AI Rx: Where Pill Identification Meets AI

Team Members & Contact Information

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Problem Statement

Our goal is to develop an application that can analyze a pill image, identify its imprint, color, and potentially shape, then integrate this with user-provided information to accurately determine the medication and provide relevant reference details. We shall limit the use case of this application to FDA approved drugs, as most FDA-approved oral pharmaceutical pills are required to have an imprint.

The goal is to use these details to then correctly identify what the pill is. For example, a picture of a Benadryl pill should detect the imprint "B," the color "pink" and the shape "oval" - based on these 3 details, it should clearly identify the pill as "Benadryl".

The current leading solution, Smart Pill ID, performs well in detecting basic pill attributes such as the imprint and color. For example, when uploading an image of a pill with the imprint "B" and the color "pink," the app correctly identifies these characteristics. However, it often provides incorrect suggestions for the pill's identity. This issue persists with multiple pills—while the app accurately detects key features like imprint and color, it consistently fails to offer the correct identification. In contrast, simple web searches or databases like drugs.com typically provide the correct result when using the same imprint and color information. Our app aims to resolve this problem by improving accuracy in pill identification based on the detected attributes.

In addition, we are considering embellishing our application with further features, that the current solution doesn't have. The options we are considering include pharmacogenomics and/or a chatbot that can tell you more about the pill that was identified. However, as we are a team of 2, we may choose to focus on the primary feature of pill identification. With Shuo's background in bioinformatics, and my background in Data Science & DevOps, this project aligns well with our interest in pharmaceuticals.

Data Sources

Source, Description and possible Quality Concerns: The primary data will be thousands of high-quality, labeled images of pills with imprints collected from drugs.com. We are not concerned about the quality of these images, but if we chose to incorporate further pill images from search engines etc., we may face quality issues – that's an issue that we'll have to weigh against the benefits of having a larger dataset for fine-tuning purposes. Example - Benadryl: https://www.drugs.com/imprints.php?drugname=Benadryl

Minimum Components for a Good Project

Large Data: Collection and utilization of large and diverse sets of data of labeled images (and potentially also unlabeled images) of FDA-approved oral pharmaceutical pills. If we chose to incorporate pharmacogenomics as well, this would involve storing and parsing quite large 23andme raw data, and cross checking their genomic information against the PGKM database, which specifies potential side-effects for known pharmaceutical-genetic connections.

Scalability: The app will be able to handle multiple users querying the computer vision model and chatbot simultaneously.

Complex Models: Use of deep learning-based computer vision models for accurate species identification. We plan to fine-tune a CNN base model, such as ResNet.

Computationally Expensive Inference: Implementation of efficient algorithms to minimize latency during pharmaceutical pill identification.
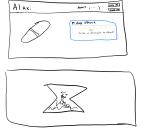
Objectives

1. Fine-tune a CNN base model (like ResNet) to better identify the imprint, color, and potentially the shape of the pill from an image.

2. Accurately identify the pill based on the detected imprint, color, and shape, addressing the current issue of incorrect suggestions in existing solutions like Smart Pill ID.
3. Implement a scalable backend to handle multiple users querying the pill identification model simultaneously.
4. Integrate additional features such as pharmacogenomics, which may highlight if someone is likely to experience an adverse effect based on ab uploaded 23andMe raw report that a user may optionally upload) and/or a chatbot to provide more information about the identified pill.

Learning Emphasis

The project will focus on building a deep learning model fine-tuned for drug image recognition, potentially alongside an integrated chatbot trained on biomedical literature, both areas covered in the course.

Application Mock Design

Upload Section: A prominent button allowing users to take or upload a picture of the pill.

Window for Identified Pill: Once the picture is processed, the app will display a window showing the name of the identified pill, along with more information.

Dialogue box: Where users can provide additional information (such as symptoms) or ask related pharmacological questions.

Research and Development

We will review literature and open-source projects related to computer vision in object identification and natural language processing for educational chatbots in the healthcare domain. Reference Paper "**CNN-Based Pill Image Recognition for Retrieval Systems**" **(18 April 2023)**

Fun Factor

The fun in identifying medications under different conditions lies in refining the model through symptom descriptions to make accurate judgments. It's exciting to explore the connections between drugs and diseases while using AI to solve real-world problems. Plus, knowing this project can help prevent medication errors makes the work even more fulfilling.

Limitations and Risks

Gathering data with high quality and suitable for drug related knowledge is challenging. The project may also encounter ethical issues, such as ensuring patient privacy when handling sensitive health data, avoiding bias in the dataset that could lead to misidentification of pills.

Milestones

Milestone 1: Research & Data Collection
Milestone 2: Model Development for computer vision
Milestone 3: Backend Development
Milestone 4: Frontend Development
Milestone 5: Testing & Optimization (including LLM finetuning)
Milestone 6: Final Testing & Documentation