IdentifyRX

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Afsheen mellonbrook@gmail.com
George Moomau gmoomau@umd.edu
Gibran Ali gali@umd.edu
Ryan Workman rworkman@umd.edu
Sina Iman sina.iman@gmail.com

Abstract
The IdentifyRX project is an iPad app that helps people figure out the names of medications they are taking, and compile a list of the drugs. The app is for people who know some information about the drugs they take, such as what the drug is for or what it looks like, without knowing the drug names themselves. IdentifyRX is intended for use in a hospital setting. In designing and building this app, we seek to provide an intuitive way to navigate through a large database of pill images and information. The drug images can be filtered by distinguishing criteria, and also searched for by name. More features would be added in later versions, such as searching by pill imprints. User testing of the original high-fidelity prototype is complete, which has resulted in revisions for the latest version.

Keywords
Prescription drug database, pill image search, medication list, visual pill identification.

Credits
Afsheen: Lo-fi prototype mockup, some usability testing, task list/questionaires.
George: Medication list, search bar, some usability testing, and contributions to the design.
Gibran: Lo-fi prototype mockup, image functionality, usability testing, research, final report.
Ryan: Naming of the app, lo-fi prototype mockup, early version of layout (in HTML/CSS), some usability testing, and contributions to the design.
Sina: All of the database and back-end work, majority of the coding overall

Introduction
A challenge for hospitals is knowing any one particular patient’s current drug prescriptions. Considering that one patient’s prescription information may be distributed among a vast, discrete set of pharmacies, compiling this information would be a huge undertaking for any hospital. Because of this challenge, most medical facilities collect a patient’s drug information on paper, manually creating a list of drugs he or she takes. A problem with this approach is that patients will often forget the name of certain drugs they take, which at best wastes hospital resources while a nurse helps the patient identify a pill, and at worst puts the patient at risk for being administered a drug with unintended drug interactions.

IdentifyRX is a solution that allows patients to efficiently and reliably create a list of drugs they take by using visual cues. IdentifyRX is different from other pill identifier applications because it doesn’t expect the user to know the name of the drug, instead IdentifyRX categorizes drugs based on layman terms such as “heart medication” or “anti-depressant”, along with the shape, color, and dosage of the pill to allow patients to narrow the list of possibilities. There are many drugs out there with similar shapes and colors, but by allowing filtering by category, along with an intuitive touch-based image navigation, patients can more readily identify correct medications.

IdentifyRX is primarily intended for use in hospital triage systems in the United States. When admitted to a hospital, there is often some “lag-time” before a patient sees a nurse or doctor. During this waiting period the triage nurse could give the patient IdentifyRX, allowing for the patient’s nurse or doctor to be aware of drug interaction possibilities before even speaking to the patient.

A challenge with IdentifyRX is the variable age distribution of its intended users, ranging from young to very old. Common problems with the 65+ demographic include inhibition to using information technology and physical handicaps such as low-
vision or restricted motion. IdentifyRX is designed with universal accessibility in mind.

Previous Works

Elderly patients may have every intention of following medical advice, but physical and cognitive decline, as a result of aging or illness can, adversely affect medication regimens (Logue 2002). Logue notes that memory deficit is one of the most common causes of medication misuse, and can result in double-dosing, forgetting to take pills, or changing the medication schedule. IdentifyRX helps solve this inconvenience by helping elderly patients identify the drugs that they cannot recall from memory. Loss of vision of manual dexterity may also affect medication use, particularly where patients are unable to read instructions, to open and close bottles, or simply hold onto pills without dropping them.

When seniors were experimented with text and multimedia, a study found out that multimedia gave better results in measures of both performance and preference (Ogozalek 1994). The participants of the study preferred video to both online and printed text, suggesting that reducing the amount of required reading and typing can make information more accessible for the elderly. IdentifyRX expands on this concept by integrating a speech recognition engine into the drug identification platform, making it possible for the elderly to identify drugs and find drug related information using voice commands rather than typing.

A tool similar to IdentifyRX, known as the RxList Pill Identification Tool, helps in quickly identifying drugs and medications. An accurate drug identification requires the user to either enter the imprint code, select the color of the pill or select the shape of the pill. The tool then identifies the drug and provides the user with a detailed description and the picture of the drug. This technique may generate thousands of drugs for the user to choose from. IdentifyRx solves this problem by filtering drugs by therapeutic indication, and sorting the drugs based on commonness and/or popularity. Furthermore, IdentifyRx uses speech recognition for easier drug identification. In addition to the RxList Pill Identification Tool, Drug.com’s Pill Identification Wizard allows users to match size, shape, color, etc. of the drug and then leads the users to find the detailed description in the drugs database. The Pill Identification Wizard works the same way as the RxList Pill Identification Tool. Users are provided with an image of the drug and basic drug information.

The authors and researchers, namely Stan Ruecker, Lisa Given, Heather Simpson, Bess Sadler and Andrea Ruskin, carried out a project to see if an alternative visual browsing interface, showing photographs of 1000 pills, could be useful for seniors interested in pill identification. Usefulness in this case involved a number of factors, ranging from basic question of whether 1000 photos would simply be overwhelming; to concerns about the best methods for providing tools to manipulate the display, down to detailed questions about specific design choices relating to contrast, legibility and control size (Ruecker et al. 2007). The images could be magnified and also clustered by participants based on similarity in two visual dimensions: color and shape.

IdentifyRX is based on an image based retrieval interface for drug information. In a study focusing on usability of such interfaces for seniors, Qualitative, task-based interviews examined participants’ health information behaviors and documented search strategies using an existing database (www.drugs.com) and a new prototype that uses similarity-based clustering of pill images for retrieval. Twelve participants (aged 65 and older), reflecting a diversity of backgrounds and experience with Web-based resources, located pill information using the interfaces and discussed navigational and other search preferences (Given et al. 2007). Findings point to design features (e.g., image enlargement) that meet seniors’ needs in the context of other health-related information-seeking strategies (e.g., contacting pharmacists).

Much of IdentifyRX’s functionality is dependent upon retrieving pictures of drugs from a huge database and displaying them to the user. The basic functionality of IdentifyRX is similar to PhotoMesa, an image browser. PhotoMesa allows the user to view multiple directories of images in a zoomable environment, and uses a set of simple navigation mechanisms to move through the space of images. It also supports grouping of images by metadata available from the file system (Bederson 2001). It requires only a set of images on disk, and does not require the user to add any metadata, or manipulate the images at all before browsing, thus making it easy to get started with existing images. Some of Bederson’s ideas have also been used in tools such as the color picker by Bumgardner. Such tools are used when generating images for drugs and medications in a drug identification system. In addition to this, IdentifyRX also makes it possible to filter images based on color. A similar functionality can be found in the Colr Pickr user interface designed by Bumgardner for Flickr. Colr Pickr is a user interface for searching large quantities of photos by color. It
also creates fascinating collages by arranging the photos by luminance, saturation or hue (Bumgardner 2005).

Presentation of Design

In order to make it easier for hospital patients to create a list of their medications, we developed an application for the iPad. Our application presents the users with large images of different medications and a variety of ways to locate the ones that they are taking. Users can filter through medications by name, category, color, or shape. These filters allow the user to quickly narrow down a field of thousands of different medications to a smaller and more manageable 5-20. From there the user can identify their pill on sight and add it to their medication list. The medication list and filter selections are always visible on-screen, allowing users to focus on remembering their medications.

The transition diagram (Fig. 1a) shows that the user is never more than one screen away from the main screen, reducing short term memory load.

Figure 1b shows the main screen. In the center of the screen there are images of different pills, arranged alphabetically. At the top are the search bar and filters. To the right is the medication list with two medications added. They can easily be removed by pressing the X in the top right if they were added to the list in error.

Figure 1c shows the drug information screen. Upon tapping on the image of a drug, the user is brought to the Drug Information screen. It contains details about the selected drug and buttons for adding to the medication list or returning to the main screen.

The search bar (Fig. 1d) auto-completes drug names as the user types, reducing typing mistakes and increasing typing speed.

All of the filters (Fig. 1e) display possible choices for that filter. Figure 1e show that the Shapes filter has not been used, the Colors filter has already been set to “Yellow” and the Drug Categories filter is open. Upon selecting a drug category, the array of images in the center of the screen will update to reflect the selection.

Report on Development Process

In order to implement the mockup, and turn it into the actual high-fidelity prototype app (Fig. 2), we divided the work up. First we made a HTML/CSS skeleton page, consisting of containers to hold each section of the app. The original skeleton HTML page was closer to the mockup, but then as we worked toward implementing the functionality of the app, it inevitably changed and evolved. We took performance into consideration, which influenced how we manipulate the DOM by adding the pill images, and ultimately manifest in the appearance of the latest version of the UI. We left most of the heavy-duty computations on the back-end server side, and likewise we try to load and display the images and deal with scrolling in an efficient manor. Each group member worked on different parts of the front-end, and collaborated using the Git version control system. We had prepared the usability test and questionnaires in advance, and when the high-fidelity prototype was stable enough to test with human subjects, we began testing.

The user testing went well, and several problems with our interface were exposed. We tested the interface with 6 human test subjects. Most of the test subjects were University students, or around that age-group. Each person had varying degrees of difficulty in completing each of the tasks, though certain trends are evident across them all. For the first task, the search bar was not instantly noticed by every subject, which we have attempted to improve upon by using a more tradition top-right positioning rather than being centered. Some users had difficulty with the second task: adding the pill to the medication list. We have attempted to alleviate this problem through the addition of “add pill” icons and also changing the app's behavior upon tapping a pill image; it will now display a popup with more info about the pill and an option to add from there as well. This improvement is closer to the lo-fidelity mockup that we originally designed, which we did not have a chance to fully implement for the hi-fidelity prototype. Other users had problems with the third task: finding a white, round, acne pill. Once again, we deviated from the mockup design during our implementation time, and placed the bar of buttons for filtering at the bottom of the screen. Our testing indicates that keeping these buttons near the search bar, just below the app’s logo, would make them noticeable and would improve usability. The fourth task was essentially a repeat of the second task, so the users generally had no trouble with that. The final task, of removing the pills from the medication list, was also completed without difficulty by each user. Some improvements that
Fig. 1a: Transition Diagram

Fig. 1b: Main Screen
Fig. 1c: Drug Information Screen

Fig. 1d: Search Bar
Fig. 1e: Filters

Fig. 2: Low Fidelity Prototype
came about during the testing, in addition to those explained above, include adding a “Medication List” label to clarify what that section of the screen is for, as well as making the names of drugs appear nearby the pill images. Despite some difficulties encountered in the tests, the interface for navigating through the database of pills was well-received by the test subjects. The users made various comments about the app having a professional look, and impressive functionality which addresses a real need for patients, doctors, or hospitals.

Conclusions

The final application provides all the necessary features with its interface design for users to seamlessly search for/identify medications. The application features several options for users to successfully execute their searches. Users have the option to search for medications with voice or manual text input. Users also have the option to use an auto-complete feature when manually searching using the application search bar. If the user chooses not to use the direct search options provided, the user also has the choice to use the applications filter features to search the medication database with a combination of queries. Those queries include Medication Shape, Color, and Purpose. Once the user has identified a medication they have the option to save/add that medication to the applications Medication list. The user then has the option to remove any medications unintentionally added. The application has been built for use with the Apple iPad and takes advantage of the touchscreen capabilities of this device. Users can scroll through the database of pills by sliding their fingers across the touch sensitive device.

However, there is room to improve the application. The current database of medications is currently limited. Access to a more complete database will enhance the overall user experience. The addition of more filter options, such as searching by medication imprints, will also provide a faster and easier search experience for users. Also, implementing the application to be compatible with other devices such as Android and desktop PCs will broaden the accessibility of the application.

There are many opportunities for future developers who are interested in pursuing tablet applications to improve patient experience at hospitals. It is highly recommended that developers acquaint themselves with health professionals for ideas and suggestions when interested in developing similar health applications. It is also important when designing a application to test it with a wide range of users for feedback. Equally as important, developers should make good use of the 8 golden rules of design and to always have the target audience of the application in mind throughout the applications development.

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References


Bumgardner, J. 2005. Flickr Colour Fields Experimental Colr Pickr


IdentifyRX Pre-Test Questionnaire

The following questions are to help the designers of IdentifyRx in refining their User Interface. These are general questions about your background. You will not be asked any personal identifying questions.

What is your gender?
- Male
- Female

What is your age?

Do you own a tablet computer or touch screen device? If so, for how long have you owned this device?

If you answered no to the question above, then have you ever used a touch screen device?

If you have had experience with a touch screen device, what features did you like? and what features did you dislike?
IdentifyRx: Post-test

On average, how much effort did finding a certain pill take?

| Minimal Effort | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Maximum Effort |

Of the following controls, which did you tend to use the least, or not at all?

- Touch scrolling
- Alphabetical sorting
- Popularity sorting
- Filter by category
- Filter by shape
- Filter by dosage
- Filter by color
- Search bar

How helpful were the pill images in helping you find the right pill?

| Not helpful | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Very helpful |

Would you recommend that IdentifyRx be deployed to hospitals to help people identify their medications while they’re in the waiting room? Why or why not?

[Blank space for answer]
Task List

The Scenario:
You are visiting a new doctor, and you are handed a clipboard with a form to fill out. The form asks for a list of current medications you are taking. You will use the IdentifyRX app to create a list.

The Tasks:
Remember that it is not you, but the interface, that is being tested. Please complete the following tasks.

1. Find an image of Advil PM.
2. Add it to your med list.
3. Find a white, round, acne pill.
4. Add it to your med list.
5. Remove both of the medications from your med list.