Stroke Disease Prediction

A PROJECT REPORT

Submitted by

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(181200107026)

In partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

In

Information Technology

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Aditya Silver Oak Institute of Technology

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CERTIFICATE

This is to certify that the project report submitted along with the project entitled **Stroke Disease Prediction** has been carried out by **Patel Bhargav Rajeshbhai** under my guidance in partial fulfillment for the degree of Bachelor of Engineering in Information Technology, 8th Semester of Gujarat Technological University, Ahmadabad during the academic year 2021-22.

Prof . Manish Singh	Prof. Jalpa C. Shah
Internal Guide	Head of Department

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DECLARATION

We hereby declare that the Internship / Project report submitted along with the Internship / Project entitled Stroke Disease Prediction submitted in partial fulfillment for the degree of Bachelor of Engineering in Computer Engineering to Gujarat Technological University, Ahmedabad, is a bonafide record of original project work carried out by me at Inexture Solutions LLP under the supervision of Pritesh Thaker and that no part of this report has been directly copied from any students' reports or taken from any other source, without providing due reference.

Sr. no.	Name of Student	Sign of Student
1.	Patel Bhargav Rajeshbhai	_____

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22/04/2022

TO WHOMSOEVER IT MAY CONCERN

This is to certify, **Bhargav Patel**, a student of Aditya Silver Oak Institute of Technology, Gota, Ahmedabad has successfully completed his internship in the field of **Python Technology** from 01st January, 2022 to 22nd April, 2022 (Total number of Weeks: 16), under the guidance of Devanshi Desai.
His internship activities include:

- Core python training
- A variety of tasks to help them practice what they've learned
- Learning of python based web frameworks

During the period of his internship program with us he had been exposed to different process and was found diligent, hardworking and inquisitive.

We wish him every success in his life and career.

Best Wishes,

INEXTURE SOLUTIONS LLP AHMEDABAD

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ACKNOWLEDGEMENT

I would start by thanking my honourable faculty Pro. Manish Singh, who has provided me with the necessary guidance and information needed to complete this project report. Also, he provided me such task which helped me to start with the right topics to think on and provided me such environment which given me a correct direction to work on my weakness. Thanks for giving me technical and non-technical knowledge and guideline during activation period, and the entire team for being helpful and support.

Your sincerely,

Bhargav Patel

(181200107026)

ABSTRACT

A stroke is a medical condition in which the blood arteries in the brain rupture, leading brain damage. Symptoms may appear if the brain's flow of blood and other nutrients is disrupted. Stroke is the leading cause of death and disability worldwide, according to the World Health Organization (WHO). Early awareness of the numerous stroke warning symptoms can assist to lessen the severity of the stroke. To forecast the chance of a stroke happening in the brain, many machine learning (ML) models have been created. Random forest, support vector machines, decision trees and classifiers, and neural networks were the most often utilised approaches.

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CHAPTER 1- Company Overview

1.1 HISTORY

Inexture Solutions LLP is established 10 years ago by the intellectuals to provide such software solutions that are functional, reliable, maintainable and cost-friendly to our existing and growing client and customer base. To consistently cater to their growing needs for an optimal solution, ensuring excellent support and service platform to give a hassle-free experience in achieving their dreams.

1.2 PRODUCT

Our company provide variety of services Software development, Web-Portal development, Website Designing, E-commerce development, SEO, Customized App Development, Data Management Software with cloud hosting facility, etc.

1.3 CAPACITY

There are currently 90+ employees are working in this company and there is different capacity of each department. Web development department have capacity of developing around 50 big full-fledged websites a year. App development department have capacity of developing around 30 big full-fledged mobile applications a year. Software development department have capacity of developing around 25 big full-fledged software a year.

CHAPTER 2- Project Introduction

2.1 Overview

When blood flow to different parts of the brain is interrupted or reduced, the cells in those areas of the brain don't get the nutrients and oxygen they need, and they die. A stroke is a life-threatening medical condition that need immediate medical intervention. To avoid additional damage to the afflicted area of the brain, as well as effects in other parts of the body, early identification and effective therapy are necessary. According to the World Health Organization (WHO), fifteen million people worldwide suffer from strokes each year, with one person dying every four to five minutes. According to the Centers for Disease Control and Prevention(CDC), stroke is the sixth greatest cause of death in the United States . Approximately 795,000 persons in the United States suffer from the devastating effects of strokes on a regular basis. It is the fourth largest major cause of death in India. Ischemic and hemorrhagic strokes are the two types of strokes. Clots hinder drainage in a chemical stroke, whereas a weak blood artery breaks and bleeds into the brain in a hemorrhagic stroke. Stroke can be avoided by living a healthy and balanced lifestyle that includes quitting smoking and drinking, maintaining a reasonable BMI and glucose level, and having great heart and kidney function.

2.2 Purpose

A stroke is a medical condition in which the blood arteries in the brain rupture, leading brain damage. Symptoms may appear if the brain's flow of blood and other nutrients is disrupted. Stroke is the leading cause of death and disability worldwide, according to the World Health Organization (WHO). Early awareness of the numerous stroke warning symptoms can assist to lessen the severity of the stroke. To forecast the chance of a stroke happening in the brain, many machine learning (ML) models have been created.

2.3 Technology

Technologies used for the project are listed below:

- Machine Learning Algorithms
- NearMiss Technique
- SMOTE Technique
- Neural Network
- Front-End: HTML5, CSS3
- Back-End: Django
- Database: Postgresql
- Version Control: Git

2.4 Project Planing

The steps for basic project planning was:

- Requirement gathering
- Data Collection
- Exploratory Data Analysis
- Training
- Testing
- Deployment

CHAPTER 3- SYSTEM ANALYSIS

3.1 Study Of Current System

In all current Systems for balancing a imblanced data they have used a SMOTE Technique which Add duplicate values to minority class**.** SMOTE first selects a minority class instance a at random and finds its k nearest minority class neighbors. The synthetic instance is then created by choosing one of the k nearest neighbors b at random and connecting a and b to form a line segment in the feature space. The synthetic instances are generated as a convex combination of the two chosen instances a and b.

3.2 Proposed System

In new system will use NearMiss Undersampling Technique to balance the imbalance data. NearMiss Technique remove the values form majority class.

Steps of NearMiss Technique :

(1) The algorithm first calculates the distance between all the points in the larger class with the points in the smaller class. This can make the process of undersampling easier.

(2) Select instaces of the larger class that have the shortest distance with the smaller class. These n classes need to be stored for elimination.

(3) If there are m instances of the smaller class then the algorithm will return m*n instances of the larger class.

CHAPTER 4- Implementation

4.1 Introduction to data

The investigation was conducted using a globally accessible stroke prediction dataset. This dataset has 5110 rows and 12 columns. The output column stroke value is either 1 or 0. A score of 0 indicates that no stroke risk has been identified, whereas a value of 1 indicates that a risk of stroke has been identified. In this dataset, the chance of 0 in the output column (stroke) is greater than the likelihood of 1 in the same column.

Attribute Name	**Type** ***(Values)***	**Description**
1. id	Integer	A unique integer value for patients
2. gender	String literal *(Male, Female, Other)*	Tells the gender of the patient
3. age	Integer	Age of the Patient
4. hypertension	Integer *(1, 0)*	Tells whether the patient hashypertension or not
5. heart_disease	Integer *(1, 0)*	Tells whether the patient hasheart disease or not
6. ever_married	String literal *(Yes, No)*	It tells whether the patient ismarried or not
7. work_type	String literal *(children, Govt_job, Never_worked ,Private, Self-employed)*	It gives different categories forwork
8. Residence_type	String literal *(Urban, Rural)*	The patient's residence type isstored
9.avg_glucose_level	Floating pointnumber	Gives the value of averageglucose level in blood
10. bmi	Floating pointnumber	Gives the value of the patient'sBody Mass Index
11. smoking_status	String literal *(formerly smoked,never smoked, smokes, unknown)*	It gives the smoking status of thepatient
12. stroke	Integer *(1, 0)*	Output column that gives thestroke status

Table 1: Data Discriptio

4.2 Exploratory Data Analysisi

4.2.1 Gender

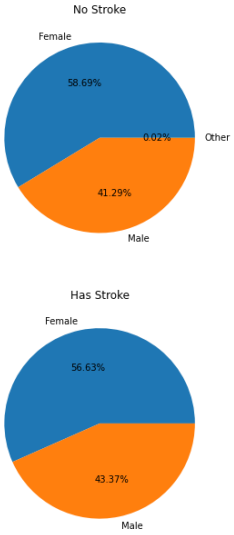


Figure 1 : Gender data Visulization

4.2.2 Age

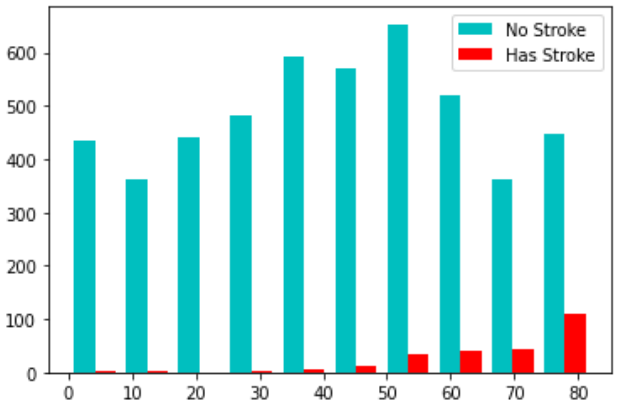


Figure 2 : Age Data Visulization

4.2.3 Hypertension

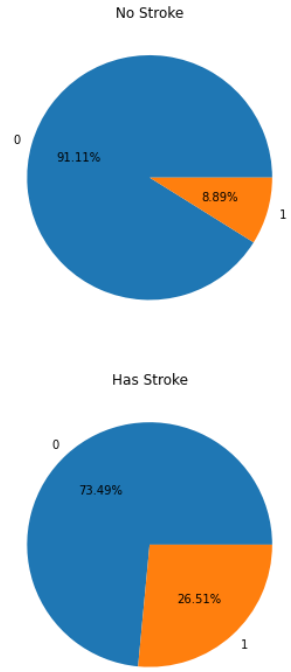


Figure 3 : Hypertension data visulization

4.2.4 Heart_disease

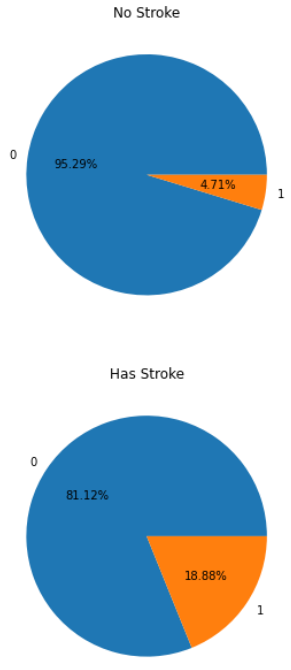


Figure 4 : Heart_disease Data Visulization

4.2.5 Ever_Married

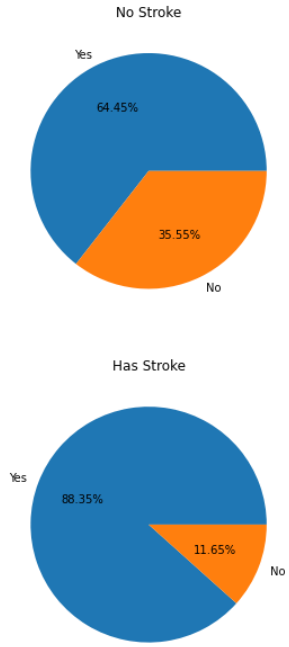


Figure 5 : Ever_Married Data Visulization

4.2.6 Work_type

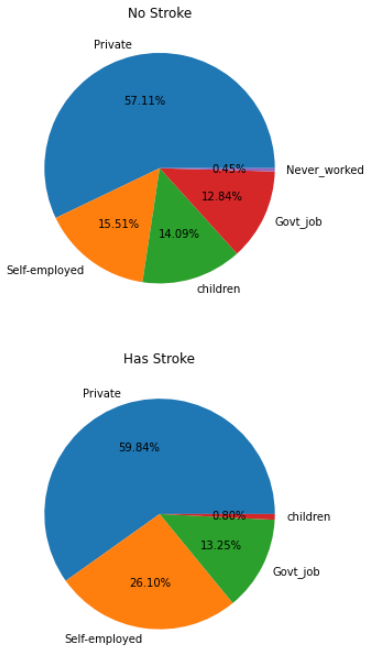


Figure 6 : Work_Type data visulization

4.2.7 Residence_type

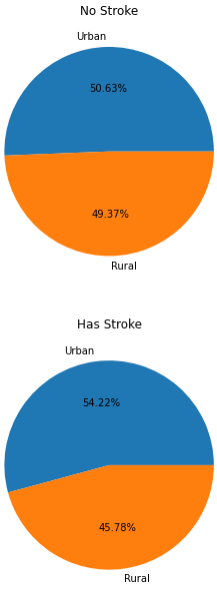


Figure 7 : Residence_type Data Visulization

4.2.8 Avg_glucose_level

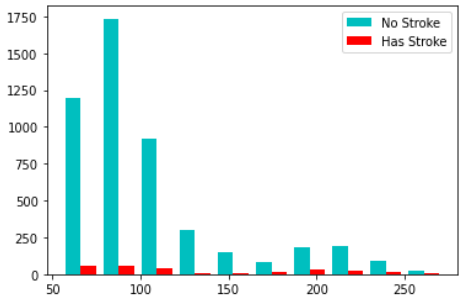


Figure 8 : Avg_glucose_level Data Visulization

4.2.9 Bmi

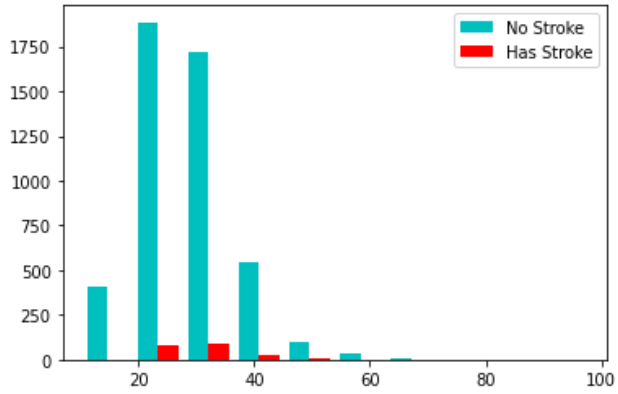


Figure 9 : Bmi Dadta Visulization

4.2.10 Smoking_status

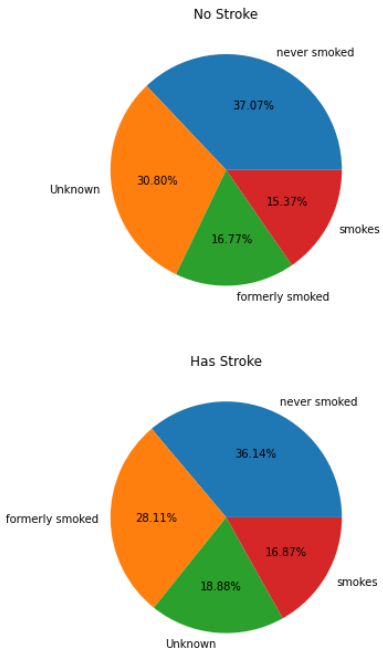


Figure 8 :Smoking_status Data visualization

4.2.10 Feature Comparision

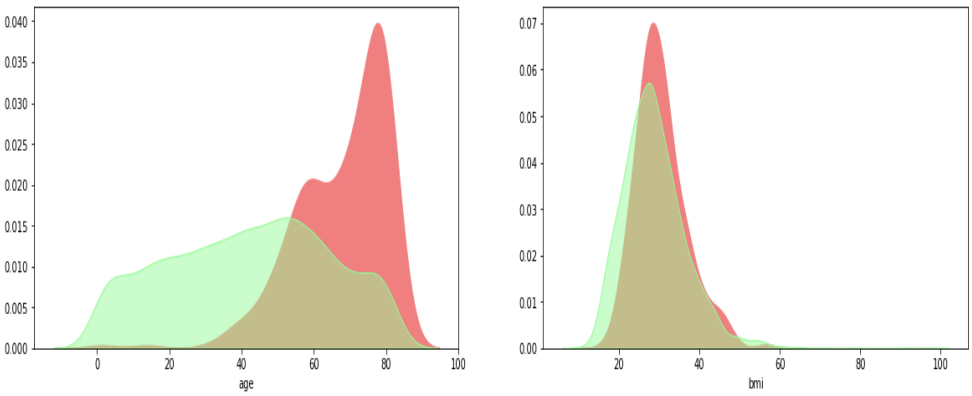


Figure 9 : feature Comparison

4.3 Feature Analysis Result

	No Stroke	Has Stroke	Note
gender (Most)	Female	Female	No Clear Difference also Other catagory can be ignore
age (Median)	43	71	the median age of stroke patients is higher than patient with no stroke
hypertension (Most)	0	0	the patient who has hypertension from stroke patient is 18 % higher than the patient with no stroke
heart_disease (Most)	0	0	the patient who has heart disease from stroke patient is 14 % higher than the patient with no stroke
ever_married (Most)	Yes	Yes	the patient who ever married from stroke patient is 24 % higher than the patient with no stroke
work_type (Most)	Private	Private	the patient who work as self-employed from stroke patient is 11.4% higher than the patient with no stroke
Residence_type (Most)	Urban	Urban	No Clear Difference
avg_glucose_level (Median)	91.5	105.2	the median of avg_glucose_level from Stroke Patient is higher than the Patient with no Stroke
bmi (Median)	28.3	30.5	the median of bmi from Stroke Patient is little higher than the Patient with no Stroke
smoking_status (Most)	never smoked	never smoked	The patient who smokes or formerly smoked from is 13% higher than the patient with no stroke
Whole Dataset	95.13%	4.87%	The Data Is Imbalanced

Table 2: Feature Analysis Result

4.4 Observations about data features

- People with age 65-85 have high chances of getting stroke.
- bmi can't distinguish stroke patterns and also have 4% missing values, Hence It can be drop.
- there are higher samples of no stroke (stroke=0) as compared to the other class. Hence it is a Highly Imbalanced dataset
- Others category in 'gender' can be ignored
- Type of Residence either Urban or Rural has no effect on having stroke. This feature can also be dropped.
- Dataset is Imbalanced.

4.5 Missing Value Handling

(1) Deleting Rows

(2) Replacing with Mean/Median/Mode

(3) Assigning An Unique Category

(4) Predicting the missing values

After doing exploratory data analysis, exclude the 'bmi', 'id', and 'Residence type' columns, as well as the row data for the Gender type 'other'.

4.6 Label Encoding

Label encoding converts a string data column to an integer type, allowing the model to better grasp the data pattern. Label Encoding is required for the 'gender','smoking status', 'work type', and 'ever married' columns.

4.7 Standardizing and splitting

Standardizing data helps model to tarin and test model faster on given standardized data. After Standardinzing the data splite the data in training and testing part For training on different models and evaluate performance.

CHAPTER 5 – Model Testing

5.1 SMOTE Technique

SMOTE Technique is a Over-sampling technique.

Working - *SMOTE first selects a minority class instance a at random and finds its k nearest minority class neighbors. The synthetic instance is then created by choosing one of the k nearest neighbors b at random and connecting a and b to form a line segment in the feature space. The synthetic instances are generated as a convex combination of the two chosen instances a and b.*

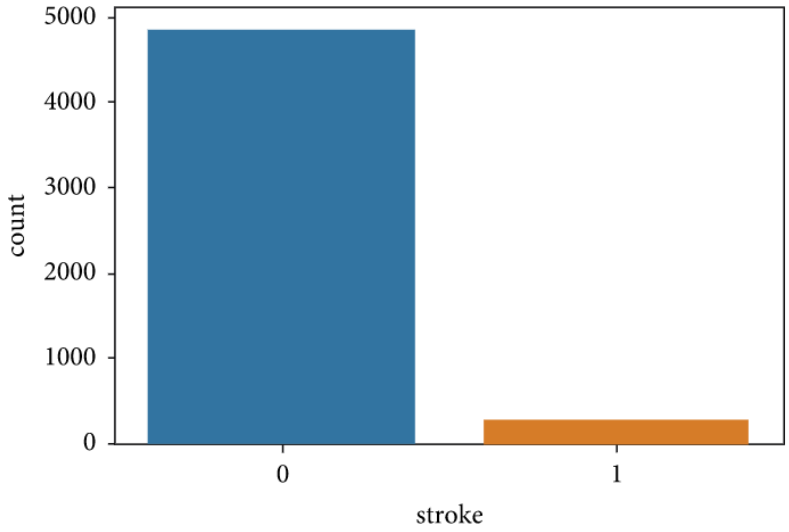


Figure 10 : Data Before Balancing

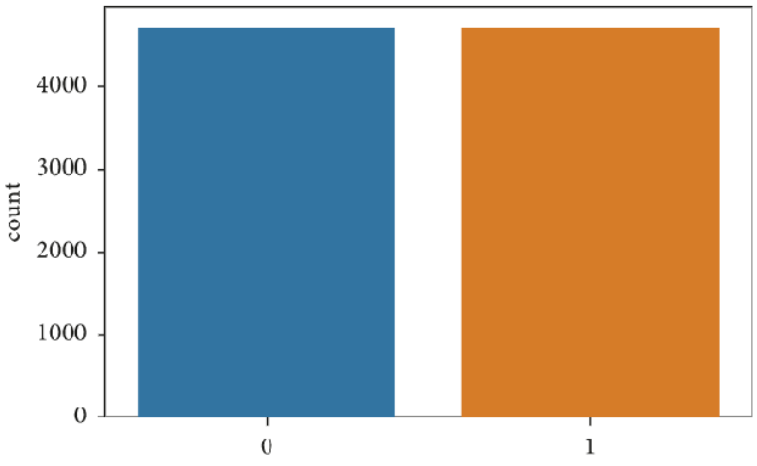


Figure 11 : Data After Balancing

	Model	Precision	Recall	F1	balanced_accuracy
0	LogisticRegression	0.758555	0.812842	0.784723	0.779670
1	KNeighborsClassifier	0.841099	0.963609	0.898139	0.892595
2	DecisionTreeClassifier	0.898514	0.903815	0.901880	0.902018
3	RandomForestClassifier	0.922971	0.943074	0.932647	0.931979
4	BernoulliNB	0.660416	0.927474	0.771435	0.730086
5	SVC	0.776550	0.884065	0.826799	0.817447

Figure 12 : Performance Evaluation of Various Model (SMOTE Technique)

	precision	recall	f1-score	support
0	0.95	0.97	0.96	931
1	0.97	0.96	0.97	1013
accuracy			0.97	1944
macro avg	0.96	0.97	0.96	1944
weighted avg	0.97	0.97	0.97	1944

Figure 12 : Performance of RandomForestClassifier

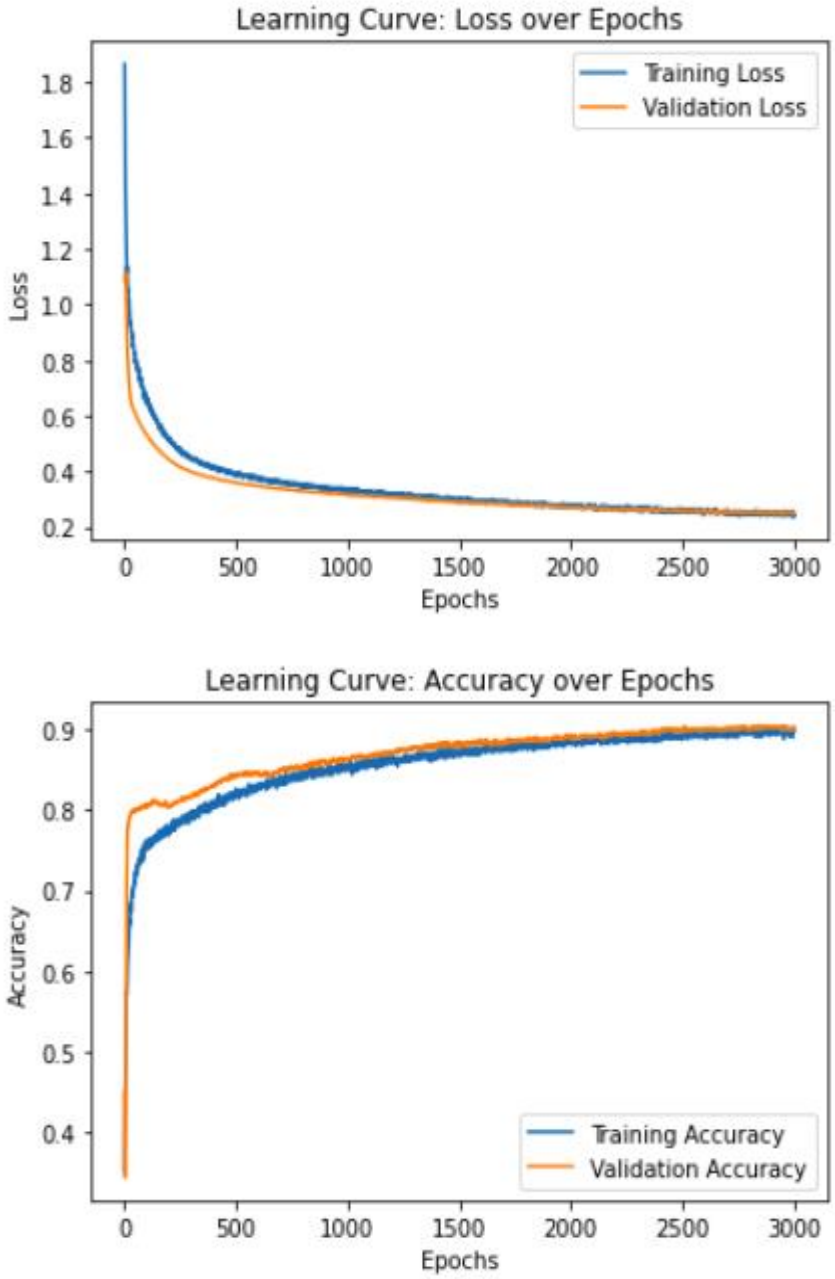


Figure 13 : Learning Curve For Neural Network

Classification Report:	precision	recall	f1-score	support
Had no stroke	1.00	0.85	0.91	3929
Had stroke	0.86	1.00	0.92	3847
accuracy			0.92	7776
macro avg	0.93	0.92	0.92	7776
weighted avg	0.93	0.92	0.92	7776

Figure 14 : Neural Network Classification Report

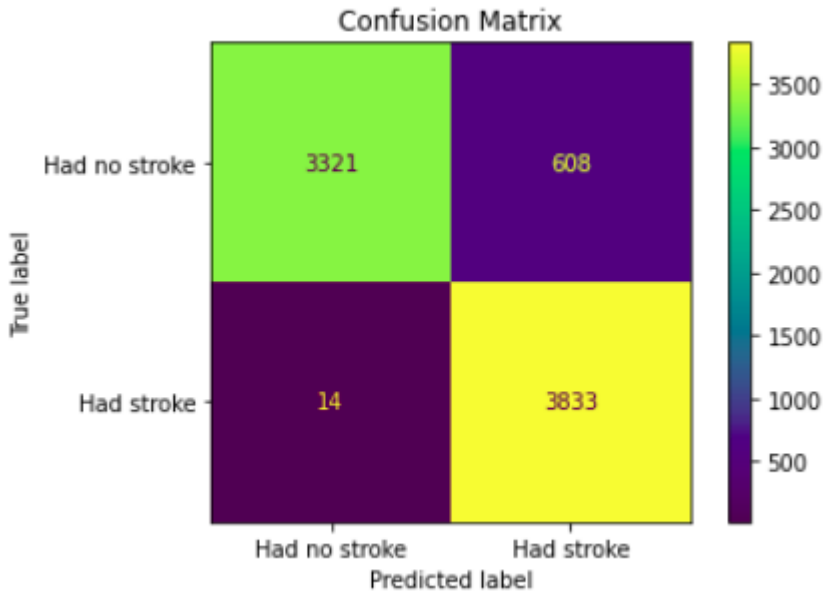


Figure 15 : Confusion Matrix For Neural Network Model

5.2 NearMiss (Under- Sampling) Technique

NearMiss (Under-Sampling) technique Used For Balancing the data which removes data from majority class. For this technique We need large set of data.

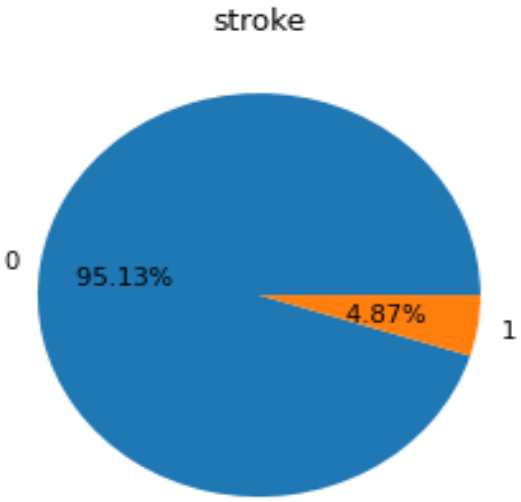


Figure 16 : Data before Balancing

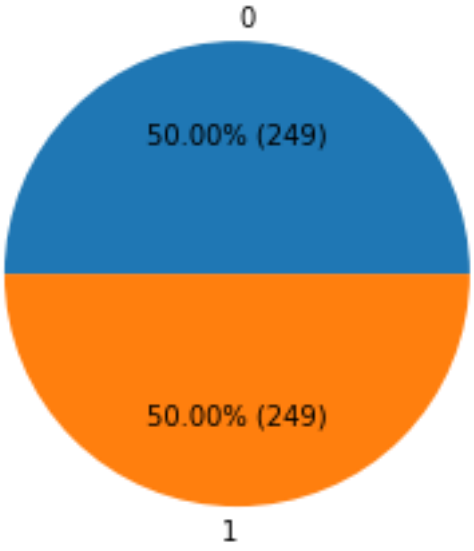


Figure 17 : After data Balancing

:

	Model	Precision	Recall	F1	balanced_accuracy
0	LogisticRegression	0.740247	0.688684	0.710752	0.723033
1	KNeighborsClassifier	0.907342	0.694211	0.785020	0.812462
2	DecisionTreeClassifier	0.823394	0.755526	0.786155	0.801122
3	RandomForestClassifier	0.868658	0.841316	0.858393	0.868897
4	BernoulliNB	0.749542	0.672368	0.707098	0.727018
5	SVC	0.926121	0.805789	0.859993	0.870633

Figure 18 : Performance of various model(Near-Miss Technique)

	precision	recall	f1-score	support
0	0.83	0.85	0.84	47
1	0.87	0.85	0.86	53
accuracy			0.85	100
macro avg	0.85	0.85	0.85	100
weighted avg	0.85	0.85	0.85	100

Figure 19 : Performance of RandmForestCLassfication

Classification Report:

	precision	recall	f1-score	support
Had no stroke	0.93	0.99	0.96	202
Had stroke	0.99	0.93	0.96	196
accuracy			0.96	398
macro avg	0.96	0.96	0.96	398
weighted avg	0.96	0.96	0.96	398

Figure 20 : Evaluation of Neural Network

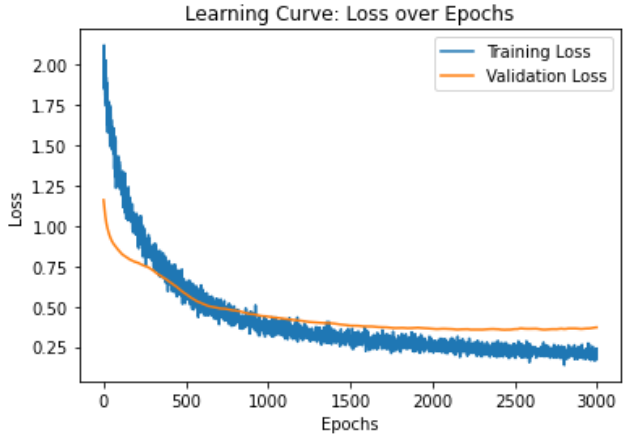


Figure 21 : Learning Curve (Loss over Epochs) : For Nueral network

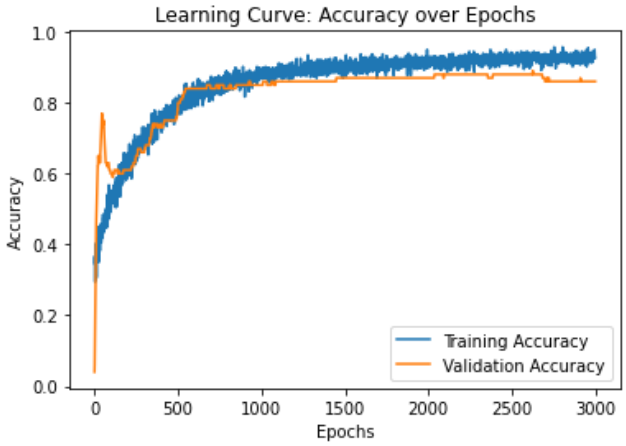


Figure 22 : Learning Curve (Accuracy Over Epochs) : For Nueral Network

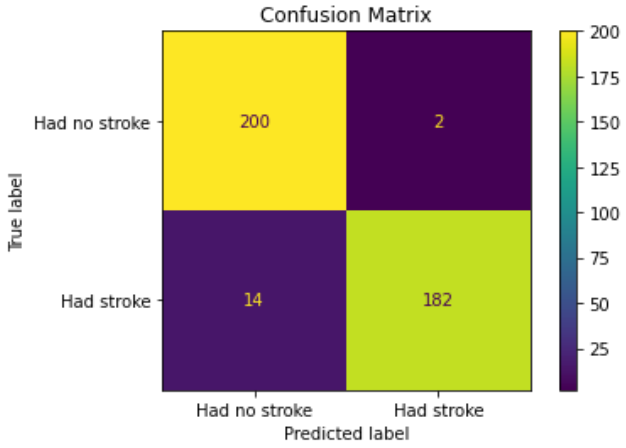


Figure 23 : Confusion Matrics of Neural Network

5.3 Performance Evaluation of Models With Nearmiss Technique

The 'Neural Network' algorithm performs the best out of all the algorithms tested, with a 96 percent accuracy rate. The following graph shows a comparison of accuracies achieved from various methods. 'Neural Network' outperformed the others in terms of accuracy, recall, and F1 scores.

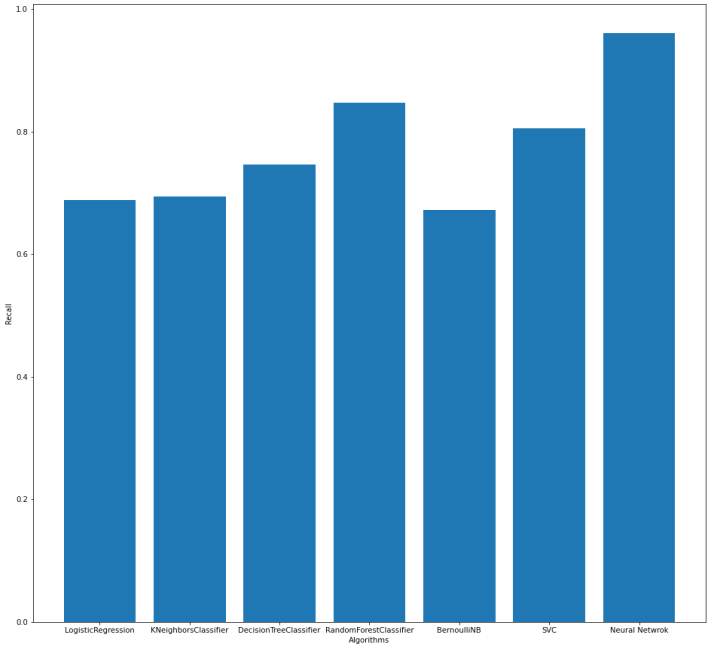


Figure 24 : Recall values Comparision

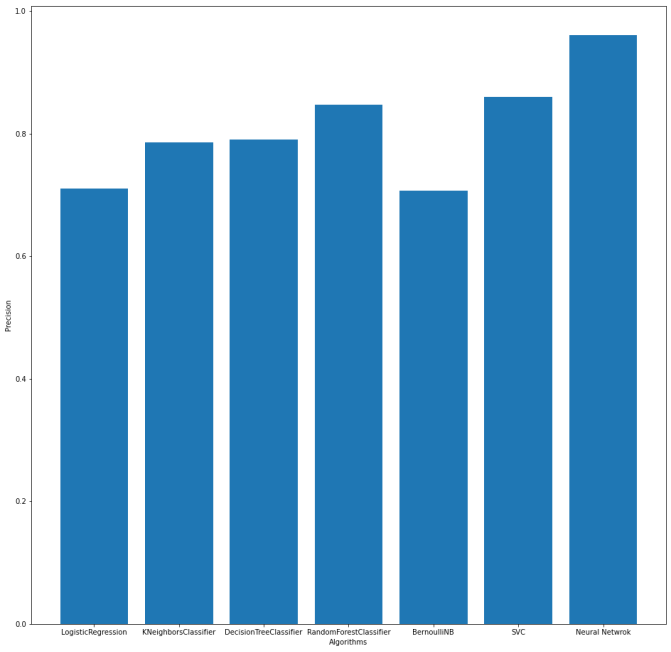


Figure 25 : Precision Values Comparision

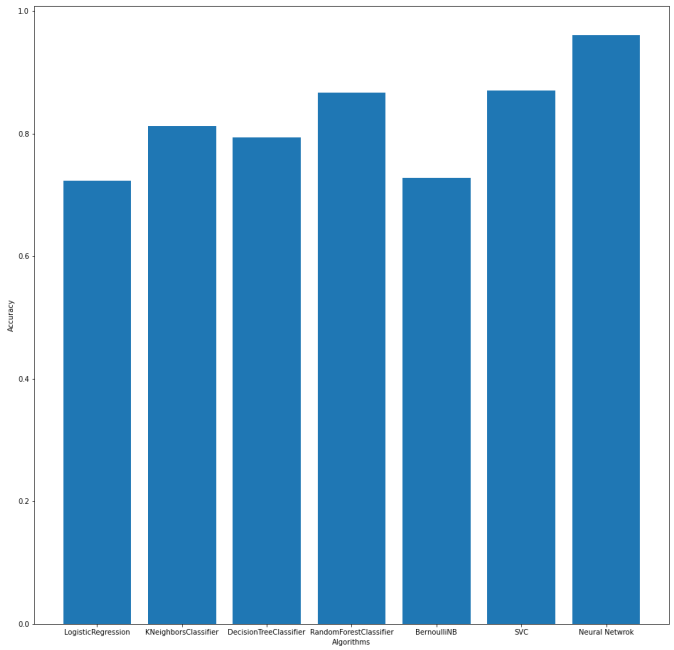


Figure 26 : Accuracy Values Comparision

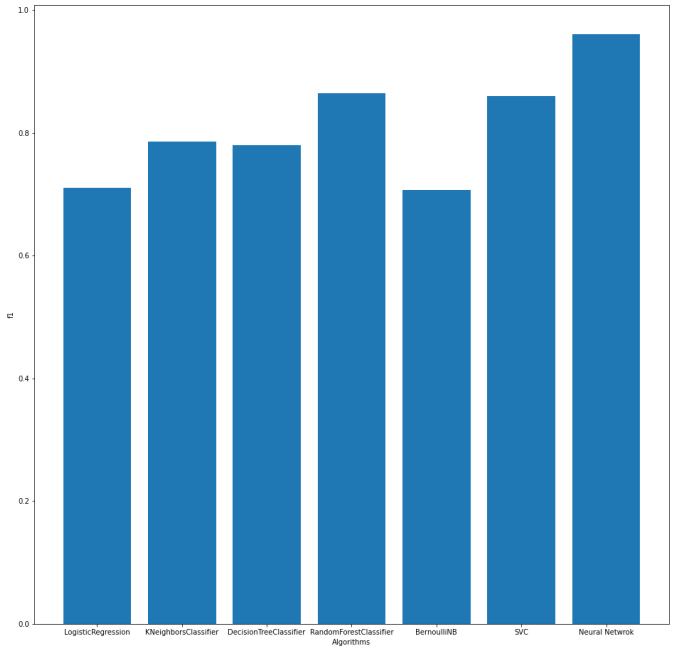


Figure 27 : F1 Score Comparision

CHAPTER 6 - H5 And Pickle files

6.1 H5 file

Using H5 file we can store scaler file which will be used to ssclae our data in when we connect our model to frontend.

6.2 INTRODUCTION TO PICKLE MODULE

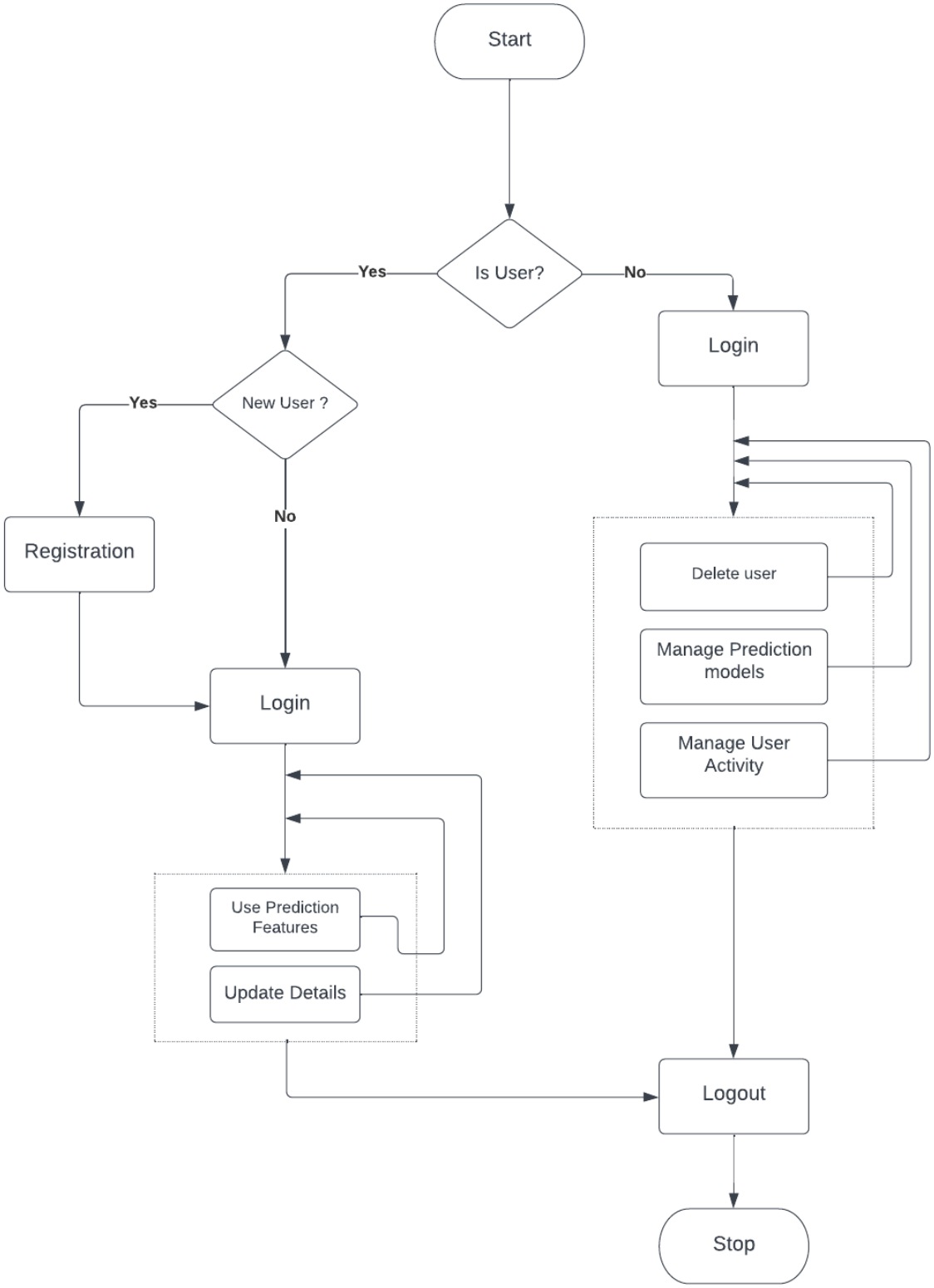
By python pickle module we can load the Machine learning model gathered in pickle file as above mentioned. And after opening the pickle file using open function of file module we can give the opened file to pickle.load(openFileObject). Then we can call this pickle file function called predict inside our callback function of DASH in this way we can link the pickle file to website.

6.3 INTRODUCTION TO KERAS MODULE

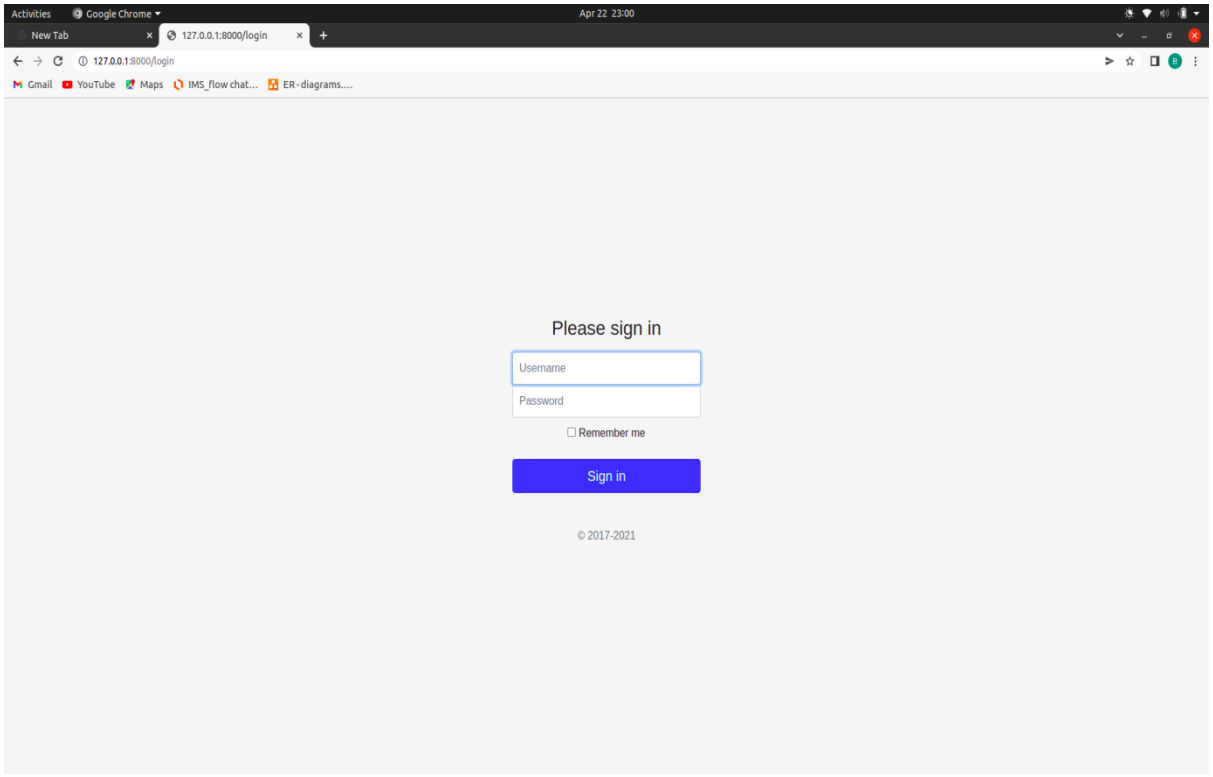
Keras is the main module of python in which the models module is located in which there is a function names load_model which is used to load the h5 files as mentioned above. But h5 files need to have the preprocessed data because these models take data of some period of regular time interval and predicts the data of one time interval so numpy and pandas one of the famous python modules come into the picture of this model, after predicting the values from the learned data set the callback function of DASH use these created predicts functions by providing some set of inputs to it.

CHAPTER 7 – User Interface Design

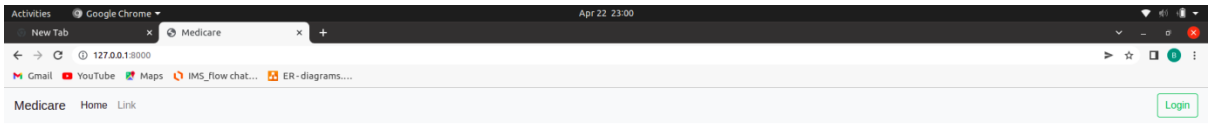
7.1 Flow Chart



7.2 Login page



7.3 Home page



7.4 Conclusion

With NearMiss imbalanced data managing technique The 'Neural Network' algorithm performs the best out of all the algorithms tested, with a 96 percent accuracy rate. The following graph shows a comparison of accuracies achieved from various methods. 'Neural Network' outperformed the others in terms of accuracy, recall, and F1 scores.

Delivering additional data as an input-set to neural networks and giving Brain CT Scan Image as input can increase neural network accuracy.

7.5 Future Work

Complete the user interface design and integret it with h5 and pickle file model using keras model to make end-to-end system.

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