** The brain is a complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body. Cluster of abnormal cells in the brain is known as Brain Tumor. Brain is a rigid part of our body, any kind of growth inside such restricted space poses a problem.

Tumor is an abnormal growth of tissues which is uncontrollable and goes on growing. Similarly, Tumor in the brain is growth of tissues which are not desired to grow or should die. This may lead to cancer. Brain Tumor is one of the risky and life-threatening diseases. If it is not treated in the beginning or if preventive measures are not taken, it may lead to something harmful or even death in some cases.

Brain tumors are categorized into primary and secondary. A primary brain tumor is a tumor that originates in the brain itself whereas a secondary brain tumor or metastatic brain tumor occurs when the cancerous cells are spread to the brain from distant organs for example lung etc.

Brain tumors can be Benign or Malignant. These brain tumors are not always cancerous, sometimes they may be cancerous, sometimes they are noncancerous. There is an increase in pressure when such Benign or Malignant grows inside your skull. Benign brain tumors are noncancerous. Benign brain tumors typically grow slowly, have distinct borders and rarely spread. Benign tumors can still be dangerous. They affect the parts of brain by damaging and compressing it, causing severe dysfunction. If the location of benign brain tumors is in a vital area of the brain, it can be life-threatening. There are very few cases in which, a benign tumor can become malignant. Examples of typically benign tumors include

meningioma, vestibular schwannoma and pituitary adenoma. Malignant brain tumors are cancerous. They tend to grow fast and invade surrounding healthy brain structures. Brain cancer can be life-threatening due to the changes it causes to the vital structures of the brain. Some examples of malignant tumors that originate in or near the brain include olfactory neuroblastoma, chondrosarcoma and medulloblastoma.

One of the reasons of Brain tumors becoming dangerous is that they can put pressure on healthy parts of the brain. Some brain tumors can also be cancerous or become cancerous. They can cause problems if they block the flow of fluid around the brain, which can lead to an increase in pressure inside the skull. Maytime's a few types of tumors can spread through the spinal fluid to distant areas of the brain or the spine.

There are various symptoms that can be faced when suffering from Brain Tumor. Symptoms include Headaches, Difficulty in thinking, Weakness or numbness or paralysis in one part or one side of the body, Loss of balance, dizziness, Loss of hearing, Vision changes and many others. There may be some cases where a person may experience different symptoms than the actual one.

The method used to detect is Magnetic Resonance Imaging (MRI). Magnetic Resonance Imaging (MRI) is used to help diagnose or monitor treatment for various parts of the human body. Nowadays, MRI is very useful in medical science. From the MRI images, we get information about the abnormal growth of tissues in the brain. Using magnetic resonance imaging, biomedical image processing makes it easier to detect and locate brain tumors.

Detection of brain tumor using computer field makes use of various algorithms. Here, MRI is used as an input for the detection of brain tumor. Various algorithms like K means clustering, Convolutional neural networks, and others can be used for training the image dataset that consists of MRI of the brain. The selection of algorithm is based on the requirements of the project. Select an algorithm which gives higher accuracy on the training of the model.

The images need to go through various processes before going to the training phase. Functions like image pre-processing, data augmentation, cleaning, filtering, etc. After the operations performed on the images, a selected algorithm can be used to train the images. The trained model is then tested.

a. Problem Definition :

Problem Statement -

To build a system for brain tumor detection.

Problem Description –

The human brain is the central and one of the most important organ of the human nervous system. The brain consists of the cerebrum, the brainstem and the cerebellum. It is one the complex parts of the human body. Brain controls thoughts, vision, touch, emotion, hunger, temperature and every other process that regulates our body. Overall, it is the seat of intelligence, interpreter of the senses, initiator of body movement, and controller of behaviour. The human brain is thus the most vital part of the human body.

The cerebrum is the largest part of the brain and has right and left hemispheres. The Brainstem is the relay centre that connects the cerebrum and cerebellum. The Cerebellum is to coordinate muscle movements, maintain posture and balance. As we have seen how brain is the important part of our body it is also essential to know that it can be affected and has to be cured in time.

A tumor is nothing but unusual growth of tissues when they should not grow or should die. Skull is a rigid part of the human brain. Any growth inside such a restricted area or space can cause problems. Primary brain tumors originate in the brain itself or in tissues close to it , such as brain-covering membranes, cranial nerves, pituitary gland or pineal gland. There are cases in which the cause of brain tumors is unknown. Brain and other nervous system cancer is the 10th leading cause of death, and the five-year survival rate for people with a cancerous brain is 34% for men and 36% for women. Moreover, the World Health Organization (WHO) states that around 400,000 people in the world are affected by brain tumors and 120,000 people have died in the previous years.

There are two main types of tumors: malignant(cancerous) tumors and benign(non-cancerous) tumors. When such types of tumors grow, they can cause the pressure inside your skull to increase, it leads to brain damage, and it can be harmful to life. These are further classified as 1) Primary Brain Tumor 2) Secondary Brain Tumor.

Primary brain tumors start within the brain and Secondary most commonly have spread from tumors located outside the brain known as Brain Metastasis tumor . Primary brain tumors begin when normal cells develop changes (mutations) in their DNA. A cell's DNA contains the instructions that tell a cell what to do. The mutations tell the cells to grow and divide rapidly and to continue living when healthy cells would die. The result is a mass of abnormal cells, which forms a tumor. On the other hand , Secondary brain tumor results from cancer that begins elsewhere and metastasizes to your brain. Secondary brain tumors often occur in people who have a history of cancer.

Primary brain tumors are less common than secondary ones. Many types of brain tumors exist, examples of Gliomas, Meningiomas, Acoustic neuromas and so on. Secondary brain tumors are more common than primary ones. Common types from which it can spread are breast cancer, kidney cancer, lung cancer and so on.

People with brain tumors may face various symptoms or signs. In some cases, there are no signs or symptoms of tumor in a patient. Even, there may be cases in which the symptoms detected are not the one usually detected; symptoms may be rare. Symptoms can be general or specific and may vary from person to person. A symptom is caused by the pressure of the tumor on the brain or spinal cord. They are also caused when a specific part of the brain is not working well because of a tumor. General symptoms include Headaches, Seizures, Loss of consciousness and Body tone, Change in sensation, Vision, Smell, Nausea, Vomiting, Drowsiness, Fatigue, Sleep problems and many more. People may also experience Location-specific symptoms. Risk factors for brain tumors may include Family history, Age, Chemical Exposure, Exposure to radiation, etc.

The diagnosis of a brain tumor begins with a physical exam and analysis of medical history. Various tests like the CT-scan of head, MRI of the head, Angiography, Skull X-rays, Biopsy are performed as required by the doctor. Out of which MRI is typically the reference standard used for diagnosis. Benign brain tumors often show up as hypodense (darker than brain tissue) mass lesions on CT scans. On MRI, they appear either hypodense or isointense (same intensity as brain tissue) on T1-weighted scans, or hyperintense (brighter than brain tissue) on T2-weighted MRI, although the appearance is variable.

The important task performed by the neurologists and radiologists is early brain tumor detection. Detection of tumors on the basis of Magnetic Resonance Imaging (MRI) scans manually

is challenging, and the results can be prone to errors. Thus, the use of an automated brain tumor detection system is required for early diagnosis of the disease**.**

So, detection of brain tumor at an early stage can help the patient to start the treatment soon by just providing the MRI scan of the brain. In this project, we proposed an efficient and skillful method which helps in the segmentation and detection of the brain tumor without any human assistance based on the Convolutional Neural Network.

b. <u>Aim and Objective of the Project :</u>

Aim -

To build a system which makes it easy for the detection of the presence of tumor in the brain.

Objectives –

1. To study and analyse different techniques in brain tumor detection.
2. To acquire suitable brain tumor detection images dataset for tumor detection testing.
3. To develop algorithms for tumor detection using CNN technique.
4. To train and test the CNN model to detect the brain tumor.
5. To analyse the accuracy and efficiency of CNN model for brain tumor detection.

c. <u>Scope and Limitation of the Project :</u>

Scope:

Our project currently aims at detecting the presence of tumors in the brain and classifying the brain as cancerous or non-cancerous type.

In future, other features can also be added in the project that can provide more information about the tumor present in the brain. The feature may provide information about the percentage of brain affected with the part of the brain affected and may also provide remedies for the tumor present.

Limitations:

1. Prediction accuracy is based on a collected database.
2. The bias generated from the model can reduce the efficiency.
3. The application runs on a local machine.
4. Excessive computational cost and also required manual interaction

d. Timeline of project :

Month	Task performed	Description
July	Project Domain selection and Analysis of various problems suitable in the selected Domain.	Analysed various project domains and finalised our project domain. Considered various problems related to that domain.
August	Domain finalisation, Problems detected and Research on various problem statements detected.	Selected one domain to resolve. Detected few problems over considered domain.
September	Problem Statement finalisation, Study of Research papers and Documentation of synopsis.	Finalised problem statement, Study on various Research papers and Documentation of synopsis requirement analysis.
October	System Requirement. Module Identification and study and SRS Documentation and presentation.	Identified the system requirements. Studied and identified the required modules in detail. Created the Software Requirement Specification Document (SRS Document) and PowerPoint presentation.

November - December	Collecting database Studying various algorithms and finalising, Coding and Implementation 30%.	Collected required database for training and study on various algorithms and finalising one. 30% coding done. Collection of the required data for code implementation and Analysis of limitations and drawbacks.
December - January	Coding Implementation 70%. Testing and Improvements. Code updation. Testing and accuracy improvements.	70% coding done. Implementation and Testing. Updation of code for meeting the desired requirements. Work on accuracy improvements.
February	Code updation and coding 90%.	Made changes in code according to need.
March	100% coding complete and documentation.	Coding done and perform documentation.

e. <u>Project Management Plan :</u>

Task	Duration	Start Time	End Time	Priority
Domain Selection	7 days	15-07-2021	22-07-2021	High
Analysis of various problems suitable in the selected domain	7 days	23-07-2021	29-07-2021	High
Domain finalisation	10 days	30-07-2021	08-08-2021	Medium

Problems detected	7 days	09-08-2021	15-08-2021	High
Research on various problem statements detected	7 days	18-08-2021	25-08-2021	Medium
Problem statement Finalisation	14 days	26-08-2021	09-09-2021	Medium
Study of research papers	10days	10-09-2021	19-09-2021	High
Documentation of Synopsis	12 days	20-09-2021	01-10-2021	High
Requirement Collection	07 days	02-10-2021	08-10-2021	High
Module identification	10 days	09-10-2021	18-10-2021	Medium
SRS documentation and Presentation	14 days	19-10-2021	01-11-2021	Medium
Collecting datasets	07 days	02-11-2021	08-11-2021	High
Studying various algorithms	10 days	09-11-2021	18-11-2021	High
Coding implementation 30%	25 days	19-11-2021	13-12-2021	High
Coding Implementation 70%	30 days	14-12-2021	12-01-2022	High
Testing and accuracy Improvements	20 days	13-01-2022	01-02-2022	High

Code updating	10 days	02-02-2022	11-02-2022	High
Coding 90%	20 days	12-02-2021	03-03-2022	High
Testing and Implementation 100%	days	6-02-2022	13-02-2022	High

f. <u>Project Cost :</u>

Hardware/Software	Cost
Computer System with i3 7 th generation or above 40000.	45000 RS
Visual Studio Code to train and run the CNN (convolution neural network) Model.	0 RS
4GB or Above RAM	2000 RS
XAMPP Server to connect database	0 RS
Electricity	300 RS
Internet	3000 RS

Estimated cost by considering other factors will be approximately – RS 50,300/-

COCOMO Model:

In this Project, the Cost Estimation based on COCOMO (Constructive Cost Model) is calculated as below

Line of code : To develop the system 15271 lines of codes are required.

KLOC : KLOC is the estimated size of the software product indicates in Kilo Lines of Code.

Effort : The effort is only a function of the number of lines of code and some constants evaluated according to the different software systems.

Time : The amount of time required for the completion of the job, which is, of course, proportional to the effort put in. It is measured in the units of time such as weeks months.

Persons Required : Persons required is nothing but effort divide by time.

The coefficient ab, bb, cb and db are given below.

Software Project	**ab**	**bb**	**cb**	**db**
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

KLOC = LOC / 1000
= 15271 / 1000
= 15.271

Effort = a * (KLOC) ^ b
= 2.4 * (15.271) ^ 1.05
= 2.4 * 17.5
= 42

Time = c *(Efforts) ^ d
= 2.5 * (42) ^ 0.38
= 2.5 * 4.14
= 10.34

Persons Required = Efforts / Time
= 42 / 10.34
= 4.06 ~ 4

BACKGROUND STUDY AND LITERATURE OVERVIEW

a. Literature Overview :

One of the most challenging as well as demanding tasks is to segment the region of interest from an object and segmenting the tumor from an MRI Brain image is an ambitious one. Researchers all around the world are trying to find the best-segmented ROI, and various approaches have been found from a distinct perspective. Currently, Neural Network based segmentation gives prominent outcomes, and the flow of employing this model is augmenting day by day.

Chirodip Lodh Choudhury et al.,[1] made the use of deep learning techniques involving deep neural networks and also incorporated it with a Convolutional Neural Network model to get the accurate results of MRI scans. A 3-layer CNN architecture was proposed which was further connected to a fully Connected Neural Network. F-score equal to 97.33 and an accuracy equal to 96.05% was achieved.

Neelum et al.,[2] used a concatenation approach for the deep learning model in this paper and the possibility of having a brain tumor was analysed. Pre-trained deep learning models which are Inception - v3 and DenseNet201 were used to detect and classify brain tumors. Inception - v3 model was pre trained to extract the features and these features were concatenated for tumor classification. Then, the classification part was done by a SoftMax classifier.

Parnian Afshar et al.,[3] used a bayesian approach for the classification of brain tumors using capsule networks. To improve the results of tumor detection, a capsule network instead of CNN was used as CNN can lose the important spatial information. The team proposed the Bayes Cap framework. To test the proposed model they used a benchmark brain tumor dataset.

S. Irsheidat et al.,[4] Using Kaggle dataset, applied augmentation in the dataset and expanded its size to 14 times. x ACNN was designed for the classification of MRI images. Images are labelled, label 1(having tumor) and label 0(not having tumor). Overall accuracy achieved was 96.70%.

b. Critical appraisal of other people's work :

There are many researchers and people that have contributed in the research work focussing in the medical field. There is immense growth of research works in the concept of using computer science in the medical field. People are inclining more towards the use of smart technology in the field of medicine.

Owing to the increase in the use of computer science concepts in medicine, many researchers are contributing in the research work related to this field. The work done by the researchers helps the people who want to get acquainted with this field or gain more knowledge or perform research work in this field.

There are many researchers that have contributed to the research work of Brain Tumor Detection. Some of their works are listed below -

1. Chirodip Lodh Choudhury et al.,[1] -

- This researcher made the use of deep learning techniques involving deep neural networks and also incorporated it with a Convolutional Neural Network model to get the accurate results of MRI scans.
- A 3-layer CNN architecture was proposed which was further connected to a fully Connected Neural Network. F-score equal to 97.33 and an accuracy equal to 96.05% was achieved.

2. Neelum et al.,[2] -

- This researcher used a concatenation approach for the deep learning model in this paper.
- The possibility of having a brain tumor was analyzed.

● Pre-trained deep learning models which are Inception - v3 and DenseNet201 were used to detect and classify brain tumors.

● Inception - v3 model was pre trained to extract the features and these features were concatenated for tumor classification. Then, the classification part was done by a softmax classifier.

3. Parnian Afshar et al.,[3] -

● This researcher used a Bayesian approach for the classification of brain tumors using capsule networks.

● To improve the results of tumor detection, a capsule network instead of CNN was used as CNN can lose the important spatial information.

● The team proposed the Bayes Cap framework.

.● To test the proposed model they used a benchmark brain tumor dataset.

c. Investigation of current project and related work :

The goal when we started our project was to build a system which would detect the presence of tumor in the brain. So, we started with collecting the dataset that we needed for our tumor detection. We looked for a dataset on the internet and we found one that satisfied our requirements on Kaggle. We wanted a dataset with both yes and no images so that the model can be trained precisely for both the cases.

The next step was to decide which algorithm should be used. There were many approaches to detect tumor like K means clustering algorithm, FCM clustering algorithm, Convolutional Neural Network algorithm, and many more. We scaled down to Convolutional Neural Network (CNN) algorithm. We resized the images, performed training on the images with different CNN layers and finally obtained a trained model. We got an accuracy of about 92% in our trained model. The model was tested and it predicted the presence of a tumor successfully.

Training and testing a model were just not enough, so we decided to ask the user to input symptoms as well. We stored these symptoms in a database so that it can be used later. Rare symptoms too were collected to use later on.

As we moved ahead, we thought it was necessary to encapsulate all this in a single website. Using html, CSS, JavaScript for frontend we designed a website and used flask for the backend. Our website runs on a local server.

REQUIREMENT ANALYSIS

a. Requirement Gathering :

Admin -

1. As an admin, I want to manage the entire database system.
2. As an admin, I want to store user information.
3. As an admin, I want to check the user information.
4. As an admin, I want to send an error message if an incorrect login is detected.
5. As an admin, I want to view and store user symptoms and brain images. 6. As an admin, I want to make changes if any to the system.

User -

1. As a user, I want to enter my details (name, username, email id, password) on the system.
2. As a user, I want to get an error message if invalid credentials are entered.
3. As a user, I want to enter my symptoms and upload images of my brain.
4. As a user, I want to get a message regarding whether a tumor is present or not.

User Stories:

Admin -

1. Admin can collect the user information and store it in the database.
2. Admin can view the database.
3. Admin can view the symptoms of the user.
4. Admin can view the brain images.

User -

1. Users can add details on the system.
2. Users should get an error message if invalid details are entered.
3. Users can add symptoms and brain images on the system.
4. Users should get a message of whether a tumor is detected or not.

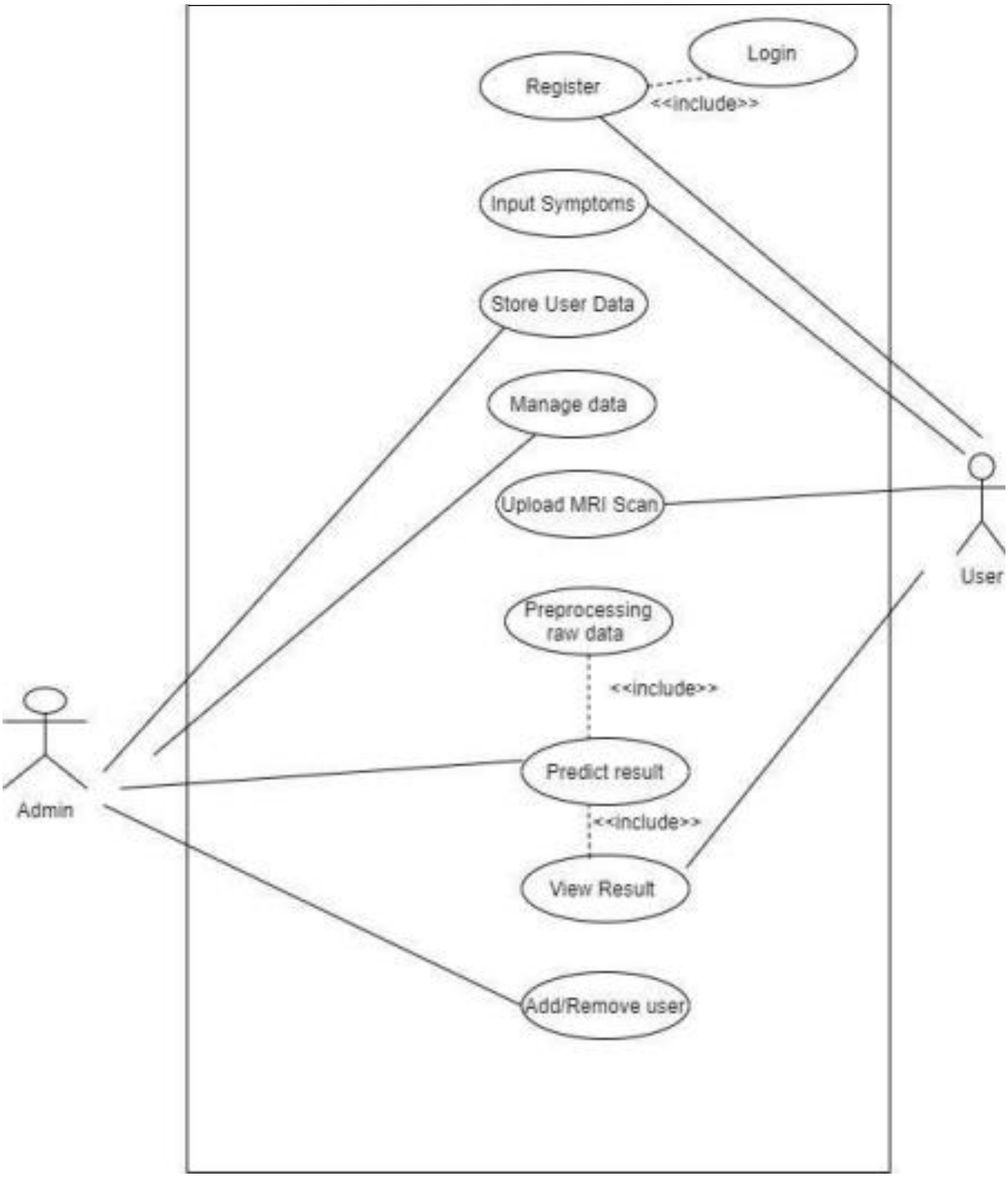
b. Requirement Specification :

No	Requirement	Essential/ Desirable	Description of Requirement	Remarks
RS1	The system should be able to add name of user	Essential	If the user does not have an existing account, the user should sign up by entering the name of the user.	Name should be First and LastName.
RS2	The system should be able to add username	Essential	If the user does not have an existing account, the user should sign up by entering the username.	Username should be unique.

RS3	The system should be able to add password	Essential	If the user does not have an existing account, the user should sign up by entering the password.	Passwords should contain at least 8 characters including at least one capital letter, number and unique symbol.
RS4	The system should be able to generate error if invalid credentials are entered	Essential	If the user enters invalid information or the entered information does not match the credentials entered while signing up then the system must generate an error.	Error must be generated.
RS5	The system must be able to add symptoms	Essential	The symptoms entered by the user must be stored in the database by the system.	
RS6	The system must be able to add brain	Essential	The brain image uploaded by the user	

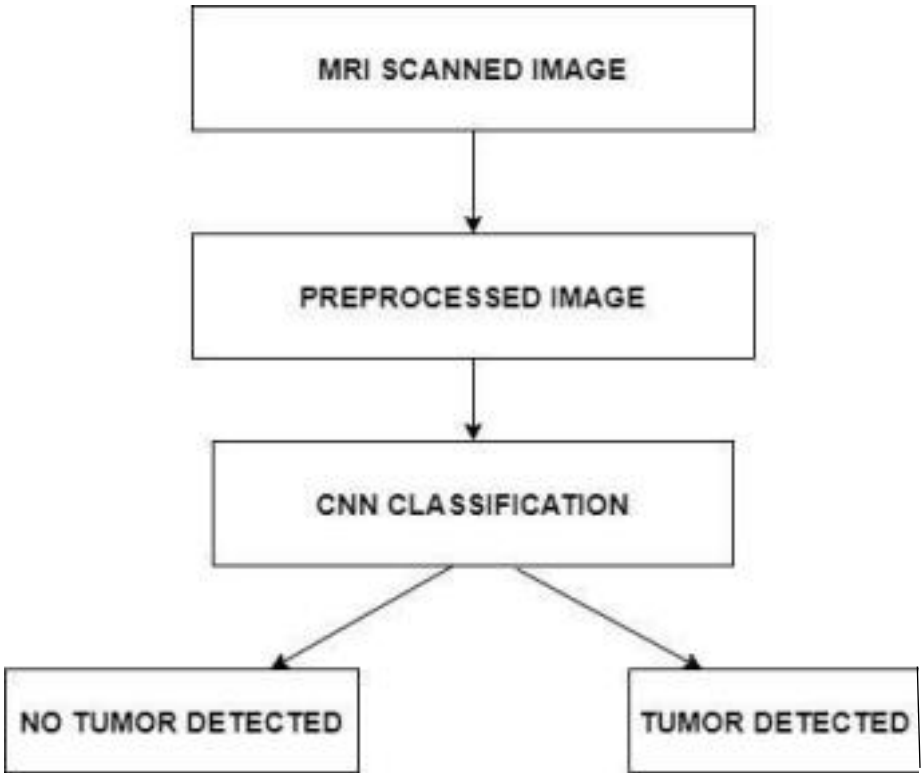
	image		must be stored by the system.	
RS7	The system must be able to manage databases.	Essential	The system must be able to add, modify and edit information if required in the database.	
RS8	The system must be able to detect tumor	Essential	The system must be able to detect whether a tumor is present or not and display a message regarding the same.	Yes or No result should be displayed.

c. Use case Diagram :

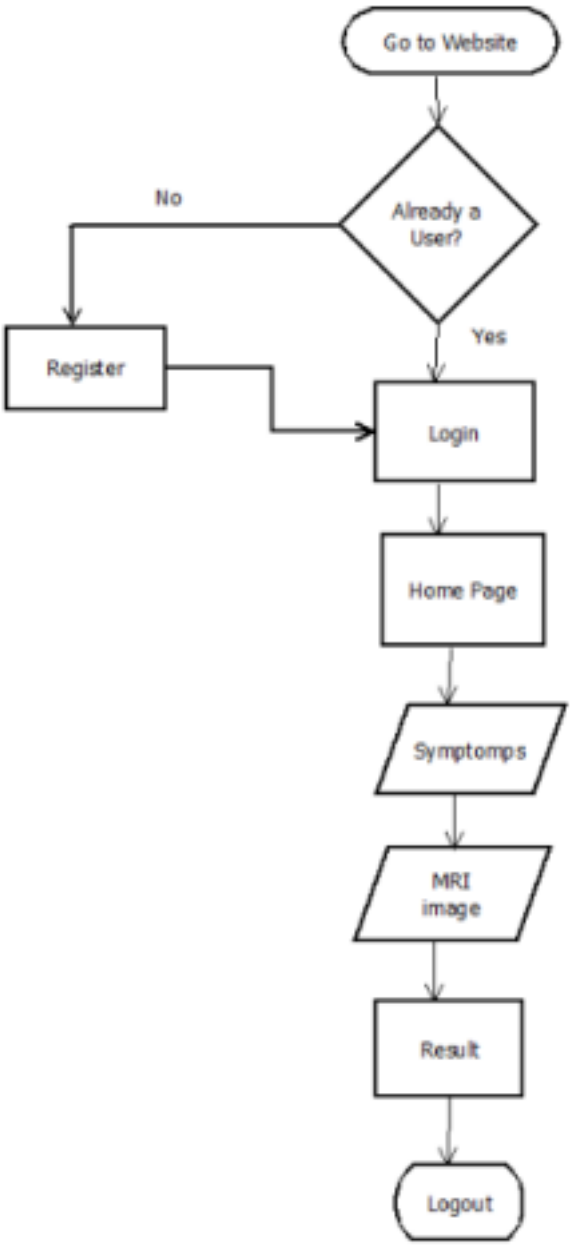


SYSTEM DESIGN

a. Architectural Design:



b. User Interface Design:



c. Algorithmic description of each module:

Our project aims at detecting the presence of tumor in the brain. It is composed of various modules. The modules present in our project are as follows:

1. Login/Register to the system
2. Input the symptoms and the brain images
3. Training and Testing of the model
4. Result found

1. Login/Register to the System -

A user is able to login/register on the system. If there is a new user to the system, one can register to the system. The registration form consists of basic details like the First Name, Last Name, Email Id, Phone, Gender, Age, Username and Password. After filling these details, users can login to the system. If the user is already registered to the system, then the user can login using its username and password.

The details provided by the user gets stored in the database. As the data gets stored in the database, if the user enters invalid login credentials, then an error will be generated and the user will not be able to login unless correct credentials are entered. The admin of the system is able to view the details of the user.

Algorithm:

1. Open the website.
2. If existing user, then login

   else

   Register to the system. Enter First Name, Last Name, Gender, Age, Email Id, Phone, Username and Password. Submit details.

3. Login successful.

2. Input the Symptoms and MRI of Brain -

After the user gets successfully logged in, the user is directed to a page where the user has to enter the symptoms that he/she is facing the MRI of the brain. There are checkboxes provided by the system which consist of common symptoms faced by people, these checkboxes can be selected if one faces the same problems, else there is a text box provided to enter any other symptoms faced by the user. These symptoms get stored in the database.

Next, the user has to upload an MRI of the brain. This MRI is further given to the tested model so as to detect whether a tumor is present or not.

Algorithm:

1. If login successful,

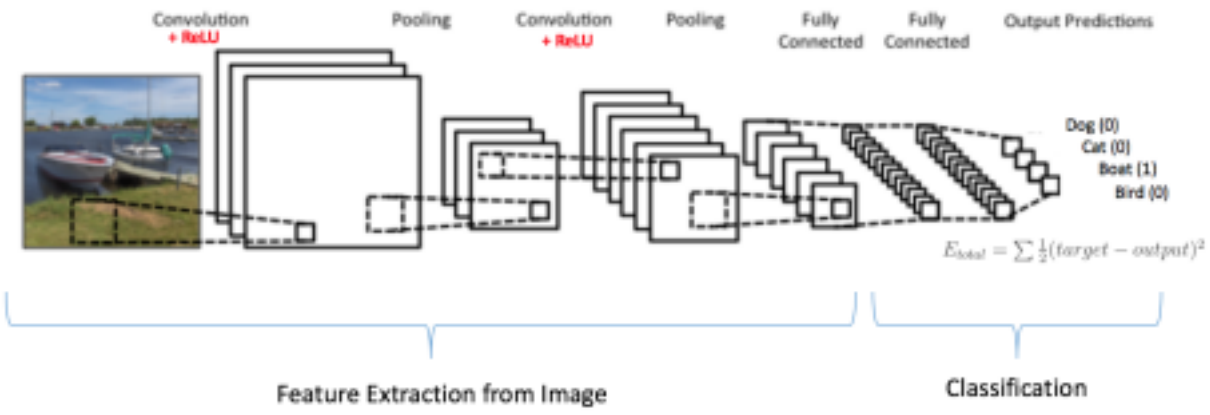
   then, go to the next page.

2. Select Symptoms
3. Upload MRI of brain

3. Training and Testing of Model -

The training and testing is performed on the image dataset that consists of brain images containing yes and no tumor presence images. The dataset is collected from Kaggle. It consists of two folders, consisting of yes and no tumor. First, the training of the model is carried out and then the model is tested. The algorithm used for the training purpose is CNN model.

CNN Model:



In deep learning, a convolutional neural network (CNN/ConvNet) is a class of deep neural networks, most commonly applied to analyze visual imagery. Now when we think of a neural network we think about matrix multiplications but that is not the case with ConvNet. It uses a special technique called Convolution. The layers in CNN are:

1. Sequential Layer : This layer is used to initialize the neural network.

2. Convolution2D : It is used in image processing to blur and sharpen images, as well as to perform other operations.
3. MaxPooling2D : It selects the maximum element from the region of the feature map covered by the filter.
4. Activation Layer : It defines how the weighted sum of the input is transformed into an output from a node or nodes in a layer of the network.
5. Dropout Layer : It is used to prevent a model from overfitting.
6. Flatten : It is a function that converts the pooled feature map to a single column that is passed to the fully connected layer.
7. Dense Layer : Adds the fully connected layer to the neural network.

Thus, using CNN Algorithm, the images can be trained. This trained model is then loaded into the testing phase. In the testing phase, other images than the images used in the training phase are collected and then prediction is made about the presence of the tumor.

Algorithm :

1. Install Python.
2. Import required libraries
3. Import datasets
4. Resize the images
5. Build model using layers

6. Save the trained model
7. Perform testing

Result -

After the successful training and testing phase, results are generated. The user gets to know whether there is a tumor in his/her brain or not. After getting the results, the user can logout from the system.

Algorithm :

1. If tumor is detected,

then print “Yes Tumor Detected”

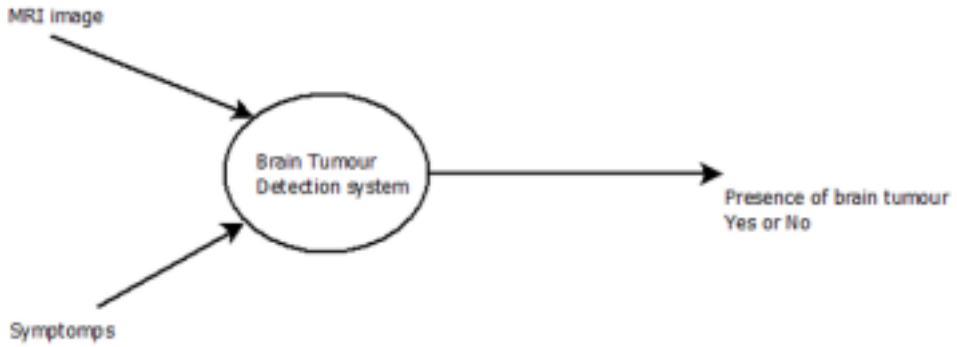
else

print “No Tumor Detected”

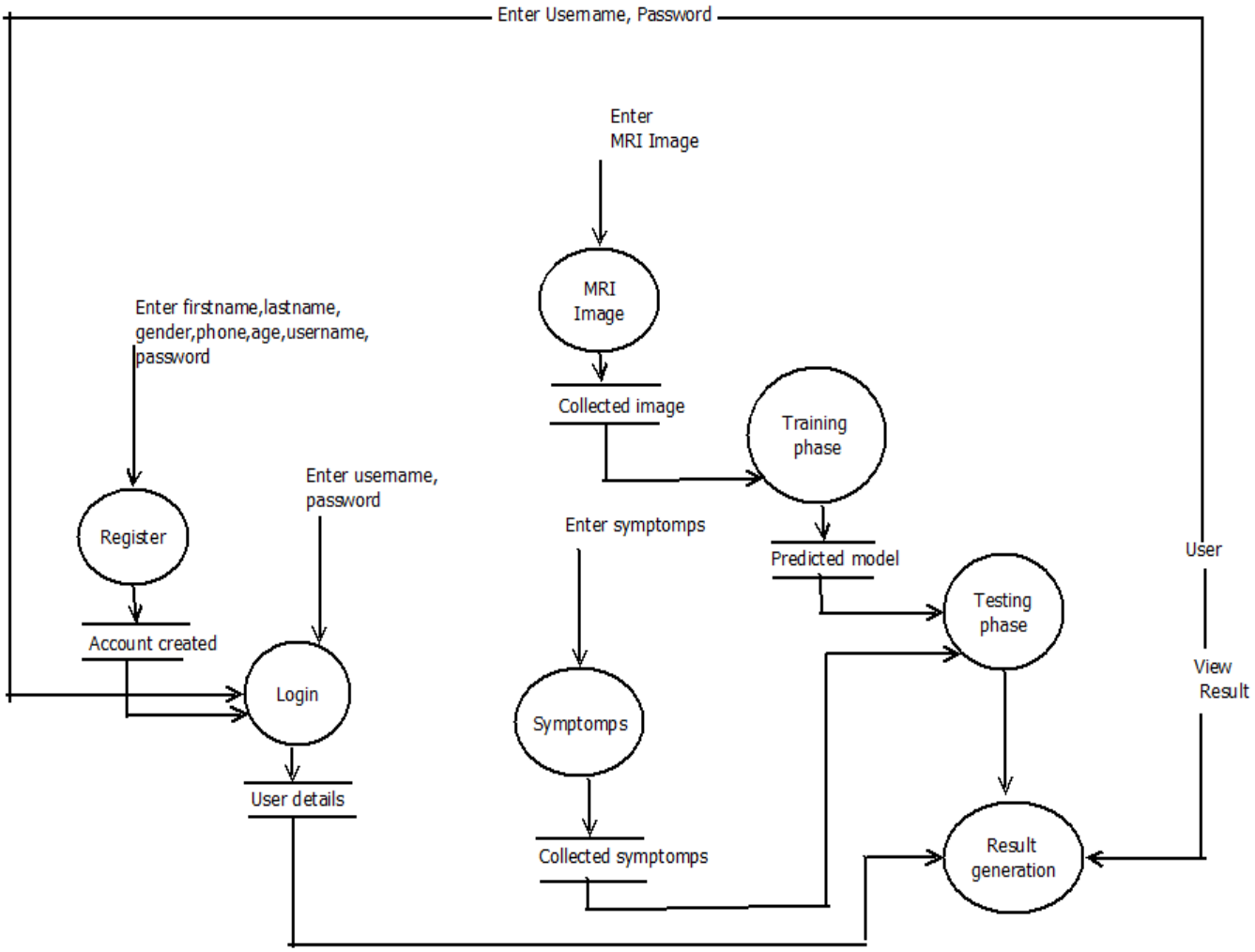
4. System Modelling :

1. Dataflow Diagram :

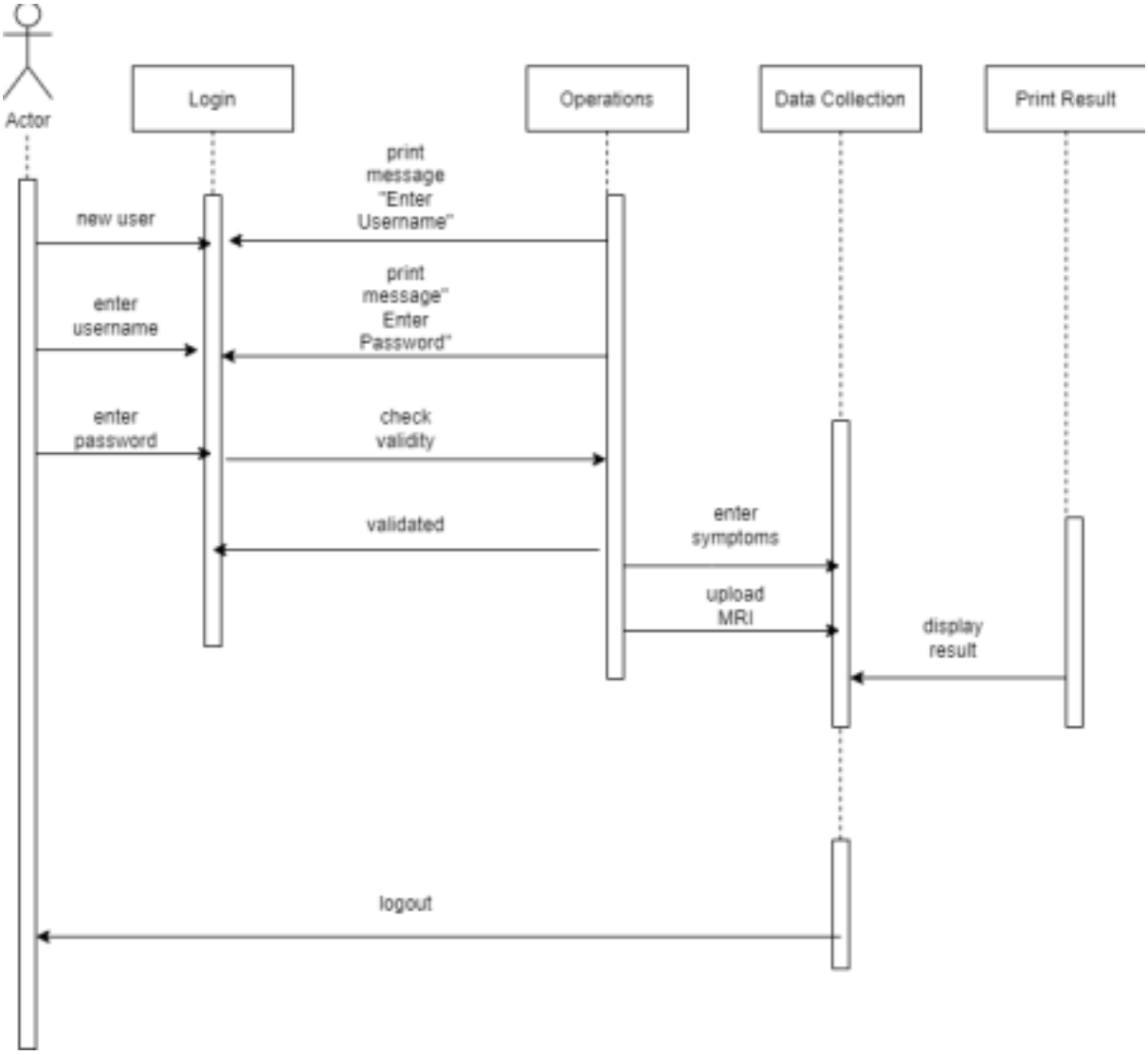
Level-0



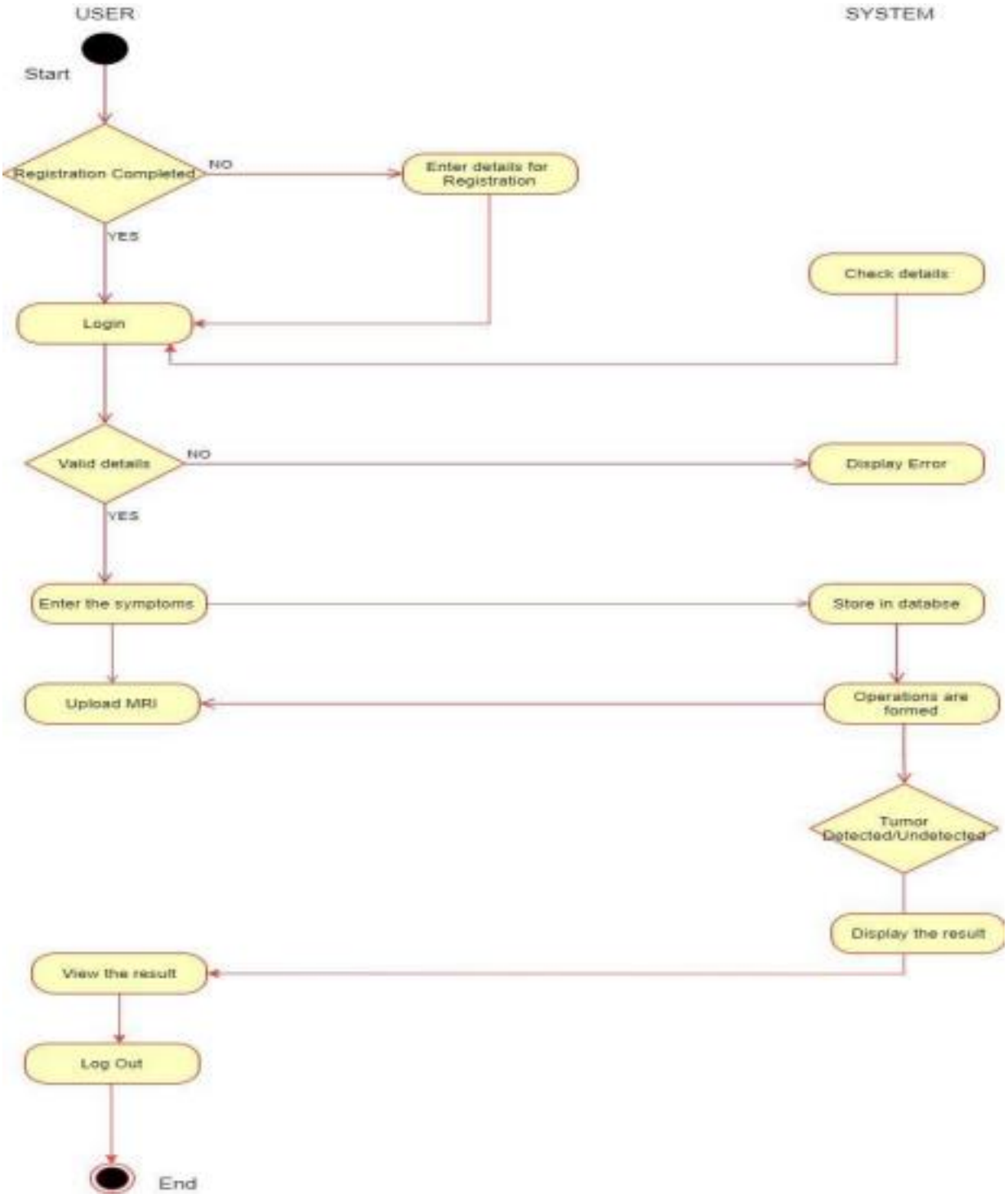
Level-1


Enter Username, Password
Enter
MRI Image
MRI
Image
Collected image
Training
phase
Predicted model
Enter firstname,lastname,
gender,phone,age,username,
password
Register
Account created
Enter username,
password
Login
User details
Enter symptomps
Symptomps
Collected symptomps
Testing
phase
User
View
Result
Result
generation

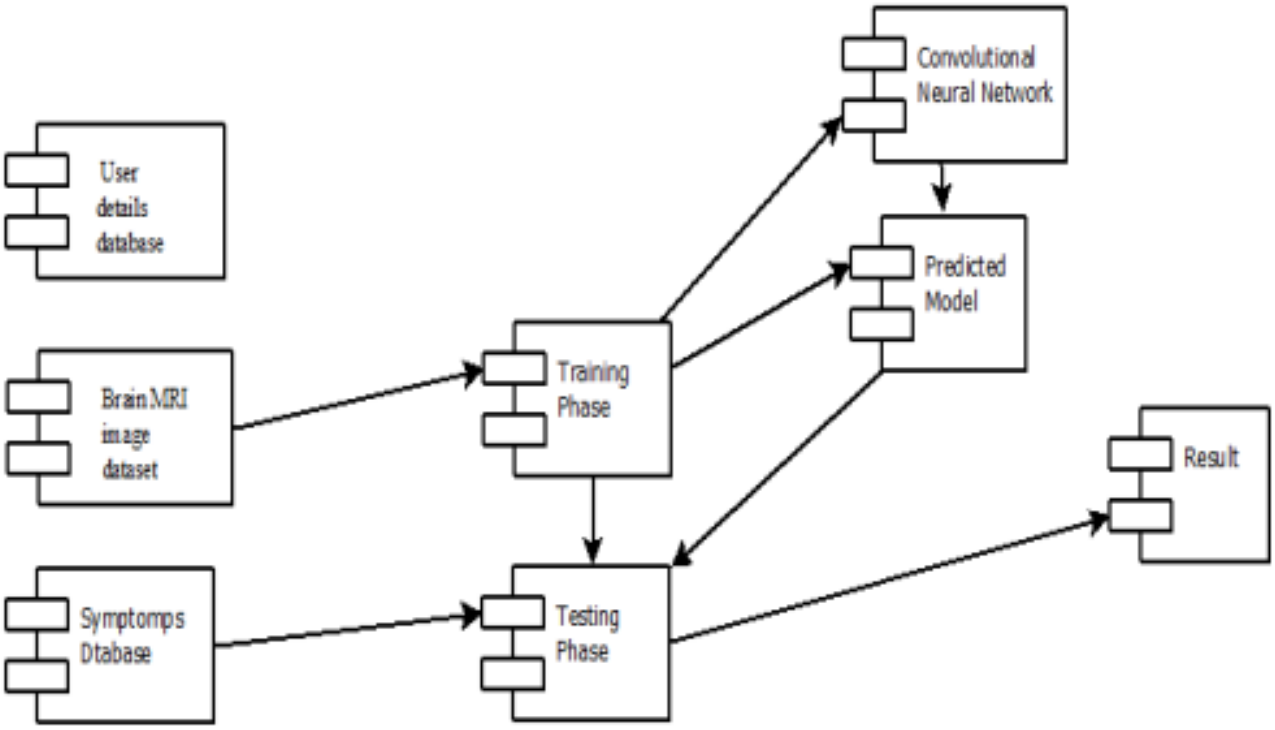
2. Sequence Diagram :



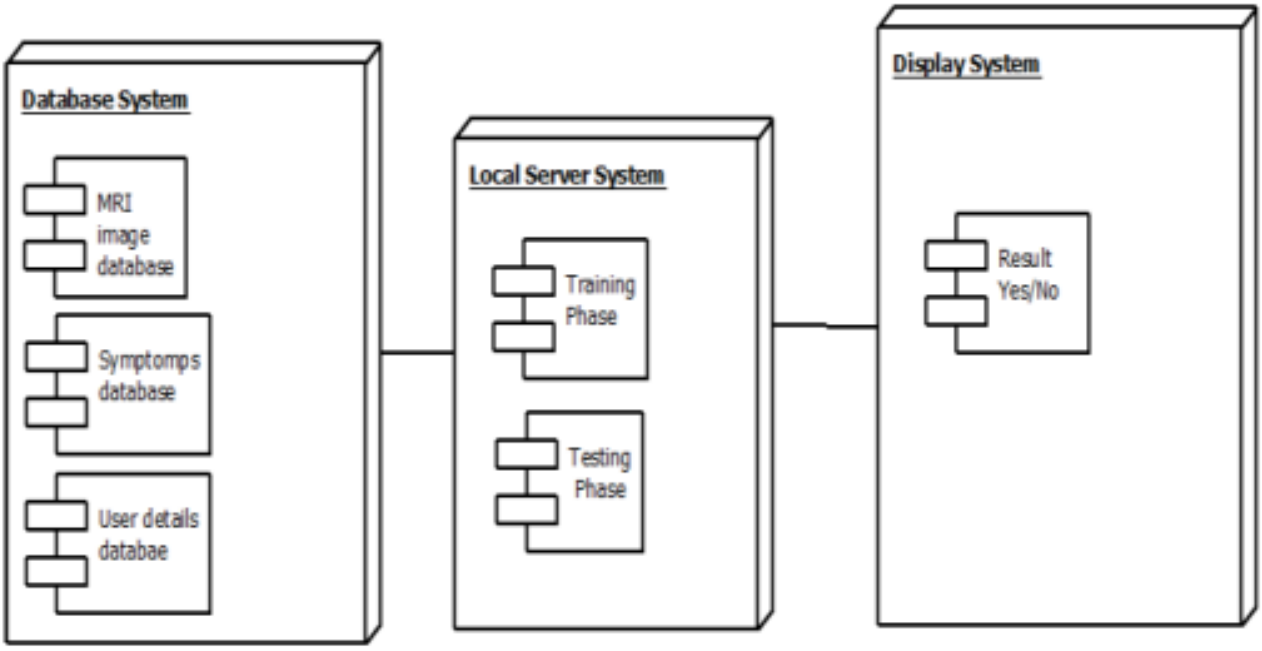
3. Activity Diagram :



4. Component Diagram :



5. Deployment Diagram :



IMPLEMENTATION

Implementation is the method of execution or carrying out a plan or design for doing something. In IT context , it includes all the processes involved in the environmental setup , the method's implementation and the detailed information about the system.

a. Environmental Setting for Running the Project :

1. Windows Operating System: 8, 10 or above
2. Processor: Intel core i5 or above.
3. 64-bit, quad-core, 2.5 GHz minimum per core
4. Ram: 4 GB or more.
5. Hard disk: 10 GB of available space or more.
6. Python: 3.8.0 or above
7. HTML
8. CSS
9. MySQL

Python –

Python is an interpreted , high-level , general purpose programming language created by Guido Van Rossum and first released in 1991. It provides code readability and helps the programmers to write clear , logical code for small and large scale projects.

PIP -

It is the package management system used to install and manage software packages written in python.

NumPy -

NumPy is a general purpose array-processing package. It provides a high-performance multidimensional array object , tools for working with these arrays.It is a fundamental package for scientific computing with Python.

TensorFlow-

TensorFlow is an open-source library developed for deep learning applications such as neural networks.

Keras -

Keras is an open-source neural network library written in Python. It is capable of running on top of TensorFlow. It is designed for developing and evaluating deep learning models.

Open CV -

OpenCV is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel. It is a great tool for Image Processing and performing computer vision tasks.

Flask -

Flask is a small and light-weighted Python web framework that provides useful tools and features that make creating web applications in Python easier. It gives developers flexibility and is a more accessible framework for developers using a single Python file.

MySQL -

MySQL is an open-source relational database management system. Used to add, access , and process data stored in a computer database.

b. Detailed Description of Methods :

1. **Login/Register**

   User has to fill in the personal details used for further login process.

2. **Upload Image**

   Upload MRI Image here which has to be processed.

3. **Data Collection –**

There are several open-source datasets available for Brain Tumour Images. We have downloaded a dataset from Kaggle which consist of nearly 1500 images with Yes (tumour present) and 1451 images with No (tumour absent)

Training Images – 2951 Testing Images -60

4. **Classification using CNN (Image classification) –**

Classification is the best approach for identification of images like any kind of medical imaging. All classification algorithms are based on the prediction of an image, where one or more features and that each of these features belongs to one of several classes. An automatic and reliable classification method Convolutional Neural Network (CNN) will be used since

it is robust in structure which helps in identifying every minute details. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower s compared to other classification algorithms.

For this step we need to import Keras and other packages that we're going to use in building the CNN. Import the following packages:

· Sequential is used to initialize the neural network.

· Convolution2D is used to make the convolutional network that deals with the images.

· MaxPooling2D layer is used to add the pooling layers.

· Activation layer defines how the weighted sum of the input is transformed into an output from a node or nodes in a layer of the network.

· Dropout layer is used to prevent a model from overfitting.

· Flatten is the function that converts the pooled feature map to a single column that is passed to the fully connected layer.

· Dense adds the fully connected layer to the neural network.

c. <u>Implementation details :</u>

a. User Details –

The user is asked to input his/her details by registering or signing into the system.This website is implemented using HTML, CSS ,JavaScript , and manage database by PHP integrated with popular database MySQL.

b. Implementation details –

CNN is used for image classification and its role is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction.

Layers used are as follows –

1. **Sequential –**

To initialize the neural network, we create an object of the Sequential class.

· classifier = Sequential ()

2. **Convolutional –**

To add the convolution layer, we call the add function with the classifier object and pass in Convolution2D with parameters. The first argument feature detectors which is the number of feature detectors that we want to create. The second and third parameters are dimensions of the feature detector matrix. The next

parameter is input shape which is the shape of the input image. The images will be converted into this shape during pre-processing. If the image is black and white it will be converted into a 2D array and if the image is coloured it will be converted into a 3D array

The final parameter is the activation function. Classifying images is a nonlinear problem. So, we use the rectifier function to ensure that we don't have negative pixel values during computation. That's how we achieve non-linearity classifier.add (Convolution2D (32, 3, 3, input_shape = (input size, input size , 3), activation='relu'))

3. **Pooling –**

The Pooling layer is responsible for reducing the spatial size of the convolved feature. This is to decrease the computational power required to process the data through dimensionality reduction. Furthermore, it is useful for extracting dominant features which are rotational and positional invariant, thus maintaining the process of effectively training of the model. There are two types of Pooling: Max Pooling and Average Pooling. Max Pooling returns the maximum value from the portion of the image covered by the Kernel.

On the other hand, Average Pooling returns the average of all the values from the portion of the image covered by the Kernel. Generally, we use max pooling.

In this step we reduce the size of the feature map. Generally, we create a pool size of 2x2 for max pooling. This enables us to reduce the size of the feature map while not losing important image information. classifier.add (MaxPooling2D (pool_size= (2,2)))

4. **Dropout-**

Dropout layer is used to prevent a model from overfitting. classifier.add (Dropout (0.5))

5. **Flatenning –**

In this step, all the pooled feature maps are taken and put into a single vector for inputting it to the next layer. The Flatten function flattens all the feature maps into a single long column.

classifier.add (Flatten ())

5. **Fully Connected –**

The next step is to use the vector we obtained above as the input for the neural network by using the Dense function in Keras. The first parameter is output which is the number of nodes in the hidden layer. You can determine the most appropriate number through experimentation. The higher the number of dimensions the more computing resources you will need to fit the mode

classifier.add (Dense (output = 64))

The next layer we have to add is the output layer. In this case, we'll use the sigmoid activation function since we expect a binary outcome. If we expected more than two outcomes, we would use the SoftMax function. The output here is 1 since we just expect the predicted probabilities of the classes.

classifier.add (Dense (output=1, activation='sigmoid'))

INTEGRATION AND TESTING

a. Description of the Integration Modules :

Sr. No.	Module	Input	State	Output	Result
1	Register	Enter name, email id, phone, gender, age, username, password	Flag = 1	Go to login page	Ok
2	Login	Enter username, password	Flag = 1	Go to Main page	Ok
3	Input Symptoms	Select symptoms	Flag = 1	Store input in database	Ok
4	Input MRI	Upload MRI	Flag = 1	Store image in database	Ok
5	Result	Symptoms and MRI	Flag = 1	Result displayed	Ok
6	Logout	Logout from system	Flag = 1	Go to Home page	Ok

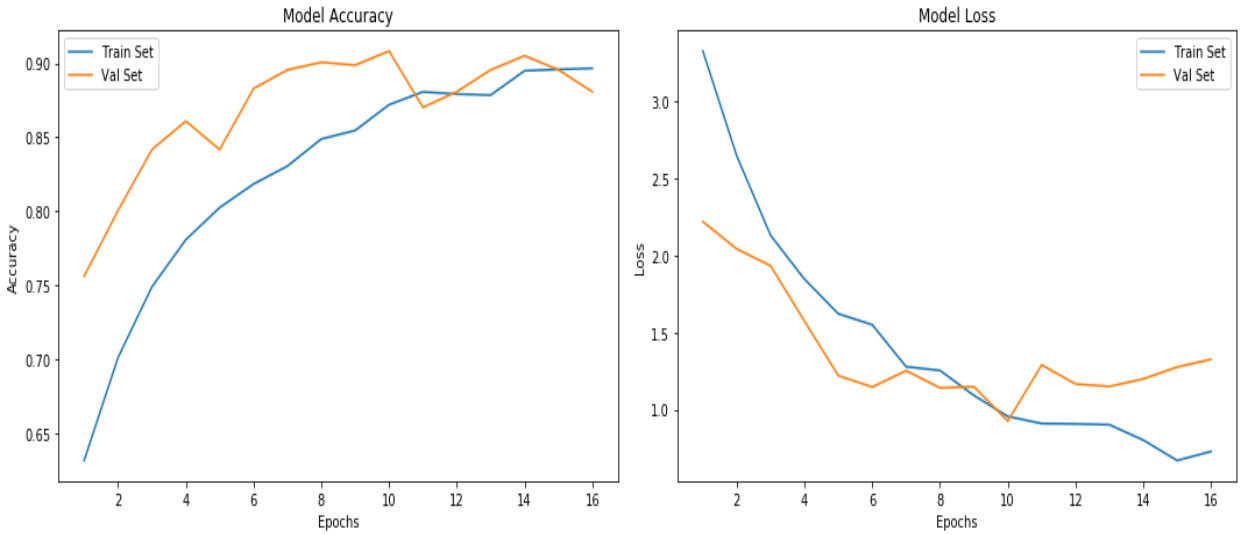
b. Testing :

Test case No.	Test case	Input	Expected Output	Actual Output	Status
01	Registration	Name, EMail, Gender, Age, Username, Password	Registration successful	Registration successful	Pass
02	Login	Username, Password	Login successful	Login successful	Pass
03	User details	MRI, Symptoms	-	-	Pass
04	Brain tumor detection	-	Tumor detected or not	Tumor detected or not	Pass
05	Logout	-	Logout Successful	Logout Successful	Pass

PERFORMANCE ANALYSIS

The performance analysis of the project is based on the classification and prediction model. If the model predicts the output with high accuracy, then the system will successfully classify the brain images and will tell whether a tumor is present or not. To integrate the prediction model with a web page we use a framework like flask. To train the prediction model we use neural network (Convolutional Neural Network). Using this Convolutional Neural Network we get accurate classification of brain images. For the brain tumor prediction task, we have used different Magnetic resonance images (MRI) of the brain. This task is done through CNN algorithm. We have a dataset of 3000 M.R.Images used to classify those images into whether a tumor is present in the brain or not. The images can be classified and according to the classification of MRI, MRI can predict the presence of a tumor in the brain. Overall system gives accuracy between 90% to 92%. Predicted output will be displayed on the webpage.

The graphical representation of training loss vs validation loss and training accuracy vs validation accuracy of baseline CNN model is displayed from below Figure.



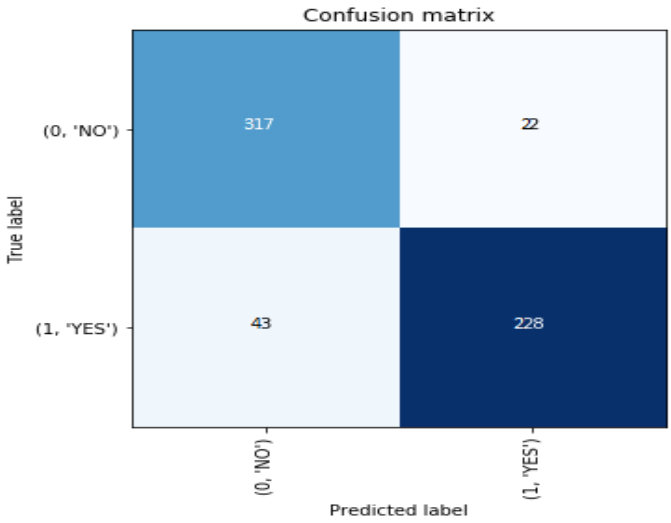


Figure. Result of Baseline CNN Model (Accuracy, loss curve and confusion matrix 'Actual and predicted labels are displayed on the x and y respectively").

According to the figure above, there is an optimal convergence between the training data and the validation data in the accuracy model. As well, we are correctly monitoring the increase in precision and loss between n train and validation in epoch this reflects that with each epoch the model is learning more information. For the loss model, the accuracy and loss start to deviate steadily, this could be a sign of stopping training at an earlier time. Likewise, we see that the global confusion matrix illustrated in Figure 8 giving a satisfactory result for the two classes such that the totality of the images well classified in the two classes “No Tumor” and “Tumor” is 317 and 228 with a precision of 0.92 and 0.86 respectively. Moreover, the totality of misclassified images is 65 images out of 706 test images with an accuracy curve of test data with 92.68%.

FUTURE SCOPE

Our project aims at detecting whether there is a tumor in the brain or not. We have detected the presence of a tumor using CNN model. Currently, our project detects tumors in the brain using images of the brain and symptoms entered by the user.

There are many advancements that can be made in our project. In future, using this project, detailed information regarding tumors can be detected which may include the size of the tumor, the position where the tumor is present.

The brain tumor is classified as Malignant(cancerous) and Benign(non-cancerous) tumor. This project can also help in classifying the type of tumor i.e whether the tumor is cancerous or non-cancerous.

With the help of this project, we can provide one with the necessary information after detection of tumor like what are the preventive measures that can be taken and also provide details about the hospitals and doctors that can assist you.

APPLICATIONS

1. Designing tool for early brain tumor prediction :

As already stated, there is an increase in the use of computer technologies in the medical field. Our project aims at developing a system which predicts the presence of tumor. We have used the CNN model which is a prediction algorithm which works on images. We train the images of both yes and no type so as it makes it easy for us to test the new images. By training the model, predictions can be made. This is an early stage prediction based on mri which may help patients to start the treatment.

2. Scalable for patients :

Our system is scalable as it has the capability to cope and perform well under an increased or expanding workload or scope. It can work on huge data as well. So different patients can use this system at the same time and make use of this system efficiently.

3. Provide database to hospital :

As we collect user details, Symptoms and MRI from the user, the data gets stored in the database. We have maintained a database to store the input provided by the user. The purpose for collecting this data is to provide this data to hospitals so that doctors can make use of it for their work purpose or to treat a patient.

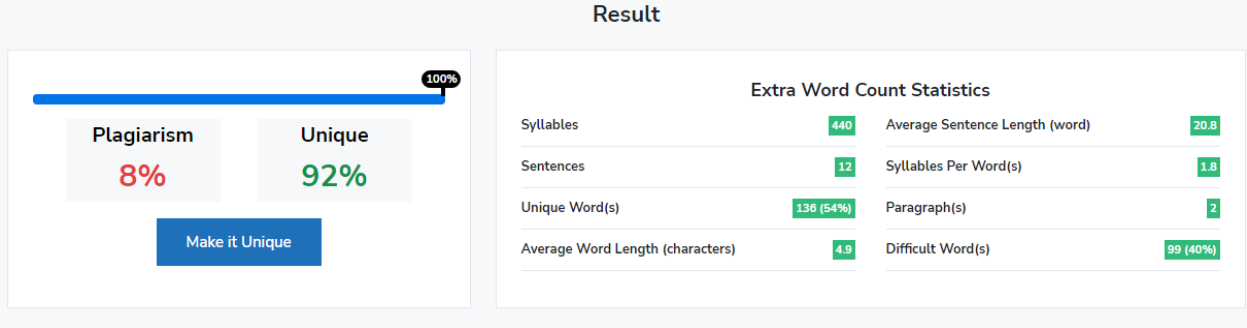
4. Provide database to researchers :

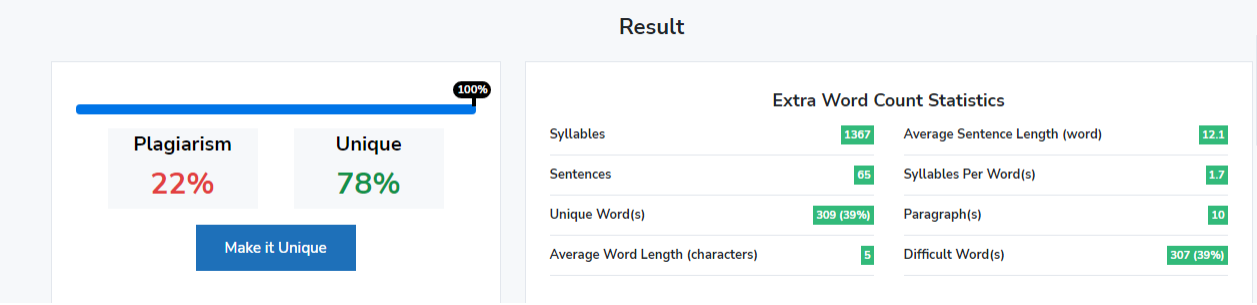
As we collect user details, Symptoms and MRI from the user, the data gets stored in the database. We have maintained a database to store the input provided by the user. This data can be used by the researchers to perform research in this topic and also help others to enhance their knowledge about tumors.

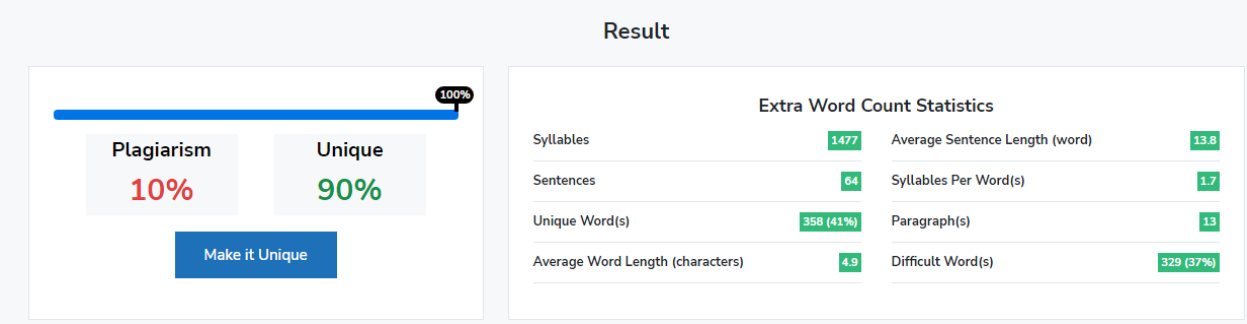
INSTALLATION GUIDE AND USER MANUAL

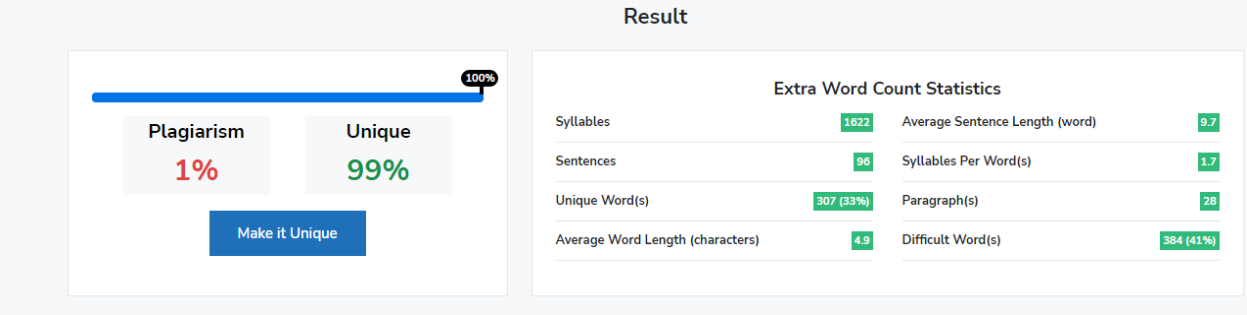
1. Visit our website.
2. If you are already a user then login using your login credentials, else register by entering your name, age, email id, username, password.
3. Submit the details and go to the main page.
4. Enter your symptoms and brain MRI.
5. Results will be displayed whether the tumor is present or not.
6. Logout from the system.

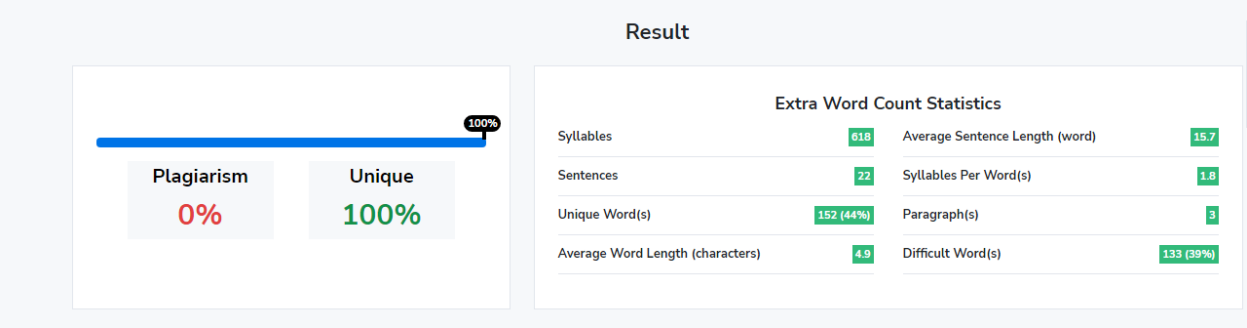
PLAGIARISM REPORT

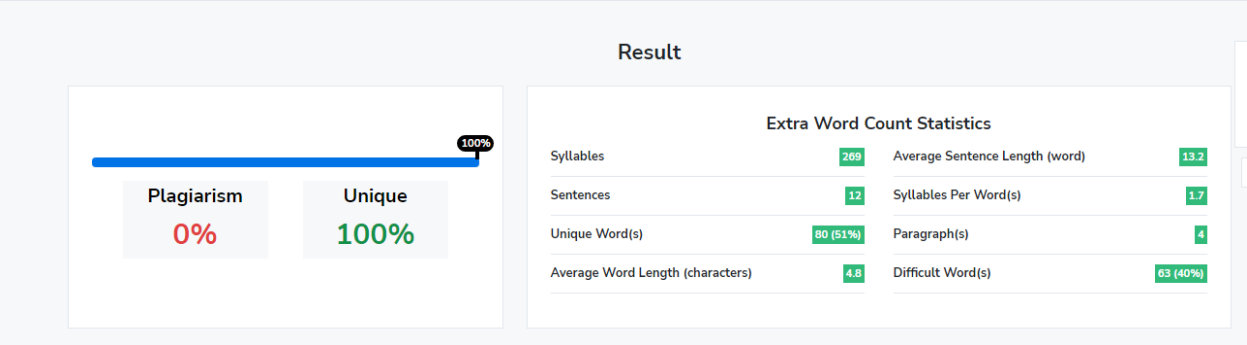


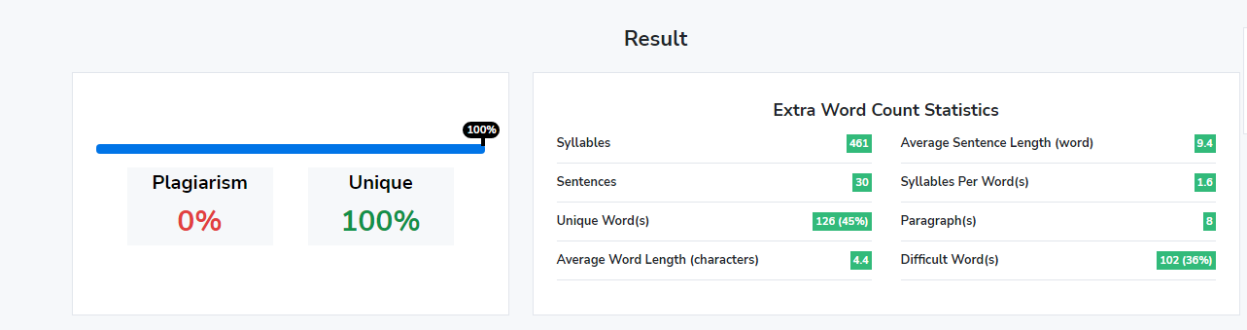












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• Purchase or submit a research or term paper from the internet to a class as one's own work

• Cheat on a graded assignment

• Cheat on an exam

• Plagiarize other people's work without citing or referencing the work

• Add the name of a non-contributing person as an author in a project/research study

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- D. F. Specht. Probabilistic neural networks. Neural Networks, 3(1):109–118, 1990

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