**A Detailed Review on Disease Prediction using Symptoms based on Machine Learning**

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**ABSTRACT**

Technology is doing wonders to the health care world. We have advanced tremendously from previous years. information technology has been transforming health care industry. This dissertation investigates the use of health information technology by health care providers and patients as well as its outcomes. With the increased computational power and ease of gathering medical information, Artificial Intelligence has helped all areas of health in developing algorithms and techniques for disease diagnosis and staging. The technology has been applied in several areas, due to its wide range of features, some activities become simpler with your help. Health Information needs are changing the information seeking behavior drastically and can be observed around the globe. Many challenges are faced by people when looking online for health information around diseases, different treatments and diagnosis. People face many problems in understanding the heterogeneous medical vocabulary. People are confused because a huge amount of medical information is available on various mediums. If a prediction system can be made for laymen, doctors and the medicine industry using Review Mining will be very useful and save a lot of time. The idea behind the Disease Prediction System is to adapt to cope up with the special requirements of the health domain. In the present paper we have explained how we have developed a prediction model which is trained using four machine learning algorithms in the same model and achieved accuracy greater than 94%. User interface will help to connect to a machine learning model which gets easier for lay public and connection of machine learning model to user interface will be useful for making interactive programming interfaces with higher functionality.

In the present paper we have tried to explain how we have built disease prediction system based on symptoms. Prediction System is accurately predicts a disease by looking at the symptoms of the patient. The interesting thing we did while building this model is training the prediction model by more than one algorithm in the same model. We have used 4 different algorithms for this purpose and gained an accuracy of 92-95%. Idea behind using multiple algorithms is that every algorithm will try to suggest a disease with its higher accuracy and by that we will get multiple recommendations and then we can have a clear idea about what kind of diseases a patient may have. Also by getting the result of various algorithms we can learn in depth working of algorithms with various cases. Such a predictor system can have a very large potential in the medical Industry and diagnosis of the diseases in the future. We have also designed an easily understandable interactive user interface to facilitate interaction with the system and attempted to show and visualize the result of our study. Connection of machine learning model to user interface will give idea to build interactive programming interfaces with higher functionality. Disease prediction system is recommended in part to support society, doctors, patients, medical industry, Clinics and OPDs in hospitals. Research work can be useful for Data Scientist, Data Analyst, Artificial Intelligence and Machine Learning Experts and consultants and for Researchers as well for information based on valuation of a machine learning model building.

***KEYWORDS****- Decision Tree, Machine Learning, Naïve Bayes, Random Forest.*

**INTRODUCTION**

According to McKinsey’s report, 50% of Americans have multiple chronic diseases. Due to living habits that people have, the chances of chronic disease is increasing [1]. In India, as the lifestyle of people has improved, the frequency of diseases is also increased. Approx. 60% of death has happened

due to non-communicable diseases like heart disorder, cancer, and diabetes. These diseases are often caused by environmental conditions and living habits that people have [2]. Continuous growth in medical data gave us a way to extract the required information to predict the disease. Data Science and

 Big Data can be applied to detect various types of diseases by using past health data collected from thepatient. These disease prediction models are very important to know the presence of disese . For the detection of the diseases we require machine learning techniques like supervised, semi-supervised, unsupervised learning, etc. and raw medical data [4]. This raw data could easily obtained from famous government hospitals. Machine learning techniques can use the raw data for the learning process.

**LITERATURE REVIEW**

There have been numerous studies done related to predicting the disease using different machine learning techniques and algorithms which can be used by medical institutions. This paper reviews some of those studies done in research papers using the techniques and results used by them. Reviews are given below:

**A Reviews**

**MIN CHEN et al, [1]**was an Assistant Professor with the School of Computer Science and Engineering, Seoul National University (SNU), proposed a disease prediction system in his paper where he used machine learning algorithms. In the prediction of disease, he used techniques like CNN-UDRP algorithm, CNN-MDRP algorithm, Naive Bayes, K-Nearest Neighbor, and Decision Tree. This proposed system had an accuracy of 94.8%. he describe the overall results about Structure data and Structure and text-data.the performance of CNN-MDRP (S&T-data) is better than CNN-UDRP (T-data).For S-data, he used traditional machine learning algorithms, i.e., NB, KNN and DT algorithm to predict the risk of cerebral infarction diseaset the accuracy of the three machine learning algorithms are roughly around 50%. Among them, the accuracy of DT which is 63% is highest, followed by NB and KNN. The recall of NB is 0.80 which is the highest, followed by DT and KNN.

 In conclusion, for disease risk modelling, the accuracy of risk prediction depends on the diversity feature of the hospital data, i.e., the better is the feature description of the disease, the higher the accuracy will be. For some simple disease, e.g., hyperlipidemia, only a few features of structured data can get a good description of the disease, resulting in fairly good

effect of disease risk prediction.But for a complex disease, such as cerebral infarction mentioned in the paper, only using features of structured data is not a good way to describe the disease.

**Sayali Ambekar et al, [2]** recommended Disease Risk Prediction and used a convolution neural network to perform the task. In this paper machine learning techniques like CNN-UDRP algorithm, Naive Bayes, and KNN algorithm are used. The system uses structured data to be trained and its accuracy reaches 82% and achieved by using Naïve Bayes**.**

**Naganna Chetty et al, [3]** at NIT suratkhal karnataka developed a system that gives improved results for disease prediction and used a fuzzy approach and used techniques like KNN classifier, Fuzzy c-means clustering, and Fuzzy KNN classifier. In this paper diabetes disease and liver, disorder prediction is done and the accuracy of Diabetes is 97.02% and Liver disorder is 96.13.

**Dhiraj Dahiwade et al, [4]** designed a model for prediction of the disease using approaches of machine learning and used techniques like KNN and CNN.Moreover, the proposed solution was supplemented with more information that concerned the living habits of the tested patient, which proved to be helpful in understanding the level of risk attached to the predicted disease. compared the results between KNN and CNN algorithm in terms of processing time and accuracy. The accuracy and processing time of CNN were 84.5% and 11.1 seconds, respectively This paper suggests disease prediction i.e. based on patient’s symptoms. The accuracy of KNN is 95% and the accuracy of CNN is 98%.

**Pahulpreet Singh Kohli et al, [5]** we apply different classification algorithms, each with its own advantage on three separate databases of disease (Heart, Breast cancer, Diabetes) available in UCI repository for disease prediction. The feature selection for each dataset was accomplished by backward modeling using the p-value test. The results of the study strengthen the idea of the application of machine learning in early detection of diseases.suggested disease prediction by using applications and methods of machine learning and used techniques like Logistic Regression, Decision Tree, Support Vector Machine, Random Forest and Adaptive Boosting. This paper focuses on predicting Heart disease, Breast cancer, and Diabetes. The highest

accuracies are obtained using Logistic Regression that is 95.71% for Breast cancer, 84.42% for Diabetes, and 87.12% for Heart disease.

**Deeraj Shetty et al, [6]** studied the uses of data mining for diabetes disease prediction by using Naïve Bayes and KNN algorithms. This system predicts diabetes and accuracy obtained by KNN are better than Naïve Bayes.

**Rashmi G Saboji et al, [7]** tried to find a scalable solution that can predict heart disease utilizing classification mining and used Random Forest Algorithm. This system presents a comparison against Naïve-Bayes classifier but Random Forest gives more accurate results with accuracy 98%.

**Rati Shukla et al, [8].** He suggested prediction and detection for breast cancer by utilizing machine learning techniques like Decision Tree, Support Vector Machine, Random Forest, Naïve Bayes, Neural Network, and KNN. In this system, the Support Vector Machine gives more accurate results than all other algorithms. Senthilkumar Mohan et al, [11] focused on hybrid

**Lambodar Jena et al, [9]** focused on risk prediction for chronic diseases by taking advantage of distributed machine learning classifiers and used techniques like Naive Bayes and Multilayer Perceptron. This paper tries to predict Chronic-Kidney-Disease and the accuracy of Naïve Bayes and Multilayer Perceptron is 95% and 99.7% respectively.

**Dhomse Kanchan B. et al, [10]** studied special disease prediction utilizing principal component analysis using machine learning algorithms involving techniques like Naive Bayes classification, Decision Tree, and Support Vector Machine. The accuracy of this system is 34.89% for Diabetes and 53% for Heart disease.

**Senthilkumar Mohan et al, [11]** focused on hybrid techniques in machine learning that can be used for effectively predicting heart disease and used algorithms like Decision Tree, Support Vector Machine, Random Forest, Naïve Bayes, Neural Network and KNN. The accuracy of this system is 88.47%.

**Anjan Nikhil Repaka et al, [12]** designed and implemented a prediction model for heart disease using naive Bayesian. Any user can use this system using any smartphone device and get the prediction results. The accuracy of this system is 89.77%.

**Aakash Chauhan et al, [13]** proposed a disease prediction model for heart disease by utilizing evolutionary rule learning. Association Rule is used in this proposed system. This system is not very efficient because it has an accuracy of 53%.

**Aditi Gavhane et al, [14]** suggested prediction for heart disease that utilizes Machine Learning. Multi-Layer Perceptron model is used in this system. This system predicts heart disease based on basic symptoms like age, sex, pulse rate, etc. The accuracy of this suggested system is 91%.

**Ankita Dewan et al, [15]** recommended a disease prediction system that uses data mining classification hybrid technique for predicting heart disease. This system is using techniques like Neural Network, Decision Tree, and Naive Bayes. The accuracy of this system is 87%. .

**B. A comparative study using various algorithms in the literature review Table**

**1: Comparative study using various algorithms in the literature review**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Authore** | **Purpose** | **Techniques used** | **Accuracy** |
| **2017** | MIN CHEN et al[1] | Proposed a disease prediction system in his paper where he used machine learning algorithms. | CNN-UDRP algorithm, CNN-MDRP algorithm, Naive Bayes, K-Nearest Neighbor, Decision Tree | 94.8% |
| **2018** | Sayali Ambe kar et al, [2] | Recommended Disease Risk Prediction and used a convolution neural network to perform the task | CNN-UDRP algorithm, Naive Bayes and KNN algorithm | The highest accuracy of 82% is achieve d by Naïve Bayes. |
| **2015** | Nagan na Chetty et al, [3] | Developed a system that gives improved results for disease prediction and used a fuzzy approach | KNN classifier, Fuzzy c-means clustering, and Fuzzy KNN classifier | Diabetes: 97.02 % Liver disorder: 96.13% |
| **2019** | Dhiraj Dahiw ade et al, [4] | Designed a model for prediction of the disease using approaches of machine learning | K-Nearest neighbor (KNN) and Convolutional neural network (CNN) | KNN: 95% CNN: 98% |
| **2017** | Lambo dar Jena et al, [5] | Focused on risk prediction for chronic diseases by taking advantage ofdistributed machine learning classifiers | Naive Bayes | 95% |
| Multilayer Perceptron | 99.7 |
| **2016** | Dhom se Kanch an B. et al, [6] | Studied special disease prediction utilizing principal component analysis using machine learning algorithms | Naive Bayes classification, Decision Tree and Support Vector Machine | Diabetes Diseas e: 34.89 % Heart Diseas e: 53% |
| **2018** | Pahulp reet Singh Kohli et al, [7] | Suggested disease prediction by using applications and methods of machine learning | Logistic Regression | Breast Cancer : 95.71 % Diabet es: 84.42 % Heart Disease: 87.12 |
| Decision Tree | Breast Cancer : 94.29 % Diabet es: 74.03 % Heart Disease: 70.97 |
| Random Forest  | Breast Cancer : 97.14 % Diabet es: 81.82 % Heart Disease 77.42 |
| Support Vector Machine | Breast Cancer : 97.14 % Diabet es: 85.71 % Heart Diseas e: 83,87 |
| Adaptive Boosting | Breast Cancer : 98.57 % Diabet es: 80.52 % Heart Disease: 83.87 |
| **2017** | Deeraj Shetty et al, [8] | Studied the uses of data mining for diabetes disease prediction | Naïve Bayes and KNN | KNN gives better accurac y, compar ed to Naïve Bayes |
| **2017** | Rashm i G Saboji et al, [9] | Tried to find a scalable solution that can predict heart disease utilizing classification mining | Random Forest Algorithm | 98% |
| **2019** | Rati Shukla et al, [10] | Suggested prediction and detection for breast cancer by utilizing machine learning techniques | Naive Bayes Classifier, Logistic Regression, Support Vector Machine(SVM), Artificial Neural Networks and K-Nearest Neighbor | SVM provide s a more accurate result compaed to others. |
| **2019** | Senthi lkuma r Mohan et al, [11] | Focused on hybrid techniques in machine learning that can be used for effectively predicting heart disease | Decision Tree, Support Vector Machine, Random Forest, Naïve Bayes, Neural NetworkAnd KNN | 88.4% |
| **2019** | Anjan Nikhil Repak a et al, [12] | Designed and implemented a prediction model for heart disease using naive Bayesian | Naïve Bayes | 89.7% |
| **2018** | Aakas h Chauh an et al, [13] | Proposed a disease prediction model for heart disease by utilizing evolutionary rule learning | Association Rule | 53% |
| 2018 | Aditi Gavha ne et al, [14] | Suggested prediction for heart disease that utilizesMachine Learning | Multi-Layer Perceptron | 91% |
| 2015 | Ankita Dewan et al, [15] | Recommended a disease prediction system that uses data mining classification hybrid techniques | Neural Network, Decision Tree and Naive Bayes | 87% |

## FUTURE DIRECTIONS

## Although early studies assessing the prognostic value have demonstrated promising outcomes, further research is needed. To address whether the use of ML in predicting outcomes is truly a worthwhile avenue for clinicians to explore, prospective randomized clinical trials are needed.

## CONCLUSION

## Machine learning is a quickly advancing field in medicine and can be of great utility to clinicians in the near future, particularly in predicting the prognoses of complex disease conditions. As this technology advances, dermatologists will need to develop a foundational understanding of how it works and when it should be appropriately used in their clinical practice.

## To predict the diseases using multiple data mining and machine learning techniques and algorithms have been summarized. Each algorithm has its disease prediction performance and one can apply the proposed system according to his or her needs. It is also possible to improve the performance and accuracy of the algorithm if independent variables or features are selected more correctly. After studying these methods it has been found that if we have a structured dataset then the accuracy of prediction is improved.

## If we can collect millions of structured datasets for a particular disease then that disease can be predicted with the highest accuracy and data mining can help us collecting such datasets. These reviews have shown as that any machine learning model can be improved through multiple revisions and by changing the algorithms that they use. Sometimes it is good for the model but sometimes it reduces the performance of the model. In conclusion, by using a literature survey it has been identified that a single algorithm cannot perform very well but if it is combined with other algorithms then the accuracy can have huge improvements. So the combination of these algorithms should be used in multiple sequences and a comparison must be collected to check which of these combinations are performing with more accuracy than the previous ones in predicting the disease. There are so many possibilities ahead that could be utilized to improve the performance of these prediction systems and increase the scalability and accuracy of the system. It is not possible to explore all the options within this limited time, the following research options can be performed in the future. Multiple classification techniques and regression techniques should be combined, different types of decision trees and neural networks should be used to check how much accuracy has been improved.

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