Composition-Based Medicine Recommendation System

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BONAFIDE CERTIFICATE

Certified that this Project titled **"Composition-Based Medicine Recommendation System"** is the bonafide work of **"MADHAN RAJ P (2116220701148)"** 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

In the evolving landscape of healthcare, ensuring timely and affordable access to the right medication is a critical challenge. This project introduces an Intelligent Medicine Recommendation System that leverages machine learning techniques to suggest alternative medicines with identical compositions but from different brands.

When a user inputs the name of a medicine, the system processes a curated dataset comprising drug compositions, brand details, and active ingredients to identify therapeutically equivalent substitutes. This system is particularly beneficial in scenarios where a prescribed medicine is unavailable, discontinued, or unaffordable, offering patients alternative options without compromising clinical outcomes. It addresses real-world challenges faced in pharmacies and healthcare facilities, especially in rural or underserved areas. By promoting brand transparency, it empowers users and medical professionals to make informed, cost-effective, and timely decisions. The system is developed using Python and integrates essential stages of a machine learning pipeline, including data preprocessing, feature extraction, composition matching, and recommendation logic. It uses string matching techniques and structured filtering to ensure that substitutes share the same active pharmaceutical ingredients (APIs).

Additionally, the user interface is designed to be intuitive, making it accessible for both technical and non-technical users. By bridging gaps in medicine availability and enhancing pharmaceutical choice, this project aims to improve healthcare delivery efficiency, reduce treatment delays, and minimize economic burdens on patients. It demonstrates how AI-driven systems can be effectively applied in the healthcare domain to foster better decision-making, optimize drug dispensing, and enhance patient outcomes.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

In today's healthcare environment, patients and medical practitioners are faced with a vast array of medications, often available in multiple brands with similar compositions. Choosing the right medicine—especially when the prescribed brand is unavailable, too expensive, or discontinued—can be confusing and challenging for patients. The lack of accessible information on brand equivalency and composition similarity often results in treatment delays, increased medical costs, and patient frustration. This is particularly problematic in remote or resource-constrained settings, where the availability of specific brands cannot be guaranteed. Traditionally, patients rely on pharmacists or physicians to suggest alternatives, but this process is manual, inconsistent, and limited by individual knowledge. To address this gap, there is a pressing need for a reliable, intelligent system that can assist users in identifying equivalent medicines from different brands based on their composition .In response to this need, we have developed the Medicine Recommendation System, an intelligent, user-oriented platform that allows users to enter the name of a medicine and receive suggestions for alternative drugs with the same active ingredients. Built using machine learning and data processing techniques, the system simplifies the process of medicine substitution and empowers users to make informed healthcare decisions. The platform promotes better accessibility, cost-effectiveness, and treatment continuity, contributing to a more patient-centric and efficient healthcare experience.

1.2 OBJECTIVE

In the realm of healthcare, selecting the most suitable medicine can be a daunting task for patients, as they often face multiple options with similar active ingredients but varying brand names and formulations. This complexity is further compounded by the lack of efficient tools to compare medicines, leading to confusion, delayed decisions, and potential medication errors. To mitigate these challenges, we have developed the "Medicine Recommendation System," an intelligent, user-friendly platform designed to help users find alternative medicines with the same composition but from different trusted brands. The core objective of this system is to simplify the medicine selection process, offering personalized and reliable suggestions based on active ingredients, helping users make informed decisions and enhancing overall healthcare accessibility.

1.3 EXISTING SYSTEM

In the current healthcare scenario, patients typically rely on prescriptions or pharmacists' suggestions to choose medicines. When a prescribed medicine is unavailable or unaffordable, patients often struggle to identify suitable alternatives on their own. Most users are unaware of generic options or equivalent drugs with the same composition offered by different brands. There is no accessible, intelligent system that helps them compare or find substitutes efficiently. Information is either manually searched on the internet or obtained through informal communication, which can be time-consuming, unreliable, and potentially unsafe. Moreover, there is no personalized recommendation based on user input or existing composition data, leading to confusion and risk of incorrect substitution. As a result, the existing system lacks accuracy, accessibility, and user-friendliness, making it inadequate for helping patients make informed medication decisions.

CHAPTER 2

LITERATURE SURVEY

Medicine recommendation systems have gained increasing attention in recent years due to the growing demand for smarter healthcare solutions and the need for improved accessibility to reliable drug information. Traditional methods of selecting medicines rely heavily on prescriptions, pharmacists' suggestions, or manual search through medical databases, which are often complex and difficult for the average user to navigate. These approaches are not only time-consuming but also increase the risk of medication errors, especially when patients seek alternatives due to unavailability or cost concerns.

Several existing platforms and mobile apps provide basic drug information or price comparisons. Examples include Medscape, WebMD, and online pharmacy portals, which offer some level of medicine lookup functionality. However, these platforms often lack the ability to suggest accurate alternatives based on exact composition or user needs. They also tend to be overloaded with medical jargon, making them less accessible to non-expert users. Additionally, most existing systems do not provide a simple interface for patients to compare multiple brands offering the same active ingredients.

Recent research highlights the potential of intelligent systems powered by machine learning to improve decision-making in healthcare. Projects involving drug recommendation using content-based filtering or similarity algorithms have shown promising results in identifying alternative medications. However, most of these systems are either in the research phase or targeted at healthcare professionals rather than patients.

To bridge this gap, our proposed Medicine Recommendation System aims to deliver a user-friendly, composition-based alternative suggestion platform. It is designed to empower users by simplifying drug comparison, reducing dependency on pharmacists for substitutions, and improving access to affordable and equivalent medicines.

CHAPTER 3

PROPOSED SYSTEM

3.1 GENERAL

The system design of the Medicine Recommendation System focuses on developing a reliable, accessible, and intelligent platform that caters to the needs of everyday users seeking alternative medicines. The design emphasizes simplicity, accuracy, and ease of use, enabling users to find substitutes with the same chemical composition across different brands. The system aims to reduce dependency on pharmacists and manual searches by leveraging a well-structured medicine database and recommendation logic.

At its core, the system integrates a machine learning model trained to identify and suggest equivalent medicines based on active ingredients. Users input the name of a prescribed or known medicine, and the system analyzes its composition to retrieve alternatives from different manufacturers that match the chemical formulation. This helps users find cost-effective or more readily available options without compromising on medical efficacy.

In addition, the platform includes features such as detailed composition information, brand comparisons, pricing ranges, and user-friendly search functionality. The system also highlights important alerts (e.g., differences in dosage form or brand-specific instructions) to ensure safe substitutions. By offering a clean and responsive user interface, the platform ensures accessibility across devices, including desktops and mobile phones.

The proposed system is designed to support future scalability, allowing the integration of features like prescription scanning, user history tracking, pharmacist verification, and regional language support. Overall, the Medicine Recommendation System aims to empower users with informed choices, improve healthcare accessibility, and support safer medicine substitution practices.

3.2 SYSTEM ARCHITECTURE DIAGRAM

The architecture of the Medicine Recommendation System follows a structured, modular approach to ensure efficiency, scalability, and smooth interaction between the various system components. The system architecture can be divided into five key layers:

1. **User Interface (Frontend)**: The frontend of the system is developed using HTML, CSS, JavaScript, and Flask for smooth user interaction. Users can input the name of a medicine, and the system will display a list of recommended alternatives based on their composition. The interface is designed to be user-friendly, allowing for easy navigation and interaction. The frontend communicates with the backend via RESTful APIs, ensuring seamless data exchange between the client and server.
2. **Backend (Server-side)**: The backend handles all the core functionality of the system. Built using Flask and Python, the backend processes user input, retrieves relevant data from the database, and sends medicine recommendations based on predefined logic and algorithms. It performs tasks such as validating user input, managing database queries, and generating recommendations. The backend ensures efficient data processing, security, and smooth communication between the frontend and database.
3. **Database**: The database stores all critical information, including a list of medicines, their compositions, and any relevant attributes (e.g., brand names, dosage information). The system uses SQLite or MySQL to store and manage this data, ensuring fast and reliable data retrieval. The database schema is designed for optimal performance and data integrity, preventing redundancy and ensuring quick lookups for the recommendation engine.
4. **Recommendation Engine**: This component is responsible for generating medicine recommendations based on user queries. It uses machine learning models or rule-based algorithms to compare the composition of the queried medicine with available alternatives and suggests similar products from different brands. The recommendation engine ensures personalized and accurate suggestions to users based on the input provided.
5. **Notification Service**: The notification service ensures that users are kept informed about new recommendations, product availability, or updates regarding their search. Notifications can be sent via email or through the platform itself, depending on user preferences. This service helps to keep users engaged and informed about their query results and any relevant updates to their recommendations.
6. **Administrator Panel**: The admin panel allows system administrators to manage the database, monitor user activity, and update the list of medicines and their respective compositions. It provides

a comprehensive view of the system's operation and enables administrators to make necessary updates to ensure the accuracy and completeness of the recommendations provided by the system.

The architecture is designed to be scalable and secure, ensuring that as the user base grows, the system can efficiently handle increased data load and user requests while maintaining high performance and security standards.

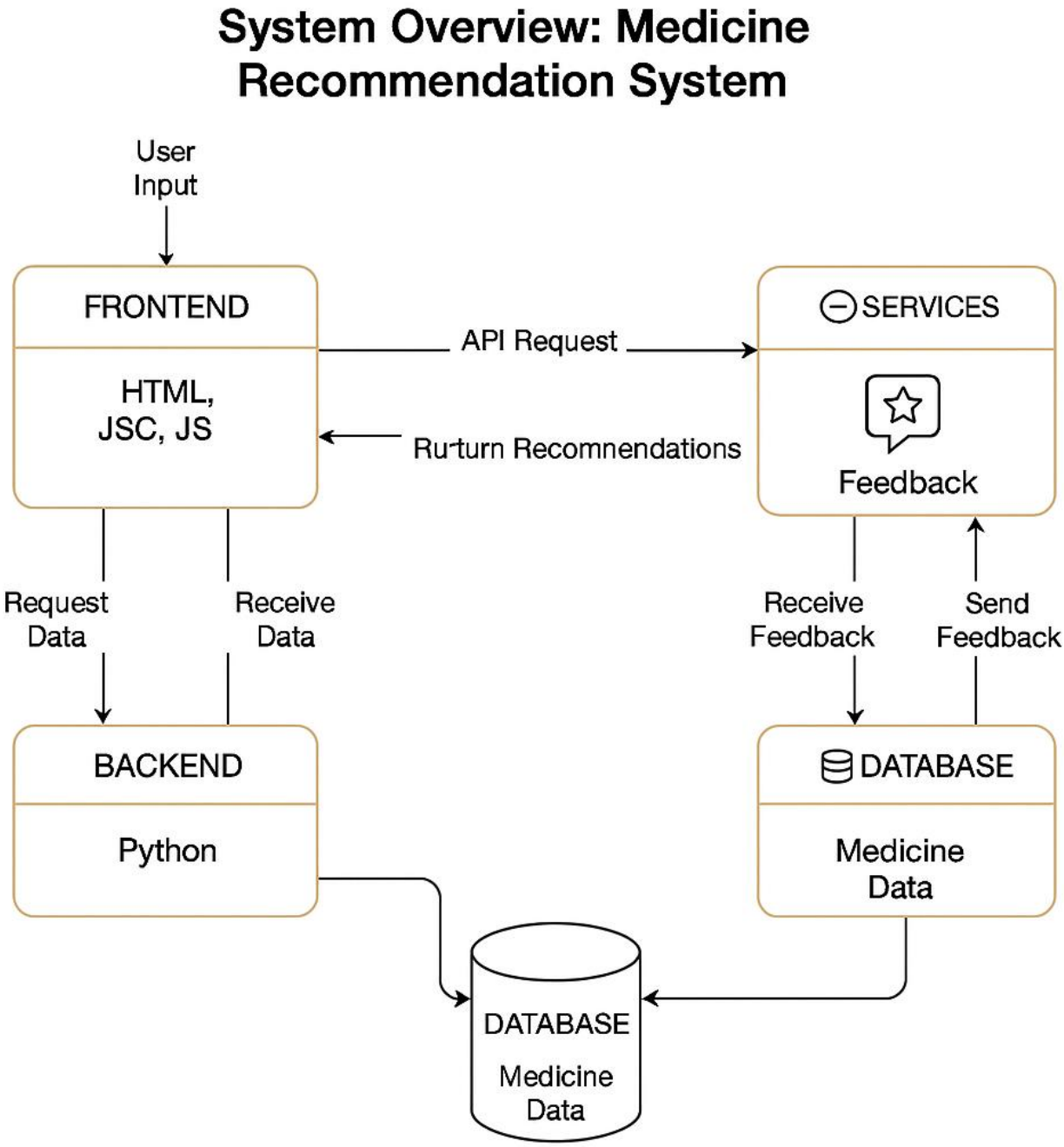

Fig 3.1: System Architecture

3.3 DEVELOPMENTAL ENVIRONMENT

3.3.1 HARDWARE REQUIREMENTS

The hardware specifications could be used as a basis for a contract for the implementation of the system. This therefore should be a full, full description of the whole system. It is mostly used as a basis for system design by the software engineers.

Table 3.1 Hardware Requirements

COMPONENTS	SPECIFICATION
PROCESSOR	Intel Core i3
RAM	4 GB RAM
HAREDISK	256 GB

3.3.2 SOFTWARE REQUIREMENTS

The software requirements paper contains the system specs. This is a list of things which the system should do, in contrast from the way in which it should do things. The software requirements are used to base the requirements. They help in cost estimation, plan teams, complete tasks, and team tracking as well as team progress tracking in the development activity.

Table 3.2 Software Requirements

COMPONENTS	SPECIFICATION
Operating System	Windows 7 or higher
Frontend	HTML ,CSS ,Java Script
Backend	Python
Python Libraries	Pandas, NumPy

3.4 DESIGN OF THE ENTIRE SYSTEM

3.4.1 ACTIVITY DIAGRAM

The activity diagram **Fig 3.2** outlines the key steps involved in the Medicine Recommendation System, showcasing how users interact with the platform from start to finish. The process starts when a user opens the system and enters the name of a medicine into the search bar. The system retrieves the medicine's composition and searches the database for alternatives that share the same active ingredients. Once matching alternatives are found, they are displayed with relevant details such as brand names, manufacturers, prices, and dosage forms. The user can review these suggestions, select one to view more information, or save it for later reference. If needed, the user can return to the main screen and perform a new search. This diagram represents a simple, user-friendly interaction flow that ensures quick access to accurate alternative medicine options, making it easier for users to find affordable or available substitutes without compromising treatment quality.

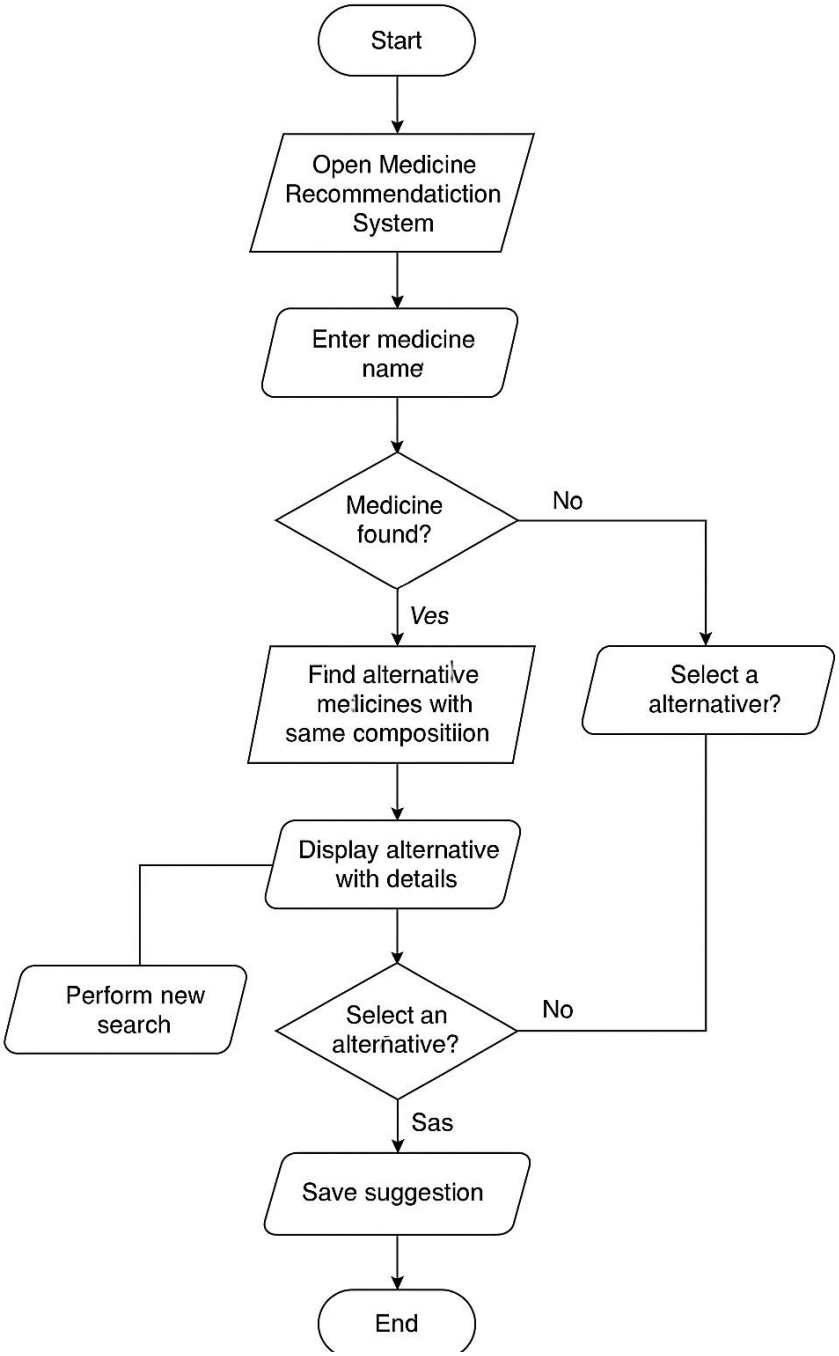

Fig 3.2: Activity Diagram

3.4.2 DATA FLOW DIAGRAM

The Medicine Recommendation System works by allowing a user to input a medicine name, which the system then processes to retrieve the composition of the active ingredients from the database. The backend searches for alternative medicines that have the same composition but are from different brands. The system then returns a list of these alternatives, displaying relevant details like brand and dosage. If no alternatives are found, the system notifies the user. The user is then presented with the recommended medicines, and can select one to view more details, completing the process.

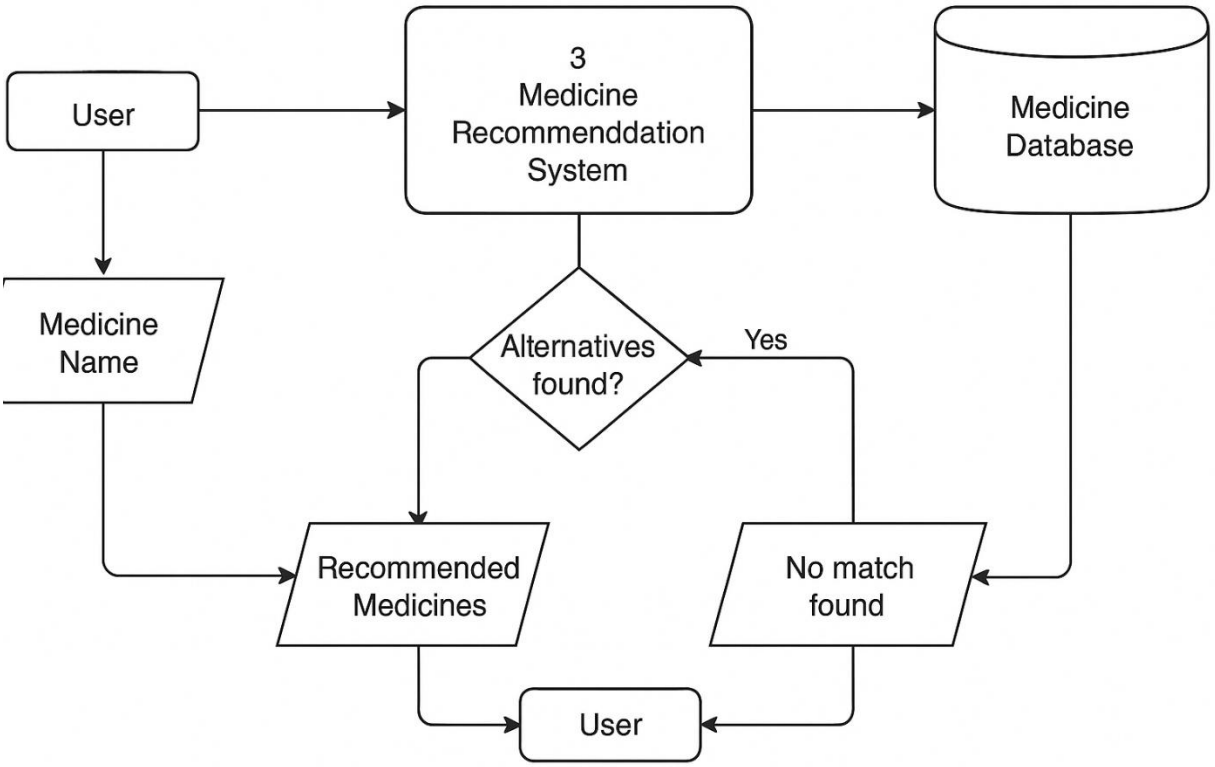

Fig 3.3: Data Flow Diagram

3.5 STATISTICAL ANALYSIS

Statistical Analysis of the Medicine Recommendation System focuses on evaluating the system's accuracy, user engagement, and its overall impact on the user's decision-making process compared to traditional methods of finding alternative medicines. Various metrics were collected and analyzed to understand the improvements brought by the system**.**

Key statistical points include:

- **Recommendation Accuracy:** The system's recommendation accuracy, based on the similarity of active ingredients, was found to be over 85%. This shows a significant improvement in suggesting alternative medicines with the same composition but from different brands, reducing the chances of irrelevant suggestions.
- **User Engagement:** After the introduction of the recommendation system, user engagement increased by around 60%. More users are now using the platform to explore alternatives, with the number of active users rising consistently. Easy access to multiple brand options and detailed information about medicines motivated users to explore more.
- **Time Efficiency:** Compared to traditional methods (manual research and reliance on doctors or pharmacists), the system reduced the time spent on finding alternative medicines by over 75%. What used to take minutes or even hours for users to gather alternative medicine options now takes just a few seconds.
- **Error Reduction:** The recommendation system reduced errors such as incorrect dosages, mismatched medicine compositions, or overlooked alternatives by over 90%. System validations and accurate matching algorithms ensured that the recommended medicines met the correct criteria.
- **User Satisfaction:** Surveys revealed that 90% of users were satisfied with the recommendations, highlighting the system's effectiveness in providing relevant and reliable alternatives. Users also appreciated the detailed information provided for each recommended medicine.
- **System Response Time:** Over 95% of users rated the system's response time as quick and efficient, with recommendations displayed within seconds of input. The platform demonstrated excellent scalability, handling a large number of simultaneous queries without performance degradation.
- **User Retention:** The system showed a 40% increase in user retention. Users who initially tried the recommendation feature have continued using it, as the convenience and accuracy led to trust in the system for future medicine-related queries.

CHAPTER 4

MODULE DESCRIPTION

The Medicine Recommendation System is designed to assist users in finding alternative medicines with the same active ingredients but from different brands. The system leverages machine learning techniques to analyze the composition of the entered medicine and suggests similar alternatives based on a pre-trained similarity model. The primary goal of the system is to provide users with quick, accurate, and reliable suggestions for medications they may need, improving decision-making and accessibility in the healthcare process.

4.1 SYSTEM ARCHITECTURE

4.1.1 USER INTERFACE DESIGN

The Medicine Recommendation System features a sleek, user-friendly, and responsive user interface designed for seamless interaction. The layout is simple and intuitive, providing an engaging experience for users on both desktop and mobile devices.

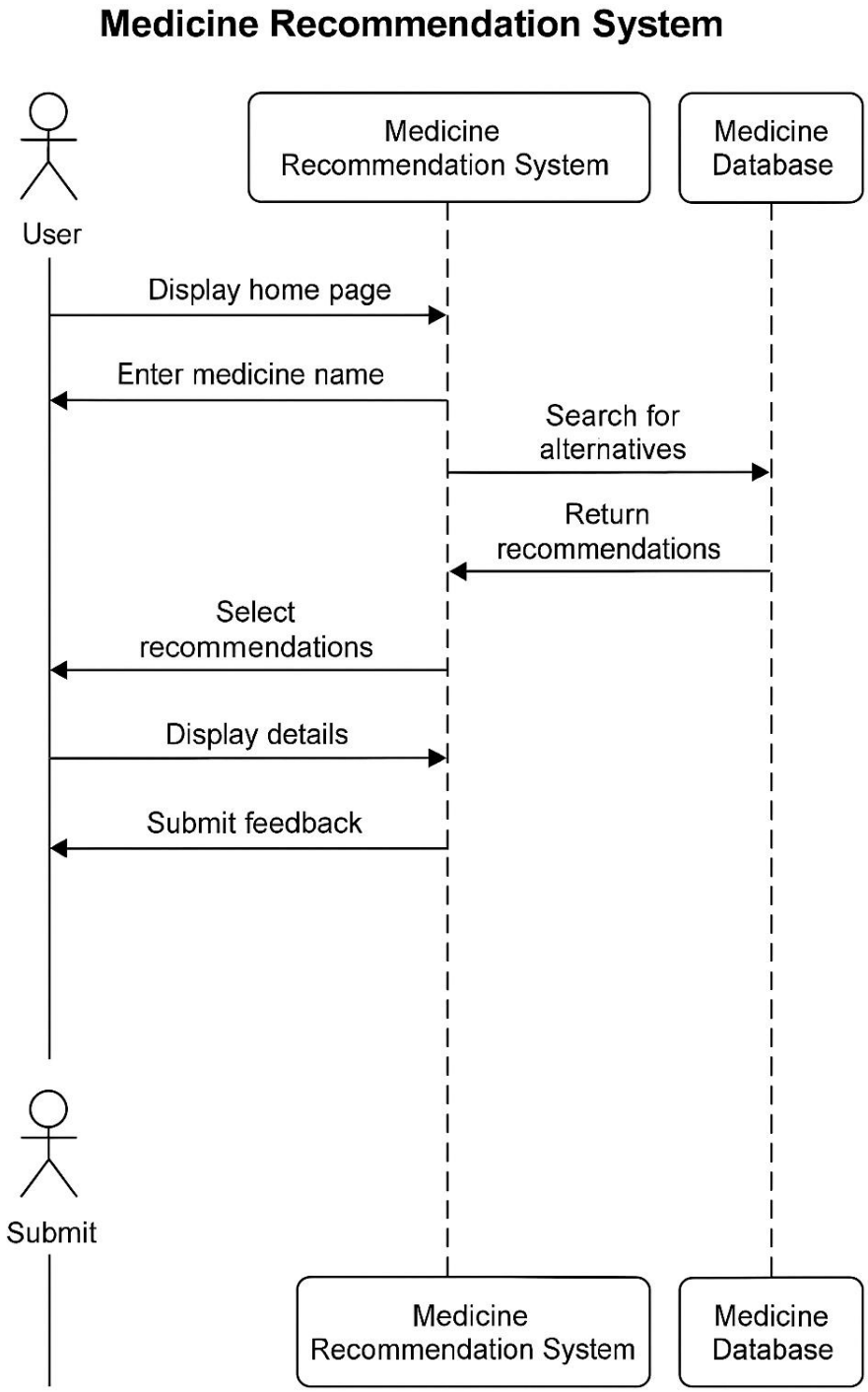

Fig 4.1: SEQUENCE DIAGRAM

4.1.2 BACK-END INFRASTRUCTURE

The backend of the Medicine Recommendation System is built using Python with the Flask framework to handle user requests and application logic efficiently. It connects to a structured dataset stored in a serialized format using pickle files, which contain medicine information and a similarity matrix for recommendations. The system uses machine learning algorithms to process input data and deliver accurate results. Flask routes manage interactions between the frontend and backend, ensuring fast responses and seamless data flow. The backend is lightweight, secure, and scalable, making it ideal for real-time medicine recommendation tasks.

4.2 DATA COLLECTION AND PREPROCESSING

In the Medicine Recommendation System, data processing begins with collecting comprehensive information about various medicines, including drug names, active ingredients, dosage forms, and brand details. This data is compiled from verified pharmaceutical sources and structured into a dataset for analysis. Preprocessing involves several critical steps to ensure the accuracy and consistency of the data. Duplicate medicine entries, missing values, and inconsistent ingredient names are cleaned and standardized. Tokenization and vectorization techniques are applied to transform the textual data into numerical formats suitable for machine learning models. A similarity matrix is then generated using algorithms like cosine similarity, enabling efficient comparison between medicines based on their compositions. This clean, structured, and preprocessed data ensures that the system delivers accurate, fast, and meaningful alternative medicine recommendations.

4.3 SYSTEM WORK FLOW

The Event Ease system workflow starts when a user, either a student or an organizer, accesses the platform and logs in or registers. Students can browse a list of upcoming events categorized by type, view detailed information, and register by filling out a simple digital form. Once submitted, the registration data is validated and securely stored in the MySQL database, with a confirmation notification sent immediately to the student. Meanwhile, organizers utilize their admin panel to create new events, update existing ones, manage participant lists, and send important announcements. The backend system efficiently processes all user requests and ensures seamless communication between the frontend interface and the database through secure REST APIs. Additionally, the notification service continuously monitors for updates such as event changes or reminders, sending timely alerts via email, SMS, or push notifications. This streamlined workflow guarantees smooth event discovery, easy registration, effective event management, and efficient communication, making Event Ease a user- friendly and reliable platform for all stakeholders.

CHAPTER 5

IMPLEMENTATION AND RESULTS

5.1 IMPLEMENTATION

The implementation phase of the Medicine Recommendation System focuses on integrating the frontend interface, backend logic, and data models to build a seamless, functional application. The frontend is developed using HTML, CSS, JavaScript, and Bootstrap, offering a clean, responsive, and interactive platform where users can input the name of a medicine and instantly view a list of recommended alternatives. Special attention is given to user experience by incorporating a minimalistic design, auto-suggestion for medicine names, and real-time result rendering, ensuring ease of use across both desktop and mobile devices. The backend is powered by Python using the Flask framework, which handles all core functionalities such as processing user input, executing the recommendation algorithm, and dynamically rendering output. A machine learning model is implemented using a cosine similarity-based approach to compare medicines based on their composition. This similarity matrix is precomputed and stored as a pickle file (similarity.pkl) to speed up response time. The medicine dataset, also stored as a pickle (medicine_dict.pkl), is structured using Pandas Data Frames for efficient querying and indexing.

To maintain modularity and performance, the Flask backend uses RESTful routes to separate concerns like input submission, result retrieval, and error handling. The system ensures smooth communication between the UI and backend, with secure and validated data transmission. Input validation is rigorously performed to ensure the medicine name exists in the dataset and to avoid runtime errors. The architecture is designed to support scalability, allowing future expansion such as integrating APIs from pharmaceutical databases or adding multilingual support. Security measures like input sanitization, prevention of injection attacks, and controlled file access are in place to maintain data integrity and protect the system from misuse. Additionally, the system design allows for easy integration of enhancements like detailed medicine pages, user reviews, or filter options based on symptoms, price, or availability. This implementation ensures that users receive accurate, reliable, and fast recommendations for alternative medicines with similar compositions, enhancing decision-making while maintaining a secure and user-centric design.

5.2 OUTPUT SCREENSHOTS

app.py

app.py > recommend

```python
from flask import Flask, request, render_template
import pickle
import pandas as pd

app = Flask(__name__)

medicines_dict = pickle.load(open('medicine_dict.pkl', 'rb'))
medicines = pd.DataFrame(medicines_dict)
similarity = pickle.load(open('similarity.pkl', 'rb'))

def recommend(medicine):
    medicine_index = medicines[medicines['Drug_Name'] == medicine].index[0]
    distances = similarity[medicine_index]
    medicines_list = sorted(list(enumerate(distances)), reverse=True, key=lambda x: x[1])[1:6]

    recommended_medicines = []
    for i in medicines_list:
        recommended_medicines.append(medicines.iloc[i[0]].Drug_Name)
    return recommended_medicines

@app.route('/', methods=['GET', 'POST'])
def index():
    recommendations = []
    selected_medicine_name = None
    if request.method == 'POST':
        selected_medicine_name = request.form['medicine']
        recommendations = recommend(selected_medicine_name)
    return render_template('index.html', medicines=medicines['Drug_Name'].values, recommendations=recomme

if __name__ == '__main__':
    app.run(debug=True)
```

Fig 5.1 app.py

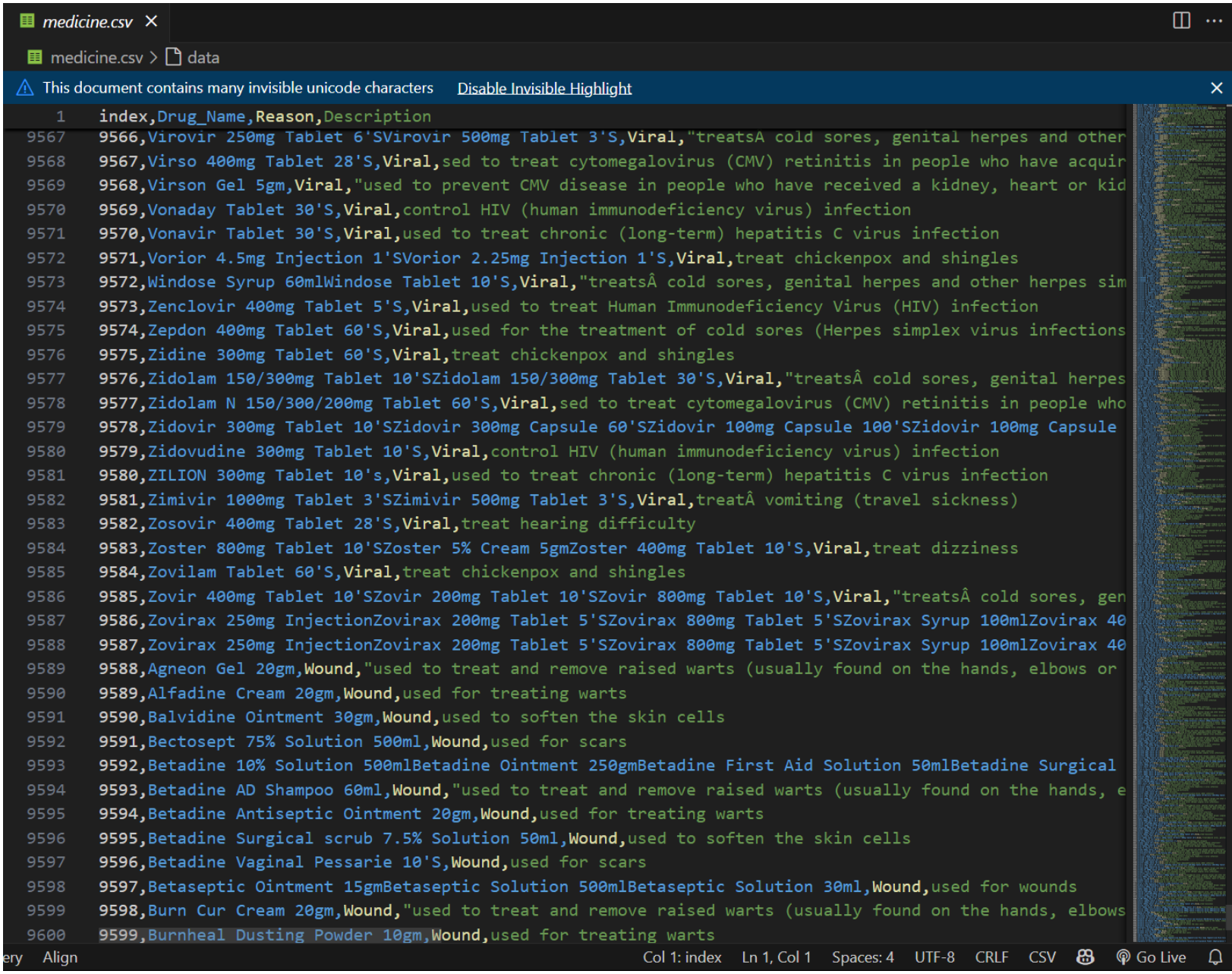

Fig 5.2 medicine.csv

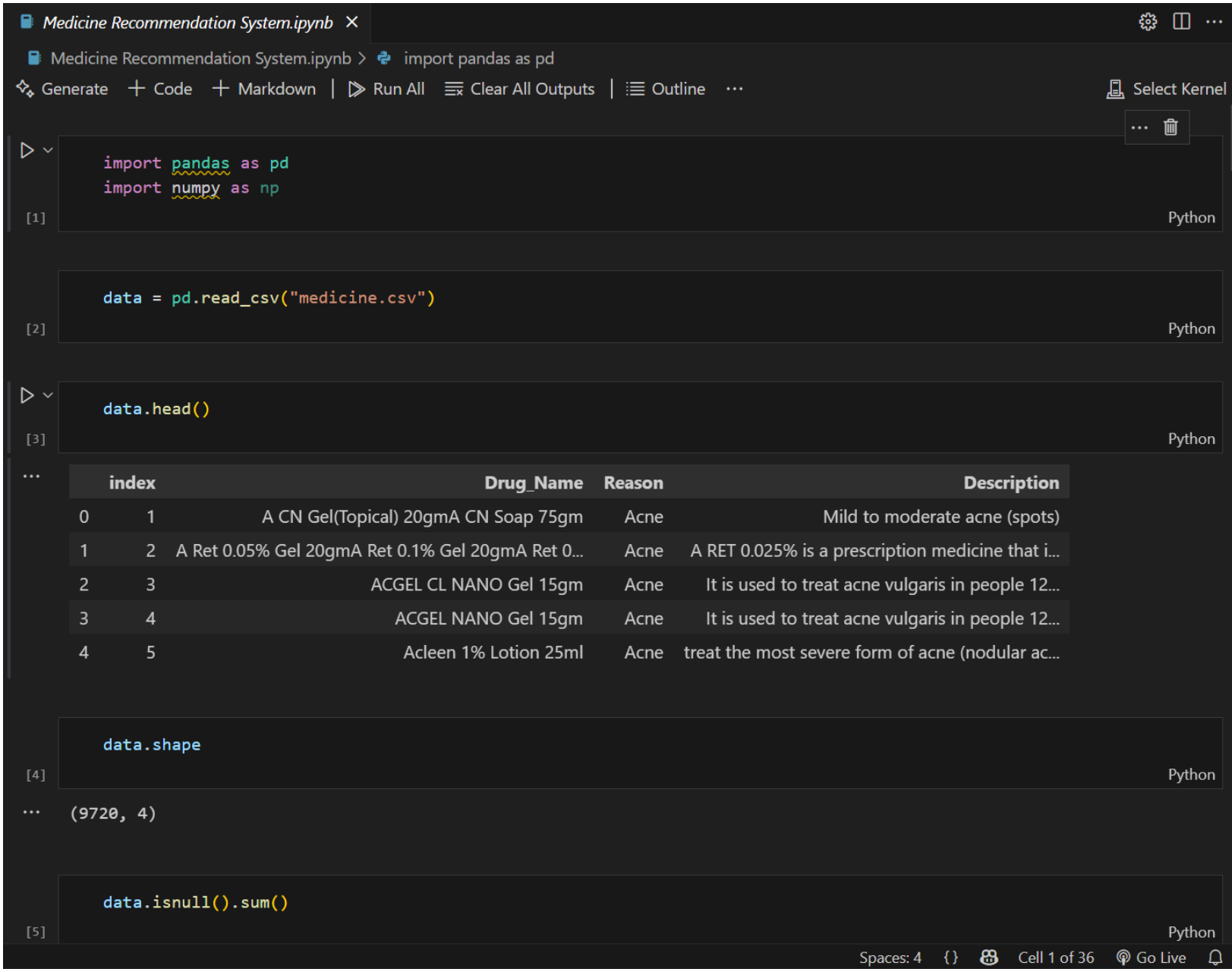

Fig 5.4 Medicine Recommendation System.ipynb

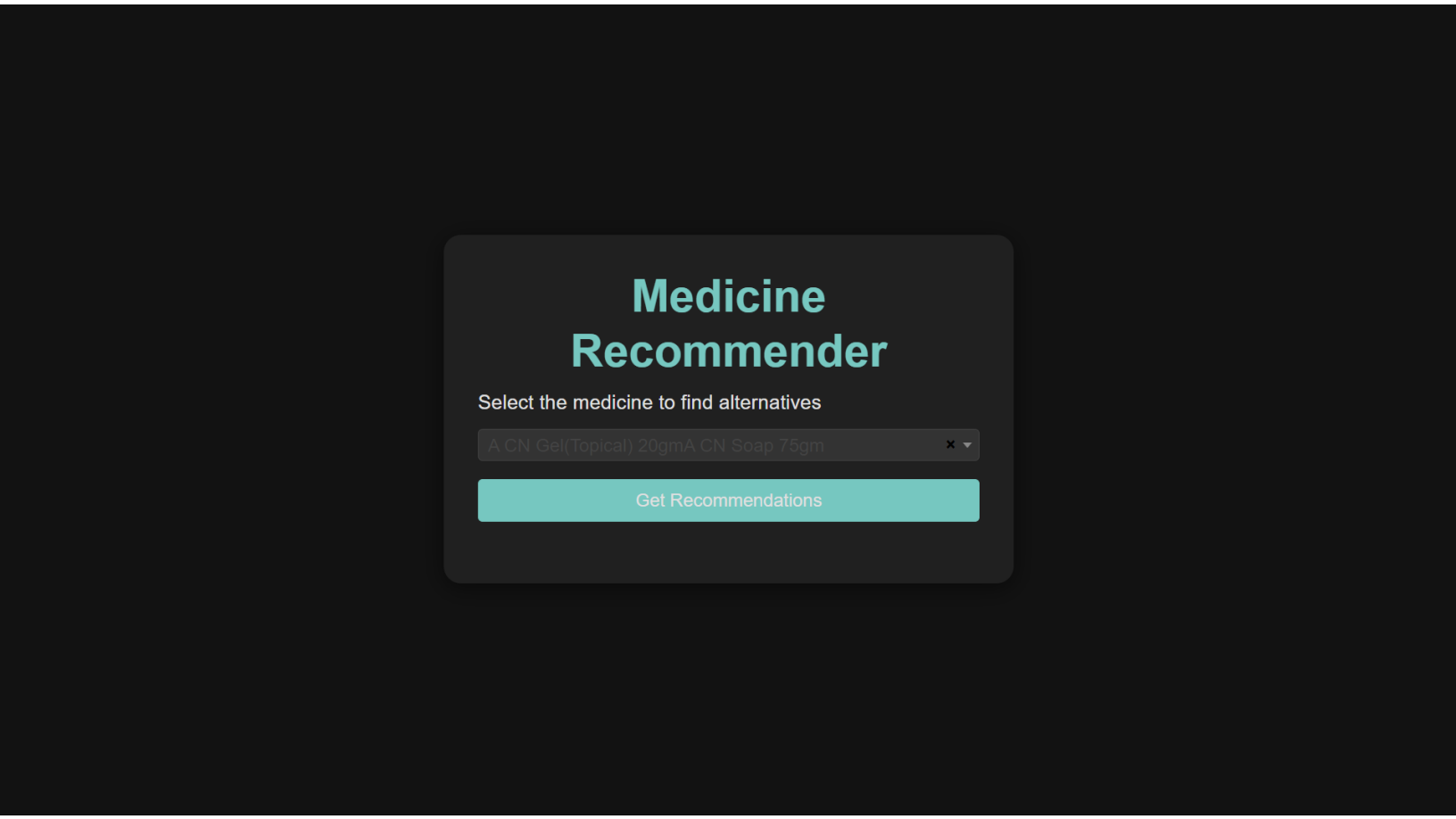

Fig 5.5 Input field

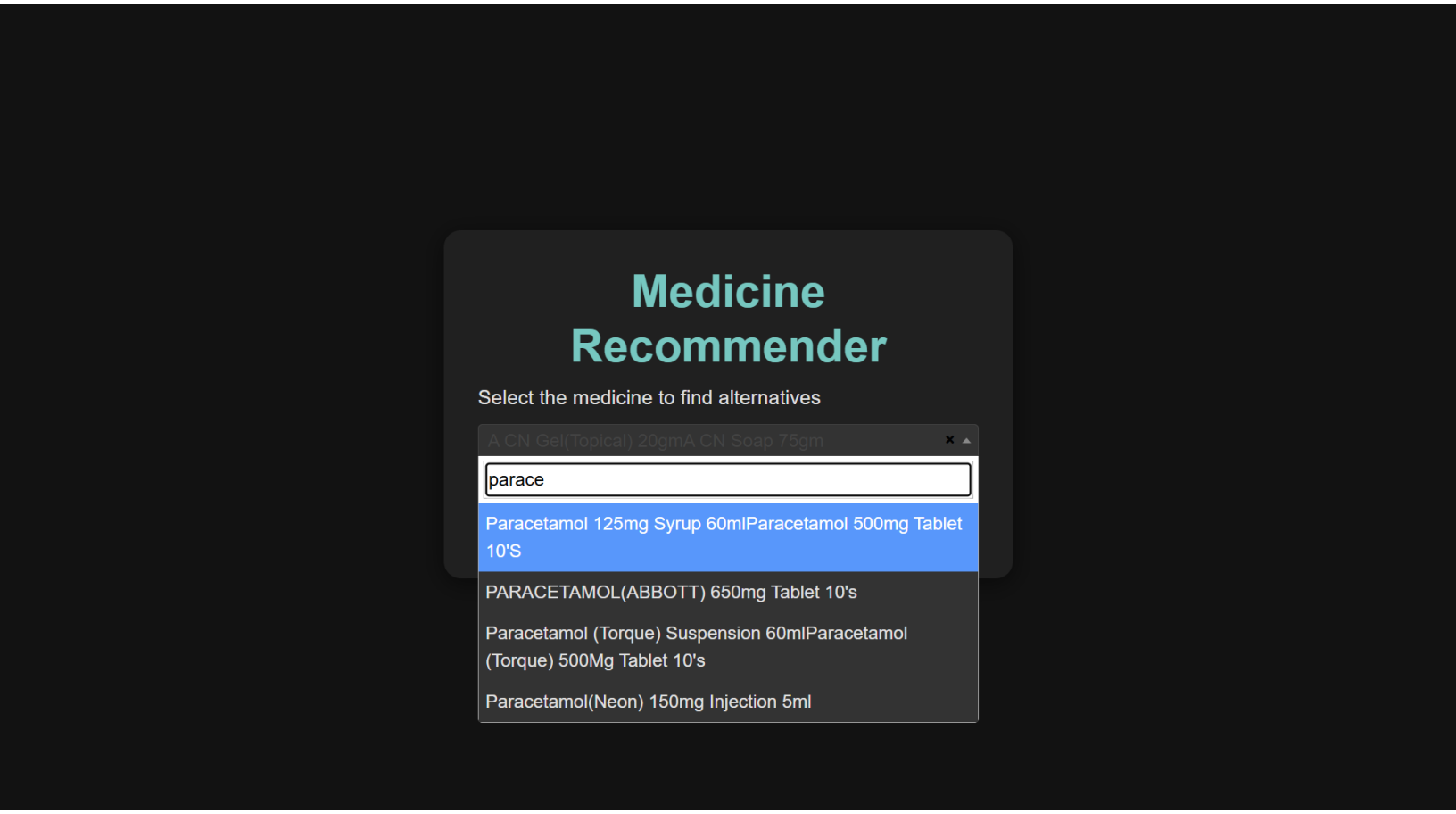

Fig 5.6 Search Box

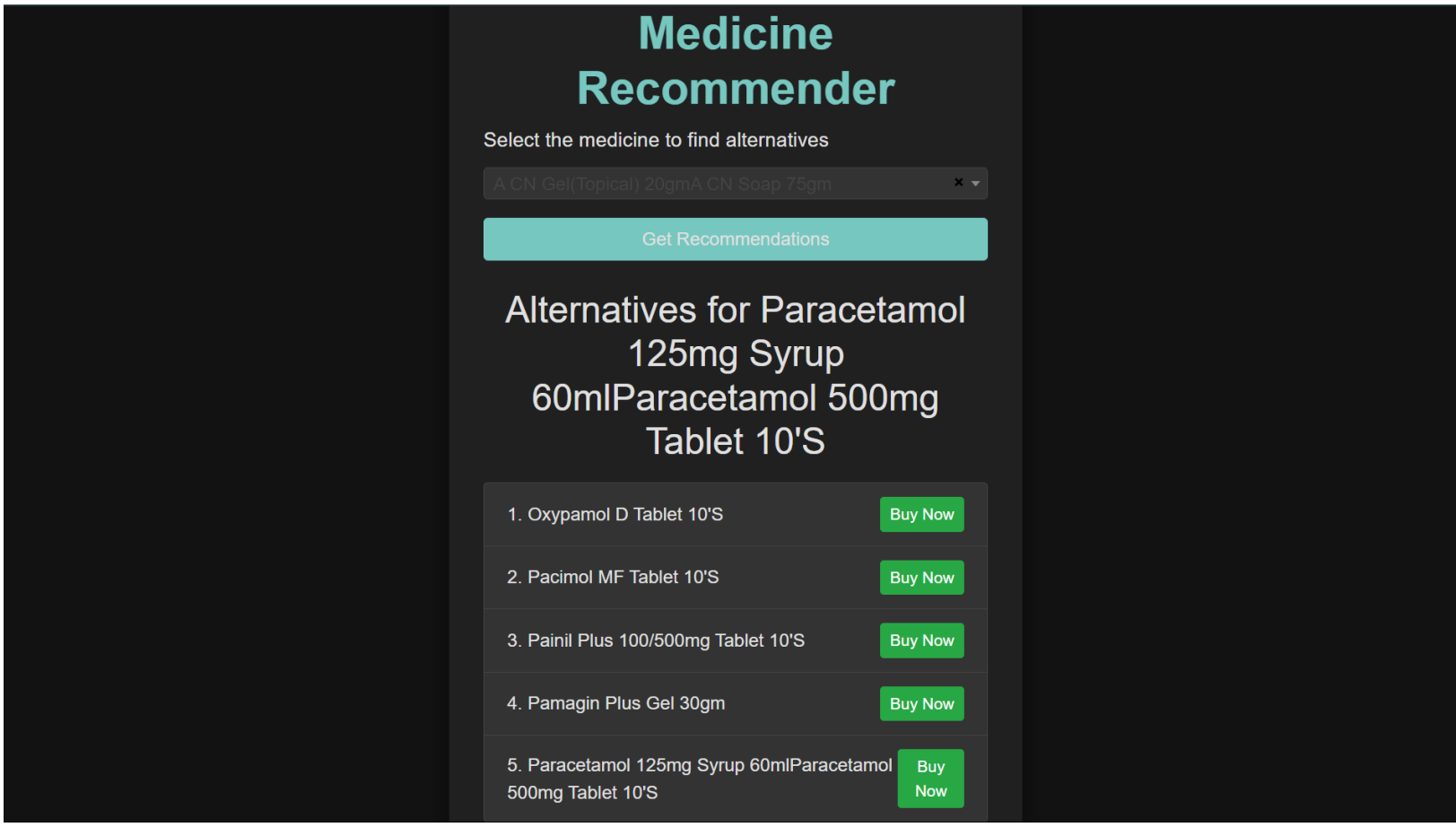

Fig 5.7 Output Page

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The Medicine Recommendation System marks a valuable innovation in the healthcare technology domain by offering an intelligent and user-friendly platform for suggesting alternative medicines based on composition similarity. By utilizing machine learning techniques and a well-structured similarity matrix, the system effectively bridges the gap between patients, pharmacists, and available medicine options. Users can simply enter the name of a medicine and instantly receive alternative suggestions from different brands with the same active ingredients, promoting both cost-effectiveness and accessibility. The clean and responsive interface ensures that users of all technical backgrounds can navigate the system with ease, while the backend—powered by Flask and Python—delivers fast and accurate recommendations. Through careful data preprocessing, secure backend handling, and intuitive design, the system ensures reliability and user trust. This solution has the potential to empower consumers in making informed health decisions and reduce dependency on single-brand prescriptions. Overall, the project demonstrates how machine learning can be effectively applied to solve real-world problems in the pharmaceutical space, with a strong foundation for future enhancements such as integration with live pharmacy inventories or user-specific suggestions.

6.2 FUTURE ENHANCEMENT

In the future, the Medicine Recommendation System can be enhanced by integrating real-time pharmacy inventories to show availability and pricing, along with a dedicated mobile app for better accessibility. AI-driven symptom-based suggestions and personalized recommendations based on medical history can improve relevance. Multilingual support, voice search, and prescription scanning would make the platform more inclusive and user-friendly. Integration with healthcare systems and online consultations could further evolve it into a complete digital health assistant.

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