



Comprehensive Predictive Health Diagnosis System Using Machine Learning

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ABSTRACT: This paper proposes a comprehensive health diagnosis system using machine learning algorithms to predict major diseases such as diabetes, heart disease, and Parkinson’s disease. The datasets used in this study are collected from Kaggle and contain relevant clinical attributes for disease prediction. Support Vector Machine (SVM) models are used for diabetes and Parkinson’s prediction, while Logistic Regression is used for heart disease prediction. The integration of multiple machine learning algorithms allows the system to handle different disease characteristics effectively and improve prediction accuracy. The proposed system is deployed using the Streamlit platform to provide an interactive and user-friendly interface for healthcare prediction. The results demonstrate that machine learning techniques can support early disease diagnosis and assist healthcare professionals in making informed medical decisions.

Keywords: Health diagnosis system, diabetes prediction, heart disease, Parkinson’s disease, support vector machine, logistic regression.

Contents

1 Introduction	1
2 Literature Survey	2
3 Research Gaps	3
4 Proposed Methodology	3
4.1 Algorithm Approach for Diabetics Prediction	3
4.2 Algorithm Approach for Heart Disease Prediction	3
4.3 Algorithm Approach for Parkinson’s Prediction	4
4.4 Streamlit Integration	4
5 System Workflow	4
5.1 Strengths of the Proposed System	4
6 System Design	4
6.1 Introduction of Input Design	4
6.2 Data-Flow Diagram	5
7 Results and Discussion	5
7.1 Diabetes Prediction ML Model	6
7.2 Heart Disease Prediction ML Model	7
7.3 Parkinson’s Disease Prediction ML Model	8
8 Conclusion	10

1. Introduction

We work together because both of us have a vision of using machine learning to better the healthcare outcome. To facilitate this process, we focus on the prediction of diseases like Parkinson’s, diabetes, and heart disease since Early diagnosis and management will highly impact the outcomes of the patient. [25]. The Rolling LR and the SVM were incorporated in the open-source platform Streamlit, thereby creating an economically viable diagnostic solution. Our research is, therefore, an advocator for reducing the

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plethora of chronic ones and improving the general public's health by facilitating access to healthcare, especially in resource-scarce domains. Our group project aims at locating significant and dependable patient data for machine learning models to act upon. These models require a large, well-documented dataset on symptoms related to various diseases in order to provide an accurate diagnosis. Therefore, our focus is on how technology can be utilized to collect such crucial data. Systems will be created to facilitate the entire process, rendering it easier, more accessible, and effective, thereby improving overall healthcare-related machine-learning-model efficiency [25]. Our primary objective in this joint venture is to harness the full potential offered by medicine enhancement through machine learning methods. Great in the concrete sense would be building a prediction model for early detection of diseases such as Parkinson's, diabetes, and heart disease. The goal at the higher level is to apply the open Streamlet framework with logistic regression and SVM algorithms in building an efficient diagnosis application and also envision that with this technology, we can help address the issue of gathering reliable patient data sets for training purposes, thereby smoothing out the collection process. Our joint research emphasis is on the advancement of diagnostic using machine learning, whereby the trio of Azeez, Mohammed Adnan, and Muhammad Mehboob identified the forefront value of early disease identification and particularly with diabetes, Parkinson's, and heart disease. The encouragement for this proposal is the knowledge ML models that require a large libraries of reliable understanding graphics so that they can predict and benchmark across the useful constructs for many of the diseases. we seek to deploy technology as a tool to expedite and simplify the process so that there is a more reproducible and accessible process across contexts. With that motivating factor, we agreed to blend the logistic regression and SVM algorithms in the Streamlet. This logical abstraction is indicative of our technical knowledge but will also support our ability to develop a Reliable Diagnostic Pathway that is of high quality.

Our research will suggest that advanced machine learning algorithms and addressing the challenges of data collection will be a significant contribution toward a more effective and accessible health care system. We hope to improve the public health through a comprehensive diagnostic framework that supports early disease detection and treatment.

2. Literature Survey

Chauhan et al.'s article [1] with an accentuation on indications as input, this ponder investigates the utilize of numerous ML calculations, such as SVM and DT, for numerous ailment expectation. It looks at how well these calculations work on four diseases, such as diabetes and heart illness. The creators push how prescient analytics might offer assistance healthcare experts make provoke judgments approximately patients' wellbeing. Given inadequately restorative offices and a moo physician-to- population proportion, the exertion endeavors to unravel the trouble of early location and determination of perilous diseases. The paper binds together numerous infections beneath a single client interface for forecasts and highlights the noteworthiness of early discovery in sparing lives. The study [2] investigate proposes a system for early illness expectation utilizing an outfit demonstrate combining Calculated Relapse, SVM, and K-NN. It exhibits the viability of this approach for different infections, possibly counting your chosen ones. The consider highlights the noteworthiness of exact figures and provoke medications to upgrade persistent results by giving data on the application of machine learning within the therapeutic calling for the early forecast of a few infections. This study [3] uses a variety of machine learning algorithms, including Random Forest, DT, and Light GBM, to investigate symptom-based disease prediction. You could modify the methods to your particular diseases of interest, even though it concentrates on 41 diseases. The technology is said to produce extremely precise forecasts, which are meant to assist physicians in making better decisions and delivering more individualized care. This work represents a significant advancement in the healthcare domain, offering a holistic and integrated approach to disease risk, early detection, and personalized interventions. This paper [4] digs into include building procedures for making strides numerous illness forecast utilizing K- Closest Neighbors and Fluffy K-NN approaches. This may well be supportive for optimizing your highlight determination and information arrangement. The consider makes a critical expansion to the region of healthcare by shedding light on how machine learning may be utilized to estimate maladies and illustrating how include building approaches can enhance show execution. The paper is accessible within the Worldwide Investigate Diary of Modernization in Building Innovation and Science. The paper emphasizes how vital highlight choice, demonstrate optimization, and comparative

investigation are to making exact and reliable illness forecast models. This study [5] investigates the use of a hybrid deep learning architecture for the prediction of numerous diseases, including heart disease and diabetes. Studying their approach might provide insights for applying deep learning techniques to your project. CNN and LSTM networks are two examples of deep learning approaches that the authors use to assess a large dataset of medical records and symptoms of different diseases.[24]. The proposed system consists of three stages: data normalization, weighted normalized feature extraction, and prediction. According to reports, the technology's highly precise forecasts can help doctors make better decisions and administer more specialized therapies. By clarifying how deep learning may be used to predict diseases and illustrating how hybrid deep learning architectures may improve model performance, the study significantly advances the healthcare sector.

3. Research Gaps

- Machine learning methods for predicting different illnesses may not be properly integrated into current procedures. Combining multiple approaches could improve the diagnostic solution.
- Large volumes of reliable patient data are difficult to gather using many of the current methods. There is still much to learn about effectively gathering and handling this data for machine learning model training.
- There could be a gap in the diversity of algorithms used in existing methods. Our project, with the integration of SVM and logistic regression, aims to fill this gap by providing a more varied and adaptable approach.
- Some existing methods might lack user-friendly deployment mechanisms. Exploring how to enhance accessibility for healthcare practitioners and ensuring ease of use could be a valuable research focus.

4. Proposed Methodology

The main aim is to create a thorough and efficient diagnostic system by integrating machine learning algorithms using the open-source Streamlit platform. The system focuses on predicting major diseases: Diabetes, Parkinson's and heart disease.

4.1. Algorithm Approach for Diabetics Prediction

SVM will be used for diabetes and heart disease prediction. Because of how well it performs in classification tasks, this method was selected. Numerous medical datasets can benefit from its ability to function effectively with both data. The huge data set is considered which includes characteristics like age, family history, blood sugar levels, BMI, and other relevant diabetes-related parameters. These parameters help in achieving the accurate predictions. Data Pre-processing will address missing values, eliminating data redundancies, outliers etc. Data cleaning and normalizing numerical features is done to achieve consistent dataset. The techniques such as correlation analysis is done to determine the key characteristics which influences diabetes. To train the model, these features are considered to achieve the high accuracy. Features which are identified are considered to train the model in predicting the diabetics. To achieve the better results and high accuracy we can even tune the model by adjusting the parameters. Results achieved through the models need to be evaluated to know the accuracy of the given models. This can be achieved through implementing the metrics like F1 score, recall, accuracy, and precision. Cross validation will also be performed to guarantee the robustness and generalization.

4.2. Algorithm Approach for Heart Disease Prediction

Logistic regression algorithm is considered in predicting Heart Disease. Because of its suitability for binary classification problems, this algorithm is considered to predict whether heart disease is present or not based on the features considered. The dataset that includes important characteristics like age, blood pressure, cholesterol, exercise routines, and other pertinent variables associated with heart disease. All these features help acts as precursors in predicting the heart disease. We need to preprocess the dataset includes normalizing, handling missing values and outliers, handling categorical data etc. Finally, data should be consistent so that different operations can be performed on it. With the help of statistical

analysis, required features are identified and selected. This kind of selection will increase the prediction accuracy. We can even the prediction accuracy by adding some derived features to the existing data set. After implementing the model, one need to know the accuracy. Metrics are used to know the performance of the model. These metrics include precision, accuracy, recall, and other pertinent data to measure the model's accuracy. Finally, cross- validation is done to know the robustness of the model.

4.3. Algorithm Approach for Parkinson's Prediction

SVM is considered to predict the Parkinson's disease. This algorithm is considered because of its efficiency in classifying the tasks. It works well with both linear and nonlinear data and also well suitable for a range of medical datasets and proper data need to be collected which contains factors like tremor intensity, age, and voice characteristics. Apart from these main characteristics, one can consider the other medical factors to identify the Parkinson's disease. Gathered data can not be used directly because of noise, outliers, missing values etc. All such unnecessary data need to be eliminated and the data set need to be standardized. From the given dataset one need to identify essential features which diagnoses the Parkinson's disease and refine the dataset by incorporating relevant features. To evaluate the model accuracy, we are using sensitivity and accuracy metrics. Verify the robustness of the model using cross-validation.

4.4. Streamlit Integration

One of the important factor of our application is considering the Streamlit to implement this health diagnosis system. This is one of the open source used to build the web applications. By using Streamlit, one can create amazing and interactive interfaces for machine learning models. Both expert and naïve users can make use of this tool to implement different machine learning models. Another importance is to have the data visualization with different graphical representation. It contains well established frameworks that helps in reducing the application development time.

5. System Workflow

Application will be developed with the friendly user interface by making use of Streamlit. Any type of users can use this application without any training. People can make use of this application by entering the required data to have the proper disease diagnosis. This system is developed by making use of different algorithms like logistic regression and SVM. These algorithms will help in anticipating the corresponding diseases. These models will be considering the input and generates the output. This output gives the information related to the rate of occurrence of the diseases like Parkinson's, diabetes, and heart disease. The Streamlit interface will be used to convey this data in an intelligible manner.

5.1. Strengths of the Proposed System

The system's accuracy in predicting a variety of diseases is improved by the utilization of numerous algorithms. Streamlit makes sure that both technical and non-technical users may easily access and utilize the system. Our system seeks to provide a more dependable and effective diagnostic solution by utilizing these algorithms in conjunction with Streamlit. By offering a tool that is both technically sound and easy to use, we want to advance healthcare diagnostics with the suggested system.

6. System Design

6.1. Introduction of Input Design

In common, the advancement of an easy-to-use interface and non-obtrusive interaction between human creatures and our prescient healthcare framework can be to a great extent upheld by the angle of input plan. It has got to do with making strategies and methods by which clients yield information or data into the framework. How we do input plan specifically goes to impact our machine learning demonstrate and ultimately influences the execution of the whole framework. Our input plan technique considers components such as straight forwardness, clarity, and inclusivity. We need to make an interface through which clients can instinctively give the essential data, cultivating a smooth interaction with the framework. The input interfaces to be intuitive and easily navigable for a seamless user experience and that should

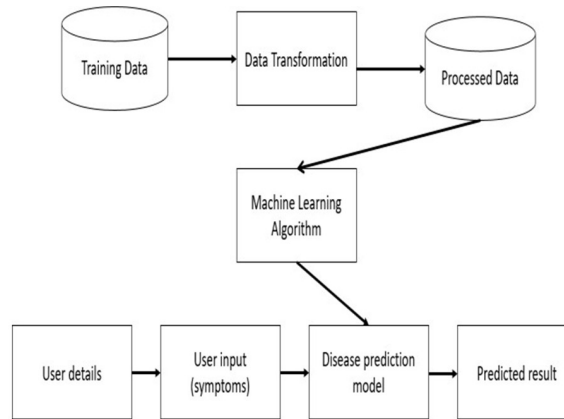


Figure 1: Proposed Architecture Diagram

make sure the data is entered accurately to increase the precision of ML predictions, to Optimize input processes to streamline data collection and system responsiveness. Create input systems that make it easier to interpret data in a way that makes sense for accurate disease prediction. The output will focus on how to convey the results of disease predictions in a clear and understood manner. A critical function of output design is to restate the information produced by ML algorithms, understandable for healthcare professionals. The main object is to display prediction results in a usable and transparent way. Relevance, accuracy, and clarity are key facts. We will ensure that relevant outputs are educational and informative to users with varying levels of technological savviness. The Potential influence on user confidence will factor into design, as the information displayed must be conducive to promoting confidence in the system predicted outcomes. To display outputs with visualizations that are clear and understandable. Present information, way that is relevant to the users and can facilitate to the users in making informed decisions and actions based on the predictive results. To develop user confidence in the system by design outputs that create a feeling of trust and provide a clear and accurate depiction of the predictions of the disease.

6.2. Data-Flow Diagram

The DFD is a visual representation showing how the data flows through the healthcare diagnostic subsystem. It is a visual representation containing the various DFD processes, data stores, data flows, and external entities that provides an abstract overview of how information flows at a high level. The DFD processes, such as data input, data processing to ML algorithms, and presenting the result, are mapped to show processes' interactions and dependencies to each other as well as the data stores being trained on the patient data, show where the information is stored in the system. Data flows represented visually denote the paths of the data transfer between processes and data stores as data moves, showing the transformation of input data as it is processed, leading to the output of disease predictions in this case. Incorporation of external entities, such as the users and the external systems, show where the data interacts with the external environments through interactions. The Data Flow Diagram (DFD) is helpful in determining any potential bottlenecks or redundant sources, identifying places to optimise the healthcare diagnosis framework for the healthcare work flow and for understanding the data, which can help inform bottlenecks and otherwise under area in the healthcare diagnosis framework, ensuring efficiency of data processing for the overall system.

7. Results and Discussion

The Multiple Disease Prediction System's successful prediction of heart disease, diabetes and Parkinson's disease is a significant achievement. This section examines how well each algorithm performed, how the user interacts with the Streamlit environment, and the potential impact on healthcare overall. The algorithm performance is utilized different approaches for each health condition: SVM for Diabetes and

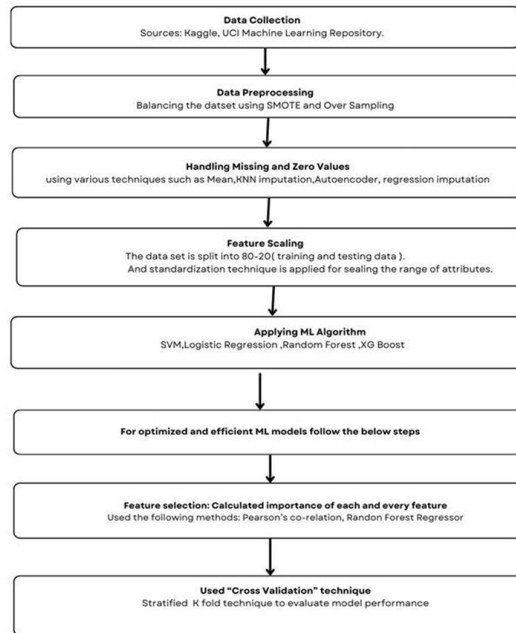


Figure 2: Data Flow Diagram

Parkinson's, and LR for Heart Disease. This demonstrative approach exemplifies the responsiveness of the project to different health issues, and its ability to meet the challenges of handling various health conditions represents a strategic diversity. Detailed performance charts in the form of confusion matrices, offer valuable insights into the system's ability to avoid mistakes. These matrices contribute to the reliability of predictions, providing a granular understanding of the system's accuracy and aiding in identifying areas for potential improvement. The thorough examination of performance metrics adds depth to the project's evaluation.

7.1. Diabetes Prediction ML Model

Collected the data from Kaggle which is named as PIMA Dataset. This contains data of female whose age is 21 and above. For machine learning classification, the Pima Indian dataset is an open-source dataset [6] which is available to the public. 268 of the 768 patients whose data it contains have diabetes. Attributes in dataset are Skin Thickness, Glucose, Blood Pressure, Pregnancies, Insulin, Diabetes Pedigree Function, BMI, Age, Outcome. This dataset is unbalanced. To balance the data, we used various techniques such as SMOTE, Oversampling. After balancing the data, no missing values are found and zero values of the attributes (excluding Insulin, Glucose, Pregnancies) was replaced by mean values. And we did not consider the zero values of Glucose and Pregnancies as they were less in number. For replacing zero values in Insulin, we tried 3 different techniques – Autoencoder, KNN Imputation and Regression Imputation. We considered Regression Imputation has best among the 3 techniques. Because using Autoencoder we lost the originality of the data and by using KNN imputation, it resulting in more missing values. Then the Testing and Training data are separated from the dataset. (80-20). Then applied standardization technique for scaling the range of attributes. we have used Recursive Feature Elimination Technique to remove the features, which has less importance. The Features we considered as last are Glucose, Insulin, BMI, age. Now we built the ML Models by training the algorithms with optimized data. Figure 3 and figure 4 shows the results SVM – 71% , LR – 69.5%, RF – 85% , XGBoost – 85% and XGBoost as ML Model for diabetes are considered.

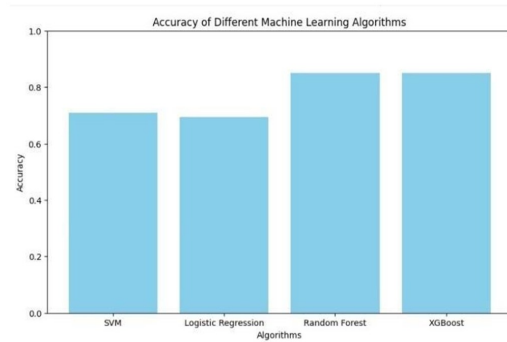


Figure 3: Diabetes Prediction-Accuracy of Different Machine Learning Algorithms

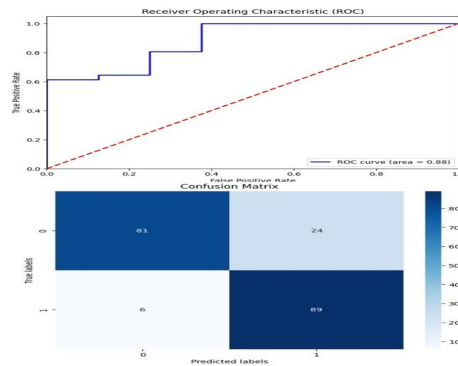


Figure 4: Diabetes Prediction -Confusion Matrix for XGBoost

7.2. Heart Disease Prediction ML Model

Collected the data from Kaggle. The machine learning classification dataset is publicly available and is available as an open-source dataset [6]. 526 of the 1025 patients whose data is organized into 14 columns have cardiac disease. The attributes in dataset are cp, trestbps, cholesterol, sex, fbs, restecg, thalach, exang, oldpeak, age, slope, ca, thal, target This dataset is unbalanced. To balance the data, we used various techniques such as SMOTE, Oversampling. The dataset is complete with no missing values Then the Testing and Training and data are separated (80-20). Then applied standardization technique for scaling the range of attributes. Applied following ML Algorithms and figure 5 and figure 6 shows the the results for SVM (Support Vector Machine) (kernel - linear) 80.84% SVM (kernel-poly) 90.91% SVM(kernel-rbf) 88.96% LogisticRegression-80.52% Random Forest-98.05% XGBoost - 99.03%

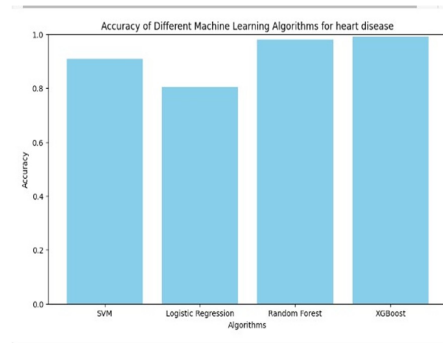


Figure 5: Heart Disease Prediction-Accuracy of Different Machine Learning Algorithms

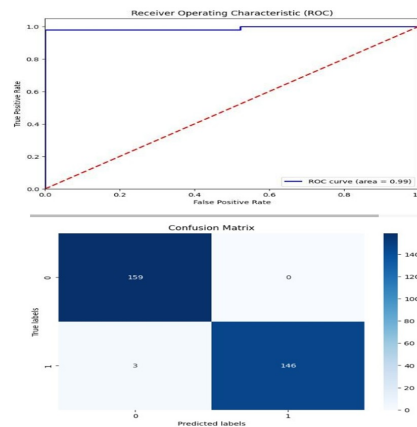


Figure 6: Heart Disease Prediction -Confusion Matrix and ROC cuve for XGBoost

7.3. Parkinson's Disease Prediction ML Model

Collected Parkinson's dataset from Kaggle. The machine learning classification dataset is publicly available and is available as an open-source dataset [6].It has 24 columns with the data of 195 people, 147 of them had Parkinson's disease. The dataset is not balanced to balance it Oversampling technique is used There are no missing values in dataset. Testing and Training data are separated from the dataset. (8020). Then applied standardization technique for scaling the range of attributes. Applied following Machine learning algorithms and figure 7 and figure 8 shows the results for SVM 89.74%, RF 79.49%, XGBoost 84.62%, LR -82.05%

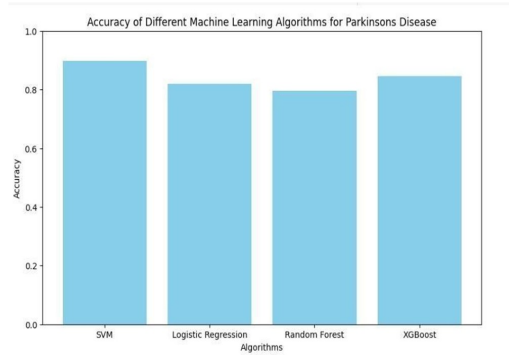


Figure 7: Parkinson’s Disease Prediction- Accuracy of Different Machine Learning Algorithms

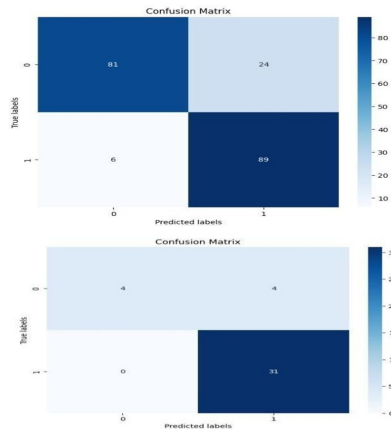


Figure 8: Parkinson’s Disease Prediction -Confusion Matrix and ROC curve for SVM

An exploration of feature importance identifies key health indicators for predictions, enhancing understanding of the factors influencing the models. This analysis contributes to the interpretability of the system, providing valuable insights into the underlying mechanisms of predictive modeling. Understanding feature importance is crucial for healthcare professionals and stakeholders to trust and interpret the predictions effectively. The existing research on SVM and Logistic Regression, reinforcing its credibility within the healthcare domain. Important differences are into dataset-specific patterns and algorithmic behavior, contributing meaningfully to ongoing discussions in healthcare literature. This alignment enhances the relevance and standing in the scientific community. This section also underscores the importance of recognizing its limitations. Despite the dataset’s breadth, acknowledging potential gaps is essential. This reflection paves the way for future enhancements, reinforcing that research is iterative and future work could benefit from more diverse and expansive datasets. It highlights that the system could have a significant impact on healthcare. The goal of supporting a more responsive healthcare system ties in with wider trends toward increased patient outcomes and efficiency in healthcare as a whole. The Multiple Disease Prediction System demonstrates the power of predictive modeling to support proactive and personalized healthcare. By integrating machine learning algorithms such as Decision Trees, SVM, and Neural Networks, the project has developed sophisticated models capable of detecting complex patterns across multiple datasets. These models not only improve early diagnosis of diseases like diabetes, heart disease, and Parkinson’s but also enable patient-specific risk assessments by incorporating genetics,

lifestyle, and clinical measures. This will give us the generic predictions to individualized recommendations represents a significant step toward personalized medicine, improving treatment effectiveness and preventive interventions and equally important is the system's focus on accuracy, interpretability, and trust, which are crucial for clinical adoption. By offering reliable and understandable predictions, the system strengthens confidence in healthcare providers and patients, making it a valuable tool for real-world implementation.

8. Conclusion

The Multiple Disease Prediction System itself as a top in healthcare innovation through its accurate prediction model, patient-specific risk assessment, interpretability, preventive healthcare focus, and multidisciplinary integration. This initiative demonstrates how technology can positively disrupt patient-centered care while promoting collaborative innovation and ethical practices. More than a conclusion, this project marks a milestone in an ongoing journey of exploring ideas, addressing challenges, and fostering future possibilities. By continuously creating, evaluating, and improving, the project not only delivers a powerful healthcare tool but also enriches the broader knowledge base, serving as a springboard for future innovation at the intersection of technology and healthcare.

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