Predicting disease from several symptoms using machine learning approach.

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Abstract - *Humans are the most intelligent species on the earth and are very health conscious. The evolution of recent technologies like data science and machine learning has opened the trail for healthcare communities and medical establishments, to observe the diseases earliest as potential and it helps to supply higher patient care. For many medical organizations, disease prediction is very important for making the best possible healthcare decisions. Machine Learning is a field where we can develop a model to learn machines to make decisions on their own from real-time data and from past experience. We proposed a model to predict disease from some symptoms. So, in this experiment, we propose a new knowledge-based system for disease prediction using KNN, SVM, NB, DT, RF, and LR for data modeling and we got maximum 98.36 percent accuracy from the KNN algorithm. This paper is planned to develop multi-disease prediction using the machine learning concept. Our main contribution is to implement feature engineering and standard scal-ing to optimize our algorithm and better performance. The decision pro-posed support system for disease diagnosis might be implemented using the suggested methodology, aiding doctors in their work and enhancing patient outcomes. So, future studies will concentrate on increasing the dataset to cover a wider range of patient demographics and improving the machine learning algorithms to better prediction accuracy.*

Key Words: **Machine Learning, Disease, Syndromes**

1.INTRODUCTION

Machine learning is the programming field of computers where computer systems learn from data and experience. Nowadays, demands for health-related information are transforming information-seeking behavior, as demonstrated globally. Finding accurate health information online on symptoms, diagnoses, and treatments can just be time-consuming and expensive for many people. Today, billions of searches are performed daily, and sometimes the results are significant, and sometimes they are not. Such search terms generate thousands of results linked to medical advice. Diseases and health-related problems like Pneumonia, dengue, AIDS, Diabetes, Hepatitis, Jaundice, Arthritis, etc.

Cause a major effect on someone's health and sometimes might also come to death if they ignore[1]. People usually want to know if their symptoms are indicative of any serious diseases. However, they cannot access any tools that would provide them with precise information. Mainly machine Learning technology gives us a superior platform in the medical field so that healthcare issues will be solved effectively[10]. From the Centers for Medicare and Medicaid Services, 50% of Americans have multiple chronic diseases with a total US healthcare expenditure in 2016 being about $3.3 trillion, which amounts to $10,348 per person in the US[11]. This project intends to give them the tools they need to tell end users about disease prediction. If review mining can be used to create a prediction system for physicians and medicine, a lot of time will be saved. Understanding complex medical terms, such as scientific names, might be challenging while using this type of system's user interface. The user is confused by the wealth of medical knowledge on numerous symptom categories that are provided. This system's objective is to change to meet the particular user interaction requirements of the health area. A crucial part of treatment is using symptoms to anticipate sickness. In our experiment, we give an effort to accurately predict a disease by examining the patient's symptoms.

In the field of health informatics, machine learning becomes more popular to diagnosis, prognosis, personalized medicine and identify any disease by using some machine leaning technique. So, if we can predict any disease at it's early stage, it will be more easy to give treatment to the patient by any medical servant. Overall, machine learning has the potential to change the medical industry by giving medical experts strong tools to more precisely and effectively predict, diagnose, and treat diseases.

2.LITERATURE REVIEW

Grampurohit, S. and Sagarnal, C., [1] Via assisting doctors in early clinical diagnosis and prediction, a classification method that was constructed employing machine learning techniques was intended to greatly aid inside this settlement for mental well-being challenges. One representative collection

containing 49201 patient records having diagnosis covering 40 diseases were selected for the study. The multiple regression was made up of 42 disorders. There must have been 95 of 132 independent factors (symptomatology) that were clearly related to diseases. In just this research study, a sickness estimation system was originally developed using machine learning algorithms like Classifier, Random Forest classifier, and the Naive Bayes classifier was exhibited. In just this study, 3 systems' effectiveness on a health file is thoroughly compared, with each algorithm producing results with just a reliability of upwards to 94%

Marouane Fethi Ferjani's [2] Through examining key metrics, these research seeks to find trends across different based On supervised model types towards sickness detection. Regarding classifiers, the K-Nearest Neighbor, Decision Tree (DT), and Naïve Bayes classifier (NB) algorithms attracted the most interest (KNN). Svm Classifier (SVM) is indeed the best at detecting parkinson's, as according to studies. Using Logistic Regression (LR) performed extremely well enough in terms of predicting heart conditions. Lastly, recommendations were performed employing Convolutional Neural Networks (CNN) and Random Forest (RF), accordingly, both precise specific diseases of infectious symptoms.

Anant Agrawal, Harshit Agrawal, Shivam Mittal, and Mradula Sharma declared [3] About this research, researchers propose a hybrid machine learning framework composed of support vector machines and evolutionary algorithms. Data sets for the liver, diabetes, and heart, that everything retrieved either from a reputed university were utilized to assess our algorithm. On the data sets, researchers evaluated their algorithms. These were 75.4% effective on the Cleveland Heart dataset. By maintaining all of the parameters, researchers were able to cut the feature count from Thirteen to Ten with sustaining overall compromise on accuracy as evaluated by the SVM alone across the entire data. For such liver datasets, they achieved the highest precision (78.6%). By minimizing the number of components, they were able to achieve marginally lower accurateness, however, they were both still well within acceptable parameters.

Chauhan, R.H., Naik, D.N., Halpati, R.A., Patel, S.J., and Prajapati, M.A., discussed [4] This test measures the patient's signs as input and determined the risk that the sickness may arise. Utilizing a decision-tree classifier, disease prediction is actually achieved. The frequency of an illness is computed by a decision tree classifier. Appropriate diagnosis data management improves in earlier disease classification and clinical management as big data demand increases inside the healthcare and biomedical industries.

Keniya, R., Khakharia, A., Shah, V., Gada, V., Manjalkar, R., Thaker, T., Warang, M. and Mehendale, N., wrote [5] it created a methodology to predict diseases employing multiple Machine learning techniques. Upwards of 235

diseases were included in the dataset that has been examined. This assessment system includes an outcome as such sickness which a person might well be encountering in light of the symptoms, age, and gender of the patient. Through comparing the different algorithms, a balanced KNN algorithm generated the greatest outcomes. This balanced KNN algorithm had a predictive performance around 93.6%. If an illness is identified earlier, our diagnostics program may play the role of a doctor, enabling appropriate care as well as the possibility of ensuring safety. designations.

3. METHODOLOGY

So, In this part, we have discussed some important phase So, In this part, we have discussed some important phase that is given below :

- Dataset Description.

- Data Preprocessing and exploration.

- Feature Engineering.

- Model Selection.

- System Architecture.

- Model Evaluation.

- Result and Discussion.

3.1 DATASET COLLECTION:

We collect the data from Kaggle[16], which has 132 syndromes from 4920 pa-tient data and we have taken into consideration consists of 132 symptoms and 41 disorders. We intend to create a model that incorporates user-provided symptoms and predicts the disease based on the 4920 patient data.

3.2 DATASET DESCRIPTION:

From the dataset, here is all syndromes that we analyzed for this experiment. This 132 syndrome is our independent variable. Depending on those syndromes we target the prognosis column to predict disease.

Table-1: The table shows the all syndromes from our dataset.

1. itching	45. acute_liver_failure	89. loss_of_smell
2. skin_rash	46. fluid_overload	90. bladder_discomfort
3. nodal_skin_eruptions	47. swelling_of_stomach	91. foul_smell_of_urine
4. continuous_sneezing	48. swelled_lymph_nodes	92. continuous_feel_of_urine
5. shivering	49. malaise	93. passage_of_gases
6. chills	50. blurred_and_distorted_vision	94. internal_itching
7. joint_pain	51. phlegm	95. toxic_look_(typhos)
8. stomach_pain	52. throat_irritation	96. depression
9. acidity	53. redness_of_eyes	97. irritability
10. ulcers_on_tongue	54. sinus_pressure	98. muscle_pain
11. muscle_wasting	55. runny_nose	99. altered_sensorium
12. vomiting	56. congestion	100. red_spots_over_body
13. burning_micturition	57. chest_pain	101. belly_pain
14. spotting_urination	58. weakness_in_limbs	102. abnormal_menstruation
15. fatigue	59. fast_heart_rate	103. dischromic_patches
16. weight_gain	60. pain_during_bowel_movements	104. watering_from_eyes
17. anxiety	61. pain_in_anal_region	105. increased_appetite
18. cold_hands_and_feets	62. bloody_stool	106. polyuria
19. mood_swings	63. irritation_in_anus	107. family_history
20. weight_loss	64. neck_pain	108. mucoid_sputum
21. restlessness	65. dizziness	109. rusty_sputum
22. lethargy	66. cramps	110. lack_of_concentration
23. patches_in_throat	67. bruising	111. visual_disturbances
24. irregular_sugar_level	68. obesity	112. receiving_blood_transfusion
25. cough	69. swollen_legs	113. receiving_unsterile_injections
26. high_fever	70. swollen_blood_vessels	114. coma
27. sunken_eyes	71. puffy_face_and_eyes	115. stomach_bleeding
28. breathlessness	72. enlarged_thyroid	116. distention_of_abdomen
29. sweating	73. brittle_nails	117. history_of_alcohol_consumption
30. dehydration	74. swollen_extremeties	118. fluid_overload.1
31. indigestion	75. excessive_hunger	119. blood_in_sputum
32. headache	76. extra_marital_contacts	120. prominent_veins_on_calf
33. yellowish_skin	77. drying_and_tingling_lips	121. palpitations
34. dark_urine	78. slurred_speech	122. painful_walking
35. nausea	79. knee_pain	123. pus_filled_pimples
36. loss_of_appetite	80. hip_joint_pain	124. blackheads
37. pain_behind_the_eyes	81. muscle_weakness	125. scurring
38. back_pain	82. stiff_neck	126. skin_peeling
39. constipation	83. swelling_joints	127. silver_like_dusting
40. abdominal_pain	84. movement_stiffness	128. small_dents_in_nails
41. diarrhoea	85. spinning_movements	129. inflammatory_nails
42. mild_fever	86. loss_of_balance	130. blister
43. yellow_urine	87. unsteadiness	131. red_sore_around_nose
44. yellowing_of_eyes	88. weakness_of_one_body_side	132. yellow_crust_ooze

Table-2: All the syndromes in prognosis.

1. Fungal infection	15. Jaundice	29. Dimorphic hemorrhoids(piles)
2. Allergy	16. Malaria	30. Heart attack
3. GERD	17. Chickenpox	31. Varicose veins
4. Chronic cholestasis	18. Dengue	32. Hypothyroidism
5. Drug Reaction	19. Typhoid	33. Hyperthyroidism
6. Peptic ulcer disease	20. hepatitis A	34. Hypoglycemia
7. AIDS	21. Hepatitis B	35. Osteoarthritis
8. Diabetes	22. Hepatitis C	36. Arthritis
9. Gastroenteritis	23. Hepatitis D	37. (vertigo) Paroxysmal Positional Vertigo
10. Bronchial Asthma	24. Hepatitis E	38. Acne
11. Hypertension	25. Alcoholic hepatitis	39. Urinary tract infection
12. Migraine	26. Tuberculosis	40. Psoriasis
13. Cervical spondylosis	27. Common Cold	41. Impetigo
14. Paralysis (brain hemorrhage)	28. Pneumonia	

3.3 Data preprocessing and exploration:

Data pre-processing is an approach that changes the raw data or encodes the data into a form that the algorithm can quickly decode. The preprocessing methods applied in the study that is being presented in given below:

Data cleaning: Data cleaning is an important method for data pre-processing. Data is made clean through procedures including filling in missing values and removing null values which eliminate the data's discrepancies.

Data reduction: When working with large databases, analysis becomes challenging. That's why we eliminate some independent values that will not or have little effect on the target variable. So, 95 out of 132 symptoms that are closely related to the diseases are chosen for this research.

So for betterment, we have made several data visualizations to check the case of these factors.

In the dataset, we got several null values present in the columns. For modeling purposes, we decided to remove all the null values from each column and we converted all object values into categorical integer values.

From the given dataset, we were selected four target columns, which include the results from prognosis.

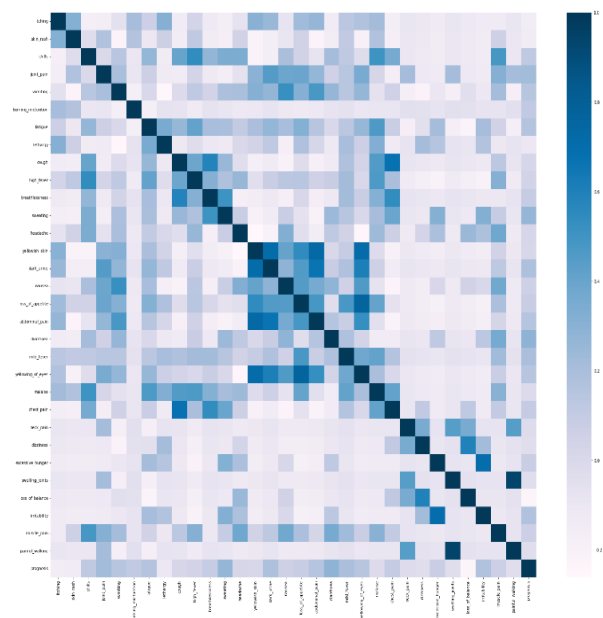Now, here is the correlation matrix diagram from our experiment.

Chart-1 : Correlation Matrix.

So, the correlational matrix is a table that shows the correlation coefficients between two symptoms.

3.4 Feature Engineering:

After preprocessing the dataset, we got 132 symptoms from 4920 patients. Then we use some method to predict the accuracy but the was 100 percent which was overfitted. So, in this case, we use feature engineering to remove low-importance features. After removing the low-importance feature we got 33 symptoms from 4920 patients. For example :
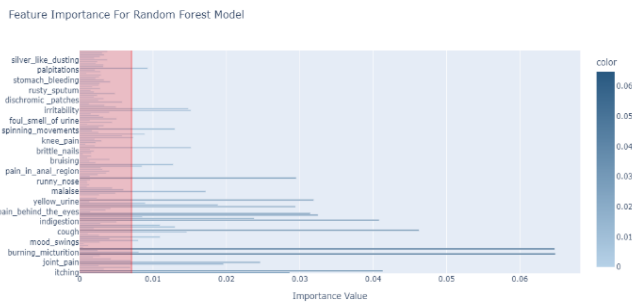

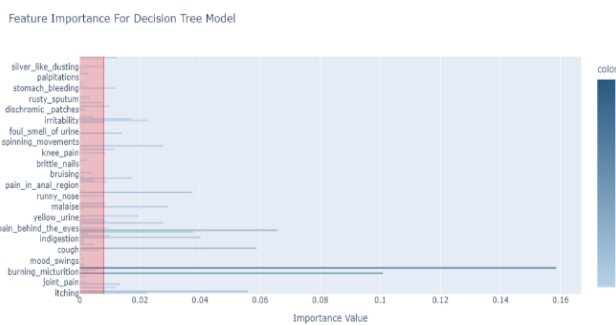**Chart-2:** Feature Importance for Random Forest Model.

Chart-3: Feature Importance for Decision Tree Model.

Lastly, after using feature engineering, we get the final data shape and we split the dataset into train and test datasets.

3.5 Model Selection:

We use six algorithms to predict diseases from the trained model.

- **K-Nearest Neighbor (KNN):**

- **Support Vector Machine. (SVM)**

- **Gaussian Naive Bayes (GNB)**

- **Decision Tree Classifier. (DT)**

- **Random forest Classifier. (RF)**

- **Logistic Regression. (LR)**

3.6 Working Procedure:

We analyze some historical data depending on syndromes. Then we input all data after cleaning the dataset to learn every model to predict the outcome.

Here are some models that we use in this project:

K- NEAREST NEIGHBORS – k-NN is a supervised learning classifier, non-parametric, which uses proximity to predictions the group of an individual data point.

SUPPORT VECTOR MACHINE – SVM is a type of deep learning supervised algorithm for the classification or regression of data groups.

GAUSSIAN NAÏVE BAYES – GNB is a probabilistic classification algorithm based on applying Bayes' theorem with strong independence assumptions.

DECISION TREE – A decision tree is a particularly particular sort of probabilistic tree that allows users to choose an approach to take a decision. It is a supervised learning method that is used for both classification and regression applications.

RANDOM FOREST – Leo Breiman and Adele Cutler are the creators of the widely used machine learning technique known as random forest, which mixes the output of several decision trees to produce a single outcome.

LOGISTIC REGRESSION – A statistical analysis approach called logistic regression uses previous observations from a data set to predict a binary result, such as yes or no. By examining the correlation between one or more already present independent variables, a logistic regression model forecasts a dependent data variable.

3.7 System Architecture:

In the given figure shows the working procedure of our system. In the system firstly we select the dataset then we preprocess the whole dataset, 2ndly we use feature engineering to remove all the low-importance features from the chosen dataset. 3rdly we clean the whole dataset after that we divide the dataset into train and test set. Lastly, we choose six classifiers to predict the disease.
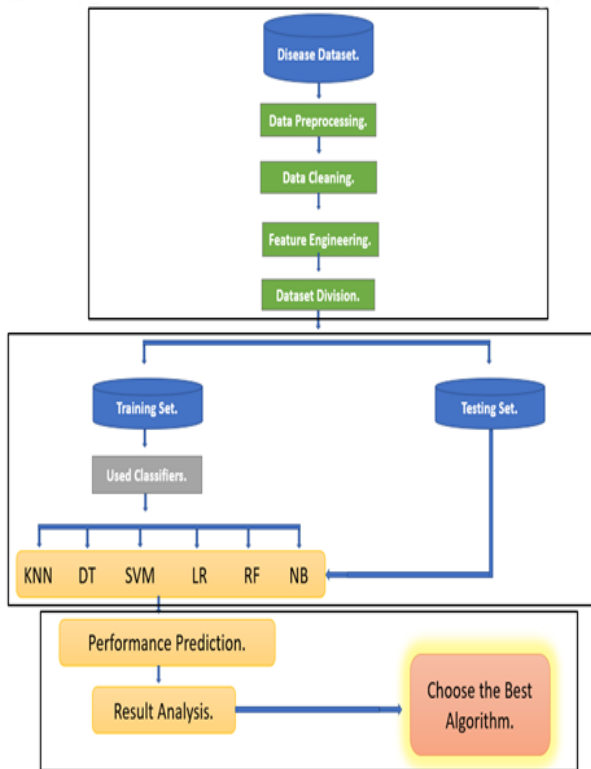
Chart-4 : System Architecture.

3.8 Evolution Method:

In this experiment, we calculate the performance of evolution. Firstly we represent TP, TN, FP, and FN, which represent True Positive, True Negative, False Positive, and False Negative respectively. Now, we will calculate the four measurements: recall, precision, accuracy, and F1 score as given below :

Accuracy: $\dfrac{TP + TN}{TP + TN + FP + FN}$ (1)

Precision: $\dfrac{TruePositive}{TruePositive + FalsePositive}$ (2)

Recall: $\dfrac{TruePositive}{TruePositive + FalseNegative}$ (3)

F1-Score : $\dfrac{2*Precision*Recall}{Precision + Recall}$ (4)

4. RESULT AND DISCUSSION.

In this work we use six algorithms to predict the accuracy of the model and calculate the classification report of each algorithm. So, the table shows the result obtained from our experiment.

Table-3: The table shows the accuracy and classification report of each algorithm.

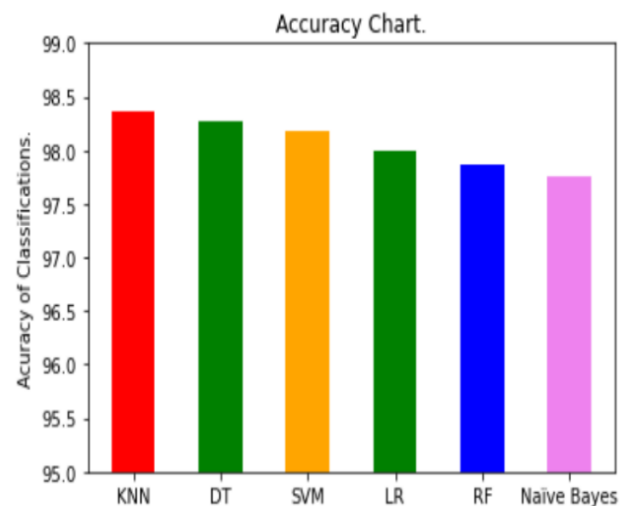| Algorithm	Accuracy	Precision	Recall	F1
K-Nearest Neighbor.	98.37%	98	98	98
Decision Tree	98.27%	98	98	98
Support Vector Machine.	98.17%	98	98	98
Logistic Regression	98.0%	98	98	98
Random Forest	97.86%	98	98	98
Naïve Bayes	97.76%	98	98	98

Chart -5: The chart shows the accuracy of six classifiers.

Here we use six machine learning models to predict the disease. Out of six models, we got 97% or more accuracy for all models. As shown in Figure-5 out of all the models, we got the highest accuracy for the KNN (K-Nearest Neighbor) that is 98.37% and the lowest accuracy for NB (Naive Bayes) which was 97.76%. Moreover, other models are DT, SVM, LR and RF Classifiers also the accuracy is accordingly 98.27%, 98.17%, 98.0%, and 97.86%. Lastly, Precision, recall, and F1 scores are 98% for all the models.

5. CONCLUSION

This project aims to predict any disease with the given symptoms. So, the experiment that we organized in a way that system takes input which is symptoms from the user and generates output by predicting the actual disease. To

sum up, the variety of aspects of the hospital data affects how accurately risk is predicted for diseases using risk modeling and we got maximum accuracy up to 98.37 percent from KNN algorithm.

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BIOGRAPHIES

Md. Atikur Rahman currently a undergraduate student till 2023 and studying in department of Computer Science and Engineering in Daffodil International University, Bangladesh. He works in the field of Machine Learning, Deep Learning, NLP & Artificial Intelligence also area of interest is health.

Tania Ahmed Nipa currently a student in the Department of Computer Science and Engineering at Daffodil International University. She have a genuine passion for web development and specifically specialize in the MERN stack. In addition to her technical skills, also she have a strong passion in the field of research.

Md. Assaduzzaman is a ex student of Daffodil International University. He is currently working as a Senior Lecturer at Daffodil International University. His interest in research area is Machine learning and NLP.