A

PROJECT REPORT

ON

"BRAIN STROKE DISEASE CLASSIFICATION"

SUBMITTED TO

SHIVAJI UNIVERSITY, KOLHAPUR

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

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UNDER THE GUIDANCE OF

MR. S. J. MURCHITE

DKTE

Promoting Excellence in Teaching, Learning & Research

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DKTE SOCIETY'S TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI

(An Autonomous Institute)

ACCRIDITED WITH 'A+' GRADE BY NACC

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D.K.T.E. SOCIETY'S

TEXTILE AND ENGINEERING INSTITUTE, ICHALKARANJI
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that, project work entitled

"BRAIN STROKE DISEASE CLASSIFICATION"

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

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is in the partial fulfillment of 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 Stroke Disease Classification" which is being submitted to D.K.T.E. Society's Textile and Engineering Institute Ichalkaranji, affiliated to Shivaji University, Kolhapur is in partial fulfillment 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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ABSTRACT

Stroke is the number one leading cause of mortality and obesity in many countries. A stroke is a medical condition in which poor blood flow to the brain results in cell death. It is nowadays a leading cause of death all over the world. Several risk factors believe to be related to the cause of stroke has been found by inspecting the affected individuals. Using these risk factors, a number of works have been carried out for predicting and classifying stroke diseases. Most of the models are based on data mining and machine learning algorithms. This study preprocessing data to improve the image quality of CT scans of stroke patients by optimizing the quality of image to improve image results and to reduce noise, and also applying machine learning algorithms to classify the patient's images into two sub-types of stroke disease, namely ischemic stroke and stroke hemorrhage. In this work, we have used four machine learning algorithms to detect the type of stroke that can possibly occur or occurred form a person's physical state and medical report data. We have collected a good number of Brain CT scan images from the Lab and use them to solve our problem. The classification result shows that the result is satisfactory and can be used in real time medical report. We believe that machine learning algorithms can help better understanding of diseases and can be a good healthcare companion.

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CHAPTER 1

INTRODUCTION

1.1 Problem Definition

Image processing means capturing an image and that image is going to be processed in a way that it can be modified or it can be sharpened. so, whatever the user requirement based on that, the image can be processed. Performing operation on an image in order to get enhanced image or to extract some useful information from it. The process starts with an existing image and refining, modifying in a such way that to obtain another image. It performs operation of image like rotation, blurredness etc. Digital images contain a fixed number of pixels in rows and columns, which are stored in computer memory according to size. These values are often sent and stored in compressed format. And this technique is used in the Brain stroke disease classification project.

Since the project is a classification of stroke disorders, it is important to know what a stroke is before you start. Basically, stroke is the leading cause of mortality and obesity in many countries. Stroke occurs when the blood supply to a part of the brain is cut off or diminished, preventing brain tissue from receiving oxygen and nutrients. Brain cells begin to die within minutes. Early action can be reducing the brain damage and other complications. Treatment of stroke depends on the type of stroke, so it is important to get a proper diagnosis before starting treatment for stroke. The effects of a stroke include paralysis or loss of muscle movement, speech or swallowing problems, memory loss or thinking problems, emotional problems, behavioral changes, and the ability to care for a oneself.

The World Health Organization (WHO) estimates that 15 million people worldwide suffer from stroke each year and one of the affected populations dies every 4-5 minutes. There are two types of strokes, the first being0 a ischemic stroke. Ischemic is the most common type of stroke. It occurs when blood vessels in the brain become narrowed or blocked, resulting in a significant decrease in blood flow (ischemia). Clogged or narrowed blood vessels are caused by the accumulation of fat deposits in the blood vessels and the passage of blood clots and other debris into the blood vessels of the brain. The another type is a hemorrhagic stroke. Hemorrhagic stroke occurs when a blood vessel in the brain leaks or get ruptures. Bleeding in the brain can result from many conditions that affect blood vessels. Factors associated with hemorrhagic stroke include uncontrolled hypertension, overtreatment with anticoagulants, swelling at weak points in the vessel wall (aneurysms), and trauma such as car accidents.

As mentioned earlier, it turns out that stroke is an emergency and can be treated if detected early. Therefore, in order to solve this problem, we developed a stroke disease classification model and classified normal brain and damaged brain. When the brain is damaged again, it is classified into two types, ischemic stroke and hemorrhagic stroke. This model helps everyone look at the pictures and get immediate results with or without a stroke. The most important aspect of the method used and the results obtained is that Random Forest has the best performance of the four different classification algorithms tested and is a more accurate metric compared to other algorithms. Is to achieve. The downside of this model is that it is trained with textual data rather than real-time brain images. This paper presents the implementation of four ML classification methods.

1.2 Aim and Objective

Aim:

Design and development of a Brain Stroke Disease Classification System. This system facilitates the work of doctors and technicians, as classification has traditionally been done manually.

Objectives:

1. To minimize the use of instruments which is needed for stroke disease and make it affordable
2. To develop the classification model.
3. To extract features from images.
4. To perform some operations on an image for enhancing the classified image.

1.3 Scope and Limitation of the Project

Scope:

1. The general public can also use it. People who have a CT scan of the brain can also check for a stroke. The system has a user-friendly GUI, which makes it easy for users to interact with the system.

2. Our system can be used in hospitals. Older systems are useful for doctors because they need to check for a stroke. Therefore, our system helps them.

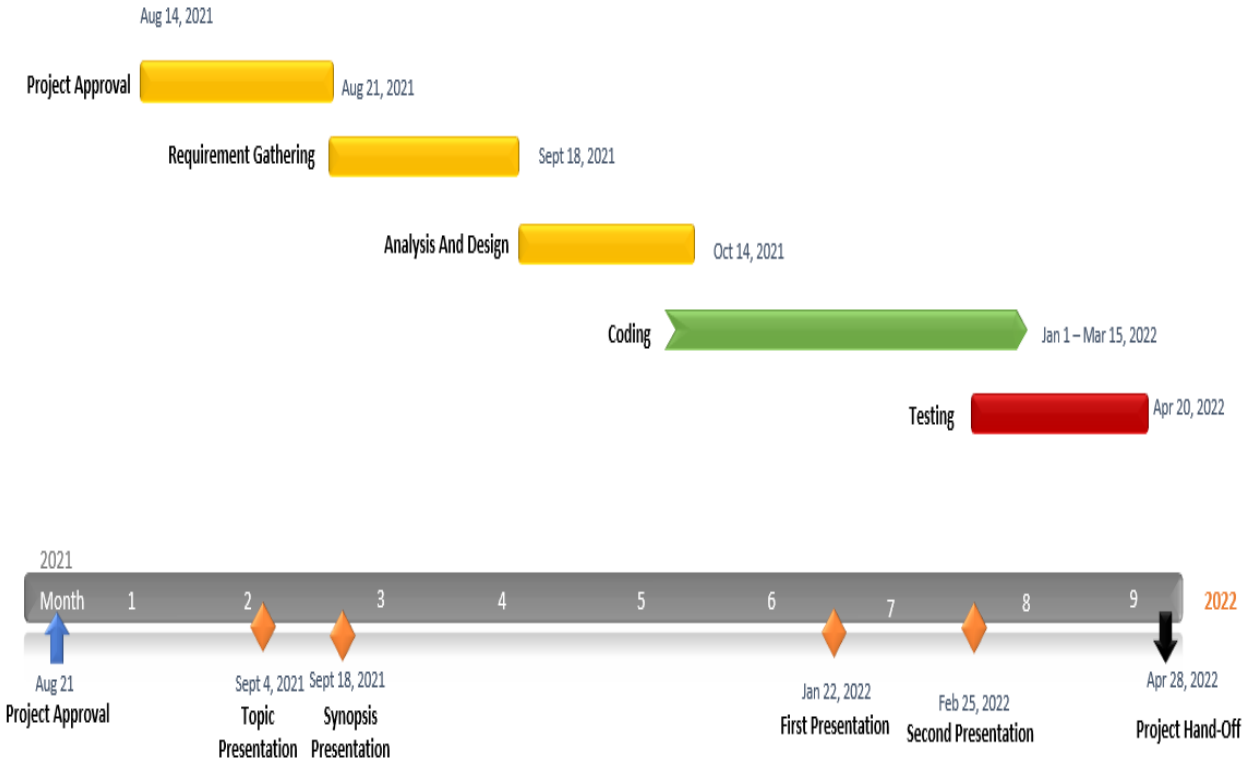
Limitation:

1. CT scan image is necessary.

2. User has to convert dicom extension CT scan images into jpg or png format.

3. Users need to set up environment by set up libraries needed for project

1.4 Timeline of the Project



1.5 Project Management Plan

Project Scope:

The scope of Brain Stroke Disease Classification includes the design development and testing of the software package for classifying whether the given brain image of ischemic or hemorrhagic stroke type. The scope of project also include completion of all documentation, manuals and training aids to be utilized in conjunction with software.

Project completion will occur when the software and documentation has been successfully executed and tested. The project collects the CT scan images given by person for getting the stroke type as a result. The scope of project does not include any changes in requirement for straight forward operating system to run the system, Software updates or revision.

Milestone list:

The below chart lists the major milestone for the Brain Stroke Disease Classification. This chart consists of major project milestone such as completion of project phase. There can be smaller milestones that are not included in this chart buys those are included in project schedule and WBS.

Milestones	Description	Date
Complete requirement gathering	All the requirements of the user collected to have base for design of system	Sept 18, 2021
Complete design document of the system	This is the theoretical design for software and its functionality.	Oct 14, 2021
Complete source code of the system	All coding completed resulting in software prototype	Mar 15, 2022
Complete testing and the debugging of the software	Functionality of the individual modules are tested and identified errors are corrected	Apr 20, 2022
Complete integrated model testing	All modules are integrated and the system is tested and identified errors are corrected	Apr 20, 2022

Schedule Baseline and Work Breakdown Structure:

The WBS for Brain Stroke Disease Classification consist of work package and the project members closely collaborates to develop work packages. The WBS dictionary defines all work packages for classifying brain stroke disease by using CT scan images given by person project. These definitions include all the task, resources and deliverables. Every work package within the WBS is defined within wbs dictionary and can aid in resource planning, task completion and ensuring deliverables and project requirement.

Change Management Plan:

The following steps comprise the change control process utilized on the Brain Stroke Disease Classification project:

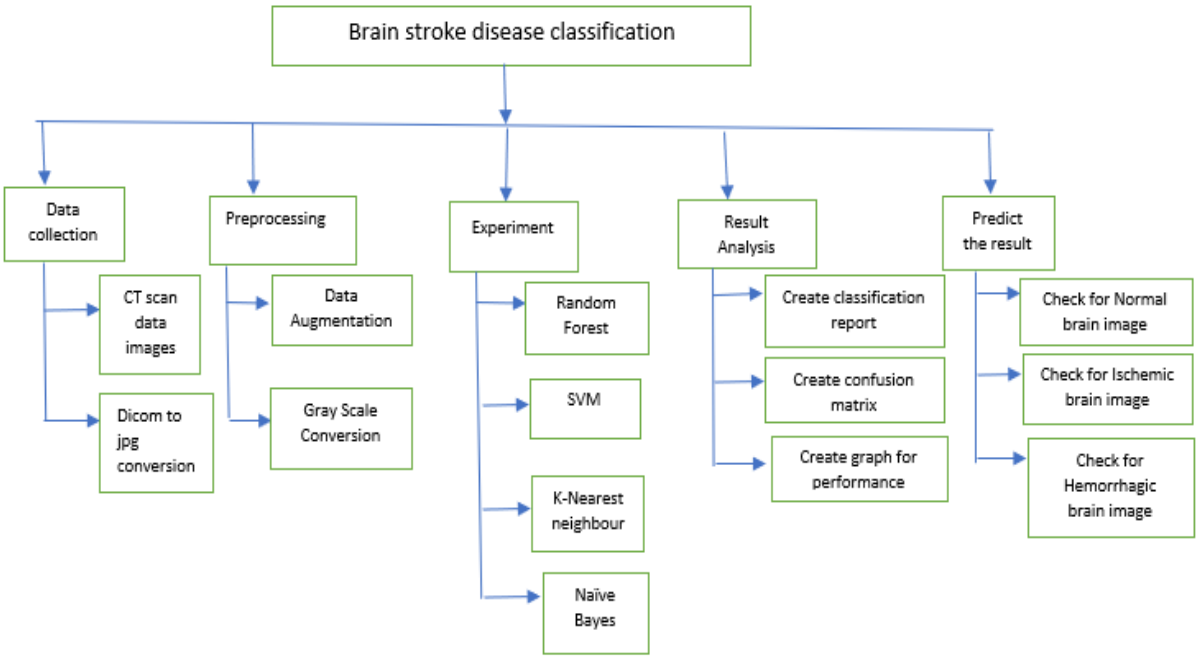
Step #1: Identify the necessity for change
Requester will submit change request form to the project lead.

Step #2: Log change within the change request register.
The project lead will maintain a log of all change request for the duration of the project.

Step #3: Conduct an evolution of change.
The project lead will conduct an evolution of the impact of the change to cost, risk.

Step #4: Submit change request to project guide.
The project lead will submit the change request and analysis to the guide for review.

Step #5: Project guide decision.



WBS for Brain Stroke Disease Classification

Communication Management Plan:

This communication management plan sets the communication framework for this project. It will function as a guide for communication throughout the lifetime of the project and ca be updated as communication requirement change. This plan identifies and define the roles of Brain Stroke Disease Classification project team member as they pertain to communication. It also includes a communication matrix which maps the communication requirement of this project and communication conduct for meetings and other styles of communication. A project team directory is additionally included to supply contact information for all members directly involved within the project.

The project lead will take the important role in ensuring effective communication on this project. The communication requirement is documented within the communication matrix below. The communication Matrix used as the guide for what information to communicate, who is to do the communicating, when to communicate it, and to whom to communicate.

Communication Type	Description	Frequency	Format	Participants	Deliverables	Owner
Weekly status report	Email summary of project status	Weekly	Email	Project Team & Guide	Status Report	Project lead
Weekly Project Team Meeting	Meeting to review action register and status	Weekly	In Person	Project Team	Understand Action Register	Project lead
Project Monthly Review(PMR)	Present metrics and status to team	Monthly	In person	Project team and guide	Status and Metric presentation	Project lead
Project Gate Review	Present closeout of project phase and kickoff next phase	As Needed	In Person	Project Team and guide	Phase completion report & phase kickoff	Project lead
Techical Design Review	Review of any t Project lead ed with the project technical design or work ass	As needed	In person	Project Team	Technical Design Package	Project lead

Project team directory for all communication is:

Name	Title	E-Mail	Mobile no
Prof.S.J.Murchite	Project Guide	Sandipmurchite2006@gmail.com	9975950681
Srushti Birajdar	Team Member	srushtibirajdar07@gmail.com	8080201826
Pratiksha Mane	Team Member	mpratiksha566@gmail.com	9665736608
Dhanashri Patil	Team Member	patildhanu4111999@gmail.com	7218871102
Poonam Patil	Team Member	pooamppatil223@gmail.com	7499229294
Pratibha Sawant	Team Member	sawantpratibha12@gmail.com	7387972873

Communication Conduct:

Meetings:

The Project lead distributes a gathering agenda a minimum of 2 days before any scheduled meeting and every one particular is expected to review the agenda before the meeting .During all project meeting the timekeeper will make sure that the group adheres to the days started within the agenda and therefore the recorder will take all notes for distribution to the team upon completion of the meeting .its imperative that each one participant arrives at every meeting on time and every ones cell phones should be turned off to minimize distractions. Meeting minutes are distributed no later than 24 hours after each meeting is completed.

Email:

All email regarding the Brain Stroke Disease Classification project should be professional, freed from errors, and supply brief communication. Email should be distributed to the right project participants in accordance with the communication matrix above supporting its content. All attachment should be in one in every of the quality software suite software programs. If the email is to bring a difficulty forward then it should discuss what the difficulty is, provide a short background on the difficulty, and supply a recommendation to correct the difficulty. The project lead should be included on any email regarding the Brain Stroke Disease Classification project.

Informal Communication:

While informal communication could be a part of every project and is important for successful project completion, any issues, concerns, or updates that arise from informal discussion between team members must be communicated to the project lead that the appropriate action is also taken.

1.6 Project Cost

Formula to Find Cost:

Effort = a(KLOC)^b

Time = c(Effort)^d

Person required = Effort/Time

Where, a, b, c and d are constant values for organic software projects.

a= 2.4

b= 1.05

c= 2.5

d= 0.38

So,

Lines of code (LOC) = 1000.

KLOC-1000/1000=1

Effort(E) = 2.4(1) ^ 1.05 = 2.4*1 = 2.4

Time = 2.5(2.4) ^ 0.38 = 2.5*1.39 = 3.47

Person Required= Effort/time = 2.4/3.47 = 0.69 = 0.7 = 1 person required.

In India, average base pay of Lab Technician is RS. 15000/month.

So,

Cost = RS. 15000/-

CHAPTER 2

BACKGROUND STUDY AND LITERATURE OVERVIEW

2.1 Literature overview

Jaewoo Lee, Hyunsun Lim, Dongwook Kim, Soon-ae Shin, Jinkwon Kim, Bora Yoo, Kyunghee Cho have introduced 'Computer Methods and Programs in Biomedicine', The Purpose of this paper was Calculation of 10-year stroke prediction probability and classifying the user's individual probability of stroke into five categories.

Philip A. Wolf, Ralph Agostino, Albert J. Belanger and William B. Kannel, have published 'Probability of Stroke: A Risk Profile from the Framingham Study'. In this paper, A health risk appraisal function has been developed for the prediction of stroke using the Framingham Study cohort

M. Sheetal Singh, Prakash Choudhary have introduced 'Stroke prediction using artificial intelligence'. In this paper, decision tree algorithm is used for feature selection process, principle component analysis algorithm is used for reducing the dimension and adopted back propagation neural network classification algorithm, to construct a classification model.

Tessy badriyah, nur sakinah, Iwan syarif ,daisy rehmania syarif have implemented a stroke disease prediction using Ct scan image dataset of patients with the help of various algorithms like KNN, naive bayes, logistic regression, etc. Hence, Existing system is implemented up to prediction of the stroke disease. So we have scope to take a step forward to classify which type of stroke is occurred using various algorithms.

Ms.Prabhu, has given a brief knowledge about CNN (convolutional neural network). They have also explained why CNN mainly used for Image classification. We have learned from this article that what is cnn and how it works, what are the layers of it etc. For our project CNN is key part.

Author has written article related Image Processing. From this article we have learned that to extract useful information that is feature from image we need to first pre-processed it before give input to the model.

PralhadGavali ME, J. SairaBanu, has given an information related Image classification. We have learned from this article is to do Image classification we should use neural network and neural networks provide better results than existing methods.

1.2 Critical appraisal of other people's work

In recent years, various papers based on machine learning algorithms have been published. Some of them are described below:

Govindarajan al. Stroke disease was classified using artificial neural networks (ANN), support vector machines (SVMs), decision trees, logistic regression, and ensemble methods (bagging and boosting). They collected data from Sugam Multispecialty Hospital in India. The hospital contains information about 507 stroke patients aged 3590 years. The novelty of their work lies in the data processing phase, which uses an algorithm called the Novel Stemmer to retrieve the dataset. In the dataset collected, 91.52% of patients experienced ischemic stroke and only 8.48% of patients experienced hemorrhagic stroke. Of the algorithms mentioned, artificial neural networks with stochastic gradient descent learning algorithms have the highest accuracy in classifying strokes at 95.3%.

Jeena and Kumar have proposed a support vector machine-based model for stroke prediction. They collected data from the International Stroke Exam Database. The dataset contains 12 risk factors (attributes). They used 350 samples to work. About 300 samples were used for training purposes and 50 samples were used for testing. Various core functions such as polynomials, squares, radial basis functions, and linear functions have been applied. The highest accuracy of 91% was found in the linear kernel. This gives the equilibrium measurement F1-score F-measure 91.7.

Singh and Choudhary evolved a version with Artificial Neural Network (ANN) for stroke prediction. They have accumulated datasets from the Cardiovascular Health Study (CHS)database. Three datasets have been built which includes 212 strokes (all 3) and 52, 69, seventy-nine non-strokes respectively. The very last dataset incorporates 357 attributes and 1824 entities with 212 occurrences of stroke. During function selection, the C4.5 selection tree set of rules became used and Principle Component Analysis (PCA) for size reduction. In ANN implementation they've used Back Propagation learning method. They have been given the accuracy as 95%, 95.2% and 97.7% for the 3 datasets respectively.

Adam et al. had been evolved a category version for ischemic stroke the use of selection tree set of rules and k-nearest neighbor (k-NN). Their dataset became accumulated from several hospitals and scientific facilities in Sudan that's the primary dataset for ischemic disorder in Sudan. It incorporates 15 capabilities and data approximately four hundred patients. The effects of the experiment display that the overall performance of selection tree category is better than the overall performance of k-NN set of rules.

Sudha et al. used the Decision Tree, Bayesian Classifier, and Neural Network for stroke category. Their dataset incorporates one thousand records. PCA set of rules became used for dimensionality reduction. In ten rounds of every set of rules, they have been given the best accuracy as 92%, 91%, and 94% in Neural Network, Naive Bayes classifier, and Decision tree set of rules respectively.

Some of the techniques like support vector machine-based models and KNN use a totally small dataset. Govindarajan al. have expected simplest training of stroke. Therefore, we've proposed a technique which makes use of a massive dataset with 4 training of stroke.

1.2 Investigation of current project and related work

In this work, we discussed many strokes related problems from the state-of-art. The reviewed studies were grouped in several categories based on their similarities. We went through an IEEE paper 'Machine Learning Algorithm for Stroke Disease classification'.

There are many approaches used to implement stroke-related problems. Results can be obtained using algorithms such as CNN (Convolutional Neural Network). There are many problems that can be solved by using this algorithm. Stroke diagnosis and prediction by Chiun Li Chin, et al. Developed by. The person who developed the ischemic stroke early detection system that automatically uses the CNN deep learning algorithm. The CNN architecture used uses two convolutional layers, a layer that is fully connected to the pooling layer. The main purpose of the pooling layer is down sampling. This means that the layer compresses the amount of data and parameters, reducing the problem of overfitting. After trying this, it was found that this only applies to ischemic stroke detection systems and that users suffer from different types of strokes. B. Hemorrhagic stroke. Otherwise, the user will not have a stroke.

The system is used to resolve the above problem. In this system we are taking one step ahead. User can upload the brain image after uploading the image system will first do preprocessing, then it will identify whether given image is normal or healthy brain image or unhealthy brain image. After that if the image is normal image, the system directly displays the result. If the image is of unhealthy brain image, then the system will extract the different features from the image and by using different algorithm the system will classify the image into ischemic stroke type or hemorrhagic stroke type with their affected portion of the brain. For implementing these projects first, we study the IEEE standard paper for getting the best solution over the problem. Next, I reviewed the guide for implementing the project using. Next, we got suggestions and guidance from 'I lab Diagnostic imaging center's' Dr. B.S. Kitture. Real-time CT scans were acquired for testing purposes.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 Requirement Gathering

1. As a user, I want to upload CT scan image of brain, to check whether Stroke is present or not. So that I can get an early treatment as soon as possible.

2. As a user, after uploading an image of the brain, I would like to see if the brain is healthy or ill. After knowing if a stroke present, we can treat it faster

3. As a user, I want to see what kind of stroke I have, know if I have a stroke, and then check the affected area of the brain.

3.2 User Stories

1. A User can upload the brain image by clicking on the upload image button on given window.

2. A user can check whether the brain is healthy or unhealthy after uploading brain image.

3. A user can check which type of stroke is present in brain and shows the affected portion of brain.

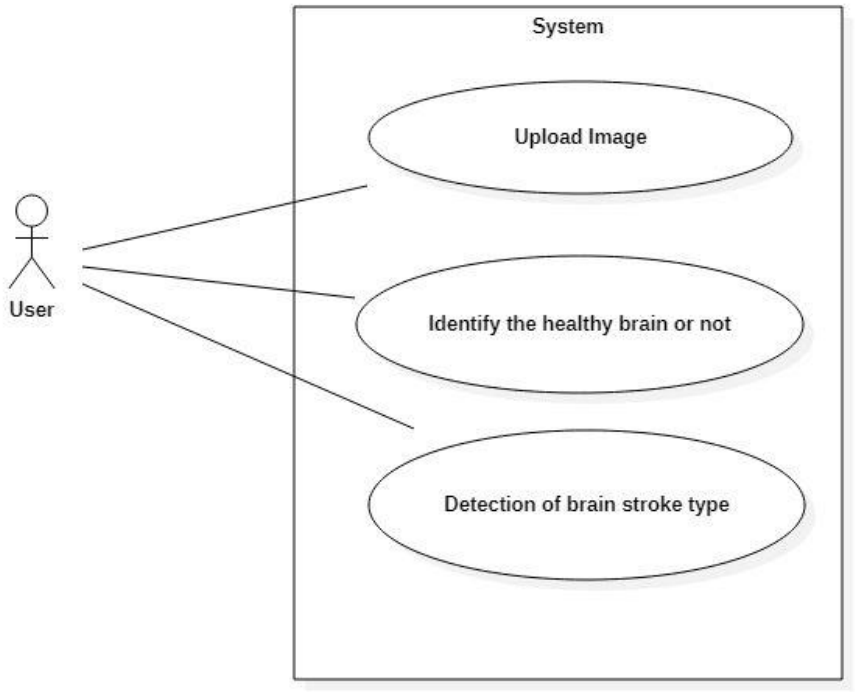
3.3 Requirement Specification

No	Requirement	Essential / Desirable	Description of Requirement	Remarks
RS1	The system should have facility to upload a new brain image.	Essential	After clicking on 'upload' button's	Edition may not accept null.
RS2	The system should have converted image into grayscale image.	Essential	After loading image, it should be converted into grayscale image	-
RS3	The system should classify and identify stroke present or not.	Essential	Preprocessed images should be classified.	-
RS4	The system should extract features from image	Essential	After extracting features based on it classifies into two parts i.e., ischemic and Hemorrhagic.	-
RS5	The system should classify image into damaged brain image and normal brain image.	Essential	After uploading image, it should classify image into damaged and normal image and again if image is damaged it again classify image into two parts.	-
RS6	The system should identify damaged image.	Essential	After uploading image, it identifies image is damaged or not if image is damaged it classify it into two parts and identify which stroke disease is present and again identify the damaged portion of brain.	-
RS7	The system should give clear results.	Essential	After uploading image, it should classify image as normal and damaged if image is normal, it simply shown normal image label as a result and if image is damaged it is shown as label respected to that type and shows the damaged portion.	-

Hardware/software Requirements:

Sr. No.	Hardware Requirements	Software Requirements
1.	Minimum 4 GB RAM	Windows 7 or above
2.	Minimum 128 GB Hard Drive	Anaconda version 4.8.3 and above
3.	Intel core i3 9300H processor	Kaggle cloud platform
4.	NVIDIA GeForce RTX graphics card	Any Browser

3.4 Use Case Diagram



Description:

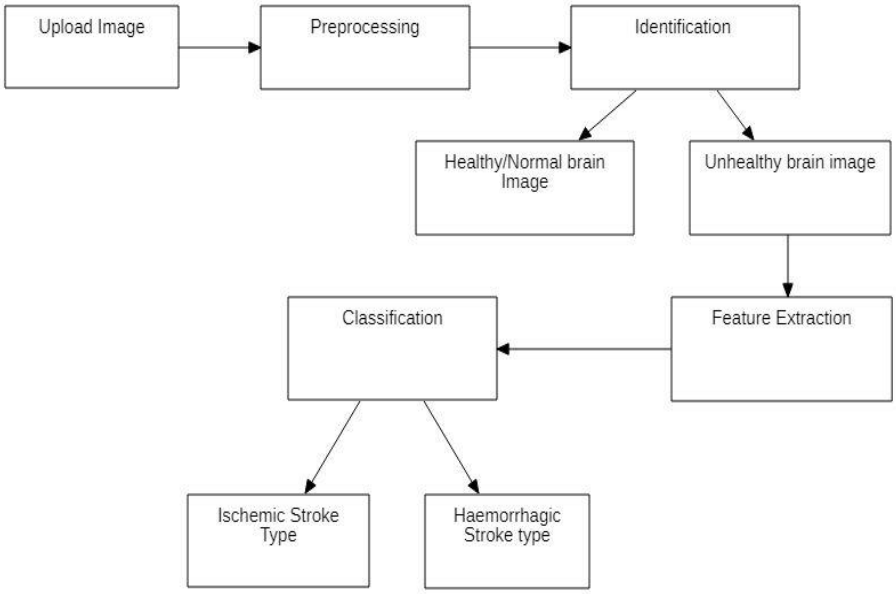
A use case is a methodology used in system analysis to define, clarify, and organize system requirements. In this context, the term "system" refers to something being developed or operated, such as a website that sells and services mail-order products. Use case diagrams are used in Unified Modeling Language (UML), a standard notation for modeling real-world objects and systems. There are several advantages to having a use case diagram over diagram-like diagrams.

In the use case diagram above, the user interacts with the system to upload images and then determine whether the brain is healthy or the brain is diseased. And finally, the detection of brain strokes. And result is displayed to user.

CHAPTER 4

SYSTEM DESIGN

4.1 Architectural Design



Description:

An architecture diagram is a visual representation that maps the physical implementation of software system components. It shows the general structure of the software system and the links, limits and boundaries between each element.

Above Architecture diagram includes 5 main stages. Image upload, pre-processing, feature definition, extraction and classification. User's CT scan imaging system. Pre-processing is performed on this image. The preprocessed image goes to the recognition section where the system checks if the brain is healthy. If it's unhealthy, then the image is passed to feature extraction. The extracted features are then used to classify the type of stroke that has occurred, i.e., ischemic or hemorrhagic.

4.2 Algorithmic Description of Each Module

Algorithm

1. Data augmentation

Input: Dataset of brain images

Output: augmented images of 1000 of each type

Steps:

1. Start

2. Import keras.preprocessing.image Library

3. Initialize the imageDataGenerator class and pass the augmentation parameter like rotation_range, zoom_range in the constructor.

4. Generate the image and save it in folder you want.

5. End

2. Greyscale Conversion

Input: Brain image

Output: Greyscale Brain image

Steps:

1. Start.

2. Import Image from PIL(Python Imaging Library).

3.Give image as an input to convert () function to grayscale the image.

4. End

3.Classification using CNN

Input: Dataset of Greyscale Brain images

Output: Model which identify stroke is present or not

Steps:

1.Start

2.Import sklearn, keras, skimage Libraries for preprocessing and CNN.

3. Perform following operations to Preprocess the images

3.1. Convert images to array

3.2. Convert the image labels into integers

3.3. Use to_categorical () function to convert integers to binary class matrix.

3.4. Normalize the image data by dividing 225.0

4. Build the model by adding following CNN layers using add () function.

4.1. Conv2D(32, kernel_size=(3, 3), strides=(1, 1), input_shape=input_shape)

4.2. Activation('relu').

4.3. MaxPooling2D(pool_size= (2, 2)).

Add these layers three times just changing the filter parameter of Conv2D function.

4.4. Flatten()

4.5. Dense(num_classes, activation='sigmoid')

5. Use the adam optimizer and give this optimizer as a input to compile () function and use loss () function as binary_crossentropy.

6. Use fit function for training the model and give input to this function as training data.

7. Stop

4. Feature Extraction:

Input: Dataset of Hemorrhagic and ischemic brain images

Output: Dataset of Extracted features

Steps:

1. Start.
2. Import graycomatrix,graycoprops from skimage.feature libraries.
3. Use the graycomatrix(image) functionand give image as input.
4. Get all the features by using graycoprops() function.
5. Save all the features in dataframe.
6. Save the dataframe as csv file using to_csv() functions.
7. End.

5.Classification using Random Forest algorithms:

Input: Dataset of Extracted Features

Output: Model which identify type of stroke

Steps:

1. Start.
2. Import random forest classifier from sklearn library from sklearn ensemble import RandomForestClassifier.
3. Create a Random Forest Classifier using a RandomForestClassifier() class.
4. Train the model using the training dataset using fit() function.
5. End

Module Description:

Module 1-Upload image:

The first requirement of the project is that the user needs to upload a CT scan image of the patient to get the results of a damaged or normal brain.

Module 2 -Preprocessing:

This module accepts input as an image addition. This module preprocesses the image. First, you need to perform data expansion to improve accuracy. Next, you need to crop the image. Then perform a jellyscale conversion of the image. This will create a preprocessed output image.

Data preprocessing is a step to improve the quality of the image data, along with conversion data, cropping, scaling to change the scaling of the pixels used, grayscale that contributes to the uniformity of the gray level of the image, and noise. is. Elimination serving is improved to remove noise and provide blurring, except for feature extraction.

Cropping manner is completed to hobby more at the triumphing CT Scan picture head item thru way of way of leaving a bit black background. Data augmentation is the manner of reproducing a picture without dropping its essence. At this stage, there are 7 (seven) techniques of augmentation in particular random brightness, Horizontal Flip, Vertical Flip, Random Rotation, horizontal shift, vertical shift and zoom picture. After augmentation, the dataset used for every form of stroke has the equal quantity of 1 thousand data for hemorrhage stroke and 1000 data for ischemic stroke.

Module 3-Identification of Healthy Brain or Unhealthy Brain:

This module will take the enter from preprocessing module which generate the preprocessed picture. In this module device will pick out whether or not or now no longer or now not the given picture is of healthy brain or lousy mind. If the device gets the given picture is of healthy mind, then it`ll prevent further steps and right away show the cease give up end result as regular mind. Otherwise, it`s going to maintain to subsequent step it honestly is characteristic extraction which completed on lousy mind picture.

Module 4- Feature Extraction:

In this module the system will extract the different features from the image. The features are extracted by using GLCM algorithm. GLCM is nothing but Gray Level co-occurrence Matrix.

Gray-Level Co-Occurrence Matrix (GLCM) is a calculation of the associated texture features is an image analysis technique. The image data to be extracted features are images consisting of pixels, each with a certain gray level intensity. There are 6 features used in GLCM feature extraction, namely Contrast, Dissimilarity, Homogeneity, Energy, Correlation, and ASM.

Contrast using GLCM: Returns a measure of the intensity contrast between a pixel and its neighbor over the whole image. Contrast is 0 for a constant image. The property Contrast is also known as variance and inertia.

Dissimilarity: Dissimilarity is a measure of distance between pairs of objects (pixels) in the region of interest.

Homogeneity: Returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal. Range = [0 1] Homogeneity is 1 for a diagonal GLCM.

Energy: Returns the sum of squared elements in the GLCM.Range = [0 1]

Energy is 1 for a constant image. The property Energy is also known as uniformity, uniformity of energy, and angular second moment.

Correlation: Returns a measure of how correlated a pixel is to its neighbor over the whole image. Range = [-1 1]. Correlation is 1 or -1 for a perfectly positively or negatively correlated image. Correlation is NaN for a constant image.

ASM: Angular Second Moment: Angular Second Moment is also known as Uniformity or Energy. It is the sum of squares of entries in the GLCMAngular Second Moment measures the image homogeneity. Angular Second Moment is high when image has very good homogeneity or when pixels are very similar.

Module 5- Classification of Brain stroke type:

In this module system will have to classify which type of stroke is present. There are two types of brain stroke: Ischemic stroke and Hemorrhagic stroke. After getting the result user will get treatment as per the stroke type.

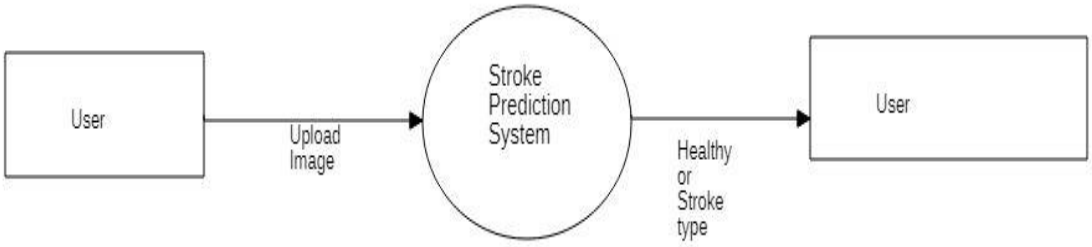
Ischemic stroke occurs when a blood clot blocks or narrows an artery leading to the brain. A blood clot often forms in arteries damaged by the buildup of plaques (atherosclerosis). It can occur in the carotid artery of the neck as well as other arteries. This is the most common type of stroke.

A hemorrhagic stroke occurs when blood from an artery suddenly begins bleeding into the brain. As a result, the part of the body controlled by the damaged area of the brain cannot work properly. There are two main types of hemorrhagic stroke: Intracranial hemorrhages, when the bleeding occurs inside the brain.

4.3 System Modeling:

1. Dataflow Diagram:

DFD 0:

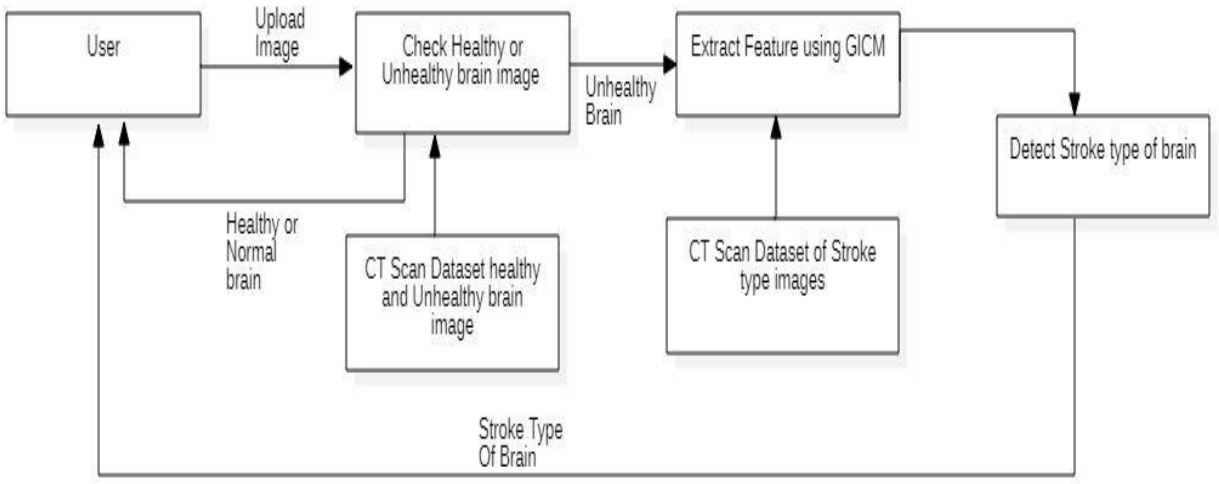


Description :

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled. They can be used to analyze an existing system or model a new one. 0-level DFD is also known as a context diagram. It's designed to be an abstraction view, showing the system as a single process with its relationship to external entities. It represents the entire system as a single bubble with input and output data indicated by incoming/outgoing arrows.

In above DFD level 0 diagram, there are two main components, first is user and second is system. Which depicts User firstly uploads CT scan image to stroke prediction system. System checks if brain is healthy or unhealthy. If brain is unhealthy then system will classify its type and return result to the user.

DFD 1:

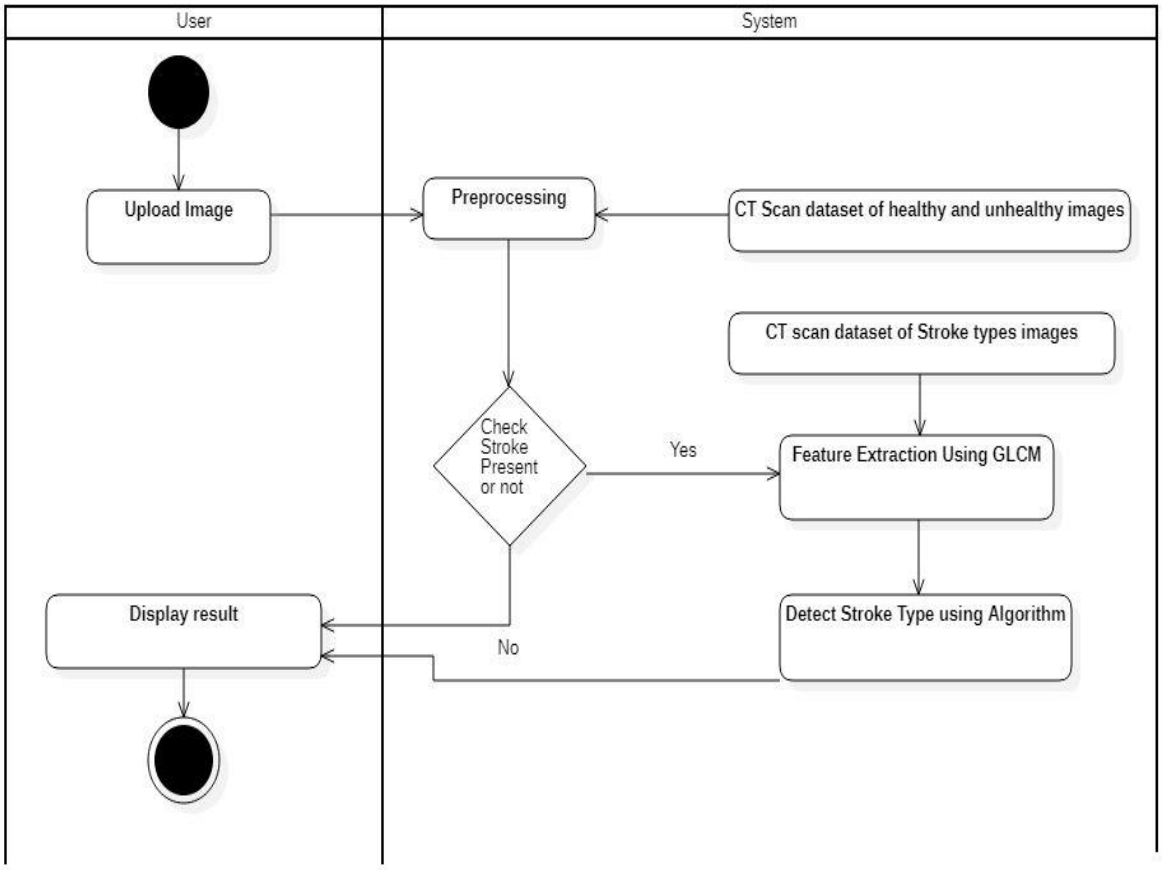


Description:

DFD Level 1 provides a more detailed breakout of pieces of the Context Level Diagram. You will highlight the main functions carried out by the system, as you break down the high-level process of the Context Diagram into its subprocesses.

In above DFD level 1 diagram, User Uploads image to system. System checks if brain is healthy or not. If Unhealthy Brain detected then features gets extracted using GLCM algorithm. After features extraction, system detects what type of stroke is and then result is displayed to user. In between two datasets are required, first is CT scan data set of healthy and unhealthy images and second is CT scan dataset of stroke type images.

2.Activity Diagram:



Description:

The activity diagram helps in envisioning the workflow from one activity to a special. It put emphasis on the condition of flow and therefore the order during which it occurs. The flow is often sequential, branched, or concurrent, and to affect such sorts of flows, the activity diagram has come up with a fork, join, etc.

There are two stakeholders in above activity diagram User and System. User uploads image and checks the result. System does preprocessing using CT scan dataset of healthy and unhealthy images. Next checks if stroke is present or not. If yes, then feature extraction using glcm is completed with the assistance of CT scan dataset of stroke type images. And using multiple algorithms, stroke type is detected and showed user. If no, then direct results of Healthy brain is showed User.

CHAPTER 5

IMPLEMENTATION

5.1 Environmental Setting for Running the Project:

1. Need to setup jupyter notebook. basically, jupyter notebook interface is a web-based application that combine live code with narrative text and visualization.

2. We have to install anaconda after that we can run jupyter notebook by typing command jupyter notebook.

3. We have to download and install anaconda into our system. Anaconda is a distribution of python and r programming languages for scientific computing, machine learning, large scale data this used simply to package management and deployment.

4. How to give project to user:

1.Install the library pyinstaller. Type below command in the command prompt:

Pip install pyinstaller

2.Go into the directory where your '.py' file is located.

3.Press the shift button and simultaneously right-click at the same location.

4.You will get the box. Click on 'open PowerShell window here'.

5.You will get a window.

6.Type the command given below in that PowerShell window.

Pyinstaller --onefile –w 'filename.py'

7.For any missing package:

Pyinstaller --hidden-import 'package_name'

8.Typing the command 'Hit the Enter'. It will take some time to finish the process depending on the size of the file size and how big is your project. After the processing has been finished the window will appear.

9.See the directory.

10.Build folder and '1.spec' is of no use. You can delete these if you want, it will not affect your .exe file.

11. Open ‘dist’ folder. Here you will get your ‘.exe’ file. Right – click on the file and check the properties. click ok.

5.2 Detailed Description of Methods:

1. CNN-

CNN is a convolutional neural network, a deep learning algorithm designed to manipulate images and videos. It takes images as input, extracts them, learns about their characteristics, and classifies them based on those characteristics. It's basically a kind of Anne. That is, the artificial neural network used for image recognition convolution operations includes matrix arithmetic operations, and each image is represented in the form of an array.

Methods used for CNN:

1. add():

   In CNN add() methos use for adding methods to our model.first layer is to add Is conv2d layers these layers are dealing with our input images which are 2 dimensional matrices.kernel size is the size of filter matrix for convolutional. we have kernel size 3*3 filter matrix.

2. compile():

   Compile()method is used if the our python code is in string format then it should have to convert it into code object for that purpose compile() method is used. Adam optimizer is a stochastic gradient descent method.learning rate used to modulate how the learning rate our optimizer changes over time.

3. fit():

   Model fitting is the measure of how well a machine learning model generalizes data similar to that which it was trained. A good model fit refers to a model that accurately approximates the output when it is provided with unseen inputs. The input argument data is what gets passed to fit as training data .if we pass NumPy array by calling fit(x,y,..),then data will be tuple(x,y).

4. predict():

   Predict() function enables us to predict the labels of the data values on the basis of the trained model. The predict() function accepts only a single argument which is usually the data to be tested.

2. Grayscale conversion:

In grayscale conversion color image converted into black and white. this process removes all color information, leaving only luminance of each pixel.

1. Convert():

   image.Convert () returns a converted copy of this image. Color conversion can be done using convert() method.to read an image and convert it to gray scale add convert('L'). If we have L mode image that means it is a single channel image-normally interpreted as grayscale. L means just store the luminance. it store only grayscale not color.

3.GLCM (Grey level co-occurrence matrix):

Glcm stands for gray-level co-occurrence matrix. glcm is a second order statistical texture analysis method. we consider two pixels at a time, called reference and the neighbors pixel. We define a particular spatial relationship between the reference and neighbor pixel before calculating glcm. after creating the glcm using graycomatrix we can derive several statistics from them using graycoprops. These statistics provide information about the texture of an image. Some of these are:

1. Contrast: Measure the local variations in the gray-level co-occurrence matrix.
2. Correlation: Measures the joint probability occurrence of the specified pixel pairs.
3. Energy: Provides the sum of squared elements in the glcm. Also known as uniformity or the angular second moment.
4. Homogeneity: Measures the closeness of the distribution of elements in the glcm to the glcm diagonal.

Methods:

1. graycomatrix():

   Graycomatrix calculates the glcm from scaled version of the image.by default, if it is a binary image,graycomatrix scales the image to two gray_levels.

2. graycoprops():

   Graycoprops normalizes the gray-level co-occurrence matrix so that the sum of its elements is equal to 1.graycoprops uses the normalized glcm to calculate properties.

4. Random Forest Algorithm:

Random forest is a supervised machine learning algorithm that is used in classification and regression problems. Random forest contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset. The greater number of trees in forest leads to higher accuracy and prevents the problem of overfitting. Random forest works in two phase first is to create the random forest by combining n decision tree and second is to make predictions for each tree created in the first phase.

1. RandomForestClassifier(Random_state):

   Random state is used to set the seed for the random generator so that we can ensure that result we get can be reproduced. hence, nature of splitting the data in train and test is randomized.

   e.g., random_state=1 then random numbers are 1,3.

5.Pickle dump():

The dump() method of pickle module simply converts a python object hierarchy is converted into a byte stream.it is also known as serilization.any object in python can be pickled so that it can be save on disk.

5.3 Implementation Details:

1.Data Augmentation:

```
Datagen = ImageDataGenerator(rotation_range = 40, zoom_range = 0.2, horizontal_flip = True)

For batch in datagen.flow(x, batch_size=1,save_to_dir=

r'C:\Users\vishal\Documents\megaproject\Dataset\H1',save_prefix='Heammorhagic',

save_format='jpg'):

 i += 1

  if i > 2:

     break
```

This code is to increase the size of dataset. First it will read all the images from given directory then apply the properties like rotation range, zoom range or flipping randomly and save it in same directory.

2.Grascale Conversion:

```
img=img.convert('L')
```

This is a function of PIL (Python imaging library) library convert the color image into grayscale image.

3.CNN

```
input_shape = (x_train.shape[1], x_train.shape[2], x_train.shape[3])

num_classes = 2

model = Sequential()

model.add(Conv2D(32, kernel_size=(3, 3), input_shape=input_shape))

model.add(Activation('relu'))
```

```
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(64, (3, 3)))

model.add(Activation('relu'))

model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(128, (3, 3)))

model.add(Activation('relu'))

model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(256, (3, 3)))

model.add(Activation('relu'))

model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Dropout(0.5))

model.add(Flatten())

model.add(Dense(1024))

model.add(Activation('relu'))

model.add(Dropout(0.4))

model.add(Dense(num_classes, activation='sigmoid'))

model.compile(optimizer=tensorflow.keras.optimizers.Adam(learning_rate=0.001),
loss='binary_crossentropy',metrics=['accuracy'])
```

The above code is to build CNN model. The type of model that will be using in sequential model then we have used add function to add layers to our model first layer is Conv2D basically this layer deal with the input image. Then next two layers are Activation and MaxPooling2D.Then we have used Dropout layer to stop overfitting. There is flatten layer which provides the connection between convolution and dense layer .Dense is used as output layer. There is one more layer which is activation layer the parameter for this layer is sigmoid which sums the output to one then the model makes prediction based on which class has highest probability.

4.Feature Extraction:

```
glcm=skimage.feature.greycomatrix(im, [1], [0], levels=8)

contrast.append(skimage.feature.greycoprops(glcm, 'contrast')[0][0])

energy.append(skimage.feature.greycoprops(glcm, 'energy')[0][0])

homogeneity.append(skimage.feature.greycoprops(glcm, 'homogeneity')[0][0])

correlation.append(skimage.feature.greycoprops(glcm, 'correlation')[0][0])

dissimilarity.append(skimage.feature.greycoprops(glcm, 'dissimilarity')[0][0])

ASM.append(skimage.feature.greycoprops(glcm, 'ASM')[0][0])
```

This code is used to get features from image like contrast, energy, homogeneity, correlation, dissimilarity, ASM by using GLCM algorithm.

5.Random Forest:

```
model1 = RandomForestClassifier(random_state=4)

model1.fit(x_train, y_train)

y_pred1 = model1.predict(x_test)
```

This code is for training the model by random forest algorithm we have provided 80% training data.

CHAPTER 6
INTEGRATION AND TESTING

- **Unit Testing:**

Unit testing is a type of software testing that test individual units or components of software. The purpose is to verify that each unit of software code is working as expected. Unit tests are performed by the developer during application development (coding phase). Unit tests separate sections of code and verify their accuracy. A unit can be a single function, method, procedure, module, or object.

Test Case ID	Test case	Input	Expected Output	Actual Output	Remark
TC-1	Perform Data Augmentation	Uploaded Image from user	Images must be reproduced without losing their essence	Images are reproduced without losing their essence	Pass
TC-2	Perform Gray- Scale Conversion	Data Augmented images	It will must give gray scale converted images	Gray scale Converted Images	Pass
TC-3	Compiling and fitting the model using CNN	80% Training Images and 10% validation Images	It should loss,accuracy,val_loss, Val_accuracy,etc.	It shows loss,accuracy,val_loss, Val_accuracy,etc.	Pass
TC-4	Detect status of brain whether it is healthy brain or unhealthy brain	Images of the brain	It should detect or identify healthy brain or unhealthy brain	It shows detect or identify healthy brain or unhealthy brain	Pass
TC-5	Perform feature extraction using GLCM	Unhealthy brain images	It should extract features - Contrast, Dissimilarity, Homogeneity, Energy, Correlation, and ASM	It shows extracted features table - Contrast, Dissimilarity, Homogeneity, Energy, Correlation, and ASM	Pass
TC-6	By using different algorithm (Random forest, Naive bayes, svm, k-nearest neighbor) detect stroke type.	Feature extracted image	It should display the stroke type with their affected portion of brain.	It shows the result as stroke type with their affected portion of brain.	Pass

- **Integration Testing:**

Integration tests are defined as a type of test in which software modules are logically integrated and tested as a group. A typical software project consists of several software modules coded by various programmers. The purpose of this level of testing is to reveal interaction errors when these software modules are integrated.

Test case Id	Test Case	Input	Expected output	Actual Output	Remark
TC-1	Perform Preprocessing	Image given from user for testing	Images must be augmented and converted into gray scale.	Images are augmented and converted into gray scale.	Pass
TC-2	Identification Healthy brain image or Unhealthy brain image	Augmented and Gray scale image	It should classify the image whether it is healthy brain image or unhealthy brain image.	It shows the image whether it is healthy brain image or unhealthy brain image.	Pass
TC-3	Classification of Image into Ischemic stroke type or Hemorrhagic stroke type.	Unhealthy brain image.	It should display stroke type with their affected portion of the brain.	It shows the image with stroke type and affected portion of brain.	Pass

- **System Testing**

System testing is a level of testing that validates a fully integrated software product. The purpose of system testing is to evaluate end-to-end system specifications. Software is usually just one element of a larger computer-based system. Ultimately, the software is combined with other software / hardware systems. System testing is actually a series of different tests, the sole purpose of which is to test the entire computer-based system.

Test Case Id	Test Case	Input	Expected Output	Actual Output	Remark
TC-1	Check the given image is normal brain image	Image given for testing	It should display damaged status as not detected; type as normal.	It displays damaged status as not detected; type as normal.	Pass
TC-2	Check the given image is Ischemic stroke type	Image given for testing	It should display damaged status as detected, type as Ischemic stroke with their affected portion of brain.	It displays damaged status as detected, type as Ischemic stroke with their affected portion of brain.	Pass
TC-3	Check the given image is Hemorrhagic stroke type	Image given for testing	It should display damaged status as detected, type as Hemorrhagic stroke with their affected portion of brain.	It displays damaged status as detected, type as Hemorrhagic stroke with their affected portion of brain.	Pass

CHAPTER 7

PERFORMANCE ANALYSIS

After processing the data, we used the CNN algorithm to detect the presence of strokes. Therefore, the accuracy during training was 95% and the accuracy during testing was 82.37%.

Classification Algorithm	**Accuracy**	**Precision**	**Recall**	**F1-Score**
Random Forest	90%	90%	90%	90%
SVM	81%	82%	81%	81%
KNN	86%	86%	86%	86%
Naïve Bayes	78%	80%	79%	79%

Table 1: Performance Comparison of Classification Algorithm

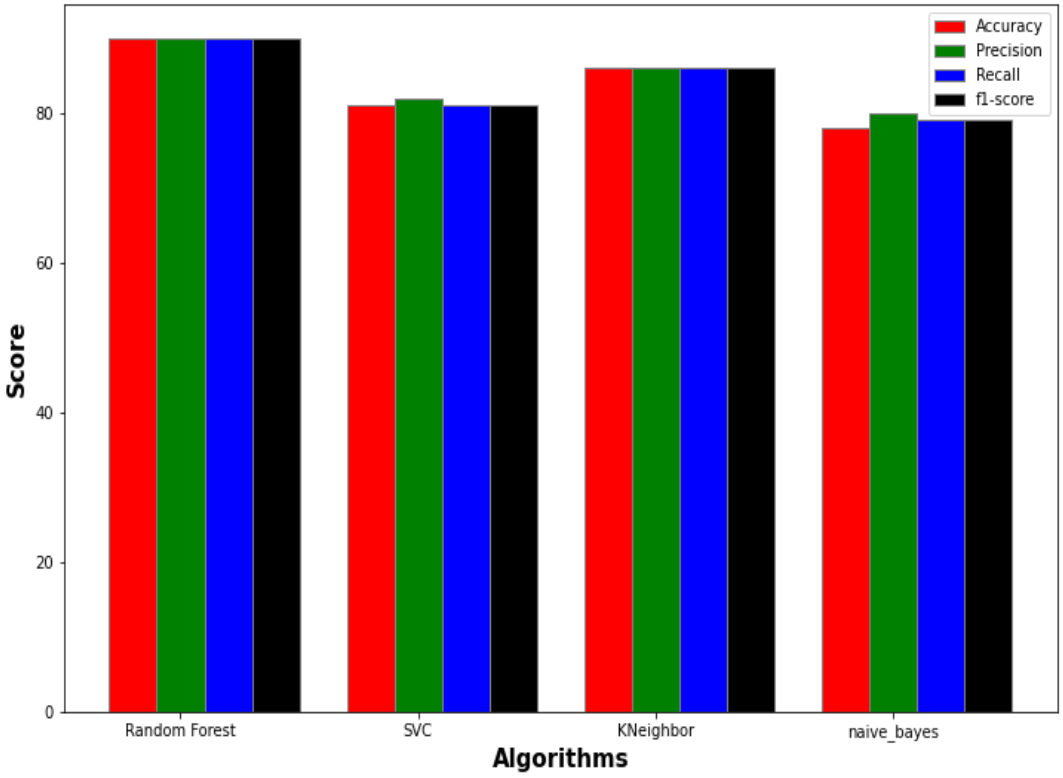


Fig1: Algorithms Performance Bar Chart

The above Chart and Table are the result of the 4 classification algorithms used for the identification of brain stroke type. It showed that the classification algorithm using random forest achieved the best results that are 90.25% accuracy 90% precision 90% recall 90% f1-score.

CHAPTER 8

FUTURE SCOPE

In future, Brain Stroke Disease Classification system can be enhanced in following ways

1. Android application of brain stroke disease detection can be built.

2. Project can be extended up to getting more information about Hemorrhagic and Ischemic stroke with their different stroke type.

3. Web application of Brain stroke classification can be launched so that user can reach up to it easily.

4. We can extend project by combining with pressure detection project so that the system can predict the future possibility of stroke occurrence to patient by considering blood pressure and other functionalities of human body.

5. The feature of suggesting the basic common precautions to patient about stroke disease. Also, if stroke detected, system will suggest expert doctors to get treatment of stroke.

CHAPTER 9

APPLICATIONS

Applications of Brain Stroke Disease Classification are as follows :

1. Non-Technical person can use and understand easily.

If a non-technical person has a CT scan of the brain, the system can also be used to determine if a stroke has occurred. The system has a user-friendly GUI, which makes it easy to operate the system.

2.In the Hospitals:

In existing systems, doctors manually analyze CT scan images to determine if a stroke is present. However, this existing system can be very time consuming if you need to analyze multiple CT images. In this case, our system helps doctors identify the type of stroke.

CHAPTER 10

INSTALLATION GUIDE AND USER MANUAL

Created an .exe file for the entire Stroke Disease Classification project. Users simply need to follow these steps to detect and classify strokes:

1. Extract the ZIP file. To do this, right-click on the zip file and select the Extract option from here.

2. Open the unzipped folder and click on the BrainGUI.exe file.

3. A window of Upload image will open.

4. Click the Upload File button and select the .jpg image of your brain to see the results.

CHAPTER 11

INDUSTRY GUIDANCE


DISPO VAN


Dr. Kittur B.S
LAB
DIAGNOSTIC IMAGING

CHAPTER 12

PLAGIARISM REPORT

PLAGIARISM SCAN REPORT

Words		Date	April 21, 2022
Characters	807	Excluded URL	

0% Plagiarism	100% Unique	0 Plagiarized Sentences	6 Unique Sentences

PLAGIARISM SCAN REPORT

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PLAGIARISM SCAN REPORT

Words	976	Date	April 22, 2022
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3% Plagiarism	97% Unique	2 Plagiarized Sentences	57 Unique Sentences

PLAGIARISM SCAN REPORT

Words	738	Date	April 22, 2022
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18% Plagiarism	82% Unique	8 Plagiarized Sentences	37 Unique Sentences

We have used a SmallSEOTool website to check for plagiarism. Here, uploaded about 1000 words each time as it is the limit and generated a report. Therefore, the average non-plagiarized content for Brain Stroke Disease Classification project is **92%.**

CHAPTER 13
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