Undergraduate Experience Developing a Medication Reminder App

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Abstract – This paper describes the process of implementing and testing a taking medication reminder app. The medication app utilizes a simple interface that is easy for the audience, mostly of elderly. Functions to enter and change medications are easy and quick to use. This project was completed for an undergraduate Human Computer Interaction course taught at our institution. The student had around one month to design, implement and evaluate the system.

Keywords: medication app, reminder

1 Introductions

Not taking medication when scheduled reduces the effectiveness of a treatment and imposes a financial burden on health care systems [2][11]. In the USA alone, it is estimated that $100 billion each year is spent including the cost of hospital and nursing home admissions [9]. Even motivated people can forget which results in unintentional non-adherence [8]. For example, around one million unwanted pregnancies each year results from nonadherence [6] and forgetfulness [3][7]. One trend focuses on reminders, which alerts people to take their medication at a specified time [1][10]. However, it is important to understand that time-based tasks are more difficult to remember than tasks related to routine actions [5] and that medication regimens can be easily incorporated into a daily routine. This support can be provided by technology. With the increasing popularity of smartphones, people now have access to thousands of health-related applications ("apps") [4] that could help them remember their medication.

2 Analysis and Design

In an undergraduate human computer interaction course, the student developed an app that reminds users, mostly elderly, to take their medications. The medication app should utilize a simple interface that is easy for the audience to navigate and use. Functions to enter and change medications should be quick to use.

Examples of usability goals are:
• The medication app should include functions to store a medication name, dosage, and time to take medication.
• Functions of the buttons on the medication app should be obvious to the user.
• The buttons on the medication app should only require one click to activate functions.
• Movement between functions on the medication app should flow logically (i.e., buttons should be arranged, based on a logical order of medication app functions)

Examples of use experience goals are:
• The medication app should not frustrate the user.
• The medication app should not illicit a negative response from utilizing it (for instance, make the user feel stupid or patronized by the app).

With regard to the Conceptual Model, the medication reminder app is like a specialized digital planner (specialized to track medication only). Dates for medications could be arranged in a calendar-like format, with medications displayed for certain times for certain days on the calendar. Clicking on a certain day would display the times of all medications needed to be taken on that day. The system checks the times entered for the current day using the device’s timer. If the times match, the medication reminder app displays a reminder to the user (either for each medication at that time or one reminder for all medications needed to be taken at one time). Times for medications entered into the app would be organized by day rather than month (the interface would show all the medications for a particular day instead of a particular month).

3 Implementation

3.1. Consider interface design issues
The app needs to maintain access to the device’s timer. Therefore, it will be running at all times in the background. In addition, to make the app effective, it should be installed on a device that the user will be using frequently. Therefore, the ideal interface involves the use of the Mobile and Multimedia interface types. While WIMP can be used, this type suggests that the device would be a desktop or laptop computer, which may not be as readily accessible as a mobile device.

3.2. Implementation related issues

The system is implemented using C#. Rather than storing dosage as mg (text input), it was stored as number of pills to avoid confusion and mistakes. The app will only show the medications that are currently being taken although more medications are stored.

4 Evaluation and results

4.1. Determine evaluation goals

The focus of the evaluation is to determine the medication app’s ease of use. The goals of the evaluation are the following:

- Find out whether medications in the medication app can be entered, modified, removed, and used easily by the users.
- Find out whether the functions of the medication app are easily understood from the interface.
- The evaluation should assess the overall usability of the medication app.

4.2. Explore the questions

From evaluation goals, the following questions can be derived:

- Does the user understand what a function will do just from reading button names?
- Does the user have any difficulties with the processes of entering, modifying, or removing a medication?
- Does the app prevent duplicate entries or otherwise invalid entries?
- Does the app update to the next time correctly after taking medication?
- Is the correct information displayed?

4.3. Choose the evaluation method

The evaluation method appropriate for the goals and questions listed above would be a usability test. Evaluation methods used will be observation (to test if the functions are usable and easy to understand), interview (to obtain information about specific problems that participants noticed), and questionnaire (to obtain quantitative data about the effectiveness of the medication app and get the general consensus on app effectiveness).

For observation tasks,

- The participant will enter a medication approximately 2 minutes after the current time.
- The participant will modify the added medication to change the dosage to 2 pills instead of 1.
- The participant will click on the ‘taken medication’ button for the modified medication.
- The participant will add another medication and then remove it.

With regard to the interview component,

- The participant will be asked to offer any recommendations to improve the app.

For the questionnaire component,

- The participant will select his/her age group, gender, and whether the participant has used a medication reminder app before.
- The participant will assess the ease of understanding the different interfaces (main interface, add medication interface, modify medication interface), selecting one option out of five (strongly disagree, disagree, in between, agree, strongly agree).
- The participant will assess the functions of the medication app for ease of use and understanding, selecting one option out of five (strongly disagree, disagree, in between, agree, strongly agree).

4.4. Identify the practical issues

Practical issues with the evaluation mainly involve the time allowed for the evaluation and the ideal participants for this type of evaluation. The app mainly focuses on the elderly as the primary audience. However, with only a week to conduct the evaluation, participants will not be limited to the elderly for the study. Additionally, an ‘in the wild’ evaluation method would have been unrealistic to implement. Therefore, the evaluation will have to be conducted in a controlled environment.

4.5. Decide how to deal with ethical issues

The main ethical issue is related to ensuring that the data collected could identify participants and jeopardize their careers. If the information collected could identify a participant, an informed consent form is completed before we can conduct the evaluation legally. However, the data collected from the observation (mainly, if the participant encountered problems), interview (mainly, recommendations to improve the medication app), and
questionnaire (age group, gender, experience with medication reminder apps, etc.) does not identify a participant. Therefore, an informed consent form is not required for this particular evaluation. The ethical issue is dealt with by ensuring that collected information cannot be used to identify a participant. In addition, to avoid the problem of damaging someone’s device, testing will be performed using the developers’ own device.

4.6. Running the system

Figures 1, 2, and 3 show screen shots of the interface of the app. In the main form (interface), the list of medications is displayed in a text box. Four buttons are available for adding a medication, modifying a medication, removing a medication and “I have taken this medication”. In the add medication form (interface) the user will enter the name of medication, number of pills, how many times, start date and start time. Once finished, the user can submit the changes or cancel. The start date is in calendar format where the user can select the day, date and year.

4.7. Evaluate the collected data

The participants varied widely by age group, and were evenly distributed by gender. The data obtained from the evaluation relates to the usability of the app such as problems with reading text on the app or functions not working as intended, and all data collected points to the goals of the evaluation. Therefore, the evaluation method seems to be valid.

As the environment used was the evaluator’s computer in a controlled setting, this method does have low ecological validity.

The evaluator was in charge of recording problems that users experienced with the medication app, so there may be some bias in the data collected through this evaluation method.

The scope of the evaluation was concerned with the usability of the app, in terms of its interfaces and functions.

4.8. Analyze the data

Most of the ratings for the interfaces and functions were in the ‘Strongly Agree’ category for ease of use and understanding, so, despite glitches with certain functions and issues with reading text, the medication app is generally easy to use and understand. These ratings do not seem to be skewed by gender, as the participants were evenly distributed by gender. The participants were somewhat weighted in the 20-30 age group and elderly age groups (60-70 and 70+). However, the distribution is even overall.

Problems observed by the participants include: time glitch in the ‘Modify Medication’ function, font size being too small for particular portions of the app, notification message too large for high numbers of
medications, list update function interfering with other functions on the app, etc. However, the most consistently noticed problem was the aforementioned time glitch. This suggests that the time glitch could cause considerable losses in usability (one participant even pointed out that it was not easily noticeable) and should be resolved (high priority).

4.9. Interpret the data

Judging from the high concentration of results in the positive categories for interface and functions being easy to use and understand, the medication app is, overall, easy to use and understand. However, participants have also noted problems with the app itself (like the time glitch, small font size, list update function interfering with other functions, etc.). The problems observed, apart from the time glitch and list update function overriding other functions, could be resolved with little modification to the code. Most errors within the program seemed to be minor and did not seriously detract from the usability of the app. While the problems certainly need to be fixed, the medication app still seems to retain the impression that it is easy to use and understand.

4.10. Present the data

The age groups of the participants varied widely: three participants were in the 20-30 group, one participant was in the 30-40 group, one participant was in the 40-50 group, one participant was in the 50-60 group, two participants were in the 60-70 group, and two participants were in the 70+ group. Given that the interfaces and functions generally received positive ratings for ease of use and understanding, this suggests that the medication app is easy to use, virtually regardless of age group. Genders were split evenly with collected data (five males, five females), suggesting that gender does not impact understanding how to use the medication app.

Ten subjects were asked to participate in evaluating the system. The following is a summary to the observation component of collecting the data:

- The participant added a medication for the next day and noticed that the medication was not displayed. As the app was supposed to show medications to take in the current day, this was normal.
- When the participant changed the time of the medication in the ‘Modify Medication’ function, the time moved to the next day, even though the current day would have been valid (this is not normal behavior).
- The participant noticed that the ‘Remove Medication’ function prompts the user before removing a medication.
- The participant kept pressing ‘Delete’ to “remove” the incorrect elements of the time and add the correct elements of the time. Deleting was not necessary.
- The participant noticed that the time moved to the next day when modified (when it should not have and asked why the app did that.
- The participant had minor difficulties reading the text in many parts of the interface, including elements of the “list of medications to take today” and the text box that displays messages to the user.
- The participant noticed the aforementioned time glitch noticed by the other two participants.
- The participant noticed that the function sometimes did not activate when selected and was confused. After explaining that the function did not run because the list was updating the time until time to take, the user wondered if this feature in the list is necessary.
- The participant noticed that the app did not notify the user when a particular medication was supposed to be taken. After being told that the app was not running at the time and, thus, could not notify the user to take a medication, the participant wondered why the app had to be running at all times to function properly.
- The participant entered multiple medications with the same time to take. When the time to take arrived, the participant noticed that the notification message sent seemed excessively long (10+ medications being displayed one by one).
- The participant noticed the time glitch in the ‘Modify Medication’ function and suggested that the function should be fixed, so the glitch does not occur (could easily be missed, resulting in the app tracking the medication tomorrow instead of today).
- The participant understood why the app only showed the medications for the current day, but noted that, if an incorrect medication was entered for a different day than the current day, it couldn’t be removed until that day.
- The participant liked that the time “until time to take medication” was displayed, but wondered why clicking on a function button did not always call the function.
- The participant had some difficulty reading the text within the medication list.

The following is a summary to the interview component of collecting the data:

- The participant suggested including an additional list that shows all of the medications added into the medication app.
- The participant suggested adding decimal dosages (adding dosages by 0.25 of a pill and incrementing by 0.25 when increasing dose).
- The participant suggested adding a list that showed all the medications that a user has taken in the current day.
• Several participants noted a glitch in the Modify Medication function where the time moved to the next day when it was not supposed to.
• The participant suggested increasing the font size on many parts of the interface, including the text box that displays messages, start time, start date, dosage, times to take per day, and medication name (the labels are large enough, though).
• The participant noted that the value of “the time until time to take” interferes with the other functions of the app.
• The participant suggested having the program run in the background to ensure that the app can notify users even if no forms are displayed. The user is unlikely to keep the form open at all times.
• The participant suggested displaying a message to check the list of medications when several medications have to be taken at the same time.
• The participant suggested fixing the time glitch in the ‘Modify Medication’ function and adding an additional list that shows all medications stored in the app.
• The participant suggested fixing the app to ensure that clicking on a function button will always call the function (i.e., the list updating function should not override medication app functions).
• The participant suggested increasing the font size of the text in the medication list.

Figures 4 to 10 summarize the results of the questionnaire component of collecting the data:
5 Conclusion

The student applied the concepts studied in the human computer interaction course to develop a medication reminder app. The student was required to design, implement and evaluate the system within a month. According to the participants that tested (evaluated) the system, the developed medication app was easy to use and to understand.

6 References


