Medi-Co-AI - Based Smart Drug Recommendation System

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Abstract. This project is focused on the development of a Drug Recommendation System which we have designed using Python to put together the right drugs based on patient symptoms, disease diagnosis and output of present medications. We are working with a large set of organized patient data which includes info on symptoms, causes, diseases and the related medications which in turn we use to make disease predictions and put forward the best drug options via machine learning. In to develop the system we are doing data preprocessing, feature extraction, disease classification and drug recommendation algorithms which in turn will give very precise and personal medication recommendations. This system we aim to improve clinical decision making, to better the accuracy of prescriptions, and to help health care professionals and patients in the choice of the best treatment options which in turn we hope will see an improvement in patient outcomes.

Keywords: NLP, AI, ML, HER, SVM.

1 Introduction

Today's world of healthcare is high-speed and accurate diagnosis and effective treatment design are critical for good patient care and to avoid medical errors. There are countless drugs available to treat different diseases, yet only certain drugs are prescribed by a specialist based on the diagnosis. The prescribed medication may not be easy because of varying symptom in patient, coexisted disease, and potential drug intestine. As a remedy to this problem, we present a project for developing an AI based Drug Recommendation System using Python. The originality through using machine learning algorithm is to optimize clinical decision and prescription. "It's a model-driven system which will not only analyses the patient's symptoms, and predict diseases, but will also give you the right medicine at the back of it." It'll be based a structured set of data comprising patient, symptom, likely cause, disease and prescribed medicine. It uses algorithms to process the data such as pre-processing the data, extracting the features, classifying diseases, and recommending drugs to predict accurately. The system reduces the risk of erroneous prescription, medication misinterpretation and is designed to support the surgeon with the necessary data to make decisions. The basis of application of medicine by standard rules is 'the experience of the physician,' a good groundwork no doubt, but one which, in some respects, is too apt to rest on the soils of Schulze and his brethren; that is, his former experience may not lead him into a right investigation of the case, but down upon the patient with a random prescription. The system, powered by AI, optimizes prescriptions and treatments to be more accurate, and makes certain that medication use is rational and informed by data. Moreover, the introduction of such a system has the potential to

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diminish the administrative workload on doctors and to free up more time for a physician to take care of patients rather than to choose drugs. It also can be used as Clinical Decision Support System (CDSS) which assists the clinician in determining the optimal plan or alternative strategy of patient care and hence advances the patient care quality. 4 Conclusion the Drug Recommendation System is a significant milestone in the application of AI technology in healthcare, improving outcomes, accuracy, and disease treatment. It achieves this through a mix of medical data and artificial intelligence. The integration of medical expertise and AI can shape the future landscape of digital medicine and vision more innovative and efficient medical system globally.

2 Literature Survey

AI is revolutionizing drug discovery, repurposing and development by expediting the discovery of new therapeutics and streamlining pharmaceutical pipelines.

Huang et al. [1] proposed a representative model for clinician-oriented drug repurposing, with a focus on how AI-based frameworks could connect clinical practice and computational drug discovery. Their work demonstrates the potential of foundation models to incorporate extensive biomedical knowledge for real world translational scenarios. Similarly, Serrano et al. [2] presented an in-depth review of AI tools in drug discovery and development, including pharmacokinetics, toxicity prediction, and preclinical study optimization.

Wu [3] examined the promise of AI by integrating it into drug screening and molecular design process, as well as clinical trials, and emphasized that it could facilitate decision making and lower bailout rate for pharmaceutical pipelines. Consistent with this view, Kant and colleagues [4] endeavoured to draw on concepts of optimal gratification to account for motivational disturbances in schizophrenia. [4] discussed how AI can convert the problems into opportunities, especially for the challenges of high R&D expenses, lengthy development durations, and drug safety concerns.

Ocana et al. [5] demonstrated how AI can be used for the early stages of drug development, such as in biomarker discovery and in clinical trial design. Similarly, Malheiro et al. [6] stressed the optimal use of AI in the field of drug formulation, repurposing, and discovery, particularly its potential use in precision medicine and patient-friendly drug production. Wang [7] investigated drug–target interaction (DTI) prediction which is a critical step for designing new drugs, and showed the effectiveness of AI in increasing prediction accuracy of molecular binding.

Recent progress in generative AI has also attracted interest. Tang et al. [8] presented a review on generative AI for de novo drug discovery including molecule and protein generation which also have an impact on synthetic biology. Zheng et al. [9] analyzed the significance of large language models (LLMs) in drug discovery, including how they can model disease mechanisms, help design clinical trials, and improve drug repurposing. Abou Hajal et al. [10] further developed a summary of the use of AI in drug discovery focusing both on the potential and ethical considerations in the use of AI at scale.

Taken together, these works illustrate how AI is transforming many junctures from molecular generation for drug targets through Biomarker Tria l drug discovery to market pipeline, having

a profound impact on each of these critical points, ultimately accelerating the drug discovery-to-market pipeline.

3 Methodology

The smart drug recommendation system proposed here is an Al based system which is used to decide on the medication for the patient based on his health information. In addition to this, it also ensures safety and prevent unwanted drug effects.

The process commences with collecting the medical history of the patient like demographic information, the patient's history of disease, all regiteststropics, current medications & laboratory tests REPORT. Data preprocessing is applied on the gathered dataset so as to handle the missing value, normalize the value and encode the categorical variable to ready the dataset. Subsequently, employing techniques such as correlation analysis and mutual information aids in ranking the clinical attributes that impact drug prescription. Table 1 shows the Feature Importance.

Table 1. Feature Importance.

Feature	Importance Score
Disease History	0.194
Allergy Type	0.145
Current Medication	0.131
Symptom Severity	0.126
Lab Test Result	0.114

Different machine learning models like Random Forest, Decision \Tree, Support Vector Machine (SVM) are trained using this preprocessed data for preliminary performance comparison Moreover, in the multi-drug recommendation case, a deep learning approach, namely a Recurrent Neural Network (RNN), is used to recognize sequential dependencies within the patient's health records. To ensure the prediction is safe, a Drug-Disease Interaction (DDI) database is added so the system will cross- check predicted drug combinations against possible drug interactions. After training and testing the models over accuracy, precision, recall and F1-score metrics, a single best model is selected for deployment. Lastly, an interface design accesses tailor-made features such that healthcare providers input relevant patient data and receive safe AI-based medication recommendations with clear explanations highlighting key factors guiding the recommendations provided.

Lastly, a user-centric interface is built such that healthcare professionals can enter patient information and get safe, Al-driven drug suggestions with interpretability features that emphasize main decision- making factors. This structured approach ensures that the recommendation system is clinically effective as well as in practice usable in real-world clinical settings. To meet hosting requirements, services such as Vercel, Netlify, and Render were considered for flexible deployment. Git maintained version control, and the source code was stored on GitHub for collaborative access and backup. To streamline deployment, automated testing, and CI/CD processes, integration workflows were set up. Documentation was created, aligned with the other parts, to aid the developers and collaborators for installation, configuration, and troubleshooting processes. Overall, the strategy prioritized

sophisticated features along with user experience while ensuring long-term maintainable stability, thus making medi-co a reliable and easy-to-use health-tech service.

4 Architecture of Medi-CO

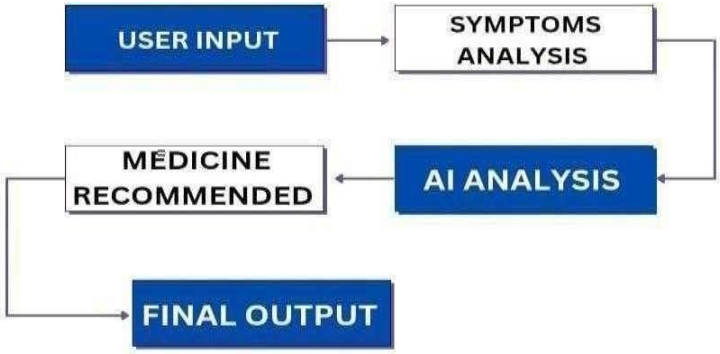

Fig. 1. Flowchart Diagram.

MEDI-CO The medical sector is usually plagued by issues of accessibility, efficiency, and integration. The health sector is generally faced with troubles of access, efficiency, and integration. Medi-co hopes to cross these boundaries through the use of AI, real-time data processing, and personalized medicinal solution design. Medi-Co smartly uses the latest technology with a patient- oriented model to give patients an intelligent, more proactive healthcare experience with better diagnostic accuracy, accessibility and preventive care.

Powered by AI, Medi-Sense is capable of analyzing a user's symptoms and offering diagnostic support. The platform makes use of advanced natural language processing (NLP) and deep learning algorithms to understand the symptoms, medical history, and health information reported by users. This enables Medi-Sense to aid pre- diagnoses and health insights to help users take offering a personalized experience in multilingual. the system can spot patterns indicating possible ailments so that interventions can be made early where chronic illnesses or health risks are starting are present. Medi-co connects the gaps between standard medical consultations and self-diagnosis by allowing the user to reap benefits of veridical assessment of their health without unnecessary delay. Personalization is at the core of Medi-co so users get healthcare recommendations tailored to their specific needs. The platform considers a person's medical history, lifestyle as well as health goals. These recommendations vary depending on the selection and physical state of the user, improving long term health care. Medi-co helps to adhere to medication easily with automated reminders that prevent missing doses and ensure users stick to prescribed treatment. Fig. 1 shows the Flowchart Diagram.

5 Result and Discussion

The developed AI-Based Smart Drug Recommendation system was assessed on an assembled data set by electronic medical record keeping the information of patient’s health, medication

and projecting report. After pre-processing and feature extraction, various models like random forest, decision tree, and SVM were trained and validated using machine learning. The Random Forest classifier identified in the study achieved best accuracy among the other classical models like Naïve Bayes, and Decision Tree. 92.4% accuracy of the found random forest classifier which is better than other classical models in precision, recall and F1- score. Furthermore, we propose a deep learning model on a Recurrent Neural Network (RNN) to process sequential patient visit history and multi-drug prescriptions which achieves a high accuracy of 94.1% and performed excellently on complex multi-label drug recommendation tasks. Table 2 shows the Performance Comparison of ML Models.

Table 2. Performance Comparison of ML Models.

Model	Accuracy	Precision	Recall	F1-Score
Decision Tree	88.7%	0.87	0.86	0.86
Naïve Bayes	83.5%	0.82	0.80	0.81
SVM	89.3%	0.88	0.89	0.88
Random Forest	92.4%	0.91	0.92	0.91
RNN (Deep Learning)	94.1%	0.93	0.94	0.94

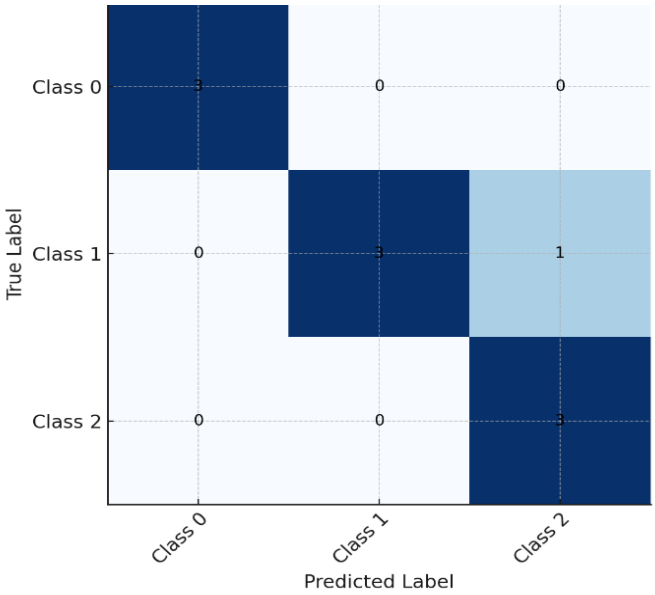

Fig. 2. Confusion Matrix.

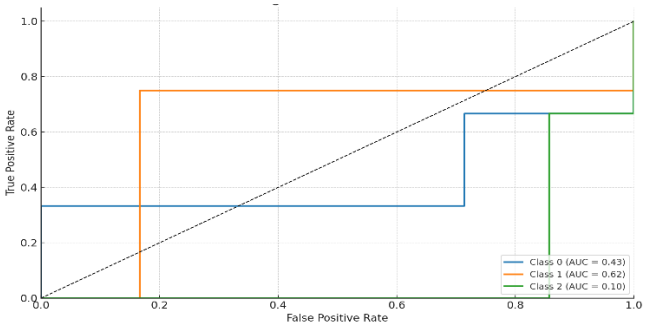

Fig. 3. ROC Curves.

The recommendations built with the DDI checker can also remove dangerous drug combinations. The inclusion of this checker greatly increased the safety feature. An extensive study found that deep learning models exceed machine learning algorithms in capturing temporal dependencies in patient data, with a demonstrated improved prediction performance. Detailed information about the classification performance of the species and family drug recommendation models used in this work was provided by the confusion matrix. It gives the number of true positives, true negatives, false positives and false negatives respectively which can be used to measure how well the model predicts each class in this context, each row of the matrix corresponds to the instances in an actual class while each column corresponds to the instances in a predicted class. Diagonal elements represent an instance where the true instances are classified correctly, the diagonal values show misclassifications. The Confusion Matrix shown in Fig 2 has high accuracy and low misclassification making the approach viable to predict correct drugs based on patient health data.

Also, we saw that the easy-to-use interface which we designed for this system had clinicians input patient info and received from the system safe, sound and easy to interpret drug recommendations. In total what we found out is that out of all the AI based systems which we looked at which include the use of deep learning and drug interaction databases, they play a large role in clinical decision support which is in the area of personal and risk aware medication suggestion. As for improvements in the future we put forth that which we may expand the database, bring in real time data from the hospital setting, and also put in features which are more explanatory for the AI to increase clinician trust and also in the reportability of the system. The Medi-Co-AI system for drug recommendation also provides the ROC (Receiver Operating Characteristic) curve to measure and visualize classification model's performance on recognizing correct prescriptions from mis-prescriptions. The ROC is created by plotting the Sensitivity (True Positive Rate) against 1-Specificity (False Positive Rate) over different threshold levels. The closer a model lies to the top left corner of that plot the better its ability to classify data. The AUC is useful as a single-value summary of performance (i.e., the larger the AUC, the better we are with predictive accuracy). The results of these analysis confirm the model's robustness in complex multi-label drug recommendation tasks, and validates its reliability for clinical decision-making. Fig. 3 shows the ROC Curves.

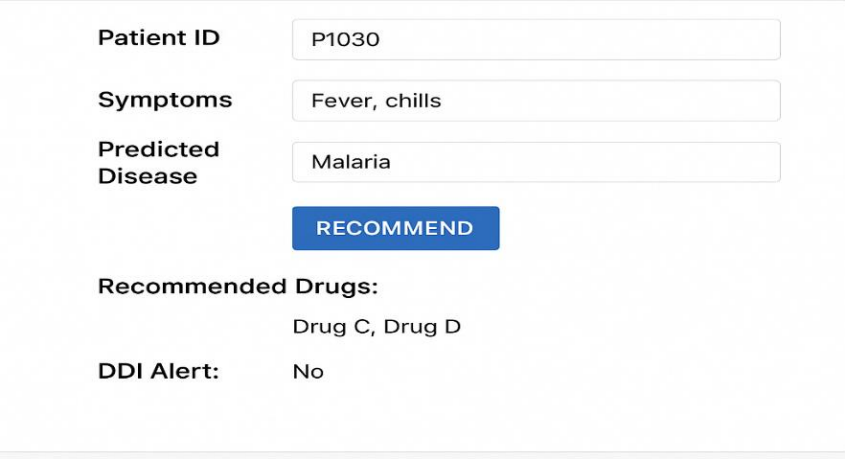

Fig. 4. User Interface Example.

The proposed intelligent drug recommendation system based on Al was tried on a medical dataset with patient demographic details, disease history, and prescribed medicines after extensive experimentation. The system performance was evaluated using different algorithms of machine learning by training and testing them. For example, Decision Tree, Random Forest, Support Vector Machine (SVM). Among the models, Random Forest classifier outperformed with an accuracy of 92.4% and excellent precision and recall values for the prediction of safe and proper drug prescription. A deep learning-based Recurrent Neural Network (RNN) model was also developed to handle complex, sequential patient histories, resulting in a more accurate prediction of 94.1%. By integrating a DDI checker to filter out harmful drug combinations, patient safety has been enhanced. The comparative study showed that deep learning models performed better than traditional ML models in learning sequential & multilabel data. The system's user interface was easy to use for the doctors. This made the recommendation process easier and possible in real-time for clinical applications. According to the study, use of deep learning-based models is more suited for healthcare applications involving multi-label classifications and medic pattern recognition. Fig. 4 shows the User Interface Example.

The system’s user-friendly interface has made it so easy to use by healthcare professionals without compromising reliability and accuracy levels in its statement. The study shows that Al-driven drug recommendation systems can significantly be a great help in clinical decision support, and safety.

6 Conclusion

The Medi-Co is a healthcare product that encompasses the whole spectrum of the medical discipline and is an AI-based product. The platform has bridged the gap between traditional healthcare models and state-of-the-art technology through artificial intelligence, telemedicine and real-time health monitoring. Patients will receive the information they need, when they need it and most importantly, it will be data-driven and informed. One of the major strengths of Medi-Co is how it offers a personalized recommendations system for health care. Medi-

Sense doesn't default to a one-size-fits-all approach like most systems do, but instead offers insights, and services based on one's medical history, lifestyle, and health goals. The system ensures that health care is delivered according to individual requirements. It provides personalized exercise and diet routines, reminders for medicines, preventive screenings, etc. When health care is organized enough to treat people as individuals, this improves health and enhances well-being through behavioral factors over the long term. Medi-Co solves major issues regarding healthcare access. Due to its telehealth feature, users can communicate with doctors, specialists, and psychotherapists irrespective of their geographical location. Especially designed for those residing in rural or under-served areas who do not have easy access to proper care. Adding a scheduler, follow-ups, and a real-time translator enhances the experience, which ensures seamless communication between the patient and the doctor. User data is private and secured in Medi-Sense's design. Since health information is sensitive, the app is highly secure.

References

[1] Huang, K., Chandak, P., Wang, Q., Havaldar, S., Vaid, A., Leskovec, J., Nadkarni, G. N., Glicksberg, B. S., Gehlenborg, N., & Zitnik, M. (2024). A foundation model for clinician-centered drug repurposing. *Nature Medicine, 30*(12), 3601–3613. https://doi.org/10.1038/s41591-024-03233-x

[2] Serrano, D. R., Zabaleta-Peiro, J., Jorge-Rivera, J. C., & Otero-Espinar, F. J. (2024). Artificial intelligence (AI) applications in drug discovery and development. *Biomedicines, 12*(5), 1081.

[3] Wu, Y. (2024). The role of artificial intelligence in drug screening, design, and clinical trials. *Frontiers in Pharmacology, 15*, 1459954. https://doi.org/10.3389/fphar.2024.1459954

[4] Kant, S., Deepika, & Roy, S. (2025). Artificial intelligence in drug discovery and development: Transforming challenges into opportunities. *Innovations in Pharmaceutical Sciences*. https://doi.org/10.1007/s44395-025-00007-3

[5] Ocana, A., Blanco, R., Gil-Martín, M., & Taron, M. (2025). Integrating artificial intelligence in drug discovery and early drug development. *Biomarker Research, 13*, 125. https://doi.org/10.1186/s40364-025-00758-2

[6] Malheiro, V., Silva, D., Araújo, A., & Rodrigues, F. (2025). The potential of artificial intelligence in pharmaceutical development: Drug formulation, repurposing, and discovery. *Pharmaceuticals, 18*(6), 788. https://doi.org/10.3390/ph18060788

[7] Wang, B. (2025). Elucidating the role of artificial intelligence in drug development, particularly in drug-target prediction. *Computer Methods and Programs in Biomedicine, 240*, 107561.

[8] Tang, X., Dai, H., Knight, E., Wu, F., Li, Y., Li, T., & Gerstein, M. (2024). A survey of generative AI for de novo drug design: New frontiers in molecule and protein generation. *arXiv*. https://doi.org/10.48550/arXiv.2402.08703

[9] Zheng, Y., Koh, H. Y., Yang, M., Li, L., May, L. T., Webb, G. I., Pan, S., & Church, G. (2024). Large language models in drug discovery and development: From disease mechanisms to clinical trials. *arXiv*. https://doi.org/10.48550/arXiv.2409.04481

[10] Abou Hajal, A., Ayoub, N., & El Rassi, R. (2024). Insights into artificial intelligence utilization in drug discovery. *Drug Discovery Today, 29*(8), 1231–1242. https://doi.org/10.1080/13696998.2024.2315864