Designing a Familiar Technology For Elderly People

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***Abstract* — Older adults have a difficult relationship with technology mostly because hardware and software have not been designed to suit them. For a large part of the old population, technology is unfamiliar and "alien" and even when elderly people perceive the potential of technology, they consider the investment of personal resources needed to use a new artefact as too high. The language spoken by technology is unfamiliar to elderly people because it depends on a series of elements that are out of their culture.**

In the present paper we propose a design approach based on familiarity, investigating how to translate technology language into a language familiar to those individuals grown up before the technological revolution.

I. INTRODUCTION

THE work presented in this paper is based on the findings emerged within the NETCARITY European project on the design of technologies supporting services for social inclusion for elderly people aging in place.

The progressive aging of the world population has huge social and economical consequences that will be crucial in the next decades. Despite the significance of this issue, still there is a lack of technologies at the service of the elderly people. Older adults have a difficult relationship with technology [4], but the conviction that age-related "technophobia" represents the main obstacle to elders' technology usage is progressively disappearing. On the contrary, one of the main reasons for elderly users being neglected by technology is that hardware and software design, and in particular interfaces, have simply not been conceived to suit them [7]. Elderly people have been considered a market niche for the sales of technology products. A real, big advancement step is now required to embrace the challenging vision that considers elderly people as a huge class of relevant users, for whom technology can provide support for physical independence and can stimulate the social and psychological engagement that fosters the emotional well-being enhancing dignity and quality of life. This effort should rise from a design philosophy based on the conviction that senior users are not a niche, but a group of users which have peculiar needs and values that should represent the key objectives of a sound and winning design.

Our generation has grown up in a world filled up with technology, we are used to deal with interactive systems, computers and interfaces and we have created a common ground of knowledge with machines allowing us to interact with them. A tacit, unspoken mass of meanings has instilled in our practices providing us with a language to relate with technology. The generation who has grown before the technological revolution has not the same knowledge, they are not provided with the same common ground of experience, being unprepared to properly relate with modern technologies. In his latest work, Norman speaks about the importance of sharing with machines a common language in order to naturally interact with them [14]. But he points out that technologies are not capable to adapt their language to different classes of humans, unless they are designed to do so. What we tried to do in our work is to design the right language to let the machines properly communicate with older adults, who do not have the cultural tools to access the technological world. In this way technology will be familiar also to those who are reluctant to undertake a relation with it.

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II. SETTING THE PROBLEM SPACE

In order to design a proper language for the machine to speak naturally with an older adult we should firstly answer the question: "Why are elderly people so far from technology?". In the literature we can find a wide range of answers: usability [7], accountability [7], accessibility [21], acceptability issues [12], all seem to play a relevant role. To gain an insight into the phenomenon, we conducted a sociological study focussed on this key question. We performed 5 focus groups (Fig. 1), 15 structured interviews and 7 contextual inquires with a group of 26 elderly people from 65 to 85 years old.

Fig. 1. A focus group

In focus groups we presented to the attendants scenarios of daily life where technology could be helpful, asking them to image pros and cons. In interviews we investigated: (i) how elderly people approach technological artefacts, (ii) which technologies they are used to use, (iii) in which way they use them and (iv) which values they associate to these interactions. In contextual inquiries we tried to access the domestic environment of elderly people to observe the actual use of technology. What we discovered was that older adults would really like to benefit from the services of technology, but they can't understand what technology can do for them and how they can access these services. Two major factors appeared to have a high impact. First of all, the lack of engagement: for a large part of the old population, technology is perceived as unfamiliar and "alien" and is associated with feelings of hostility and anxiety. Second, even when elderly people perceive the potentials of technologies, they consider the investment of personal resources needed to use a new artefact too high. This is a matter of accountability and acceptability because technology is not sufficiently transparent to communicate its uses and objectives, and a matter of accessibility and usability, because elderly people cannot overtake the high step necessary to learn how to reach their own objectives by using a technology.

Drawing from this analysis it clearly appears that a major role in the liaison between elderly people and technology is played by the familiarity of the language used by the technology to tell about its usage, objectives and meanings, covering issues of usability and accessibility, accountability and acceptability and of emotional experience and perceived value. In the next section, we summarize the state of the art of studies considering age-related changes affecting these three main issues.

III. AGE-RELATED FACTORS

Researches exploring the relationship between the aging process and technology have shed some light on the factors hindering older adults' accessibility and acceptance of new technologies and suggest how "traditional" Human-Computer Interaction (HCI) principles should be reconsidered to meet older adults' needs; it is crucial, in these respects, that the peculiar social, psychological, cognitive, perceptual and motor factors related to ageing be considered when designing acceptable and accessible artifacts.

A. Aging and perceptual, motor and cognitive changes affecting usability and accessibility

Several studies report the implications for the design of digital technology of age-related changes in functional capabilities [5]. Designing technologies for older adults means, first of all, to carefully take modifications in perceptual, motor and cognitive capabilities into account. Indeed, usability problems often lead older people to experience dissatisfaction when operating with technologies, with the eventual consequence of rejecting them. Several studies demonstrated for instance how texts can become difficult to read, metaphors and icons difficult to be interpreted, how memory and motor problems can make it hard to operate a system [19].

B. Aging and acceptance issues

User acceptance can be defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed for. Studies conducted on elderly people usage of IT technologies (PC, mobile phones, Internet) demonstrate how the reluctance of adopting communication technologies is not only due to a lack of skills but, above all, to the absence of perceived advantages and benefits [12]. Selwiyn [20] observes that older adults' ambivalence with respect to ICT originates from the limited perceived relevance to day-to-day life. As the relevance of a new artifact depends also on contextual (social, cultural, environmental, psychological) aspects specific to a target group, it is very important to understand the meanings and the values underlying the relationship between older people and technology, and the motivations supporting the use or non use of digital artefacts.

The model of "Selective Optimization with Compensation" (COS) developed by Baltes and Baltes [1], explains why it is more difficult for older people to cope with the challenges of adopting new technologies and new practices. The model posits that "people increasingly tend to focus their limited energy on activities and domains that they perceive as being most essential and valuable in their lives". The perception of high benefits associated with the adoption of new technologies is therefore an important incentive to motivate older people to cope with perceived costs and effort associated with the usage of a new technology [12].

C. Moving from the workspace to the domestic environment: the role of emotional experience

Recent studies point out that designing technology for the home presents specific challenges. As stated by Bell et al. [3], albeit the design of workplace technologies – focused on productivity and efficiency – is facilitated by the existence of well understood approaches, the design of domestic technologies requires the re-thinking of principles and methodologies. Besides usability, other issues become central: emotion, affection, pleasure, and aesthetics. Home is a private and intimate place where artefacts and technologies are "embedded within an ecology that is rich of meaning and nuance" [3]. With the aging process the home acquires other meanings and values. As stated by Oswald et al. [16] "the home becomes more relevant to people as they age, due to the increased time they spend at home, as well as the many activities that take place there".

All these considerations emphasise the importance of the notion of user experience for the design of home technologies, a notion where the user, the objects and the context of use are integrated in a network of actions and interactions. The user experience must find a place and an importance in the design of home technologies that is at least identical to that occupied by the traditional concerns for cognitive and functional aspects.

D. Major implications for design

From the analysis presented above, we have identified the following general requirements and principles for an effective design.

- The consideration of age-related changes in perceptual, motor and cognitive abilities is required to guarantee accessibility. However, awareness of the importance of these aspects must be coupled with the acknowledgment of the importance of the compensatory processes that older people develop to adapt to the changes, and by the crucial role played by motivation, affection, and experience ("learning by doing") in supporting them.

- Acceptance of IT technologies is a complex and multifaceted issue. Drawing from theories of aging - such as the Model of "Selective Optimization with Compensation" - and from NETCARITY findings, we argue that one of the primary goals of the design is to turn technology into something “familiar”, i.e. artifacts that are perceived as belonging to our own world, that fit into our daily practices, and that can be interpreted and used exploiting common and practical knowledge acquired through experience. “Familiarity” knocks down two main barriers to the accessibility to, and acceptance of, digital technologies: the lack of perceived advantages of the technology, and the perception of a negative trade-off between the investment of personal resources required and the expected benefits.

- Finally, the design should be grounded on the affective and aesthetic value of artifacts besides that on efficiency-oriented principles, and should consider the specific meanings and values associated to the home, e.g. the role of the home in maintaining identity and independence.

IV. FAMILIARITY

Pelle Ehn suggests an interesting definition of technology design that fits well with the considerations above:

“As designers of information technology we can be said to have relations to three "worlds": the objective, the social and the subjective. [...] The objective world has to do with rationalistic design. Quality is a question of prediction and control. The social world concerns understanding, interpretation and communication. Quality becomes ultimately a question of ethics. In the subjective world we deal with emotional experiences and creativity. Quality is a question of aesthetics.”[7] .

Adapting this definition to the described problem space, our design process can be represented as in Fig. 2:

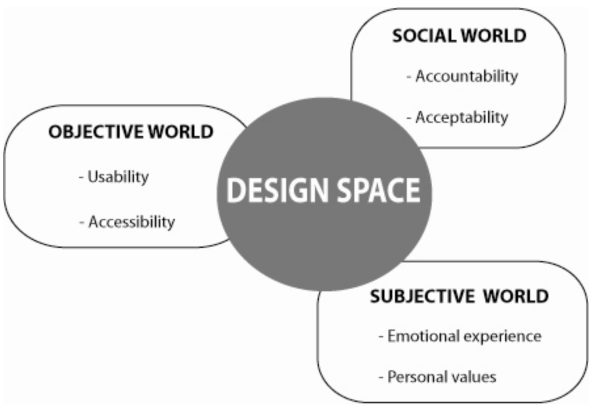


Fig. 2. Problem setting of the design process

The three areas in the figure correspond to the major issues discussed in the previous section, and the role of design is to provide solutions that embrace functional (objective), social and aesthetical (subjective) aspects.

Familiarity-based design [21] was chosen as an appropriate answer to those issues. As our research demonstrated, artefacts are preferable that embody meanings and practices already known by seniors, and do not force them to “adapt” to new paradigms, learning a new language. Current applications and products for elderly people, on the contrary, typically handle accessibility, but they often fail on familiarity. E.g., a web site built to be accessible is surely more readable and simpler, but remains an artefact distant from the culture and knowledge of a senior person. In other words, such a technology is grammatically legible for a senior, but it is based on an unknown semantic. Interacting with a technology does not only mean to fit cognitive and physical features of man and machine. It means also to undertake a relation with the machine, because a technological artefact is seen not just as a mere tool, like an hammer, but as a complex entity [14]. Familiarity is defined by Heiddeger as “the readiness to cope with an entity” [10]. Coping with an entity means understanding it, previewing it and sharing knowledge with it. A familiar technology is something that the user is ready to face on the base of a common ground of concepts, meanings and practices that are not conscious or intended, but that are rather present in a non prominent way [21]. Thus, if we see a new technological artefact for the first time, we just don’t perceive it as a jumble of wires and plastic, but we are able to give it a sense and sometimes we can even guess its functions. This “familiarity effect” is a powerful and needful tool for the design of new technologies, but it stands on the complex net of factors described in Fig. 2, including social practices and cultural schemes (social world), motor patterns and sensorial perception (objective world) and emotional experience (subjective world). All of these factors are peculiar for elderly people, so what is familiar to a young designer can result unfamiliar for an older adult. That’s why very often the relation between elder and technology, even when technology is accessible, is a liaison between strangers.

V. FAMILIAR DESIGN

In NETCARITY we aim at artefacts that are immediately understandable because their syntax and semantics are rooted in the elders’ experience, either because schemes are used that are grounded on familiar cultural practices, or because their physical features (e.g., interaction patterns) are familiar. These requirements do not easily fit with a “classic” WIMP (Windows, Icons, Menus and Pointing) interface [2]. WIMP interfaces are designed to be used just with a keyboard and a mouse. All the interaction lies on point, click and drag actions. Such a small vocabulary of input is used to activate a wide vocabulary of commands. All the interface functioning necessarily rely on a variety of secondary elements, such as menus, toolbars, scrollbars and dialog boxes to specify the commands. For example, in order to view the entire content of a window it is often necessary to shrink or pan the window using toolbars or scroll bars. These secondary objects are not constituting elements of the interface: they are extensions and attributes of the objects of interest, allowing all the actions that is necessary to perform over them. The ensemble of objects of interest and related secondary objects, and the relations that occur between them shape a language, that is the language of the technology. People who do not understand and own this language finds it not familiar. For instance, elders do not know the concept of “panning a digital content” and they need to learn how to use a secondary tool necessary to achieve this task. Furthermore the use of ancillary objects for the task implies the acquisition of a complex syntax: it is necessary to learn which secondary element allows the desired effect on the object of interest (e.g., which tool from my toolbar will turn the mouse drag into a pan action) and in what sequence it is necessary to act in order for the action to take effect (e.g., first point on the window that I want to pan, then select the pan tool, finally drag the contents). This is in contradiction with the issue of familiarity because something that must be learnt and memorized is definitely not ready to be coped with. Unfortunately, eliminating the secondary elements from the interface does not magically assure a familiar language. As stated in section IV, familiarity is a matter of objective, social and subjective factors. A familiar language depends on each of these interface elements. Objects of interest are surely an important factor to be accounted in order to shape a familiar language, but this language is also made up of the interaction modalities with which they are provided with and of the emotional experience and values they are linked to. All these elements should be in harmony in order to shape a familiar language.

A. *Familiarity in interaction modalities*

Stemming from Norman's concept of directness [15], implying short semantic and referential distance and a high degree of engagement, we propose an interaction "completely" direct. As we have seen, classic WIMP interfaces use indirect manipulation of the objects of interest through direct manipulation of secondary objects. What we propose here is to allow the user to directly manipulate every object of the interface as if it was in the real world: objects should be touched rather then pointed and clicked. Clicking is a sudden and precise action, anticipated by pointing; touching an object in the real world, instead, has no reason to be a quick or exact action. Touching is more similar to the action of pressing an object: a prolonged action performed on the object with a certain force. Obviously, the touched object has to behave in accordance with the behaviour of a common object leaning on a plane. This implies the reification all the objects of interest, and the avoidance of every secondary element (such us contextual menus), because an action available through an ancillary tool is not a direct and familiar action, but it needs a specific language, different from the real world one. The physical actions needed to perform a task should recall motor patterns used in the real world, for instance scrubbing with the finger an object to erase or consume it: without a semantic relationship between the gesture and the event on the interface, the action will result not familiar even though the representation is.

Following these guidelines the interaction modality we foresee is based on few rules of interaction and few commands based on natural gestures (e.g. scrubbing with the finger an object in stand of the "erase" command).

B. *Familiarity in the represented domain*

In order to stay close to users' knowledge we aim at designing a reality-based interface. We want the user to perceive a familiar domain where to act, as distant as possible from the idea of a common PC. Metaphors will be used whereby tasks are represented by real world tasks (e.g., switching the light off to signal non-availability), and the objects mimic real world objects(e.g., envelops containing messages). Especially for a senior audience it is very effective to use a representation as close as possible to the real world: representing the device functions and elements in terms of real world objects and proprieties gives to the layman the tools to interpret it. Using real world metaphors it is just a way to equip the user with instructions and to relieve her/him from learning and memorizing procedures. This does not mean to create digital clones of the objects of the real world, but to present novel entities following the real world functioning: into the interface there will be objects that are coherent and reliable to user's knowledge and experience, but not mere digital reproductions of real world tools. In this way users will own the resources to interpret and act in this model-world, and, at the same time, thanks to the digital technology, they will have possibilities they can't exploit in the real world, such as keeping in touch with their social network, share contents with them remotely or just writing a letter several times without wasting paper.

C. *Familiarity in personal meaningful practices*

Stemming from our social analysis we have chosen a context and a domain for our interface not only socially and objectively suitable, but also close to elderly people practices, expectations and emotions. Thus we have chosen meaningful metaphors and a pleasurable appearance. Being familiar means also to evoke emotions and memories. The aesthetics of the interface have the power of "evoking" concepts and meanings activating patterns of emotions, memories and practices already experienced before [18]. Provoking this sense of anticipation turns the interaction into something that is recognizable and where the interpretation is guided by past experiences. So, memories and practices already experienced through one's own life can relive during the interaction giving sense to it.

VI. PUTTING FAMILIARITY INTO ACTION

Putting the principle of familiarity into practice, we have elaborated a set of practical guidelines for the design of interaction interfaces appropriate for elderly people that have been validated with our final users during several sessions of prototype testing.

A. *Look & feel*

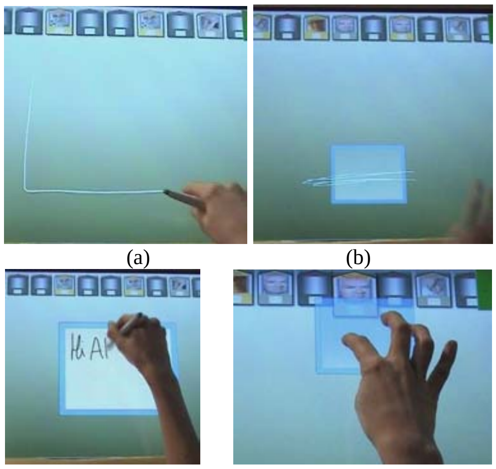
The "look & feel" of an artifact directly impacts on the experience users have using it. Ergonomic, aesthetical and graphical aspects of the artifact should be carefully considered when designing technologies for home interaction for elderly people. In the first place, look & feel concerns perception, so it is very important to consider how the interface can meet the sensorial abilities of the users. Plainness, intended as clearness consequent to simplicity, is a global feature that includes requirements taking into consideration psychophysical and cognitive aspects. In the design of NETCARITY interface we traduced the plainness concept into a list of more specific issues such as: i) avoid visualizing decorative elements that serve no functional goals, ii) use strong contrasts particularly between different objects, to avoid confusing them, iii) text messages have to be written in simple and non technical language, iv) layers of opacity can be an effective way to differentiate between: active objects in the foreground vs. passive objects in the background, v) graphical rendering of digital objects should use a stylized rather than a realistic way, vi) avoid clutter: the interface must look tidy and organised, vii) quick animations are difficult to perceive. Animations should be smooth and slow, viii) the graphical style should not be futuristic or technical.

B. *Interaction modality*

In order to achieve familiarity, interaction must have few clear and simple rules, grounded on the daily experience of the user, in order to let him/her learn and apply them easily and to allow a linear navigation. Such a successful interaction depends also on a well designed information infrastructure and presentation. We specified these general principles in more specific guidelines regarding the input modality, the interaction rules and the navigation. In particular: i) touch-based interfaces represents the best choice because input and output occur at the same time and space thus assuring directness, ii) when touch is the principal mode of interaction, the different modalities of touch (simple touches, drags and more complex gestures) should be clearly distinguished to give different commands to the system, iii) gestures must be highly intuitive, easy to remember and strongly linked with the action they command. Gestures recalling the shape of a physical object (for instance, shaping a rectangle with the finger to evoke a sheet of paper, as in Fig. 3(a)) or a real-life action (e.g., scrubbing with the finger over an object to erase or consume it, as in Fig. 3(b)) seem the most appropriate, iv) every activity must be possible through physical actions that do not require the knowledge of a logical syntax, v) all the tools, properties and resources over the interface have to be reified, that is they have to be designed as concrete entities. A reified concept is self-explaining and does not need instructions or presentation, vi) avoid complex hierarchical structures, vii) navigating through the interface has to be transparent: users should always have clues available that remind them where they are and which activity they are undertaking, vii) avoid unnecessary messages requiring confirmation from users. Confirmation should be required only in those cases where the user may execute a delicate activity by mistake.

C. *Contents*

In order to obtain a unitary and robust representation, the interface has to depict a consistent and coherent domain. The internal coherence of representation is a basic rule to make the interface familiar and usable. Furthermore, the representation given by the interface should be believable. Any irregularity or evident incoherence is a serious threat for the whole interface functioning. If the user refers to its everyday experience to understand and interact with the device, any element contrasting with its experience can mix things up, leaving him/her without knowing how to go on. All the objects of interest in the interface have to resemble to a real world entity and have to function like their real world correspondent (as shown in Fig. 3 (c) and (d)): if we have to represent a tool to write it is preferable to represent it like a pen. The fictional pen has to function like a real one: it has to write when touching a specific surface and it has to spread ink from the tip. The ensemble of objects represented within the interface has to create a recognizable, familiar and consistent domain. All the objects populating the interface have to pertain to the same context. It would be confusing to use a pencil and a car in the same activity, while it is normal to use a pencil with a rubber. Finally, the represented domain has to be coherent with the tasks whereby the interface is designed for: if the interface is meant to write and read text documents it is not a good choice to create a domain recalling the idea of a farm.



(a) (b) (c) (d)

Fig. 3. Sample design solutions based on familiarity. (a) Gesture for creating a new empty document. (b) Gesture for deleting it. (c) Writing with a pen. (d) Moving an envelop to send a message to a friend.

VII. Conclusions

We presented in this paper a design approach based on the concept of familiarity to face the challenge of designing acceptable domestic technologies for elderly. The output of such a design approach should be a technology speaking a familiar language, close to the real world logic and dynamics. Translating this concept into interface design principles means designing an interface physically and culturally embodying the schemes and the meanings at the base of interaction. Embodiment represents a key concept to design for a senior audience. Our research demonstrated how elderly people are reluctant to undertake a learning process remodelling their knowledge and beliefs, discarding everything that requests such an effort as alien. An artefact that embodies meanings and practices already known by seniors do not force them to “adapt” to a new paradigm. The embodied schemes could be both cultural practices, and physical features, so our interface should refer to familiar cultural schemes and to well known physical interaction patterns. This rules out a “WIMP” or “windows-fashioned” logic structure of the interface and interaction modalities based on point and click or other “standard” information system devices.

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