SMART HOME AND ARCHITECTURE: THE CASE STUDY OF DWELLINGS FOR PEOPLE WITH COGNITIVE DISABILITIES

Antonio Frattari, Michela Dalprà, Michela Chiogna
Department of Civil and Environmental Engineering
University of Trento
Trento, Italy

ABSTRACT

In order to improve the accessibility and the use of the home environment for disabled people, today the domotic applications play a leading role.

The domotic applications are born to meet the needs of security, safety, comfort and self-care, communication, property management but they are also a great help to people with motor, sensorial and cognitive disabilities in daily life.

At the present time there are several smart home technologies to insert in a building. However to select and to insert the right technology in home environment for disabled people is a very tricky decision. The reason is that it is necessary a very deep knowledge of disabilities and smart technologies in relation to very careful evaluations of the users needs.

This paper deals with a research work carried out by CUnEdI (Centro Universitario Edifici Intelligenti) of the University of Trento. The aim of this work is to define and verify a design methodology for domotic dwellings that can answer to needs of different categories of disabled people. This design is interdisciplinary and involves designers, users and caregivers in the different design phases in order to give an architectural, technological, and social sustainable answer aimed to satisfy the needs of the disabled people and of the aid agencies.

In particular this article describes briefly the phases of this methodology and its check with a case study. The case study concerns a semi-sheltered dwelling for cognitive
disabled users. The dwelling will be built in Pergine (TN-Italy) and it will be planned by means of a synergetic work among CUnEdI, a social cooperative, and companies of technological sector of the territory of the Autonomous Province of Trento.

Keywords: smart technologies, semi-sheltered dwelling, disabled people, cognitive disabilities, interdisciplinary design

Introduction

Today there is the will to give to disabled people the possibility to live autonomously in own apartment and not in public aid structures. The disabled people, like everybody, need to have personalized answers, that are not always reducible to the standards of the public offer.

It seems easy to design for disables people: there are regulations, special furniture and today smart technologies. But to design for disabled users is very difficult because there are different levels and typologies of disabilities.

In particular there is not much documentation in the literature to design for people with cognitive disabilities unlike for motor and sensorial.

It is necessary to introduce a new form of design, that should be not limited only to technical intervention, provided by experts like standard solution, but that should involve both the final users and the caregivers in order to asses and specify together the design choices on the basis of a careful evaluation of the users needs.

The fields to involve in this design methodology are different because of the complexity of users needs and because of the large variety of planning solutions. The work group for this new form of design is therefore so structured: technicians of the health sector (doctors, nurses, physiotherapists, etc.), technicians of the social-aid sector (social workers, psychologists, caretakers), technicians of the construction sector (engineers, architects, system integrators).

In order to avoid that these technicians work sectorially, it is necessary to coordinate the activity of the work group.

Design methodology

The CUnEdI (Centro Universitario Edifici Intelligenti) of the University of Trento has developed a methodology of participated interdisciplinary design for housing solutions for disabled users. It involves directly and actively in almost all phases of design: a) users in order to improve not only their final expectations but also the
autonomy, the quality of life, etc.; b) delegates of different fields (health, social-aid, construction, technological) in order to share the specific competences to get a global and not regional result.

The methodology has been divided into the sequential six phases.

1. User needs analysis
The user needs analysis is the most important part of the design process in order to understand what the customer want and to focus on the results that the work group want to reach in short and long-term (total autonomy, social integration of the users using domotic supports). In this first phase it is necessary:
a) to discuss with the customers (social associations, users, family members) and social workers to identify the needs and to find the solutions for the furniture and for the smart devices in order to guarantee users safety and security. We must think carefully in terms of user needs and not only in terms of furniture and domotic components.

“User need” means not only the activity that user must carry out but also a function, a scenario. “Device” means any system that permits to carry out specific functions (sensors, actuators, etc.). “Scenario” means: the ensemble of the planned events that they activate as a consequence of a specific command (telegram that has been sent from a sensor to an actuator) or a particular event that appears in the system (what happens because of an accidental situation or because of a fixed condition);
b) to collect and organize information in order to plan the choice of the furniture and the devices/scenarios by means of a deep knowledge of the users. This knowledge depends on the direct contact with the users (if it is possible) or on detailed reports of the users disabilities;
c) to propose solutions that will be elaborated and developed by designers in the next phases. Complex designs require specific competences able to satisfy from beginning the different user needs by means of an analysis of the home environments and of products that the technology today offers.

The results of this first phase is: a rich preliminary documentation (a list of the user needs in terms of furniture and smart devices to insert in the dwelling; health reports; drawings of the pre-existing building when we have to redesign dwellings; photographic documentation, sketches).

2. Organizing of the space in environments
In this phase the space to design, is divided into environments. “Environment” means both the physical space where the furniture are placed to carry out one or more domestic activities and the physical space where the domotic components are installed and/or work. For example entrance, living room, kitchen, bedrooms, bathroom, and balcony can be the environments of a dwelling.
The organizing of the space into environments is necessary to place both the furniture and the domotic devices.

3. Preliminary design
According to the choices agreed with the customer and the work group in the first phase and according to the organizing of the space into environments we must proceed:

a) listing furniture and domotic components for each environment. The list must describe the main characteristics of the furniture and domotic components;
b) drawing plans of the dwelling with furniture and domotic components.

The final products of this phase are: scale plans, drawings of the furniture, and technical standards of the domotic components to bring for discussion.

4. Check of the preliminary design
The aim of this phase is to verify the methodological, social and environmental quality of the preliminary design.

The preliminary design is checked by the work group and the system integrator companies in order to verify if the design is adapt to the users profile, to improve the elaborated solutions and to identify other possible optimal solutions.

5. Final design
The final design describes completely what realize according to requirements and criteria established in the preliminary design. It is composed of scale drawings (plans, details) and of a detailed report that describes the criteria used for the design solutions, the characteristics of the furniture and the domotic components.

6. Experimental monitoring
The monitoring and the experimental check activities begin after the start of the users live in the dwelling. They consist of a data recording and a technical analysis in order to:

- verify the users activities;
- test the functionality of the furniture and the domotic components;
- assess the impact that the smart technologies have on the disabled people;
- verify if the design solution answers to expected aims.

The validity of this design methodology will be verified with case studies concerning dwelling for cognitive disabled people.

Case study

The case study refers about the design with smart devices of a semi-sheltered apartment for people with psycho-physic disabilities. This project is included in a big plan for future realization, that has been sanctioned with the subscription of a program agreement among local companies specialized in commissioning and construction of
new devices, CUnEdl and social welfare cooperatives. This agreement is coordinated and promoted by the Autonomous Province of Trento (Service for Social Policy).

The design aim is included into the services plan of the CS4 cooperative of Pergine (TN) in order to support people with psycho-physic disabilities for which it is difficult to realize their life project.

The goal is to offer the possibility to improve the home activities guaranteeing at the same time an adequate security level. This goal will be pursued building a dwelling planned for people with specific needs and potentialities.

At first, the users of the dwelling will be three cognitive disabled people. They have been selected because of:
- desire to experiment himself in an apartment as independent people in a different situation from the familiar context; this will be an expectative into the life project;
- availability to share with other people this experience;
- possibility to have already experienced the commune live, even if only in the cooperative activities during the daily assistance and the summer holidays;
- demonstration to have a good relationship and commune interests;
- enough autonomy level to this project (this analysis refers about cognitive, motor, social and relational area).

In the future the users will be more than there. For this reason the customer wanted a flexible dwelling to divide afterwards in two home units.

The space where will be built the experimental dwelling (an open space of 180 square meters) has been individuated into a new building in the surrounding of Pergine (Fig. 1). A part of this building (ground, first, and part of second floors) is CS4 cooperative property. At ground and first floor the cooperative has planned one socio-educative centre, at the second floor the semi-sheltered apartment. In the remaining part of the building there are six private apartments.

Fig. 1: Open space of the existing situation
1. User needs analysis
This phase is based on a meetings plan with the social workers, the director and the coordinators of the CS4 cooperative to examine the first users specific needs. Until the final approval of the definitive project, the users have not taken part to these meetings, in order to don’t create false illusions about the final design.

The work tool used was the social report, analyzed and discussed by the multidisciplinary team. This team includes system and building experts of the CUEnDi and socio-sanitary experts of the CS4 cooperative and of the Autonomous Province of Trento.

The first needs of the cooperative customers were:
- to have a divisible home solution: only one apartment for the first three users, in future two different dwellings for five users;
- to maintain a collective dimension in the commune rooms (kitchen/living room, room for home activities, entrance), so that the users can satisfy their expectations about the domestic habits to meet their needs;
- to design individual solutions for furniture and technology in order to characterize the rooms with a domestic and comfortable aspect, safeguarding the user personality.

The final product of this first phase is an accurate analysis of the user’s activities that will be going on in the different dwelling rooms and a list of necessary furniture and smart devices.

2. Organizing of the space in environments
Together with the social workers the indoor spaces division has been decided. The planned solutions are two: the first with one home unit for three persons and the second with two home units for six persons (3+2).

One dwelling typology: one entrance, one living room/kitchen, two bath rooms (already existing), three bed rooms, one closet (to iron, wash, etc.), two corridors.

Divided dwelling typology: inner entrance with two entrance doors and for each dwelling one kitchen/living room, one bathroom and two bedrooms. The division in two home units will be realized with only one additional division wall.

3-4 Preliminary design and its check
By means of the users needs analysis, the spaces organizing, the choice criteria to define furniture and technological scenarios, both the design drawings for one dwelling and for two dwelling typology have been prepared (Fig. 2 and Fig. 3).

The furniture choice criteria were: ergonomic shape, using safety and simplicity (as well in relation to the use of different colours). Each furniture element of the design depends on specific needs individuated with the social workers that are working
everyday at the day centre. During a next the users will take part of the design (choice of the colour furniture, etc.) by means of 3D models of the apartment too.

In the drawings of the preliminary plans each furniture element has a letter code to indicate the home environment and a sequential number. In the attached reports dimensions, division and materials are described (Fig. 4).

In the drawings of the preliminary design are located the devices that provide to security, safety, entertainment and personal solutions (Fig. 5).

For the security an entrance control system has been introduced. It includes:
- one finger print entrance control, in which it is possible to insert the finger prints of users, social workers (specially who will be reached by phone for nightly emergence), firemen, etc.;
- one electric lock for the armoured door;
- one entry phone to record the images of who comes inside the apartment, so that it will be possible to control the last visitors);
- two cameras connected with the entry phone system: one to visualize the visitors at the main building entrance, one at the dwelling entrance.

For the safety, in relation to the users emotionality (primary emotions, frustration, anxiety self-control), both an automatic alarm system and a call system to the operator have been planned. For this reason each alarm registered with the smart devices (smoke detector, thermo-velocimetric detector, water detector, gas detectors, magnetic contact, etc.) activates both a visual alarm on the main video and a call to the operator so that it will possible to activate a bilateral communication.

For the entertainment, a webcam communication system will be installed, in order to see relatives and friends during the phone call. So it will possible to develop a social net too. In each bed room will be present a touch screen to remember the daily activities, in order to maintain the personal domestic organisation. The visual signal of the on going action will be visualize on the video. Therefore, when the signalled action has been done, the user will touch the display in order to confirm the end of the demanded activities.

Over the solutions above described, adapt to each user, personalized and specific technical solutions have been included in the project. Such example, in order to improve the personal hygiene for a user with special needs, four lighting push buttons in the shower will be installed. These buttons should have an ergonomic shape in relation to the manual ability and an image of the on going action. It will become lighting automatically in order to remember the next action. Therefore it will be switched off by user manual pushing in order to confirm that the activity has been concluded. The next action will be suggested with the lighting of the other button consecutively.
5-6 Final design and monitoring
The final design and the planning of the monitoring activities are working on.
Conclusions

The semi-sheltered apartment design for people with cognitive disabilities is today increasing.

It is important to develop a design methodology with an interdisciplinary team in order to build integrated dwellings appropriate to the user needs. In this way it will be possible to offer them the possibility to live autonomously at home, guarantying an adequate security and safety level.

The final result should be a synthesis design that includes architectonical solutions, furniture definition, smart devices and automatic control system installation, verified by the team during each design phase.

The evaluation of this methodology will be completed be means of other case studies that will support the correct use of design elements. So it will be possible to have concrete and significant ideas and real situations in order to have an exhaustive critical version of the problems related to design for cognitive disabled people.

References

1. Frattari, A. - *Codice di Pratica per la localizzazione di sistemi domotici*”. Provincia Autonoma di Trento, Trento, 2005


7. Cipolla, M.- Progettare la domotica, Maggioli Editore 2004

8. Quaranta, G., Mongiovì P.- L’ABC della domotica, Il sole 24 ore, 2004
