Title: Heart Disease Detection Using Machine Learning Techniques: A Comparative Analysis

INTERNSHIP PROJECT REPORT

Submitted in partial fulfillment of the requirements for the award of the degree

Of

MASTER of TECHNOLOGY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCES

By

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Guided by

Shailesh D Kamble
Associate Professor
Indira Gandhi Delhi Technical University For Women

INDIRA GANDHI DELHI TECHNICAL UNIVERSITY FOR WOMEN
NEW DELHI – 110006

June 2024-August 2024

CERTIFICATE

I, Nayan Saxena, certify that the Internship Project Report entitled Heart Disease Detection Using Machine Learning Techniques: A Comparative Analysis is done by me and it is authentic work carried out by me at Indira Gandhi Delhi Technical University For Women. For this project, no work has been submitted before for any degree or diploma of the award, to the best of my knowledge and belief.

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Date: 04/12/2024

Certified that the project report entitled Heart Disease Detection Using Machine Learning Techniques: A Comparative Analysis done by the above student is completed under my guidance.

Signature of Mentor
Date: 04/12/2024
Mentor Name: Dr.Shailesh D Kamble
Designation: Associate Professor
Compnay/Univeristy Name: Indira Gandhi Delhi Technical University For Women

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ACKNOWLEDGEMENT

I would like to acknowledge my mentor Dr.Shailesh D Kamble for his very helpful comments, support and encouragement.

Finally, I am grateful to Indira Gandhi Delhi Technical University For Women, for providing a healthy, supportive and understanding environment. They allowed me the freedom to explore innovative models to simplify a complex business problem. This made my project work possible without any hindrance.

Signature of the Student

Nayan Saxena

00902212023

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I, **Nayan Saxena** solemnly declare that the internship project report, ***Heart Disease Detection Using Machine Learning Techniques: A Comparative Analysis,*** is based on my own work carried out under the supervision of **Dr.Shailesh D Kamble.** I assert the statements made and conclusions drawn are an outcome of my work. I further certify that:

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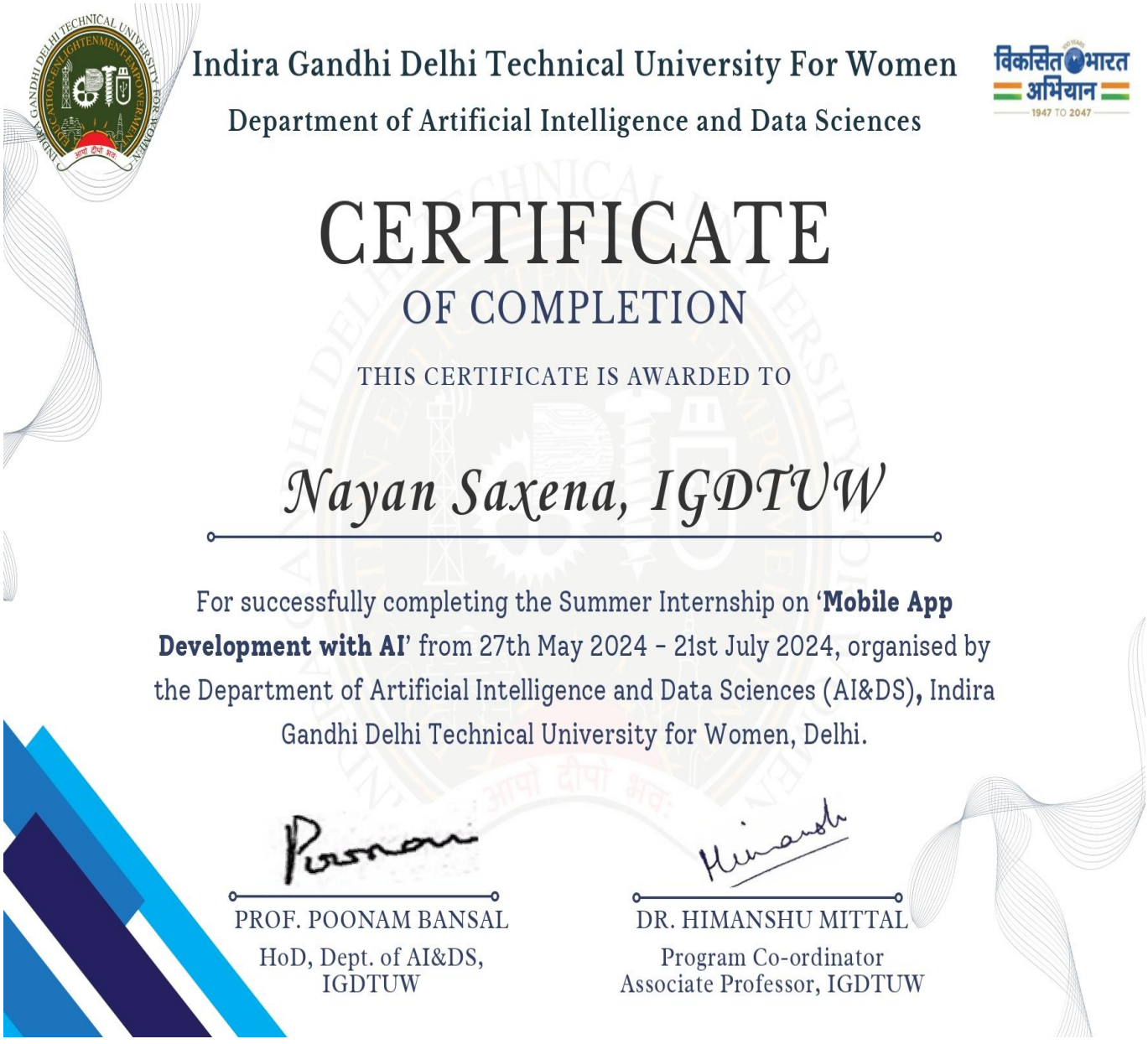

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PROF. POONAM BANSAL
HoD, Dept. of AI&DS,
IGDTUW

DR. HIMANSHU MITTAL
Program Co-ordinator
Associate Professor, IGDTUW

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Introduction

Heart disease is a leading cause of death worldwide. Early detection plays a crucial role in reducing mortality rates and improving patient outcomes. Leveraging machine learning techniques, this project evaluates and compares the performance of several models—Support Vector Machine (SVM), Bagging, Boosting, Random Forest, k-Nearest Neighbors (KNN), and Logistic Regression—for heart disease detection. The study also highlights significant insights into demographic and clinical patterns using data visualization.

System Requirement Analysis

Software Requirements

- **Operating System:** Windows 10 or higher / Linux / macOS
- **Programming Language:** Python (version 3.7 or above)
- **Libraries and Frameworks:**
  - Scikit-learn
  - Pandas
  - NumPy
  - Matplotlib
  - Seaborn

Hardware Requirements

- **Processor:** Intel i5 or higher / AMD equivalent
- **RAM:** 8 GB minimum (16 GB recommended)
- **Storage:** 20 GB free disk space
- **GPU (Optional):** NVIDIA GTX 1050 or higher for accelerated computations

System Analysis

Feasibility Study

The feasibility study focuses on determining the project's practicality across different dimensions.

Economic Feasibility

- The project is cost-effective, relying on open-source tools like Python and Scikit-learn. No proprietary software or expensive hardware is required.

Implementation Feasibility

- The models were implemented using well-documented libraries and require basic machine learning expertise. The dataset used was publicly available, ensuring easy reproducibility.

Work Description

1. **Dataset Preparation:**
    - Cleaned and normalized clinical data.
    - Features included age, gender, chest pain type, blood pressure, cholesterol, fasting blood sugar, ST depression, and exercise-induced angina.
    - Data split: 70% for training, 30% for testing.

2. **Model Implementation:**
    - **SVM, Bagging, Boosting, Random Forest, KNN, Logistic Regression** were trained and evaluated.

- Ensemble techniques (Bagging, Boosting, and Random Forest) enhanced predictive accuracy.

3. **Data Visualization:**
   - Observed heart disease prevalence by demographics and symptoms.
   - Identified age-related trends in blood pressure and cholesterol.

4. **Performance Metrics:**
   - Models evaluated using accuracy scores and confusion matrices.

Work Outcome

Model Performance

Model	Accuracy	Comments
SVM	99%	Excellent for non-linear data and high-dimensional spaces.
Bagging	99%	Reduced variance, highly stable predictions.
Boosting	99%	Corrected weak learners for enhanced performance.
Random Forest	99%	Effective with high-dimensional and noisy data.
KNN	96%	Simple, struggled with large and noisy data.
Logistic Regression	85%	Interpretability was its key strength.

Visualization Insights

1. **Prevalence:**
    - 54% of the population had heart disease.
    - Males had a higher prevalence compared to females.
2. **Chest Pain Analysis:**
    - 85–90% of heart disease cases were asymptomatic.
    - Non-anginal chest pain was more common in males.
3. **Age Trends:**
    - Blood pressure and cholesterol peaked between ages 42–77.
    - Post 77, cholesterol and blood pressure declined.
4. **Gender-based Observations:**
    - ST Depression (Myocardial ischemia) and fasting blood sugar levels were more prevalent in males.
5. **Exercise-induced Angina:**
    - Exercising with angina significantly increased the risk of heart disease.

Conclusion

This study demonstrates the effectiveness of machine learning models in detecting heart disease, with SVM, Bagging, Boosting, and Random Forest achieving 99% accuracy. Data visualizations provided critical insights into demographic and clinical patterns, emphasizing the importance of machine learning tools in clinical decision-making. Future work will focus on improving model explainability and applying these findings to real-world datasets.

Plagiarism Report

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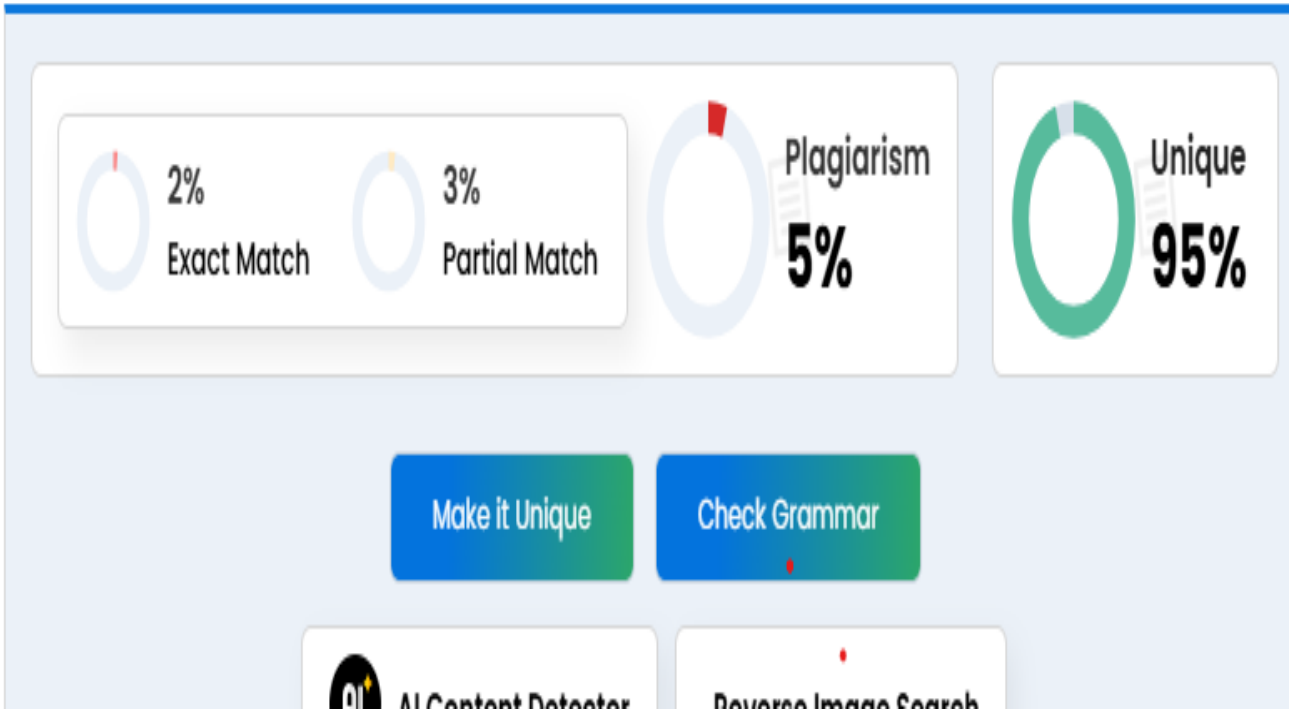

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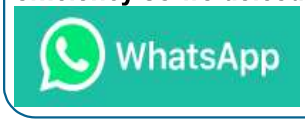

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