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MEDIFRAME A TABLET APPLICATION FOR OLDER ADULTS MEDICAL INTAKE

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ABSTRACT

In this paper, we discuss experiences from designing the tablet-based application MediFrame. MediFrame is a personal medication management system to support older adults in non-clinical settings such as the home. The paper describes the user-centered design process and the resulting tablet application. We show how MediFrame can be used to support adherence in medical treatments through fieldwork informed use scenarios.

***Index Terms*: medication management; design; tablet; older adults; user-centered design**

I.INTRODUCTION

The World Health Organization [1] reports that adherence to long-term therapies is around 50% in developed countries and even lower in developing countries. For instance, about half the people subject to prescribed medication fail to take their medications accordingly.

Institutional care is more resource-demanding compared to home-based care [5] and moving from an independent to a dependent life situation is a major concern among people over the age of 60 [6]. To address this, the healthcare system tries to enable citizens to remain self-sufficient. This paper presents the iPad-based prototype *MediFrame* that aims to postpone the transition across care settings by supporting people's everyday medication intake. In the following, we present related work, our user-centered design process with older adults and medication experts, the *MediFrame* application and its early evaluation phase.

The main contribution is the presentation and discussion of the design of mobile medication management supportfor older adults in everyday life. Finally, we present a *MediFrame* medication management support for older adults in everyday life

II. RELATED WORK

A. Mobile Technology and Older Adults

The use of smartphones and their built-in sensors has become widespread when supporting older adults' daily activities. However, one disadvantage of mobile phones may be the limited screen size when an older adult is expected to use screen-based interaction [8]. Here tablets with touch-technology can be an alternative . Research has also shown that touch screen interaction is more suitable for computer-novice older adults rather than using keyboard or mouse Furthermore, touch-based interfaces suite activities that should be integrated into people's

everyday lives..

When designing healthcare technology for the home, it is important to consider how people arrange things and activities at specific places to maintain the order of the home . In this sense the aesthetics of the home plays an important role and tablet cases, covers and sleeves can provide several opportunities to allow a more personal and aesthetical fit in private homes.

B. Technology for Medication Management

A set of physical and digital artifacts are available to support people's medication intake, such as reminders, pill boxes, software applications, tablet-holders, automatic medication dispensers and paper-based medication lists .

C. Patient-Physician Collaboration and Information Sharing

How to enable an effective patient-physician communication has been widely studied and recognized as a key factor in increasing treatment compliance . To successfully carry out agreements, the collaborative partners rely on a shared intention within the group. The facilitating technology can be seen as one actor in such collaborations. At clinics, information exchange is composed by information seeking, documentation and patient education [9]. Using modern telecare solutions, communication can include locations outside of the clinical setting and mobile phone-based diaries have been used to support for example everyday diabetes management .

D. Design Implications for Medication Management

Design implications for medication management systems include

1) to pay special attention to placement, readability, and terminology of instructions and confirmations;

2) to prioritize performance over preference when designing interfaces for personal health applications;

3)to present individual's health information by finding a balance between textual information and design metaphors;

4) to provide automated mechanisms to perform basic medication management tasks

5) to consider all stakeholders to address possible conflicts and avoid misunderstandings between each stakeholders;

6) to explore and understand individual's unique practices for health information management;

7) to provide the possibility to add more functionalities as users master the basic ones

8) to provide customizable reminders;

9) to facilitate information search

10) to recognize the value of portability for the reminding.

III.DESIGNING FOR MEDICATION MANAGEMENT

First, the project initially carried out a quantitative study with older adults over 60 years of age and a qualitative study with 9 older adults (aged 60-93) [9]. This initial fieldwork revealed that the lack of knowledge about medication, forgetting the medication intake, complexity of the medication regimen, taking medication outside the home, the lack of support for caregivers, and substitution of medication are important challenges for older adults. Second, we reviewed existing mechanisms and technologies used to support peoples' medication intake. Our review included electronic reminders, tablet holders and dosing aids with electronic reminders, automatic dispensers, and non-electronic tools such as paper-based medication lists and pillboxes . Based on our initial

fieldwork and this review, we defined a set of functional and non-functional meta-requirements for the design medication management systems .

Third, *MediFrame* was designed following a user-centered design process . This process involved older adults, medication experts and researchers. Eight older adults (aged 57-90) and seven medication experts participated in several workshops .The medication experts were two doctors, two healthcare workers, two pharmacists and a developer from SMR. The *MediFrame* design team was informed by the initial user meta-requirements and the related work in which tablet technology seems to provide several opportunities for home-based healthcare technology. Workshops together with the older adults involved

1) discussions about how participants manage their own medication, the amount of medications and the frequency of the medication intake, strategies to remember a medication dose, current technology to support the medication intake and their need of medication information,

2) identification of older adult's daily routines including their medication intake by filling a paper-based weekly calendar, and

3) early feedback regarding the functionality and goals of *MediFrame* based on early prototypes.

Workshops together with medication experts involved

1) discussions about the results of the workshop activities with older adults

2) gathering knowledge regarding medication information for example the exact definition of a dosage, the use of generic and active substances and the right phrasing for a medication dose, and

3) feedback and suggestions on the functionality, vision and goals based on early and revised prototypes of *MediFrame*.

A. Initial MediFrame List of Requirements

Based on the related work and the tablet technology the project defined the initial list of requirements for *MediFrame*. We focused on a specific set of the afor requirements .

1) Integration: MediFrame should integrate validated medication information from trustable sources . This also implies an automatically update of prescribed medication .

2) Reminder: MediFrame should provide customizable reminders to each person's medication regimen and in accordance with their daily activities including the medication refill reminder.

3) Tracking: MediFrame should document the patient's medication intake or lack of it over time. This tracking information includes issues about intentional non-adherence and regarding the current medication regimen such as side effects or reasons for skipping a dose.

4) Mobility: MediFrame should support medication intake in and outside the home especially when daily routines are broken.

5)Search: search the actual medicine .

6)*Control: MediFrame* should let the users decide when to start or stop sharing their medication information and receiving reminders.

7)Privacy: MediFrame should allow users to provide privacy to their personal dignity by giving them control over functionalities.

B.Exploring the design space

We initially investigated several metaphors such as the "medication cabinet" and the "clock" to explore

possibilities of arranging medications and reminders . We used a number of early low fidelity prototypes to elicit discussions and get early feedback from participants. These prototypes were manifested in several design drawings and mock-ups that in combination with the tablet device allow us to get a rapid user feedback on our *MediFrame* concept.

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IV. THE MEDIFRAME APPLICATION

MediFrame Applications are:

1) plan their medication intake on a day-to-day basis.
2) retrieve information about each medication they are prescribed;
3) get reminders when to take their medications;
4) get documentation and support in their medication-related dialogue with their general practitioner, and
5) support the intake of "according to need".

A. MediFrame System Architecture

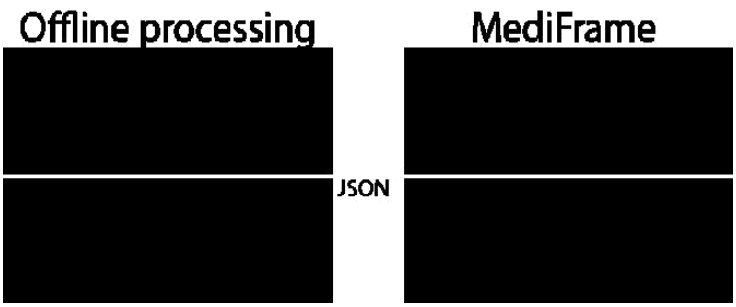

***Fig.MediFrame* System Aarchitecture**

MediFrame is a web (cross-platform) application based on the Model View Controller (MVC) design pattern. It uses the Sencha Touch Framework to access native device APIs and is embedded as a native shell .

Two main components describe the system architecture of MediFrame: 1) the offline processing, and

2) the MediFrame App

1) Offline processing: It is necessary to preprocess and re-structure the data that comes from the two Danish services: SMR and DMI. This is managed by the Data Miner. The Data Miner generate JSON files to instantiate the data model for the MediFrame App.

2) MediFrame App: The MediFrame App is the tablet application developed using the MVC design pattern. The status and the application's data are stored using SQLite in the tablet device. Furthermore, the application defines and combines the controllers, views and models to provide the user with different functionalities. Each functionality has its own controller and view classes except from the main Controller Application which manages the MainView of the application, the TakeMedicineView and MoreInfoView.

B.MediFrame Functionalities

As a result from the cooperative design process, MediFrame implements the following functionalities:

1) Calendar: This function provides an overview of the scheduled medication intake (see Figure 4) in relation to other planned activities.

. *2)Medication:* This function makes the user and potential caregivers able to get an overview, and retrieve information, about all prescribed medication.

3)*Diary:* This function allows the user to document information about the medication and experienced side effects in a diary-style log..

4)Reminder: This function provides users with medication reminders when it is time to take medication or a refill is needed. A reminder can be set to be active or passive.

5)According to Need: This function allows the user to document the use of 'according to need'- medication.

6)Take Medicine: This function allows the user to register the medication intake at specific times a day by tapping each medication button .

V. DISCUSSION AND LESSONS LEARNED

Based on our observations and the input gathered during our design process, we will now discuss lessons learned during the *MediFrame* design process.

A. The Use of Tablets by Older Adults

MediFrame facilitates the transition between the clinic and the home by supporting people to manage their daily medication intake. The older participants in our study did not previously use smart phones and tablets. However, all were positive about using a tablet that can help them gain more information about their medication. So far, they have used pillboxes, reminders and paper-based forms to track their prescriptions. Medication experts expressed a positive feedback as *MediFrame* can be seen as a tool that can mediate the communication between care settings. They emphasized that it is useful to know what is happening with older adults at home between consultations. One nurse commented that "it [MediFrame] can be a way to know why they are not taking their medication as we [nurses and general practitioners] don't know why they come back after few weeks of discharge from the hospital".

1)Introduction of Tablet Technology: It turns out to be a good strategy to give older adults an introduction to the iPad technology – how it works and how they can use it – before the test. This introduction helps us to discover their attitudes towards the technology as such.

B Guidelines for Touch Interfaces: We have considered existing guidelines for designing touch interfaces provided by: 1) related work areas such as user interface design, mobile interface design and usability and accebility for mobile devices, 2) specific work on touch-based interfaces for older adults, and 3) guidelines to design for older adults.

C The Taking Medicine Interface - Simplicity is the Key

The *MediFrame* design involved different actors during the design process. In particular, medication experts were concerned about the complexity of the medication regimen. They emphasized that a clear overview that contains all medications for a specific time should be visible to older adults on the screen. Previous work has applied the medication clock metaphor for medication management on a mobile device Tablet. However, we found that the clock metaphor might be challenged due to the complexity of our older adults medication intake . Indeed, the older adults in our study are taking up to 35 medications distributed across the day at different times.

This complexity challenged our interface design as we moved away from our initial idea of metaphors as also suggested by through the use of the diverse low fidelity prototypes.

The "Take Medicine" interface provides directed, active, medication information (search) by giving an overview of a specific time's medication dosages at a glance. This facilitates the registration of the medication intake. An undirected active medication information is provided by giving access to more relevant specific medication information by selecting the ("I")nformation icon. This can support the medication intake by providing relevant information such as instructions of how to take a medication. Directed passive medication information is provided by the overview where the selected/taken medication changes color and a progress bar provides overview. An undirected passive medication information is provided by medication reminders and warnings as a user wants to skip a medication.

1)Addressing the complexity of the medication regimen: Medication experts see *MediFrame* as a medication checklist that can help them to track and remember whether or not the older adults have taken all medications for a specific time, specially during a complex regimen. *3)Providing user's identity*: Medication experts expressed that "*it is very important to see the name of the person which the information concerns*". Especially if the system can help more than one person. For example, spouses play an active role and there are cases in which the couple are taking the same medications (i.e. diabetes medication) as supported by our empirical material.

2) Facilitating the information seeking in the interface:

Considering the feedback from the older adults and the discussions together with the medication experts, we took several design decisions to improve the visual information seeking. For example, the main menu was removed from the "Take Medicine" interface, a combination of textual information with a visual representation of the number of medications to take for a specific dose was provided, and a clearly distinction of all selected medications was applied.

C. The Calendar Interface - Planning and Reminding the Medicaton Intake at Home

MediFrame aims to help people plan their medication intake by combining information across care settings. First, *MediFrame* uses data from the Shared Medication Record [9]. This information is currently generated at a clinical setting. Second, it uses data from people's scheduled everyday activities that is generated in non-clinical settings.

Based on our fieldwork, we have encountered participants that do not have well-established everyday routines. To provide medication awareness, monitoring, browsing and searching according to the Calendar interface provides an overview of the current and daily medication intake combined with people's scheduled activities . The calendar provides directed active medication information (search) by giving an overview of several dosages of medications during the day or a week. This facilitates the planning and adjustment of medication intake when Ann needs to go out. An undirected active medication information (browsing) is provided by giving access to the specific medication information.This information is provided when users search for that knowledge and tap of specific medication. Directed passive medication information (monitoring) is provided by the calendar using different colors for the medication icon. This helps users to remember whether or not they have taken a medication, and follow up their medication intake or look for conflicts between medication intake and planned activities like the red pill icon on the screen. Finally, undirected passive medication information (awareness) is

provided by the calendar by giving warnings for possible conflicts between future medication intake and scheduled activities apart from the red color pill. The participant also experienced small problems regarding the scrolling in the calendar.

D. Documenting and Providing an Overview and Knowledge about Medication at Home

1) the medication intake, and 2) information why a user might have skipped a dose. This can inform a later dialogue between the individual and the physician. During our evaluations, medication experts expressed the necessity of presenting the right additional information or instructions when supporting the current medication intake. While the Patient information leaflet is always distributed together with the medication, this information is not always available at hand.

We suggest that a medication overview that supports the registration of medication intake should be designed to integrate, and visualize, relevant parts of the medication. To do this, it is important to get an understanding of the user's information seeking needs in order to apply the information seeking mantra on the interface. By considering user's information seeking behavior, designers can provide a more complete and fresh experience-based interaction schema as suggested by . Moreover, helping users to document all the specific medication particularities at home and in practice can support physician's information seeking according to specific care plan. This documentation can bridge the gap between laypeople and health professionals that exist between consultations due to the lack of knowledge about what is happening at home during a medication treatment.

VI. CONCLUSIONS

We have presented the table-based reference implementation *MediFrame*. Naturally, an implementation of medication support can take many other forms and *MediFrame* represents only one attempt to interpret and work with a challenging group as older adults. As *MediFrame* is not a disease-specific application, *MediFrame* targets most medication situations including 'according to need' and substitute medications.

at home. We have described how *MediFrame* implements two of these functionalities in detail (calendar and taking medicine) . The existing design guidelines that can be adapted for tablet-touch interfaces need to be further validated with users to see how the visual information seeking can be improved but getting a better understanding of the user's information seeking needs. These strategies can help designers to improve tablet-touch interfaces for older adults supporting a holistic medication management activity and facilitating the information exchange between patient and doctors.

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