P. R. Pote (Patil) College of Engineering & Management, Amravati

(An Autonomous Institute)

Department of Artificial Intelligence and Data Science

Presentation on

HEART HEALTH PREDICTOR

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Abstract

- This project is about creating a machine learning system to predict heart disease using individual medical parameters . The model training is done on few algorithms out of which logistic regression performs as the best module and provides insights into how the model makes its predictions using SHAP .

Going beyond black-box predictions, our system incorporates interpretability through SHAP value . — providing human-readable insights into inner decision-making. Our application is deployed using Streamlit, offering an accessible and responsive web interface for non-technical users. Integrating predictive power, explainability, and usability, this system serves as a prototype for future AI-assisted healthcare diagnostics. The goal is to create a healthcare model and interpretable system that can assist healthcare professionals to predict the possibility of the heart disease.

Introduction

- **Cardiovascular diseases (according to WHO) :**

  - Leading cause of morbidity and mortality globally (17.9 million deaths/year).
  - Preventable: Early diagnosis and timely intervention can prevent heart attacks, strokes, and coronary artery disease.

- **Streamlit deployment:**

  - User-friendly web app for non-technical users to input patient data and receive predictions with explanations.

AIM & Objectives

- **Aim:** The core aim of this project is to develop an intelligent, accurate, explainable, and user-friendly Heart Disease Prediction System that leverages advanced machine learning algorithms to predict whether a person is at risk of developing heart disease, based on clinically significant features.

- **Predictive Accuracy**: High-performing heart disease risk model.
- **Interpretability**: SHAP for human-understandable explanations.
- **Accessibility:** User-friendly Streamlit interface
- **Scalability:** Modular design for future integration.

- **Objectives**

- **High-Performance Model:** Develop accurate heart disease prediction model.
- **Model Explainability:** Integrate SHAP for interpretable decisions.
- **Result Analysis:** Visualize results for better insights.
- **Scalability:** Build modular system for future enhancements.

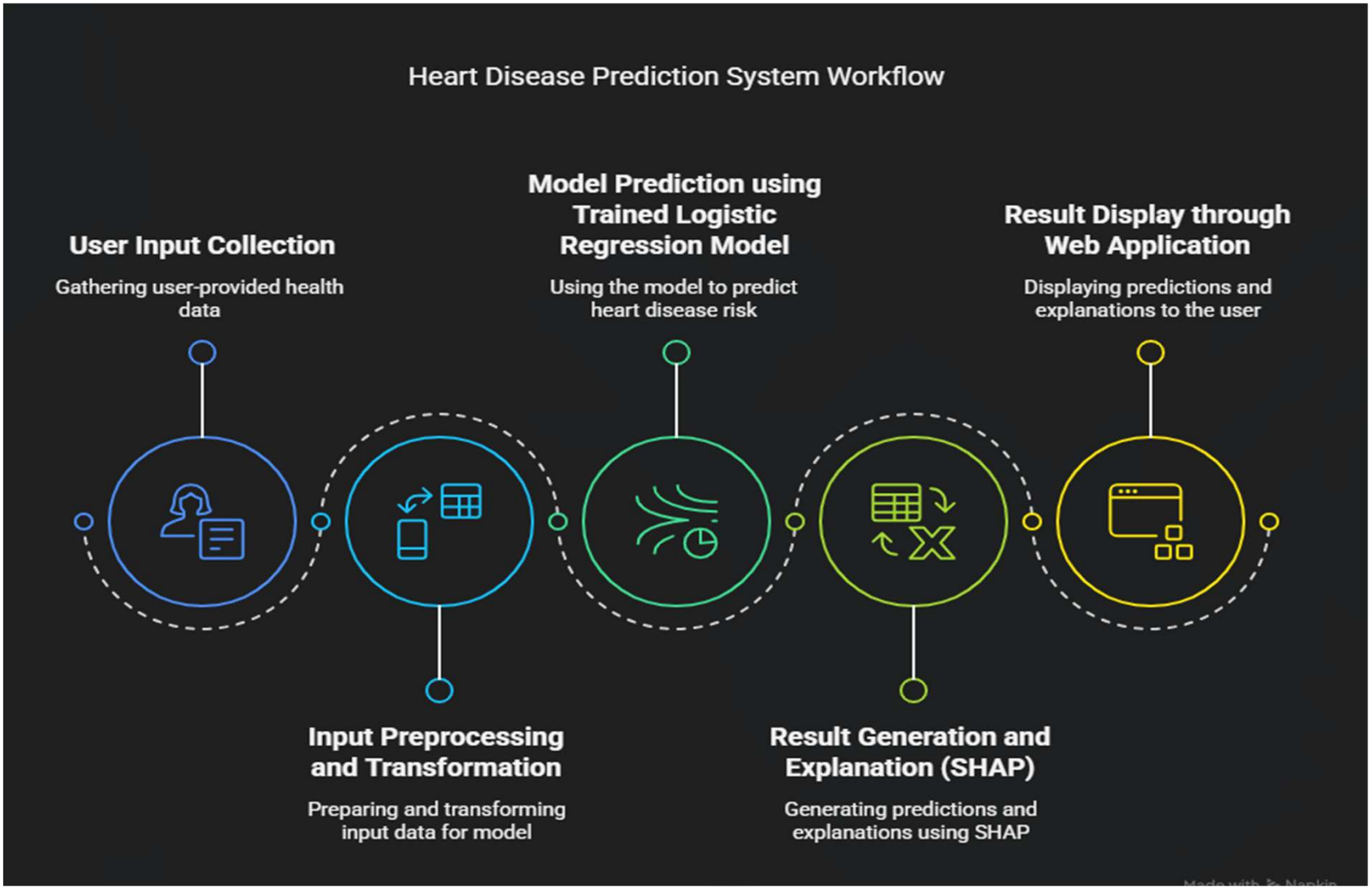
Problem Statement

- **High Prevalence of Cardiovascular Diseases:**
  - Leading cause of morbidity and mortality globally, with 17.9 million deaths/year.
- **Delayed Diagnosis and Intervention:**
  - Traditional diagnostic pathways are retrospective, reactive, and dependent on invasive tests.
- **Limited Accessibility:**
  - Specialized expertise, time, and costly equipment required for diagnosis, making early screening inaccessible to millions.
- **Lack of Interpretability:**
  - Many ML models fall short in providing explainable predictions, leading to low adoption in clinical practice.
- **Need for Scalable and Intelligent System:**
  - Augment medical decision-making with science-backed, data-driven precision, and democratize access to early screening.

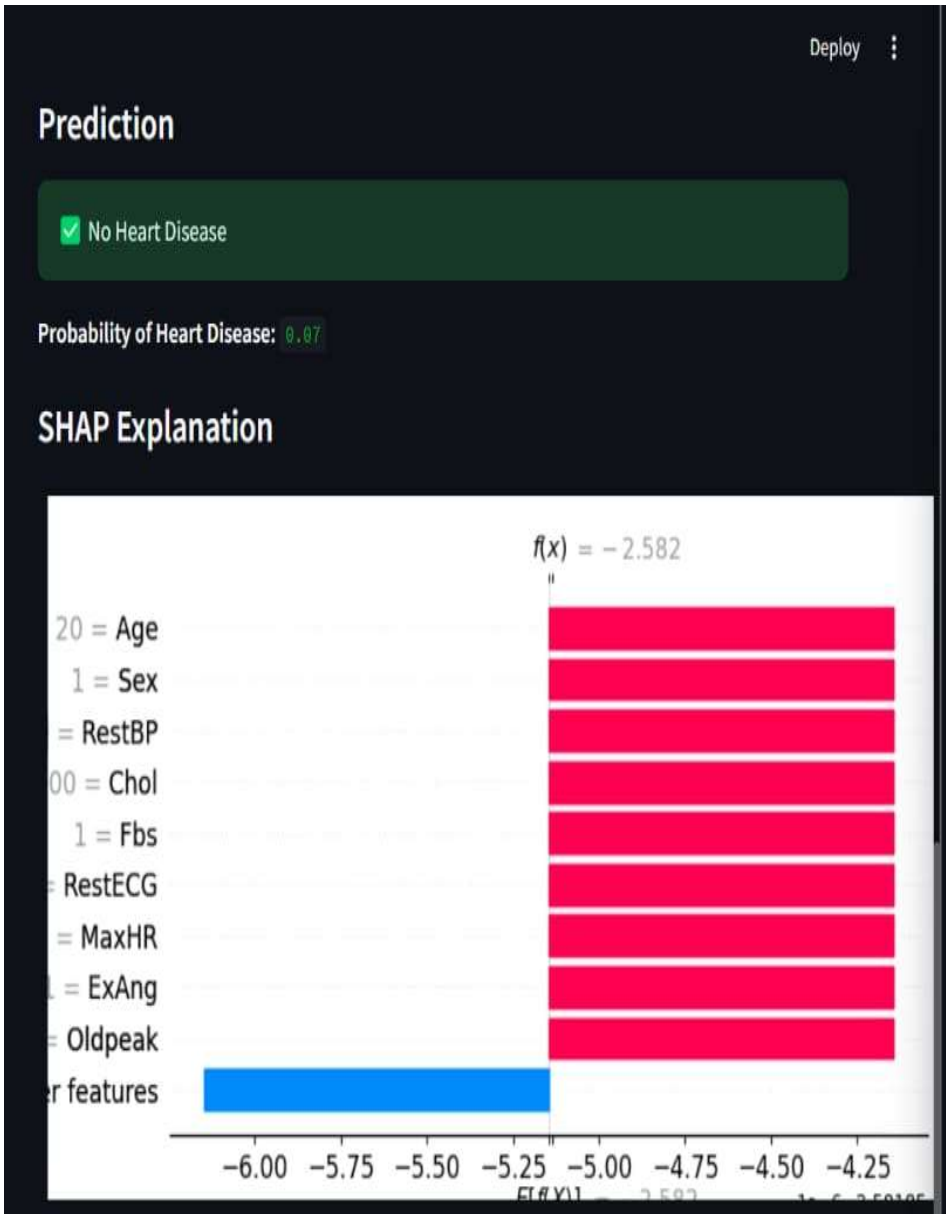
Literature Survey

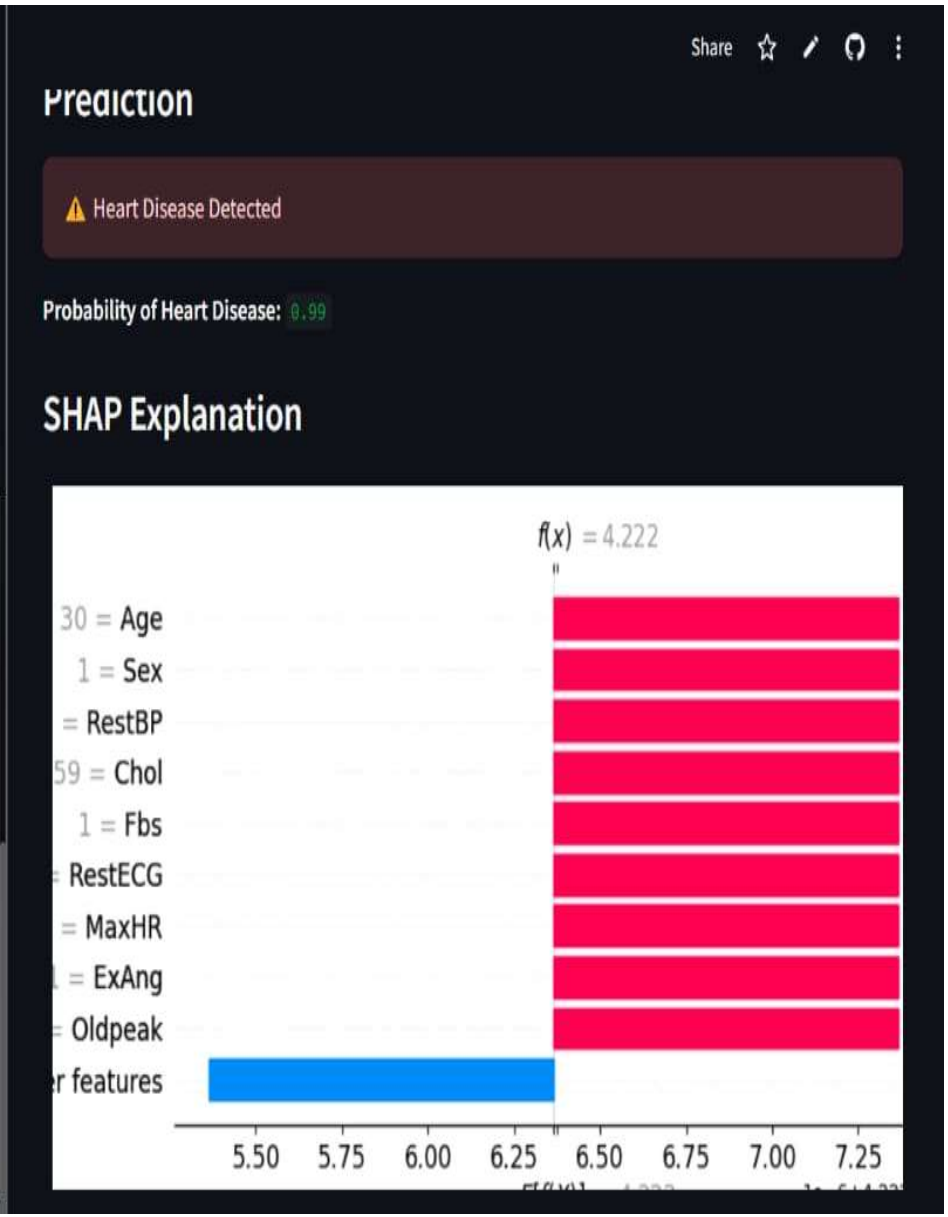
- **Background**
  - Heart Disease: Leading global killer, 17.9 million deaths/year.
  - Traditional Risk Assessment: Manual check-ups, ECG/Echo reports, family history analysis.
  - Issues: Subjectivity, delayed detection, inaccessibility in rural areas.
- **Related Work**
  - Study 1: Logistic Regression, Random Forest and few other models.
  - Study 2: Finding the best suitable model.
  - Study 3: SHAP values for model interpretability, human-understandable explanations.
- **Limitations**
  - No Ethical Framework: Missing ethics, transparency, and safeguards.
  - Poor Front-End Integration: No user interface, UX, or end-user accessibility

Idea / Methodology



Screen shots/ Results





Result Analysis

❑ **Evaluation Metrics**

- Accuracy: 85.4%
- Precision: 86.2%
- Recall: 84.7%
- F1-Score: 85.4%

❑ **Key Findings**

- Balanced Precision and Recall: Model doesn't favor either class.
- High Interpretability: Logistic Regression offers clarity.
- Real-Time Predictive Capability: Instant predictions.
- Transparency via SHAP: Explanatory tool for decision support systems.

❑ **Comparative Analysis**

- Logistic Regression: Outperformed baseline models

Opportunities and Challenges

❑ **Opportunities**:

- **Early Detection Saves Lives** : Early Risk Prediction
- **Decision Support for Doctors** : Enhances diagnosis by prediction
- **Educating Non-tech Users** : SHAP provides explanation
- **Clinical Trials** : Real-world effectiveness.

❑ **Challenges**

- **Need Clinical Validation** : Model should under go clinical trials.
- **Privacy and Security** : Patient data must be handled with confidentiality.
- **AI Skepticism in healthcare** : Need to be transparent with the result.

Conclusion

- **This project developed a Heart Disease Prediction System using Logistic Regression, achieving :-**

  - Average accuracy: 85.4%
  - F1-score: 85.4%

- **The model's strength lies in its :-**

  - Transparency and explainability (using SHAP)
  - Clinical relevance (focusing on features like chest pain type, resting ECG, thalassemia, and ST depression)
  - Alignment with established cardiology research

- This project demonstrates the potential of machine learning in preventive medicine, serving as a proof-of-concept for deploying lightweight, explainable AI in resource-constrained environments.

References

❑ **Research Paper**

➢ **Sharma & Parmar (2021):** "Predicting Risk of Heart Disease using Machine Learning Algorithms" - Cross-validation and robust preprocessing.

❑ **Web Articles and Official Sources**

➢ UCI Machine Learning Repository – Heart Disease Dataset
https://archive.ics.uci.edu/ml/datasets/heart+Disease

➢ SHAP : https://shap.readthedocs.io/en/latest

❑ **Heart health predictor**

https://heart-health-predictor3.streamlit.app