

# From a Common Chair to a Device that Issues Reminders to Seniors

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**Abstract.** Over the years, people tend to fail to recall different activities of everyday life, especially those that are performed less frequently. Forgetting a medical appointment, a family member's birthday, or to take a medicine, is a common problem for many older adults. Although Information and Communication Technologies provide several options to help older adults remember activities like these, many of them could feel discouraged by not being able to properly use these tools and take full advantage of them. In other cases, elderly people may feel intimidated and even refuse to interact with technological devices. For these reasons, this paper proposes the use of a conventional object, which can be found in any home, to help older adults remember certain activities. Specifically, an ordinary chair has been selected to be employed as a device to provide the necessary reminders. The reminders implemented in the designed prototype are provided by audio, lights and vibrations, things that users do not notice at first sight the presence of technology in the chair. This prototype was evaluated through a user study with the collaboration of older adults. The results of the evaluation were positive, which concludes that the proposal has a favorable reception. Thus, this proposal could provide an important contribution to the major goal of helping to improve the quality of life of the elderly population.

**Keywords:** Older adults, reminders chair, ubiquitous computing, everyday objects.

## 1 Introduction

Aging is a normal stage that all of us will reach. This stage is not a limitation to having a totally normal life and to be able to continue doing day to day activities. However, there are age-related impairments that could interfere with the performance of these activities; one of the most frequent problems being memory loss.

Many experts have developed different technological devices and applications that provide help to older adults who have trouble remembering. Some examples of these solutions are the interactive dashboards [1], intelligent pill dispensers [2][3], software

that shows important episodes in the lives of older adults in order to keep their memory alive [4], and application of assistance for the elderly [5].

All of these solutions have been evaluated with the participation of older adults, resulting in a great acceptance. Even solutions such as smart pill dispensers are already marketed. However, there are limitations: not all users have an economic solvency that can afford these devices; they have a limited amount of reminders that they can store and their functionality requires them to be transportable, but they do not have a convenient size for mobilization.

Based on the above, this paper analyzes the possibility of using everyday objects to provide reminders to older adults in a transparent way. The proposal aims to take advantage of the Internet of Things (IoT) [6] to enable the used objects to communicate, for example, with a mobile application. This application would make it possible, on the one hand, to set up reminders and, on the other hand, to deliver alerts to a caregiver or a relative of the older adult. However, one of the previous steps is the analysis of candidate objects to provide reminders. For this reason, this article describes the evaluation of a conventional chair “turned” into a “ubiquitous device” that can help older adults remember day-to-day activities. This chair provides reminders through auditory, vibratory and light alerts, without older adults feeling that they are interacting with a technological device; they will only see the chair in which they are sitting.

The developed prototype was evaluated through a user study. The study involved the type of people for whom the device is intended in order to assess its usefulness and functionality. The obtained results showed that participants liked the device. They expressed an understanding of the functionality of the chair and, most importantly, they did not notice that there was an extra device to send reminders. Participants suggested that this device could be used to provide everyday reminders, and in addition, it may provide some kind of companionship, for example, speaking to them.

The rest of the paper is organized as follows. In Section 2, some work related to the proposed prototype system has been written. Section 3 describes the materials and methods used in the development of the proposal: (1) prototype design and (2) its evaluation. The results and discussion are presented in Section 4. Finally, section 5 presents the conclusions and future work.

## **2 Related Work**

Today there is a remarkable growth of the elderly population. This growth causes an imbalance in the costs of public health services and the probable shortage of direct care workers such as nurses, paramedics and health aides. In addition, there are a significant number of older adults with progressive health problems who prefer to live in their homes where they have been established for many years [7].

According to Saracchini et al. [5], memory loss in older adults is one of the most common progressive health problems. They propose that the most viable solution to this problem is the use of technology through intuitive software assistance for the elderly. This proposal promotes the brain activity of the elderly; it helps to remember appointments and pending daily tasks. The software interface tries to simplify the

preferences of the elderly. However, several of the subjects who participated in the evaluation said they had trouble managing the reminder's agenda because of its difficulty.

Situations of complexity such as the one mentioned above, plus others such as text size, size of buttons, lack of adaptability, among others, led a group of researchers to evaluate various mobile applications to determine which are suitable for use by older adults [8]. The applications Med Helper Pill [9], MediSafe [10], Pill Reminder [11] were recommended for their friendly interfaces, efficiency in health control at individual and population levels. These applications can encourage healthy behaviors to prevent or reduce health problems, offer reminders to take medications, scheduled appointments, and warning when medications are running out.

Other related work [12], which evaluates the acceptance of assistive technology in older adults, indicates that it is not only necessary to create the technological devices; designers of devices should also ensure that those devices are pleasing and easy for seniors to understand them. This study [12] found that users prefer an intelligent device that performs its functions autonomously. In addition, participants suggested that devices should offer company while supervising them periodically, "be an advisor" to maintain a healthy physical condition and have alarm or reminder functions to take the right medication at the right time.

Remembering to take medication is one of the most important daily activities that older adults forget to do. These omissions can accelerate the progression of a disease and subsequently increase medical expenses [2]. The solution to this problem can be found in a pillbox [2]. It requires to be fed by the medicine with its respective schedule, administered by an assistant that must have knowledge of the use of the device. This pillbox fulfills its function, but it necessitates the use of batteries and has a limitation on the maximum number of alarms that can be stored.

A similar but more updated design is proposed by Muñoz [3]. It consists of a dispenser of pills for older adults with reduced autonomy. This dispenser has a touch screen on which the user can enter the medication schedule. In addition, it has a built-in NFC bracelet which is used to remind the elderly whenever it is time to take his/her medication. Despite its optimal functionality, the dispenser has a significant size that makes it difficult to move from one place to another.

In order to maintain stable health, it is not only necessary to take care of oneself physically or to take one's medication on the established schedules; but emotional states of older adults also have an influence on their health. For this reason, Etchemendy et al. [4] developed an application called Mayordomo that collects photos of happy moments from childhood to the present with a short story that narrates the events, photos of loved ones, relevant information of their lives, and so on. However, the interface of this software needs improvements to attract users, since many people do not want to involve technology in their lives.

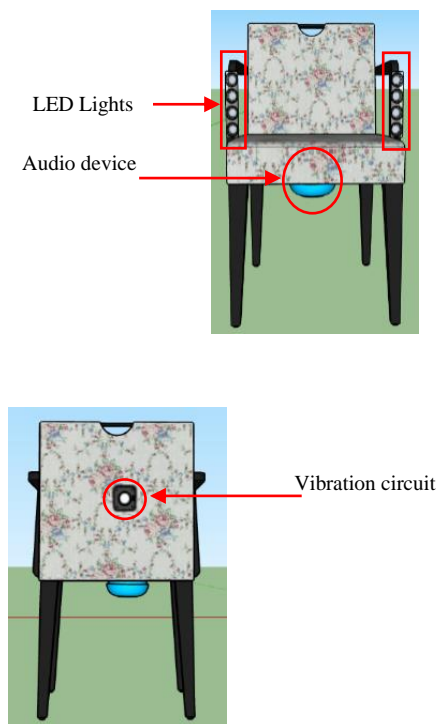
Considering that it is difficult to involve technology in the lives of older people, Veldhoven et al. designed an interactive display of messages and reminders in the form of a board [1]. The designers wanted the screen to be nice so that seniors feel comfortable and do not think they are using technology, but they are using a simple dashboard to show the ads that people must remember daily. In addition, it has a website where

family members can place the reminders that have to appear on the board. Nevertheless, there are other ideas that could be explored, particularly taking into consideration household objects that often go unnoticed.

### 3 Materials and Methods

#### 3.1 Prototype Design

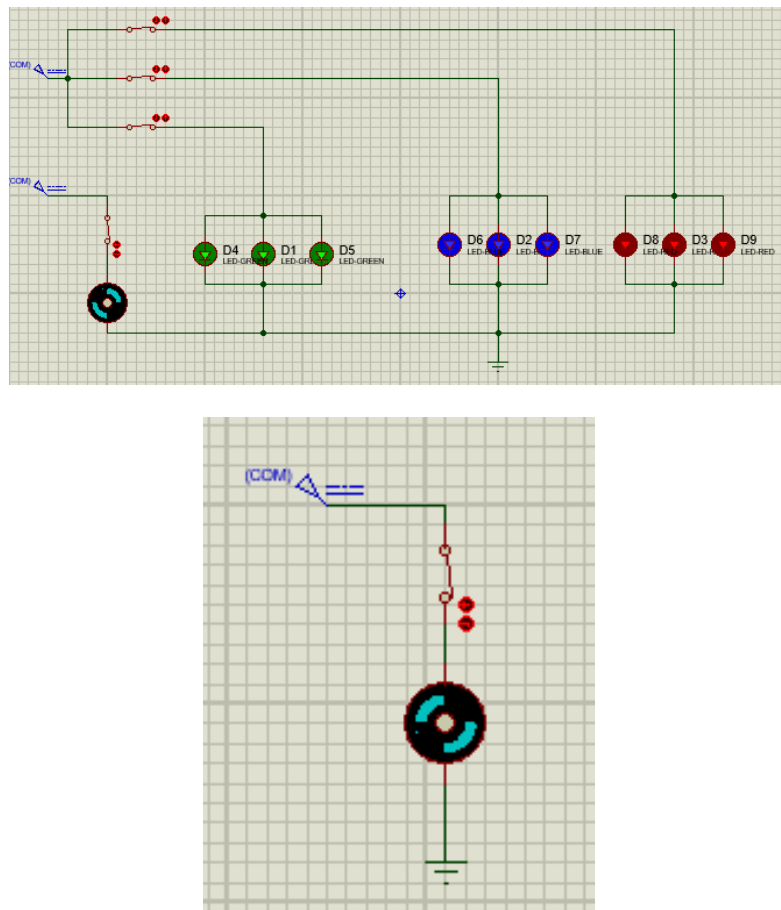
Faced with the problem of the decreasing memory in older adults, which in many cases may lead to dependence on another person to cope with their lives normally, this paper proposes to use an "intelligent" chair that can issue reminders semi-transparently. The idea of using a chair is based on the fact that it is a very popular object to rest and, in certain cases, older people tend to have a preference for a chair in their home. The chair, according to the proposal, will provide the necessary reminders combining voice, lights and vibrations. This prototype will work for people who still react to stimuli and understand verbal communication. In other cases it could serve as an alert or reminder device to the people who are responsible for their care. Figure 1 shows the front and back views of the proposed chair.



**Fig. 1.** Proposed prototype

For the development of the prototype to evaluate our proposal, a chair with armrests similar to the one in Figure 1, was selected. Preliminary tests were also carried out planning scenarios of how an older adult would act if he/she were using the chair. These tests helped to define the location of the different components/circuits.

The lights circuit (see Figures 1 and 2) was implemented in the front of the chair to allow the user of this device to have visibility of the color reflections emitted by the employed LED strips [13]. This circuit was previously simulated using Proteus [14]. It is composed of three LED strips (red, blue and green), buttons and a battery connected as shown in Figure 2 (above).



**Fig. 2.** Diagrams of the simulated circuits in Proteus: vibrating motor (bottom) and LED lights (top).

The use of colors is very common to alert people about events that take place. Some of these events are scheduled (e.g., traffic lights), and others are unexpected (e.g., traffic accidents). In [15], the author's two present studies, (1) about the appropriate values of intensity, color, frequency of changes and brightness of lights to transmit information,

and (2) how lights affect context consciousness in people. The favorable results obtained in these studies increased the motivation to use colored lights in our prototype.

The vibration alert circuit was also simulated by using Proteus software as shown in Figure 2 (above). A power supply, a switch, a pushbutton and a motor were employed for its implementation. The switch was utilized to control the general circuit and provide the necessary voltage. Finally, the location of the circuit was determined. The back of the chair was chosen, because people usually lay back to support their backs. This decision allows older adults to better receive the vibratory alerts.

Finally, a speaker integrated in the lower part of the chair was used so that it is not visible. This speaker was employed to emit the sounds corresponding to the reminders emitted as if they were voice memos.

Once the circuits were ready and placed on the chair used, a pilot test was carried out with the collaboration of three people. These tests allowed verifying the correct operation of the prototype and fine-tuned details such as the duration of the lights on and vibratory signal. Once the prototype was ready, a user study was prepared and performed.

### **3.2 Evaluation**

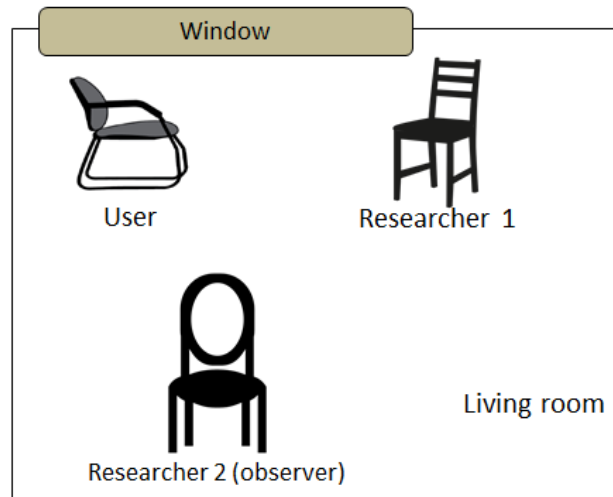
Twelve older adults, all Ecuadorians (from the littoral region), between the ages of 65 and 87, participated in the evaluation. Half of them were male and half were female. Most of the participants had a basic level of education, except for three who had completed secondary school and one without formal studies.

None of the participants had physical or cognitive ailments that prevented them from taking part in the study. However, two of them self-reported pain in their back/spinal column and five others indicated suffering from a disease that did not influence the study, such as gastritis or diabetes.

All participants were transported from their homes to the study site with the researchers' collaboration. The site was the home of one of the authors. Figure 3 illustrates the spots occupied by each person present in the study. The chair prototype was positioned in the living room of that house, eliminating any type of distractor that could influence the study. The living room was chosen in order to use a room of a house environment closer to reality. Next, each participant sat down on the chair while a researcher conducted the evaluation. This researcher (researcher 1 in figure 3) sat down in front of the participant, while another researcher (researcher 2 in figure 3) acted as observer. This researcher remained seated near the user and researcher 1 took notes. In addition, there were no more people present during the evaluation. This decision also avoided distractions during the study.

The evaluation began with a brief introduction of the functionality of the prototype reminders chair to each participant. Then, researcher 1 provided some instructions to the participant to proceed to sit down on the chair and to begin a dialogue about different topics in his/her life. As the conversation unfolded, reminders were issued in random time lapses. These reminders were as follows:

- You have to take your medicine (health reminder).



**Fig. 3.** Distribution of spots for people present in the study.

- Today is your son's birthday (birthday reminder).
- You have a medical appointment today at 16:00 (appointment reminder).
- It's time for your favorite TV show (leisure reminder).

Since some older adults tend to separate activities according to gender, a final reminder of domestic chores was made for women and another for men. These reminders were as follows:

- You have to turn off the stove burners (woman).
- You have to turn off the bedroom light (man).

The reminders were emitted through a combination of lights, vibration and audio. The visual alerts were sent by means of LED lights of different colors. The color red meant a family alert, the color blue meant a health alert, and the color yellow meant an alert for a leisure activity. Both the lights and the vibrations were emitted twice by reminder. Each alert lasted two seconds, with an interval of one second, based on the pilot test mentioned above. The used audio consisted of a female voice indicating the above reminders.

After the evaluation with the prototype, a questionnaire was applied to collect additional data. The participants first answered questions of a demographic nature and then about the evaluation of our proposal. The first part consisted of questions about age, sex, educational level, health condition, among others. In the second part, the following questions were raised:

1. Do you have a clear idea of the purpose of the device?
2. Do you think the service offered by the device is useful for your personal case?
3. Which was the aspect of the device that most caught your attention, positively or negatively?
4. Did the device cause you any discomfort when it was delivering the reminder?

#### 5. Would you recommend the use of this device?

In addition, it was explained to the participants that the confidentiality of the data collected would be maintained, that the study would not pose any risk to them, and that they would not receive any compensation for taking part in the study. These explanations were supplemented by the signing of an informed consent form before starting data collection.

## 4 Results and Discussion

The following results were obtained by processing the data acquired from the questionnaire. Firstly, 100% of the participants stated that they were very clear about the purpose of the prototype. They noticed clearly the emission of lights, audios and vibrations to remind them of activities they should perform. In addition, there were other details to discuss. In general, when the participants received the first reminder, they were amazed because it was something they did not expect. The second reminder caused less amazement than the first one. By the time the third reminder appeared, the participants had already realized the objective of the prototype. There was no novelty in the reaction of the users in the reminders provided later. In the end, all participants made reference to the fact that the device had mechanisms for remembering activities or tasks to be performed while they are resting quietly.

Similarly, referring to the second question, all participants responded that in their personal case this prototype would be useful.

Thirdly, results about what caught the attention to participants positively or negatively from the device are shown below in Table 1. According to this table, the use of vibrations was the preferred kind of alert to catch their attention, followed by sound. On the contrary, particularly in comparison to [15], the lights went practically unnoticed. One possible motive could be the clarity of the evaluation site because the study was conducted during the day and near a window (bearing in mind participants' comfort). Also, there was a person who was not struck by any of the ways of issuing the prototype reminders. However, this answer could be due to the fact that the participant showed little interest during the evaluation, which could have derived in not being adequately aware of the different elements.

**Table 1.** Kind of alerts that most caught participants' attention.

Alert	Number of participants	Percentage
Vibration	7	58.4
Sound	4	33.3
Lights	0	0.0
None	1	8.3
TOTAL	12	100



Considering that the participants did not know how the reminders were going to be sent, when we asked them if the alerts caused some discomfort, all of them replied that it did not. Several of them even went further, saying that it would be a very useful chair because, at their age, it is very common to forget many things. In addition, some participants pointed out that the chair could be “a good companion”, as it could speak to them when they were alone.

Finally, the participants were asked whether they would recommend the use of the device or not. All the older adults who participated responded that they would recommend it. Two of them provided additional comments. One said that while he agreed with the proposal, the reminders “interrupted him during the conversation”. Another participant stated that the reminders “awakened his mind” and that they would help him greatly to improve his memory.

## 5 Conclusions and Future Work

Considering that older people are becoming “technologically excluded”, a significant amount of effort has been made to improve this situation. Even though some of them may be against the use of technological tools, they can be provided with ubiquitous solutions for the home that help seniors in their daily activities. For this reason, in this work we have analyzed the possibility of using a conventional chair to provide reminders to older adults about day-to-day activities that they may have a tendency to forget.

For this purpose, a prototype was built and an evaluation was carried out with senior citizens. In general, the prototype was well accepted by the older adults. Most of them said they understood the functionality of the prototype, and only one was indifferent.

Referring to the type of alerts used, it was evident that the LED lights were unnoticed. On the other hand, the sound alerts and vibrations that were emitted were clearly noticeable to the participants. However, these facts did not influence the acceptance of the prototype.

While the evaluated reminder device successfully fulfills its purpose, it may evolve to offer greater functionality. The chair may be suitable to act as a companion device for older adults. This aspect could eventually be addressed in future work.

In the future, the reminder chair will be supplemented with an application (mobile and/or web) that allows family members, or staff caring for an elderly person, to manage the necessary reminders. This application should allow configuring the needed reminders, with their schedule and even select the type or types of alerts with which an older adult would prefer receiving the reminders. Furthermore, in order to reduce the chances of seniors ignoring reminders, a wireless sensors network [16] (e.g., using motion sensors [17]) could be implemented so that alerts cease when the elderly joins in to comply with what the reminder suggests (similar to [18]). This could be notified to the relative or caregiver of the older adult. In addition, taking advantage of this sensors network and IoT, reminders related to events that could cause damage to the elderly or even to trigger a catastrophe could be incorporated (e.g., forget a plugged up iron or a stove left on). Finally, we plan to use other common things available at homes to work

together with the proposed chair, taking advantage of IoT. All in all, we hope to contribute in this manner to help to improve the quality of life of the elderly population.

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