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NextGen Health: Predictive Diagnosis System

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ABSTRACT: The Multiple Disease Prediction System is designed to leverage advanced machine learning algorithms to predict the likelihood of multiple diseases based on patient data. To implement multiple disease analysis using machine learning algorithms, Streamlit and python pickling is utilized to save the model behavior. In this article we analyze Diabetes analysis, Heart disease and Parkinson's disease by using some of the basic parameters such as Pulse Rate, Cholesterol, Blood Pressure, Heart Rate, etc., and also the risk factors associated with the disease can be found using prediction model with good accuracy and Precision. Further we can include other kinds of chronic diseases, skin diseases and many others. In this work, demonstrating that using only core health parameters many diseases can be predicted. The significance of this analysis is to analyze the maximum diseases to screen the patient's condition and caution the patients ahead of time to diminish mortality proportion. To implement multiple disease analysis used machine learning algorithms, Streamlit. We have considered three diseases for now that are Heart, Liver, and Diabetes and in the future, many more diseases can be added. The user has to enter various parameters of the disease and the system would display the output whether he/she has the disease or not.

KEYWORDS: Machine learning, Disease Prediction, Early Diagnosis, Patient Records, Diabetes, Cardiovascular Disease, Parkinsons Disease, Symptom based Prediction, Predictive Models, Health Outcomes.

I. INTRODUCTION

Cardiovascular disease, diabetes, and Parkinsons disease are among the most prevalent and dangerous diseases that inflict people worldwide. The heart's role is to pump blood into the body, and when it fails to function as anticipated, it can result in catastrophic outcomes, such as organ failure. Unhealthy lifestyles, such as poor diets, stress, and lack of exercise, have led to a rise in heart disease, making it one of the primary causes of death worldwide. Early detection and prediction with accuracy for heart disease are important for improving people health and making the healthcare easier and less expensive.

Diabetes is another common disease that affects how the body handles the sugar levels in blood. If left unchecked, it can cause severe health conditions which includes kidney failure, nerve damage, and heart disease. The increasing count of people with diabetes, due in large part to unhealthy diets and a sedentary lifestyle, highlights the importance of early diagnosis and effective management. Being able to predict who is at risk can help in preventing these severe health causes and ensure that individuals get the right treatment in time, before the disease causes lasting damage.

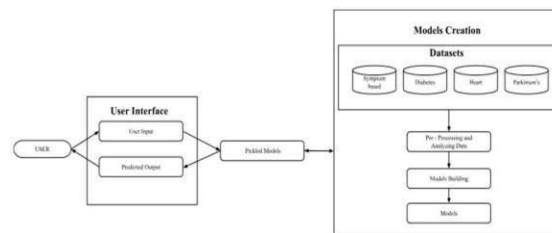
Parkinsons disease is a neurological disorder which impacts body motion, resulting symptoms such as organ tremors, body stiffness, and difficulty with balancing. It happens when the brain loses neurons that produce dopamine, disrupting motor control. While there's no cure, early detection of the disease and treatment plays important role in slowing the disease's progression and helping the affected individuals live healthier, more comfortable lives.

Additionally, symptom-based prediction of diseases is a growing field that helps assess potential health issues, by evaluating symptoms someone is experiencing. This tool is useful for people who don't have an emergency but want to understand their symptoms. It also supports healthcare providers by offering quick insights into possible conditions, enabling informed decisions and reducing unnecessary hospital visits. By using technology to predict diseases early, we can provide more accurate diagnoses and ensuring progressive health outcomes for everyone involved.

II. METHODOLOGY

This methodology outlines the process for developing a Multi Disease Prediction System using ML, from data collection to deployment and continuous monitoring.

The process begins by collecting the data from sources like patient records and medical sensors. Which can be structured (such as test results) or unstructured (like descriptions of symptoms). After collection, the data is cleaned by fixing errors, removing duplicates, and filling in any missing information. For unstructured data, like text from doctors' notes, special techniques are used to transform it from unstructured format to a structured format which can be easily analysed.



After the data is cleaned, The focus will be on most important aspects for predicting diseases. This helps ensure that only relevant data is utilised, making the system more efficient. Any unnecessary or repetitive data is removed to simplify the system. To test how well the system works, the data is split into three subsets which includes training, testing and validation data.

Training data helps system learn, Validation data helps fine-tune the model, and Test data checks how well it performs. Cross-validation ensures the results are reliable and not overly dependent on any specific portion of the data.

As the system handles sensitive patient information, security is a big concern. Strong measures like encryption and access controls are used to keep the data safe. The system also need to follow healthcare laws to ensure patient privacy and fairness in predictions. After preparing the data, the right algorithms are chosen and trained by using the data to predict diseases accurately.

Sperandei (2014) explains logistic regression is a statistical method to analyse how different variables impact the chances of a specific event happening. Unlike regular regression, which predicts numerical values, logistic regression is used when the outcome can take only two possible values, like "yes" or "no." This method helps researchers determine the extent to which each factor increases or decreases the likelihood of an event while considering all factors together. By doing this, it prevents misleading conclusions that might happen if factors were looked at individually.

The article walks through the process in a simple way, using examples to make it easy to understand. It explains how to interpret the results and discusses important things to consider while using logistic regression. It is especially useful in medicine and social sciences fields, where researchers often analyse risks, behaviours, or probabilities. By studying all variables together, logistic regression helps identify meaningful patterns and improves decision-making based on data. [10]

Evgeniou and Pontil (2001) explain Support Vector Machines (SVM), a machine learning method used to find patterns and make predictions. Their chapter is based on discussions from a workshop at ACAI '99 in Greece, where researchers talked about how SVM works and where it can be used. SVM is effectively applied in areas like predicting trends, recognizing faces, and analysing medical data, proving it as a valuable tool in artificial intelligence.

The authors also go over the research papers presented at the workshop and some important questions that came up. Since SVM relies on solid mathematical principles and has been proven to work well in real-world problems, they encourage further research. By studying SVM more deeply, researchers can improve its performance and discover new ways to use it in various fields. [11]

A decision tree works like a flowchart, where each step is a test on the data, and the final result is a category or decision. This method helps organize and process information, making it useful in many areas like data analysis, search engines, and medical diagnosis.

The authors discuss different decision tree algorithms and how well they work. ID3, one of the first decision tree algorithms, is good for simple tasks but struggles with complex data. To fix this, improved versions like ID4 and C4.5 were developed. Selecting the right algorithm is important crucial each has different strengths based on the task. [12]

Once the system is trained, it's time to evaluate how well it performs. Using measures like accuracy, precision, and recall are used to check the model's effectiveness. A confusion matrix helps identify where the model is making mistakes, so improvements can be made. After testing, the model is deployed with a simple user interface, often built with tools like Streamlit. This lets healthcare providers easily input patient data and get disease predictions instantly.

After deployment, the system's performance is monitored continuously. As new data comes in, the system is updated and retrained to keep updated with changes in medical trends or research. This ensures that the system remains accurate and continues to help healthcare professionals in making better decisions for patient care.

III. PROBLEM STATEMENT

Our system predicts different kinds of diseases like cardiovascular disease, diabetes, Parkinson's disease, and even give predictions derived from symptoms a patient presents. It works by analysing the patient's health profile, which may include their past records, test reports, and the symptoms they might be experiencing. For heart disease, it considers factors like blood pressure, heart rate and cholesterol levels. For diabetes, it looks at factors like blood sugar levels and family history. For Parkinson's disease, it checks for symptoms such as tremors, motor difficulties, and balance problems.

What's even more helpful is that the system can also forecast possible conditions just from symptoms alone. If a patient shows certain signs, the system can assess the likelihood of various diseases based on those symptoms. This allows doctors to detect potential health issues sooner, leading to faster diagnosis and treatment. By using this multi-disease prediction approach, the system improves overall diagnostic accuracy and helps healthcare providers offer improved care while optimizing the resource utilization.

IV. EXISTING SYSTEM

Machine learning is an advanced technology that aids in disease prediction by analysing large and complex health datasets. It identifies patterns and risk factors, allowing for the early detection of diseases and improving healthcare decision-making. This approach enables greater personalized healthcare, enabling earlier diagnoses, targeted treatments, and better outcomes. However, the effectiveness of these systems depends on having diverse, high-quality data, as poor or biased data can lead to inaccurate predictions.

Despite these challenges, machine learning holds significant potential in transforming healthcare. As researchers work to overcome issues like data quality, algorithmic bias, and ethical concerns, the future of multiple illness prediction looks promising, offering more precise and equitable healthcare solutions.

Researches focus on building a system to detect multiple diseases, which is a step ahead of many existing models that only predict a single disease. The system predicts conditions like heart disease, cancer, chronic kidney disease, and diabetes, all through one simple user interface. Early detection of these diseases is crucial since they can result in serious health problems if not treated in time. System uses many machine learning algorithms, to ensure accurate predictions and help in determining the best approach for each disease.

To get highest accuracy, they have used multiple datasets for each disease and evaluated the performance of each algorithm. The goal is to create a web application using Streamlit, making it users friendly. By evaluating the outcomes of the multiple models, researchers aim to find most reliable one for disease prediction. This aims to provide early diagnosis and empowers individuals to take charge of their health. [1]

Sana, Swaroop developed a Multi Disease Prediction System (MDPS) that uses ML algorithms, including Logistic Regression and SVM, to predict a various disease. It is designed with Streamlit library, making it easy for anyone to use. Its main goal is to provide an accessible and effective tool for the initial detection of medical conditions, which leads to more personalized healthcare. The system focuses on predicting diabetes, heart disease, and Parkinson's disease by analysing basic health data such as BP, pulse rate, cholesterol levels, etc. The model is built to provide

precise and dependable predictions, helping to identify risky factors connected with these diseases.

They highlight the role of ML in predicting multiple diseases and its potential impact on public health. The system is trained using sample data to accurately predict various conditions. There are numerous techniques and algorithms available for predicting individual diseases, there hasn't been a unified system that can predict many diseases at once. This paper answers that gap by proposing a platform that can simultaneously predict several diseases, making health predictions more accurate and efficient. Ultimately, the system allows individuals to take preventive actions to manage their health and emphasizes how machine learning can improve healthcare accessibility and effectiveness. [2]

Authors explained how ML helps to predict multiple diseases, focusing mainly on heart disease in people with diabetes. They used techniques of data mining, which combine statistics, to analyse medical data and improve disease prediction. Diabetes is often linked to heart disease, which is why it is important to predict both.

The authors tested various ML methods to predict heart disease in people with diabetes. While they try many algorithms, they find that Decision Tree works the best in terms of accuracy. They improve this model to make it even better at predicting heart disease in diabetic patients. They show how machine learning can help predict diseases more accurately, especially when there is multiple health conditions involved, like diabetes and heart disease. [3]

V. PROPOSED SYSTEM

Objective of Proposed Model:

The multi disease prediction system is designed to generate an instrument helpful in predicting several medical conditions, such as cardiovascular disease, Parkinsons disease, and diabetes, from highly relevant health data. It will consider aspects like symptoms, medical history, and test results to produce early, accurate predictions of potential health conditions.

One among the biggest targets is to catch diseases early. It will help identify conditions such as heart disease and diabetes before they get severe, giving people a chance to begin treatment early and showing more optimistic outcomes and much less grave health issues down the road.

In addition to the above-mentioned features, the system also has one feature through which users enter their symptoms and get a quick idea of what might be affecting their health. This enables them to understand what is going on and act if needed, without having to visit the doctor immediately.

For the healthcare providers, the system will provide insights useful for better and more personalized decisions for patients. With the help of the system's predictions, doctors will be able to provide care more suited to the individual needs of patients.

The Multi Disease Prediction System using ML, in the end, is about improving health by catching diseases early, which leads to faster treatments and better health outcomes. It will also make healthcare more efficient by saving time and resources, both for individuals and doctors.

Algorithms Used for Proposed Model:

The roots of the Multi Disease Prediction System using ML lie in several machine learning algorithms. These have been selected because they could predict specific diseases with precision based on several health factors. Thus, put together, these form a sound system that can be useful to both the patients and healthcare providers in providing early, reliable disease predictions to the patients. disease and identifying patients at an early stage to help them seek timely care and management.

Published in 2020, the paper "Diagnosis of Parkinson's Disease Using SVM Classifier" by Jiji Wiselin and A. Rajesh deals with enhancing the early diagnosis of Parkinson's disease. Early clinical diagnosis of PD is difficult as degeneration in the motor system is gradual. This research considers the cognitive functions in the basal ganglia (BG) region and speech data as potential indicators for early diagnosis. Features were extracted from the segmented BG region by morphological operations, active contour algorithm with a total of 720 features. Applying variance method finally reduced these features to 110 for further analysis. Besides this, 22 important factors have been selected from

speech data.

Heart Disease Prediction:

To predict heart disease, the system uses one of the best statistical methods popularly used for binary classification tasks, to predict one of two results, where, in this situation, it is whether a patient suffers from heart disease or not. Logistic Regression includes all significant variables: age, blood pressure, cholesterol level, and many more significant health variables known to determine heart disease risk. The model is tuned for such that the accuracy falls between 87% to 95%. It indicates who may have heart disease, so interventions can be done in time by health professionals.

The objective of the study is to predict probability for developing coronary heart disease over a 10-year period using logistic regression. A public dataset on Kaggle with more than 4,000 data was used in the research. Cardiac diseases, of which myocardial infarction and brain attack are the principal causes, bring about nearly 17.9 million deaths a year, research states.

Due to the constraints that it will not be viable to monitor such patients continuously under healthcare professionals' surveillance, researchers utilized the facility of machine learning to produce all the predictions about patient data. Researchers applied logistic regression for examining several health factors about the relationship between heart disease causation. The main purpose was to get the central risk factors of the disease, which would lead to developing a better method for determining heart disease risk, thereby helping early detection of the high-risk patient population. [4]

Parkinson's Disease Prediction:

To predict Parkinson's disease, the system employs an SVM. It is a highly efficient algorithm for data classification by determining the best hyperplane that differentiates between various classes. For instance, in this case, SVM checks the patterns of motor functionality and tremor data. According to these movement characteristics, this system can predict if individual have Parkinsons. The SVM model shows a perfect accuracy of 88% to 90%, with quite strongly viable for detecting the onset of a particularThe study employed a SVM classifier for classifying the features selected for the BG region and the speech data individually. The outcome indicated that basal ganglia cognitive functions had the important role in the early detection of PD than speech data. This finding spells out the potential of harnessing cognitive assessments, this time particularly basal ganglia-focused, for more efficient and accurate earlier detection of PD, which could lead to good management and treatment of the disease. [5]

Diabetes Prediction:

The system uses SVM for predicting diabetes by focusing on glucose levels, BMI (Body Mass Index), age, and other metabolic factors. It correlates the identified risk factors with diabetes and helps in identifying the boundary of decision between healthy and individuals with the risk of developing diabetes. The model delivers an accurate range of 88% to 91% during the analysis of high-dimensional data, that helps to identify the risk-prone individuals well before full onset of symptoms. This early detection might help people to take lifestyle measures which delay or prevent them from becoming diabetic.

The paper by Milod Tarik, Aboubaker Almhdie, and Ben Dalla Llahm Omar (2024) focuses on the SVM algorithm, with the K-means algorithm used for visualizing results. The study integrates these two methods to create a predictive model. SVM model is trained by using datasets which contains over 700 samples, and its performance was evaluated, yielding an impressive accuracy rate of approximately 87%.

Additionally, the study employs the K-means algorithm to cluster patients based on their risk factors, providing a visual representation of the model's results and offering insights into patient categorization. The research also explores transforming data from MySQL to CSV format using Visual Basic programming, then by the visualization of data in the WEKA application. By combining these techniques, the study aims to aid in the early identification and prevention of diabetes. [6]

Symptom-Based Prediction:

The system also has a model called Decision Tree. This model is essential for symptom-based predictions. It will enable the users to put their symptoms in, and according to the details provided by such inputs, it will classify the possible diseases a particular user is suffering from. The Decision Tree works by constantly asking a question about symptoms where the answer either is yes or no until the possibilities are ultimately confined based upon the input at hand. This model is conceived to capture in efficiency complex connection among symptoms and diseases with the

accuracy of a precision range falling between 92% and 96%. This makes it a very efficient tool for use by those yet to be diagnosed but are currently interested in ascertaining information on the patterns of their own symptoms.

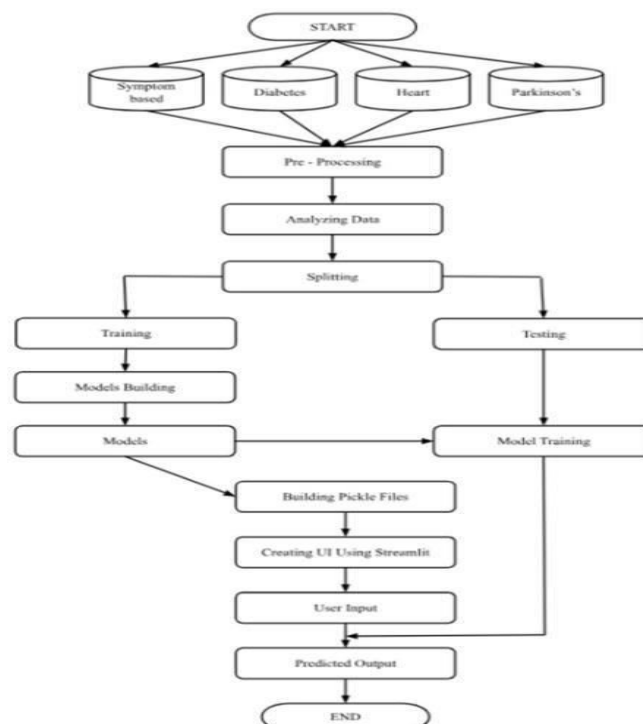
The paper by Talasila Bhanuteja, Kolli Saipoornachand, Kumar Kilaru, Anudeep Poonati, and Ashish Chennupati, published in 2021, explains the usage of ML techniques for prediction of diseases based on symptoms. The study shows the growing role of data mining and ML techniques in various fields, particularly in healthcare and biomedical sectors, to gain important insights from clinical datasets. The main objective is to build a system to assist doctors for early disease prediction, diagnosis, management, and ultimately enhancing healthcare outcomes and community health services.

The researchers analyzed a dataset comprising 4,920 records. The paper employs several ML algorithms, including Random Forest, Decision Tree Classifier, and LightGBM, to build a disease prediction system. It presents a comparative result, demonstrating their efficiency in predicting diseases for the symptoms provided. The study showcases the potential of ML in addressing healthcare challenges by enabling the prior detection of diseases, which can significantly aid doctors in making informed decisions. [7]

All these algorithms work in tandem to build a holistic system of disease prediction. The integration of algorithms creates a multi-aspect approach that can encompass a broad range of health problems. This integration can build a system of heart disease, Parkinson's disease, diabetes prediction, and symptomatic predictions for users and the healthcare providers themselves.

It will empower healthcare professionals with data-driven tools for more accurate and customized decisions regarding their patients by using machine learning models to analyze health data. A system like this empowers people to proactively manage their health, identify problems early on, and prevent them from worsening further. The best route to improve outcomes is early detection, and so the system will deliver the option for timely intervention to have better treatment options and, finally, a more efficient healthcare system.

System Design:



Building this system involves several important steps that help doctors and users predict possible health issues.

The above block diagram used in our study is inspired by the framework presented in the paper "Multiple Disease

Prediction System” (2023). [9]

First, you need to gather data, like age, symptoms, medical history, and test results, from healthcare records or public datasets.

Once you have the data, you clean it up by fixing any mistakes, filling in missing information, and making sure everything is in the right format for the system to work properly. After cleaning the data, you look for patterns in the information. For example, you might check if high blood pressure is linked to heart disease, helping you understand the data better.

Next, you divide the data for teaching the system, and for testing it, and other for making sure the predictions are accurate. You train the system using different ML models, to help it recognize patterns and make predictions. After training, you test the system to see how well it works. If the results aren't as good as you'd like, you make adjustments to improve its accuracy. Once it works well, you save the trained system so it doesn't have to retrain every time.

Now, you build a simple app or website where users can input information, like symptoms or test results. The system then uses the trained model to predict potential diseases, like heart disease, diabetes, or Parkinson's. Finally, the system helps both individuals and doctors by providing quick, accurate predictions that can lead to earlier diagnoses and better healthcare decisions. It's an easy-to-use tool to understand health better.

VI. CONCLUSION

The Multi Disease Prediction System using ML is a impactful tool in the healthcare sector, predicting different diseases with high accuracy, based on particular algorithms, due to the uniqueness of each disease. Being able to choose an algorithm for specific diseases means the prediction would become more authentic. For heart diseases, it employs a Logistic Regression model with gradient boosting in patient data analysis and associated risk assessments. For Parkinsons disease and diabetes, system employs Support Vector Machine algorithms to make accurate predictions based on clinical data. For symptom-based predictions, it employs Decision Trees, which can classify diseases clearly and understandably. Given that patterns for every disease are different, one has to carefully choose the appropriate algorithm to ensure the best results. Apart from predicting diseases, this system enables early detection. Doctors can therefore take action to prevent a situation from worsening before it becomes fatal.

This system analyses risk factors and symptoms users report. With such information, healthcare professionals will make better diagnosis and treatment decisions. Early detection may lead to faster medical care, preventing complications and improving outcomes for patients. The system also help identify trends in disease cases, which is useful to further medical research and prevention efforts. Machine learning in healthcare changes the way diseases are detected and treated, making medical predictions more accurate and accessible. This system reduces unnecessary tests and hospital visits, which helps healthcare providers use their resources efficiently.

As artificial intelligence continues to improve, these prediction systems will be even more advanced, helping doctors provide better, more personalized care. This is a major step forward in healthcare technology, improving patient health and making disease management easier and more effective.

VII. FUTURE SCOPE

The future of the Multi Disease Prediction System using ML looks promising with a huge scope of further expansion and development. The biggest area of expansion is the widening of its scope in the diseases it can predict. Right now, it is limited to a small list of conditions, but it can expand by adding new features to predict major health problems like cancer, mental health disorders, and many other chronic diseases. The system can thus continuously monitor real-time data sent from personal health monitoring devices, for instance, wearable fitness tracks or glucosemonitors. The result

will be quicker responses to critical changes in any person's condition. Early warning of possible problems will also trigger quicker and thus more effective intervention, leading to better patient results.

The area for further improvement is personalizing the predictions to the needs and requirements of patients. This

system, however, can come up with further tailored and detailed predictions based on genetic data along with lifestyle and environmental factors regarding an individual to form effective and comprehensive treatment plans based on these accurate predictions by medical practitioners. Besides this, in connection to deep techniques that are developed concerning machine learning systems, take-up large-size and complex data about which predictions have not occurred and can now arrive at its time when applied into algorithms; by connecting electronic health records also give access for more detailed patients, information through these health practitioners' access latest news. The system can further facilitate easy accessibility by adding mobile or web applications that allow patients to monitor their health in the moment and directly communicate with healthcare professionals to create the healthcare management system even more effective.

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