Designing visual interface for nutrition tracking of patients with Parkinson's disease

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ABSTRACT

In this paper, we describe the design of a visual interface of a mobile a mobile app for tracking nutrients and foods consumed by patients with Parkinson's disease. The interface should enable the patients to recognize objects on the screen, easily perceive their function and interact with them thus providing an efficient way of entering the dietary intake data. The app has been validated by five patients and the preliminary results are encouraging.

Categories and Subject Descriptors

H.5.2 [**User Interfaces**]: Graphical user interfaces (GUI), Prototyping, User-centered design

General Terms

Design, Human Factors

Keywords

User interface, Design, Food and nutrition tracking, dietary assessment, mobile app, Parkinson's disease.

1. INTRODUCTION

There exist different methods for dietary intake assessment, which are used to explore eating habits of individuals by measuring nutrients and foods. Information about dietary intake is needed for both risk prediction and dietary treatment of chronic diseases. Dietary assessment is possible using either open-ended surveys, such as dietary recalls or records, or closed-ended surveys including food frequency questionnaires.

Continued efforts have been done to improve the accuracy of these methods as inaccurate dietary assessment may be a serious obstacle of understanding the impact of dietary factors on disease. Recently, the technology for image detection and recognition by using Deep neural networks has developed significantly, enabling its application for automatic dietary assessment as well. The technology could not only provide automatic recognition of food and drinks but also enable estimation of volume and nutritional values.

While the need of tracking dietary intake is well recognized, the problem of acquiring the dietary intake data remains a challenge issue. In practice, it appears that patients with Parkinson's disease, such as the older adults, often have problems handling electronic devices. Consequently, designing user interfaces for this population has been quite well researched topic. There are numerous studies addressing both interfaces on normal displays [1], [2] and touch-screens [3], [4] to name just a few.

Extensive and in-depth research of user design guidelines for smartphone applications for people with Parkinson's Disease has been done by Nunes et al [5]. Their study featured literature review of disease symptoms, interviews with care-givers and usability testing experiments with (39) patients. They concluded that the patient's interaction with smartphones may be directly influenced by their: motor symptoms (bradykinesia, rest tremor, muscle rigidity, postural instability and gait impairment), non-motor symptoms (sensory symptoms, cognitive disorders, dementia) and on/off phenomenon (the variety between the symptoms when the medication is acting in a great way and when not). They evaluated the performance of four touch gestures: tap – is accurate with the large target size; swipe – should be used without activation speed; multiple taps – are comfortably performed; drag – are not preferred (are better replaced with multiple tap controls). They furthermore constructed the information display guidelines, that included: the use of high contrast colored elements, carefully selected information to display, the presence of indication of location, the avoidance of time-dependent controls, the use of multi-modality and also the application of guidelines for older adults.

Another study [6] carried out pilot questionnaires to (22) patients with their caregivers – trying to understand requirements for designing the user interface for them. The PD-diary application for big touch-screens was designed based on assumptions about the patients concluded from the interviews. They suggested that most potential users are older than 60 years and are not computer-literate. Patients have been using only a few electronic devices (a mobile phone e.g.) and are not good with computer peripherals (such as mouse and keyboard) and may have negative associations with such equipment (because they don't use it often). The answers indicated that it may be helpful to use the GUI logic that is well known to the patients (such as nine button numeric keyboard from the cash machine). The results also conformed with previously mentioned research guidelines in suggesting the use of large objects (buttons, labels, etc.), high contrast (bright objects on dark background and vice versa) and multi-modality (visual information combined with voice announcements and sound effects).

While previously mentioned research [5] included only testing of general touch gestures, recently also some usability testing of applications with a specialized purpose for PD patients has been done. For example, Barros et al [7] designed the medical application for patients' following their medical schedule based on the interviews with doctors, patients and care-givers. They performed usability tests with (12) patients that wasn't familiar with medication managing application. They used the application on a smartphone, while tactile information was being recorded and task performance was being observed. The results indicated that: there were some problems with tapping the buttons with icons placed very close to the boarders; swiping gestures on buttons with the arrows were observed; tapping on the check-boxes wasn't very accurate; patients did not always understand the additional step of confirming the input. Otherwise the researchers observed that recorded errors weren't severe, the patients grasped the main concept and quickly learned how to use the application.

Several studies researching the design of rehabilitative exergames (digital exercise based games) have been done (e.g. [8], [9]) and also the design of self-management applications for the patients to manage their diaries has been documented (e.g. [6], [10]). The mentioned research was taken into account when designing a mobile application for tracking the nutrition of patients – as part of PD_manager project, briefly presented in Chapter 2. While the previously described guidelines can here be seen applied in practice, the paper also presents new specific ways for making an application more user-friendly for the patients that interact with it. The focus of the study was how to make the visual language of user interface as easy to understand as possible for the focus group (Parkinson's disease patients). The results in form of design solutions, presented in Chapter 3, can therefore be useful for others designing user interfaces for patients with Parkinson's Disease (and also older adults in general).

2. NUTRITION TRACKING OF PATIENTS WITH PARKINSON'S DISEASE

In the European funded project PD_manager, we have developed a mobile app for tracking nutrients and foods consumed by patients with Parkinson's disease. The app provides two modules, which are used by experts and patients. The module for patients is simple and enables food recording based on images. Patients take photos of food, which are tagged by food names either in an automatic way or by the patients or their caregivers. Tagged images are uploaded on the server of the Open Platform for Clinical Nutrition (OPEN), where detailed analysis of the food diary is performed. The results of the analysis are sent to the PD_manager Decision Support System and to the patient's experts (dietitian, physician, logopedist), who perform education and, if needed, nutritional and logopedic therapy.

3. SPECIFIC VISUAL LANGUAGE

While establishing an information structure (that helps users understand the system) and designing an interaction (that makes it easy for them to finish a given task) were also a part of designing the user interface, this paper focuses on designing an adjusted visual language. The goal was to design it specificity in a way, that enables users to quickly recognize the objects on the screen – consequently making the whole experience more user-friendly.

Designed visual language provides an easy way for the patients to: locate interactive elements on screen, pay attention to the most important information, differentiate between input text and instructions, understand which functions are available to them and stay aware of the current activity that they are participating in.

Design choices not only incorporate previously described guidelines from the research of designing interfaces for patients with Parkinson's disease but are furthermore grounded in other design principles of graphical user-interfaces and visual communications.

We used color and shape in a way that utilizes specific characteristics of visual variables – selective and associative perception. We determined the same color for objects with the same functionality, making it easy for users to recognize, locate and isolate them – grouping them into categories (e.g. static and interactive objects). Within the main categories, we use the difference of shape to enable users to differentiate between sub-categories, while still preserving the perception of the main categories (e.g. icons of functions and input suggestions – both interactive objects). We established visual hierarchy by designing a few instances of different brightness of information and increasing the difference between them, making it easier for users to process them. Furthermore, we used semiotic principles to communicate different functions of buttons and provide the feedback of successfully completed tasks.

Designed visual language was unified and used throughout the whole app, which makes the interface predictable and consequently allows users to quickly learn how to use the app. It should be also noted, that the visual style differs from the ones usually found in mobile applications in its boldness, strong use contrast and the presence of clear, emphasized elements. At some points the aesthetic value was compromised for making sure that the interface as evident as possible for the users from the focus group, which may have problems with their sight.

3.1 Differentiation of interactive objects

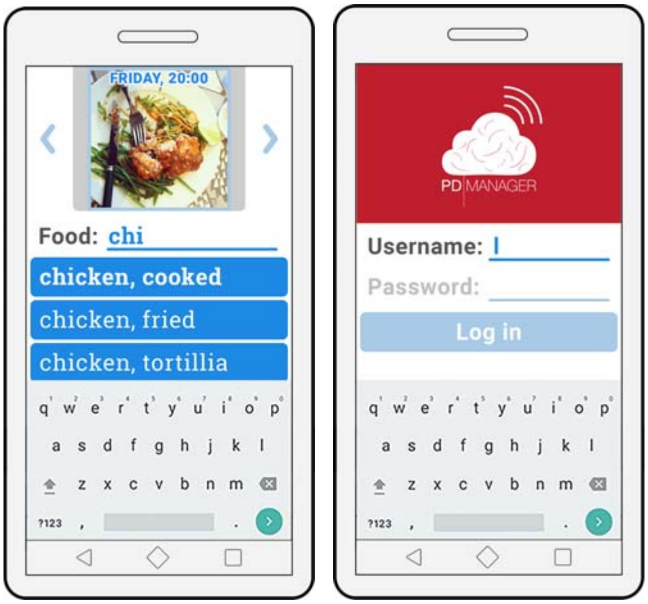
We enabled users to quickly see, on what they can tap on and on what not, by determining a distinctive color hue for interactive and static objects. We colored all the interactive objects blue and all the static ones gray. That means that all the buttons and input information are designed to have a blue color, while all the category titles and input field labels are gray. For example, the user can easily recognize every button by blue color and every field input label by gray color (Figure 1a).

3.2 Emphasis of prioritized information

We guided users' attention to parts of the screen, that are most important in given step by applying a bigger contrast to such parts. We determined two instances of brightness of the objects (for both the interactive and static ones) – we applied a lower brightness to objects with prioritized information and a higher brightness to others. For example, the user automatically focuses the attention first on the active row which is dark, while all the other passive text input rows are bright (Figure 1b).

3.3 Special text style for input

We made it easy for users to differentiate, which text is a label and which is an input, by choosing a different font (from the same typeface family) for each of them. We chose a serif font for text input (Roboto Slab) and sans serif for other information (Roboto). For example, the user can recognize every input text without reading it from observing a serif font alone and similarly he/she can recognize every field labels by a sans serif font (Figure 2a).

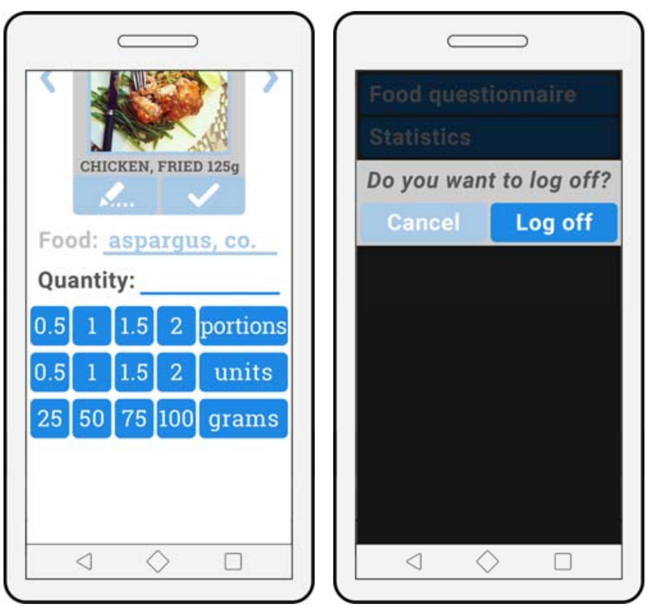


(a) (b)

Figure 1: (a) Example of button recognition, (b) example of guiding focus by higher/lower brightness

3.4 Special text style for instructions

We made it simple for users to recognize, which text is addressing them directly (instructions and questions) and which not, by choosing a different font (from the same typeface) for each category. We chose Italic font for the instructions and Regular font for other information. For example, the user can swiftly recognize the log out question without reading it by its Italic font and similarly he/she can recognize the buttons by their Regular font (Figure 2b).



(a) (b)

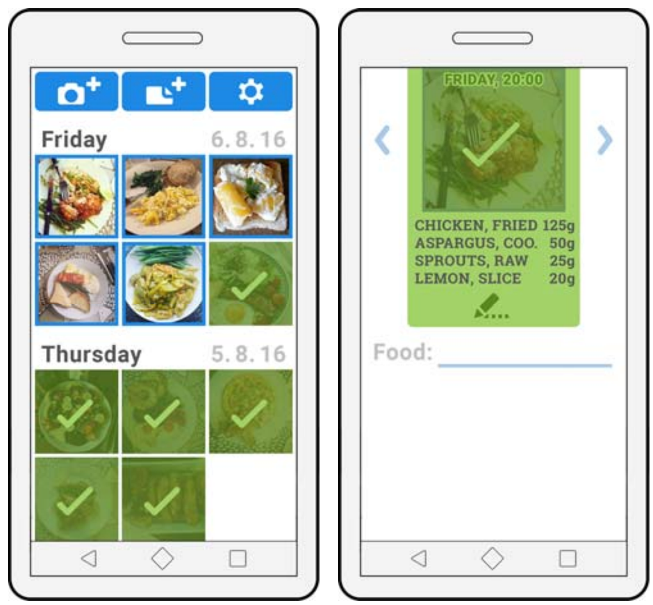
Figure 2: (a) Special text style for input, (b) special text style for instructions

3.5 Icons for functions

We helped users to perceive, what functionality provide certain buttons, by representing it in the form of pictogram icons. We designed icons of the functions to have minimal amount of details and a unified look amongst them. For adding a new meal with a photo we chose the plus sign in front of the camera and for adding a new meal without photo a plus sign in front of a blank page. For options we chose the icon of a gear, for switching between opened meals we used the icon of an arrow. For editing past input we chose the icon of a pencil and for completing the tagging process the icon of a check. For example, the user can understand in a moment (without reading any indicating text) that pressing the icon of plus and a camera will add a new photo in a gallery with meals (Figure 3a).

3.6 Feedback for task completion

We reassured that users know, when they have completed the task, by giving them visual feedback in the form of a green color. We indicated successfully finished tasks with a dark green background and a bright green check icon. For example, the user can be sure that he/she successfully performed all the steps of tagging the meal, when seeing the background of text turning green and the check icon appearing over the picture of the meal (Figure 3b).

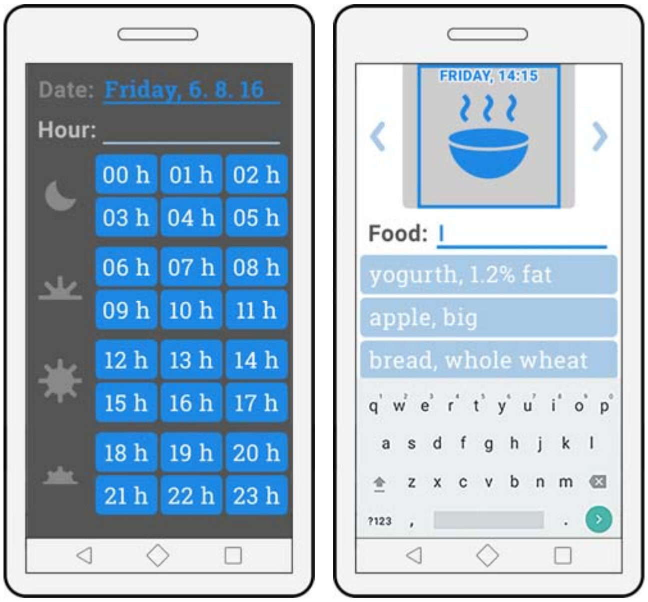


(a) (b)

Figure 3: (a) Example of pictogram icons, (b) example of feedback for task completion

3.7 Indication of current activity

We assisted users in recognizing, which task are they currently performing, by assigning a distinctive background color to different types of tasks. We chose a dark background for the task of adding a new meal (and also for viewing the options) and a bright background for the task of editing them. For example, a user can rapidly recognize that he/she is in the process of adding anew meal just by observing the dark background of the screen (Figure 4a). Similarly, he/she can recognize the process of tagging a meal by a white screen background alone (Figure 4b).



(a) (b)

Figure 4: Examples of indication of current activity

4. CONCLUSION

In this paper, we reviewed the literature on designing user-interfaces for patients with Parkinson’s disease and presented the designed visual language for the interface of mobile application for tracking the nutrition of patients. The designed solution is based on: differentiating between interactive and static objects, emphasizing of prioritized information, differentiating between input information and instructions, communicating of available functions, giving feedback for task completion and indicating current activity. As it was designed in a way to make it easy for patients to recognize objects on the screen, perceive their function and know how to interact with them, the results can come in handy for others designing user interfaces for people with Parkinson’s disease.

While not included in this paper, a specific information structure of application was also constructed (for enabling users to easily understand the system – by breaking tasks in several steps for example), and appropriate touch interaction was designed (for making it easy for users to effortlessly complete the tasks – by reducing the number of required taps for example). The studies were done as part of user-interface design for a mobile application for nutrition tracking of patients with Parkinson’s disease (a part PD-manager project).

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