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Virtual Medicine Recommendation

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***Abstract*:**

According to the World Health Organization, a significant number of medication errors are caused by doctors prescribing medication based on their limited experience. However, with advancements in technology and data science techniques such as data mining and recommender systems, it is possible to analyze patient history records and assist doctors in accurately prescribing drugs. By recommending the appropriate medication based on the patient's diagnosis, we can aim to reduce experimentation and minimize adverse drug effects. In this research project, we developed a novel recommender system that provides clinical drug recommendations by considering not only symptoms but also the patient's medical record, current treatment, and if any side effects. Taking into consideration these parameters we make our system unique and even more accurate compared to a lot of other pre-existing systems, resulting in better outcomes for patients. The system's effectiveness was evaluated through extensive experimentation, and the results demonstrated its potential to improve medication safety and efficiency.

Keywords: *Medicine-Medicine Interaction, Machine Learning (ML), Neural Network (NN), MMI Dataset, Medicine Dataset.*

Introduction:

Wrong drug prescription is one of the most significant and unfortunate problems in the world today, resulting in millions of deaths annually worldwide. According to the World Health Organization's 2019 report, wrong drug prescriptions are responsible for 138 million deaths each year. Specialists mainly base their recommendations on limited factors such as their experiences, knowledge, diagnosis, and human error, which can sometimes result in fatal consequences. In the current era of advanced technology, we can utilize AI/ML-based recommendation systems to assist doctors in suggesting the accurate medication to the patient which may save lives of millions.

However, the current models for Medicine recommendations have constraints as they mostly rely on sentiment analysis and drug's reaction on the patient, which are subjective and not always accurate. Additionally, these models don't take into account the past medication, which is a vital factor in recommending the right medication. Due to misleading medical

suggestions, a multitude of people have suffered long-term damage, and some have even lost their lives. Another drawback of existing systems is that they don't consider the patient's ongoing medication. Some drugs can be fatal if prescribed along with certain other medications.

Example: - A patient is pregnant and experiencing a medical condition. An existing model may suggest a medication that is not safe for use during pregnancy, which may affect the fetus. Therefore, it is essential to take into consideration the patient's pregnancy status and medical condition before recommending any medication.

In our research project, we propose a novel AI/ML-based recommender system that considers the patient's medical record, current treatment, and allergies or side effects to recommend the best-suited medication. The proposed system aims to minimize experimentation, reduce adverse drug, and improve medication safety and efficacy. The system's effectiveness is evaluated through extensive experimentation, and the results demonstrate its potential to save lives and improve the quality of medical practice.

Therefore, there is a need for such a model which can suggest medicines as per the following parameters:

- Medical Record of patient.
- Ongoing treatment of patient.
- Medical complications.
- Ongoing problems of the patient.

EASE OF USE

- **User-Friendly Interface**

The software should be designed with a Graphical User Interface (GUI) which should be easy to use and navigate. The interface is intuitive and efficient, allowing users to input their medical information quickly and easily. It is optimized to be compatible with a wide range of devices, such as Kiosks, Computers, Smartphones, and Tablets, ensuring that it is easily accessible to all users.

- **Cloud-Based Computation**

The system utilizes cloud computing to perform machine learning and other computations through open APIs. This enables cross-platform support. By leveraging cloud computing, the system can process and analyze data faster and more efficiently, while also reducing the load on the user's device. This ensures that the software is accessible to a wider range of users, regardless of their device or platform.

- **Full forms of terms used in paper**

MMI: Medicine-Medicine Interaction.

ML: Machine Learning.

- **Requirements**

To deploy the ML Model, a compatible computing device or cloud computing service is required. An input device is needed to collect inputs from users, while an output device is necessary to display the system's output result. The system may consist of multiple dataset and corresponding ML Models that work in sequence to generate the desired results. To achieve the most user-specific results, the system begins by asking basic diagnostic questions to narrow down the data. This may involve segmenting data based on factors such as gender and age group. These parameters can be variable.

- ***System Dataset:*** The system begins by taking the symptoms of patient as the input and adds it to the user's file. The ML Model of this data is then used to predict the possible illness of the patient. The system narrows down the possible illness by identifying similar features and asking the user similar questions in different ways to corroborate and clarify the exact symptoms that they are feeling. As soon as the model is satisfied by the answers the system will move forward.

- ***Medicine Dataset:*** The ML Model for this dataset takes the now-established illness as the input parameter and explores the dataset for the most suitable medicines. It filters down to the best options, with addition to any substitute medicine. The model then looks for any medical complications of the patient and asks the user counter questions to ensure that the selected medicine is safe and do not conflict with any existing medication. To do this, the system

utilizes the medicines dataset to track the side effects and list of harmful medicines and register any existing illnesses of the user. If the selected medicine is not suitable due to medical complications, the system searches for a substitute medicine that will be safe and possess similar effects. Once the best suitable medicine is identified, the system will do the further proceedings.

- **MMI Dataset:** This is a crucial component of our recommendation system, as it contains information on medicine interactions. Although it is designed for pharmaceutical scientists, we utilize it in our system to ensure that the recommended medicines do not react adversely with other drugs that the user may be taking.

In case a patient is already taking a certain medication such as "ABC", the system will compare this medicine with the medicine "DEF" recommended by the medicine searching algorithm to check for any potential side effects. If any side effects are found, the system will recommend an alternative medicine, such as "XYZ", that is non-reactive with "ABC".

- **Comparison to Similar Frameworks:**

There are several existing frameworks that use sentiment analysis and patient surveys to recommend medication based on ordinal information. However, the precision of these models is often low, and the appropriateness of the recommended drug can be questionable. It is very important to consider the patient's past treatment, as certain medications should not be given to patients who are already taking certain drugs due to the risk of negative side effects, including death.

To address this issue, our proposed drug recommendation system utilizes the patient's medical history and sentiment analysis to generate more accurate and reliable results. However, in order to do this effectively, we need to acquire new data collections that help us to identify Medicine-Medicine interactions that are harmful when taken together. This is where the Medicine-Medicine Interaction (MMI) prediction dataset is crucial.

Our proposed framework, called Neural Drug Discovery, utilizes a multi-step pipeline to accurately predict MMIs. It uses a Neural Network Model along with similar determination and combination strategies to provide the accurate MMI prediction. Neural Drug Discovery can select the most beneficial and least frequent occurrence of similarity types and integrates

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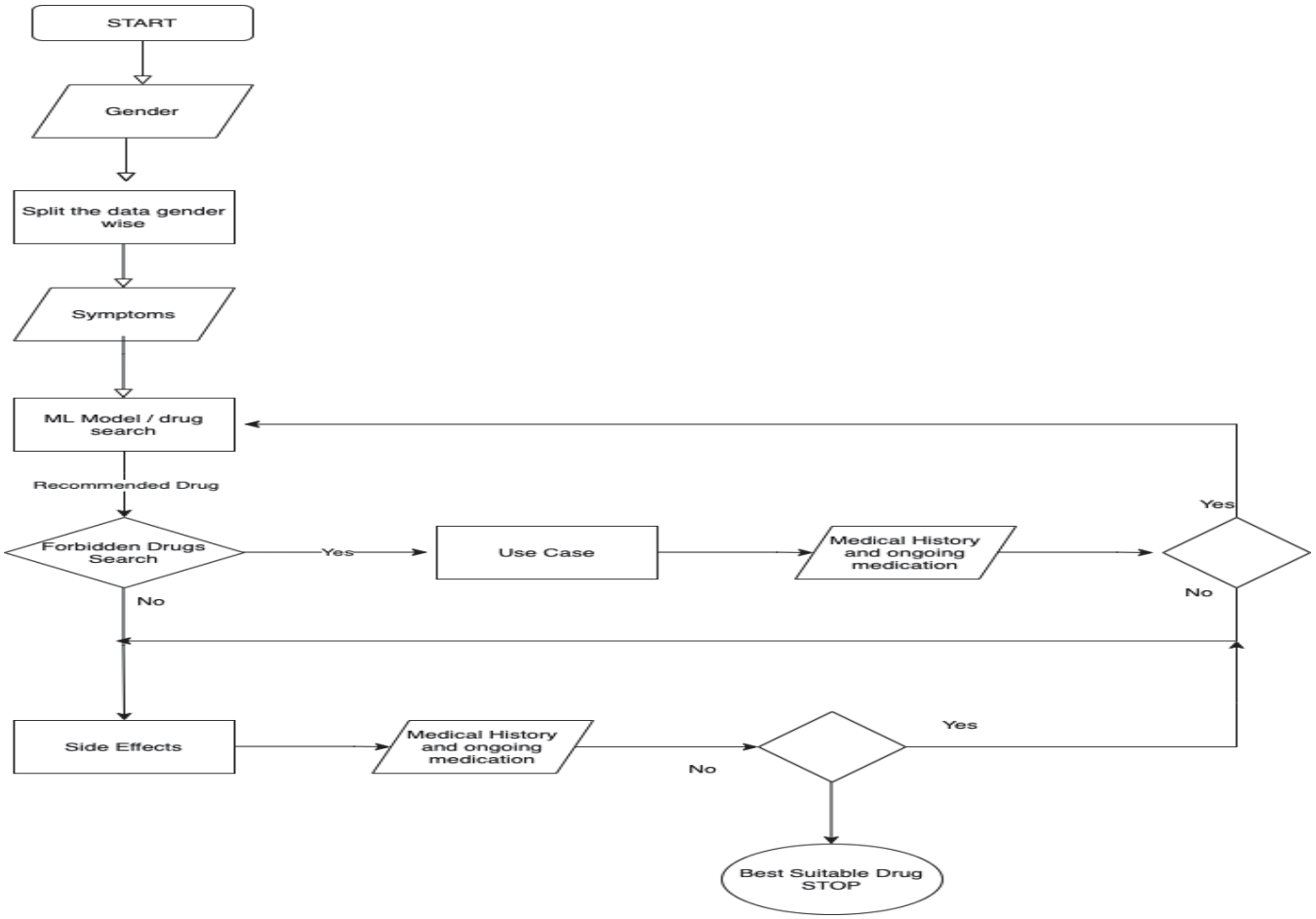
them using a non-linear similarity fusion technique called SNF. The integrated similarity system, along with interaction data, is then used to train the neural network.

Another important dataset for our proposed framework is the medical history dataset, which consists of two major fields: disease and medication/drugs. By comparing the drugs prescribed by the sentiment-based drug recommendation system with the drugs being consumed by the patient and the medicines in the MMI dataset, we can predict the most favorable remedy that will be required for the patient based on their medical history.

Finally, we also utilized a dataset that contains various details about drugs, including its expiry date, user surveys, professional evaluations, and situations in which it is used. This dataset helps to predict how useful the recipients found a particular drug to be, and analyzed each rated medicine individually.

Flowchart



Future Enhancements

In order to improve the system further, we can incorporate AI-powered natural language processing that can understand and respond to the feedback received from the patient through voice prompts. This will simplify the process for the user and reduce the possibility of human errors in data entry. The system can collect and process the input data, matching it against the sentimental voice analysis, medical record, and Medicine-Medicine Interaction datasets to advocate the best suitable drug for the patient. This will enable the system to consider a larger amount of data and avoid any mistakes in drug recommendation. Additionally, we can integrate machine learning algorithms to continuously improve the system's accuracy and efficiency in recommending drugs.

Limitations

There are a few limitations to our approach that need to be taken into consideration. Firstly, the data collection for medicine-to-medicine interactions is not easily accessible to the general population, which can limit the effectiveness of our model. Secondly, patients should always be aware of their medications and provide accurate information to healthcare professionals to avoid any errors in diagnosis, which could potentially result in fatal medicine recommendations. These limitations supposed to be addressed taking into consideration the overall effectiveness and reliability of our drug recommendation system.

Conclusion

The use of AI/ML-based recommender systems in the medical field can significantly improve the accuracy and precision of drug prescriptions, ultimately saving millions of lives worldwide. However, existing models have limitations as they do not consider critical factors such as the patient's medical record, current treatments, and allergies or side effects. Therefore, we proposed a novel AI/ML-based recommender system that considers these factors to recommend the best-suited medication. Our research project aims to minimize experimentation, reduce adverse drug effects, and improve medication safety and efficacy. We believe that this research project's findings can pave the way for future developments in AI/ML-based recommender systems that consider a patient's medical record, current treatments and allergies or side effects, leading to a safer and more effective healthcare

system.

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