A Minor Project Report

On

"STROKE PREDICATION MODEL"

SUBMITTED TO THE

Savitribai Phule Pune University

In Partial fulfillment for the award of the Degree of

Bachelor of Technology

in

Data Science

By

Gaurav Deepak Modhave [2021ADSE1101139]

Prasad Vilas Mustapure [2021ADSE1111142]

Om Namdev Sanap [2021ADSE1101148]

Under the guidance of

Mr. Chiranjit Das

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

(CYBER SECURITY AND DATA SCIENCE)

G. H. RAISONI COLLEGE OF ENGINEERING AND MANAGEMENT

(An Autonomous Institute affiliated to SPPU)

WAGHOLI , PUNE – 412207

SAVITRIBAI PHULE PUNE UNIVERSITY

2023-24

CERTIFICATE

This is to certify that the project-based seminar report entitled **"Brain Stork Prediction Model"** being submitted by **Gaurav Modhave, Prasad Mustapure, Om Sanp** is a record of bonafide work carried out by him/her under the supervision and guidance of **Mr. Chiranjit Das** in partial fulfillment of the requirement for **B. Tech (Data Science) – 2020 course** of Savitribai Phule Pune University, Pune in the academic year 2023-2024.

Date: 30/10/2023

Place: Wagholi , Pune.

Mr.Chiranjit Das	**Mr. Santosh Biradar**	**Dr. Deepika Ajalkar**
(Guide Name)	(Project Coordinator)	(HOD)

External Name & Sign

Dr . R . D. Kharadkar

(Director)

ACKNOWLEDGEMENT

We here by wish to take this opportunity to express our gratitude to our Project Guide Mr. Chiranjit Das , Project Review Committee Members and Head of Department Dr. Deepika Ajalkar for their consistent guidance and motivation toward the completion of our project. We take a great honor in presenting this Project Report to our Director, Dr. R. D. Kharadkar. We are very grateful to our teaching staff for guiding us all over the duration of the degree. They were very helpful to us as and when we required their help. We are also very grateful to non-teaching staff to help us in the laboratory in various ways. We would also like to extend our gratitude to those friends whose knowledge and time helped us in many ways.

Name	**Roll No**	**Sign**
Gaurav Modhave	35	
Prasad Mustapure	39	
Om Sanap	46	

ABSTRACT

The Brain Stroke Prediction Model project aims to develop a robust machine learning model for the early detection of stroke risk in individuals. Leveraging a diverse dataset encompassing medical records, demographic information, and lifestyle factors, the model employs advanced analytics to predict the likelihood of a stroke. By focusing on early identification, the project intends to empower healthcare professionals with a proactive tool for personalized intervention, ultimately improving patient outcomes and optimizing healthcare resource allocation.

The Early Stroke Prediction Model employs machine learning techniques to assess an individual's risk of experiencing a brain stroke. Utilizing diverse datasets, including medical records and lifestyle factors, the model aims to enable early intervention by identifying high-risk individuals. The project focuses on model accuracy, generalization across populations, and practical integration into healthcare systems for personalized preventive measures. The anticipated outcome is a precise and actionable tool, contributing to proactive healthcare strategies and reducing the impact of strokes on public health

TABLE OF CONTENTS

Chapter No.	Title	Page No.
	ACKNOWLEDGMENT	iii
	ABSTRACT	iv
1	Introduction	1
2	Literature Survey	10
3	Requirements and Analysis	14
4	System Design	18
5	System Implementation	25
6	Results	33
7	Conclusion and Future Scope	34
8	Reference	36

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Advanced Brain Stroke Prediction Model project addresses the critical need for early detection of strokes, a leading cause of morbidity and mortality worldwide. By harnessing the capabilities of machine learning, this project aims to develop a sophisticated predictive model that accurately assesses an individual's risk of experiencing a brain stroke. The research encompasses data from diverse sources, including medical records, demographic information, and lifestyle factors, to create a holistic approach to stroke prediction.

1.2 PROJECT DEFINITION

The Brain Stroke Prediction Model project aims to create a sophisticated and accurate predictive tool using machine learning techniques. The primary objective is to develop a model capable of assessing an individual's risk of experiencing a brain stroke. This involves the integration of diverse datasets, including medical records, demographic information, and lifestyle factors, to identify key indicators of stroke risk.

1.3 DECLARATION OF THE PROBLEM

The prevalence of brain strokes as a leading cause of morbidity and mortality underscores the critical need for early detection and intervention. Despite advancements in medical science, the challenges associated with timely identification of individuals at risk of experiencing a stroke persist. This declaration highlights the core issues that the Brain Stroke Prediction Model project seeks to address:

1.4 PROJECT PURPOSES

The purpose of the Brain Stroke Prediction Model project is to develop a predictive algorithm that can assess the risk of stroke in individuals. This model aims to enable early detection, intervention, and personalized healthcare strategies, ultimately reducing mortality, morbidity, and healthcare costs associated with strokes. The project seeks to optimize resource allocation, raise awareness about stroke risk factors, and contribute to ongoing research in stroke prevention and treatment.

Here are some potential purposes and benefits of developing a brain stroke prediction model:

- **Early Detection and Intervention:**
- **Reducing Mortality and Morbidity:**
- **Resource Optimization:**
- **Patient Education and Awareness:**
- **Customized Treatment Plans:**
- **Healthcare Cost Reduction:**
- **Research and Data Analysis:**
- **Integration with Telemedicine:**

1.5 ARCHITECTURE & COMPONENTS

The architecture of a Brain Stroke Prediction Model involves various components that work collaboratively to process data, analyze risk factors, and generate predictions. Below is a high-level overview of the architecture and key components involved in developing such a model:

1. **Data Collection:**
   - Gather relevant health data from diverse sources, including electronic health records (EHRs), medical imaging, patient demographics, lifestyle factors, and genetic information. Data may be collected from hospitals, clinics, wearables, and other healthcare systems.
2. **Data Preprocessing:**
   - Clean and preprocess the collected data to address missing values, outliers, and inconsistencies. This step involves normalization, scaling, and handling categorical variables to prepare the data for further analysis.
3. **Feature Selection:**
   - Identify and select the most relevant features or variables that contribute significantly to stroke risk prediction. Feature selection helps in reducing dimensionality and focusing on the most informative aspects of the data.
4. **Machine Learning Model:**
   - Develop a machine learning model, such as a predictive algorithm or a deep learning neural network, that can learn patterns and relationships within the selected features. Common algorithms include logistic regression, decision trees, random forests, support vector machines, or deep neural networks.
5. **Training the Model:**
   - Train the machine learning model using historical data with known outcomes (labels). The model learns to associate patterns in the data with the occurrence or non-occurrence of strokes. This training phase involves optimizing the model's parameters for accurate predictions.
6. **Validation and Testing:**
   - Validate the model's performance using a separate dataset not used during training. Fine-tune the model based on validation results. After validation, test the model on a completely new dataset to assess its generalization capability.
7. **Prediction and Risk Assessment:**
   - Once trained and validated, the model can be used to predict stroke risk for new individuals. Input their relevant health data, and the model will output a probability or classification indicating their risk level.
8. **Integration with Healthcare Systems:**
   - Integrate the prediction model with existing healthcare systems and workflows. This may involve incorporating the model into electronic health record systems or creating APIs for seamless interaction with healthcare providers.
9. **User Interface (UI):**
   - Develop a user-friendly interface for healthcare professionals to input patient data, view predictions, and interpret results. The UI should provide relevant visualizations and explanations to enhance the interpretability of the model's predictions.
10. **Alerts and Notifications:**
    - Implement an alert system that notifies healthcare providers of high-risk predictions. This facilitates timely intervention and ensures that individuals at elevated risk receive the necessary attention.
11. **Continuous Monitoring and Model Updating:**
    - Establish mechanisms for continuous monitoring of the model's performance and update the model periodically with new data. This helps in adapting to changing patterns and maintaining the model's accuracy over time.
12. **Ethical and Regulatory Compliance:**
    - Ensure compliance with ethical standards, patient privacy regulations (such as HIPAA), and any other relevant healthcare regulations throughout the development, deployment, and operation of the prediction model.

By integrating these components into a cohesive architecture, a Brain Stroke Prediction Model can offer valuable insights to healthcare professionals, contribute to proactive patient care, and potentially reduce the incidence and impact of strokes.

1.6 PROJECT SCOPE

The Brain Stroke Prediction Model project seeks to create a machine learning-based system for forecasting stroke risk. The project scope involves collecting diverse health data, identifying key risk factors, and implementing a user-friendly model integrated with existing healthcare systems. The goal is to enable timely interventions by alerting healthcare providers to high-risk predictions. Ethical considerations, regulatory compliance, and continuous monitoring for long-term impact assessment are integral parts of the project scope. The overarching aim is to enhance stroke prevention, improve patient outcomes, and ensure the model aligns with ethical and legal standards.

1.7 Data Visualization

Data visualization is a crucial aspect of the Brain Stroke Prediction Model project, enhancing the interpretability of complex health data and model predictions. Here's how data visualization can be incorporated into the project:

These visualizations include:

Exploratory Data Analysis (EDA):

Utilize visualizations to explore and understand the characteristics of the input data. This may include demographic distributions, trends in risk factors, and the prevalence of stroke-related variables.

Feature Importance Visualization:

Present visualizations that illustrate the importance of different features in the prediction model. This helps healthcare professionals understand which factors contribute most significantly to stroke risk.

Model Performance Metrics:

Display visual representations of the model's performance metrics, such as accuracy, precision, recall, and area under the receiver operating characteristic curve (AUC-ROC). Visualizations like confusion matrices can provide a comprehensive overview of the model's strengths and weaknesses.

Patient Risk Profiles:

Create visual representations of individual patient risk profiles, showing the contribution of various risk factors to their overall stroke risk. This can aid in personalized patient communication and education.

Temporal Trends:

If applicable, visualize temporal trends in stroke risk factors or predictions. This could be essential for understanding how risk evolves over time and identifying potential seasonal or long-term patterns.

Geospatial Visualization:

If the project involves a geographical scope, use maps to visualize variations in stroke risk across different regions. This can be valuable for healthcare resource allocation and targeted intervention strategies.

Educational Materials: Develop visual materials for patient education, explaining the significance of various risk factors and the impact of lifestyle changes on stroke risk. This can be integrated into the healthcare professional's interface or provided separately.

1.7.1 Type of Data Visualization

for healthcare professionals and stakeholders to easily interpret and interact with the model's predictions and insights.

Iterative Improvement:

Fine-tune the model: Based on insights gained from data visualization and model performance, iterate on the model to improve its accuracy and generalizability.

Data visualization serves as a powerful tool throughout the entire process, from exploring the data to communicating the results effectively. It enables researchers, healthcare professionals, and stakeholders to better understand the complex relationships within the data and the model's predictions.

In the specific context of a brain stroke prediction model, the following types of visualizations may be particularly relevant:

1. **Risk Heatmaps:**
    - Display the distribution of stroke risk across different demographic groups or risk factors using a heatmap. This can help identify high-risk populations.
2. **Temporal Trends:**
    - Plot the occurrence of strokes over time to identify any temporal patterns or trends. This could be useful for understanding if there are seasonal variations or long-term trends.
3. **Geospatial Visualization:**
    - If the data includes geographic information, map the prevalence of strokes in different regions. This can help in understanding regional variations and targeting interventions.
4. **Patient Profiles:**
    - Visualize individual patient profiles, highlighting their risk factors and the predicted probability of having a stroke. This aids in personalized medicine and patient-specific interventions.
5. **Interactive Dashboards for Healthcare Professionals:**
    - Develop dashboards that allow healthcare professionals to input patient data and instantly see the predicted stroke risk, along with relevant visualizations. This facilitates quick decision-making.
6. **Feature Importance Plots:**

- Create visualizations, such as bar charts, to show the importance of different features in predicting strokes. This helps healthcare professionals focus on key risk factors.

7. **Explanatory Visuals:**
   - Generate visualizations that explain how certain factors contribute to stroke risk. This could involve illustrating the impact of variables like blood pressure, cholesterol levels, and age on the prediction.
8. **Prediction Confidence Intervals:**
   - Visualize prediction confidence intervals to provide insights into the uncertainty associated with each prediction. This is crucial for understanding the reliability of the model's predictions.

These visualizations collectively provide a comprehensive understanding of the data, model performance, and key factors influencing stroke predictions. They empower healthcare professionals to make informed decisions and communicate effectively with patients and other stakeholders.

1.7.2 How does this Data Visualization work

for healthcare professionals and stakeholders to easily interpret and interact with the model's predictions and insights. Iterative Improvement: Fine-tune the model: Based on insights gained from data visualization and model performance, iterate on the model to improve its accuracy and generalizability. Data visualization serves as a powerful tool throughout the entire process, from exploring the data to communicating the results effectively. It enables researchers, healthcare professionals, and stakeholders to better understand the complex relationships within the data and the model's predictions. In the specific context of a brain stroke prediction model, the following types of visualizations may be particularly relevant:

1. **Risk Heatmaps:**
   - Display the distribution of stroke risk across different demographic groups or risk factors using a heatmap. This can help identify high-risk populations.
2. **Temporal Trends:**
   - Plot the occurrence of strokes over time to identify any temporal patterns or trends. This could be useful for understanding if there are seasonal variations or long-term trends.
3. **Geospatial Visualization:**
   - If the data includes geographic information, map the prevalence of strokes in different regions. This can help in understanding regional variations and targeting interventions.
4. **Patient Profiles:**
   - Visualize individual patient profiles, highlighting their risk factors and the predicted probability of having a stroke. This aids in personalized medicine and patient-specific interventions.
5. **Interactive Dashboards for Healthcare Professionals:**
   - Develop dashboards that allow healthcare professionals to input patient data and instantly see the predicted stroke risk, along with relevant visualizations. This facilitates quick decision-making.
6. **Feature Importance Plots:**
   - Create visualizations, such as bar charts, to show the importance of different features in predicting strokes. This helps healthcare professionals focus on key risk factors.
7. **Explanatory Visuals:**
   - Generate visualizations that explain how certain factors contribute to stroke risk. This could involve illustrating the impact of variables like blood pressure, cholesterol levels, and age on the prediction.
8. **Prediction Confidence Intervals:**

- Visualize prediction confidence intervals to provide insights into the uncertainty associated with each prediction. This is crucial for understanding the reliability of the model's predictions.

These visualizations collectively provide a comprehensive understanding of the data, model performance, and key factors influencing stroke predictions. They empower healthcare professionals to make informed decisions and communicate effectively with patients and other stakeholders.

1.8 SUMMARY

Throughout the model development process, visualizations play a key role in iterative improvement. Insights gained from visualizations inform adjustments to the model, contributing to increased accuracy and generalizability.

In summary, data visualization in a brain stroke prediction model encompasses the entire model development lifecycle. It aids in understanding the data, selecting relevant features, training and evaluating the model, interpreting results, developing interactive dashboards, profiling patients, and communicating findings effectively. Visualizations are instrumental in turning complex data into actionable insights, ultimately contributing to more informed decision-making in stroke prevention and patient care.

CHAPTER 2

1. INTRODUCTION

This project is predictive analytics approach for stroke prediction. The project objective is to predict the chances of getting a brain stroke. This project helps to predict the stroke risk using prediction model in older people andfor people who are addicted to the risk factors as mentioned in the project. In future, the same project can be extended to give the stroke percentage using the output of current project. This project can also be used to find the stroke probabilities in young people and underage people by collecting respective risk factor information's and doctors consulting. An improvised Random Forest ensemble technique with a stroke prediction algorithm is implemented in this research work to identify the risk factor. An accuracy of 96.97% is achieved through the stroke predictor (SPR) model with an error rate of 0.03%. Using an improvised Random Forest model, we obtained efficient results with improved prediction accuracy. As future research, we can derive methods for different types of strokes along with risk levels using an image data set

2.1 PROBLEM STATEMENT:

Stroke is the second leading cause of death worldwide and remains an important health burden both for the individuals and for the national healthcare systems. Potentially modifiable risk factors for stroke include hypertension, cardiac disease, diabetes, and dysregulation of glucose metabolism, atrial fibrillation, and lifestyle factors. Therefore, the goal of our project is to apply principles of machine learning over large existing data sets to effectively predict the stroke based on potentially modifiable risk factors. Then it intended to develop the application to provide a personalized warning on the basis of each user's level of stroke risk and a lifestyle correction message about the stroke risk factors

1.1 OBJECTIVES:

The objective stroke is the second leading cause of death worldwide and remains an important health burden both for the individuals and for the national healthcare systems. Potentially modifiable risk factors for stroke include hypertension, cardiac disease,.

Some of the major objectives of this project are-

i. Gender
ii. Age

iii. BMI
iv. HyperTension
v. Avg Glucose Level

1.2 SCOPE:

Future Scope This project helps to predict the stroke risk using prediction model in older people and for people who are addicted to the risk factors as mentioned in the project.

In future, the same project can be extended to give the stroke percentage using the output of current project.

This project can also be used to find the stroke probabilities in young people and underage people by collecting respective risk factor information's and doctors consulting.

SMS/Email Module – In the proposed system, the admin creates ID and password credentials for doctors and receptionists.

For enhancing the application in the future days we can turn this manual process into an automated process by buying email hosting services or deploying on cloud platforms using its integrated SNS services

3 RELATED WORK

2.1 EXISTING SYSTEM/ Papers:

The current system works as the stoke cannot be directly predict by using any of the content using such as BMI, Work Type and other factors. The working steps we need to take Ct scan report need to get in detail. The current system prediction is given only by using only one of the algorithms in themachine learning In this project, we have applied 4 types of classifiers in which one gives the accuratevalues that have been used for the prediction.

4 SYSTEM DESIGN

System design is the conceptual model that defines the structure, behavior, and views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. The overall logical structure of the project is divided into processing modules and conceptual. System analysis or study is an important phase of any system development process. The system is viewed as a whole, the inputs are identified and the system is subjected to close study to identify the problem areas. The solutions are given as a proposal. The proposal is reviewed on user request and suitable changes are made. This loop ends as soon as the user is satisfied with the proposal.

4.1 PROPOSED SYSTEM

In the proposed system patient need to fill the required data. The given information in the forms would be helpful for the prediction.

The user directly need to go to doctor he can directly input his info in the details of the person and the program will determine his chances of getting a stroke . Here the details of the person are not shared to any of the hospital so he would need to find he has chance of getting a stroke or not .this system has a user-friendly interface and can help people understand the details and chances of getting a stroke.

4.2 SYSTEM DESIGN

4.2.1 Gender

User need to specify its gender

4.2.2 Age

A user need to give it age .

4.2.3 Hyper tension, Heart disease

User need to clear it medical history for having a heart disease or not as well as he need to define it has a hyper tension or not.

4.2.4 Martial status, Work type, Residence type ,Smoking status

User need to give answer for above mentioned status.

4.2.5 Avg glucose level, Bmi :

The user has to give total accurate glucose level as it is the essential part of the prediction model and also it need to provide BMI which play a key role for the prediction.

5 METHODOLOGY

1. **Input data:** Risk factors like age, gender, hypertension, heart disease, BMI, Smoking status, Glucose level.
2. **Machine Learning Techniques:** Artificial Neural Networks, Decision Tree, Naïve Bayes classifier.
3. **Analysis:** Prediction and analysis of stroke whose performance is based on machine learning techniques.
4. **Management:** Suggestion and improvement of stroke victims.

Dataset used

The dataset is collected from UCI Machine Learning repository. Around 5000 recordsare collected which had 18 parameters. The dataset is based on stroke diagnosis of past patients. The parameters includes family history, work type, alcohol habits, smoking, WBC count, blood pressure, age, gender, BMI, heart disease and others. The dataset are error freeand their analysis helps in realizing the type of stroke disease.

Performance Evaluation

Naïve Bayes and Artificial Neural Networks are constructed from the given set of parameters. Naïve Bayes works on probability statistical classification, for each feasible value in the selected/desirable range. The presence of a particular feature in a category is not to the presence of anyother feature. Naïve Bayes works on conditional probability since it is built upon Bayes theorem. When the patient details or parameters are given as input, it analyzes all these parameters and finds out the type of stroke disease. Here, we have divided the data into testing dataset and training dataset. Naïve Bayes takes the testing data as input and compares it with the training dataset by analyzing their parameters to give the maximum a posterior, which is used tonormalize the result. On the other hand, Artificial Neural Networks utilizes neural computations. It creates the bridge between input layers and output layers through the hidden layers. In neural networks, codebook vectors are numbers that have some input and output astraining dataset.

6. SYSTEM REQUIREMENTS

6.1 Hardware Requirements

Operating system	Hardware	Disk space	RAM
Microsoft Windows	1.6GHz	256GB	02 GB
Mac OS (pre-Catalina)	1.66GHz	600MB	192MB
Linux (with 32-bit libraries)	1.6GHz	1GB	512MB
By core			
Dual-core	–	4GB	1.5GB
Quad-core	–	8GB	3GB
Hex-core (requires 64-bit OS)	–	12GB	4.5GB
8-core (requires 64-bit OS)	–	16GB	6GB

6.2 Software Requirement:

Visual Studio Code [Backend]

- Jupyter Notebook [Backend]
- Python 3.9 or higher [Backend]
- Web browser [FrontEnd]

- **Templates**
  1. **Index.html**

```
<!doctype html>
<html lang="en">

<head>
    <!-- Required meta tags -->
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1">

    <!-- Bootstrap CSS -->
    <link
href="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/css/bootstrap.min.css"
rel="stylesheet"
        integrity="sha384-
+0n0xVW2eSR5OomGNYDnhzAbDsOXxcvSN1TPprVMTNDbiYZCxYbOOl7+AMvyTG2x"
crossorigin="anonymous">

    <title>Stroke Prediction</title>
</head>

<body>
    <div class="alert alert-success alert-dismissible fade show text-center mb-0"
role="alert">
        <strong>Welcome to Stroke Prediction machine</strong>
        <button type="button" class="btn-close" data-bs-dismiss="alert" aria-
label="Close"></button>
    </div>
    <nav class="navbar navbar-expand-lg navbar-dark bg-dark">
        <div class="container-fluid">
            <a class="navbar-brand text-warning" href="#">Stroke Prediction</a>
            <button class="navbar-toggler" type="button" data-bs-toggle="collapse"
                data-bs-target="#navbarSupportedContent" aria-
controls="navbarSupportedContent" aria-expanded="false"
```

```
                aria-label="Toggle navigation">
                <span class="navbar-toggler-icon"></span>
            </button>
            <div class="collapse navbar-collapse" id="navbarSupportedContent">
                <ul class="navbar-nav me-auto mb-2 mb-lg-0">
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="#">Home</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="#">Analysis</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page" href="#">About
us</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="#">Contact us</a>
                    </li>


                </ul>
                <form class="d-flex">
                    <input class="form-control me-2" type="search"
placeholder="Search" aria-label="Search">
                    <button class="btn btn-outline-success"
type="submit">Search</button>
                </form>
            </div>
        </div>
    </nav>
    <div id="carouselExampleCaptions" class="carousel slide" data-bs-ride="carousel">
        <div class="carousel-indicators">
```

```
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="0" class="active" aria-current="true" aria-label="Slide 1"></button>
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="1" aria-label="Slide 2"></button>
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="2" aria-label="Slide 3"></button>
        </div>
        <div class="carousel-inner">
          <div class="carousel-item active">
            <img src="../static/img/image3.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
              <h5>Stroke prediction</h5>
              <p>In this project our top priority is to predict patient have stroke or
not.</p>
            </div>
          </div>
          <div class="carousel-item">
            <img src="../static/img/image2.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
                <h5>Stroke prediction</h5>
                <p>In this project our top priority is to predict patient have stroke
or not.</p>
            </div>
          </div>
          <div class="carousel-item">
            <img src="../static/img/image.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
                <h5>Stroke prediction</h5>
                <p>In this project our top priority is to predict patient have stroke
or not.</p>
            </div>
          </div>
        </div>
        <button class="carousel-control-prev" type="button" data-bs-
target="#carouselExampleCaptions" data-bs-slide="prev">
```

```
          <span class="carousel-control-prev-icon" aria-hidden="true"></span>
          <span class="visually-hidden">Previous</span>
        </button>
        <button class="carousel-control-next" type="button" data-bs-
target="#carouselExampleCaptions" data-bs-slide="next">
          <span class="carousel-control-next-icon" aria-hidden="true"></span>
          <span class="visually-hidden">Next</span>
        </button>
      </div>


      <div class="container">
        <div class="pricing-header p-3 pb-md-4 mx-auto text-center">
            <h2 class="fw-normal">Fill this form to predict stroke.</h2>
            <p class=" text-muted"><b>A stroke occurs when the blood supply to part of
your brain is interrupted or
                reduced, preventing brain tissue from getting oxygen and nutrients.
Brain cells begin to die in minutes.</b>
            </p>
            <p class="text-danger"><b>{{prediction_text}}</b></p>
        </div>
        <div class="container">
            <form action="/" method="POST">
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-
label">Gender</label>
                    <select class="form-select" id="gender" name="gender" aria-
label="Default select example">
                        <option selected>-- select gender --</option>
                        <option value="Male">Male</option>
                        <option value="Female">Female</option>
                        <option value="Other">Other</option>
                    </select>
                </div>
                <div class="mb-3">
```

```
                    <label for="exampleInputEmail1" class="form-label">Enter
age</label>
                    <input type="text" class="form-control" id="age" name="age"
placeholder="Age">
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-
label">Hypertension</label>
                    <select class="form-select" id="hypertension" name="hypertension"
aria-label="Default select example">
                        <option selected>-- select Hypertension --</option>
                        <option value="1">Yes</option>
                        <option value="0">No</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Heart
Disease</label>
                    <select class="form-select" id="disease" name="disease" aria-
label="Default select example">
                        <option selected>-- select Heart Disease --</option>
                        <option value="1">Yes</option>
                        <option value="0">No</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Marrital
status</label>
                    <select class="form-select" id="married" name="married" aria-
label="Default select example">
                        <option selected>--select marrital status --</option>
                        <option value="Yes">Yes</option>
                        <option value="No">No</option>
                    </select>
                </div>
                <div class="mb-3">
```

```
                    <label for="exampleInputPassword1"  class="form-label">work
type</label>
                    <select class="form-select" id="work" name="work" aria-
label="Default select example">
                        <option selected>-- select work type --</option>
                        <option value="Self-employed">Self-employed</option>
                        <option value="Private">Private</option>
                        <option value="children">children</option>
                        <option value="Govt_job">Government Job</option>
                        <option value="Never_worked">Never_worked</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Residence
Type</label>
                    <select class="form-select" id="residence" name="residence" aria-
label="Default select example">
                        <option selected>-- Select residence type --</option>
                        <option value="Urban">Urban</option>
                        <option value="Rural">Rural</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputEmail1" class="form-label">Enter average
glucose level</label>
                    <input type="text" class="form-control" id="glucose"
name="glucose" placeholder="Average Glucose level">
                </div>
                <div class="mb-3">
                    <label for="exampleInputEmail1" class="form-label">Enter Body Mass
Index (BMI)</label>
                    <input type="text" class="form-control" id="bmi" name="bmi"
placeholder="Body Mass Index (BMI)">
                </div>
                <div class="mb-3">
```

```
                    <label for="exampleInputPassword1"  class="form-label">Smoking
status</label>
                    <select class="form-select" id="smoking" name="smoking" aria-
label="Default select example">
                        <option selected value="Unknown">-- Select smoking status if
unknown --</option>
                        <option value="never smoked">never smoked</option>
                        <option value="formerly smoked">formerly smoked</option>
                        <option value="smokes">smokes</option>
                    </select>
                </div>
                <div class="text-center"><button type="submit" class="btn btn-
primary">Submit</button></div>
            </form>
        </div><br><br>
        <br> <br> <br> <br> </div>


    <!-- Optional JavaScript; choose one of the two! -->


    <!-- Option 1: Bootstrap Bundle with Popper -->
    <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/js/bootstrap.bundle.min.js"
        integrity="sha384-
gtEjrD/SeCtmISkJkNUaaKMoLD0//ElJ19smozuHV6z3Iehds+3Ulb9Bn9Plx0x4"
        crossorigin="anonymous"></script>


    <!-- Option 2: Separate Popper and Bootstrap JS -->
    <!--
    <script
src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.9.2/dist/umd/popper.min.js"
integrity="sha384-IQsoLXl5PILFhosVNubq5LC7Qb9DXgDA9i+tQ8Zj3iwWAwPtgFTxbJ8NT4GN1R8p"
crossorigin="anonymous"></script>
    <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/js/bootstrap.min.js"
integrity="sha384-Atwg2Pk <!doctype html>
<html lang="en">
```

```
<head>
    <!-- Required meta tags -->
    <meta charset="utf-8">
    <meta name="viewport" content="width=device-width, initial-scale=1">

    <!-- Bootstrap CSS -->
    <link
href="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/css/bootstrap.min.css"
rel="stylesheet"
        integrity="sha384-
+0n0xVW2eSR5OomGNYDnhzAbDsOXxcvSN1TPprVMTNDbiYZCxYbOOl7+AMvyTG2x"
crossorigin="anonymous">

    <title>Stroke Prediction</title>
</head>

<body>
    <div class="alert alert-success alert-dismissible fade show text-center mb-0"
role="alert">
        <strong>Welcome to Stroke Prediction machine</strong>
        <button type="button" class="btn-close" data-bs-dismiss="alert" aria-
label="Close"></button>
    </div>
    <nav class="navbar navbar-expand-lg navbar-dark bg-dark">
        <div class="container-fluid">
            <a class="navbar-brand text-warning" href="#">Stroke Prediction</a>
            <button class="navbar-toggler" type="button" data-bs-toggle="collapse"
                data-bs-target="#navbarSupportedContent" aria-
controls="navbarSupportedContent" aria-expanded="false"
                aria-label="Toggle navigation">
                <span class="navbar-toggler-icon"></span>
            </button>
            <div class="collapse navbar-collapse" id="navbarSupportedContent">
                <ul class="navbar-nav me-auto mb-2 mb-lg-0">
                    <li class="nav-item">
```

```
                        <a class="nav-link active" aria-current="page"
href="#">Home</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="#">Analysis</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page" href="#">About
us</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="#">Contact us</a>
                    </li>


                </ul>
                <form class="d-flex">
                    <input class="form-control me-2" type="search"
placeholder="Search" aria-label="Search">
                    <button class="btn btn-outline-success"
type="submit">Search</button>
                </form>
            </div>
        </div>
    </nav>
    <div id="carouselExampleCaptions" class="carousel slide" data-bs-ride="carousel">
        <div class="carousel-indicators">
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="0" class="active" aria-current="true" aria-label="Slide 1"></button>
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="1" aria-label="Slide 2"></button>
          <button type="button" data-bs-target="#carouselExampleCaptions" data-bs-
slide-to="2" aria-label="Slide 3"></button>
        </div>
        <div class="carousel-inner">
```

```
          <div class="carousel-item active">
            <img src="../static/img/image3.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
              <h5>Stroke prediction</h5>
              <p>In this project our top priority is to predict patient have stroke or
not.</p>
            </div>
          </div>
          <div class="carousel-item">
            <img src="../static/img/image2.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
                <h5>Stroke prediction</h5>
                <p>In this project our top priority is to predict patient have stroke
or not.</p>
            </div>
          </div>
          <div class="carousel-item">
            <img src="../static/img/image.jpg" class="d-block w-100" alt="...">
            <div class="carousel-caption d-none d-md-block">
                <h5>Stroke prediction</h5>
                <p>In this project our top priority is to predict patient have stroke
or not.</p>
            </div>
          </div>
        </div>
        <button class="carousel-control-prev" type="button" data-bs-
target="#carouselExampleCaptions" data-bs-slide="prev">
          <span class="carousel-control-prev-icon" aria-hidden="true"></span>
          <span class="visually-hidden">Previous</span>
        </button>
        <button class="carousel-control-next" type="button" data-bs-
target="#carouselExampleCaptions" data-bs-slide="next">
          <span class="carousel-control-next-icon" aria-hidden="true"></span>
          <span class="visually-hidden">Next</span>
        </button>
```

```
      </div>


      <div class="container">
        <div class="pricing-header p-3 pb-md-4 mx-auto text-center">
            <h2 class="fw-normal">Fill this form to predict stroke.</h2>
            <p class=" text-muted"><b>A stroke occurs when the blood supply to part of
your brain is interrupted or
                reduced, preventing brain tissue from getting oxygen and nutrients.
Brain cells begin to die in minutes.</b>
            </p>
            <p class="text-danger"><b>{{prediction_text}}</b></p>
        </div>
        <div class="container">
            <form action="/" method="POST">
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-
label">Gender</label>
                    <select class="form-select" id="gender" name="gender" aria-
label="Default select example">
                        <option selected>-- select gender --</option>
                        <option value="Male">Male</option>
                        <option value="Female">Female</option>
                        <option value="Other">Other</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputEmail1" class="form-label">Enter
age</label>
                    <input type="text" class="form-control" id="age" name="age"
placeholder="Age">
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-
label">Hypertension</label>
                    <select class="form-select" id="hypertension" name="hypertension"
aria-label="Default select example">
```

```
                        <option selected>-- select Hypertension --</option>
                        <option value="1">Yes</option>
                        <option value="0">No</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Heart
Disease</label>
                    <select class="form-select" id="disease" name="disease" aria-
label="Default select example">
                        <option selected>-- select Heart Disease --</option>
                        <option value="1">Yes</option>
                        <option value="0">No</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Marrital
status</label>
                    <select class="form-select" id="married" name="married" aria-
label="Default select example">
                        <option selected>--select marrital status --</option>
                        <option value="Yes">Yes</option>
                        <option value="No">No</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">work
type</label>
                    <select class="form-select" id="work" name="work" aria-
label="Default select example">
                        <option selected>-- select work type --</option>
                        <option value="Self-employed">Self-employed</option>
                        <option value="Private">Private</option>
                        <option value="children">children</option>
                        <option value="Govt_job">Government Job</option>
```

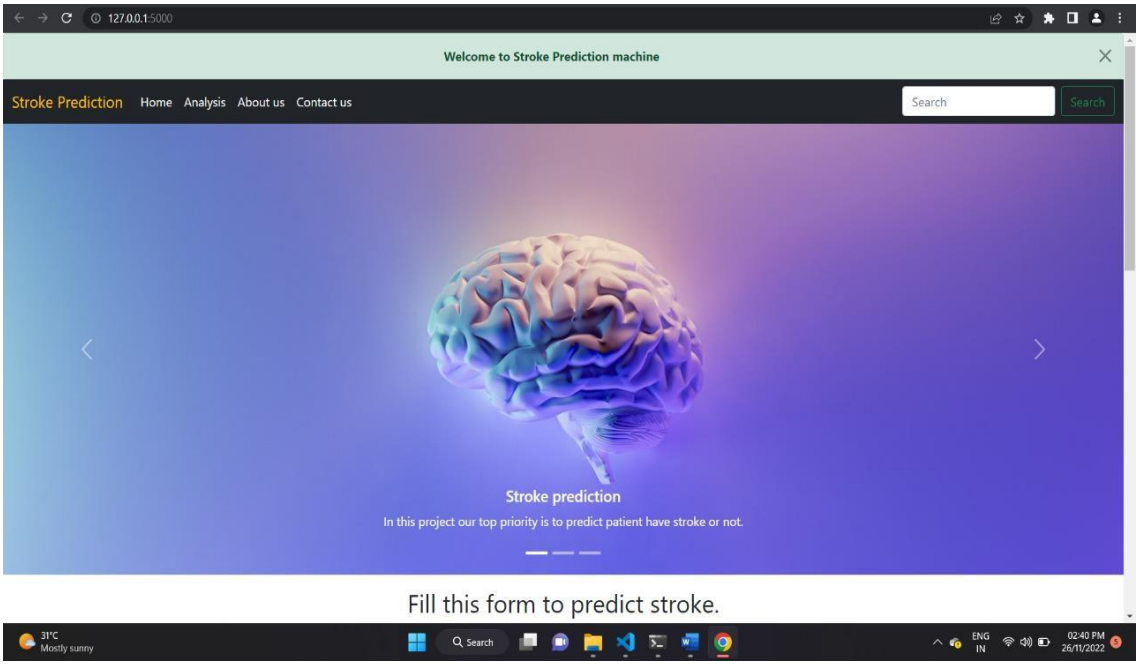
```
                        <option value="Never_worked">Never_worked</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Residence
Type</label>
                    <select class="form-select" id="residence" name="residence" aria-
label="Default select example">
                        <option selected>-- Select residence type --</option>
                        <option value="Urban">Urban</option>
                        <option value="Rural">Rural</option>
                    </select>
                </div>
                <div class="mb-3">
                    <label for="exampleInputEmail1" class="form-label">Enter average
glucose level</label>
                    <input type="text" class="form-control" id="glucose"
name="glucose" placeholder="Average Glucose level">
                </div>
                <div class="mb-3">
                    <label for="exampleInputEmail1" class="form-label">Enter Body Mass
Index (BMI)</label>
                    <input type="text" class="form-control" id="bmi" name="bmi"
placeholder="Body Mass Index (BMI)">
                </div>
                <div class="mb-3">
                    <label for="exampleInputPassword1"  class="form-label">Smoking
status</label>
                    <select class="form-select" id="smoking" name="smoking" aria-
label="Default select example">
                        <option selected value="Unknown">-- Select smoking status if
unknown --</option>
                        <option value="never smoked">never smoked</option>
                        <option value="formerly smoked">formerly smoked</option>
                        <option value="smokes">smokes</option>
                    </select>
```

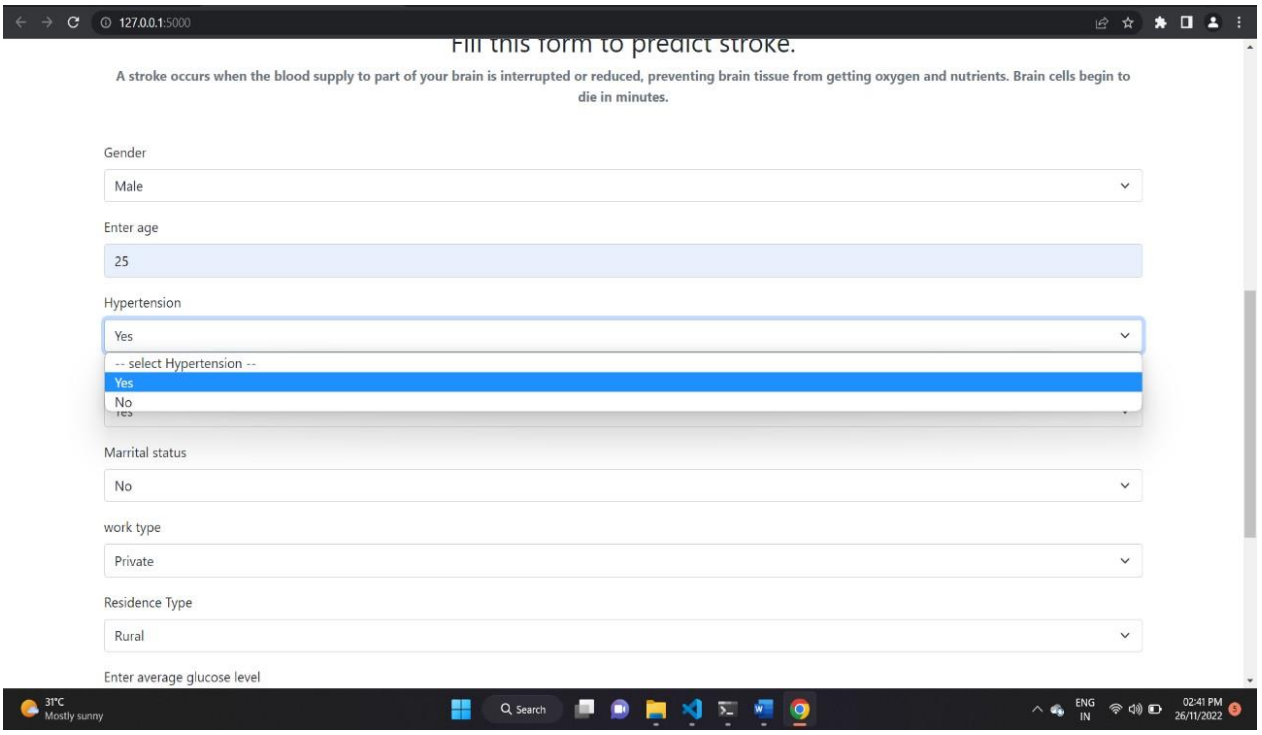
```
                </div>
                <div class="text-center"><button type="submit" class="btn btn-
primary">Submit</button></div>
            </form>
        </div><br><br>
        <br> <br> <br> <br> </div>


    <!-- Optional JavaScript; choose one of the two! -->


    <!-- Option 1: Bootstrap Bundle with Popper -->
    <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/js/bootstrap.bundle.min.js"
        integrity="sha384-
gtEjrD/SeCtmISkJkNUaaKMoLD0//ElJ19smozuHV6z3Iehds+3Ulb9Bn9Plx0x4"
        crossorigin="anonymous"></script>


    <!-- Option 2: Separate Popper and Bootstrap JS -->
    <!--
    <script
src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.9.2/dist/umd/popper.min.js"
integrity="sha384-IQsoLXl5PILFhosVNubq5LC7Qb9DXgDA9i+tQ8Zj3iwWAwPtgFTxbJ8NT4GN1R8p"
crossorigin="anonymous"></script>
    <script
src="https://cdn.jsdelivr.net/npm/bootstrap@5.0.1/dist/js/bootstrap.min.js"
integrity="sha384-Atwg2Pkwv9vp0ygtn1JAojH0nYbwNJLPhwyoVbhoPwBhjQPR5VtM2+xf0Uwh9KtT"
crossorigin="anonymous"></script>
    -->
</body>


</html>
wv9vp0ygtn1JAojH0nYbwNJLPhwyoVbhoPwBhjQPR5VtM2+xf0Uwh9KtT"
crossorigin="anonymous"></script>
    -->
</body>


</html>
```

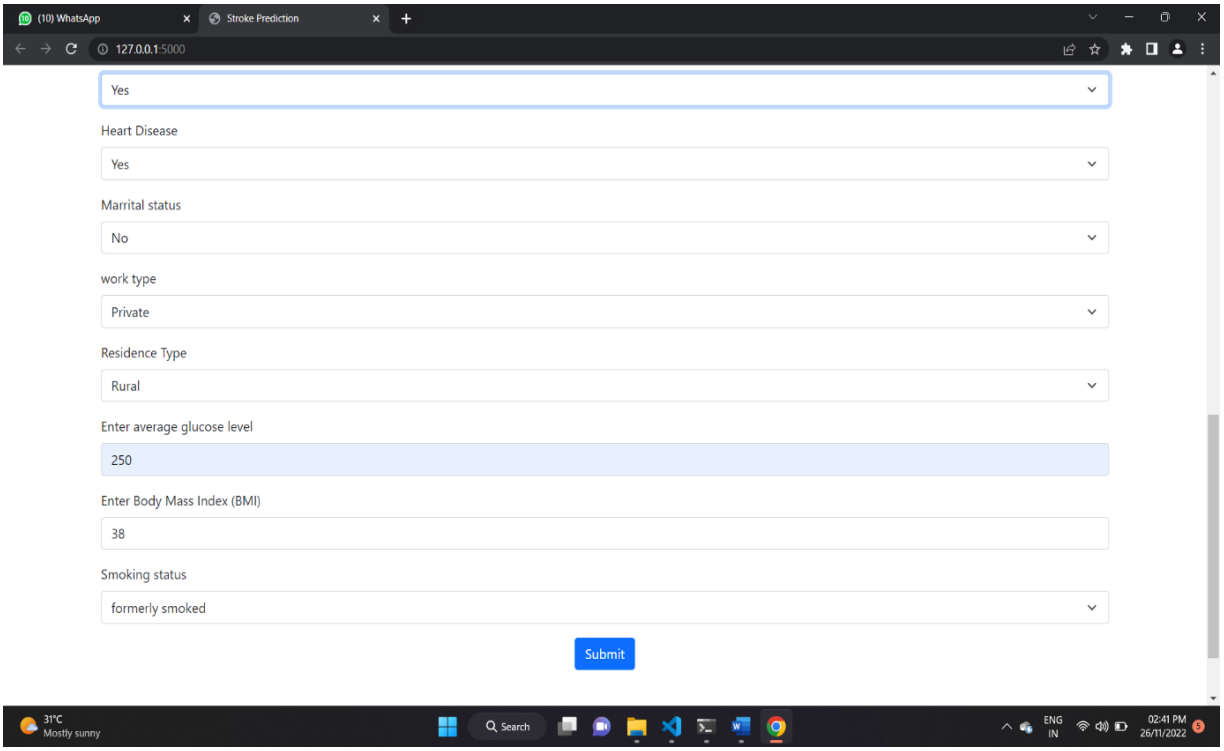
1. RESULTS

1.1 SCREEN SHOTS

It gives prediction of the chances of having the stroke or not by analysis the user data it try to predict the output




127.0.0.1:5000
Fill this form to predict stroke.
A stroke occurs when the blood supply to part of your brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. Brain cells begin to die in minutes.
Gender
Male
Enter age
25
Hypertension
Yes
-- select Hypertension --
Yes
No
Marrital status
No
work type
Private
Residence Type
Rural
Enter average glucose level
31°C
Mostly sunny
Search
ENG
IN
02:41 PM
26/11/2022


(10) WhatsApp
Stroke Prediction
127.0.0.1:5000
Yes
Heart Disease
Yes
Marrital status
No
work type
Private
Residence Type
Rural
Enter average glucose level
250
Enter Body Mass Index (BMI)
38
Smoking status
formerly smoked
Submit
31°C
Mostly sunny
Search
ENG
IN
02:41 PM
26/11/2022

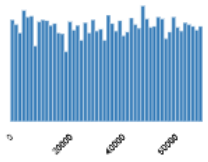
Variables

id
Real number (ℝ≥0)

UNIQUE

Distinct	5110
Distinct (%)	100.0%
Missing	0
Missing (%)	0.0%
Infinite	0
Infinite (%)	0.0%

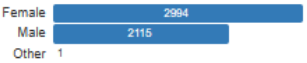
Mean	36517.82935
Minimum	67
Maximum	72940
Zeros	0
Zeros (%)	0.0%
Memory size	40.0 KiB



Toggle details

gender
Categorical

Distinct	3
Distinct (%)	0.1%
Missing	0
Missing (%)	0.0%
Memory size	40.0 KiB

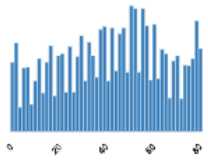


Toggle details

age
Real number (ℝ≥0)

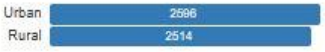
Distinct	104
Distinct (%)	2.0%
Missing	0
Missing (%)	0.0%
Infinite	0
Infinite (%)	0.0%

Mean	43.22661448
Minimum	0.08
Maximum	82
Zeros	0
Zeros (%)	0.0%
Memory size	40.0 KiB



Residence_type
Categorical

Distinct	2
Distinct (%)	< 0.1%
Missing	0
Missing (%)	0.0%
Memory size	40.0 KiB

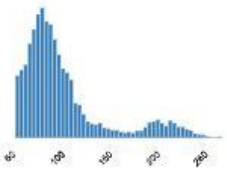


Toggle details

avg_glucose_level
Real number (ℝ≥0)

Distinct	3979
Distinct (%)	77.9%
Missing	0
Missing (%)	0.0%
Infinite	0
Infinite (%)	0.0%

Mean	106.1476771
Minimum	55.12
Maximum	271.74
Zeros	0
Zeros (%)	0.0%
Memory size	40.0 KiB

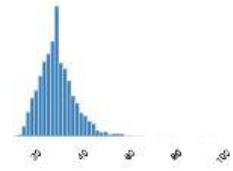


Toggle details

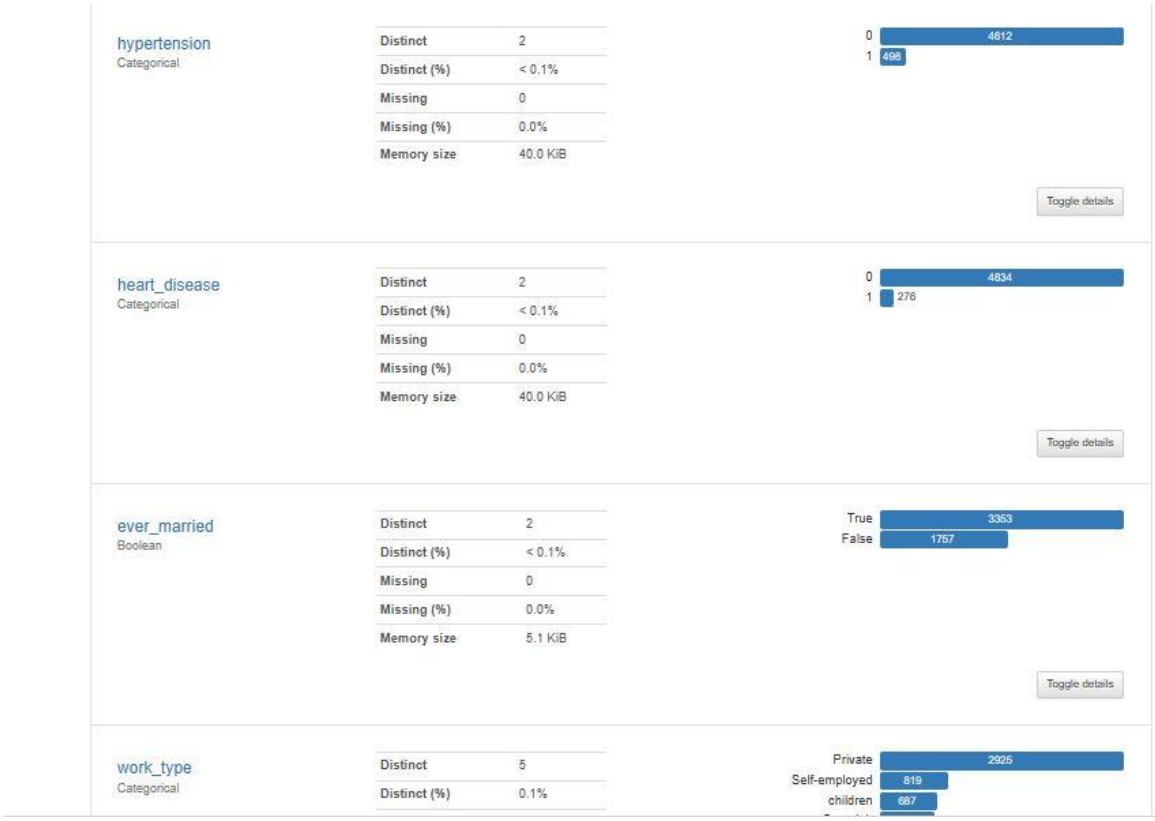
bmi
Real number (ℝ≥0)

Distinct	419
Distinct (%)	8.2%
Missing	0
Missing (%)	0.0%
Infinite	0
Infinite (%)	0.0%

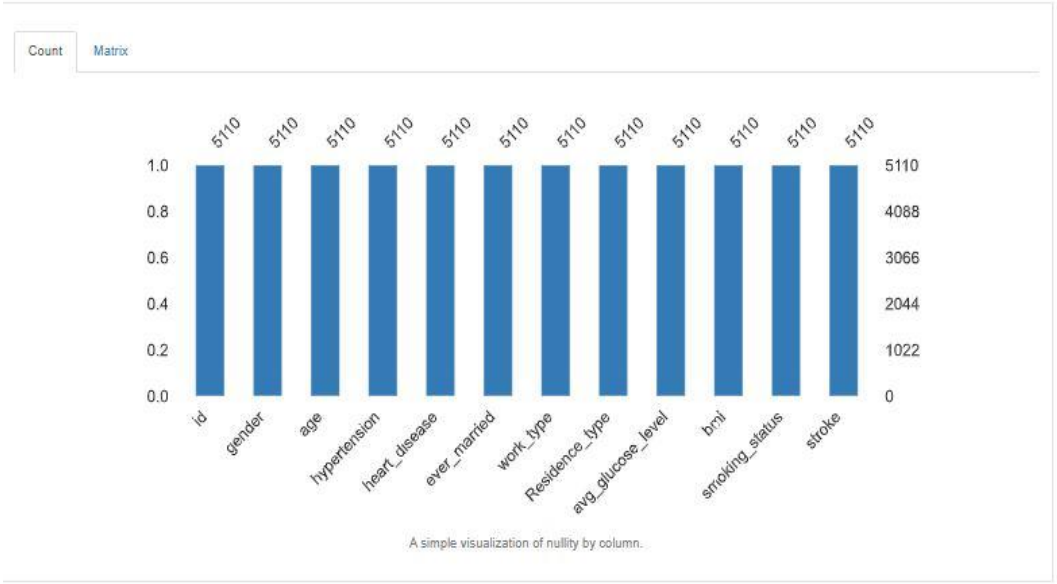
Mean	28.89323691
Minimum	10.3
Maximum	97.6
Zeros	0
Zeros (%)	0.0%
Memory size	40.0 KiB

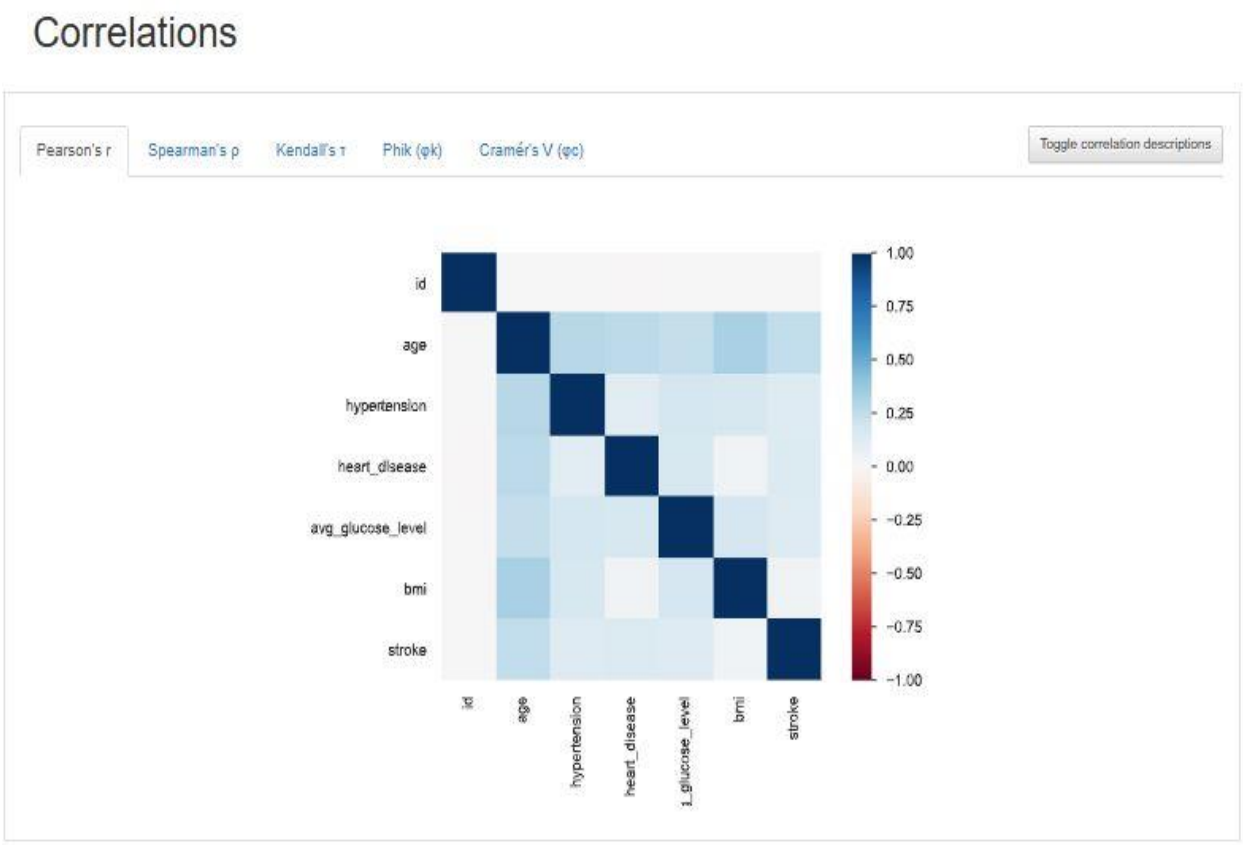


Toggle details



Missing values





1. CONCLUSION

Several assessments and prediction models, Decision Tree, Naive Bayes and Neural Network, showed acceptable accuracy in identifying stroke-prone patients. This project hence helps to predict the stroke risk using prediction model and providepersonalized warning and the lifestyle correction message through a web application. By doing so, it urges medical users to strengthen the motivation of health management andinduce changes in their health behaviors.

2. REFERENCES

[1]. “Computer Methods and Programs in the Biomedicine” - Jae–woo Lee, Hyun-sun Lim, Dong-wook Kim, Soon-ae Shin, Jinkwon Kim, Bora Yoo, Kyung-hee Cho

[2]. “Probability of Stroke: A Risk Profile from the Framingham Study” - Philip A. Wolf, MD; Ralph B. D'Agostino, PhD, Albert J. Belanger, MA; and William B. Kannel, MD

[3]. “Development of an Algorithm for Stroke Prediction: A National Health Insurance Database Study” - Min SN, Park SJ, Kim DJ, Subramaniyam M, Lee KS

[4]. “Stroke prediction using artificial intelligence”- M. Sheetal Singh, Prakash Choudhary