GEORGIA SOUTHERN UNIVERSITY

PharmaCheck

Drug Interaction Database System

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Statesboro, GA

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Outline (1/2)

1. Introduction

1.1. Personal Motivation

1.2. The Need

1.3. Project Overview

2. Stage 2: Project Proposal

2.1. Beta I Conception

2.2. Database Design Goals

3. Database Design

3.1. Relational Schema

3.2. Normalization

3.3. Key Tables

4. Implementation: Backend

4.1. Technology Stack

4.2. Web Scraping System

4.3. Web Scraping Code

4.4. Database Integration

4.5. API Endpoints

4.6. AI Translation Feature

Outline (2/2)

5. Implementation: Frontend

5.1. User Interface Design

5.2. Core Features

5.3. Doctor-Patient Features

5.4. Patient Management View

6. Live Demonstration

6.1. Demo: Registration

6.2. Demo: Drug Interactions

6.3. Demo: AI Translation

6.4. Demo: Food & Disease

6.5. Demo: Doctor Dashboard

7. Challenges & Solutions

7.1. Technical Challenges

7.2. Design Challenges

7.3. UI/UX Challenges

8. Beta I: First Working System

8.1. Achievements

8.2. Data Import

8.3. Metrics

9. Future Work

9.1. Planned Enhancements

Introduction

Personal motivation, the need for drug interaction systems, and project overview.

Personal Motivation

Why this project matters to me

- This semester, I received a cancer diagnosis
- Treatment required managing multiple medications simultaneously
- Witnessed firsthand how doctors track complex drug interactions internally
- Realized patients often lack visibility into potential medication conflicts
- Inspired to build an accessible system for drug interaction awareness

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The Need

Why drug interaction systems matter

- Drug interactions cause 100,000+ hospitalizations annually in the US
- Patients often take 5+ medications simultaneously
- Healthcare providers use internal systems not accessible to patients
- Existing public tools lack transparency and real-time accuracy

Key Statistics

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- 82% of Americans take at least 1 medication
- 29% take 5+ medications
- Drug interactions are the 4th leading cause of death

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What is PharmaCheck?

PharmaCheck

Stay Informed, Stay Safe.

- **PharmaCheck**: A web-based drug interaction checking platform
- Built with MySQL database, Flask backend, and modern HTML/CSS/JS frontend
- Real-time web scraping from Drugs.com for up-to-date information
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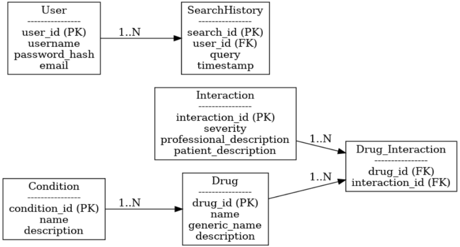
Stage 2: Project Proposal

Initial planning, ER diagram design, and Beta I conception.

Beta I Conception

Initial planning and entity identification



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Interaction
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Drug
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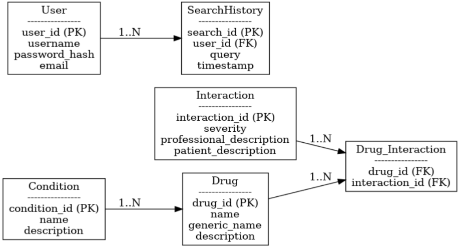

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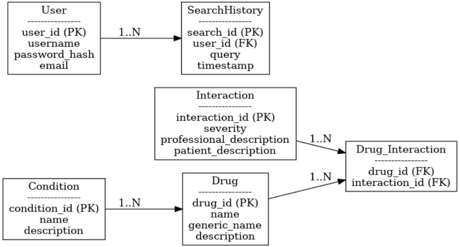

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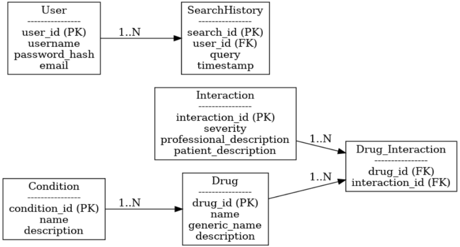

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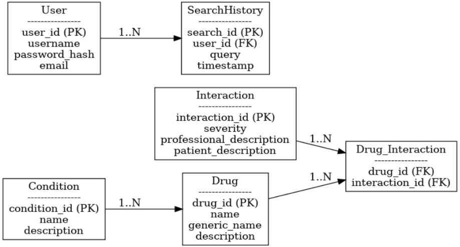

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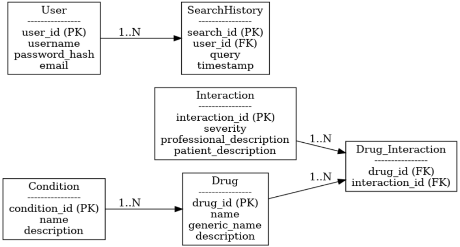

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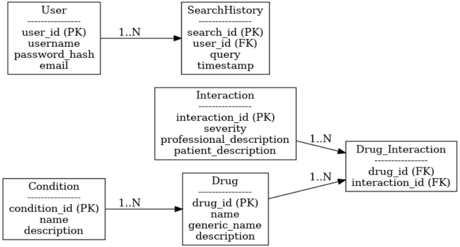

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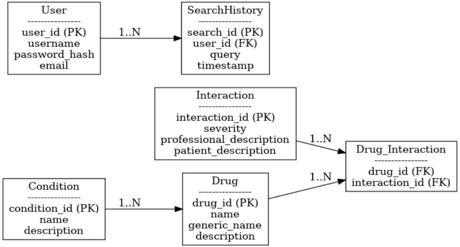

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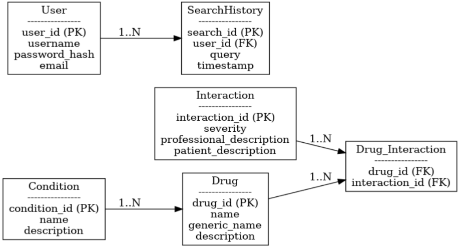

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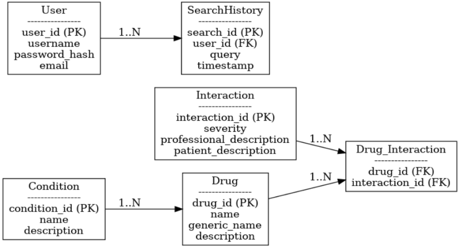

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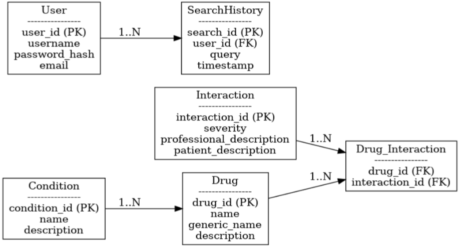

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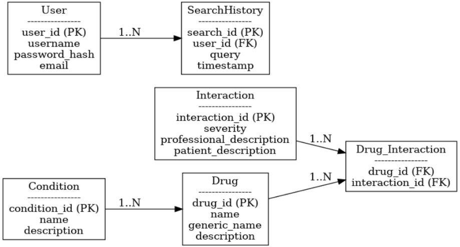

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Requirements for the system

- Support user accounts with distinct roles (Patient, Doctor)
- Track drug interactions with severity levels (Major, Moderate, Minor)
- Enable comprehensive search history for audit and review
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Database Design

Relational schema, normalization, and key table structures.

Relational Schema

Eight core tables

- **User** – Authentication & roles
- **Drug** – Medication information
- **Condition** – Medical conditions
- **Interaction** – Drug-drug interactions

- **Drug_Interaction** – Junction table
- **FoodInteraction** – Food/lifestyle
- **DiseaseInteraction** – Disease interactions
- **SearchHistory** – User searches
- **Doctor_Patient** – Assignments

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- **Drug** – Medication information
- **Condition** – Medical conditions
- **Interaction** – Drug-drug interactions
- **Drug_Interaction** – Junction table
- **FoodInteraction** – Food/lifestyle
- **DiseaseInteraction** – Disease interactions
- **SearchHistory** – User searches
- **Doctor_Patient** – Assignments

Relational Schema

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Normalization

Third Normal Form (3NF) compliance

- All tables satisfy Third Normal Form (3NF)
- **User**: user_id → username, password_hash, email, role
- **Drug**: drug_id → name, generic_name, description, condition_id
- **Interaction**: interaction_id → severity, professional_description, patient_description
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Key Tables Deep Dive

User and SearchHistory tables

User Table

```
CREATE TABLE User (
  user_id INT PRIMARY KEY
    AUTO_INCREMENT,
  username VARCHAR(64)
    NOT NULL UNIQUE,
  password_hash CHAR(60)
    NOT NULL,
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    NOT NULL UNIQUE,
  role ENUM(’PATIENT’,
    ’DOCTOR’) NOT NULL
);
```

SearchHistory Table

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CREATE TABLE SearchHistory (
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  user_id INT NOT NULL,
  query TEXT NOT NULL,
  search_type ENUM(’DRUG’,
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  search_data TEXT,
  created_at DATETIME
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Implementation: Backend

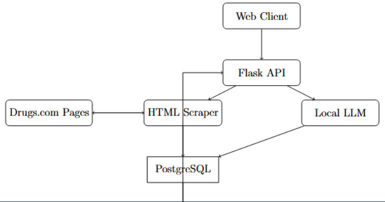
Technology stack, web scraping, database integration, and AI features.

Technology Stack

Backend components

- **Database**: MySQL
  - Originally planned PostgreSQL
  - Switched to MySQL for compatibility
- **Backend**: Flask (Python)
- **ORM**: SQLAlchemy

- **Web Scraping**: BeautifulSoup
- **Authentication**: JWT + bcrypt
- **AI Translation**: Ollama LLM
- **Data Format**: JSON APIs



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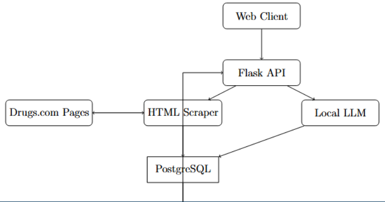

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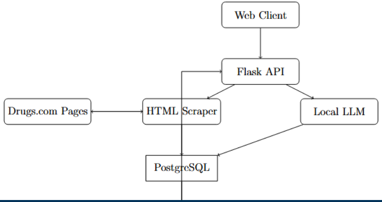

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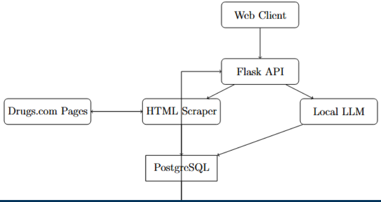

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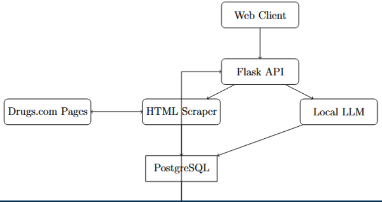

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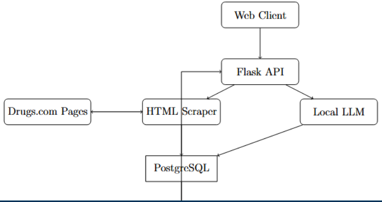

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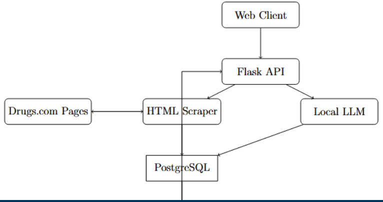

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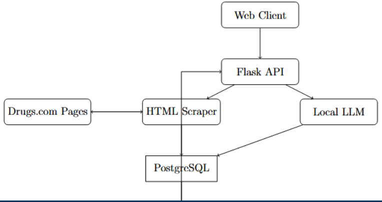

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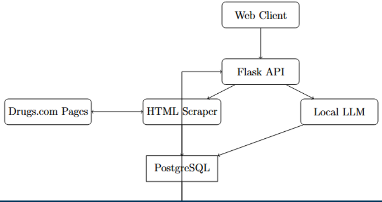

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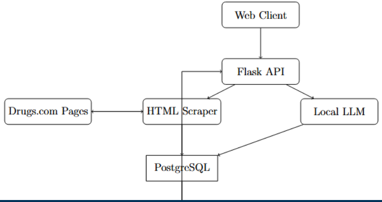

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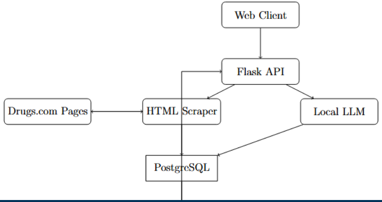

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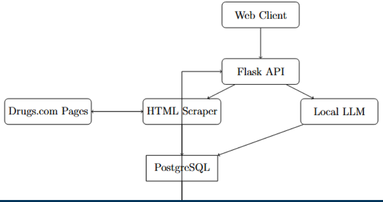
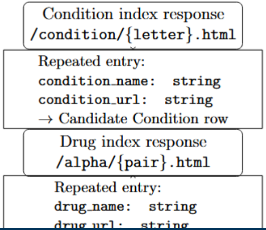


Web Scraping System

Real-time data acquisition from Drugs.com

- **DrugInteractionChecker**: Primary scraper class
- **FoodInteractionScraper**: Food/lifestyle interactions
- **DiseaseInteractionScraper**: Disease-related interactions
- HTML parsing with BeautifulSoup
- Intelligent caching to reduce redundant requests
- Brand name → Generic name resolution (e.g., Valium → Diazepam)



Condition index response
`/condition/{letter}.html`

Repeated entry:
`condition_name:  string`
`condition_url:  string`
→ Candidate Condition row

Drug index response
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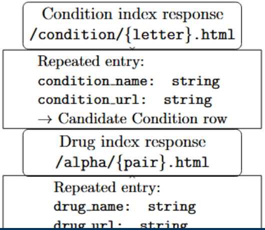

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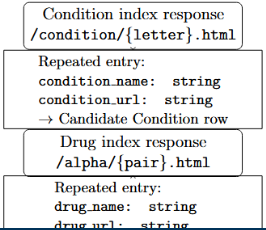

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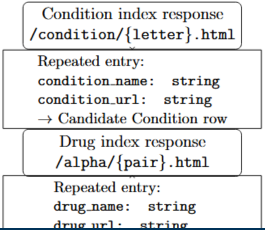

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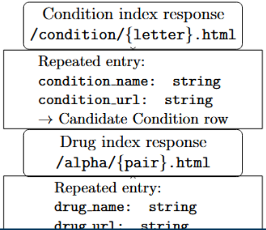

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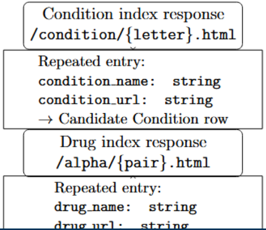

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Web Scraping System

[CODE DEMO] scraper.py - DrugInteractionChecker

[DEMO: Show scraper.py in IDE]

Key methods to highlight:

- `get_drug_interactions()` – Fetches drug-drug interactions
- `get_food_interactions()` – Fetches food/lifestyle interactions
- `_get_generic_name()` – Resolves brand names

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Database Integration

SQLAlchemy ORM models

```python
class User(Base):
    __tablename__ = 'User'

    user_id = Column(Integer, primary_key=True, autoincrement=True)
    username = Column(String(64), nullable=False, unique=True)
    password_hash = Column(String(60), nullable=False)
    email = Column(String(255), nullable=False, unique=True)
    role = Column(Enum('PATIENT', 'DOCTOR'), nullable=False)

    # Relationships
    search_history = relationship('SearchHistory', back_populates='user')
    patients = relationship('User', secondary=doctor_patient_table,
                           primaryjoin=(user_id == doctor_patient_table.c.doctor_id),
                           secondaryjoin=(user_id == doctor_patient_table.c.patient_id))

```

[DEMO: Show database.py in IDE]

API Endpoints

RESTful API design

Authentication

- POST /auth/register
- POST /auth/login
- GET /auth/me

Drug Search

- GET /search_drugs
- GET /search_conditions

Interactions

- POST /check_drug_interactions
- GET /food_interactions
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Doctor-Patient

- GET /doctors/patients
- POST /patients/request_doctor

[DEMO: Show api.py endpoints in IDE]

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AI Translation Feature

Ollama LLM integration

- Translates professional medical descriptions to patient-friendly language
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Before (Professional)

"Using fluoxetine together with diazePAM may increase side effects such as dizziness, drowsiness, confusion, and difficulty concentrating..."

After (AI Translated)

"Taking these two medications together may make you feel more dizzy or sleepy than usual. Be careful when driving..."

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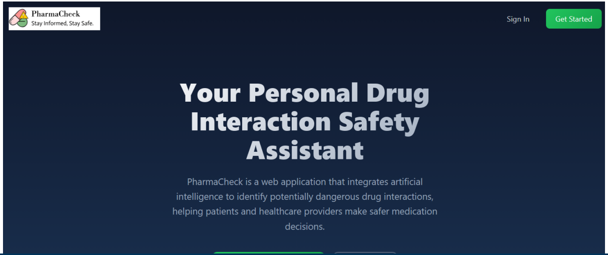
Implementation: Frontend

User interface design, core features, and doctor-patient views.

User Interface Design

Modern, responsive web application

- Built with vanilla HTML, CSS, and JavaScript
- No heavy framework overhead
- Flask serves static files directly
- Responsive design for desktop and mobile
- Clean, medical-professional aesthetic



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PharmaCheck is a web application that integrates artificial intelligence to identify potentially dangerous drug interactions, helping patients and healthcare providers make safer medication decisions.

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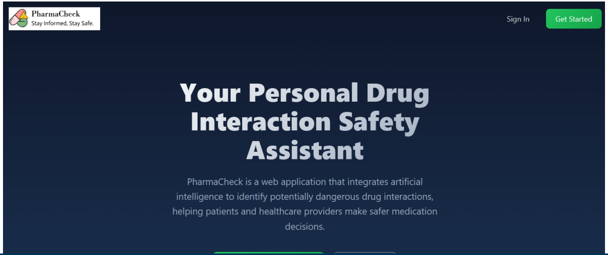

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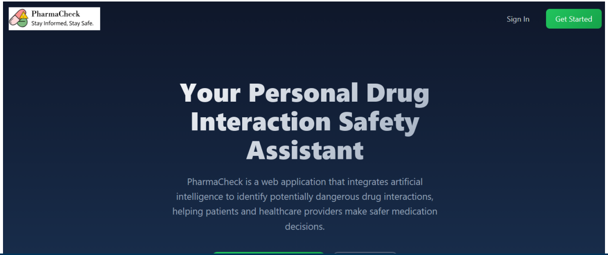

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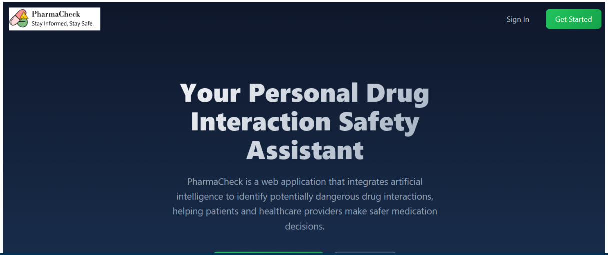

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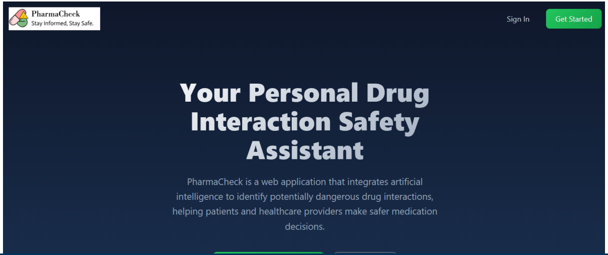

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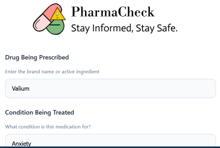
PharmaCheck
Stay Informed, Stay Safe.

Drug Being Prescribed
Enter the brand name or active ingredient
Valium

Condition Being Treated
What condition is this medication for?
Anxiety

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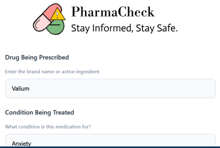

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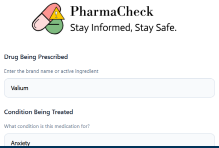

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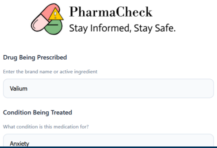

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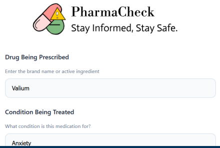

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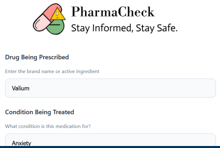

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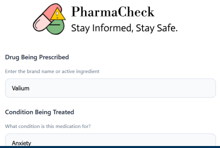
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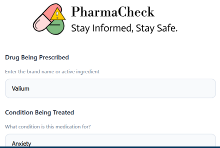

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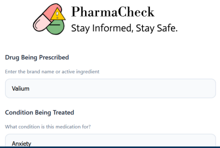

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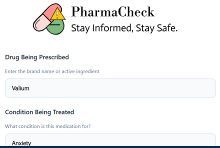

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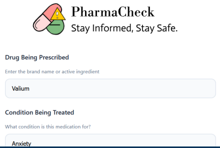

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Oversight and monitoring capabilities

- **Patient Registration**: Select a doctor during signup
- **Doctor Dashboard**: View all assigned patients
- **Search History Access**: Doctors can view patient search history
- **Real-time Tracking**: Recent searches displayed at a glance
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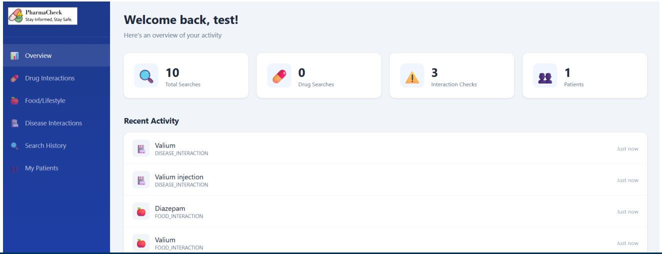

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Here's an overview of your activity

10	Total Searches
0	Drug Searches
3	Interaction Checks
1	Patients

Recent Activity

Valium	DISEASE_INTERACTION	Just now
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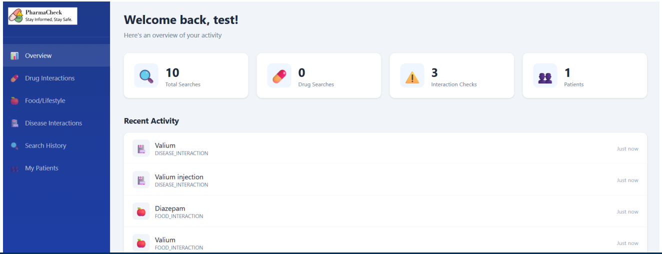

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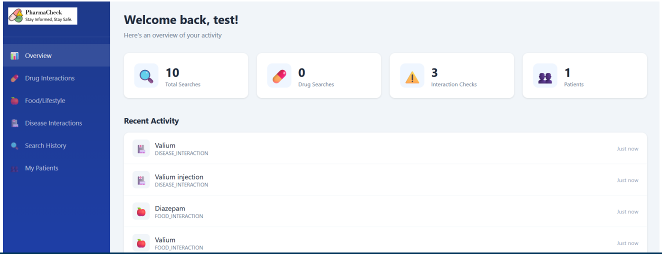

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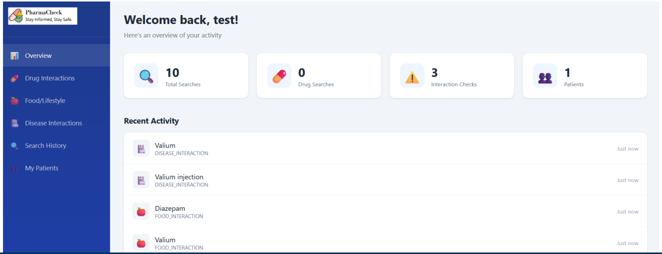

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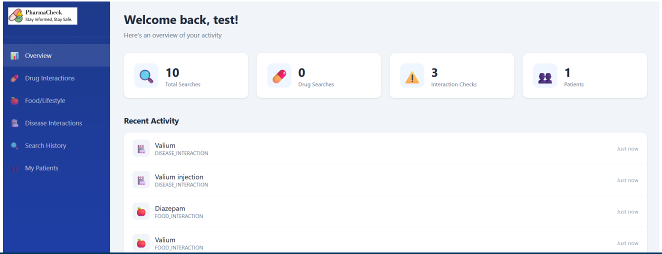

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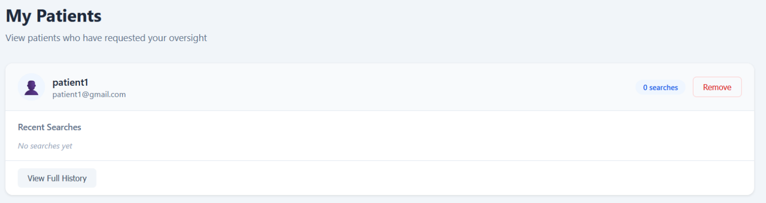
Patient Management View

Doctor’s patient list interface



My Patients

View patients who have requested your oversight

patient1

patient1@gmail.com

Recent Searches

No searches yet

Live Demonstration

Live walkthrough of system features.

Demo Part 1: User Registration & Login

[LIVE DEMO]

Demonstrating:

- Creating a new patient account
- Selecting a doctor from dropdown
- Login authentication flow
- Dashboard navigation

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Demo Part 2: Drug Interaction Check

[LIVE DEMO]

Demonstrating:

- Checking interactions between Prozac and Valium
- Viewing severity levels (color-coded)
- Expanding interaction details
- Browsing through multiple interactions

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Demo Part 3: AI Translation

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Demonstrating:

- Clicking “Translate to Patient-Friendly” button
- Animated loading dots during translation
- Before/after description comparison
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Demo Part 4: Food & Disease Interactions

[LIVE DEMO]

Demonstrating:

- Checking food/lifestyle interactions for Diazepam
- Checking disease interactions
- Brand name to generic name resolution
- Dashboard navigation between checkers

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Demo Part 5: Doctor Dashboard

[LIVE DEMO]

Demonstrating:

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- Seeing patient’s recent searches at a glance
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Challenges & Solutions

Technical, design, and UI/UX challenges encountered during development.

Technical Challenges

Backend and scraping issues

- **HTML Structure Changes**: Drugs.com format evolved during development
  - Solution: Robust parsing with multiple fallback selectors
- **Brand Name Resolution**: Prozac $\neq$ Fluoxetine in URLs
  - Solution: Implemented `_get_generic_name()` lookup
- **Performance**: Initial scraping took 2+ minutes
  - Solution: Caching mechanism with `use_cache=True`
- **Python Indentation Errors**: Inconsistent formatting
  - Solution: Careful code review and syntax checking

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Beta I: First Working System

First working system achievements and metrics.

Beta I Achievements

First working version milestones

- Fully functional MySQL database with 8+ tables
- Complete web scraping pipeline
- Working AI translation feature
- JWT-based authentication system
- Role-based access control
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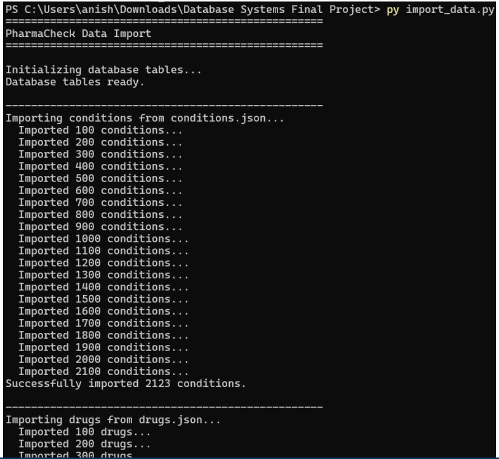
Data Import Process

Populating the database with drugs and conditions



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PharmaCheck Data Import
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Initializing database tables...
Database tables ready.

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Importing conditions from conditions.json...
  Imported 100 conditions...
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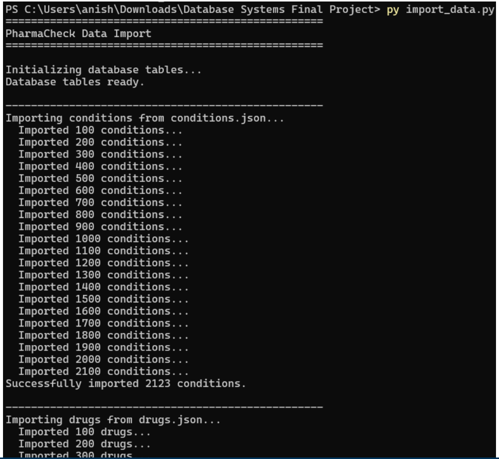

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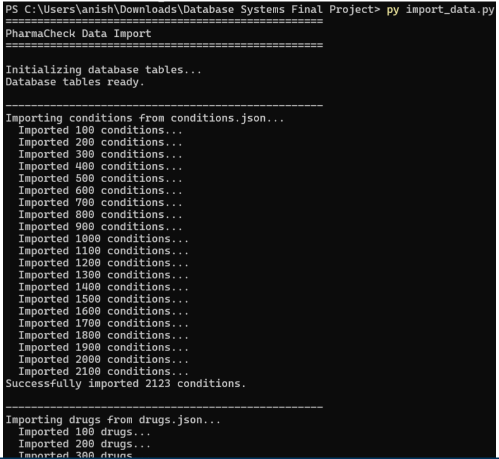

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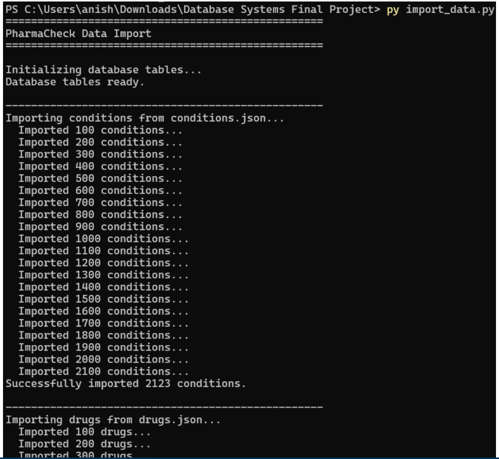

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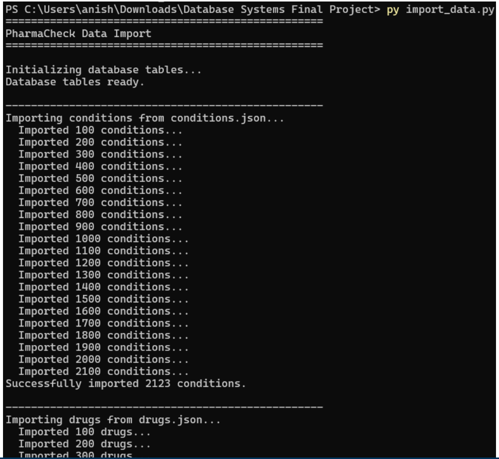

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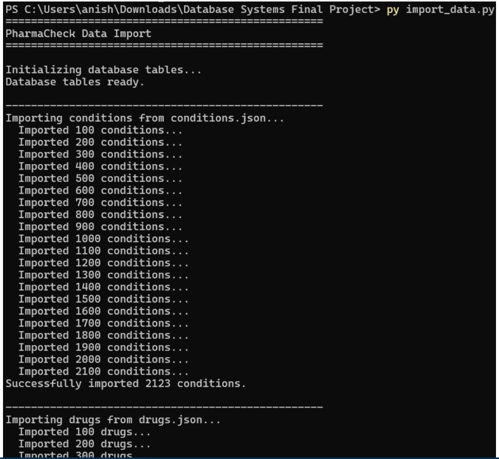

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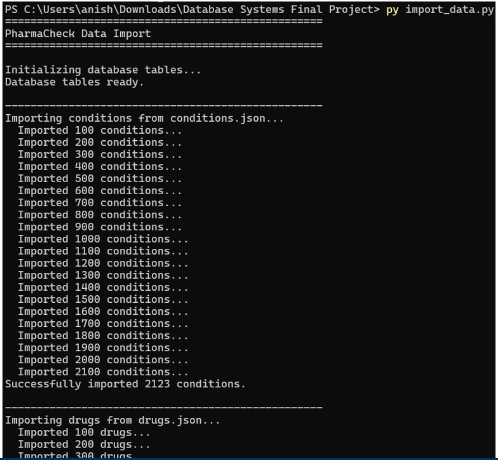

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Data Coverage

- **15,775** drugs in database
- **2,126** medical conditions
- Real-time access to all Drugs.com interactions
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Beta I Metrics

Project statistics

Codebase Size

- **api.py**: 1,115 lines
- **scraper.py**: 927 lines
- **database.py**: 351 lines
- **auth.py**: 303 lines
- Frontend: 1,500+ lines (HTML/CSS/JS)

Data Coverage

- **15,775** drugs in database
- **2,126** medical conditions
- Real-time access to all Drugs.com interactions
- Support for food and disease interactions

Future Work

Planned enhancements and technical improvements.

Planned Enhancements

Feature roadmap

- **Doctor-Patient Communication**: Direct messaging system
- **Medication Reminders**: Scheduled notifications
- **Prescription Management**: Track current prescriptions
- **Drug Allergy Tracking**: Alert on known allergens
- **Enhanced Patient Profiles**: Medical history, demographics
- **Doctor Notes**: Add annotations to patient interactions

Planned Enhancements

Feature roadmap

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Technical Improvements

Infrastructure and performance

- **Background Job Queue**: Async scraping with Celery
- **Full-Text Search**: Elasticsearch integration
- **Mobile Application**: React Native or Flutter app
- **PDF Reports**: Export search history as reports
- **Pharmacy Integration**: Connect with pharmacy systems
- **Analytics Dashboard**: Patient adherence tracking for doctors

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- Implements real-time web scraping with intelligent caching
- AI-powered translation makes medical information accessible
- Doctor-patient features enable professional oversight
- Personal goal achieved: Building a tool I would have wanted during treatment
- Potential for real-world impact in patient medication safety

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Complete System Demonstration

Full walkthrough

[LIVE DEMO]

Complete walkthrough of PharmaCheck

`http://localhost:5000`

References

[1] R. Ramakrishnan and J. Gehrke, *Database management systems*, 3rd Edition. McGraw-Hill, 2003.

[2] Drugs.com, Drugs.com drug interaction checker. 2024.

[3] Ollama, Ollama: Run large language models locally. 2024.

[4] Pallets Projects, Flask: A python microframework. 2024.

[5] SQLAlchemy, SQLAlchemy: The python SQL toolkit and ORM. 2024.

GEORGIA SOUTHERN UNIVERSITY

PharmaCheck

Drug Interaction Database System

Thank you for your attention!

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