Universal product design involving elderly users: a participatory design model

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Abstract

Since people prefer to age in familiar environments, the designers should provide an environment for the ageing people that they can benefit regardless of their physical conditions or limitations. Therefore, a participatory design model is proposed that the human beings can improve the quality of life by promoting independence, as well as safety, useability and attractiveness of the residence. Brainstorming, scenario building, unstructured interviews, sketching and videotaping are used as techniques in the participatory design sessions. Quality deployment matrixes are employed to find the relationships between the elderly user's requirements and design specifications. A case study was devised to apply and test the conceptual model phase of the proposed model.

Keywords: Elderly user; Participatory design; Universal design

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1. Introduction

Reviewing the literature related to design for elderly with respect to the relationship between the person and environment shows that the subject has been studied from various points of view. The designers are mostly interested in the physical attributes of housing, although researches have shown that psychological well being is one of the most intrinsic aspects of successful aging (Carp, 1976; Lawton and Nahemow, 1973; Schwirian and Schwirian, 1993). Besides having the required physical characteristics, the physical environment itself should be used to form friendship and

encourage socialisation and relations. The design professional faces a tremendous task and challenges to keep abreast of technological advances and research pertaining to many facets of men and the built environment (Benktzon, 1993; Dagistino, 1996; Demirkan, 1996; Pinto et al., 2000; Sagdic and Demirkan, 2000).

A house that is inadequate for the needs of the people living in it, never becomes a home. A wide spectrum of professionals is concerned with life-span design (universal design) for an aging population. These disciplines can be stated as design, engineering, gerontology, ergonomics and architecture. All try to support aging in place so that independence, freedom of choice and life style are promoted. Designs considering the data related to both physical and psychosocial characteristics of the human beings can improve the quality of life by promoting independence, as well as safety, useability and attractiveness of the residence (Demirbilek and Demirkan, 1998).

The elders dealing with changed capacity, reduced ability and increased need require the same accommodations and compensations in late life that they found at earlier years. The homes must provide solutions that address these distinctions in capacity, ability and need for daily living. Universal design is a concept that extends to a broad diversity of users who have to interact with the built environment (Sandhu, 2001; Scott et al., 2001; Steinfold and Danfort, 1993; Story et al., 1998).

Sanoff (1990) claimed that ‘All designers who are concerned with improving the quality of their efforts and the quality of everyday life should consider participation through user involvement” (p.1). In fact, design is a project-oriented process and people execute design activities including problem solving documentation and communication among the parties. In order to achieve the design goals effectively, the participation of individuals for sharing information, responsibilities and resources has to be organised (Ciccantelli, and Magidson, 1993; Reich et al., 1996; Sanoff, 1990; 2000; Wulz, 1990). Therefore, this paper proposes the Useability, Safety, Attractiveness Participatory (USAP) Model based on quality function deployment design system. Also, a case study is conducted for designing door and door accessories with participatory design sessions to test the conceptual design phase of the proposed model.

2. Useability, Safety, Attractiveness Participatory (USAP) Design Model

A participatory design model is proposed in order to design and develop safe and functionally appropriate products that will promote and maintain independent living of elderly. There are five phases of the design model in order to transform a concept into a design description in such a way that the artefact being described is capable of producing the determined functions. The phases of the USAP design model are depicted in Fig. 1.

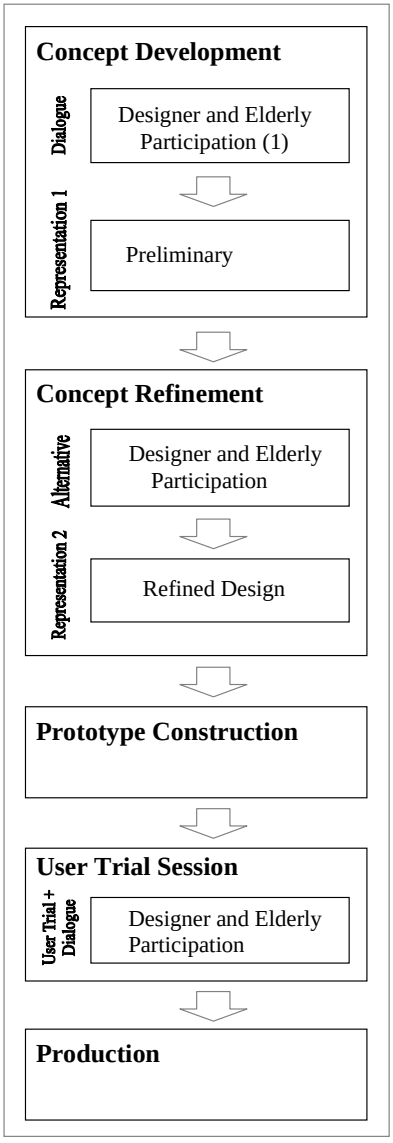

Figure 1. The seven steps of the USAP design model (Demirbilek, 1999).

2.1. Concept development phase

In the first phase of the design model, where the designer and the elderly participants are involved, participatory design sessions are organised with small groups of elderly people. The techniques that are applicable in participatory design sessions are scenario building (Fulton and Marsh, 2000), brainstorming, idea writing and sketching, unstructured interview and asking pre-set questions (Wulz, 1990). At this phase, the participants produce ideas and define their exact needs and preferences pertaining to the artefacts. Due to the difficulties in extracting information from elderly people (Allan et al., 1996), the participatory design sessions are a combination of brainstorming, scenario buildings, and unstructured interviews, with written and oral parts, sketches, and/or gestures. The designer acts as an impartial moderator and the form of participation in this phase is an a*ctive dialogue* (Wulz, 1990) in which the designer does not make any proposals for the design in the beginning but acts as a facilitator. The elderly users are the ones who make proposals during the design process. The participatory design sessions are recorded on videotapes to recall all details (especially body language and simultaneous talks) and to create a memory that can be stored and used again for similar studies (Demirbilek and Demirkan, 2000).

In the second stage of the concept development phase of the design model, the designer analyses the problem, prepares a feasibility study and tries to find out an optimal solution to the problem by satisfying the requirements and proposals of the elderly users. The designer's knowledge base is composed of three different sources: "relevant media, relevant domain, and relevant community" (Demirkan, 1998: 233). Relevant media involve knowledge from books, journals and videotapes. Relevant domain consists of observed cases from another source and the experience of the designer or other experts. Relevant community is composed of all users of the artefact, experts and other parties.

All the data collected during the first stage, including the answers to the pre-set questions, proposals, requirements and ideas, are classified in the USAP design model, using quality function deployment design system (Sivaloganathan, et al., 1995) to develop the USAP deployment matrixes (See Fig. 2). In these matrixes, relationships between elderly user's requirements/wishes/ideas and technical design specifications are determined. This stage is not an act of participation, since the

designer is the only one to be involved in it. It is a *representation*, where the designer represents the elderly users by interpreting their real desires and proposals and matches them with her/his own previous knowledge input. This is a less personal and less subjective representation, because the designer is better informed on the real requirements and needs of the elderly users. He/she can combine the information obtained from the first stage with his/her knowledge and findings on the field. According to Eason (1995), this kind of combination is a mixture of two approaches, namely: design by users and design for users. Eason (1995) also claimed that mixing the two approaches gives better results with higher success rates.

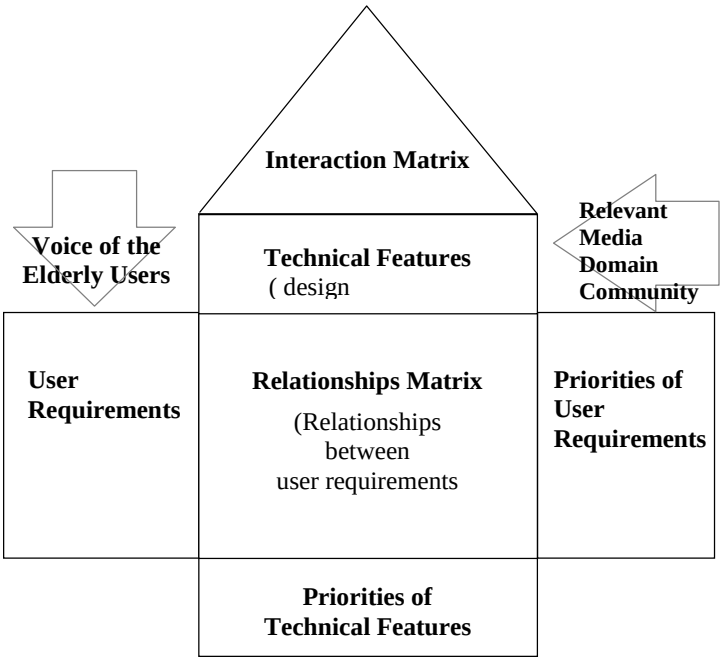

Figure 2. Quality function deployment model adapted to develop the USAP deployment matrixes.

2.2. Concept refinement phase

In the second phase of the model, the conceptual design solutions are introduced to the elderly users in a second participatory session. During this session, the elderly users are asked to criticise the drawings, modify and make comments on the design alternatives sketched by the designer. At this phase, the participation form is an a*lternative* one (Wulz, 1990). The elderly users could see and perceive the representations of the ideas and the propositions that they had made in the first phase

and had been filtered through the knowledge and the interpretation of the designer, using USAP deployment matrixes. The sketches are criticised, corrected and modified by the elderly users who act as jury members. The designer is the presenter and the facilitator. This phase tries to avoid misunderstandings and inaccurate interpretations of the designer, and reinforce the design descriptions by the approvals of the elderly participants (Demirbilek et al. 2000).

The second stage of the concept refinement phase consists of further developments and *refinements* of the design solutions. It involves the technical and detailed drawings of the products. In this stage, being similar to the preliminary design, the designer uses his/her knowledge base and makes new representations to the elderly users by interpreting their preferences and corrections done during the second participatory session. In addition, the designer makes consultation with ergonomists and engineers. This is a step for refinements of the data recorded in the second participatory design sessions (Demirbilek and Demirkan, 2000).

2.3. Prototype construction

The third phase is the prototype construction and planning, with the production of detailed technical drawings, at the end of which prototypes are to be produced. In this phase, the designer works as a team with ergonomists and engineers.

2.4. User trial

The fourth phase is the trial of the prototype of the designed artefact by the elderly participants. In this phase, the participation is a u*ser trial* (Wulz, 1990) form combined with a d*ialogue* form of participation. The team is comprised of a designer, and an ergonomist who observe the elderly users trying the prototype while discussing the design. The comments and new ideas of elderly end-users are again recorded to recall all the details and to create a knowledge domain for similar projects in the future.

2.5. Production

The production phase is the last phase of the application development process. The artefact is manufactured and provided to the consumers.

3. The case study

In order to test the USAP design model, a study was conducted with a focused group of elderly people. Two different participatory design sessions (each consisting of three groups) were held during the concept model phase. The end-users were asked to participate in the design process of doors and door handles for the house that they want to age in, considering all their possible requirements, needs, particular wishes and ideas. The first author of this paper is the mentioned designer of this case study. The participatory design sessions are conducted within the scope of her doctoral dissertation (Demirbilek, 1999) at Bilkent University.

3.1. Participants

The participatory design sessions were held with focus groups consisting of male and female end-users above the age 65, from the city of Ankara, Turkey. A sample of 13 potential elderly end-users forming 3 different groups took part in the research, each completing both participatory design sessions (Demirbilek, 1999). The sample of volunteers consisted of 10 females and 3 males with mean age 75. A pilot session was conducted with 4 elderly participants (one male and three females between 68 to 75 years old) and the participatory design session was revised accordingly.

Jones (1992) claimed that small groups consisting of 6 people successfully produce up to 150 ideas in half an hour at their first attempt. Barrett and Kirk (2000) stated that guidelines on planning and running focus groups with special considerations for elderly participants are lacking in literature and they aimed to use 6 people as minimum focus group size. Since this study involves a design process, the groups were composed of 3-6 (3, 4 and 6; respectively and 1 male in each) elderly people. Each session lasted between 40 to 50 minutes.

3.2. Participatory Design Sessions

In the USAP design model, two different participatory design sessions were held. In the first participatory design session the designer and the participants were seated around a table, having papers, pens and a blank page. The reason was to make them to control the design process and consider themselves to be equal parties in the process. No perfect drawings were expected and the intention here was to see if they could use

sketching as a tool to express their ideas. The outputs of these design sessions did not aim to end up with finished products or designs, but only to initiate the design process.

In this study, the designer used scenario building technique, unstructured interviews and asked pre-set eight groups of questions related to the design of doors and door handles (Demirbilek, 1999). These questions were grouped under the following headings:

- problems faced with main entrance door,
- problems with keys while opening or closing doors,
- door safety while opening and closing doors,
- reasons of closing doors in interiors,
- problems and recommendations on door handles and knobs,
- problems and recommendations related to the glazed parts on doors,
- problems and recommendations related to the material choice,
- different door types.

In order to help the participants to express themselves more freely, without being limited to the questions, the designer introduced some scenarios. As the participants started to create various scenarios, the designer encouraged them to start brain storming in order to propose any kind of solutions to the problems that they can be faced with.

Some examples of the used scenarios during these sessions are as follows:

- You are coming back from shopping, hands full. Nobody is at home and you have to open the door. The keys are somewhere deep in your bag (or pocket). What do you do?
- You are in the kitchen preparing a meal, the door is closed, and your hands are all greasy and dirty. The telephone is ringing in the other room. How do you open the kitchen door?
- You are alone at home. Somebody rings at the door. You look from the eyehole but you cannot see the visitor well. What do you do?

The designer asked the participants to tell their ideas, whether positive, negative, or neutral during the scenarios. From the stated negative points by the participants, the designer asked them how it can be improved, and how the related parts can be designed. The designer while writing down the comments and ideas of the participants encouraged them to draw or write on the papers. Also, the information was recorded on video for later evaluation. The analysis of the videotapes allowed a full range of behavioural traits and the sequence of events to be observed (Demirbilek and Demirkan, 2000).

After the completion of the first set of participatory design sessions, the outputs (responses to the questions, drawings, and additional comments) had been grouped under several topics such as door characteristics, door operation and accidents related to doors. The USAP deployment (see Fig. 3 and 4) matrixes were formed to find the existing relationships between the elderly requirements with the technical design considerations for entrance and interior doors.

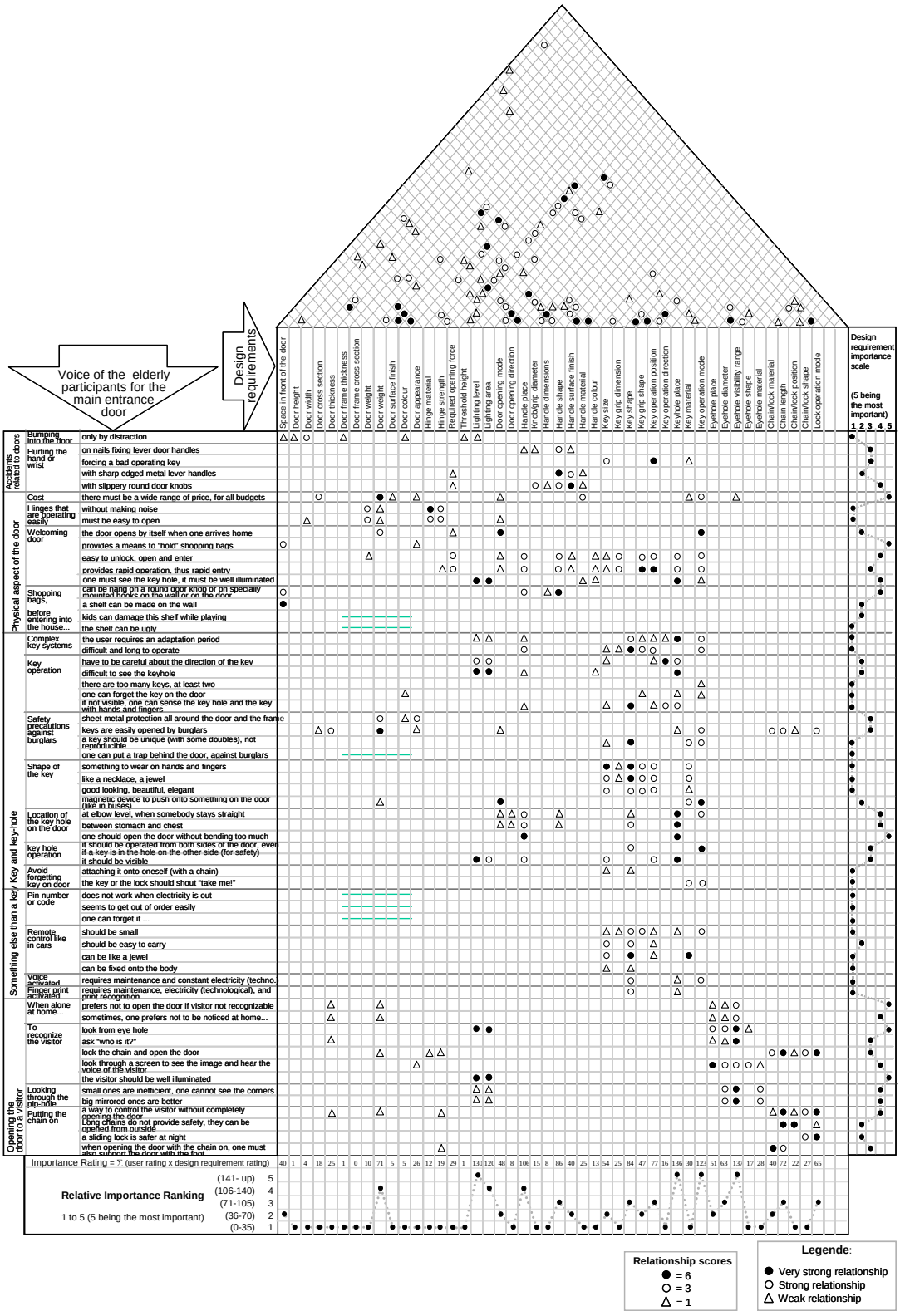

Figure 3. Correlation matrix for the main entrance door.

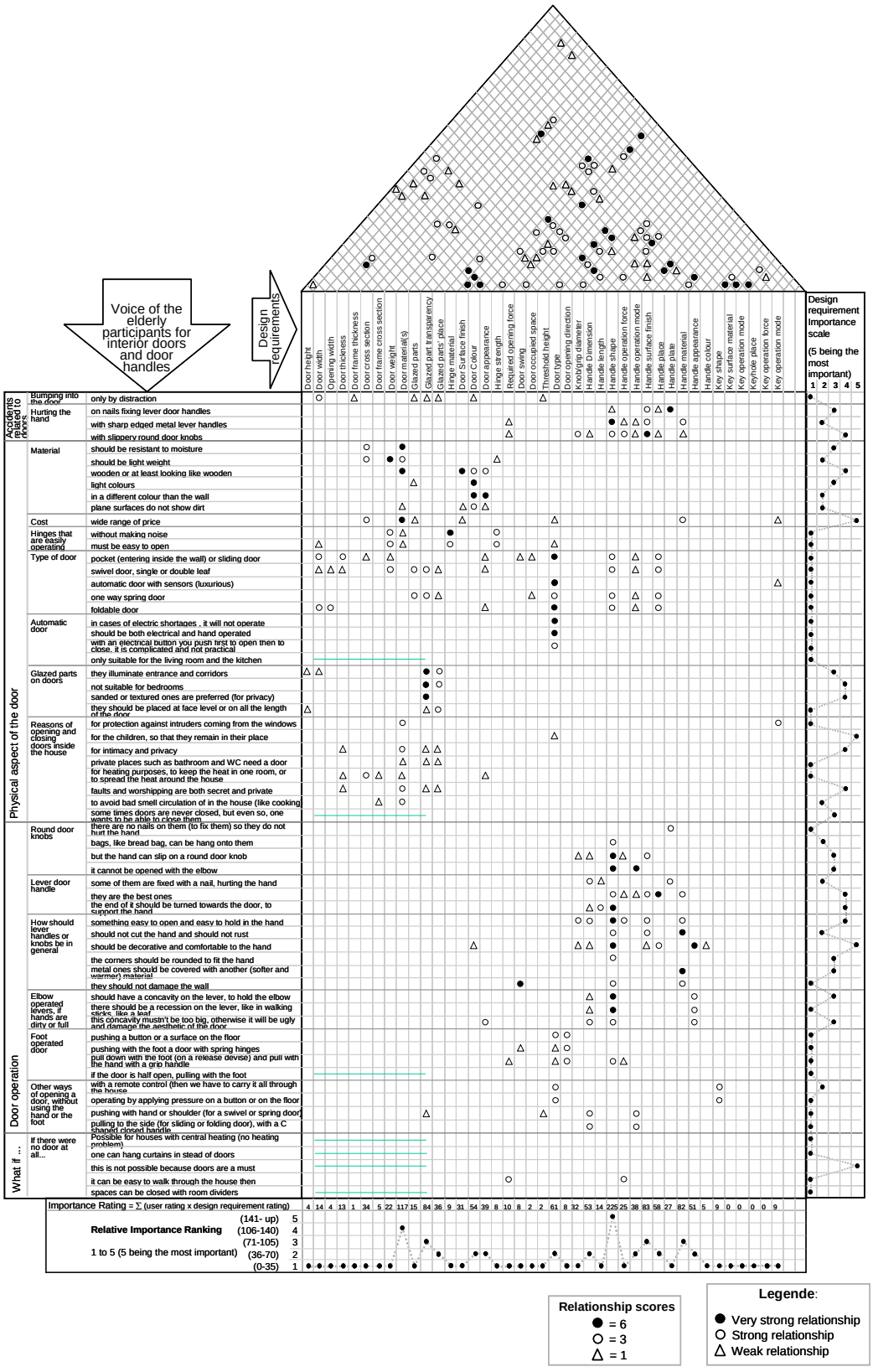

Figure 4. Correlation matrix for the interior doors and door handles.

In the second participatory design session, the designer presented the drawings that were formed as the outputs of the first session. The presentations were in the form of hand and computer sketches, not too perfectly drawn, to avoid the feeling that every thing has already been decided, and nothing was left for them. Each participant received the copies of the drawings on which he/she can criticise and redraw. The designer encouraged the subjects to express their ideas and make corrections on the sketches. Every given comment and drawing revised by the participants, were collected at the end of the session. Discussions were recorded by note taking and on video.

4. Results

4. 1. Results related to the first participatory design sessions

After the analysis of data, the important issues determined by the elderly users were introduced into the matrixes to categorise the relationships between the elderly users' requirements, design limitations, and technical requirements. The matrixes were prepared based on the knowledge accumulated both from the participatory design sessions and the relevant media, domain and community. Both the elderly user's requirements and the design specifications were rated on a 5-point numerical scale (see Fig. 3 and 4). For the elderly user's requirements, the importance was rated according to the number of participants having (or approving) the same opinion. For the design specifications related to the design of a door, the importance was rated according to the professional knowledge of the designer.

The results obtained from quality deployment matrixes were grouped under three categories as the most, moderately or less important for the main entrance door and the interior doors and door handles (Table 1 and 2, respectively).

Table 1. Classification of design requirements of the entrance door

Most important	**Moderately important**	**Less important**
Eyehole visibility range	Handle shape	Space in front of the door
Keyhole place	Key shape	Door height
Lighting level	Key operation position	Door width
Key operation mode	Chain length	Door cross section
Lighting area	Door material	Door thickness
Handle place	Lock operation mode	Door frame thickness
	Eyehole diameter	Door frame cross section
	Key size	Door weight
	Eyehole place	Door surface finish
	Key grip shape	Door colour
		Door appearance
		Hinge material
		Hinge strength
		Required opening force
		Threshold height
		Door opening mode
		Door opening direction
		Knob/grip diameter
		Handle dimensions
		Handle surface finish
		Handle material
		Handle colour
		Key grip dimension
		Key operation direction
		Key material
		Eyehole shape
		Eyehole material
		Chain/lock material
		Chain/lock position
		Chain/lock shape

Table 2. Classification of design requirements of the interior doors and door handles

Most important	**Moderately important**	**Less important**
Handle shape	*Door appearance*	*Door height*
Door material(s)	Handle operation mode	Door width
Glazed part transparency	Glazed parts' place	Opening width
Handle surface finish	*Door cross section*	*Door thickness*
Handle material	Knob/grip diameter	*Door frame thickness*
Door type	*Door surface finish*	*Door frame cross section*
Handle place		*Door weight*
Door colour		Glazed parts
Handle dimension		Hinge material
Handle appearance		Hinge strength
		Required opening force
		Door swing
		Door occupied space
		Threshold height
		Door opening direction
		Handle length
		Handle operation force
		Handle plate
		Handle colour
		Key shape
		Key surface material
		Key operation mode
		Keyhole place
		Key operation force

Based on the knowledge extracted from matrixes, three preliminary design sketches were generated in the second stage of the conceptual development phase of the participatory design model. Among them, an elbow operated door handle (see Fig. 5) and a door screen (see Fig. 6) that will allow elderly users to see a visitor without having to go near the door were proposed. Another proposal was a device at the main entrance door, being a shelf for shopping bags or a seating unit while searching for

keys in the bag (see Fig. 7).

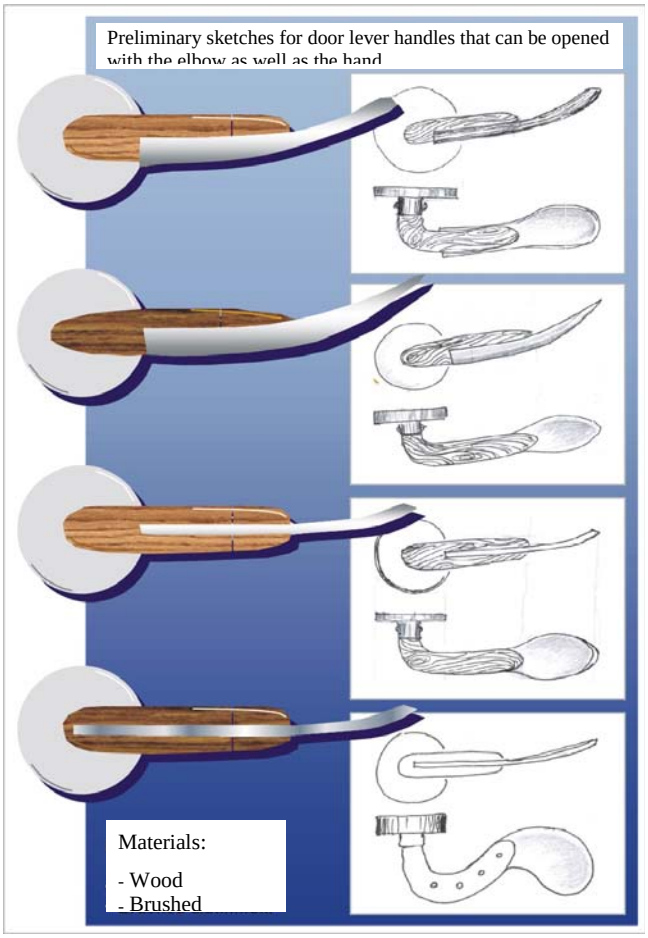

Figure 5. Preliminary sketches for lever doors handles that can be opened by both hand and elbow.

4.2. Results related to the second participatory design sessions

During the second participatory design sessions, the elderly participants seemed more comfortable, since they were familiar with the process. They listened carefully to the explanations related to the representations of the design concepts and made their comments. Some corrections were made on the given drawings.

Among the three designs presented to the elderly, the lever handle to be operated with elbow was considerably corrected. The designed lever handle can be operated with an elbow as well as hand. It was designed with wood or plastic material covering in order to provide a softer contact with the hand (see Fig.5). The concave protruding metal

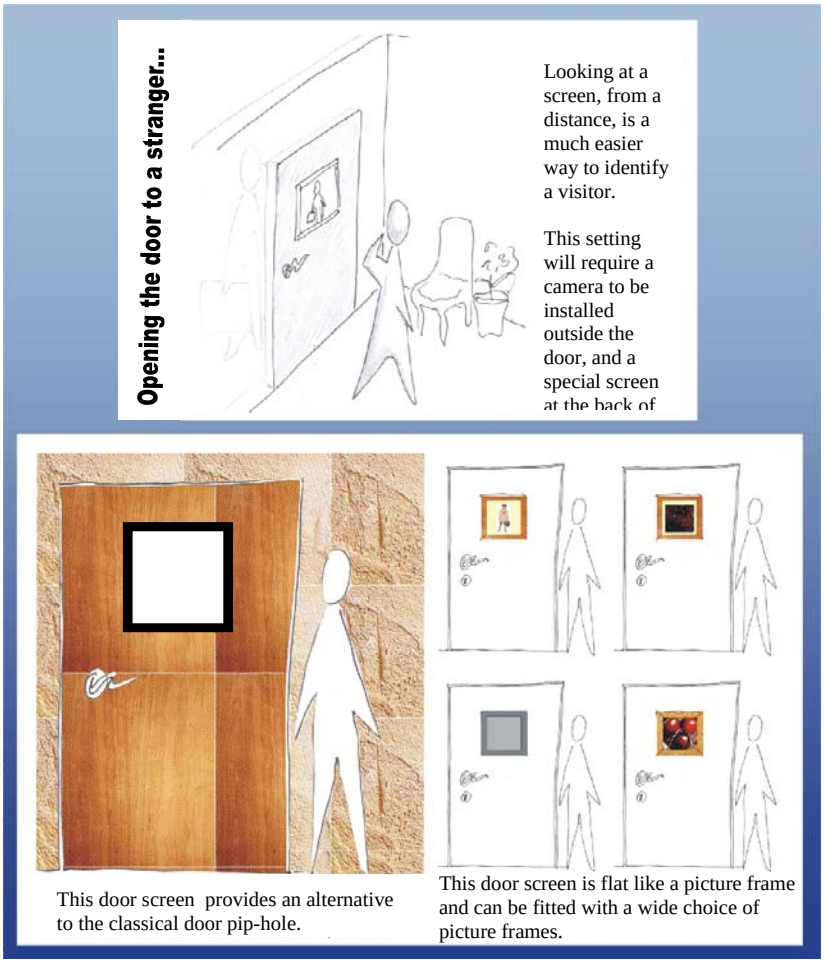

Figure 6. Preliminary sketch for a door screen.

part was designed for the elbow operation. The elderly participants stated that the metal part being thin acts as a sharp edge to injure the users. Two of them proposed to cover it completely with wood, while keeping the metal part in the middle for strength. They also said, that the varnish of the wood must not be too shiny to avoid that the elbow slips onto it (Demirbilek, 1999).

The folding shelf/stool (see Fig.7) to be hung on the wall at the main entrance door also was corrected. The proposals were made about the fixing details. The door screen was accepted and was appreciated by all of the participants. No corrections were made on the drawings.

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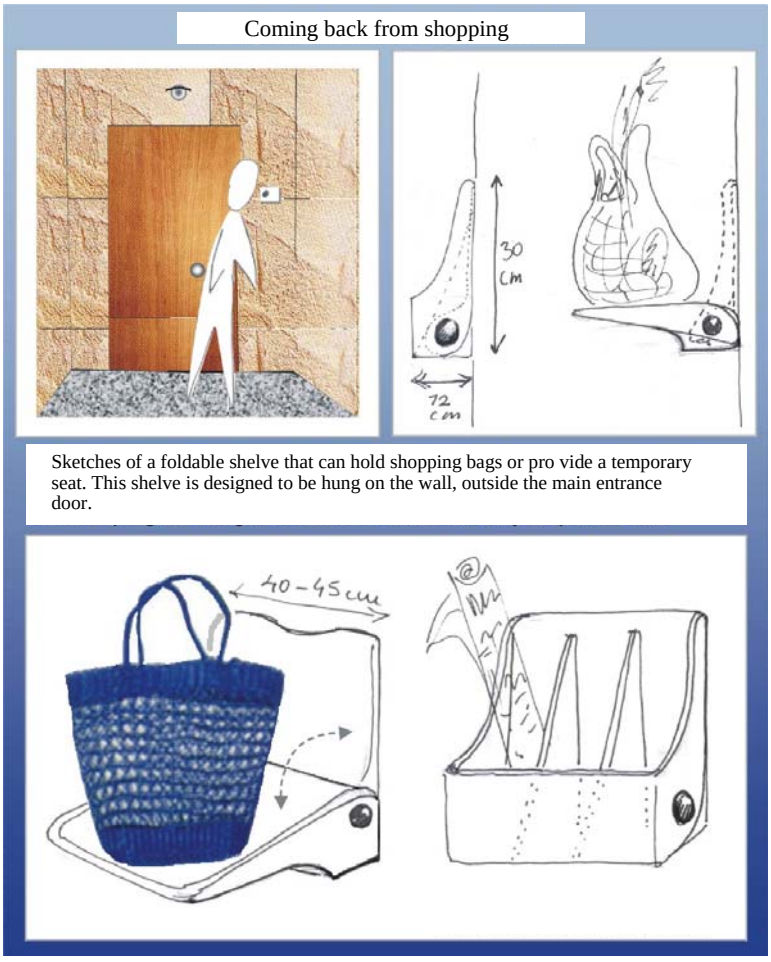

Figure 7. Preliminary sketch for a shelf near the entrance door.

5. Conclusion

A participatory design model was proposed in order to design and develop safe and functionally appropriate housing that will promote and maintain independent living of elderly. There is a growing recognition that the physical environment can enhance or impede the independence and mobility of elderly. Sanoff (2000) stated that “the elderly, a rich resource of knowledge and experience, have often been excluded from the design process has a unique common goal-living life with dignity” (p. 208). The sketches proved that involving the elderly in the design decision making process enhances the design solutions, since the experience of the users was reflected at the

final design descriptions. Also, the participatory design sessions increased elderly people's awareness of the consequences of the decisions that were taken as well as they gained satisfaction by having influenced the decisions.

Quality function deployment system represents a very suitable way to incorporate the needs and requirements of the elderly user into the design process. In this study, the deployment matrixes helped to reach the real needs and requirements of the elderly users accurately to provide their original contribution to the design process. Elderly people have shown a very good performance during the participatory design sessions and USAP deployment matrixes have proven to be potential source for designers that must be explored more deeply. This study only involved the conceptual design phase of the design process and it should be tool for further phases of the design process.

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