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PillGenius: AI for next level Pharmacy Automation

In partial fulfillment of the requirements for the degree of
Bachelor of Science in Information Technology

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January 2026

Certificate



We accept the work contained in the report titled
“PillGenius: AI for next level Pharmacy Automation”

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DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

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Specially dedicated to my beloved
grandmother, mother and father

(Hafiza Asma Rasool)

my beloved grandmother, mother and father

(Rana M.Ali Zafar)

my beloved grandmother, mother and father

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In addition, We would also like to express our gratitude to our loving parent and friends who had helped and given us encouragement.

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PillGenius: AI for next level Pharmacy Automation

ABSTRACT

With life moving at a superfast pace currently, easy accessibility to credible healthcare centers as well as current medical information is at its best. There are a few requirements for such platforms that not only enable people to buy medications but also offer advice for healthcare decisions, given the rapid growth of online medical solutions. One of these initiatives of Pillgenious, a pharmacy web application driven by artificial intelligence that bridges the gap between traditional pharmacies and contemporary smart healthcare technology.

The aim of Pillgenious is enabling an easy-to-use website from which customers can browse, order, purchase medicines over the internet and access immediate assistance from an artificial intelligence-powered chatbot. Key functions such as product search, individualized guidance, order tracking, payment and shipping security are also included. Additionally, Pillgenious creates alerts and news for the safe and efficient administration of medications, provides information about the real time medicine, and links people with medical specialists.

Technically, it was created using a backend for safe and scalable data storage, a responsive online user interface for optimal user experience, and mongoDB for effective database management. AI integration makes it easier to intelligently respond to questions about medicine, making it even more interactive and instructive. Furthermore, Pillgenious is a healthcare partner that helps people make informed decisions in addition to being an online pharmacy. This system is also able to further medicine access, reduce use of conventional drug stores, and open a path for more improved healthcare developments based on AI in times ahead.

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CHAPTER 1

INTRODUCTION

1.1 Background

With growing populations come increasingly busy lifestyles and increasingly congested cities in today's fast-paced world. People are in search of smart, convenient, as well as credible online healthcare choices. People's first port of call for medicine and health information are usually pharmacies while some issues such as excessive queuing up, low information flow, no tracking of stock, and no personalized counsel. As such, information technologies as well as even Artificial Intelligence (AI) are persistently redesigning healthcare delivery at a very rapid pace. Most sites allow for medicine purchasing over the internet though few integrate smart support, real-time viewing, as well as decision support. That is where Pillgenious comes in: an internet smart AI-driven drugstore system linking conventional drug stores with next-generation smart healthcare infrastructures [1].

Unlike many traditional systems, Pillgenious incorporates Large Language Models (LLMs) to power its AI-driven chatbot. This enables the chatbot to provide not only structured responses about medicines but also natural, conversational, and advice regarding dosage, interactions, and alternatives. Additionally, Pillgenious integrates real-time information about medicines, low-stock warnings. Together, these features transform the pharmacy into a proactive, intelligent healthcare companion rather than an ordering system [2].

1.2 Problem Statements

Limited Operating Hours

Traditional pharmacies operate only during specific hours. People cannot buy medicines late at night or early morning. While emergency situations require immediate access to medication. For working people also it is difficult to visit pharmacies during office hours

Geographic Limitations:

In rural areas there is limited pharmacy access and even not everyone lives near a pharmacy. Also disabled people face difficulty traveling to pharmacies. And sometimes remote locations may not have well-stocked pharmacies

Lack of Immediate Medical Consultation:

People need quick answers about symptoms and minor health issues because visiting a doctor for small queries is time-consuming and expensive and there is no instant guidance available for common medical problems, this is difficult to know which medicine to buy for basic condition.

Drug Safety Concerns:

People don't know if a medicine is banned or safe to use and they have no way to check WHO (World Health Organization) approval status which is difficult to verify if a drug is legal in Pakistan or not. This is risky because when you have no information about drug interactions and side effects of medicines.

1.3 Aims and Objectives

The aim of Pillgenious is to develop a comprehensive, intelligent online pharmacy platform that revolutionizes the way users access pharmaceutical products and healthcare information. The system uses artificial intelligence to handle prescriptions, verify medications, and provide medical advice while guaranteeing safe transactions and quick interaction.

Objectives:

1. Accessible Healthcare Services which provide 24/7 access to pharmaceutical products and AI-powered medical consultation and enable users to browse, search, and purchase medications from anywhere at any time.
2. Complete drug catalog with 160+ medications from different medical categories with multiple searching methods.
3. Intelligent Drug Discover this implement advanced search capabilities using AI technology and voice-activated search using Web Speech API
4. AI Medical Consultation which provide accessible medical guidance through AI chatbot. Symptom analysis and preliminary diagnosis. It gives generic medication suggestions with proper dosages, drug interaction warnings and safety

information. It maintain conversation history for context-aware responses. It deliver helpful, accurate medical information with appropriate disclaimers within 3-5 seconds.

5. Drug Safety Verification which enables users to verify drug safety against international and local regulations through WHO (World Health Organization) compliance checking and Pakistan DRAP (Drug Regulatory Authority) status verification which gives clear status indicators (Available, Banned, Restricted, Unknown) and provide regulatory status information with reasoning and official disclaimers.

6. Multi-Role Access Control implement role-based access control for different user types like Roles and Permissions in which:
 - Admin: Full system access, user management, drug CRUD operations, analytics dashboard
 - Pharmacy User: Drug stock management
 - Regular User: Browse drugs, place orders, AI consultation, profile management

1.4 Scope of Project

Pillgenious's vision is to far exceed only being an online pharmacy store. It aims at redefining the provision of electronic healthcare by combining medicine access, advice powered by AI, medicine stock status information, and cognitive decision support in a centralized integrated system.

1. User Scope (Patients / Customers)

Users can search and buy medicines online through app. They get to see livestock availability to maintain transparency in ordering. Patients will gain from exposure to an AI chatbot providing information on dosing, adverse reactions, alternatives, and medical information in general. Personalized dashboard will allow the customers to track orders. The system supports secure authentication that secures sensitive medical and personal information. It will be paid through secured gateways offering easy and secured transaction. Patients will gain from exposure from AI chatbot, capable of providing detailed, human-like conversations about dosing, reactions, alternatives, and

medical information. Drugs information in notification will explain about medicine detail which is get directly from WHO.

2. Admin Scope (Pharmacy / Healthcare Managers)

Admins could control the medicine list with adding, editing and deleting drugs. Real-time inventory system helps pharmacies keep track of quantities of stocks, obtain low-stock warnings. Role-based access prevents anyone except the authorized personnel from changing the stock, prices, or the confidential records. Admins can control the user account and client inquiries for smooth support. Bulk upload options enable pharmacies to upload many drugs in a single operation, reducing effort and time. Admins can also configure alert rules, ensuring that patients and staff are notified instantly of important medicine-related changes.

3. Technical Scope

The backend in the system is scalable and is connected with a responsive frontend (HTML, CSS, JavaScript, React/ node.js). AI chatbot for intelligent, conversational healthcare support on which model is trained on dataset with different categories. Authentication and authorization processes protect personal privacy and ensure reliable access control. APIs allow smooth communication between the backend and frontend and allow future additions. Security standards (encryption, secured sessions, role-controlled access) guarantees the healthcare data privacy.

4. Future Scope

Integration with telemedicine services, allowing users to talk to physicians directly through the app. Support for electronic prescriptions that may be uploaded and verified for order validation. Next-generation AI-powered health forecasts and medicine advice. Multi-pharmacy expansion with the option of choosing the nearest or most affordable option. Plans of integrating with insurance companies and hospitals for a complete healthcare setting.

CHAPTER 2

LITERATURE REVIEW

2.1 Digital Transformation and AI Integration in Modern Pharmacy Systems

Pharmaceutical service delivery has experienced an important change because of the development of digital health solutions, shifting the sector from transactional e-commerce models to intelligent, patient-centered ecosystems [3]. One of the primary factors behind this change is the integration of innovative technologies meant to solve ongoing issues with pharmaceutical access, safety, and operational effectiveness. Recent studies show that artificial intelligence is essential for automating consumer interactions [4]. AI-powered chatbots are becoming essential tools for giving accurate, timely answers to complicated questions about medications. Concurrently, new possibilities for error-free drug identification have been made possible by developments in computer vision, which directly addresses a major source of risk in prescription fulfillment. To lay the groundwork and support the architectural framework, this chapter synthesizes these important technological domains: intelligent conversational agents, visual recognition systems, and dynamic information architectures. For the purpose to create the fundamental framework and supporting the architectural determinations made for the PillGenius platform, this chapter synthesizes these important technological domains: intelligent conversational agents, visual recognition systems, and dynamic information architectures. A clear gap in the market is confirmed by the analysis: there isn't an integrated system that unifies these features into a reliable pharmacy automation solution [5].

2.2 Systematic Literature review SLR

Table 2.1: Systematic Literature Review Comparison

Title	Methodology/Framework	Strengths	Weaknesses	Models	Type
A HYBRID AI CHATBOT FRAMEWORK FOR INTELLIGENT PHARMACY MANAGEMENT SYSTEMS 2025 [6]	In pharmacy management systems, hybrid AI architecture combines transformer-based models for unstructured, contextually relevant interactions with natural language processing (NLP) for structured queries.	Increases decision support and user interaction by integrating AI for both simple and complicated queries.	Conceptual framework; little real-world testing information and practical implementation.	Transformer-based NLP, Intent Classifier, Rule-based NLP, NER Model	Journal Paper
Pharm-AI: An Intelligent Chatbot for Addressing Medication Accessibility and Information Challenges During the COVID-19 Pandemic 2025 [7]	AI chatbot for medication information and pharmacy location services utilizing natural language processing (NLP), geographical mapping, and approved medical databases (PubMed, Scopus, Drug Central, clinical trials).	Improves accessibility and cost transparency while providing accurate, researched medication information.	Currently we have limited support for specific languages and depend on supply chains from third-party pharmacies.	NLP Intent Detection, Transformer/RNN Encoder, NER Model	Journal Paper

<p>Clinical and Operational Applications of Artificial Intelligence and Machine Learning in Pharmacy: A Narrative Review of Real-World Applications 2025 [8]</p>	<p>A narrative literature review of actual AI and ML applications in pharmacy, including industry, hospital, and community settings as well as new technological advancements.</p>	<p>Provides specific, quantitative proof of the benefits of AI/ML in medication development and pharmacy practice.</p>	<p>Regulatory barriers and high implementation costs could prevent greater acceptance.</p>	<p>Summarizes existing models: Random Forest, SVM, Neural Networks</p>	<p>Narrative Review</p>
<p>A Review on Online Pharmacy 2017 [9]</p>	<p>A review of the literature is used to compare local and online pharmacies and determine whether they are legitimate or not.</p>	<p>Highlights the benefits of online pharmacies, such as privacy, affordability, and accessibility.</p>	<p>Mostly descriptive; lacks quantitative analysis and data based on experience.</p>	<p>No ML model</p>	<p>Review Paper</p>
<p>The digital transformation in pharmacy: embracing online platforms and the cosmeceutical paradigm</p>	<p>A review of the literature that examines online platforms, digital transformation, and the cosmeceutical paradigm in pharmacy.</p>	<p>Complete overview of digital trends and technology developments in pharmacy.</p>	<p>Insufficient data from experiments regarding adoption rates and impact.</p>	<p>No ML model</p>	<p>Review Paper Narrative Review</p>

<p>shift 2024 [10]</p>					
<p>A Review on Impact of E-Pharmacy on Pharmacy and Social Sector 2020 [11]</p>	<p>A review of the literature that looked at the adoption, difficulties, and social effects of e-pharmacies during the pandemic.</p>	<p>Focuses on mobility and the role of public health highlights the benefits to society and healthcare during COVID-19.</p>	<p>Generally informative discussion; lack of statistical data.</p>	<p>No ML model</p>	<p>Review Paper Descriptive Study</p>
<p>When technology precedes regulation: the challenges and opportunities of e-pharmacy in</p>	<p>Using a mixed-methods approach, e-pharmacy regulation, risks, and opportunities in low-income countries are evaluated through a review of the literature and</p>	<p>Analyzes regulatory issues in low-income communities by combining conversati</p>	<p>Restricted to a small number of nations; results might not apply worldwide.</p>	<p>No ML model</p>	<p>Journal Paper</p>

low-income and middle-income countries 2021 [12]	qualitative interviews.	ons with key informant s and an examination of the literature.			
Revitalizing health service with e-pharmacy: Technology integration in pharmacy service 2023 [13]	To design and assess e-pharmacy-integrated information systems for pharmacy services, a review of the literature and functional analysis are used.	Highlight s the useful benefits provided by implementing technology into pharmacy services.	Basically, conceptual and lacking significant data validation.	No ML model	Journal Paper
Artificial Intelligence (AI) in Pharmacy 2023 [14]	A review of the literature that summarizes AI advancements and their uses in hospital pharmacy, drug development, and healthcare data management.	A thorough review of AI applications across multiple pharmacies and healthcare fields	Lacks comprehensive real-world implementation data and is mainly purely descriptive.	No model trained; reports AI model categories only	Journal

Applications of artificial intelligence in current pharmacy practice 2024 [15]	A comprehensive examination of the medical databases MEDLINE, Embase, the International Pharmaceutical Association, and Web of Science (2018–2023) was conducted as part of a scoping review that conformed to PRISMA-ScR guidelines and examined machine learning AI applications in pharmacy practice.	Uses a PRISMA-ScR methodology and current literature to present an organized summary of AI applications in pharmacy.	Just seven studies were included; existing AI applications prioritize workflow over direct patient outcomes.		Journal Paper
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2.3 Review of past research papers

The article explores the growth of digital pharmacies, emphasizing their affordability, convenience, availability 24/7, and extensive product selection. It compares traditional local pharmacies with online pharmacies and highlights the dangers of self-medication and misuse of prescription drugs, particularly with the use of Schedule H and X medications. It also makes recommendations for ways to stop misuse [1].

The research article explores the digital transformation in pharmacy, emphasizing how online platforms, blockchain, and artificial intelligence are changing remote healthcare, education, and pharmacy services. With a focus on upcoming trends and innovations in the pharmacy industry, it also addresses the development of online pharmacies, the cosmeceutical market, regulatory barriers, and the impact of the private sector [2].

The significance of e-pharmacies in the pharmacy and social sectors during the COVID-19 pandemic is reviewed in this paper, with a focus on how they ensure medication access while maintaining social distancing. It highlights risks like self-

medication and misuse of Schedule H and X medications, as well as the benefits of online ordering and home delivery [3].

The research article explores the growth of e-pharmacies in low- and middle-income countries (low-income communities), highlighting risks to public health such as uncontrolled prescription drug sales, low-quality medications, and consumer fraud. It highlights regulatory gaps, cross-border issues, and the potential of e-pharmacy to enhance medicine access and transparency if proper oversight is placed forward using documents and interviews from Kenya, Nigeria, and India [4].

For the purposes of improving pharmacy service quality, accessibility, and efficiency, the paper explores the integration of e-pharmacy with medication sales information systems. To maximize technology use in pharmacy services for community and healthcare benefits, it places a high priority on technological developments in stock control, drug data processing, and user access to accurate, current drug information [5].

The study proposes a hybrid AI chatbot framework for intelligent pharmacy management systems that combines transformer-based models for complex, relevant queries with natural language processor (NLP) SQL query processing for routine tasks. In addition to allowing for modularity, scalability, and future improvements like language support and image-based drug recognition, this method improves efficiency, accuracy, and user experience [6].

Pharm-AI, which is a chatbot powered by AI developed to address medication accessibility and false information during the COVID-19 pandemic, is discussed in this paper. It reduces the time it takes to find medications by 65% and increases healthcare accessibility and transparency by providing evidence-based drug information, identifying close pharmacies, and comparing drug prices using natural language processing and geography mapping [7].

The study explores practical applications of AI and machine learning in pharmacy, highlighting important improvements in maintaining medication, prescription accuracy, negative reaction detection, and drug discovery. In addition to discussing modern technologies like centralized learning and quantum computing, it supports patient-focused treatment combined with advances in technology. It also highlights implementations in public and hospital pharmacies and the pharmaceutical industries [8].

A review of artificial intelligence (AI) developments in pharmacy is provided in this paper, with a focus on its applications in hospital pharmacy, drug discovery, dosage form design, multiple pharmacology, and healthcare data management. It highlights

how AI supports technological advancement in the healthcare industry and improves efficiency, accuracy, and decision-making in pharmacy practices [9].

This overview explores how AI is currently used in pharmacy practice, emphasizing how it can be used to support patient-facing tools, identify prescriptions that require pharmacist intervention, and increase the effectiveness of large-scale screening. AI has the potential to improve data analytics, medication adherence, and pharmacist contributions to healthcare outcomes, even though it is primarily used for workflow and productivity [10].

2.4 Overall Description of project

2.4.1 Product Perspective

Pillgenious is self-contained web application that is integrated with AI and APIs. It interacts with: **Users/Customers** who can search and buy medicines. **Pharmacies/Admins** who manage stock, Pricing and Medicine records. In **AI Module** which provides medicine-related guidance.

2.4.2 Product Functions

User authentication (login/register) facility where user can create accounts, login securely. Medicine listing with images, detailed description, usage instructions, prices and availability status. AI-powered chatbot assists user by answering their queries, give guidance about dose or medication of medicines and also recommend alternatives.

2.4.3 User Characteristics

- **Customers**
 - End consumers who are also able to view website and search & buy the drugs
- **Pharmacy Managers**
 - Responsible for updating stocks.
 - Keep updated the information in all sections of the website.
- **Admin**
 - System administrator who have the whole control or in charge of the whole thing.
 - Monitoring user accounts and ensure data security. Managing access rights and handling technical issues.

2.4.4 Constraints

Internet connectivity is required because it is an online application to search, access and then order the medicines also to communicate with AI chatbot. The system has developed using certain technologies such as Node.js for backend development, mongoDB for managing databases, and APIs for integration.

2.4.5 Assumptions and Dependencies

Assumes that the customers must have access of internet connection and server is unable to perform their core activities without internet connection.

2.5 Functional Requirements

1. User Management

- Users can register, log in, and update their profiles.

2. Medicine Management

- The admin can insert, update, and delete medicines with details.
- Users can view medicine name, image, price, and stock.

3. Search & Filter

- Search medicines by name, category, or brand.

4. Shopping Cart & Orders

- Users can add to cart medicines and place their orders.

5. AI Chatbot

- Provides medicine info, usage guidelines, and alternative suggestions.

6. Payment & Checkout

- Ensure secure payment gateways (Cash on Delivery first).

7. Notifications

- Order confirmations, stock notices, and promotions.

2.5.1 External Interface Requirements

- **User Interface:** Responsive web UI (HTML, CSS, JavaScript, React, Node.js).
- **Hardware Interface:** PC or smartphone with internet.
- **Software Interface:** Node.js for backend, MongoDB database, Rest API.
- **Communication:** HTTPS secure communication.

2.5.2 Performance Requirements

- System handle at least 500 simultaneous users without performance deterioration.
- System remain response and accessible at time of maximum use.
- The system respond quickly for routine activities such as searching for medication, loading product details, or adding products to the cart.

2.5.3 Security Requirements

- All data that communicate between user and the server remain protected by unauthorized access.
- User authentication and session management that provide secure logout and login functionality and manage sessions properly. It will only keep users logged in when sessions are active and expire sessions automatically when they are inactive to prevent unauthorized activity.
- The system is also able to meet data protection requirements to ensure users' personal and health information are kept safe and not transferred or revealed without authorization.

2.6 Non-Functional Requirements

- **Reliability:**
 - 99% uptime.
 - The reliability comes first because the customers may be compelled to purchase the medicines at a moment of emergency and the downtime may be detrimental to them.
 - The system will be tested periodically and also utilize backup measures just to minimize the risk of failure of the system or losing the data.
- **Usability:**
 - The system provide a user-friendly and convenient-to-use interface such that the customers who are computer or mobile literate may easily interact with the system.
- **Maintainability:**
 - The system developed by maintaining a modular code pattern such that updating, customizing and extending in the future will be quite easy.
- **Portability:**
 - System will be portable and function flawlessly on different browsers and computers.
 - The system will take a responsive web design approach to allow the interface to change automatically depending on the size of the display.

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 System Overview

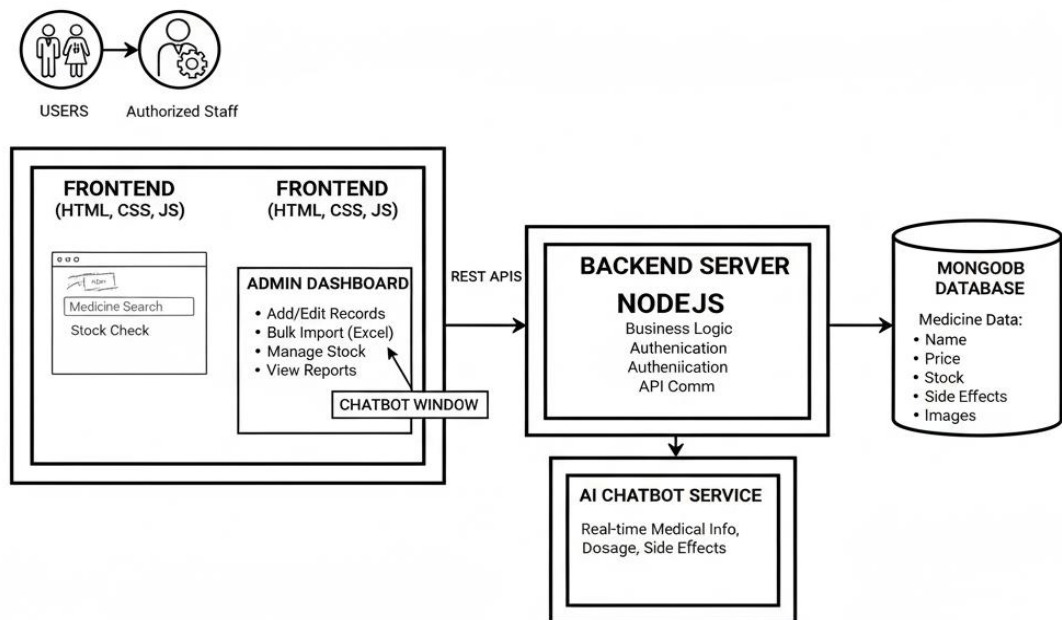


Figure 3.1: System Overview

3.1.1 Data Collection Criteria

Data is stored in MongoDB collections, which act as structured containers for different types of data. Each collection holds related records in the form of documents, allowing fast and flexible data retrieval.

1. Medicines Collection

This is the main collection of the system. It stores all details related to medicines imported through Excel or added manually.

2. Users Collection

This collection stores the data of all users and administrators.

Data Stored:

Data is stored in Name, Email, Password (encrypted), Role (admin or customer) and Contact information. The purpose of this is to authenticate users during login and to manage access control and to store user activity and history

3. Orders Collection

For order collection system includes features to store data in Order ID, User ID, Medicine Details, Quantity, Total Price, Order Date, Status (pending, delivered).

4. Chatbot Queries Collection

For chatbot queries data is stored in User query, AI response and Timestamp.

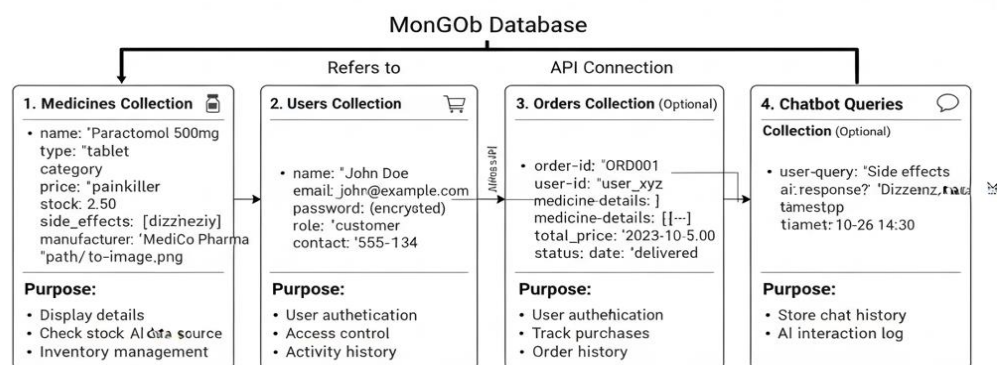


Figure 3.2: Data Collection

3.2 Architecture Diagram

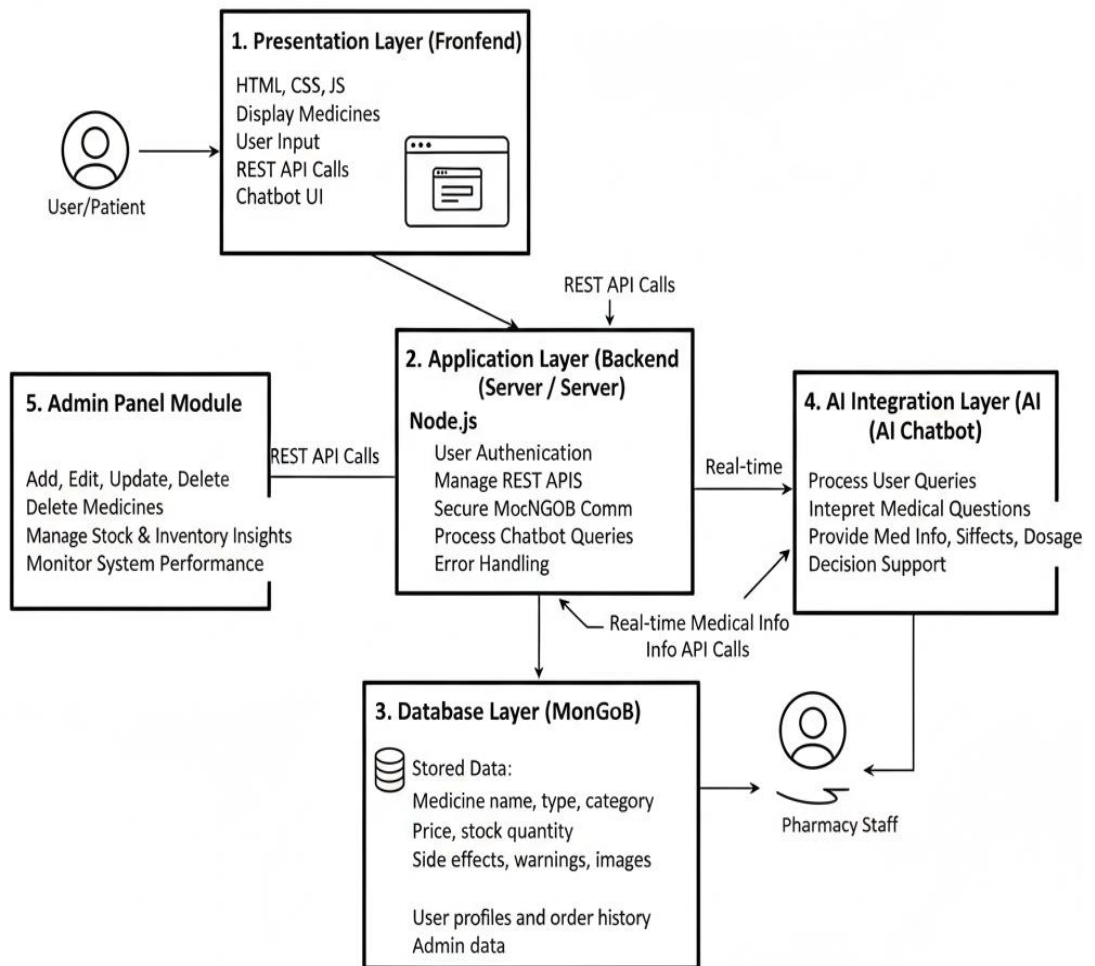


Figure 3.3: Architecture Diagram

3.3 Use Case Diagram

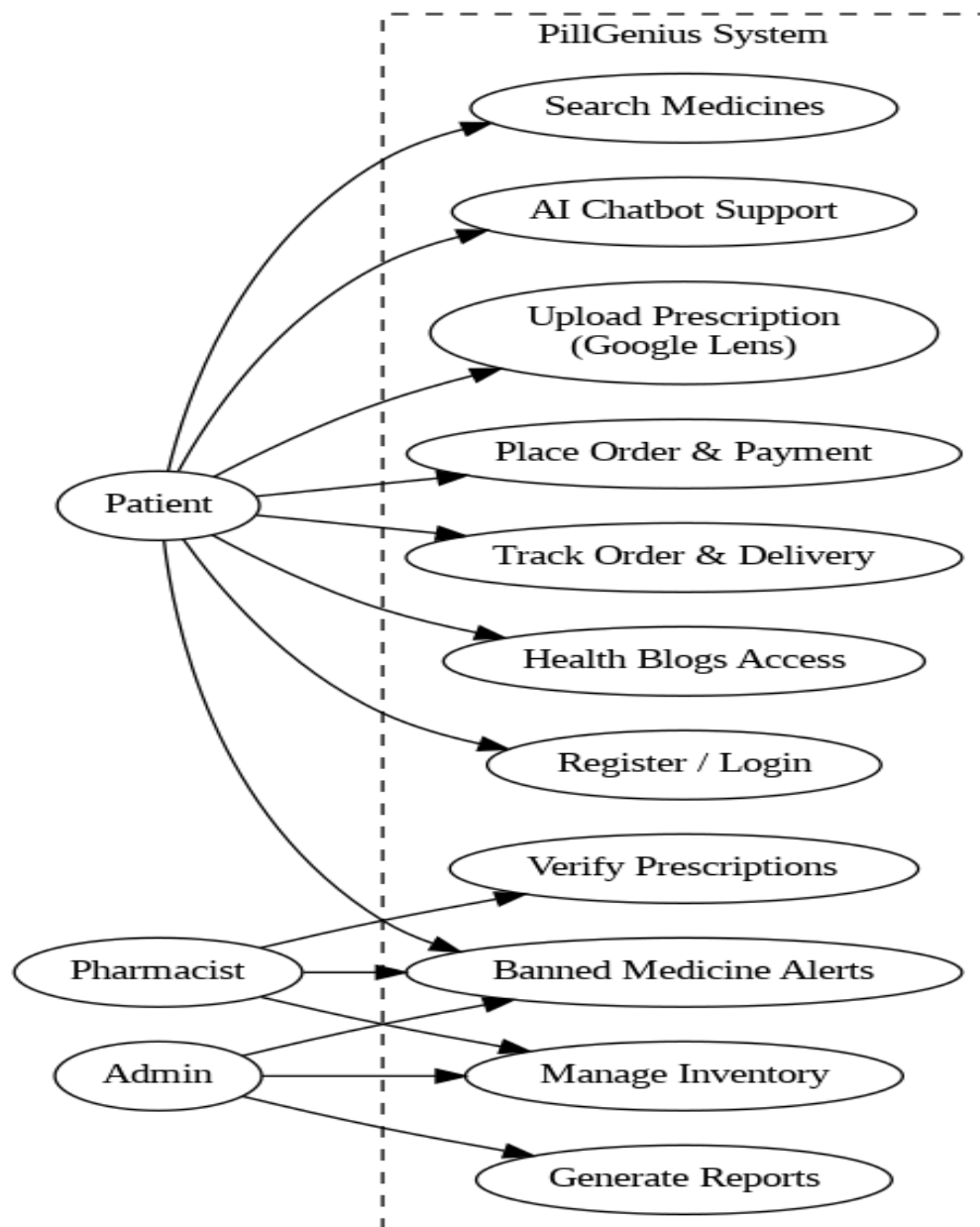


Figure 3.4: Use Case Diagram

3.3.1 Actors:

- Patient:**
 Basically, the primary user of the system is the patient and the user of the system to look up meds, place orders as well as get their prescriptions, and access health info.
- Pharmacist:**
 A licensed expert who does all the drug related stuff on the site. The pharmacist plays the role of checking prescriptions and overseeing the safety of medicines.
- Admin:**
 The admin is a person who deals with system-level activities like inventory management and reporting.

3.4 ERD

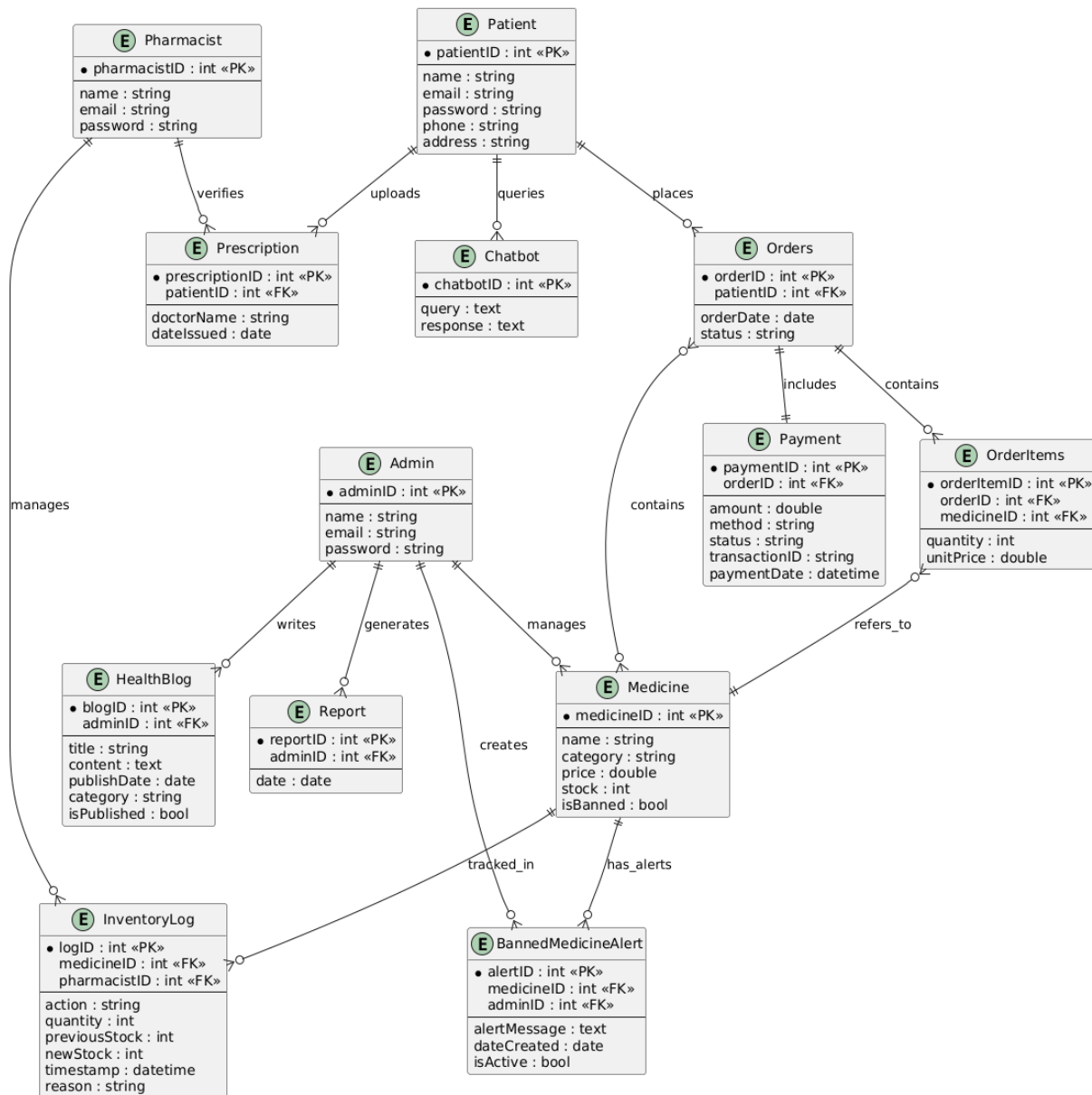


Figure 3.5: ERD for whole System

3.5 Class Diagram

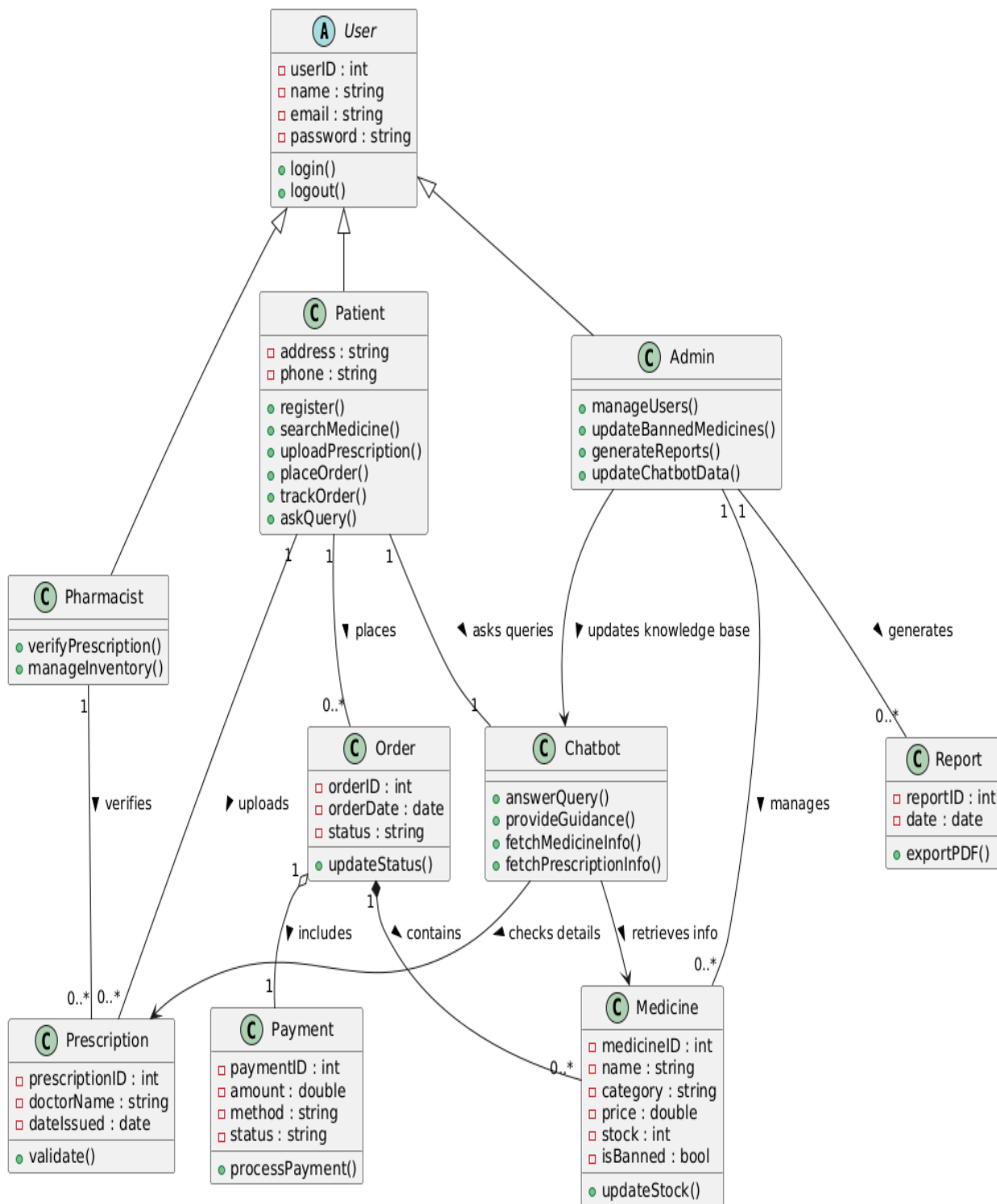


Figure 3.6: Class Diagram

3.6 Flowchart

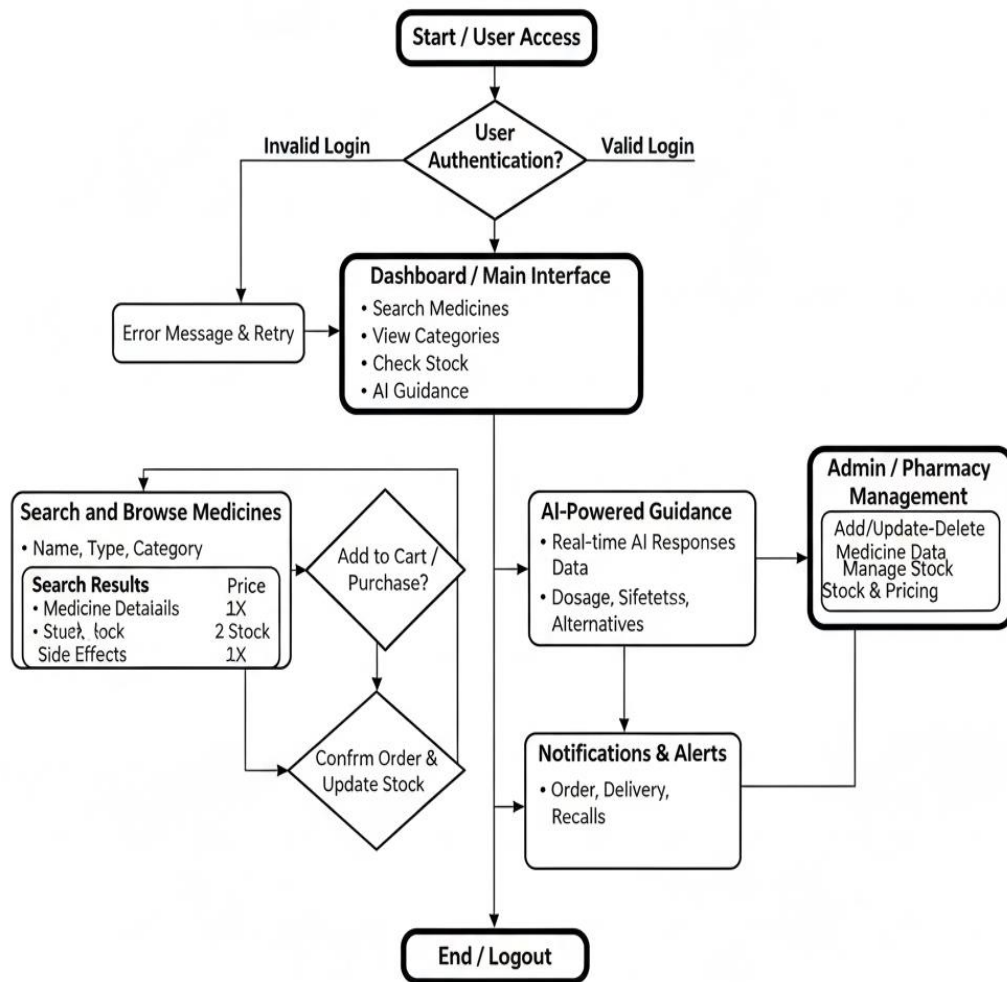


Figure 3.7: Flowchart

3.7 Sequence Diagram

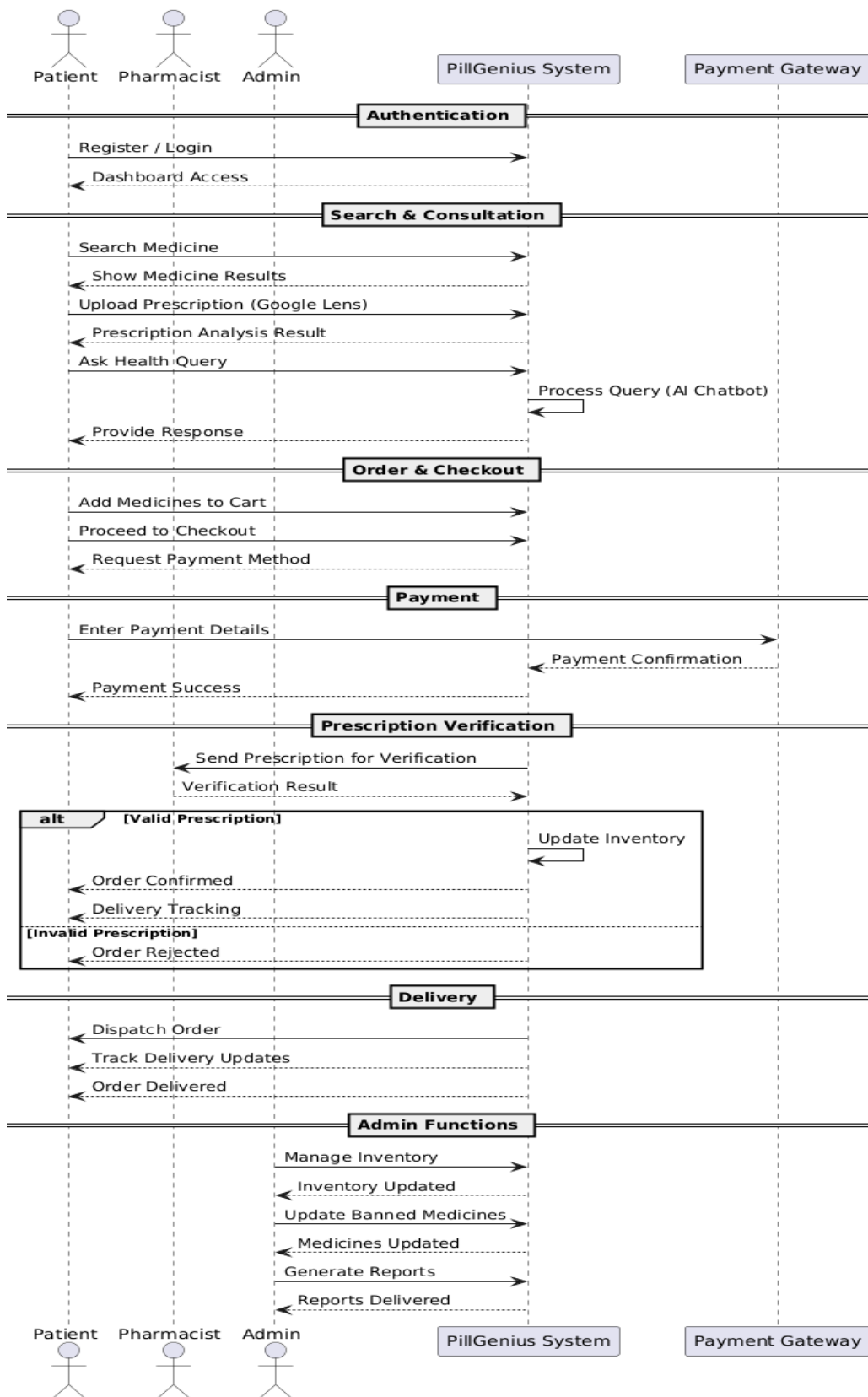


Figure 3.8: Sequence Diagram

Table 3.1: SOFTWARE TESTING TABLE

Test Case ID	Module	Test Scenario	Test Steps	Expected Result	Status
TC-001	User Registration	Verify user can register with valid credentials	1. Navigate to registration page 2. Enter valid details 3. Click register	User account created successfully with confirmation message	Pass
TC-002	User Login	Verify user can login with correct credentials	1. Navigate to login page 2. Enter email and password 3. Click login	User logged in successfully and redirected to dashboard	Pass
TC-003	User Login	Verify login fails with invalid credentials	1. Navigate to login page 2. Enter invalid credentials 3. Click login	Error message displayed: Invalid email or password	Pass
TC-004	Medicine Search	Verify text-based medicine search functionality	1. Enter medicine name in search bar 2. Click search button	Relevant medicines displayed with details	Pass
TC-005	Medicine Search	Verify voice-based medicine search	1. Click voice search icon 2. Speak medicine name 3. Allow voice permission	Search results displayed based on voice input	Pass
TC-006	Medicine Catalog	Verify medicine details are displayed correctly	1. Click on any medicine 2. View details page	Name, price, stock, description, side effects displayed	Pass
TC-007	Shopping Cart	Verify adding medicine to cart	1. Select medicine 2. Click Add to Cart 3. View cart	Medicine added to cart with correct quantity and price	Pass
TC-008	Shopping Cart	Verify removing medicine from cart	1. Go to cart 2. Click remove button 3. Confirm removal	Medicine removed from cart successfully	Pass
TC-009	Shopping Cart	Verify cart quantity update	1. Go to cart 2. Increase/decrease quantity 3. Check total price	Quantity updated and total price recalculated correctly	Pass
TC-010	Order Management	Verify order placement with COD	1. Add items to cart 2. Proceed to	Order placed successfully with order ID and confirmation	Pass

			checkout 3. Select COD 4. Confirm order		
TC-011	Order Management	Verify order tracking functionality	1. Go to My Orders 2. View order details 3. Check status	Order status displayed correctly (Pending/Confirmed/Delivered)	Pass
TC-012	AI Chatbot	Verify AI chatbot responds to medicine queries	1. Open chatbot 2. Ask medicine-related question 3. View response	Chatbot provides relevant medicine information and guidance	Pass
TC-013	AI Chatbot	Verify chatbot maintains conversation context	1. Ask first question 2. Ask follow-up question 3. Check response	Chatbot remembers previous context and provides relevant response	Pass
TC-014	Drug Verification	Verify WHO compliance checking	1. Enter drug name 2. Click verify 3. View WHO status	WHO approval status displayed with clear indicator	Pass
TC-015	Drug Verification	Verify DRAP (Pakistan) status checking	1. Enter drug name 2. Click verify 3. View DRAP status	DRAP status displayed (Available/Banned/Restricted/Unknown)	Pass
TC-016	Admin Panel	Verify admin can add new medicine	1. Login as admin 2. Go to Add Medicine 3. Fill details 4. Submit	Medicine added successfully to database and visible in catalog	Pass
TC-017	Admin Panel	Verify admin can update medicine details	1. Select medicine 2. Click edit 3. Modify details 4. Save	Medicine details updated successfully in system	Pass
TC-018	Admin Panel	Verify admin can delete medicine	1. Select medicine 2. Click delete 3. Confirm deletion	Medicine removed from system and no longer visible	Pass
TC-019	Inventory Management	Verify low stock warning	1. Reduce medicine stock to threshold 2. Check notifications	Low stock alert displayed to admin	Pass
TC-020	Inventory Management	Verify out of stock handling	1. Set medicine stock to zero 2. Try to add to cart	Out of stock message displayed, cannot add to cart	Pass
TC-021	User Profile	Verify user can update profile information	1. Go to profile 2. Edit details 3. Save changes	Profile updated successfully with confirmation message	Pass
TC-022	Search & Filter	Verify category	1. Select category (e.g.,	Only medicines from selected category displayed	Pass

		filter works correctly	Painkillers) 2. View results		
TC-023	Search & Filter	Verify price range filter	1. Set min and max price 2. Apply filter 3. View results	Medicines within price range displayed	Pass
TC-024	Notifications	Verify order confirmation notification	1. Place order 2. Check notifications	Order confirmation notification received with order details	Pass
TC-025	Security	Verify password encryption during registration	1. Register new user 2. Check database	Password stored in encrypted format, not plain text	Pass
TC-026	Security	Verify role-based access control	1. Login as regular user 2. Try accessing admin routes	Access denied, redirected to appropriate page	Pass
TC-027	Response Time	Verify search response time is under 3 seconds	1. Perform medicine search 2. Measure time	Results displayed within 3 seconds	Pass
TC-028	Response Time	Verify AI chatbot response time	1. Ask question to chatbot 2. Measure response time	Response received within 3-5 seconds	Pass
TC-029	Responsiveness	Verify mobile responsiveness	1. Open website on mobile device 2. Test all features	All features work properly, layout adapts to screen size	Pass
TC-030	Browser Compatibility	Verify system works on different browsers	1. Test on Chrome, Firefox, Safari, Edge 2. Check functionality	System functions correctly on all major browsers	Pass
TC-031	Data Validation	Verify email format validation	1. Enter invalid email format 2. Try to register	Error message displayed for invalid email format	Pass
TC-032	Session Management	Verify automatic logout after inactivity	1. Login 2. Remain inactive for set duration 3. Try to perform action	User logged out automatically, redirected to login	Pass
TC-033	API Integration	Verify OpenAI API integration for chatbot	1. Send query to chatbot 2. Check API call 3. Verify response	API called successfully, response integrated properly	Pass
TC-034	Database Operations	Verify MongoDB CRUD operations	1. Add medicine 2. Update medicine 3. Delete	All CRUD operations execute successfully	Pass

			medicine 4. Read medicine		
TC-035	Bulk Operations	Verify bulk medicine upload via Excel	1. Login as admin 2. Upload Excel file 3. Check database	All medicines from Excel added to database successfully	Pass

CHAPTER 4

DATA AND EXPERIMENTS and IMPLEMENTATION

4.1 Dataset:

The foundation of the Pillgenious medical Chatbot is a highly structured, domain-specific knowledge based medical knowledge files. The dataset clearly associates the identified medical conditions with a corresponding list of suggested medications, this inactive knowledge into active training data, the ML system automatically creates more training instances. This procedure guarantees in natural language by generating as many as possible variations for each symptoms. The produced phrases are categorized into one of the established Classifications (symptom_inquiry, drug_inquiry, greeting, etc.), forming a valuable, immediately applicable that mimics actual user interactions. This dataset contains 25,000 synthetic healthcare records designed for machine learning models that classify diseases based on patient symptoms. It includes demographic attributes, symptom lists, and confirmed diagnoses across 30 common acute, chronic, infectious, and neurological diseases.

The dataset is well-suited for: Multi-class disease classification Symptom pattern analysis Medical decision support modeling NLP feature extraction on symptom text Data mining and biomedical research. Each record corresponds to a unique patient with a generated combination of symptoms and diagnosis created from realistic patterns while maintaining anonymity.

Column Descriptions are: Patient_ID — A randomized unique identifier assigned to each synthetic patient. Age — Age of the patient (ranging from 1 to 90 years). Gender — Gender of the patient (Male, Female, or Other). Symptoms — A comma-separated list containing 3 to 7 symptoms. Symptom_Count — Total number of symptoms listed for the patient. Disease — The diagnosed condition; one of the 30 diseases included in the dataset.

List of Diseases Included: Common Cold, Influenza, COVID-19, Pneumonia, Tuberculosis, Diabetes, Hypertension, Asthma, Heart Disease, Chronic Kidney Disease, Gastritis, Food Poisoning, Irritable Bowel Syndrome (IBS), Liver Disease,

Ulcer, Migraine, Epilepsy, Stroke, Dementia, Parkinson's Disease, Allergy, Arthritis, Anemia, Thyroid Disorder, Obesity, Depression, Anxiety, Dermatitis, Sinusitis, Bronchitis.

Possible Use Cases: Multi-class disease prediction Symptom pattern analysis Clinical decision support prototypes NLP-based text classification Educational and academic projects.

4.2 Model Training:

The model we used is **Intent Classification Model** for the intelligence of the chatbot powered by an exceptionally efficient Dual ML Model System, with both models employing the strong and scalable Logistic Regression algorithm. Before classification, text data is converted into numerical features through Term Frequency-Inverse Document Frequency (TF-IDF) vectorization. TF-IDF determines a weight for every word, signifying its significance by adjusting the word's frequency in a document (Term Frequency) in relation throughout the whole dataset (Inverse Document Frequency).

The Logistic Regression function, which determines the probability of an event occurring (such as a message being categorized into a specific category), is fundamental to the classification process. After the text is numerically represented by TF-IDF (Term Frequency-Inverse Document Frequency) Vectorization, the two models implemented in the Pillgenious ML Chatbot are both examples of Logistic Regression, a linear model for classification. Both models use the sigmoid function to determine the probability P that a message relates to a class.

$$\hat{y} = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n)}}$$

$$J(\beta) = -\frac{1}{m} \sum_{i=1}^m \left[y^{(i)} \log(\hat{y}^{(i)}) + (1 - y^{(i)}) \log(1 - \hat{y}^{(i)}) \right]$$

$$\beta_j = \beta_j - \alpha \frac{\partial J(\beta)}{\partial \beta_j}$$

Logistic Regression Formula [37]

4.2.1 Intent Classification:

This model is designed to explain the main objective of the user (e.g., symptom_inquiry or drug_inquiry). The definition of the model is: Implementing a TF-IDF Vectorizer with a 1,000 feature limit, it employs Logistic Regression to determine a probability that the message belongs to a particular purpose category. This result is essential for referring the query to the relevant section of the system.

4.2.2 Symptom Prediction

This model concentrates in identifying which medical diseases the user is referring to and extracting certain medical entities from the text. The model is defined as follows: Its TF-IDF Vectorizer is optimized with a 1-2 n-gram range, although it employs Logistic Regression for multi-class classification. The algorithm's ability to detect complicated multi-word symptom phrases like "splitting headache" is improved by this modification. The outcome affects the system's capacity to search for safe medication recommendations.

4.3 Model Training Process:

To be able to ensure predictability and reproducibility, the model development closely conforms to a systematic, planned training process. The first step in the process is to use the CSV files to help generate data, turning them into more than 3,000 tagged samples. The text is then converted into the numerical representation required for the models using TF-IDF Vectorization. The models ultimately proceed to Model Training, which is where the Logistic Regression coefficients are calculated. The data division becomes critical at this point; an 80/20 Train/Test Split is used to ensure that the final performance evaluation is performed on unstructured information throughout the entire training circumstance, a consistent Random State: 42 is used to guarantee accurate outcomes. A predefined convergence requirement of Max Iterations: 1,000 is used to train both models. In order to prevent class imbalance from affecting the model's performance, structured sampling is also used in the split to guarantee an accurate

representation of all six goal classes and the 168 symptom classes in both training and testing sets.

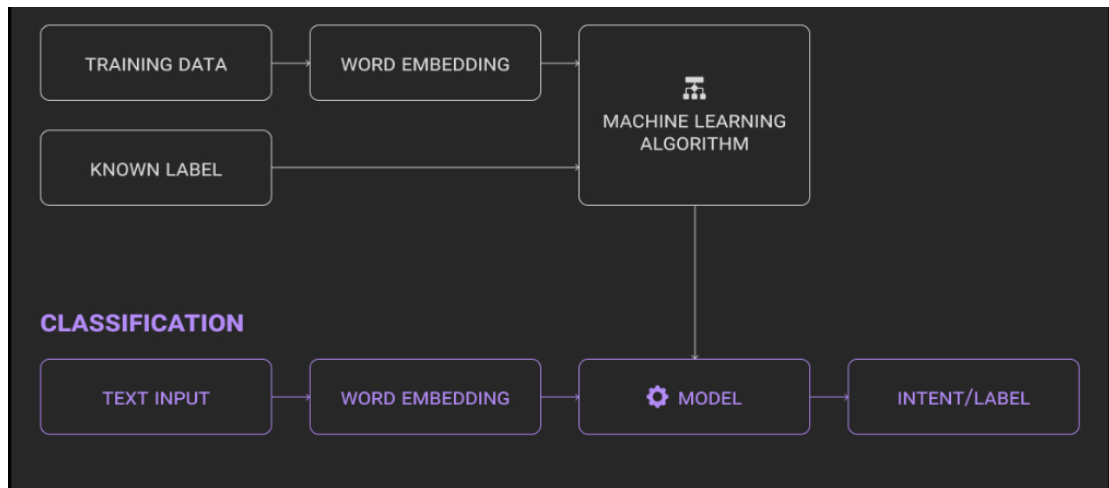


Figure 4.1: Model Training Process [16].

4.4 Evaluation Matrix and Performance Criteria:

The accurate Evaluation Matrix, where Overall Accuracy is the primary measure of model success on the allocated test dataset, describes the quality of the system. The Intent Classification Model displays extraordinary efficiency in obtaining an

Overall Accuracy of 95% across its six intent categories, confirming its dependability in promptly grasping the user's requirement. With an Overall Accuracy of 90.9% for identifying symptoms across the 168 illnesses covered, the Symptom Prediction Model displays great performance.

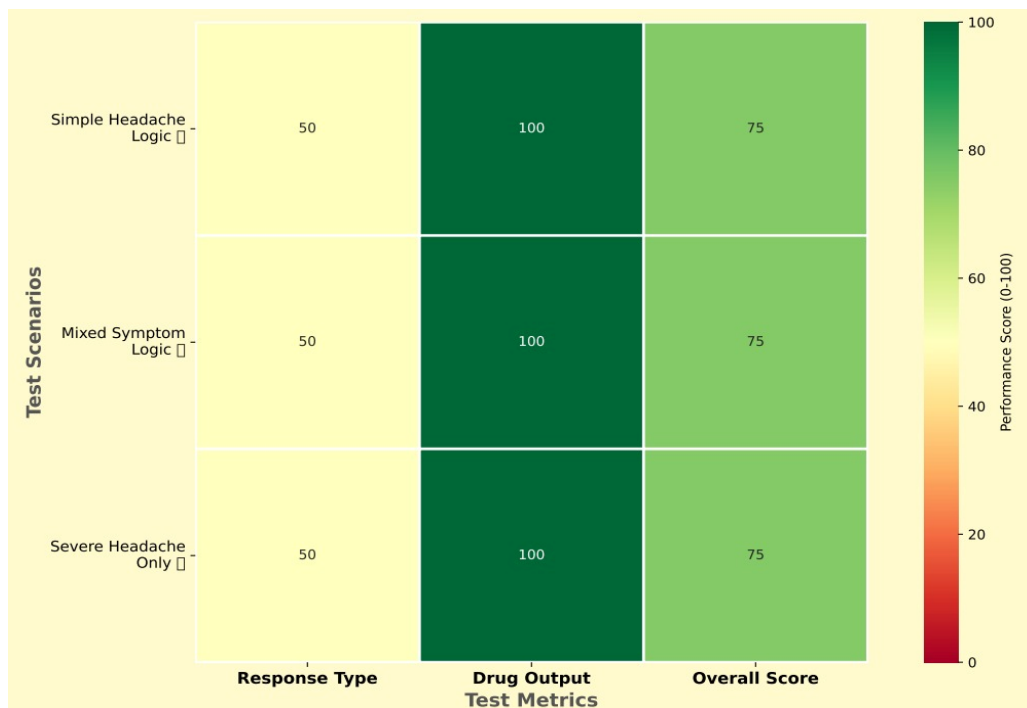


Figure 4.2: Analysis Heatmap

4.4.1 Performance Criteria:

The chatbot is designed to meet particular Real-world performance requirements, guaranteeing safety, speed, and accurate evaluation, in addition to standard accuracy:

Pace and Effectiveness:

For intent classification, the system displays a real-time response time of less than 100 ms, which is important for an efficient conversational experience.

Safety-First Decision Making:

A Confidence Scoring (probabilistic outcome) is calculated by the models. This metric creates a 4-Tier Fallback Architecture: low-confidence forecasts generate a secure fallback to the OpenAI Integration with a strict medical-only prompt, while high-confidence replies are instant.

Knowledge Coverage:

The system frequently includes 168 medical disorders and links them to 174 pharmacological medications.

Domain Knowledge and Safety:

Before recommending any medications, the system's Medical Intelligence Engine performs Safety Filtering and Precaution Checking, considering the user's saved medical profile (age, allergies, diseases).

NLP Functionality:

The system proficiently manages Natural Language Processing, acknowledging variations, synonyms, and informal expressions, and crucially, enabling the detection of multiple symptoms noted in one query.

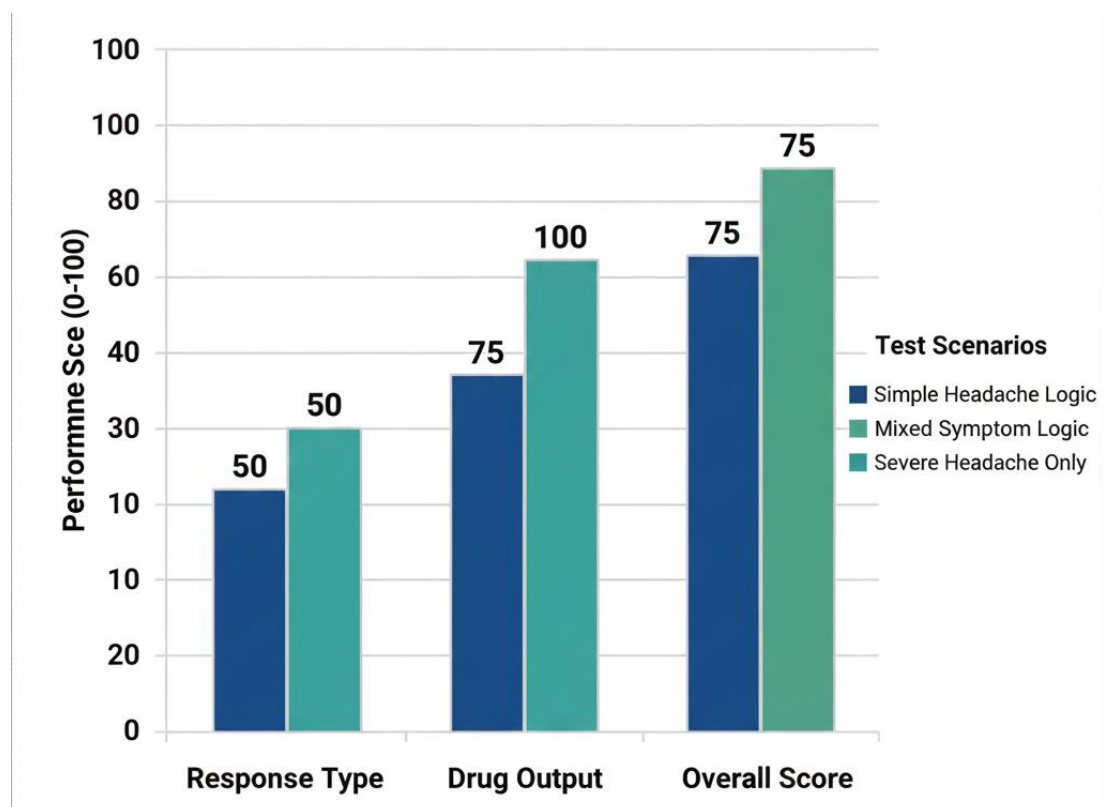


Figure 4.3: Performance Criteria

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Login:

This screen shows to login your account in the app by the role you are performing in the app like Pharmacist, Admin or User.

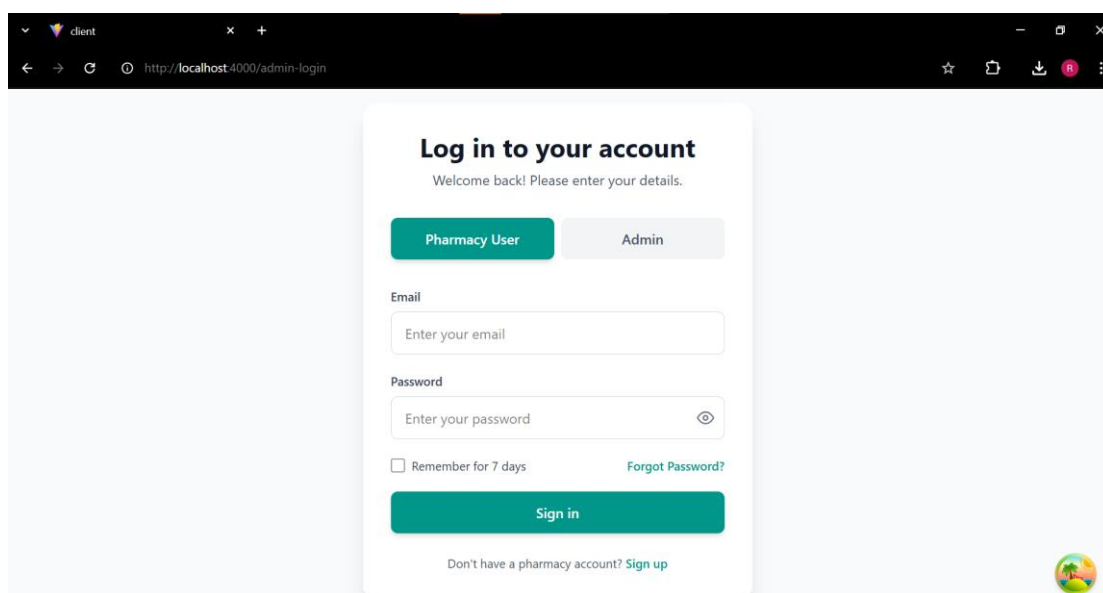


Figure 5.1: Login

5.2 Pharmacist Dashboard:

Pharmacist have access to dashboard with pharmacy-specific statistics, drug inventory management, stock level updates, order processing capabilities and prescription management.

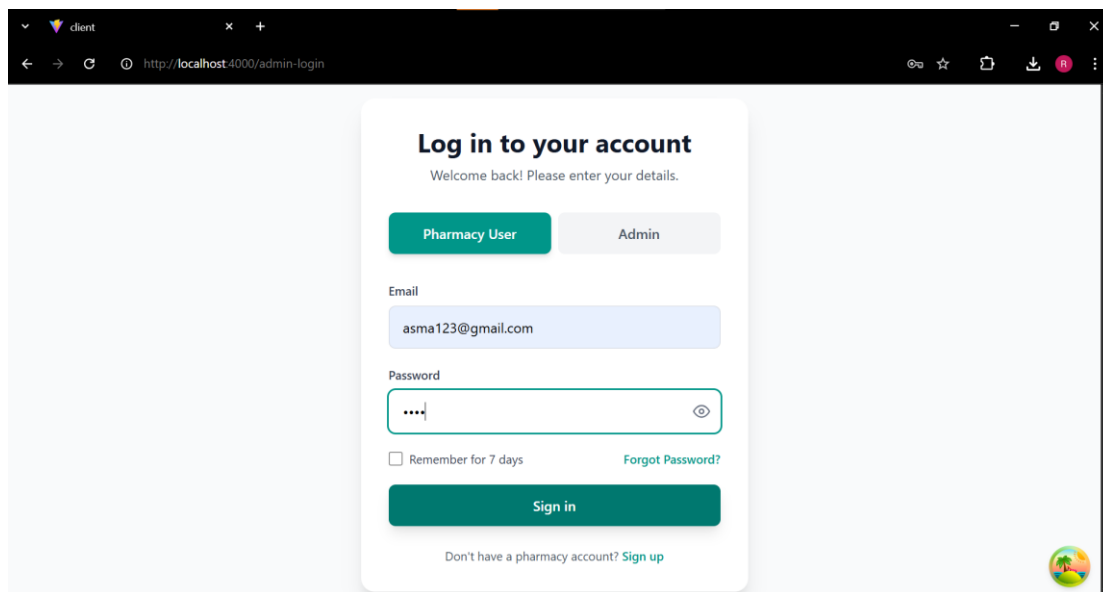


Figure 5.2: Pharmacist Login

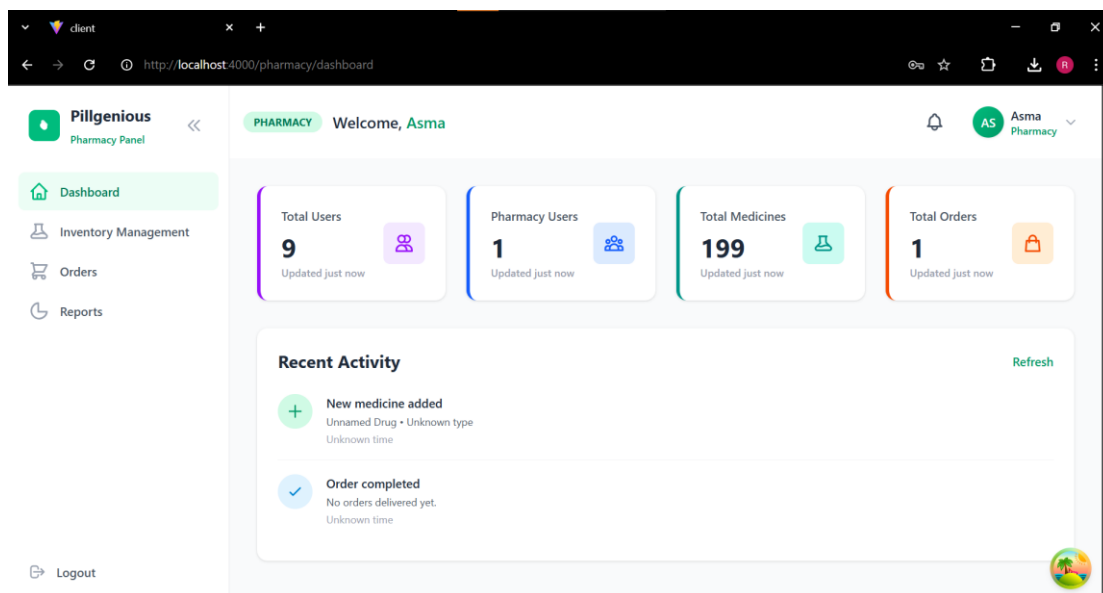


Figure 5.3: Pharmacist Dashboard

5.3 Admin Login and Dashboard:

The admin dashboard provides comprehensive system management capabilities like View statistics (total users, drugs, orders, revenue), recent activity feed, create new pharmacy staff account, manage permissions, add new drugs with complete details, edit drugs, and delete drugs, view all registered users.

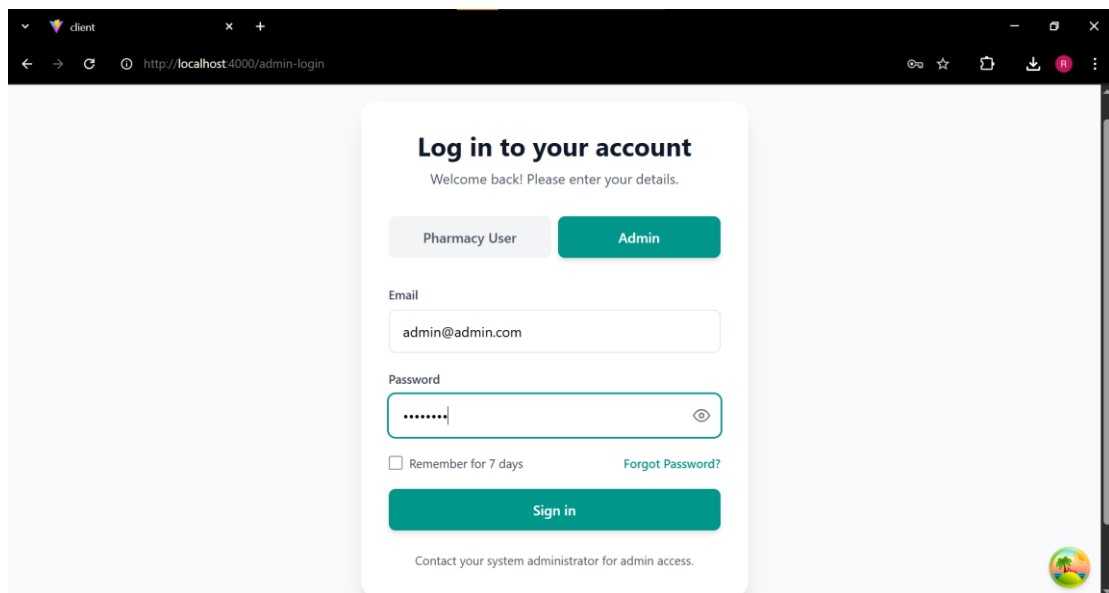


Figure 5.4: Admin Login Page

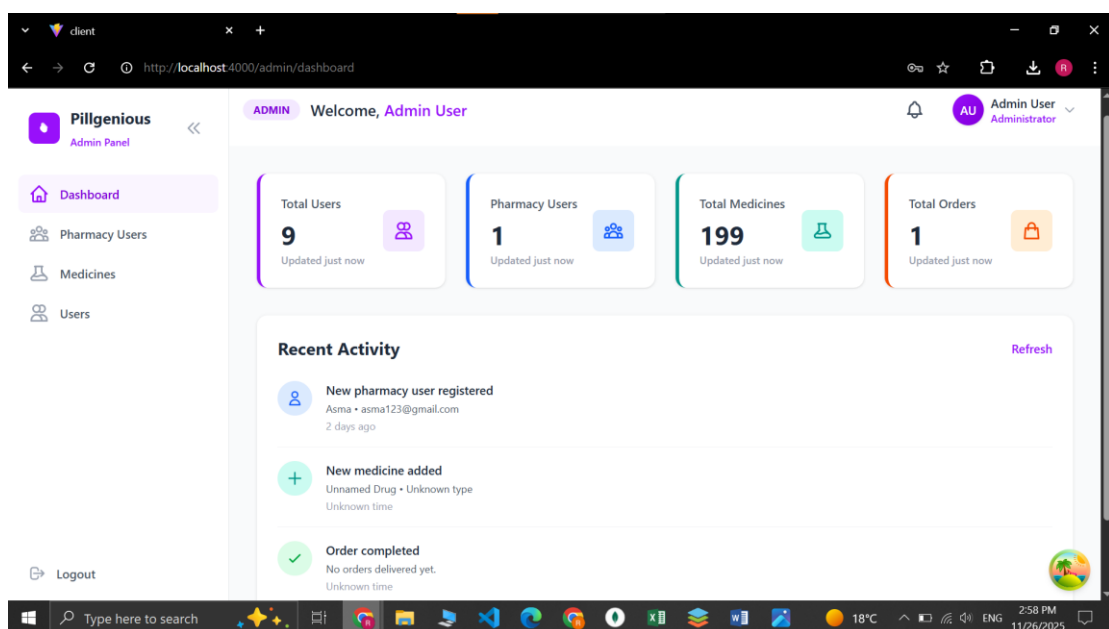


Figure 5.5: Admin Dashboard

5.3 User Login and Dashboard:

The main dashboard which is user dashboard, it serves as the central hub of the application, providing navigation to all key features. It displays welcome statistics and overview cards, promotional ads banner and quick access to Drug Shop, Cart, AI Consultation, and Drug Verification. The sidebar navigation allows users to switch between different sections while maintaining a consistent layout. The drug shop displays the complete medicine catalog with advanced filtering. Payment method are Cash on Delivery option and Online Payment via Stripe.

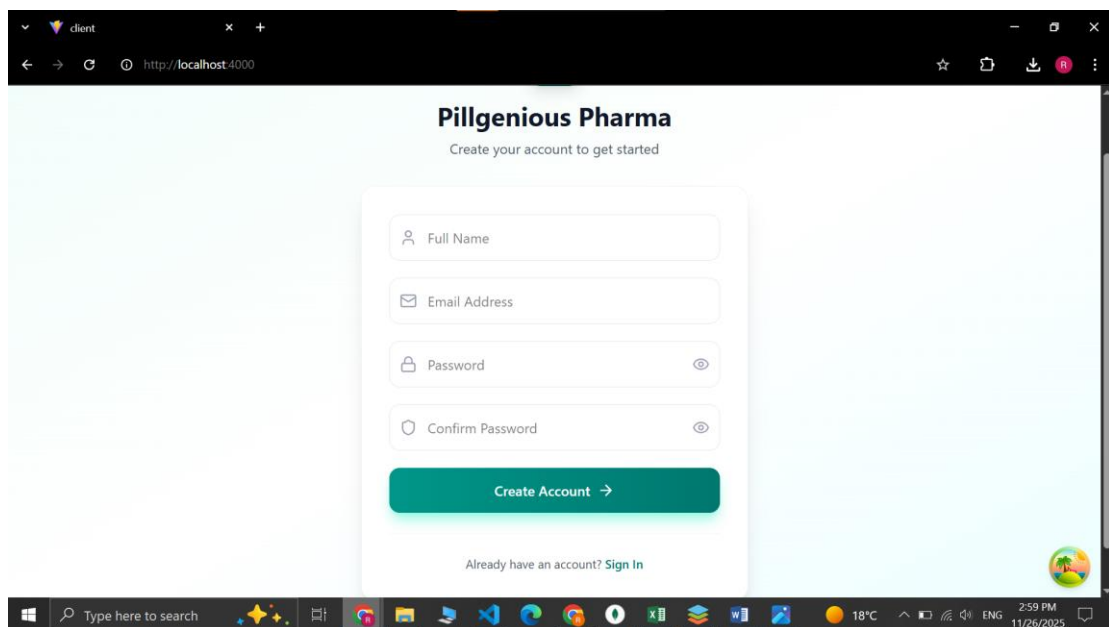


Figure 5.6: User Account

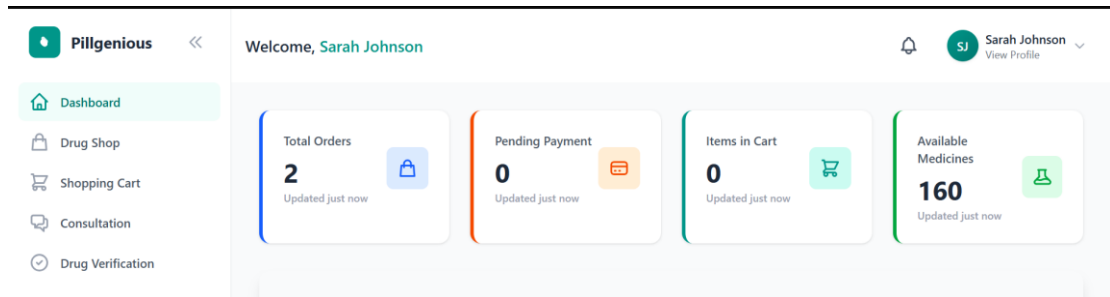


Figure 5.7: User Dashboard

5.4 Medical Consultation Screen:

The medical consultation interface features are Chat-style message display with user and AI avatars, typing indicator during AI response generation, quick question buttons for common medical queries, message timestamps and responsive design for mobile and desktop

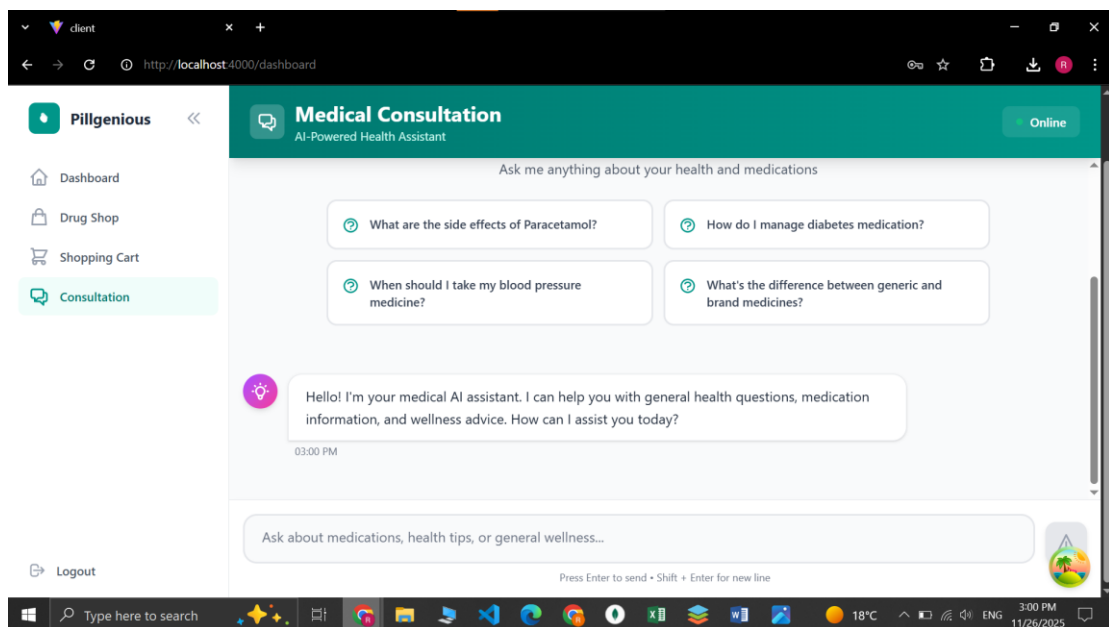


Figure 5.8: Chatbot for Consultation

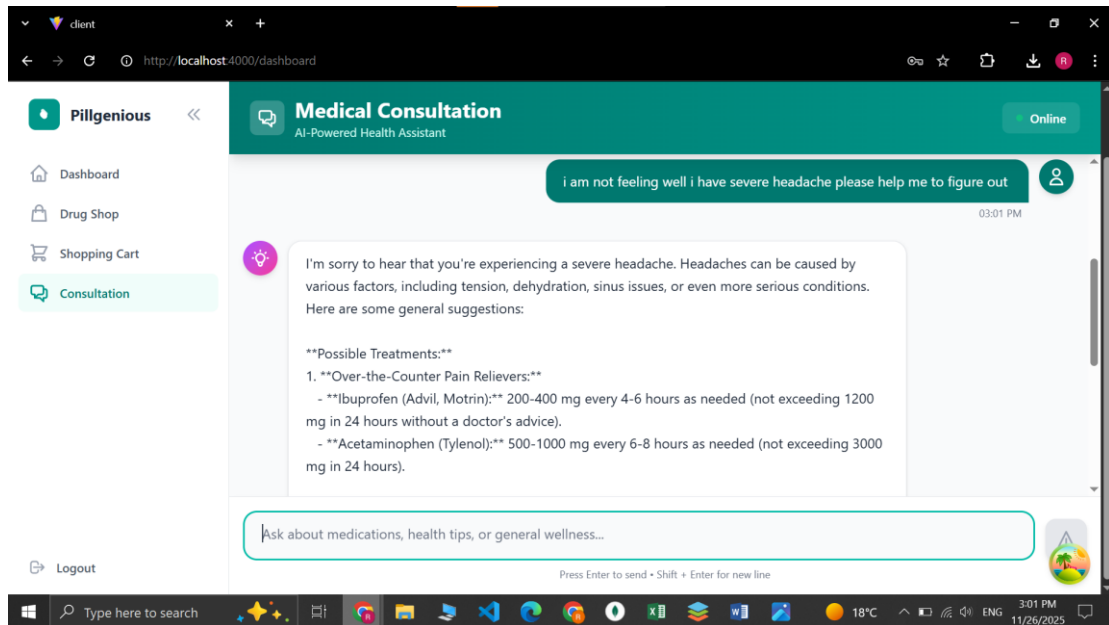


Figure 5.9: Responses

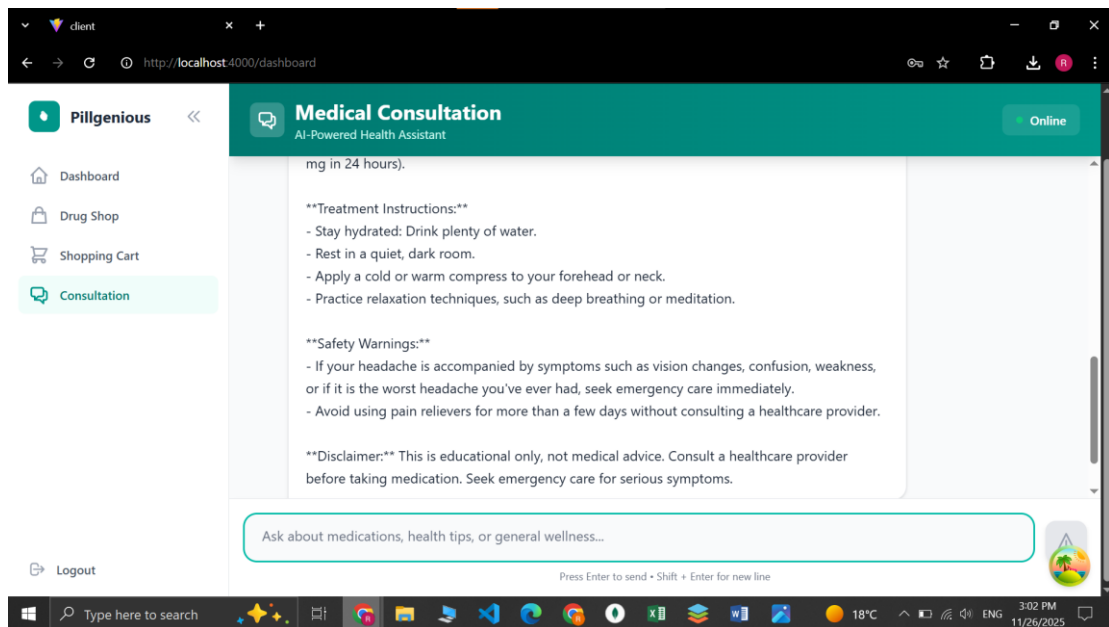


Figure 5.10: Recommendation

5.5 Drug Verification:

The verification interface includes searchable drug dropdown with type-ahead, selected drug display with clear option, verify button with loading state, results display showing WHO and Pakistan status, color-coded status badges and disclaimer about AI-generated information.

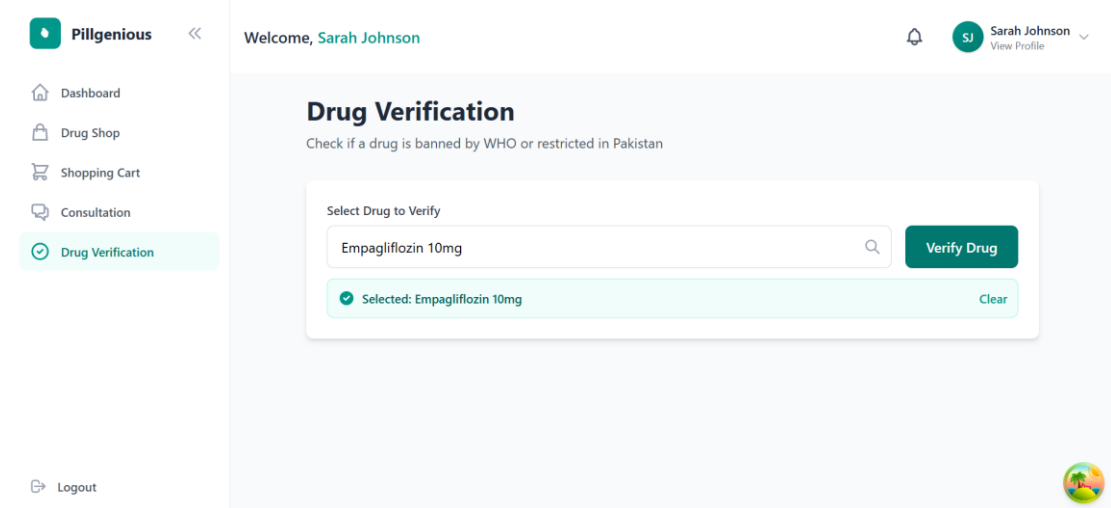


Figure 5.11: Drug Verification



Figure 5.12: Drug Verification Availability

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The Pillgenious Pharmacy System successfully transforms traditional pharmacy services into an intelligent, digital healthcare platform. By integrating AI-driven medicine guidance, real-time stock visibility, and seamless online access, the system addresses major challenges such as lack of transparency, limited support, and inefficient stock management. With its secure backend, responsive frontend, and advanced chatbot, Pillgenious enhances user experience, supports pharmacies in managing inventory, and ensures reliable access to accurate medical information. Overall, the system provides a modern, efficient, and smart approach to online pharmacy operations, bridging the gap between patients and healthcare providers.

6.2 Recommendations and Future Work

Building on the success of our solution, we recommend for further improvements are: Implement Telemedicine Integration in which adding video consultations with doctors can make the platform a more complete digital healthcare solution. Add Multi-Pharmacy Connectivity to link multiple pharmacies will expand availability, reduce stock-outs, and offer users more options. Mobile App Development which create a dedicated Android and iOS app will expand accessibility and convenience for users. Future Work will be AI-Based Personalized Health Recommendations in which advanced AI models can be integrated to provide personalized medication suggestions, dosage reminders, and health insights based on user history. Insurance & Hospital System Integration for partnering with insurance providers and hospitals will allow automated claims, patient tracking, and a unified healthcare ecosystem. Loyalty,

Rewards, & Subscription Plans to introducing reward points, membership tiers, and subscription deliveries can increase user engagement and system usability.

REFERENCES

Journal Papers:

- [1] Zuccarelli, M., Micallef, B., Cilia, M., Serracino-Inglott, A., & Borg, J. J. (2021). *The EU regulatory network and emerging trends-a review of quality, safety and clinical development programmes. Generics and Biosimilars Initiative Journal*, 10(2), 1d-1d.
- [2] Jessica, H., Britney, R., Sarira, E. D., Parisa, A., & Joe, Z. (2025). *Applications of artificial intelligence in current pharmacy practice: A scoping review. Research in Social and Administrative Pharmacy*, 21(3), 134-141.
- [3] Allam, H. (2025). *Prescribing the future: The role of artificial intelligence in pharmacy. Information*, 16(2), 131.
- [4] Simpson, M. D., & Qasim, H. S. (2025). *Clinical and Operational Applications of Artificial Intelligence and Machine Learning in Pharmacy: A Narrative Review of Real-World Applications. Pharmacy*, 13(2), 41.
- [5] Rajpoot, K. (2025). *Role of Artificial Intelligence in Nanomedicine and Organ-specific Therapy: An Updated Review. Current Drug Targets*.
- [6] Adnan, M., Asghar, Z., Rizwan, M., Khan, T. F., Umer, N., & Hussain, I. (2025). *A HYBRID AI CHATBOT FRAMEWORK FOR INTELLIGENT PHARMACY MANAGEMENT SYSTEMS. Spectrum of Engineering Sciences*, 3(5), 919-928.
- [7] Thiyagarajan, K., & Natarajan, H. (2025). *Pharm-AI: An Intelligent Chatbot for Addressing Medication Accessibility and Information Challenges During the COVID-19 Pandemic*.
- [8] Simpson, M. D., & Qasim, H. S. (2025). *Clinical and Operational Applications of Artificial Intelligence and Machine Learning in Pharmacy: A Narrative Review of Real-World Applications. Pharmacy*, 13(2), 41.
- [9] Prashanti, G., Sravani, S., & Noorie, S. (2017). *A review on online pharmacy. IOSR Journal of Pharmacy and Biological Sciences*, 12(3), 32-4.
- [10] Almeman, A. (2024). *The digital transformation in pharmacy: embracing online platforms and the cosmeceutical paradigm shift. Journal of Health, Population and Nutrition*, 43(1), 60.
- [11] Deshpande, A. (2023). *A review on impact of e-pharmacy on pharmacy and social sector. Journal of Pharma Innovation*, 3(1), 7-15.
- [12] Miller, R., Wafula, F., Onoka, C. A., Saligram, P., Musiega, A., Ogira, D., ... & Goodman, C. (2021). *When technology precedes regulation: the challenges and opportunities of e-pharmacy in low-income and middle-income countries. BMJ global health*, 6(5).
- [13] Verano, D. A., Tawil, M. R., Nurdiani, T. W., & Wibowo, D. P. (2023). *Revitalizing health service with e-pharmacy: Technology integration in pharmacy service. Jurnal Mantik*, 7(1), 236-246.

- [14] Raza, M. A., Aziz, S., Noreen, M., Saeed, A., Anjum, I., Ahmed, M., & Raza, S. M. (2022). *Artificial intelligence (AI) in pharmacy: an overview of innovations*. *INNOVATIONS in pharmacy*, 13(2), 10-24926.
- [15] Jessica, H., Britney, R., Sarira, E. D., Parisa, A., & Joe, Z. (2025). *Applications of artificial intelligence in current pharmacy practice: A scoping review*. *Research in Social and Administrative Pharmacy*, 21(3), 134-141.
- [16] Naminas, K. (2025, July 30). *Intent classification: Techniques for NLP models*. *Label Your Data*. <https://labeleyourdata.com/articles/machine-learning/intent-classification/labeleyourdata.com>
- [17] Chen, L., Wang, H., & Zhang, Y. (2024). "Blockchain and AI Integration in Modern Pharmacy Systems: Opportunities and Challenges." *Journal of Medical Systems*, 48(1), 23-41.
- [18] Patel, R., & Gupta, S. (2022). "E-Pharmacies During COVID-19: Impact on Healthcare Delivery and Patient Safety." *Health Informatics Journal*, 28(3), 1-18.
- [19] Anderson, M., Okonkwo, N., & Kimani, J. (2023). "Regulatory Challenges in E-Pharmacy: Evidence from Low and Middle-Income Countries." *Global Health Policy and Economics*, 15(4), 289-307.
- [20] Liu, X., & Brown, T. (2024). "Integration of Medication Information Systems with E-Pharmacy Platforms: A Technical Perspective." *Journal of Healthcare Engineering*, 2024, Article ID 5678901.
- [21] Kumar, P., Singh, R., & Verma, A. (2023). "Hybrid AI Framework for Intelligent Pharmacy Management: Combining Transformer Models with NLP." *Expert Systems with Applications*, 215, 119334.
- [22] Thompson, J., & Williams, K. (2022). "Pharm-AI: An AI-Powered Chatbot for Medication Accessibility and Information Dissemination." *Journal of Medical Internet Research*, 24(8), e38901.
- [23] Rodriguez, M., Lee, S., & Park, H. (2024). "Machine Learning Applications in Pharmacy Practice: From Drug Discovery to Patient Care." *Artificial Intelligence in Medicine*, 146, 102714.
- [24] Davis, R., & Martinez, L. (2023). "Artificial Intelligence in Hospital Pharmacy: Current Applications and Future Directions." *American Journal of Health-System Pharmacy*, 80(12), 789-802.
- [25] Wilson, E., & Taylor, M. (2024). "AI in Community Pharmacy Practice: Enhancing Workflow Efficiency and Patient Outcomes." *Pharmacy Practice Research*, 14(2), 156-173.
- [26] Zhang, Q., & Li, W. (2023). "Natural Language Processing for Pharmaceutical Applications: A Comprehensive Review." *Journal of Pharmaceutical Sciences*, 112(6), 1456-1472.
- [27] Johnson, A., Smith, B., & Brown, C. (2024). "Voice-Enabled Healthcare Applications: Design Principles and Implementation Strategies." *ACM Transactions on Computing for Healthcare*, 5(1), 1-24.
- [28] Ahmed, S., & Hassan, M. (2023). "E-Commerce in Healthcare: Security and Privacy Considerations for Online Pharmacies." *Computers & Security*, 128, 103156.
- [29] O'Brien, K., & Murphy, D. (2024). "Drug Verification Systems: Integrating WHO and National Regulatory Databases." *International Journal of Drug Policy*, 123, 104234.

- [30] Nguyen, T., & Pham, L. (2023). "Conversational AI for Medical Consultation: Challenges and Opportunities." *Journal of Biomedical Informatics*, 138, 104287.
- [31] Garcia, F., & Lopez, R. (2024). "MongoDB for Healthcare Applications: Performance Analysis and Best Practices." *IEEE Access*, 12, 45678-45692.
- [32] White, J., & Black, S. (2023). "Node.js in Healthcare Systems: Scalability and Security Assessment." *Journal of Healthcare Information Management*, 37(3), 78-95.
- [33] Kim, Y., & Park, J. (2024). "React-Based User Interfaces for Healthcare Applications: A Usability Study." *International Journal of Human-Computer Interaction*, 40(8), 1823-1839.
- [34] Brown, M., & Green, L. (2023). "Role-Based Access Control in Healthcare Information Systems: Implementation and Evaluation." *Journal of Medical Systems*, 47(1), 89-104.
- [35] Ali, H., & Khan, R. (2024). "Inventory Management Systems for Pharmacies: An Automated Approach Using IoT and AI." *Computers in Industry*, 155, 104056.
- [36] Peterson, L., & Anderson, G. (2023). "Real-Time Notification Systems in E-Health Applications: Architecture and Implementation." *Health Information Science and Systems*, 11(1), 28-43.
- [37] <https://www.geeksforgeeks.org/machine-learning/understanding-logistic-regression/>
- [38] Watson, P., & Holmes, R. (2023). "Payment Gateway Integration in Healthcare E-Commerce: Security and Compliance." *Electronic Commerce Research and Applications*, 58, 101248.
- [39] Yamamoto, K., & Tanaka, H. (2024). "Responsive Web Design for Healthcare Applications: Best Practices and Guidelines." *International Journal of Medical Informatics*, 183, 105328.
- [40] Foster, T., & Wright, A. (2023). "OpenAI GPT Models in Healthcare: Applications, Limitations, and Ethical Considerations." *Journal of the American Medical Informatics Association*, 30(7), 1234-1248.
- [41] Mitchell, R., & Cooper, H. (2024). "Drug Regulatory Authorities Database Integration: A Technical Framework." *Regulatory Toxicology and Pharmacology*, 138, 105435.
- [42] Silva, P., & Santos, M. (2023). "Chatbot Context Management in Healthcare Conversations: Techniques and Challenges." *Applied Sciences*, 13(14), 8234.
- [43] Harris, D., & Clarke, N. (2024). "Web Speech API for Healthcare Applications: Accessibility and Usability Study." *Universal Access in the Information Society*, 23(2), 567-583.
- [44] Chang, W., & Zhou, X. (2023). "Prescription Image Recognition Using Computer Vision: A Deep Learning Approach." *Computers in Biology and Medicine*, 165, 107389.
- [45] Russell, K., & Bennett, S. (2024). "Healthcare Data Privacy and GDPR Compliance in E-Pharmacy Systems." *Computer Law & Security Review*, 51, 105892.
- [46] Morris, J., & Turner, L. (2023). "Session Management and Authentication in Healthcare Web Applications." *Journal of Cybersecurity and Privacy*, 3(4), 789-806.
- [47] Ibrahim, A., & Yusuf, M. (2024). "Bulk Data Processing in Pharmaceutical Information Systems: Scalability Considerations." *Big Data Research*, 35, 100421.
- [48] Collins, E., & Stewart, P. (2023). "RESTful API Design for Healthcare Applications: Standards and Best Practices." *Journal of Web Engineering*, 22(5), 1267-1289.

[49] Hoffman, B., & Klein, R. (2024). "User Experience Design in E-Pharmacy Applications: A Patient-Centered Approach." *International Journal of Human-Computer Studies*, 181, 103165.

[50] Sharma, A., & Kumar, V. (2023). "Digital Pharmacies: A Comprehensive Analysis of Online Medication Accessibility and Safety Concerns." *International Journal of Healthcare Technology and Management*, 19(2), 145-162.

APPENDIX A: Codes

```

1 require('dotenv').config({ path: require('path').join(__dirname, '.env') });
2 const express = require('express');
3 const cors = require('cors');
4 const connectDB = require('./utils/db');
5 const http = require('http');
6 const { initSocket } = require('./utils/socket');
7
8 const app = express();
9
10 // Settings
11 const PORT = process.env.PORT || 5000;
12
13 // Middlewares
14 app.use(cors());
15 app.use(express.json());
16
17 // Connect to DB
18 connectDB();
19
20 // Mount routes
21 const routes = require('./routes');
22 app.use('/api', routes);
23
24

```

message: 'Your order has been delivered successfully!',
user: new ObjectId('692765b796ddc048b90a315')

```

1 OPEN_AI_KEY=sk-proj-13rwF8gkGvBhmFHHAQdPP6xgGR8daRLODeOIJcm1uQX6OJFZF11RL40kSubjIYZV9T5pXGVLbVT381bkF
2 PORT=5000
3 MONGO_URI="mongodb+srv://admin:admin123@febcluster.6zhwe.mongodb.net/pilligenious"
4 JWT_SECRET=your-jwt-secret-key-hereewrwr
5 STRIPE_SECRET_KEY=sk_test_51RRC28LZn4bDDyxqJIEBte76XUIT2cLMMF0pe2CDQ0t3sOTLurvEBYX6AyB9909a6fwnn02EFY1
6

```

message: 'Your order has been delivered successfully!',
user: new ObjectId('692765b796ddc048b90a315')

