A COMPARATIVE ANALYSIS OF ALGORITHMS AND SVM BASED IMPLEMENTATION FOR ENHANCED MEDICINE RECOMMENDATION SYSTEM USING MACHINE LEARNING

MINI PROJECT REPORT

Submitted by

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CHENNAI

BONAFIDE CERTIFICATE

Certified that this Report titled "**A COMPARATIVE ANALYSIS OF ALGORITHMS AND SVM BASED IMPLEMENTATION FOR ENHANCED MEDICINE RECOMMENDATION SYSTEM USING MACHINE LEARNING**" is the bonafide work of **"Vinisha S (210701310) , Yar Zar Min (210701318)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Healthcare plays a crucial role in our lives, acting as the cornerstone of the medical field. Nowadays, many people seek medical information online, where a plethora of resources can present challenges in accessing accurate and reliable data. Additionally, medication errors pose a significant threat to human safety. To address these issues, we underscore the essentiality of deploying medicine recommendation systems in healthcare. These systems are designed to assist patients by providing accurate medications and precautions based on their symptoms. Our proposed system offers a user-friendly platform that helps patients understand their symptoms, predict potential diseases, and receive an overview of the appropriate medications, precautions, and dietary recommendations. Leveraging a dataset of medical information, the system recognizes accurate result patterns, offering a powerful tool for health management. We employ a supervised learning approach, utilizing labeled data to predict diseases and prescribe medications. Our multifaceted classifier set includes Support Vector Machines (SVM), Random Forest, Gradient Boosting, K-Nearest Neighbors, and Multinomial Naive Bayes. These classifiers are evaluated for their efficiency in accurate disease prediction. The implementation of the selected SVM model in a practical setting allows patients to input their symptoms, with the system predicting the most likely diseases. This tool not only aids patients but also serves healthcare professionals in making informed diagnosis and treatment decisions. Our project demonstrates the efficacy of these classifiers, ensuring reliable and precise results.

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LIST OF ABBREVIATIONS

SVM	Support Vector Machines
KNN	K Nearest Neighbours
RF	Random Forest
MNB	Multinomial Naïve Bayes
GB	Gradient Boosting

CHAPTER 1
INTRODUCTION

1.1 GENERAL

Medical recommendation systems have become increasingly important in the healthcare industry. With the vast amount of medical information available online, patients often struggle to find accurate and relevant information. This can lead to misinformation and potential health risks. To address this issue, medical recommendation systems use machine learning algorithms to provide accurate and personalized medical advice based on patient symptoms.

1.2 OBJECTIVE

The objective of this project is to develop and implement an advanced medical recommendation system utilizing machine learning algorithms to accurately predict diseases based on patient-reported symptoms and provide personalized medical advice. The system aims to enhance patient care by offering tailored recommendations for medications, precautions, and diet, while conducting a comparative analysis of various algorithms, including SVM, Random Forest, Gradient Boosting, KNN, and Multinomial Naive Bayes, to identify the most effective model. Additionally, the project seeks to create a user-friendly interface for easy symptom input and immediate, reliable medical guidance, ultimately improving patient outcomes and assisting healthcare professionals in diagnosis and treatment decisions.

1.3 EXISTING SYSTEM

Existing medical recommendation systems like WebMD and the Mayo Clinic provide valuable tools for users seeking to understand their health issues. These platforms offer symptom checkers where users can input their symptoms to receive potential diagnoses and treatment options. The algorithms behind these tools are built on extensive medical databases and expert input, which help generate lists of possible conditions based on statistical correlations between symptoms and diseases. In addition to symptom checkers, these platforms offer a wealth of general medical information, including articles, videos, and resources on various health topics,

written or reviewed by medical professionals to ensure accuracy and accessibility. However, these systems often provide broad recommendations that may not fully account for individual patient histories. The recommendations are generalized to cater to a wide audience, which means they might not consider specific nuances of a user's health, such as family medical history, genetics, or previous conditions. This generalization can result in broad and sometimes inaccurate diagnoses, particularly since many symptoms overlap across different conditions. Moreover, these tools rely heavily on users accurately reporting their symptoms, which can affect the reliability of the generated advice. The lack of personalized data further limits their ability to offer precise medical recommendations.while current medical recommendation systems offer valuable initial guidance, they face limitations in terms of personalization and accuracy. Integrating advanced technologies and comprehensive health data can significantly enhance their effectiveness, providing more tailored and reliable medical advice.

1.4 PROPOSED SYSTEM

The proposed medical recommendation system aims to enhance the accuracy and reliability of medical advice provided to patients. By leveraging advanced machine learning algorithms and conducting a thorough comparative analysis, the system will offer personalized medical recommendations, thereby improving patient outcomes and aiding healthcare professionals in making informed decisions. The implementation of the SVM model will demonstrate the practical application and effectiveness of the system in a real-world healthcare setting.

CHAPTER 2

LITERATURE SURVEY

The advent of Machine learning comes under the category of AI. Machine learning act as a tool that are used in healthcare and medical professionals which involves training the computer to emulate how people learn and think. This can be used in health care to collect and manage patient data ,identify the trend in health care and recommend medicine ,treatment ,diet etc. Nowadays hospitals and healthcare related fields began to use machine learning to improve the resolution and reduce the risk in medical field which has led to several new career and job opportunities.

Jay Prakash Gupta[1] proposed a project that involves predicting the disease and medicine especially for COVID affected people which was first found in China and became a pandemic. The medicines were not available for them to cure the disease .In this situation the doctors and specialists were manually recommending the medicine based on the symptoms. This causes huge loss of life because of lack of medicine availability. So they implemented a disease recommendation system based on symptom and also they came with an idea of developing the medicine based on the symptoms of disease. He implemented using three mining algorithm which includes decision tree classifier ,Random forest classifier and Naive bayes classifier and assigned different prediction level based on the result obtained from more than one classifier and he analyzed that some disease predicted by all the three classifier are same.

Kizar Abbas [2] proposed a blockchain based drug supply chain management and recommendation system using deep learning models which includes natural language processing ,N gram for predicting the number of words in a sequence, Light GMB for sentiment analysis.

The work by Ivens Portugal [3] demonstrates a recommendation system to provide users with product and service recommendation. He made this study to identify the use of machine learning algorithm in recommendation system to identify research information .His characterization adopted new machine learning algorithms in recommendation system and used big data technologies

Some researchers[4] developed a disease prediction and drug recommendation prototype by using multiple approaches for machine learning algorithms and predicted the disease based on the symptoms and drug recommendation provided.

[5] C. Shilpa proposed a online recommender system that being used in hospitals ,medical professionals and drugs .This medical suggestion can be used during pandemic floods and cyclone hit. She used the decision tree to predict the accurate result ,In time of emergency this system provides safe medication.

The [6] research shows a content based recommender system for medicine using machine learning algorithms .This research is mainly focused on machine learning models as well as examining to determine whether the content based recommender system approach is utilized to build drug recommendation models.

Adegun [7] made a research on CAD Based machine learning project for reducing Human-Factor-Related error in medical image analysis .He used machine learning techniques such as deep learning methods .This provides a user friendly website for detecting the error in medical image.

The paper is [8] about predicting diabetes mellitus using SMOIT and ensemble machine learning approach. He used 5 different models for predicting the diabetes such as decision tree ,Naïve bayes , Logistic regression, Logistic model tree and random forest .

This study shows the potential of ensembling and SMOTE approaches for predicting diabetes. In this work we are trying to implement a Medicine recommendation system where the disease is predicted based on the input that are provided by the used i.e symptoms , based on the symptoms and disease the top 5 medications to cure the particular disease is predicted and their precautions ,diet to be followed and workouts and predicted .We are implementing this by using Support machine vector model and predicted based on the symptoms .Also the dataset are trained by using 5 different algorithm which includes Support vector machine , Random forest ,Gradient Boosting ,K-Nearest ADRs.

[9] IoMT-Assisted patient diet Neighbors and Multinomial Naive in order to get the accurate result Each model is trained using the same dataset in order to compare the accuracy of the result provided by the model.

[10]Some model is mainly aimed to focus on predicting five possible disease based on the given dataset through the use of classification and supervised learning algorithms.This research mainly aim to provide patients with accurate result.

[11]The recent paper shows that the analysis and survey of various diseases not only predict the disease based on the symptoms but also aim to predict the vulnerability of the disease.Comparing the usefulness

[12]of traditional statistical methods and machine learning algorithms is done in medical fields and aims to incorporate increasing AI companies from diagnosis to treatment of disease.

CHAPTER 3
SYSTEM DESIGN

3.1 DEVELOPMENT ENVIRONMENT

3.1.1 HARDWARE SPECIFICATIONS

This project uses minimal hardware but in order to run the project efficiently without any lack of user experience, the following specifications are recommended

Table 3.1.1 Hardware Specifications

PROCESSOR	Intel Core i5
RAM	4GB or above (DDR4 RAM)
GPU	Intel Integrated Graphics
HARD DISK	6GB
PROCESSOR FREQUENCY	1.5 GHz or above

3.1.2 SOFTWARE SPECIFICATIONS

The software specifications in order to execute the project has been listed down in the below table. The requirements in terms of the software that needs to be pre- installed and the languages needed to develop the project has been listed out below.

SOFTWARES USED	Jupyter Notebook

Table 3.1.2 Software Specifications

3.2 SYSTEM DESIGN

3.2.1 ARCHITECTURE DIAGRAM

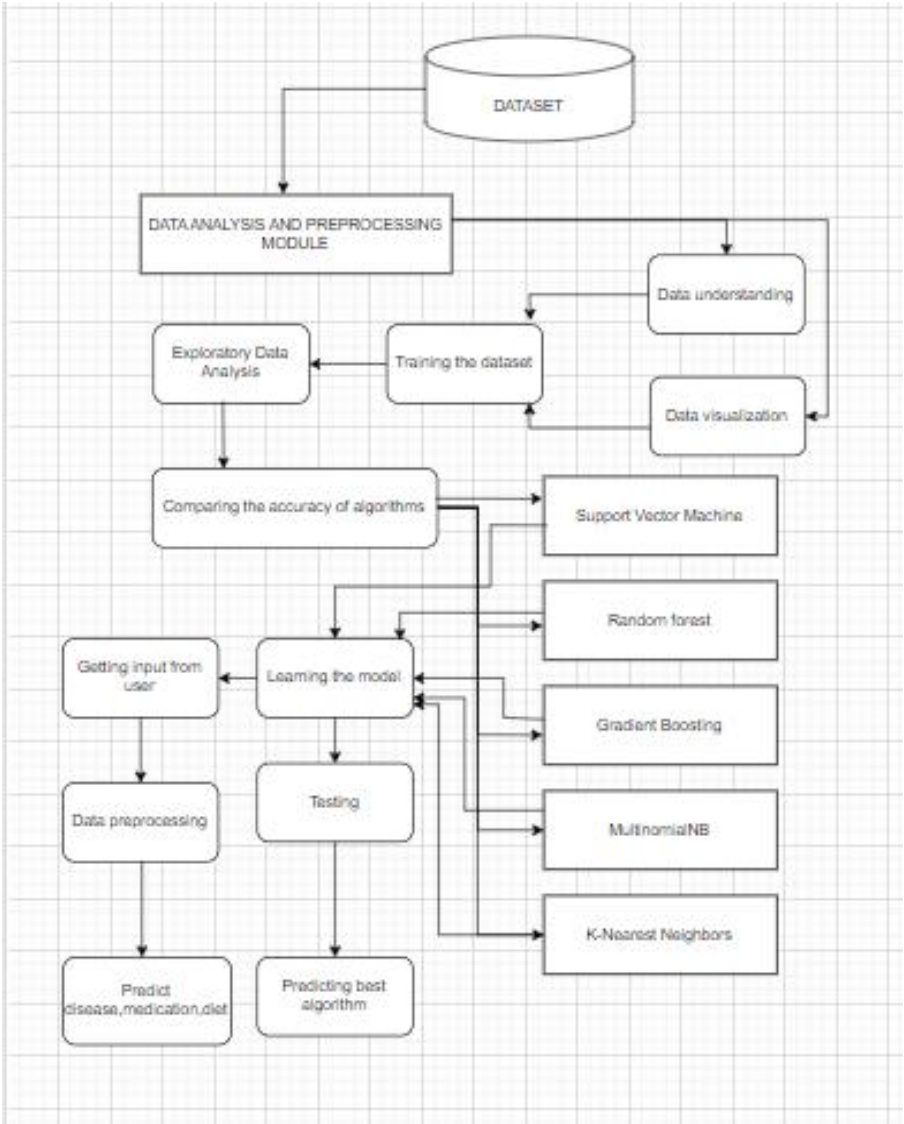

Fig 3.2.1 Architecture Diagram

PREPROCESSING AND TRAINING SET:

In the development of a robust and accurate medicine recommendation system for healthcare, data preprocessing and the creation of an effective training set are critical steps. The initial phase involves meticulous data collection from various sources, including electronic medical records, online healthcare databases, and public datasets. These datasets typically encompass a wealth of information about symptoms, diseases, and their corresponding medications. This foundational data must be meticulously curated to ensure its quality and relevance. Data cleaning is a crucial next step. This involves removing duplicate records that can skew the training process and filtering out irrelevant information that does not contribute to the predictive capabilities of the model. Handling missing values is another essential task; these can be addressed through imputation techniques, such as filling missing entries with mean or median values, or by removing records with substantial missing data if they constitute a small fraction of the dataset.F urther splitting the training set into training and validation subsets is essential for fine-tuning the model. This additional split helps in adjusting hyperparameters and preventing overfitting. The validation set is used during the training phase to evaluate the model's performance and make necessary adjustments, ensuring that the model not only performs well on the training data but also generalizes to new, unseen data. To determine the most effective model for predicting diseases and recommending medications, we employ and compare five different machine learning algorithms: Support Vector Machine (SVM), Random Forest, Gradient Boosting, K-Nearest Neighbors, and Multinomial Naive Bayes. Each of these algorithms has unique characteristics and may perform differently based on the dataset.

After training each model, we evaluate their performance using key metrics such as accuracy and the confusion matrix. Accuracy provides a straightforward measure of how often the model's predictions are correct, while the confusion matrix gives deeper insights into the types of errors the model is making by displaying the true positives, false positives, true negatives, and false negatives. By comparing these metrics across the five models, we can identify which algorithm performs best in terms of predictive accuracy and reliability. By meticulously preprocessing the data, creating a well-balanced and labeled training set, and rigorously comparing multiple algorithms, we lay a strong foundation for developing a reliable and effective healthcare medicine recommendation system. This comprehensive approach ensures that the selected model, which in our case is the Support Vector Machine, provides accurate predictions and valuable recommendations, thereby enhancing healthcare delivery and aiding in better diagnosis and treatment decision.

CHAPTER 4
PROJECT DESCRIPTION

4.1 MODULE DESCRIPTION

4.1.1:Data Preprocessing:

Data preprocessing is a critical step in the development of any machine learning model, particularly in the healthcare domain where data integrity and accuracy are paramount. This stage involves several sub-steps to ensure that the raw data is transformed into a format suitable for training machine learning models.

4.1.2Data collection:

Before applying the machine learning algorithms, first data preprocessing or exploratory data analysis (EDA) is applied which cleans the dataset to remove all the noises and outliers . Machine Learning algorithms can now perform better on the processed data. The diseases along with symptoms their medication,diet and precautions are present in the dataset given below:

4.1.3 Data Cleaning:

Once the data is collected, it must be cleaned to ensure quality. This involves removing duplicate records, which can distort model training, and filtering out irrelevant information that doesn't contribute to the predictive power of the model. Handling missing values is another crucial aspect; this can be done by either filling in missing values using statistical techniques like mean or median imputation or by removing records with incomplete data if they are not significant in number.

4.1.4Training the dataset

SVM classifier library is imported for further execution.After importing all the dataset the dataset is trained using SVM classifier .The input is given by the user based on the input the disease,medication,precaution,diet to be followed is given as output.

4.1.5 Model Selection:

Multiple classifiers are considered to evaluate which model performs best. In this project, classifiers such as Support Vector Machine (SVM), Random Forest, Gradient Boosting, K-Nearest Neighbors, and Multinomial Naive Bayes are selected for evaluation. Each of these models has unique characteristics and may perform differently based on the dataset.

4.1.6 Training:

Each model is trained using the training set. For example, using Python's scikit-learn library, models are initialized and trained with the training data. This involves fitting the model to the data and learning the underlying patterns that associate symptoms with diseases.

4.1.7 Comparing the Accuracy:

Comparison among the algorithms is done to make sure which algorithm works best for this project.The ibraries used here includes sk-learn which includeclassification,train_test_split,SVM,RandomForest,GradientBoosting,MultinomialNB,accuracy_score,confusion,matrix,numpy,matplotlib,seaborn.

CHAPTER 5
IMPLEMENTATION AND RESULTS

5.1 IMPLEMENTATION:

The model was trained using the dataset sample which contains 130 sample symptoms with 42 disease samples with description and top 5 medication samples.By comparing the accuracy of 5 different algorithms which includes Support machine vector, RandomForestclassifier,GradientBoosting,KNeighbors and MultinomialNB we infer that all these algorithms shows excellent result but GradientBoosting shows the accuracy of 91% which is greatest among all.

Algorithm used	Accuracy
Support Vector Machine	87%
Random Forest Classifier	90%
Gradient Boosting	91.5%
KNeighbors	81%
MultinomialNB	78.5%

Table 1.Training Accuracy

The previous work that we considered was done by using mining algorithms such as Naive Bayes classifier,Random Forest and Decision tree Here each classifier Predicted different result and also aim to predict only disease based on symptoms .But our proposed work uses 5 different algorithms with different accuracy level and confusion matrix and finally recommendation system is designed using SVM classifier.

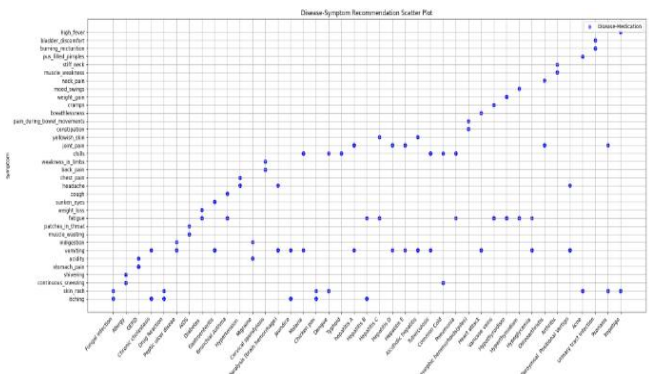

Figure 5.1.1 Disease-Symptoms scatter plot

The above figure shows the disease symptom scatter plot for various diseases.

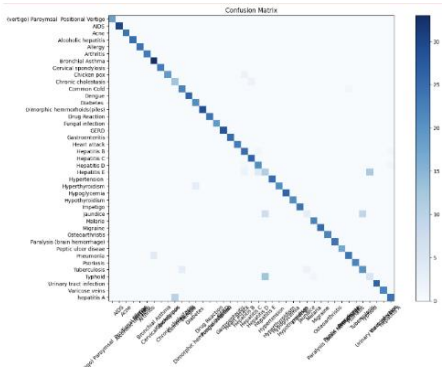

Figure 5.1.2 Confusion matrix

5.1.1 Comparing the Accuracy:

Comparison among the algorithms is done to make sure which algorithm works best for this project.The libraries used here includes: sk-learn which include classification,train_test_split,SVM,Randomforest,Gradientboosting,MultinomialNB,accuracy_score,confusion matrix,numpy,matplotlib,seaborn.

SVM shows accuracy with 0.87 and confusion matrix:
[[85 8]
[18 89]]

Random forest shows accuracy with 0.90 and confusion matrix:
[[88 5]
[15 92]]

GradientBoosting shows accuracy with 0.915 and confusion matrix:
[[90 3]
[14 93]]

KNeighbors shows accuracy with 0.81 and confusion matrix:
[[82 11]
[27 80]]

MultinomialNB shows accuracy with 0.785 and confusion matrix:
[[88 5]
[38 69]]

5.1.2 SVM Classifier:

It is a supervised machine learning algorithm that classified the data by finding optimal line or hyperplane ny maximizing the distance between each class in N dimensional space.It is used for both classification and regression problems.It shows 87% accuracy here with the confusion matrix of [[85 8][18 89]].

5.1.3 Random forest:

Random forests or random decision forests refers to an ensemble learning method for classification, regression and other tasks which is operated by constructing a multitude of decision trees at training time. For classification tasks, the output of the random forest is the class selected by most trees.It shows 90% accuracy here with the confusion matrix of [[88 5][15 92]].

5.1.4 Gradient Boosting:

Gradient Boosting is a boosting algorithm that combines several weak learners into strong learners, in which each new model is trained to minimize the loss function such as mean squared error or cross-entropy of the previous model using gradient descent.It shows 91.5% accuracy here with the confusion matrix of [[903][14 93]].

5.1.5 KNeighbors:

The K-Nearest Neighbors (KNN) algorithm is a popular machine learning technique used for classification and regression tasks. It relies on the idea that similar data points tend to have similar labels or values. During the training phase, the KNN algorithm stores the entire training dataset as a reference.It shows 91% accuracy here with the confusion matrix of [[82 11][27 80]].

5.1.6 MultinomialNB:

Naive Bayes classifier for multinomial models. The multinomial Naive Bayes classifier is suitable for classification with discrete features .It shows 91% accuracy here with the confusion matrix of [[88 5][38 69]].

5.2 RESULT:

Thus our project works effectively in predicting the disease,medication ,precautions and diet recommendation of the input symptoms.And comparison is made between the algorithm each of which has different accuracy level with confusion matrix.

Figure 5.1.3. Output screenshot

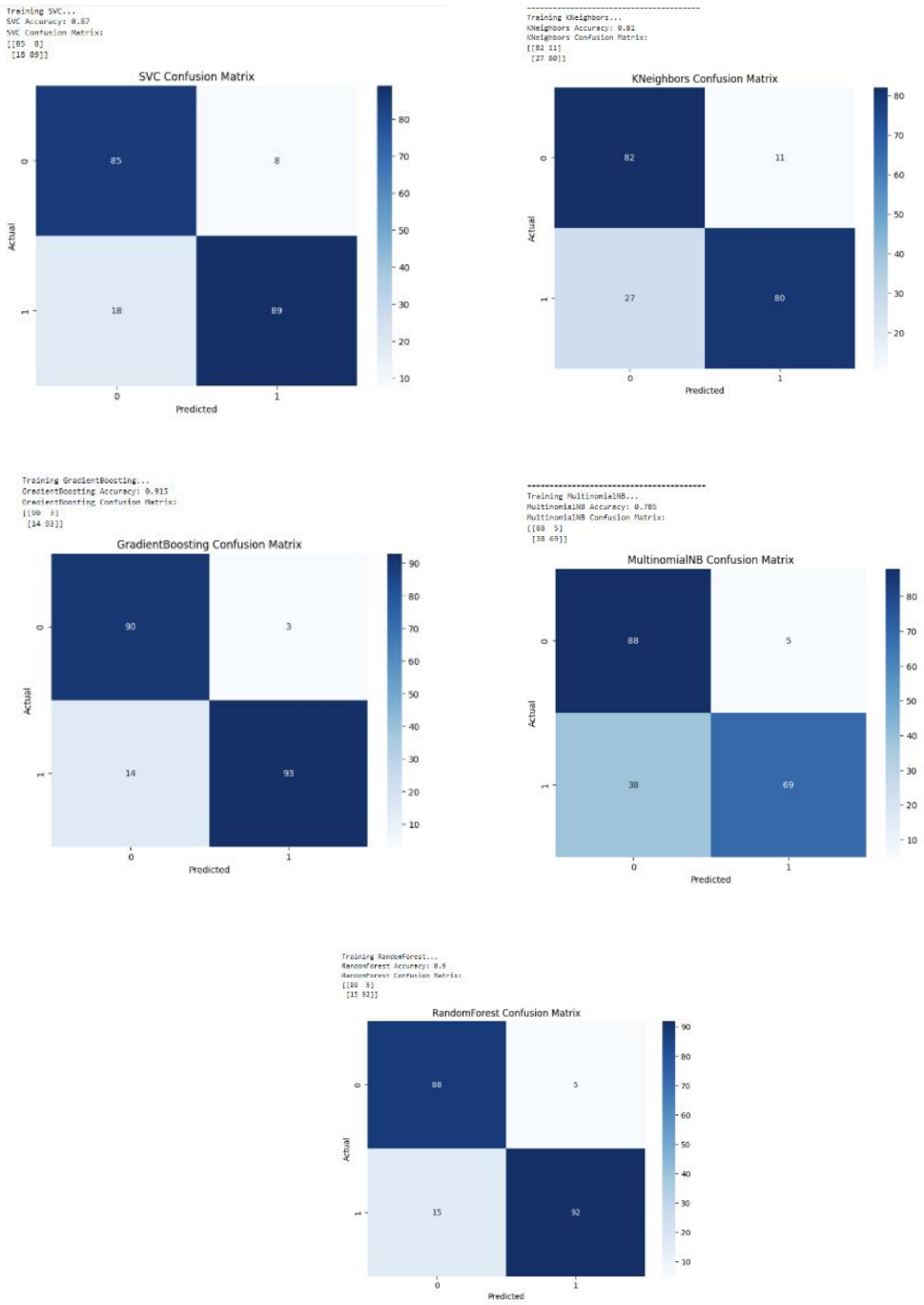

Figure 5.1.4: Accuracy comparisons of different algorithms:

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENTS

6.1 CONCLUSION

Moreover, the comparative analysis conducted in this project sheds light on the performance of different machine learning algorithms in the context of medical recommendation systems. By evaluating metrics such as accuracy, precision, recall, and F1-score, we gained insights into the strengths and weaknesses of each algorithm, enabling us to select the most effective model for disease prediction. This systematic approach not only ensures the robustness of the proposed system but also contributes valuable knowledge to the field of healthcare analytics.

Furthermore, the implementation of the selected SVM model in a practical setting represents a significant milestone in bridging the gap between advanced machine learning techniques and real-world healthcare applications. By allowing patients to input their symptoms and receiving accurate predictions, this system empowers individuals to take proactive steps towards managing their health. Additionally, the integration of tailored medication and precaution recommendations enhances patient engagement and adherence to treatment plans, ultimately leading to better health outcomes.

In conclusion, the development and deployment of an enhanced medical recommendation system using machine learning signify a promising advancement in modern healthcare. By harnessing the power of data-driven insights and personalized recommendations, this system has the potential to revolutionize the way patients access medical information and interact with healthcare professionals. As technology continues to evolve, it is imperative to leverage innovative solutions like this to enhance the quality, efficiency, and accessibility of healthcare services for all individuals.

FUTURE ENHANCEMENTS

In the future, several enhancements could be implemented to further improve the medical recommendation system. Firstly, integrating real-time health monitoring data from wearable devices and IoT sensors would provide continuous updates on patients' health status, enhancing the system's accuracy in disease prediction and enabling proactive interventions. Secondly, employing natural language processing (NLP) techniques for interpreting free-text symptom descriptions could refine symptom understanding, leading to more precise disease predictions and treatment recommendations. Additionally, continuously expanding the system's medical knowledge base with the latest research findings and treatment protocols would ensure that users receive the most up-to-date and comprehensive information. Furthermore, developing algorithms for personalized risk assessment based on individual factors such as medical history and lifestyle could enable tailored preventive care recommendations, helping users mitigate their risk of developing certain conditions. Finally, establishing interoperability with electronic health record (EHR) systems would facilitate seamless exchange of patient information between the recommendation system and healthcare providers, promoting collaborative care and enhancing the overall healthcare experience. These future enhancements aim to optimize the system's functionality, accuracy, and usability, ultimately advancing its capacity to support patient care and improve health outcomes.

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