Drug Recommendation Based on Sentiment Analysis Using Machine Learning

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Abstract : Against the backdrop of issues made worse by things like the COVID-19 epidemic and a shortage of physicians in rural compared to metropolitan regions, the importance of customized drug recommendations keeps getting bigger. Preprocessing of the data, sentiment analysis using methods like TF-IDF vectorization, and classification algorithms like CNN, KNN, and Linear Support Vector Classifier are all part of the suggested methodology. Sentiment analysis algorithms that use patient reviews to identify side effects, effectiveness of medications, and patient happiness empower both patients and practitioners. This article explains the promising potential of sentiment-based medication recommendation systems by thoroughly reviewing the body of existing research and methodology. In the rapidly developing field of digital healthcare, the combination of sentiment analysis with machine learning provides a revolutionary method for enhancing drug choice, enhancing patient outcomes, and advancing healthcare decision-making.

IndexTerms - **Drug Recommendation, Drug Reviews, Sentiment Analysis, CNN, KNN, Feature Extraction..**

I. INTRODUCTION

An innovative approach to healthcare, a Sentiment Analysis based Machine Learning Drug Recommendation System makes use of cutting edge technology to help patients and healthcare providers make educated prescription decisions. The deluge of pharmacological options available in today's fast-paced world can be intimidating for patients and healthcare professionals alike, frequently leading to unsatisfactory treatment outcomes, unfavorable side effects, or prescription non-adherence. This novel method uses cutting-edge machine learning algorithms to assess a user's or patient's sentiment, medical background, and a number of other variables in order to suggest the best prescriptions. This approach seeks to close the gap between medical knowledge and individualized care by utilizing the enormous amount of healthcare data and patient feedback that are already available. Additionally, the project integrates machine learning algorithms, which are essential to guaranteeing the precision and dependability of the system. This project's main goals are to create an extensive database of pharmacological medications, including their characteristics, uses, side effects, and contraindications. Develop a sentiment analysis model to mine and examine online patient reviews and feedback on a range of medications. Apply machine learning techniques to establish a relationship between patient sentiment and medication safety, effectiveness, and satisfaction. The reader will obtain a more profound comprehension of how this novel approach to medication suggestion can improve patient outcomes and support the broader objective of providing customized medicine as we proceed through the report. The information and conclusions in this paper will be a great help to researchers, practitioners, and other professionals who want to use data and technology to their advantage and an improvement in medical care.
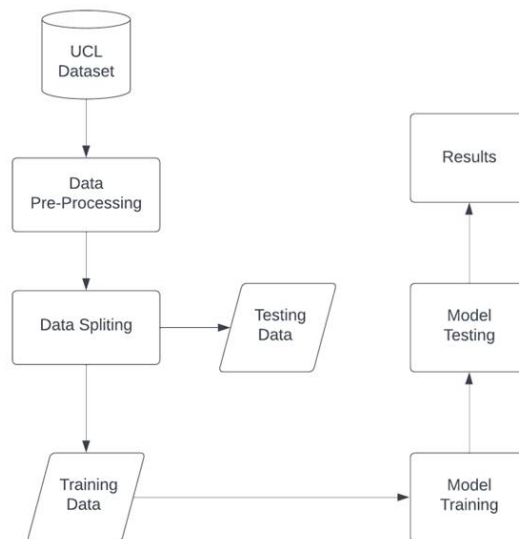
Figure 1. Generic Block Diagram.

The procedure for suggesting medications from a dataset based on product reviews is shown in Figure 1. The procedure starts with the dataset input, then pre-processing, a model that tests the data according to the patient's condition entered, and ultimately the recommendation of a drug depending on the patient's condition.

II. LITERATURE REVIEW

- B. LOKESWARA NAYAK et al. in [1] The paper explores the importance of medicine recommender systems for online health condition diagnosis, emphasizing how they help physicians and patients understand medications customized for certain disorders. Despite the paucity of prior research on the subject because of the difficulty of evaluating drug evaluations, it looks at the application of sentiment analysis and feature engineering in these systems. The suggested system architecture is examined with a number of frameworks, including multilingual sentiment analysis and Galen OWL, with an emphasis on authentication, remote server management, and data ownership. It also highlights sentiment analysis and feature engineering's benefits for natural language processing and visualization in an improved recommender system that it offers. Stakeholder duties are outlined in the implementation section, and the conclusion emphasizes the value of sentiment analysis while making suggestions for future improvements and offering a comprehensive bibliography for further exploration.

- Ankitha S et al. in [2] The paper examines a number of research projects and approaches pertaining to medication errors, suggested uses, and health-related datasets. Research on topics like clinical guidelines for community-acquired pneumonia, adverse drug reaction identification, drug interactions, and drug recommendation systems using cutting-edge technologies like Semantic Web and machine learning are presented in studies by Bartlett JG et al., T. N. Tekade et al., Doulaverakis et al., Gao Xiaoyan et al., and Li-Chih Wang et al. Furthermore, Susannabh et al. suggest using deep learning to provide individualized meal suggestions based on health-related factors. The document describes the features, architecture, and goals of a suggested system, including machine learning methods, system operations, and model assessment. The study's findings, which center on health conditions like acne, depression, high blood pressure, pain, and contraception, include drug review analysis, the best medications for each disease, and model accuracy. The need of ongoing research to improve healthcare decision-making with AI and deep learning techniques is emphasized in the conclusion.

- Dr. K. Jayasakthi Velmurugan et al. in [3] In discussing drug recommendation strategies based on aspect-level reviews utilizing machine learning algorithms, the publication emphasizes the significance of taking patient characteristics into account when determining parameters such as efficacy and side effects. In order to recommend medications based on user ratings, it suggests an approach that integrates and preprocesses data using sentiment analysis and machine learning. A review of the literature examining numerous studies on drug recommendation systems is included, along with an assessment of the shortcomings of the current systems. By employing a backpropagation neural network model, the suggested approach seeks to improve accuracy and provides advantages including precise side effect prediction and practicality for medical professionals. The paper describes the models, software interface, and methods used, highlighting the possibility of utilizing deep learning algorithms in the future to increase the response and accuracy of medication recommendations.

- CHIKAM PRIYANKA et al. in [4] The paper describes a study on a sentiment analysis drug review recommendation system that aims to address issues related to the COVID-19 epidemic, including a rise in self-medication as a result of limited access to healthcare. With the goal of lessening the workload of specialists, the suggested method uses machine learning to provide medication recommendations based on patient feedback. The system design, including data collection, model building, and outcome assessment, is described in the paper. A review of the literature also covers relevant studies on medication mistakes, community-acquired pneumonia guidelines, and drug-drug-disease interactions. The paper emphasizes the goals, outcomes, and future work of the suggested system and stresses the use of machine learning methods in pandemic healthcare decision-making.

- GV Lavanya et al. in [5] The document describes a drug recommender system that uses sentiment analysis and machine learning to help doctors and patients make well-informed decisions about prescription medication. The system classifies attitudes to offer insights on drug effectiveness, side effects, and patient happiness by assessing user sentiment and emotions in text data. The ultimate goal is to optimize medicine selection and enhance patient outcomes. The paper, which outlines the methodology, system architecture, results, potential improvements, and conclusion, emphasizes the significance of creating recommendation systems based on sentiment analysis and feature engineering. With a modular design and an emphasis on integrating cutting-edge

technology, the system seeks to improve patient outcomes and medical procedures by providing tools for evidence-based decision-making that are customized to meet individual needs.

- Yash Ritesh Tanna et al. in [6] The study project on a drug recommendation system is described in the document with the intention of addressing issues facing the medical community, especially in times of crisis such as the coronavirus pandemic. In an effort to lessen the workload for specialists and enhance treatment equality and safety, it makes medicine recommendations based on patient assessments by utilizing machine learning and sentiment analysis. Data collection, preprocessing, model construction, and validation are all part of the methodology, which uses a variety of machine learning techniques with linear SVC to achieve 93% accuracy. The study positions the research as a significant contribution to medical recommendation systems by suggesting improvements for the future and reviewing relevant literature.

- Kodepogu Koteswara Rao et al. in [7] The creation of a drug recommender system that enhances individualized medicine recommendations in healthcare through sentiment analysis of drug reviews is covered in the document. It uses a variety of machine learning algorithms to provide ratings and make recommendations, showing significant advancements over current techniques. The comprehensive approach includes sentiment analysis, data preprocessing, and model implementation. The outcomes demonstrate improved prediction and recommendation accuracy for medications. Subsequent investigations endeavor to enhance sentiment analysis methodologies and suggestion frameworks for increased precision and dependability.

- Kretika Tiwari et al. in [8] Using a thorough study, the paper investigates the creation of a machine learning-based recommendation system for adverse drug reactions (ADR) and disease-drug material. It highlights the importance of mining medical content from social media for pharmacovigilance and healthcare objectives. It presents a paradigm for categorizing intersections between Disease, Drug, and ADR, compares benchmark classifiers, and explores the use of recommendation systems in a variety of industries, including healthcare. The report also discusses how to assess the effectiveness of the system and emphasizes how online health social media platforms may help patients and their families.

- Md. Deloar Hossain et al. in [9] In order to better comprehend patient attitudes, the document highlights the importance of sentiment analysis in healthcare and discusses the creation of a medicine recommender system based on drug reviews. It talks about a framework that chooses to use the Linear Support Vector Classifier for rating creation and includes machine learning methods, sentiment analysis approaches, and data pretreatment. The study highlights the significance of sentiment traits in predicting medicine ratings and providing recommendations. It also offers a review of comparable work, insights into techniques, and finishes with reflections on study outcomes and future directions.

- Sabarmathi . G et al. in [10] Highlighting the value of telemedicine and self-diagnosis during the pandemic, the paper investigates the use of sentiment analysis in healthcare to forecast patient medication recommendations based on internet evaluations. It suggests a process that combines machine learning, feature extraction, and sentiment analysis. Models such as LGBM, XGBoost, and CatBoost have accuracy values between 0.79 and 0.91. The study emphasizes the need for additional advancements for real-time application while attempting to offer a framework for sentiment analysis-based medication recommendations. The conclusion, which is backed up by an extensive list of references, highlights the significance of in-depth study above and beyond accuracy and proposes future research areas.

- Satvik Garg et al. in [11] The paper investigates the creation of a machine learning-based drug recommendation system based on sentiment analysis of medication reviews in order to address issues in the medical industry. It highlights how crucial the system is to helping patients and healthcare providers, and it offers a methodology that makes use of several vectorization techniques and classification algorithms. The system's performance indicators are assessed in the study, and Linear SVC with TF-IDF vectorization achieves 93% accuracy. The conversation emphasizes the necessity of system upgrades and makes recommendations for next research on oversampling methods and algorithm optimization as ways to increase performance. All things considered, the study provides insightful information about developing a machine learning and sentiment analysis medicine recommendation system.

- Mridula Shukla et al. in [12] In order to solve the issues associated with healthcare access following COVID-19, the research article focuses on constructing a drug recommender system employing machine learning for sentiment analysis of drug evaluations. It highlights the value of automated procedures and future research directions for fine-grained sentiment analysis and real-world integration. It describes the system's architecture, sentiment analysis findings, and the efficacy of medication recommendations.

- Roopa D E et al. in [13] The study examines the creation of a drug recommendation system with the goal of minimizing prescription errors resulting from a lack of expert expertise. It highlights the growing trend of online drug purchases and the importance of precise medical diagnosis. In order to forecast medication suitability based on patient reviews, it makes use of sentiment analysis and machine learning methods like Naïve Bayes and SVM. The efficiency of these models is demonstrated by the results, and more research into oversampling methods and n-gram values may lead to opportunities for enhancing system performance. The study provides insights into future research areas and emphasizes the need of precise sentiment analysis and feature engineering in improving recommendation system performance.

- Shubham Throat et al. in [14] Machine learning analysis of drug reviews with the goal of addressing difficulties in obtaining resources for medical treatment, particularly during the COVID-19 pandemic. It underscores the need for such a system because of the growing reliance on internet reviews for medical decisions and stresses the scarcity of specialists, which results in self-medication and negative health outcomes. Preprocessing the data, extracting features, and training the model with machine learning techniques are all part of the methodology. The suggested system has a drug library to educate patients on the efficacy of their medications in addition to using sentiment analysis to forecast reviews. The system's accuracy in identifying patient evaluations and visualizing common fatal illnesses resulting from drug shortage is demonstrated by the results. All things considered, the study provides valuable information for advancing medication recommendation algorithms and strengthening healthcare decision-making.

- Ooha Bollampalli et al. in [15] The document describes a medication recommendation system that uses machine learning and sentiment analysis of drug reviews to alleviate the scarcity of healthcare resources brought on by the COVID-19 pandemic. It emphasizes the significance of telemedicine frameworks in remote locations and the frequency of medication errors brought on by a lack of medical expertise. In an effort to improve comprehension for medical professionals and patients alike, the suggested

method forecasts drug sentiment and makes prescription recommendations. It also offers an assessment of the available literature, describes the system's methodology, and assesses machine learning classifiers, with Linear SVC on TFIDF obtaining an accuracy of 93%. The study underscores the significance of sentiment analysis and machine learning in addressing healthcare issues and facilitating well-informed drug usage decisions.

III. SUMMARY OF EXISTING WORK

Author name	Algorithm / model used	Performance Metrics
B.LOKESHWARA NAYAK et al. [1] (2022)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93%
Ankitha. S et al. [2] (2022)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93%
Dr. K. Jayashakthi Velmurugan et al. [3] (2022)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93 %
CHIKAM PRIYANKA et al. [4] (2021)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93 %
GV Lavanya et al. [5] (2023)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93%
Vaibhav Avinash Parmar et al. [6] (2023)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93%
Kodepogu Koteswara Rao et al. [7] (2022)	Naïve bayes, Decision tree Classifier, Support vector classifier	Accuracy = 60.41%
Kretika Tiwari et al. [8] (2022)	-	-
Md.Deloar Hossain et al. [9] (2020)	Decision tree, KNN, Linear SVC	Accuracy = 83%
Sabarmathi. G et al. [10] (2021)	LightGBM, XGBoost, CatBoost	Accuracy = 91%
Satvik Garg et al. [11] (2021)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93 %
Mridula Shukla et al. [12] (2022)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93% ,
Roopa D E et al. [13] (2022)	Naïve bayes, Logistic regression, SVM, Descion tree,	Accuracy = 79.15%
Shubham Throat et al. [14] (2022)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy = 93 %
Ooha Bollampalli et al. [15] (2023)	Logistic regression, Naïve bayes, Stochastic gradient descent, Linear SVC	Accuracy=93%

Tabel 1. Summary of existing work on Drug Recommendation based on Sentiment Analysis using Machine Learning

IV. DATASET USED

Table 2 represents the summary of the datasets used by the existing literature on Drug Recommendation using Sentiment Analysis.

Dataset name	Specification
UCL Drug Review Dataset [1]	The dataset provides patient reviews on specific drugs along with related conditions and a 10 star patient rating reflecting overall patient satisfaction.

Table 2. Dataset Used in existing reference papers for Drug Recommendation using Sentiment Analysis.

V. CONCLUSION

Personalized medication recommendation systems that use sentiment analysis and machine learning algorithms offer a compelling way to transform healthcare decision-making. These systems are able to precisely evaluate the efficacy of medications, side effects, and patient satisfaction by utilizing patient reviews. This allows patients and physicians to make well-informed decisions. The approaches shown in a number of research projects highlight the possibility of improving medication recommendations' accuracy and dependability while tackling important issues made worse by occurrences such as the COVID-19 pandemic. Moreover, the focus

on ongoing research and potential improvements underscores the dynamic character of this sector, which presents chances to improve recommendation models and sentiment analysis methods. In the end, the combination of machine learning and sentiment analysis presents a revolutionary method for enhancing patient outcomes, choosing the right prescription, and developing healthcare decision-making in a more digitally connected medical environment.

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