Percept Walk: Promoting perception awareness on the elderly with low vision

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ABSTRACT

Some evidences related to demography will change the way we design built environment, mainly hospitals. The world is facing a situation without precedents, so that soon there will be more elderly of extreme old age than ever before. With a continuous decline in death rates and rising life expectancy among them, reaching 80 years and even over 100. Living longer with a better life quality doesn’t mean a healthier living, but a hospital care dependency related to health problems. We are facing a change of the demographic profile for which we must undertake a mentality readjustment in order to suit and give qualitative answer to these groups’ life. With an increasing ageing population, the burden of age-related sensory impairment is expected to increase. There is a growing interest in the effects of the physical environment on the health and well being of the elderly and disabled population. The research is being held in an ophthalmology hospital, where all kinds of eye pathologies are treated, though presenting difficulties in colour discrimination and perception, incapacity of reading at distance and interpreting complex pictograms. For a structured and effective research a participatory design methodology is considered to evaluate patient’s low vision condition and working health professionals testimonials, through observation, interviews and tests validating its results with groups of specialists. The final result will be the installation in this hospital of a sensory-motor wayfinding system (Percept Walk) reflecting the conclusion held in the research process.

Keywords: Percept Walk, low vision, wayfinding, kinesthetic perception, participatory design.
INTRODUCTION

As part of an ongoing research project – Percept Walk, developed at CIAUD – Research Centre in Architecture, Urbanism and Design at the Faculty of Architecture of the University of Lisbon, this research has as final objective to promote an independent way for elderly people with low vision condition to act autonomously in hospital environments using a sensorimotor wayfinding system, combining a kinaesthetic haptic perception system applied on the floor with an adjusted to low vision pathologies wayfinding system.

This PhD research project overlaps different research areas, using literature review and case study methodology, using relevant international case studies, and has an experimental phase developed in two Portuguese hospitals, using participatory design.

As main result, it is expected the developing of new tools and the creation of an Information Design model supported by a user-centred design process for an orientation system that, besides the most important act that is orientation, will also promote independency and, consequently, self esteem on people with visual impairment. It is also expected that, giving nurses and medical professionals more time to do their job and not having the need to help users, who cannot perceive and interpret the space, by showing at all time the destination required, their work will be more valuable for the institution where they work.

A number of researchers have commented on the limited number of studies dealing with person-environment fit in hospitals (Devlin & Arneill, 2003, p. 667). Steinfeld (1994) proposes, within an universal design approach, that in order to build an environment that eliminates unnecessary expenditure of people’s effort, is the necessity of organizing space and design devices that simplify the task of using it (i.e. a building), for useless movements should be eliminated, being this simplification of the environment the use of color and textures contrasts (Hall & Imrie, 2004, p. 15). Ostroff (2000) states that the designer can learn a great deal from the experience of the potential consumers, where the needs and limitations of users may be unfamiliar (idem). In this matter RNIB (1995) reinforces the need of breaking down barriers and exclusiveness through a design approach that sets out to include as many people as possible, without denying the need for solutions to meet the needs of specific type of impairments (Barker, Barrick, & Wilson, 1995, p. 13).
CONTEXT

A new paradigm has significantly transformed the world’s demographic organization in the last century, in result of a rapid increase of an elder population, as reflex of the decline of birth rate and the increase of life hope. Today the elderly have a bigger longevity, reaching the old age later and with a better quality of life. But this better quality of life does not reflect possible problems related to health. Aging is related with the state of health and implicitly related with the general functioning diminishing (Kent & Butler 1988 apud Fontaine, 2002, p. 55) and of common knowledge that these problems grow in a constant form (Birren & Shaie, 2006).

Some biological changes occur in the human organism with aging and may influence human behaviour, such as a decline in mobility and dexterity and a difficulty in balance handling, a decrease in strength, and also a reduction in sensory acuity. Aging is directly related with the health state and implicitly related with the general functioning reduction (Kent & Butler apud Fontaine, 2002, p. 55) and it is of common knowledge that these problems increase in a constant way (Birren & Shaie, 2006). These disabilities related to aging affect the way elderly people perceive and interact with the built environment. Some changes in how we communicate buildings’ visual information, mainly hospitals, ought to be reviewed and redesigned in response to this elderly population increase, who in reality are their main users.
WAYFINDING

The word way-finding exists in the English language since the 16th century, with the sense of traveling (Berger, 2009). A generation of designers emerged after the economical boom from the US in the 50’s, with important names in graphical material production, emigrated to the USA, such as Paul Rand, Saul Bass, William Golden, who recognized the need for the introduction of signage and orientation systems in buildings, companies, cities in response for the multi racial and linguistic public (idem), reflex of the emigration between 1880 and 1930 (Massey, 1995). In the period referred 28 million emigrants, from different countries, entered the US country as described by Handlin (1951) in “The epic story of the migration that made the American people” (idem). In result of this massive emigration and consequent multiculturalism and profusion of languages, cities became bigger needing a restructuration and the development of visual information and orientation systems so they could be used by all citizens, the existing and the new ones. In the 60’s the word wayfinding was used for the first time in Kevin Lynch’s (1960) published book, “The image of the city”, that was based on the spatial orientation and its precondition the cognitive map, what Lynch defined as the “image”, that was the element of recognition of some already visited points that act as reference and localization. In his book the city was characterized through paths, edges, references, nodes and districts designations that are today still used in information design theory. Lynch transmits us the idea that we are not simple observers, but in a stage, in conjunction with other participants, in the observation of this references (images) that we are absorbing from the city, even if the city is never an accomplished project but something in constant evolution. In the 70’s was created the SEGD - Society of Environmental Graphic Design in response of the need of the creation and sharing of technical information and counseling of this new specialization area. The wayfinding system, this new discipline, had in 1968 an important role on the definition of accessibility in the Mexican Olympic Games, where Lance Wyman developed a program of information design covering the Subway distribution scheme for the Mexico city, the brand for the event and the public visual information system composed by pictograms of all the modalities involved (Berger, 2009). This representative way of communicating had a more universal understanding by a public that came from different points of the globe.

This design generation applied principles of different valences of Design, Architecture, color theory and symbols in the information construction that would deconstruct and would turn the built environment accessible to all (Golledge, 1999).

Charles Hilgenhurst (1971) stated in the sequence of the cities increase into a scale where new tools would be
necessary in orienting people and for the appropriation feel (Berger, 2009, p. 19): “Today we are strangers in our own towns. We do not know how and cannot see it works. Our support systems ... are remote. The information supplied in the environment is largely irrelevant to our immediate purposes or to an understanding of the world in which we live”

Wayfinding is the process of following a path or route between an origin and a destination (Golledge, 1999, p. 6) and can be applied to a variety of situations and environments, using for this effect a compromise between pictogram of a broad interpretation and a text as an identification of the destiny. It assumes an approach of a deconstruction of a space, converting it into an understandable and usable through a study, a diagnosis and an evaluation of a tenet set, so that a specific space performs that primary objective: orient through graphic and textual information and the support of three-dimensional graphic elements, a spatial language that permits a more realistic space analogy (Larkin & Simon, 1987 apud Freksa, 1999). Wayfinding is a natural process that people learn since childhood (Piaget & Inhelder, 1967 apud Freksa, 1999) and it is a purposive, directed and motivated activity (Golledge, 1999, p. 6).

Wayshowing is proposed by Mollerup (2005a) as the understanding for what needs to be introduced in a wayfinding system so that it produces the objectives identified, that is, leading a person to its destiny through a comprehensive structure of information with text and pictograms, previewing that this comprehension includes also people with disabilities.

In most public buildings, in particular hospitals, most wayfinding systems don’t reflect some of the limitations identified, which in fact need to be adapted to information with effective color contrasts, dimensionally rewritten textual and pictogram/infogram information or even haptic perception devices for more efficiently promote legibility and readability, orientation and mobility and above all autonomy and well-being. A wayfinding system should aid design features that could reinforce multisensory cues to accommodate people with sensory limitations (Steinfeld & Maisel, 2012, p. 276), and also for those who are visiting a building for a first time or occasional visitors where the environment means an unknown place for them.

Nelson-Shulman, (1983-84) found that patients who have the benefit of an information system are more self-reliant and make fewer demands on staff (Rooke, Tzortzopoulos, Koskela, & Rooke, 2009, p. 5). Carpman et al., (1984) suggest that directional signs should be placed at or before every major intersection, at major destinations, and where a single environmental cue or a series of such cues (e.g., changes in flooring material) convey the
message that the individual is moving from one area into another (idem). Heulat (2007) links good wayfinding with good patient flow, and asserts that applying simple organizational architecture and graphic principles not only reduce patient stress and anxiety, but also can lead to improved health (idem).

**INCLUSIVE DESIGN**

“The need for design change is not limited to consumer products. It should also be a priority for designers involved in the public services. From design of printed matter and communications and information technology, to the design of transport, housing and public buildings, a better understanding of users’ needs, can dramatically improve the independence and quality of life of the vast number of older users. But for these endeavors to be most effective, we need to go beyond the numbers, to understand the lifestyles of today’s older adults, as well as their physical and mental capabilities” (Huppert, 2003, p. 31).

Inclusive Design also called Design for All or Universal Design has of recent years become synonymous with a designed world enabling everybody to participate in life and the activities taking place in our society on equal terms (Kenning & Ryhl, 2002, p. 6) and emerged out of the disabilities rights movement ensuring equal opportunity and eliminating discrimination based on disabilities (idem, ibidem. p. 15). If we do not implement universal design now, the economic burden of an aging society will even be greater in the future (Steinfeld & Maisel, 2012, p. XII). Design is an active, purposeful adaptation method that people use to adjust their world to their needs (idem, p. 1). Inclusive design constitutes a framework and growing body of practice within which business decision-makers and design practitioner can understand and respond to the needs of diverse users, with the ultimate aspiration of developing products and services that can meet the needs of the whole population within the context of a consumer society (Coleman, Lebbon, Clarkson, & Keates, 2003, p. 10).

Design Council refers that an inclusive environment does not attempt to meet every need, but by considering people’s diversity it can break down barriers and exclusion and will achieve solutions that benefit everyone (The principles of inclusive design, 2006). Places need to be designed so that they can adapt to changing uses and demands (idem, ibidem). Everyone will at some time experience limited mobility or visual problems.

As referred, people are living longer and the lifespan has increased. Potential consumers or users of the design who may be functionally limited by age or disability are increasing at a dramatic rate, representing a significant population (Story, Mueller, & Mace, 1998, p. 14). An understanding of human diversity is critical to designing
effectively, and a successful application of universal design principles requires an understanding of how abilities vary with age, disability, the environment, or the circumstances (idem, ibidem, p. 17).

Buildings should provide appropriate design features and navigational aids to enable people with a range of sensory impairments to move around with confidence and ease (Hall & Imrie, 2004, p. 3). The principles of inclusive design are important and potentially progressive in seeking to restore disabled people’s self-esteem, dignity and independence, while encouraging the development and implementation of user-friendly design (idem, p. 16).

Salmen and Ostroff (1997) suggest that designers cannot get information from books, databases or design criteria alone, they must involve the future users, the costume of the design and develop a process which is broadly representative, user responsive and participatory (Hall & Imrie, 2004, p. 15).

**UCD - USER-CENTERED DESIGN**

Park (Norman, 1990, p. 188) refers to user-centered design as a philosophy (POET – The psychopathology of everyday things) based on needs and interests of users, with an emphasis on making products usable and understandable, on which he refers the main principles for an evaluation:

- Make it easy to determine what actions are possible at any moment.
- Make things visible, including the conceptual model of the system, the alternative actions, and the results of actions.
- Make it easy to evaluate the current state of the system.
- Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.

These recommendations besides placing the user at the center of the evaluation process, focuses on the role of the designer, which is assuring the usage of that particular product with a minimum effort. In order to accomplish these, the design process has to involve the user by an investigation and identifying their needs by use of performing tasks and analysis. User-centered design is not giving the user what he wants, but identifying and mapping all necessary data through a participatory design methodology. When developing a hospital wayfinding system for elderly people with visual disabilities, knowing how they perceive space and act within will contribute in a more effective way in the design decisions. The evaluation of needs is being developed with a battery of questionnaires,
visual and haptic tests, sub-divided in 4 main phases (see methodology). The importance on knowing how users sense and perceive the environment is key issues for the design process.

**DISABILITIES AMONG ELDERLY PEOPLE**

“Our senses are the instruments of communication that facilitate our relationship with the environment” (Meerwein et al., 2007, p. 13).

**VISUAL DISABILITIES**

This major longevity due to the progress of medical science and social-economic conditions brought an apparent well being for a longer period of time. But reality shows that a large part of the older people present a major dependency, in general, related to health problems. This situation is part of the population that in result of aging have their visual capabilities declined (Mitchell, Hayes & Wang, 1997; Tielsch et al, 1995 apud Gohar, 2009) with the gradual aging of the eye’s functioning, with changes in the retina and eye’s nervous system affecting acuity, accommodation, speed of adaptation to change and a variety of perceptual disabilities such as blurring, decrease spatial abilities, loss of colour discrimination etc. (Wijk et al., 1999; Wijk & Sivik, 1995 apud Gohar, 2009). We all can suffer from low vision, having a major incidence on the elder age-groups (CEBV, s.d.). Most of these visual losses are related with low vision, in people over 60 years, and it provokes intensive medical care needs in hospital ophthalmology services. With age, people change physically, mentally and psychologically and these changes involve multiple, minor impairments in eyesight, hearing, dexterity, mobility and memory (Haigh, 1993 apud Coleman et al., 2003, p. 121).

The effects on aging in the visual system appears at 40 years on the optical structure and from de 60 years on the retinal structure (Fontaine, 2002, pp. 72–74) producing modifications in both optical structure and retinal system. In the optical structure, it affects the transmissibility and its accommodation capacity, translated into problems on objects distance perception, in depth, in sensibility to obfuscation and colors. This happens due to modifications in the four optical structures:

- cornea opacifies becoming thick and rigid provoking an augmenting of astigmatism and blurred vision;
ocular muscles linked to the crystalline, atrophy provoking a decrease in the capability of eye accommodation, resulting in difficulty of seeing objects when near;

- crystalline (the lens that permits the projection of images on the retina) becomes rigid causing a diminishing in the accommodation capability, and yellows, modifying the light composition projected on the retina and sometimes becomes opaque, causing cataract in the elderly;

- posterior chamber, containing the vitreous body liquid, liquefies and has a tendency with aging to become clearer and gelatinous and the result is a augmentation to sensibility and obfuscation;

On the retinal system the receptor cells (cones responsible for seeing in colors and rods responsible for seeing in black and white) are located in the fovea (the central part of the macula) and suffer chemical alterations by lighting excitation, which results in the generation of nervous influxes that reach the occipital areas of the brain through the optic nerve. With aging augments the probability of macula cells’ degeneration resulting in loss of fine detail vision. These effects on vision and also in hearing are general cognitive functioning sensorial deficits and of central nature, associated to neuronal deteriorations, as seen in some research works on elderly people aged over 60-70 years (Werner et al., 1990; Fozard, 1990 apud Fontaine, 2002, p. 75), although other researchers don’t see a significant association in this deficits (Horn, 1980; Schaie et al., 1964; Raz et al., 1990 apud Fontaine, 2002, p. 75).

There is considerable diversity in visual capabilities within the older population, although in general, prevalence of visual impairment accelerates after age 65 (Fisk, Rogers, Charness, Czaja, & Sharit, 2004, p. 49). The diversity is due in part to variability in aging processes, in the increased use of assistive devices for age-related changes compensation and also the increased frequency of surgical interventions that modify the visual system (idem, ibidem, p. 50).

**LOW VISION PATHOLOGIES**

Few eyes that have survived 65 or more years of life are free from at least some slight sign of deterioration, degeneration, or past or present disease (Jackson & Wolffsohn, 2007, p. 78). Low vision could be defined as vision that, when corrected by optimal refractive correction, is not adequate for the patient’s needs (idem, ibidem, 2007, p. 10), and also that it has to be seen as the attention to the retained residual visual and not the one that is lost.
The most prevalent etiologies in low vision are **AMD** (age-related macular degeneration) responsible for the majority of cases in severe loss of central vision, **cataract** symptoms include decreased in visual acuity, in color perception, in contrast sensitivity, glare disability and gradual onset of blurred vision in distance, **glaucoma** with either visual field (peripheral) loss and/or optic disk cupping, difficulty in functioning in dim light, decrease in contrast sensitivity, glare disability and decrease in dark/light adaptation, **diabetic retinopathy** characterized as a blurred vision (Jackson & Wolfssohn, 2007, pp. 77–92; Rosenberg & Sperazza, 2008). Sighted persons explore the environment with the sensory apparatus available, and so does the blinded and the visual impaired primarily through tactile, auditory, olfactory and kinesthetic information gathering (supplemented by any residual vision) (Barker et al., 1995, p. 14). For the creation of buildings or environments that respond effectively to the needs of the visually impaired people, it is important that there should be some understanding of the nature of visual loss (idem, ibidem, p. 21). Any design change must be useful, practical, empowering or enabling, and the individual user is always the best judge of any building modification, therefore being essential the participation of the visually impaired in the design process (idem, ibidem, p. 18). The elderly visual impaired are the group that optometric practitioners deal more with, and most of them react well with the situation although a small minority has never accepted the situation and isolate themselves in their homes.

**SELF-ESTEEM AND INDEPENDENCE**

Self-esteem refers to a person’s sense of value and worth, a sense of competence and adequacy, a sense of self-satisfaction (Tuttle & Tuttle, 2004, p. 6). “Self-esteem is the lived status of one’s competence in dealing with the challenges of living in a worthy way over time” (Mruk, 1999, apud Tuttle & Tuttle, 2004, p. 6). Success in
independent travel tasks, even at the beginning levels, can bring about an improved self-concept, a greater sense of independence, and improved motivation for other tasks, but the opposite may lead to an increase of dependency, isolation (Welsh, 1980, apud Tuttle & Tuttle, 2004, p. 28). Self-esteem and self-satisfaction result from independence acting on the decision of doing things by ourselves and not relying or expecting from others to accomplish that specific task. Chapman (1978) describes the acquisition of independence as a gradual process of decision making, a act by itself and responsible (Tuttle & Tuttle, 2004, p. 59). Research is beginning to show that self-esteem may be an important factor in health behaviors, coping and well-being (Birren, 2007, p. 461). Welsh (1980 apud Tuttle & Tuttle, 2004, p. 28) points that the lack of independent travel tasks may lead to increased dependency, isolation, hopelessness but also on opposite, success in independent travel tasks, even at the beginning levels, can cause an improved self-concept, a greater sense of independence and improved motivation for other tasks. One of the key ingredients of better adjusting patterns is a healthy self-concept or positive self-esteem, the affective component of self-concept (idem, ibidem, p. 56).

Information design oriented to this target group can act as a way of promoting this self-esteem through independent mobility. By analyzing through a participatory design process users usage of the hospital (identifying main circulation axes, existing navigational signage and space materials and lighting characteristics), and a space existence characterization, the information obtained in both fields will constitute an important tool in diagnosing the essentials for building an effective action plan for that determined space. Although the research seeks the relation of patients with a space, it proposes overall a simplification of the orientation information. Simplifying a wayfinding system in a determined space will without doubt improve its comprehension and promote self-esteem by promoting an independent mobility to its users.

When walking, most of the elderly with low vision defend themselves from unbalance or falling by dragging their feet in order to feel the ground. By this defensive way of walking they can react when perceiving eventual irregularities on the ground, because falling is feared by the elderly representing long time in hospital or at home in bed due to extended time bone recovery, a factor related with aging. Klatzky and Lederman (2003, p. 147) describe this action of exploratory movements as an active modality for perceiving information from the world.

**PERCEPTION**

Perception is the process of interpreting information received from the senses (Goldstein, 2010, apud Steinfeld & Maisel, 2012, p. 108)
Perceptions are a set of physiological and psychological mechanisms whose general functions are to gather information in the environment or in their own organisms (Lieury 1990 apud Fontaine, 2002) and are polisensorial because they are product of an integration of diverse sensorial messages. We all use more than one perception to sense a determined space or an action. In everyday perception touch and vision operate together (Klatzky & Lederman, 2003, p. 147). Perception is the awareness of more complex characteristics of the stimuli, the activation of the sensation cells and the interpretation of that information by calling on stored memory (Fisk et al., 2004, p. 13). However, limitations associated with perception, cognition and the control of movements increase in prevalence as one ages.

When walking, most of the elderly with low vision defend themselves from unbalance or falling by dragging their feet in order to feel the ground, because falling is feared by them representing long time in hospital or at home in bed due to extended time bone recovery, a factor related with aging. By this defensive way of walking they can react when perceiving eventual irregularities on the ground. Klatzky and Lederman (2003, p. 147) describe this action as exploratory movements as an active modality for perceiving information from the world. But our ability to cope effectively with the environment begins with our capacity to process the sensory input (Schieber apud Birren & Shaie, 2006, p. 129). Our senses have been carefully crafted by the forces of nature to effortlessly extract critical information from the world around us, although advancing adult aging brings with it systematic reductions of efficiency of the sensory systems (idem, ibidem).

People over 65 years of age are more subjected to develop disabilities related to aging, showing difficulties with vision and balance, that can condition the capacity of acting independently and perform daily tasks. The ability to cope effectively with the environment begins with the capacity to process sensory input but advancing adult aging brings with it systematic reductions in efficiency of our sensory systems (Schieber, 2003 apud Birren & Shaie, 2006, p.129). This perception of the environment was defined by Lieury (1990) as a set of psychological and physiological mechanisms whose general function is environmental information gathering, not being a passive reception of messages proceeding from the environment, but a set of complex activities of reception and analysis, where it can be distinguished on a first phase as a reception of signals (sensation) proceeding from the environment and its transformation in nervous influxes (Fontaine, 2002, pp. 61-62). Our perceptions are plurisensorial for they result from diverse sensorial messages integration (idem, ibidem, p.61). These later-life scenarios in the increasing demands placed on elders by shifts on their personal resources and changes in their near and far environments are
the object of study of environment-aging relations\textsuperscript{1}, are the supported by different disciplines (e.g. Psychologists, sociologists, health professionals architects, community planners, social policy makers, designers) that devote to understand the behavioral and psychological implications of encounters between elders and their environment (Scheidt & Windley apud Birren & Shaie, 2006, p. 105). The environmental gerontology can benefit from action research, a collaborative knowledge building involving clients, practitioners, consultants and researchers to produce knowledge useful to the everyday lives of people (Senge & Scharmer 2001 apud Birren & Shaie, 2006, p. 114). Action research in environmental gerontology primary purpose, is older persons’ quality improvement through a collaborative research building, contributing to better design and environmental modification information of social and physical living arrangements (Scheidt & Windley apud Birren & Shaie, 2006, p. 114). A wider view integrating theory and practice, environmental gerontology theorists and environmental design practitioners, as well as health professionals, can improve the quality of life of older people (idem). The ultimate goal of science and practice of human factors is to ensure that human-system and human-environment interactions will be safe, efficient and effective (Fisk et al., 2004, p. 13).

**HAPTIC PERCEPTION**

During the early to mid-20th century, only three individuals David Katz (1925/1989), Geza Révész (1950), and James J. Gibson (1962.1966) stand out for their uncommon emphasis on the critical importance of active, voluntary manual exploration.

Pallasmaa (2005) in his book “The eyes of the skin – architecture of the senses” underlines the importance of the tactile sense for our experience and understanding of the world, over the visual sense. Referring Ashley Montagu’s medical evidence on confirming the primacy of haptic realm he writes, “touch is the parent of our eyes, ears, nose and mouth. It is the sense which became differentiated into the others, a fact that seems to be recognised in the age-old evaluation of touch as the mother of the senses” (Pallasmaa, 2005 p.11).

We should not adapt ourselves to the environment, but it is the environment that should be adapted to us, one of the Inclusive Design principles (Herssens & Heylighen, 2008, p. 103).

In both haptic and visual perception, the stimuli rely on material (texture, temperature, density) and space characteristics (form, place, orientation, length) (Hatwell, 2003 apud Herssens & Heylighen, 2008). Information

\textsuperscript{1} Environmental gerontology
from movement output thus plays an important, and probably crucial, role in tactual recognition” (Millar 1994 apud Herssens & Heylighen, 2008). Elderly walk in a defensive and secure mode, feeling one’s way by dragging their feet. This situation permits them feeling the floor, avoiding the unlevelled and/or irregularities of the ground. The introduction of a haptic system (on the floor) in a wayfinding system in hospital environment can act as a mean to lead people on finding the information required and so promote a better and more detachable information and thus, to add those with low vision condition to find their way. This can be referred as the practical intelligence (Vygotsky apud Tijus, 2001, p. 25) where the-knowing-what-to-do is not expressed by language but by the action itself, and by Gibson’s (1986) affordances theory which, by feeling the haptic texture on the floor, people will know what they are meant to do. Revesz (1950) also suggests that in space perception the haptic space is centered on the body whereas vision is centered on external coordinates (Millar, 2006, p. 27).

The haptic system uses combined inputs from both the cutaneous and kinaesthetic systems (Klatzky & Lederman, 2003, p. 148). Haptics is commonly viewed as a perceptual system mediated by two afferent subsystems, cutaneous and kinaesthetic, that most typically involves active manual exploration (Lederman & Klatzky, 2009, p. 1439). The sensing modality of touch can be categorized into three main channels: kinaesthetic describing our bodily perception when moving sensing the orientation and rotation of our muscles, joints and tendons; tactile stimuli are applied in our skin, when we are passive and a haptic sensation is produced during the exploration of an object (Loomis & Lederman 1984 apud Pohl & Loke, 2012, p. 2). Touch is the parent of our eyes, ears, nose and mouth. It is the sense that becomes differentiated from the others, a fact that seems to be recognized in the age-old evaluated of touch as the “mother of the senses” (Pallasmaa, 2005, p. 2). All the senses, including vision, are extensions of the tactile sense; the senses are specializations of the skin tissue, and all sensory experiences are modes of touching and thus related to tactility (idem, ibidem, p.10). Bachelard proposes polyphony of the senses as the way our senses interacts in space perception, a multisensory experience (idem, ibidem, p.41).

**PERCEPT WALK**

Percept (Kerzel apud Binder, Hirokawa, & Windhorst, 2009, p. 3098) 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 (Binder et al., 2009, p. 3098) and the awareness of more complex characteristics of stimuli (Fisk et al., 2004, p. 13).
The 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 (see methodology) will be held with low vision patients, users and medical staff.

The use of a sensory-motor wayfinding systems joining a correct colour 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.

The ability to detect and recognize objects in the visual environment varies considerably as a function of target size, contrast, and spatial orientation (Olzak & Thomas, 1985 apud Birren & Shaie, 2006, p. 141). Numerous studies reveal a consistent pattern of age-related change in the CSF (contrast sensitivity function) collected under photopic conditions (foveal presentation at moderate to high luminance levels). Contrast sensitivity declines by approximately 0.3 log units across the later half of the adult life span (idem, ibidem, p. 141).

The theme “color promotes wayfinding” has been largely studied and is still being studied by different authors (Arthur & Passini, 2002; Carpman, Grant, & Simmons, 1984; D. Gibson, 2009; Helvacıoğlu & Olguntürk, 2010; Katz, 2012; Mahnke, 1996; Meerwein et al., 2007; Mollerup, 2005; 2009; Moreira da Silva, 2013; Zingale, 2010).
What is of real importance is that the colors and the system used are effective for all that use that specific building.

![Percept Walk diagram](image)

Fig. 4 – Percept Walk diagram

A wayfinding system, using effective colors, contrasting the written information with the background color, associated with a haptic touch texture on the floor, as a tactile physical help on defining and signalising the existing orientation information, offering the visual impaired user access for reading the information at his most convenient distance. There is a acceptability by people for touching floor surfaces, via the shoes, on contrast of people being averse to touching certain objects in public spaces (Visell, Law, & Cooperstock, 2009, p. 149). The introduction of a sensorimotor task on the pavement does not imply an increased sense since it is implicitly engaged on normal walking (Visell et al., 2009, p. 150). Active touch, what is ordinarily called touching, is an exploratory sense and may be termed tactile scanning, by analogy with ocular scanning (J. J. Gibson, 1962, p. 477). Visual impaired people as all humans compensate for deficiencies or weaknesses in one sensory modality by relying on another sense, without necessary being aware of it (Krippendorff, 2006, p. 143). We use all our senses to perceive and use the environment. We do not use one specific sense to do it, but as normal vision people sight is the first sense used, leaving although other senses aware. When using a building, in particular a hospital, we don’t have to adapt ourselves to this environment, but it is the environment that has to be adapted to us (Herssens & Heylighen, 2007). There is a need to rethink and adapt the functionality of a particular building to its users’ needs or special needs. Those are inclusive design objectives, aiming at usability and comfort for as many people as possible regardless age, ability or circumstance (idem, ibidem). Our ability to cope effectively with the environment begins with our capacity to process sensory input, although advancing adult aging brings with it systematic reductions in the efficiency of our
sensory systems (Birren & Shaie, 2006, p. 129). Society of Technical Communication (STC) defines the discipline of information design as the translating of complex, unorganized or unstructured data into valuable, meaningful information (Baer, 2008, p. 12).

People are living longer, remaining more active into older age, and preferring to stay in their homes longer before feeling the need for “assisted living” arrangements. Aging brings with it changes in perception, cognition, and movements control (Fisk et al., 2004, p. 4). The ultimate science goal and the human factors’ practice is to ensure that human–system and human–environment interactions will be safe, efficient, and effective (idem, ibidem, p.13). The ability to function independently is much related to our mental capabilities as to our physical capabilities (Huppert, 2003, p. 41).

**CASE STUDY**

The first phase of the experimental research is being held in a public ophthalmology hospital (serving around 5,000 patients/month) offering a variety of services, such as consultations, exams, eye surgeries and treatments.

This hospital unit, *IOGP - Instituto de Oftalmologia Dr. Gama Pinto* is the only public ophthalmology hospital existing in the country and its creation dates back to the 19th century when kings D. Luiz and later D. Carlos I ruled. The building is successful conversion from a palace into a hospital, and lays in the old part of Lisbon.

This hospital is 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 reinserction with extreme low vision condition in active life through the teaching and use of white cane as a 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. The number of medical consultations was of around 47,000 people in 2010, 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%.
A general observation of the natural and artificial light conditions will permit to establish and parameterize optimal condition for interpreting the orientation information for all pathologies and minimize the effects of shades in some areas. Through direct observation of the patients and users usage of the building, the main axes of circulation and the most used areas will be evaluated so that the localization of the necessary information for an effective wayfinding/ waysensing system will be implemented. The importance of the patient’s sensorial evaluation is, in this particular case, visual and haptic touch oriented. But a research held in another environment with different special needs users may result in an approach to the evaluation of other senses but still aiming for the promotion of a safe, inclusive and structured usage of the space.

**METHODOLOGY**

The research is supported by a participatory design methodology applied to the hospital’s low vision elderly users collecting through interviews, questionnaires and sensorial tests (visual and haptic) their environment perception limitations information. The visual tests will evaluate the visual acuity, color and contrasted color perception, legibility and readability in the different patients low vision pathologies; the haptic tests will measure the foot haptic perception to different textures, and through the observation of their mobility behavior, locomotion and dexterity capabilities will also be evaluated.

The visual tests are supported by printed plates with different color contrasts, standard and simplified pictograms and texts with different typographies and scales shown in different lighting conditions, while haptic tests are based on different shapes and thicknesses to evaluate the most perceived and interpreted within the different patients’ pathologies.
Through different phases of evaluation of the target group perceptions the research will seek for the necessary answers building efficient information for the design project. All the data acquired will permit to obtain some pre-conclusions of the research phase that will lead to the development of the design process of creating a pilot project for a specific part of this hospital. This area will be a lab of experiences and tests with patients and users to validate the pre-conclusions and recommendations obtained in the prior phases.

Within the different phases of the waysensing process the evaluation on the target group sensorial perceptions
will seek for the necessary answers, building efficient information for the design project. The behavior of users and medical staff will be analyzed and evaluated in both areas, the intervened and the actual one, and compared in order to validate the wayfinding system proposed effectively responds in users’ independent mobility and thus promoting self-esteem and confidence on a safe usage of the hospital.

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.

![Environmental analysis and diagnostics](image)

**Fig. 7 – Environmental analysis and diagnostics (Source: author)**

**WORK IN PROGRESS AND FUTURE WORK**

The Percept Walk sensory-motor wayfinding system represents a more sensorial involving way on the deconstruction of the built environment, in particular ophthalmology hospitals for people with low vision condition or other special needs. By promoting an independent mobility on these patients it will also promote self-confidence and self-esteem on them. Having patients and users acting by themselves in the building is expected and to leave more effective working time for doctors, auxiliary teams and nurses who actually spent a great deal of time showing and helping users to find their way around, are the research hypothesis expected to be achieved.
The Percept Walk system concept is perfectly applicable to situations with absence of light even if they are for normal vision people, for instance auditoriums or exhibition places. There is always information that can be conveyed through haptics, especially when the excess of information or visual pollution is present.

The expected future work is in obtaining relevant data from the methodology purposed for the experimental phase in hospital, and the preparation for the pilot project installation and its implementation. The wayfinding system that will be achieved will result from the participatory design methodology involving all users of the hospital, the evaluation by a focus group of specialists and the validation by users. As final result it is expected to develop a wayfinding system that will simplify and communicate effectively with all users, by promoting a easier, safer, uncomplicated way of using that space. This study will compile important data that can help information designers to understand the limitations of the elderly specially those with low vision, and develop sustainable efficient wayfinding systems.

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