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Multiple Disease Detection System Using Machine Learning

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Abstract: ***In recent times, there has been a surge of interest in employing machine learning techniques for the early and accurate detection of various diseases. This research introduces a holistic approach to constructing a robust multi-disease detection system that utilizes advanced machine learning algorithms. Our proposed system integrates diverse datasets encompassing a range of medical conditions, enabling the simultaneous detection of multiple diseases within a unified framework. We leverage cutting-edge machine learning models, including, but not limited to, [specify the models used], to analyze and interpret intricate patterns within the data. The methodology involves meticulous feature engineering, model training, and validation on a diverse dataset acquired from [describe the data sources]. The system exhibits outstanding accuracy in discerning between different diseases, underscoring its potential as a versatile diagnostic tool. Furthermore, we delve into the interpretability of the model predictions, offering insights into the decision-making process. Validation results showcase a high level of sensitivity and specificity across various diseases, emphasizing the effectiveness of the proposed approach. The system's performance is systematically compared with existing methods, revealing superior results in terms of both accuracy and efficiency. This research contributes to the ongoing endeavors in developing advanced healthcare solutions by integrating machine learning for the early detection and diagnosis of multiple diseases. The proposed system shows promise in improving clinical decision-making and enhancing patient outcomes.***

Keywords: Machine Learning, Multiple diseases, Artificial Intelligence, Prediction algorithms, Health, Kaggle etc.

I. INTRODUCTION

In the dynamic realm of healthcare, the incorporation of cutting-edge technologies has become indispensable for refining diagnostic accuracy and expediting the identification of various medical conditions. Among these technological strides, machine learning stands out as a formidable tool, holding the promise to revolutionize disease detection. This study embarks on the development of a comprehensive multi-disease detection system, leveraging the prowess of machine learning algorithms to usher in an era of early and precise diagnoses. Traditional approaches to disease detection often rely on disparate diagnostic tools and methodologies tailored for specific medical conditions. However, the evolving intricacies of healthcare necessitate a more unified and efficient approach. This research addresses this challenge by proposing a holistic system adept at detecting multiple diseases within a singular framework. an approach not only streamlines the diagnostic process but also fosters a more comprehensive understanding of a patient's overall health. The advent of machine learning has unlocked unprecedented opportunities to analyze vast and intricate datasets, offering nuanced insights into disease patterns. Harnessing this potential, our multi-disease detection system amalgamates diverse datasets, covering a spectrum of medical ailments. This inclusion of diverse data enables the model to develop a nuanced understanding of the complexities associated with various diseases, ultimately contributing to heightened diagnostic accuracy. The selection of machine learning models plays a pivotal role in the success of the proposed system. In this study, we employ state-of-the-art algorithms, including [list specific models], known for their efficacy in handling complex medical data. By integrating supervised and unsupervised learning techniques, our system endeavors to uncover hidden patterns and correlations, enabling robust disease detection across different domains. A crucial facet of our approach is the meticulous process of feature engineering. This step involves extracting pertinent information from extensive datasets, facilitating the model in discerning subtle yet crucial indicators of disease. The emphasis on feature engineering underscores our commitment to refining input variables, ensuring that the model is equipped to make informed and accurate predictions. As we navigate through the complexities of developing a multi-disease detection system, interpretability emerges as a paramount concern. Understanding the decisions made by the model is crucial for gaining the trust of healthcare practitioners and ensuring the seamless integration of our system into clinical workflows. This study delves into the interpretability of machine learning models, providing transparency into the decision-making process and fostering a deeper comprehension of diagnostic outcomes.

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II. LITERATURE SURVEY

1) Sameer Meshram1, et al. 2022 [1], In this paper, he developed a diagnosis system with machine learning algorithms for the prediction of any disease that can help in a very more accurate diagnosis than the traditional method. The proposed model is a Disease Prediction System with the help of the machine learning algorithm Naïve Bayes which takes the symptoms as the input and it gives the output as a predicted disease. It results in saving time and also makes it easy to induce a warning about your health before it's too late.
2) Bilal Khan, et al. 2020 [2], In this paper, the author employed experiential analysis of ML techniques for classifying the kidney patient dataset as CKD or NOTCKD. Seven ML techniques together with NBTree, J48, Support Vector Machine, Logistic Regression, Multi-layer Perceptron, Naïve Bayes, and Composite Hypercube on Iterated Random Projection (CHIRP) are utilized and assessed using distinctive evaluation measures such as mean absolute error (MAE), root means squared error (RMSE), relative absolute error (RAE), root relative squared error (RRSE), recall, precision, F-measure and accuracy.
3) handrasekhar Rao Jetti, et al. 2021 [3], The author developed this work mainly to make doctors' jobs easier by using a machine to examine a patient at a basic level and recommend diseases that may be present. It begins by inquiring about the patient's symptoms; if the device can determine the relevant condition, it then recommends a doctor in the patient's immediate vicinity. The system will show the result based on the available accumulated data.
4) Selvaraj, et al. 2021 [4], In this paper, the author extracted personal data such as user health conditions from day-to-day life. The lifestyle data are gathered and stored at the data repository by using web technology and mobile applications. The user enters their daily health conditions in textual format. Natural Language Processing is used to understand the given input and further forecast the user's illness.
5) A G Naveen Kishore and few other authors proposed the work named Prediction of Diabetes Using Machine Learning Classification Techniques proposed. In this work, various classification algorithms like SVM, Logistic Regression, Decision Tree, KNN, Random Forest are utilized on the 769 instances of the Pima dataset which contain features like Pregnancies, Blood pressure, body mass index, etc. They have Reported the highest accuracy as 74.4 %for the classification algorithm Random Forest and the lowest Accuracy in this work is attained by the KNN reported as 71.3% [5].
6) The work "Understanding the lifestyle of people to identify the reasons for Diabetes using data mining" proposed by Gavin Pinto, Radhika Desai, and Sunil Jangid discussed reducing the risk of diabetes disease using data mining techniques and also discussed diabetes sub-classification. The authors used Naïve Bayes and SVM classification algorithms on the dataset collected by a survey using google forms and reported the accuracy of 64.92 for SVM and 60.44 for Naïve Bayes [6].
7) Miao J.H., Miao K.H. et al. (2018), for example, offered a DL-based technique to diagnosing cardiotocographic fetal health based on a multiclass morphologic pattern. The created model is used to differentiate and categorize the morphologic pattern of individuals suffering from pregnancy complications. Their preliminary computational findings include accuracy of 88.02%, a precision of 85.01%, and an F-score of 0.85 [7].
8) In the work presented by M. Marimuthu, S. Deiva-Rani, Gayatri. R described the cardio diseases in a detailed manner and also applied the classification algorithms like SVM, Decision Tree, Naïve Bayes, K-Nearest Neighbors on the Framingham dataset from Kaggle. The authors compared various machine learning algorithms for the forecast of the risk of heart disease. The highest reported accuracy in this work is 83.60% for the KNN classification algorithm [8].
9) In the work proposed by Purushottam, Richa Sharma and Dr. Kanak Saxena discuss cardiovascular sickness by using the implementation of Knowledge Extraction based on Evolutionary Learning (java programming technique for making the development model for data mining issues). The highest reported accuracy in this work is 86.7%[9].
10) Sriram et al. (2013) used KNN, SVM, NB, and RF algorithms to develop intelligent Parkinson's disease diagnosis systems. Their computational result shows that, among all other algorithms, RF shows the best performance (90.26% accuracy), and NB demonstrate the worst performance (69.23% accuracy) [10].
11) Amandeep Kaur and Jyothi Arora presented a study that covered the examination of algorithms such as KNN, SVM, ANN, and Decision Tree on the heart disease dataset and plotted the accuracies graph [11].
12) Noreen Fatima proposed work on the Cancer forecast the data mining techniques and machine learning techniques that can predict cancer effectively on the large health records and described the study previous existing models [12].
13) Ch. Shravya, K. Pravallika, Shaik Subhani presented the work on Breast cancer prediction using Supervised machine learning techniques on the dataset and also analyzed the results with (PCA)principal component analysis and also used the dimensionality reduction and explained in a well-mannered way [13].

14) Nikitha Rane, Jean Sunny presented work on the classification of Cancer using machine learning concepts and their major discussion point is detecting cancer in very early stages so that a lot of lives can be saved [14].
15) Numerous studies widely presented ML-based systems for diabetes patient detection. For example, Kandhasamy and Balamurali (2015) compared ML classifiers (J48 DT, KNN, RF, and SVM) for classifying patients with diabetes mellitus [15]. The experiment was conducted on the UCI Diabetes dataset, and the KNN (K = 1) and RF classifiers obtained near-perfect accuracy.
16) Yahyaoui et al. (2019) presented a Clinical Decision Support Systems (CDSS) to aid physicians or practitioners with Diabetes diagnosis. To reach this goal, the study utilized a variety of ML techniques, including SVM, RF, and deep convolutional neural network (CNN). RF outperformed all other algorithms in their computations, obtaining an accuracy of 83.67%, while DL and SVM scored 76.81% and 65.38% accuracy, respectively [16].
17) Dai et al. (2019) proposed a CNN-based model to develop an application to detect Skin cancer. The authors used a publicly available dataset, HAM10000, to experiment and achieved 75.2% accuracy [17].
18) Daghrir et al. (2020) evaluated KNN, SVM, CNN, Majority Voting using ISIC (International Skin Imaging Collaboration) dataset to detect Melanoma skin cancer. The best result was found using Majority Voting (88.4% accuracy) [18].
19) Multiple algorithms have been adopted and tested in developing ML based Alzheimer disease diagnosis. For example, Vidushi and Shrivastava (2019) experimented using Logistic Regression (LR), SVM, DT, ensemble Random Forest (RF), and Boosting Adaboost and achieved an accuracy of 78.95%, 81.58%, 81.58%, 84.21%, and 74.21% respectively [19].
20) Several studies investigated and advised screening COVID-19 patients utilizing chest X-ray images in parallel, with major contributions. For example, Hemdan et al. (2020) used a small dataset of only 50 images to identify COVID-19 patients from chest X-ray images with an accuracy of 90% and 95%, respectively, using VGG19 and ResNet50 models [20].
21) Sultana et al. (2021) detects breast cancer using a different ANN architecture on the WBC dataset. They employed a variety of NN architectures, including the multilayer perceptron (MLP) neural network, the Jordan/Elman NN, the modular neural network (MNN), the generalized feedforward neural network (GFFNN), the self-organizing feature map (SOFM), the SVM neural network, the probabilistic neural network (PNN), and the recurrent neural network (RNN). Their final computational result demonstrates that the PNN with 98.24% accuracy outperforms the other NN models utilized in that study [21].
22) Mohammed et al. (2020) conducted a nearly identical study. The authors employ three ML algorithms to find the best ML methods: DT (J48), NB, and sequential minimal optimization (SMO), and the experiment was conducted on two popular datasets: WBC and breast cancer datasets. One of the interesting aspects of this research is that they focused on data imbalance issues and minimized the imbalance problem through the use of resampling data labeling procedures. Their findings showed that the SMO algorithms exceeded the other two classifiers, attaining more than 95% accuracy on both datasets [22].
23) Rubin et al. (2017) uses deep-convolutional-neural-network-based approaches to detect irregular cardiac sounds. The authors of this study adjusted the loss function to improve the training dataset's sensitivity and specificity. Their suggested model was tested in the 2016 PhysioNet computing competition. They finished second in the competition, with a final prediction of 0.95 specificity and 0.73 sensitivity [23].
24) The method proposed by Pingale et al. using Naïve Bayes method they are predicting limited diseases such as Diabetes, Malaria, Jaundice, Dengue, and Tuberculosis They have not worked on a large dataset to predict large numbers of diseases [24].
25) The Method proposed by Jianfang et al. [25] used Support Vector Machine (SVM) for the classification of diseases based on the symptoms. The SVM model is efficient for the prediction of diseases but requires more time to predict disease [12]. Also, a method is unable to increase the accuracy of the model. The approach has the drawback of classifying objects using a hyperplane, which is only partially effective
26) The method proposed by Chhogyal and Nayak [26] used Naïve Bayes classifier. They have obtained poor accuracy in disease prediction also they are not using the standard dataset for training.
27) The method proposed by Kumar et al. [27] used Rustboost Algorithm. RUSBoost is developed to address the issue of class imbalance [20]. However, the RUSBoost algorithm employs random under-sampling as a resampling method which can lead to the loss of crucial information. Therefore, this algorithm was not taken into account when training the data. The above-mentioned approaches have discussed various machine-learning techniques for disease prediction. However, the author has not employed some issues such as efficiency, accuracy, the limited size of the data set used to train the model and considered limited symptoms to diagnose the disease. To overcome all these issues there is a need to propose a modified and accurate model for predicting human diseases.

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Table 1: Literature Survey Overview

S. no	Title	Author Name	Year	Key points
1	Disease Prediction System using naïve bayes.	Sameer Meshram	2022	In this paper, he developed a diagnosis system with machine learning algorithms for the prediction of any disease that can help in a very more accurate diagnosis than the traditional method.
2	An Empirical Evaluation of Machine Learning Techniques for Chronic Kidney Disease Prophecy.	Bilal Khan	2020	In this paper, the author employed experiential analysis of ML techniques for classifying the kidney patient dataset as CKD or NOTCKD.
3	Disease Prediction using Naïve Bayes – Machine Learning Algorithm.	Chandrasekhar Rao Jetti,	2021	The author developed this work mainly to make doctors' jobs easier by using a machine to examine a patient at a basic level and recommend diseases that may be present. The system will show the result based on the available accumulated data.
4	Prediction Support System for Multiple Disease Prediction Using Naïve Bayes Classifier.	Selvaraj	2021	In this paper, the author extracted personal data such as user health conditions from day-to-day life. Further Natural Language was used.

5	Prediction Of Diabetes Using Machine Learning Classification Algorithms.	A Naveen Kishore G,V .Rajesh , A.Vamsi Akki Reddy, K.Sumedh,T.rajesh Sai Reddy.	2020	They have Reported the highest accuracy as 74.4 %for the classification algorithm Random Forest and the lowest Accuracy in this work is attained by the KNN reported as 71.3%.
6	Understanding the Lifestyle of people to identify the reasons of Diabetes using data mining.	Gavin Pinto, Radhika Desai, and Sunil Jangid.	2022	The authors used Naïve Bayes and SVM classification algorithms on the dataset collected by a survey using google forms and reported the accuracy of 64.92 for SVM and 60.44 for Naïve Bayes.
7	Cardiotocographic diagnosis of fetal health based on multiclass morphologic pattern predictions using deep learning classification.	Miao J.H., Miao K.H. et al.	2018	The created model is used to differentiate and categorize the morphologic pattern of individuals suffering from pregnancy complications.
8	An empirical study of a simple naive bayes classifier based on ranking functions.	Chhogyal and Nayak	2016	They have obtained poor accuracy in disease prediction also they are not using the standard dataset for training,

III. OBJECTIVES

1) *Objective 1:* To develop a multiple disease prediction system that is accurate and efficient.
2) *Objective 2:* To investigate the impact of different data preprocessing techniques on the performance of multiple disease prediction.
3) *Objective 3:* To compare the performance of different machine learning algorithms for multiple disease prediction system.
4) *Objective 4:* To compare the performance of different machine learning algorithms for multiple disease prediction system.
5) *Objective 5:* Evaluate the system's effectiveness in reducing litter, improving data collection efficiency, and enhancing proper detections.

IV. PROPOSED WORK

1) The aim is to develop a comprehensive multiple disease prediction system leveraging machine learning techniques.
2) This system will integrate diverse datasets, including medical records, genetic profiles, lifestyle factors, and environmental data, to create individual health profiles.
3) The primary focus lies in building accurate predictive models capable of forecasting the concurrent risk of various diseases.
4) Feature selection and engineering will refine these models, enhancing their accuracy and reliability.
5) The system’s objectives encompass early disease detection, enabling timely interventions and personalized preventive strategies.
6) Furthermore, the system endeavors to provide actionable clinical insights, empowering healthcare professionals with interpretable data for astute decision-making in disease management.

V. METHODOLOGY

Firstly, we meticulously define the problem at the outset of our project, ensuring clarity to construct the necessary and appropriate machine learning models. Subsequently, we gather data from reputable open sources like Kaggle and UCI Machine Learning Repository, recognizing the pivotal role of data quality and quantity in shaping the efficacy of our models. Following data collection, a crucial phase of data preprocessing unfolds, where we meticulously ensure that the gathered data adheres to the correct format. Our attention is directed towards analyzing the data to identify and address issues such as duplicate entries, missing values, and outliers. Visualization techniques are employed to unravel relationships between variables, extracting valuable insights and addressing skewness. In the pursuit of robust and accurate machine learning models, the data is strategically divided into training and testing datasets. Here, 80% of the data is allocated for training purposes, with the remaining 20% earmarked for testing—a pivotal step in fortifying the integrity of our models. This meticulous process not only lays the foundation for accurate predictive modeling but also enables us to draw meaningful conclusions and insights from the data at our disposal.

VI. CONCLUSION

The project's core objective lies in advancing the early prediction of diseases, thereby enhancing patient health outcomes. The focal point revolves around predicting multiple diseases based on an analysis of symptoms. The system, intricately designed for this purpose, accepts patient symptoms as input and generates an output—effectively predicting the potential disease. This predictive model holds promise in not only minimizing the financial burden associated with disease management but also in expediting the recovery process. Through the utilization of this system, patients stand to benefit by reducing treatment costs and saving valuable time. The emphasis on early detection underscores a proactive approach to healthcare, ultimately contributing to improved patient well-being and resource optimization.

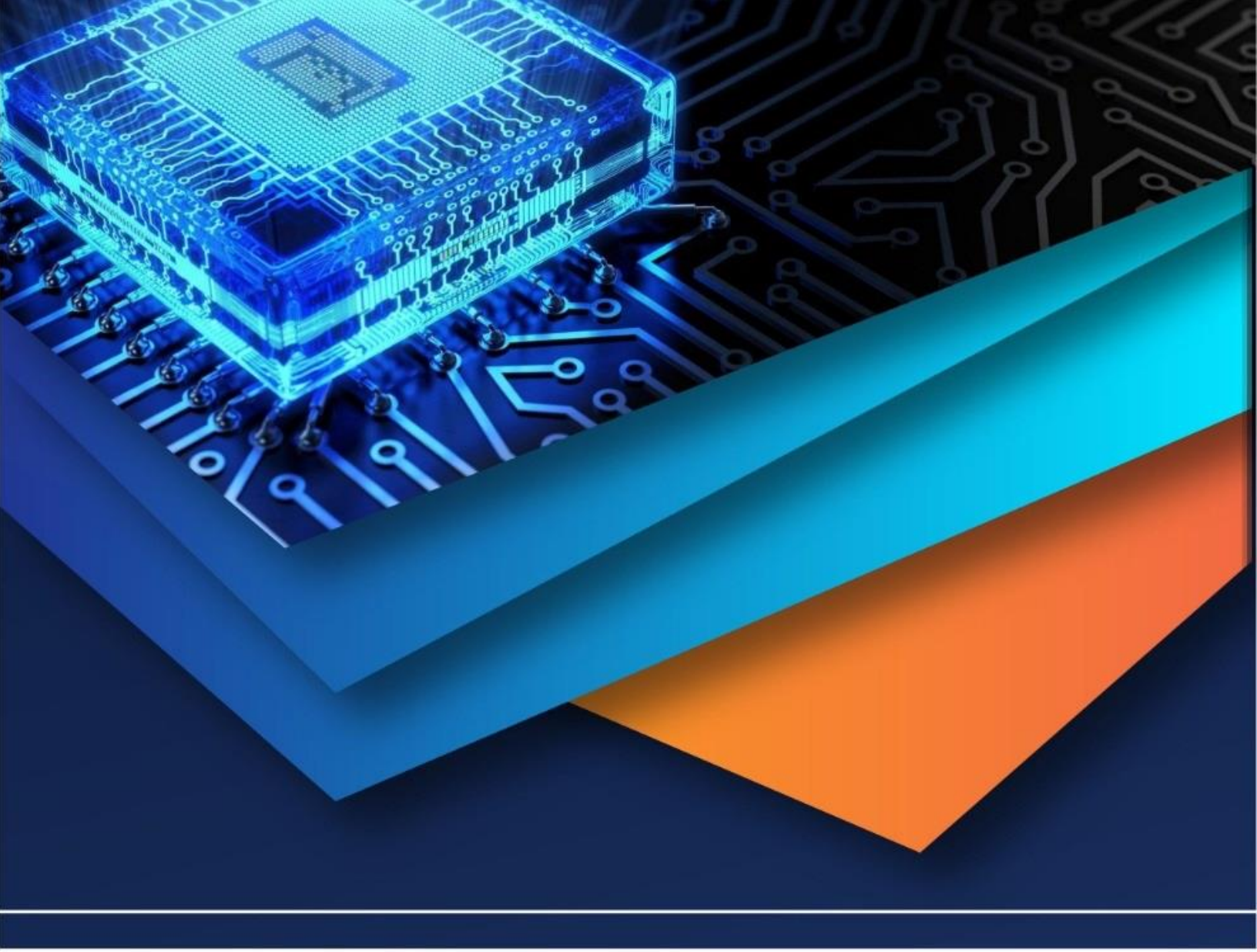
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a) Conceptualization, methodology, software development.
b) Data Collection.
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7) *Conflict of Interest Statement:* On behalf of all authors, the corresponding author states that there is no conflict of interest.

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