

ePatient and eNurses Tools Based on Tactile Interfaces Applications for Nursing Home Residents and Nurse Team Support

Extension to Ambient-Assisted Living Semiotic Command Interfaces

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Abstract—This article shows what usage can be made of touch screens to monitor elderly activities and health parameters. The system is based upon a classical 10-inch tablet on which a portal allows to access several activities for communications, cerebral activities through games, electronic mailbox, and multimedia applications. Statistical results can be used by the medical team to follow the mental and medical state of the resident, and to adapt the daily activities. The graphic interface and the game types are derived using a semiotic approach taking into account the biography of the person through the memory of gesture.

Keywords—Touch screen interface; semiotic approach; cerebral training; health statistics; nurse team support

I. INTRODUCTION AND CONTEXT

Surveys shows that only between 6% and 15% of people over 70 years use touch interfaces, against 83% for those under 35. The main cause is a lack of information leading to a lack of interest, the fear of not being able to use it because of missing skills or health problems, or a wrong idea on the cost of equipment. However, another French survey shows that, if the mobile phone is the tactile object most commonly owned today, the most wanted tactile devices are equipments for elderly and disabled people (71%) before classical comfort home automation [1].

To improve tactile interfaces design and usage, it is important to take into account the memory of gestures, especially for people with reduced autonomy because the gesture used to interact with the interface is not always obvious. This implies that the functional signs (icons, buttons) and gestural modes of interaction (gestures required for a particular action) are fully embedded in their memories of daily practices. Because each handicap situation is unique, customizable, adaptable and updatable interfaces based on physical and mental skills of each user must be designed. To help disabled people to take possession of the interface and to reactivate their memory of gestures, several parameters must be taken into account: the continuous aspect of the gesture (to increase the sense of proximity to the object), a maximum contextual speed response with a minimum delay in the resulting action, the accuracy of the response to the gesture, the adequate feedback and acknowledgment of the interface. Depending on the level of autonomy and the ability

of the person, the adequate interface can generate an effect of continuity between the user and his environment, an effect of harmony between his body and the interface. The interface is then experienced as an extension of the body of the user. This can be done using the semiotic approach. We first define semiotics for ICT and health, and then describe our touch screen demonstrator for people with loss of autonomy using this approach. We further extend the concept for the monitoring of home automation equipments.

II. SEMIOTICS OF THE INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) & HEALTH

In his *Cours de linguistique générale*, De Saussure wished to elaborate a science, which could study the “life of signs within the social life [2]”. Semiotics actually describes texts, images, objects, spaces, etc

Semiotics of ICT includes two main themes: (i) the multimedia, multimodal and hypertextual context and graphical and (ii) material interfaces; we can quote the work carried out by the University of Limoges in both areas [3-7]. In both instances, the semiotician examines how a text or an object which is intended to support interaction with a digital service and/or device is perceived. What understanding of service is suggested to the user by a text, or an object? On what mode(s) of perception should a digital support service, for a specific health need, be based? Finally, the semiotician raises the question of understanding both the sensory and cognitive appropriation of the meaning (of the text or object and the support it provides). To globally sum up, semiotics will be the innovative tool to efficiently optimize the parameters that lead to the best appropriation of the technologies by the end-user and to the best assessment of the associated impacts, for the end-users, the medical actors with a feedback to the policy makers.

Semiotics of ICT in the field of health is focused on the way that the user, with the current skills and the gestural and cultural experiences he developed in the course of the practices of his everyday life, perceives digital objects that are intended to help him. In this particular case, it is not only a question of questioning the relevance for a given user (the shape, the size, the colour of an interface), but also of questioning the efficacy of the mode of gestural interaction that the device proposes.

How to facilitate an effective interaction with an object/device based on the user perception? This is this question that we will answer.

Thus, appropriation of ICT objects under a semiotic approach will carry out the following topics:

- Social, organizational, ethical and legal aspects;
- Efficacy and effectiveness of technologies;
- Better understanding of their use.

III. TOUCHSCREEN TABLETS FOR PEOPLE WITH LOSS OF AUTONOMY IN HOSPITAL

An experiment has been carried out in a nursing home (EHPAD in French), in Ajain, (department of Creuse). This structure hosts more than 200 residents and an important medical and nursing staff including a psychologist.

A. ICT architecture and targets

Figure 1 shows the ICT network structure that has been set up in the EHPAD.

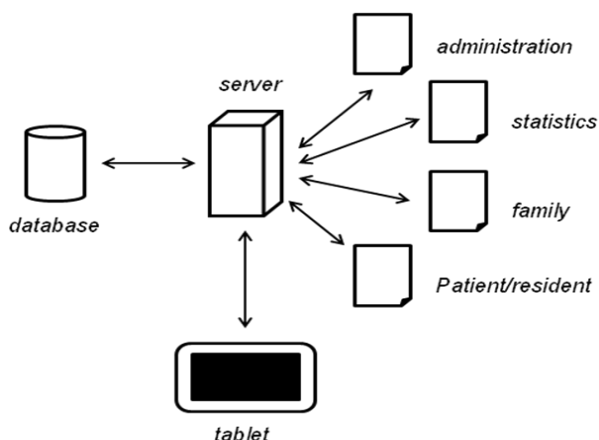


Figure 1. ICT network architecture

Such architecture has been designed to create and manage:

- A database system;
- An administration interface (account management, contents development...) for the EHPAD staff;
- A statistic interface which allows a real-time resident follow-up by the EHPAD staff;
- A family interface which permits to communicate with the family;
- A resident interface (portal) designed according to a semiotic approach.

Figure 2 shows the main portal screen.

B. The applied procedure

The different icons and related pages have been defined in a collaborative work between the residents, the psychologist and the semiotician.

It is important to note the presence of games (*Jeux*). It is recognized that people regularly in stimulating their mental activities (reading, learning, playing memory games, etc.)

delay the effects of age [8]. Games for each specific cognitive domain have been developed always guided by a semiotic approach: memory, attention, executive and visuospatial functions, competition aspect...



Figure 2. Resident personal interface main page

Through the statistic interface, the EHPAD staff can evaluate the progression of the resident: date, time per game, number and levels of errors... and proposes feedback solutions. Figure 3 shows the graphical evaluation of the resident results for a game consisting in reconstituting words from pieces. Green and blue bars compare the time taken by the resident and the average time of all the participants (vertical axis) depending on the difficulty level (horizontal axis from 1 to 9). Red and orange bars compare the number of error of the resident to the average errors of all the participants.

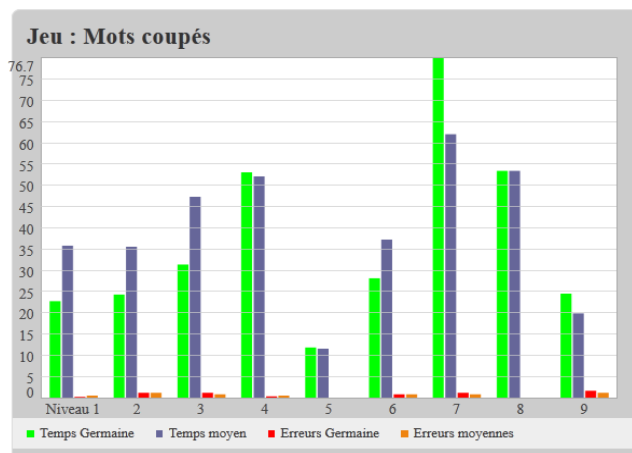


Figure 3. Statistical results

C. Studied sample and major results

Nine residents participated to 16 individual sessions over 7 weeks. The residents were from 74 to 86 years old and suffered from different pathologies: Alzheimer (weak) and Parkinson diseases, cognitive disabilities, depressive syndrome, various disorientations, etc.

From a technological point of view, the graphic chart, navigation system, games scenarios and interactivity have been validated. A touch pen is often preferred to the finger touch.

From a human point of view, all residents showed enthusiasm:

- Always voluntary. No refusal.
- They directly go to the games screen after switching on the table.
- An efficient signage has facilitated learning (contribution of the semiotic approach).
- They absolutely want to finish the game with the pride of success.

This shows that these experiments have provided a “well-being” to the residents and facilitated the work of the EHPAD staff.

IV. APPLICATION OF THE TOUCH SCREEN TABLET FOR THE MONITORING OF HOME AUTOMATION EQUIPMENTS BY THE RESIDENTS IN THEIR PRIVATE APARTMENT

A. Description of the prototype

The prototype is presented in figure 4 and consists in a touch screen associated with radiofrequency modules.

The low cost and low consumption ZigBee radiofrequency link has been chosen for the monitoring of equipments. In addition, it is open source and nowadays becomes a standard.

A synthesis image has been designed using an open source graphic software. The image reproduces in detail the apartment rooms. The resident is able to recognize all his furniture, light switches, windows... and to identify himself to his daily environment as illustrated in figure 5. This allows a better appropriation of the touch screen icons by the resident.

B. Operating mode and improvements

Touching an icon simply activates the corresponding equipment. The result of each action is immediately feedback on the screen: lights are switched on or off, shutters are opened or not, etc.

If the resident uses the classical equipment, the action result is also feedback to the tablet graphical environment.

At the next step, ZigBee modules will be miniaturized and embedded into the touch screen device and equipments. A 3D photo of the apartment taken with a fish eye camera will give a more realistic image of the housing environment.

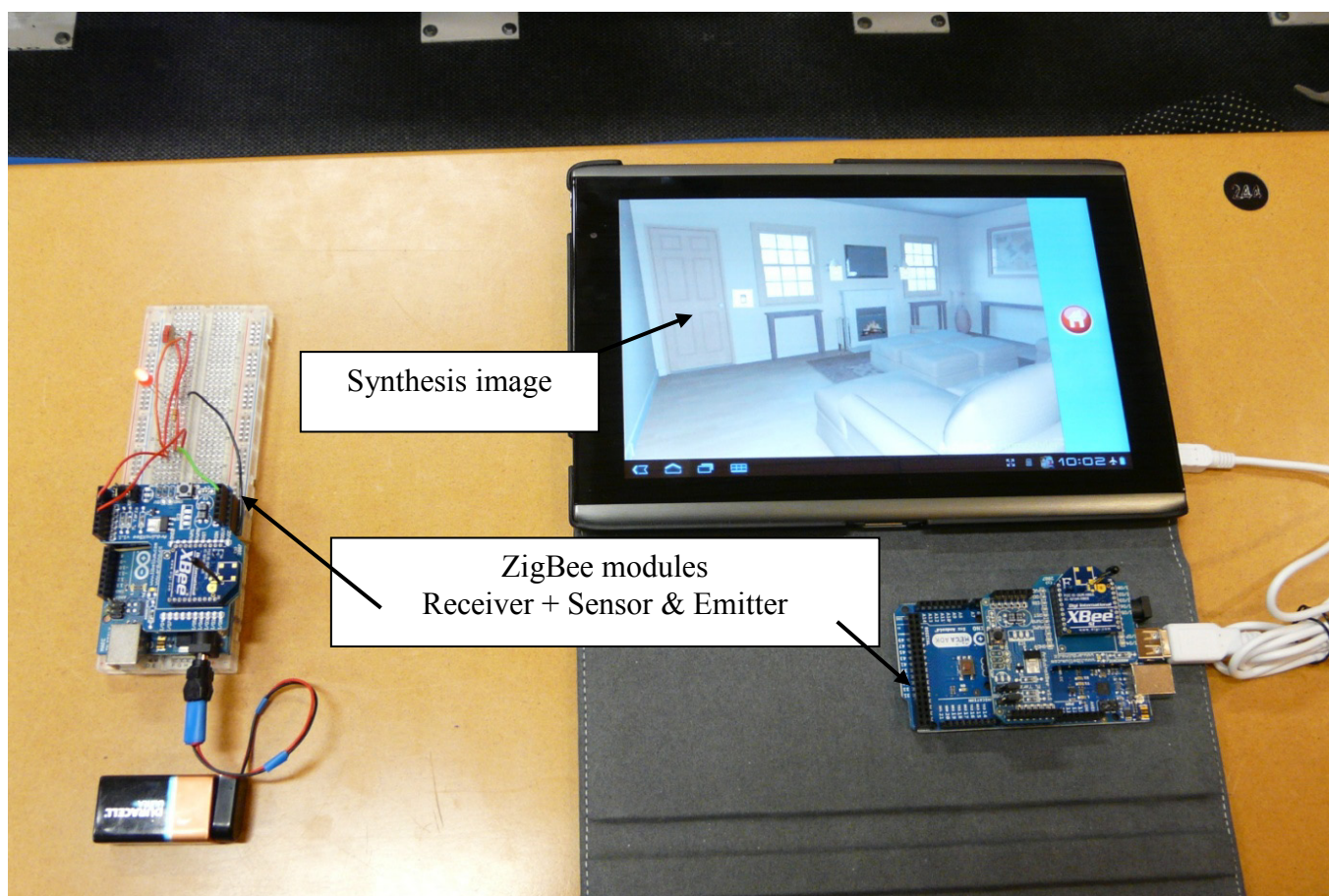


Figure 4. Prototype touchscreen with ZigBee modules

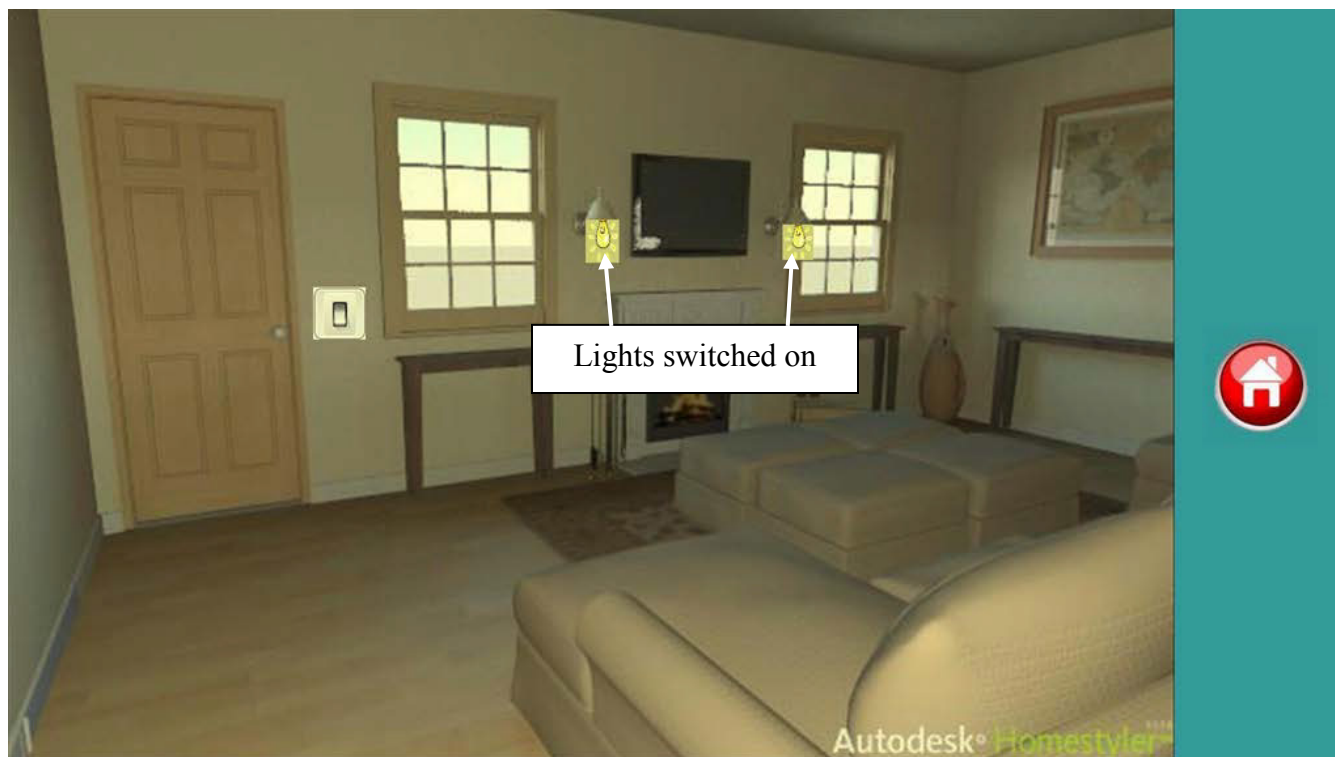


Figure 5. Detailed synthesis image

V. CONCLUSION AND FUTURE WORK

In this article, we show what usage can be made of touch screens to monitor elderly activities and health parameters. Our experimentation is based upon a classical 10-inch tablet on which a portal allows to access several activities. The originality of the interface, at this step, is that the graphic interface and the game types are derived using a semiotic approach taking into account the biography of the person through the memory of gesture.

Next step will focus on the design itself of the graphic interface, to integrate home automation application using the same approach. This command interface will be based upon the use of 3D-picture of the housing environment of the person.

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