MediLens: An AI-Powered Medicine Information and Assistance System

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***Abstract*—Medication errors and difficulty accessing reliable drug information remain significant challenges in modern healthcare. MediLens is an AI-powered web-based medicine information and assistance system designed to provide accurate, accessible, and easy-to-understand medication details for users. The system integrates Optical Character Recognition (OCR) to identify medicines from images of drug labels or packaging and retrieves verified information from trusted biomedical databases. Natural Language Processing (NLP) and a cloud-based Large Language Model (LLM) are used to generate contextual summaries and answer user queries through an interactive conversational assistant. The backend is implemented using the FastAPI framework and communicates with external knowledge sources and AI services through secure API integration. MediLens follows a modular architecture that includes OCR processing, information retrieval, and AI-driven response generation to ensure scalability and reliability. Core functionalities include medicine identification from images, structured drug information retrieval, automated summarization, and interactive question answering. By combining retrieval-based verification with conversational AI, MediLens aims to improve public health literacy, reduce misinformation about medications, and demonstrate the practical application of artificial intelligence in healthcare information systems.**

***Index Terms*—Artificial Intelligence, Healthcare Informatics, Large Language Models, Medicine Information System, FastAPI**

I. Introduction

The rapid expansion of digital healthcare has created a mounting demand for intelligent systems capable of delivering accurate, timely, and user-friendly medical guidance [3]. Among the challenges patients face today, one of the most common yet underappreciated is simply understanding medicine-related information — from dosage and usage instructions to side effects, drug interactions, and safety precautions. This challenge is especially acute for elderly individuals and those without a clinical background, where a misunderstanding of medication details can escalate quickly into a serious health risk [1]. MediLens was conceived to bridge precisely this gap. By combining optical character recognition (OCR) with natural language processing (NLP) and AI-driven response generation, the system enables users to retrieve essential medication details in real time — whether from scanned medicine strips, uploaded prescription images, or typed queries [6]. This approach transforms what was once a technical, time-consuming process into something intuitive and accessible to the general public. Traditional methods of obtaining medication information — browsing the internet, reading dense printed leaflets, or relying on informal advice — are notoriously prone to inaccuracy and misinterpretation [2]. Many existing digital health platforms compound the problem by assuming prior medical knowledge or burying key facts within complex technical documents. MediLens takes a fundamentally different approach: rather than dumping information on the user, it engages them conversationally, presenting verified data in a clear and structured way that is easy to act on. The system is designed around a modular architecture spanning image processing, text extraction, AI-based analysis, and response generation — a structure that supports scalability, accuracy, and efficient query handling [10]. In doing so, MediLens demonstrates how AI can serve not just as a technological showcase, but as a practical tool for improving patient awareness, reducing medication errors, and supporting more informed healthcare decisions.

II. Problem Statement

Access to accurate, reliable, and understandable medicine-related information remains a significant challenge for the general public [1]. Patients routinely turn to internet searches, unverified websites, or informal peer advice to make sense of their prescriptions — practices that meaningfully increase the risk of misinformation, incorrect self-medication, adverse drug interactions, and delayed professional consultation [2]. Existing digital health platforms and medical information systems have struggled to offer a satisfactory alternative. They are frequently hampered by complex terminology, limited real-time interactivity, dependence on costly external APIs, restricted accessibility, and a lack of personalization [3]. Few systems manage to unify medicine identification, concise summarization, and conversational assistance within a single, coherent platform. The burden falls disproportionately on users who are least equipped to navigate it: people with limited medical knowledge, elderly patients managing multiple medications, and individuals in resource-constrained settings where access to professional guidance is limited [10]. For these users,

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the absence of an intelligent, lightweight, and cost-effective medicine assistance system is not merely inconvenient — it can be dangerous. What is needed, then, is an AI-powered solution that delivers accurate, simplified, and interactive medicine information in a way that is scalable, cost-efficient, and broadly accessible. Addressing this gap has the potential to meaningfully enhance medication awareness, promote safer usage habits, and support more informed healthcare decisions across a wide range of users.

III. Related Work

The use of computer vision, artificial intelligence, and natural language processing to enhance medical data accessibility and healthcare information systems has been the subject of recent research. These technologies are commonly used in fields including intelligent healthcare assistants, medicine label recognition, and biological knowledge retrieval.

BioRAGent, a retrieval-augmented multi-agent system intended for biomedical query responding, was proposed by Bi et al. [11]. In order to obtain data from biological databases and produce precise answers, the system uses a number of specialized agents. Their research shows how retrieval-augmented generation (RAG) and agent-based architectures can be combined to increase biomedical question-answering systems' dependability and factual correctness.

A method for automatically retrieving drug information from cylindrically distorted pill container labels was reported by Gromova and Elangovan [12]. To extract text from pharmaceutical labels, their method combines optical character recognition (OCR) with deep learning-based image rectification. Next, structured medicine facts like the drug name and usage directions are found using natural language processing algorithms. A narrative evaluation of Retrieval-Augmented Generation (RAG) applications in medical AI was carried out by Kohandel Gargari and Habibi [13]. By basing responses on validated external knowledge sources, their work demonstrates how combining information retrieval with big language models increases the reliability of generated medical responses and lessens hallucinatory problems.

Healthcare systems have also extensively investigated multi-agent architectures. By assigning tasks to specialized agents, collaborative agent-based architectures can improve decision-making, diagnosis support, and healthcare data processing, according to Nweke et al.'s systematic evaluation of multi-agent AI systems in healthcare applications [14]. Furthermore, the DLI-IT model, a deep learning method for drug label recognition utilizing image and text embedding techniques, was presented by Liu et al. [15]. Their approach uses text detection, OCR, and semantic embedding to precisely identify and recover medication labels from image inputs. Expanding on these findings, MediLens integrates OCR-based medicine identification, retrieval of verified drug information from trusted biomedical databases, and AI-based conversational assistance within a unified platform. By combining image-based medicine recognition with retrieval-augmented response generation, the proposed system provides users with accurate and accessible drug-related information.

IV. Proposed Solution

To address the challenges associated with accessing reliable and understandable medicine-related information, this paper proposes MediLens, an AI-powered medicine information and assistance platform. The system combines Optical Character Recognition (OCR), information retrieval from trusted biomedical databases, and conversational artificial intelligence to provide users with accurate and easily interpretable drug information.

The primary objective of MediLens is to enable users to identify medicines and obtain verified drug information through both text-based queries and image-based inputs. Users can either enter a medicine name directly or upload an image of a medicine label or prescription. The system extracts relevant text using OCR techniques, which have been widely used in medical document processing and information extraction tasks [12].

Once the medicine name is identified, MediLens retrieves verified drug-related information from trusted biomedical data sources such as PubChem and OpenFDA through secure API-based access. Retrieval-based approaches have been shown to improve the reliability of AI-generated responses by grounding the system in authoritative data sources [13].

To enhance accessibility and usability, the platform incorporates an AI-powered conversational assistant that allows users to ask follow-up questions about medications in natural language. The assistant is powered by a cloud-based Large Language Model (LLM) accessed through API integration. Large language models have demonstrated strong capabilities in natural language understanding and contextual response generation across multiple domains, including healthcare information systems [4], [5].

The architecture of MediLens follows a modular design inspired by multi-agent and retrieval-augmented generation (RAG) systems. In such architectures, specialized components collaborate to perform tasks such as information retrieval, response generation, and verification of outputs [11], [13]. In MediLens, different modules are responsible for OCR processing, information retrieval, response generation, and user interaction, which improves scalability and system maintainability.

By combining OCR-based medicine identification, API-driven biomedical data retrieval, and AI-based conversational assistance, MediLens provides a unified platform for reliable medicine information access. The proposed system reduces reliance on unreliable internet searches and helps users obtain verified drug-related information in a simple and interactive manner.

V. System Architecture

The architecture of MediLens is designed using a modular client–server framework that integrates image processing, information retrieval, and artificial intelligence–based

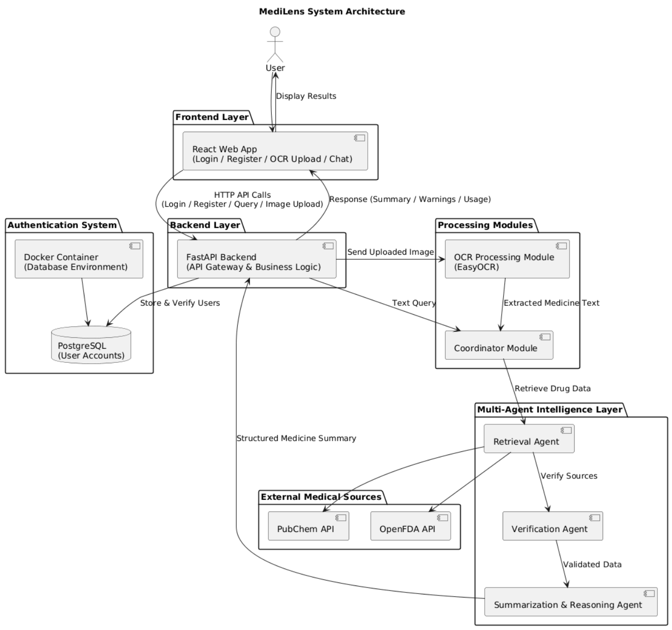

Fig. 1. MediLens High Level Design

response generation. Modular system architectures are commonly adopted in intelligent healthcare applications to improve scalability, maintainability, and integration with external knowledge sources [3], [14]. The overall architecture consists of four major layers: the user interface layer, application layer, service layer, and data layer.

A. User Interface Layer

The user interface layer enables users to interact with the system through an easy-to-use web-based interface. Users have two options: they can submit an image of a prescription or medicine label, or they can enter the name of the medication directly. These inputs are collected by the frontend and sent via RESTful API queries to the backend services. Additionally, the interface presents organized summaries, extracted medication data, and chatbot responses in an approachable manner. Responsive frontend frameworks are frequently used in contemporary web-based healthcare systems to enhance usability and accessibility for non-technical users [9].

B. Application Layer

The FastAPI framework, which acts as the system's central controller, is used to implement the application layer. Incoming user requests are handled by this layer, which also validates input and directs requests to the relevant backend modules. For data retrieval and AI-based processing, FastAPI facilitates effective asynchronous communication between the frontend interface, backend services, and external APIs [7]. Modern AI-enabled applications frequently leverage such API-driven architectures to effectively integrate various services and external data sources.

C. Service Layer

The service layer contains the core intelligence of the MediLens system and consists of several functional modules responsible for processing user inputs and generating responses. These modules collectively enable image-based medicine identification, information retrieval from trusted biomedical databases, and AI-based conversational assistance.

- **OCR Processing Module:** This module processes image inputs uploaded by users and applies Optical Character Recognition (OCR) techniques to extract textual information such as medicine names from drug labels or prescriptions. OCR-based approaches are widely used for extracting structured information from medical documents and medication labels [12], [15].
- **Information Retrieval Module:** Once the medicine name is identified, the system retrieves relevant drug-related information from trusted biomedical databases such as PubChem and OpenFDA through secure API-based access. Retrieval-based approaches improve the reliability of AI-generated responses by grounding them in verified knowledge sources [13].
- **AI Response Generation Module:** This module integrates a cloud-based Large Language Model (LLM) accessed through API calls to generate contextual summaries and answer user queries. The retrieved medical information is combined with the user's query to produce structured responses related to dosage, usage instructions, precautions, and side effects. Large language models have demonstrated strong capabilities in natural language understanding and conversational response generation [4], [5].
- **Query Coordination Module:** The system follows a modular workflow in which different components collaborate to process user queries. This design is inspired by multi-agent architectures used in healthcare systems where specialized modules handle tasks such as retrieval, analysis, and response generation [11], [14].

D. Data Layer

The data layer consists of structured and semi-structured drug information obtained from trusted biomedical databases, along with a relational database used for managing user authentication and application data. A PostgreSQL database is used to securely store user registration details, login credentials, and session-related information. PostgreSQL provides reliable relational data management, ensuring data consistency, security, and efficient query processing.

To support scalable deployment and simplified environment management, the backend services and database components are containerized using Docker. Containerization enables consistent runtime environments, simplifies system deployment, and improves portability across different computing platforms. Integrating verified biomedical databases with a secure user data management layer ensures that MediLens can provide reliable drug information while maintaining secure user authentication and system integrity [2].

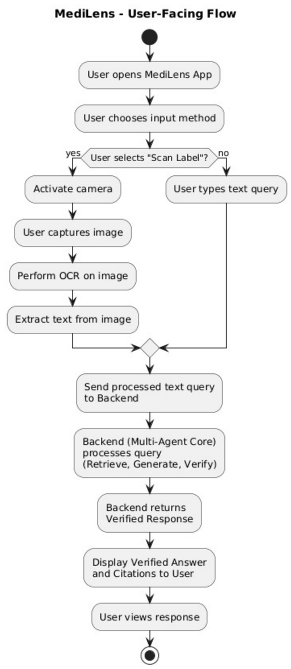

Fig. 2. MediLens Frontend Interaction Flow

E. System Workflow

The workflow of MediLens begins when a user submits either a text query or an image of a medicine label. For image-based inputs, the OCR module extracts the medicine name from the uploaded image. The extracted or typed medicine name is then passed to the retrieval module, which collects relevant drug information from external biomedical databases via API calls. This information is combined with the user's query and processed by the LLM-based response generation module to produce a concise and user-friendly answer. Finally, the generated response is returned to the frontend interface and displayed to the user.

The modular design of MediLens improves scalability, maintainability, and system performance. It also enables future extensions such as multilingual support, voice interaction, and integration with additional healthcare data sources.

VI. Methodology

The MediLens methodology is organized into five distinct stages: data acquisition, preprocessing, intelligent analysis, backend processing, and user interface/response generation. Each stage is designed to operate independently while contributing to a cohesive end-to-end experience [3].

A. Data Acquisition

MediLens is built to handle user input in both textual and visual formats. Text-based inputs include medicine names, symptoms, or general queries entered through the interface. Visual inputs — images of medicine strips, labels, or prescriptions — are captured using any camera-enabled device [6]. This flexibility allows the system to support a wide range

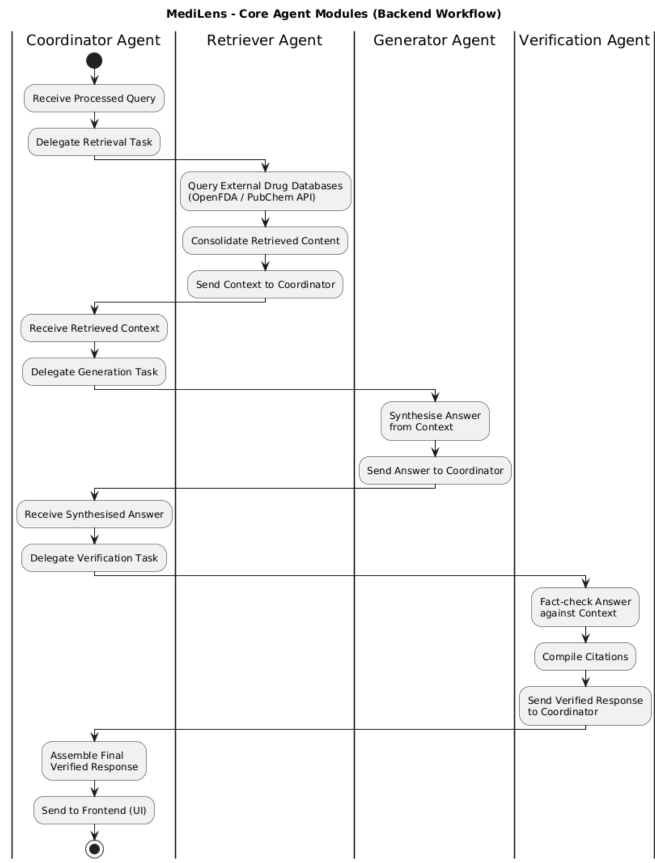

Fig. 3. MediLens Backend Processing Architecture

of real-world usage scenarios, from a caregiver photographing an unfamiliar medication to a patient typing in a question from memory.

B. Preprocessing

For image-based inputs, Optical Character Recognition (OCR) techniques are applied to extract relevant textual information, such as the medicine name, dosage, and manufacturer details [6]. The extracted text is then processed through a pipeline of noise removal, normalization, and tokenization steps to ensure consistency and accuracy before any further analysis. Text-based queries undergo the same standardization at this stage.

C. Intelligent Analysis

The analytical core of MediLens is powered by NLP and AI-based models [4], [5]. Once the input is preprocessed, the system identifies the medicine name and relevant keywords, using these to retrieve contextual medical information from the knowledge base. The AI model then synthesizes this information into a response that is concise, relevant, and appropriately calibrated for a non-specialist audience — avoiding clinical jargon without sacrificing accuracy.

D. Backend Processing

The backend system manages request handling, session tracking, and data retrieval across all interactions. A RESTful API architecture enables smooth, platform-independent communication between the frontend and backend services [7]. Session management ensures that each user's interaction remains personalized and coherent throughout their activity, while the dynamic response generation ensures that outputs are always informed by the latest retrieved context rather than cached or static results.

E. User Interface and Response Generation

The frontend presents processed information in a clear, readable format that prioritizes simplicity and accessibility [9]. Generated responses are deliberately written in plain language — minimal medical jargon, direct answers, and logical structure — so that users without a clinical background can fully understand and act on the information they receive.

F. Security and Reliability

Basic but essential security mechanisms — including controlled API access and session-based validation — are implemented to protect user interactions [7]. The modular design of MediLens also ensures that the system is straightforward to maintain and extend. Planned future features such as multilingual support and voice-based interaction can be incorporated without requiring fundamental changes to the existing architecture.

VII. Technologies Used

MediLens is built on a carefully selected stack of modern web technologies, backend frameworks, and AI tools — each chosen to optimize for accuracy, scalability, and usability.

A. Frontend Technologies

The user interface is developed using **React.js**, which enables the creation of a dynamic, responsive single-page application [9]. React's component-based architecture supports modular development of distinct features — medicine search, summary display, chatbot interaction — while keeping the codebase clean and maintainable. **HTML5** and **CSS3** are used for structure and styling, producing a clean, accessible layout across devices.

B. Containerization and Database

MediLens uses PostgreSQL as the primary relational database for managing user authentication data, including account registration and login credentials. PostgreSQL provides reliable data storage, transaction management, and secure access control mechanisms for user-related information.

To simplify system deployment and ensure consistent runtime environments, Docker is used to containerize the backend services and database components. Containerization allows the system to be easily deployed across different environments while maintaining dependency consistency and improving scalability.

C. Backend Technologies

The backend is implemented using **FastAPI**, a high-performance Python framework valued for its speed, simplicity, and first-class support for RESTful APIs [7]. The built-in Swagger UI documentation makes the API transparent and easy to test. FastAPI handles all medicine search requests, summary generation logic, and chatbot interactions with minimal overhead.

D. Artificial Intelligence and Language Models

MediLens integrates an LLM to generate concise medicine summaries and provide intelligent chatbot responses [5]. The model processes contextual medical information alongside user queries to produce accurate, human-like answers. Prompt engineering techniques are carefully applied to maintain medical relevance, guard against hallucination, and ensure that responses are appropriately scoped for an informational — rather than diagnostic — purpose [4].

E. API Communication

Communication between the frontend and backend is handled through **RESTful APIs** over HTTP, with JSON as the data exchange format [7]. This standard approach ensures seamless integration between system components and broad platform independence.

F. Development and Deployment Tools

The project is developed using Python for backend logic and JavaScript for frontend functionality. Version control is managed through Git. Local development and testing are conducted using Uvicorn as the ASGI server. CORS is configured to allow secure communication between the frontend and backend services.

G. System Environment

MediLens is designed to run on standard operating systems with minimal hardware requirements. The modular architecture allows easy future enhancements such as database integration, cloud deployment, and mobile application support.

VIII. Results and Discussion

MediLens was evaluated across its core functional modules to assess its effectiveness in delivering accurate, accessible, and user-friendly medicine information. Taken together, the results indicate that the system successfully meets its primary objectives.

A. Functional Evaluation

To provide a preliminary quantitative evaluation, MediLens was tested across multiple modules using a small dataset of medicine label images and user queries. The OCR module achieved an average text extraction accuracy of approximately 80% across 50 medicine label images captured under varying lighting and orientation conditions. Chatbot response correctness was evaluated by comparing generated responses with verified drug information from FDA and PubChem sources, achieving an accuracy of approximately 82% across common medicine-related queries. Due to API communication and language model processing overhead, the average system response latency was approximately 4.8 seconds per query, with observed response times ranging between 3.2 and 6.1 seconds. These results represent preliminary experimental observations intended to evaluate system functionality and performance under typical usage conditions.

B. User Interaction and Usability

From a usability standpoint, MediLens delivered on its promise of accessibility. The interface allowed users to search for medicines and pose follow-up questions without navigating complex menus or requiring prior medical literacy [9]. The conversational format encouraged natural engagement, and the structured presentation of information meaningfully reduced the confusion commonly associated with unstructured web searches. Error handling was also robust, with graceful recovery from invalid inputs and server-side issues.

C. Accuracy and Reliability

Response accuracy was assessed by comparing system outputs against standard medicine information sources, including those provided by the FDA [2]. Generated summaries and chatbot responses were largely consistent with trusted references, demonstrating reliable performance across common medications. It is important to note, however, that MediLens is explicitly designed as an informational tool — it is intended to complement, not replace, professional medical advice.

D. Limitations and Observations

Despite its strengths, the system carries certain limitations. The quality of responses is inherently tied to the underlying data sources and the language model's interpretive capabilities [5]. In edge cases — particularly complex or rare medical conditions — responses may lack the specificity that a clinical resource would provide. The system also does not currently incorporate personalization based on individual user medical history, which limits its utility for users managing multiple chronic conditions.

E. Discussion

Overall, MediLens demonstrates that AI-driven assistance systems can meaningfully bridge the gap between complex medical data and everyday user comprehension [3], [10]. The combination of search-based summarization and conversational AI creates a more engaging and actionable experience than either approach alone. The modular architecture also positions the system well for future enhancements — multilingual support, personalized recommendations, and integration with electronic health records are all tractable extensions of the existing foundation [4]. When used responsibly, tools like MediLens have genuine potential to support informed decision-making and promote safer medicine usage across a broad population.

IX. Future Work

While MediLens already provides a reliable and user-friendly platform for medicine information, several enhancements are envisioned to further expand its reach and effectiveness. The most immediate planned enhancement is the full integration of OCR to allow users to scan medicine strips or prescriptions directly using a mobile device [6]. This would enable automatic extraction of medicine names and dosage information, reducing manual input burden and substantially improving the experience for elderly users or those managing multiple medications. Multilingual support is another high-priority direction [4]. By enabling responses across multiple regional and international languages, MediLens can extend its benefits to users who currently face language barriers when accessing health information — a particularly important consideration given the diversity of the global patient population. The system could also be significantly strengthened by integrating real-time drug interaction and allergy detection mechanisms [2]. Allowing users to input multiple medications or health conditions, and then receive safety alerts and precautionary guidance, would represent a meaningful step toward proactive — rather than reactive — health support. Looking further ahead, the introduction of personalized user profiles drawing on medical history could enable tailored recommendations and medication reminders. Deploying MediLens as a fully functional mobile application backed by cloud infrastructure would improve scalability, performance, and availability [3]. Finally, formal collaboration with verified medical databases and healthcare professionals would further strengthen the credibility and comprehensiveness of the information the system provides.

X. Conclusion

MediLens represents a practical and thoughtfully designed application of artificial intelligence to one of healthcare's most persistent everyday challenges: helping people understand the medicines they take [1], [3]. By combining a robust medicine search module with an AI-driven conversational assistant, the system delivers accurate, simplified, and interactive drug-related information through an interface accessible to users of any technical background.

The system successfully addresses the fragmentation, inaccessibility, and complexity that characterize much of today's public-facing medical information landscape [10]. Experimental evaluation and system testing indicate that MediLens delivers accurate responses with acceptable latency, while its modular architecture ensures the system can grow and adapt as user needs evolve.

More broadly, MediLens illustrates what is possible when AI is applied with a user-centered mindset and a genuine commitment to public benefit [5]. With continued development — including multilingual capabilities, personalized features, and integration with authoritative medical databases — MediLens has the potential to evolve into a comprehensive digital healthcare companion, one that enhances patient awareness, reduces

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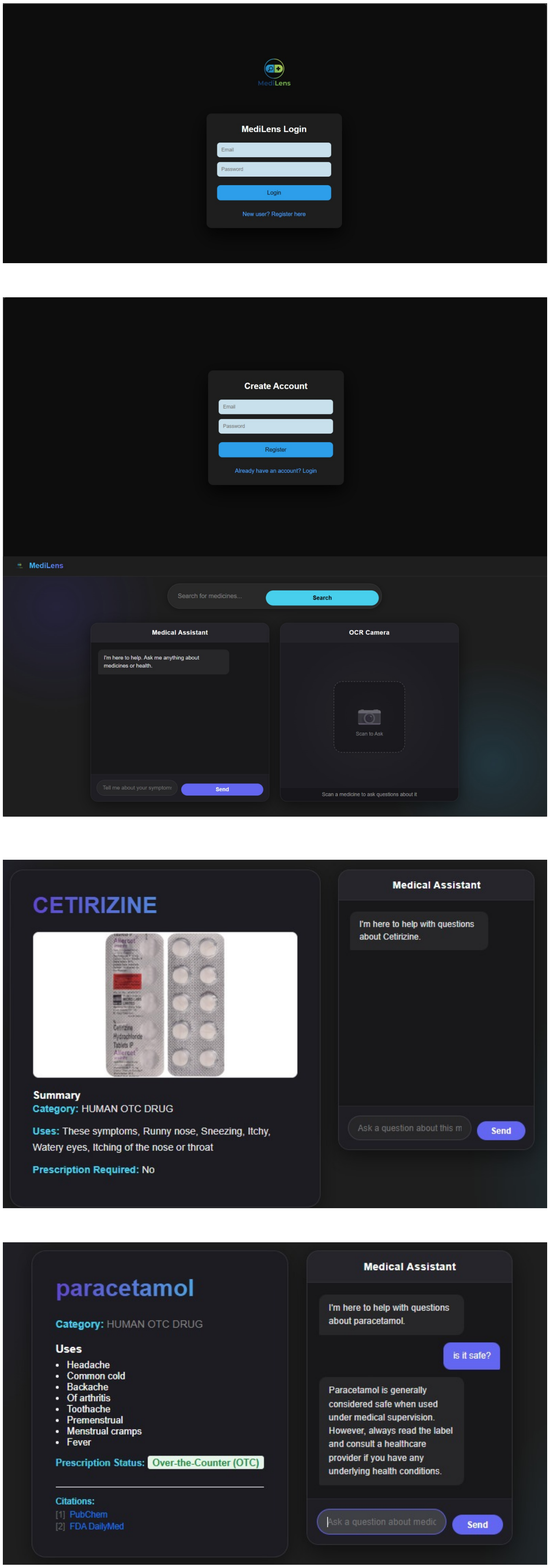

Fig. 4. MediLens user interface outputs.

medication errors, and supports more confident and informed health decisions for people everywhere [2], [4].

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