User-sensing as part of a wayfinding design process

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Abstract

User-centered design is a wide term on describing end-users influence on the shaping of a particular design process. A number of methods are used in user-centered design, including checklists and guidelines, observations, interviews, focus groups, and task analysis [1] as well as different kind of tests and pilot projects that constitute the needs measuring of a researcher or a project developer. This is one of the main methodologies used by ergonomics in project development.

Wayfinding is one of the design projects where user-centered design methodologies are necessary and applied. There is a need in defining the circulation axes and the specific areas of a determined environment and this requires a survey of who are those who will use that specific space or building and how they perceive it. A more specific evaluation is needed when projecting a wayfinding system for a hospital, and even more for an ophthalmological hospital. Concerning this last one, a varied group of users will use that particular space, from the person with normal vision until the visual impaired and specifically older people. In this case a evaluation of visual and of other senses perception is needed in order to create an organizational distribution system to be interpreted by all users specifically those with vision difficulties. Visual impaired persons are mainly the elderly and most of the pathologies observed are related with aging and the loss of vision capacities. Common to these eye pathologies, such as the loss of the visual field, are the cornea opacity resulting in a blurred vision and the yellowing of the cornea that alters color perception. The use of user-sensing evaluation process will help us in the definition of the senses that

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more efficiently promote the interpretation and usage of a particular space. For that purpose a participatory design methodology will be required through interviews and tests done to the potential users in order to create the necessary data that will define the guidelines for the wayfinding project development.

This user-sensing design evaluation, waysensing, will focus on color and background contrast color definition for the written material and also on floor stripes; on the legibility and readability, by evaluating the most efficient typefaces, text sizes and letter spacing and on the haptic evaluation of foot touch and its relation with dexterity and balance.

We all use more than one sense to perceive the environment and through the waysensing process the gathered data will guide the development of a multimodal sensory-motor wayfinding system that in this particular case is visual and haptic.

A well-designed wayfinding system can reduce hospital patients’ stress levels, aid efficient business practice, and ensure safe crowd management [2].

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1. Introduction

This paper is a ongoing research project developed at CIAUD - Research Centre of Architecture, Urbanism and Design at the Faculty of Architecture in Lisbon, seeking for the understanding through a user-centered design methodology how elderly people with age-related eye diseases (i.e. glaucoma, diabetic or pigmented retinopathy, age-related macular degeneration and cataract) perceive colors, in order to build a chart of effective color and color contrasts perception, and which typographies are better suited for written information readability and legibility, so that a specific wayfinding system can be designed. There is a correlation between ageing and a level of disability.

This age-related eye diseases (Fig. 1), low vision pathologies, are in consonance with demographic changes. People are living longer with a better life quality reaching 80 years or even more. This longer living due to medical evolution does not mean sometimes a healthier living. Vision is one of the senses that are more affected by aging, aside balance, posture2 [postural components of the musculoskeletal system characteristics change with age [3] and dexterity. Advanced adult age is accompanied by characteristic changes in the eye, retina and visual nervous system [4]. Aging in man is associated with decrements in the functional capacity of a number of organs and systems, which begin generally in the third decade of life [5]. The aging process is as referred by Carolyn M. Aldwin et al (2006) [6] as one of the most striking changes paradigm since the mid-1960s with the recognition of both individual differences and plasticity in the aging process, where some individuals become severely disabled in midlife whereas others, albeit rarely, are running marathons in their seventies and even eighties.

The focus on the present research will be centered on age-related eye diseases and on haptic perception, in particular plantar perception, on how they interfere with elderly people’s lives, being aware on the relation over their independent mobility, mainly dexterity and balance in hospital environment.

Elderly with vision disabilities may experience difficulties in identifying the street-crossing graphic representation on the left image (Fig. 2). The contrast effect of the white stripes (image on the right) over the black tar, permits the elderly to be sure that it represents the crossing, while the two longitudinal stripes (image on the left) does not define so evidently that purpose.

Woollacott (2007) also refers that it has been shown that strength of the leg muscle can show a reduction of 40% in young (30 years) vs. older adults (80 years).
Changes in vision, hearing, taste, smell, and touch may deprive older persons of necessary sensory cues to perceive the environment and may influence both their behavior and the behavior of others toward them and the consequence may be loss of independence [7](Guccione 2000, p.134).

Partial sight, aging and congenital color deficits all produce changes in perception that reduce the visual effectiveness of certain color combinations [8]. To a person with color-deficient partial sight, the left-hand panel (Fig. 3) might appear like the right-hand panel appears to a person with normal color vision [9].
Two colors that contrast sharply (Fig. 4) to someone with normal vision may be far less distinguishable to someone with a visual disorder [10].

The application of a correct color can promote an independent mobility in elderly people and contribute to well-being and self-esteem. Few buildings provide appropriate design features and navigational aids to enable people with a range of sensory impairments to move around with confidence and ease [11]. Designing for the needs of the disabled people has never been a significant feature of the development process and when professionals incorporate disabled needs into projects, there is a tendency to reduce disability to the wheelchair mobility impairment user only [12].

2. User-(centered) sensing design for an Inclusive solution

Applying a user-centered design methodology or a user-sensing process is in fact an evaluation of users’ capacity and eventual limitations or disabilities for introducing usability as a primary focus on a determined project. It represents a cue for developing an inclusive solution or response to an environment, which clearly has different users profiles identified.

Salmen and Ostroff (1997) [13] suggest that designers cannot get information from books, databases or design criteria alone. They must involve the future users, the customers of the design, and develop a process, which is broadly representative, user responsive and participatory.

The user-centered design methodology should be seen as a social design principle that is working with the users and not for them, and as Ostroff (2000) [14] refers to the needs and limitations of users being unfamiliar, the designer can learn a great deal from the experience of the potential consumer.

For the developing of new tools for the creation of a wayfinding fitted system there is a need to survey users needs and limitations. The traditional use of signs has failed to overcome the problem of wayfinding in hospitals [15]. Being aware of the visual disabilities of the elderly users, the questionnaires that are being held are demonstrating the disparity of problems related to the different pathologies. In parallel some visual tests, composed by hospital existing services toponymy, are also presented to the patients for scale legibility and readability evaluation. Further questionnaires and tests will be presented reflecting some of the transversally accepted results. Fig. 5. represents the process for this particular research by demonstrating the steps that are being carried out. This evaluation of the senses perception process – Waysensing – is centered on the perception measuring of the written information, the background colors that are more suitable for this written information and the definition of its
physical positioning. In addition haptic plantar tests are also being held, for the measuring and shape understanding through foot touch.

![Diagram](Image)

Fig. 5. Waysensing process as a user-sensing evaluation for attaining the right model of wayfinding (Source: author)

Through this user-sensing evaluation it is expected to gather important aspects of the daily problems that users experience, which represent valuable data for the design project that will influence and orient as guidelines throughout the whole creative process.

The research project aims to the installation of a wayfinding pilot project, that apart the visual aspects of a wayfinding system, introduces a floor haptic coding for promoting a second level of information for space orientation. Devlin & Arneill [16] point out on the limited number of studies dealing with person-environment fit in hospitals.

### 3. Design, wayfinding and environment

The fundamental purpose of design is to change the form and organization of our material world and even change how we interact with it, because it is more than aesthetics which is primarily a surface effect [17].

We are at some level disabled when accessing a “new” building [18] by the simple fact that we don’t have the knowledge of its structure, what makes us, users, become disoriented and lost. Good design for wayfinding facilitates user access, increases satisfaction and reduces stigma and isolation of users with disabilities, reducing also confusion of visitors and mistakes by employees, saving time and money and preventing accidents [19]. Weisman (1981) [20] refers that this ability to find one’s way into, through, and out of a building is clearly a prerequisite for satisfaction at higher goals.

Design can act as a powerful contribution on solutions or features creation to aid a wayfinding system to be user-effective [21]. Landmarks can be created using all of the senses, not just sight [22]. Multisensory cues should be used as much as possible both to accommodate people with sensory limitations and also to create a stronger “signal” [23]. Subtle color cues, being part of our daily experience, are used continuously to help us understand and move through space [24], in particular traffic signals. Understanding the properties of color, how people perceive them and how they interact with one another is a Designer need [25], especially in wayfinding design projects. The usefulness of a product or project can be defined in the two following standpoints: one, its utility considering whether functionality provides what is needed, and usability that concerns how well users access that functionality [26].

Physical therapists of age-related sensory changes and environment modifications should provide their knowledge, in particular of public buildings, to architects and designers for fostering safe access of facilities by older individuals [27].
4. Visual and haptic

Space or architecture are experienced in a multisensory way, although most people evoke visual associations [28], and are haptically explored through movement and by means of a step-by-step process or as a haptic scanning as done with the eyes. Introducing texture in the environment can be valuable in assisting independent function of older individuals, especially if there is impairment in other senses [29]. Tactual shape perception has to be understood as intersensory processing, which depends on the balance of complimentary information from touch, posture and movement [30]. If by one hand touch may be an impoverished modality compared to vision, on the other, it is an expert system by which we can identify small objects with great accuracy (Katz, 1925, 1989; Klatky et al., 1985) [31]. In both haptic and visual perception, the stimuli rely on material (texture, temperature, density) and space characteristics (form, place, orientation, length) [32]. Révész (1950) also suggests that in space perception the haptic space is centered on the body whereas vision is centered on external coordinates [33].

Vision is important in identifying environmental cues and distinguishing environmental hazards. As people age, changes in vision and visual perception may lead to misinterpretation of visual cues and result in functional dependence [34]. Within the environment, the relaxation of the upper eyelid and loss of retrobulbar fat resulting in eyes thinking more deeply in the orbits, this decrease in upper visual field may cause older individuals to miss cues found above head level, such as direction and information signs in buildings or streets [35]. Peripheral vision (the inability to detect motion, form or color on either side of the head while looking straight ahead) is particularly significant for elderly persons, because they must be able to detect people or objects in the lateral field for their safety in the environment [36]. The ability to perceive, differentiates, and distinguishes colors declines with aging as a result of changes in retinal cones and the lens [37].

The difference between the visual and the haptic processes is that haptically we perceive every part separately and on reverse we start by seeing the whole, but do not see the structure immediately (Rèvész, 1955) [38]. Whereas visual sensation only relies on two-dimensional information, i.e. an image, haptic stimuli are three-dimensional in the first place, but can be felt as two or three-dimensional dependent on the scale of the environment [39]. But in every day perception, touch and vision operate together [40]. Elderly people with a low vision condition cannot rely on their vision to perceive the environment, they need to experience space through touch (foot touch) in order to be able to act independently in a building and to find their way around as well as to ensure a safe walking. A haptic system on the pavement can be introduced in a wayfinding system as a way to promote a sensory access to information for this target group. The development of a wayfinding system that uses adjusted color and color contrasts to the pathologies of low vision, such as communication signs on the walls and guidelines on the floor with haptic information “where the perceiver seeks information from the world by exploratory movements” [41], may produce the results needed for the visibility of a hospital wayfinding system.

5. Percept Walk

This research project, Percept Walk, can be defined as the sensorial capacity that allows a human being of collecting the explicit information of the physical environment, in particular the spatial organization, in order to act in conformity, which in the present research is of visual and haptic touch order. Within the project different phases of sensorial evaluations will be held with low vision patients, users and medical staff.

Percept [42] is the conscious experience of sensory stimulus and reflects the stimulation of the sensory system (e.g. eye, ear, skin), and is also determined by higher cognitive processes, such as attention and memory. Perception is our mind’s window on the world [43] and the awareness of more complex characteristics of stimuli [44].

The use of a sensory-motor wayfinding systems joining a correct color use for legibility and readability of written information, associated with simplified pictograms, also applied in effective contrasts, and supported by a haptic system (foot touch) on the pavement, may result in an effective way of displaying information in hospital environments. Older people with a low vision condition need a wayfinding system that can be seen by them at a relative small distance.
In order to diagnose effective wayfinding needs, an analysis of the building accessibility and mobility, materials and lighting, users’ flows and existing visual communication will be carried out.

6. Case Study

The survey is being held in a hospital dedicated in exclusivity to problems related to vision, beginning with the identification through an initial screening, having different pathologies follow-up and control in specialized consultancies, surgeries when necessary, to patients reinsertion with extreme low vision condition in active life through the teaching and use of white cane as an auxiliary mean of dislocation.

The attending structure disposes of a vast set of consultancy, exams and medical treatment rooms, offering a personalized reception environment on the attendance of general consultancy and sub-specialties like retina, glaucoma, strabismus, refractive/external ocular surface surgery, ocular genetics and low vision. The sub vision (low vision) area offers full support to users through a multi disciplinary team. Number of medical consultations in 2010 was of around 47.000 people, being ophthalmology responsible for 89% distributed by retina 20%, estrabismus-genetical-pediatry 7%, glaucoma 7%, ophthalmology general consultancy 52%, anterior segment 4% and low vision 2%.

7. Work in progress and future work

Work is being implemented as in Fig. 5, with a continuous evaluation of visual and haptic perception on patients/users of the hospital. The participatory design methodology is an enriching experience within the research, narrowing the understanding of how patients, some with severe eye pathologies, act on their day-to-day living. The
challenge it represents for some patients the fact that being 5 cm away from a sign and not being able to read a 45 mm high letter or even identify the background color, but being able to be in a hospital located one hour away from their homes and comfort zone.

As future work, the evaluation of all data obtained in the questionnaires and tests, and the identification of landmarks and nodes in the building that will permit all to act autonomously and safely in their usage of this specific space.

References