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# Design for the ambient assisted living.

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**Abstract:**
The contribution of the discipline of Design for the ambient assisted living come from the several declinations that design offers into similar branches of knowledge.
The centrality of the user is the starting point to the innovation of some design sectors and his physical, psychological, social conditions too.
In this context, the research proposed defining the characteristics proper of design that constitute it, then the possible evolution:
-The ambient assisted living setting systematization defining its design characters.
-The definition of different levels of intervention according to the components role that make up the main supports of AAL.
-The collection of some case studies proposing solutions in keeping with defined systemic grid.
The vision of the user as being with an inevitable mental and physical decline that turns him into a social problem, is definitely an obsolete vision and never was true.

**Keywords:** AAL, Smart objects, Design For All

# 1. Introduction

Fundamental modification of the demographic curve, especially in Western countries, has clearly demonstrated a significant trend towards aaging of the population, especially situation reported in recent years of the last century, and that the current demographic surveys show in consolidation[1].

This condition is characterized by certain subsequent events, such as: an increase in the basis for assistance from health services, a change of economic weights is that health benefit that the community is to support, rethinking the overall approach towards types of people which on one hand increase in an important way their contribution to the community, the other moving forward the expectations of a health and a quality of life to which you should give important feedback.

A this phenomenon which in fact presents a positive raising expectations of quality of life, by an increasing number of people, they are offset by equally significant issues and that seem to actually affect in a negative way this demographic change.

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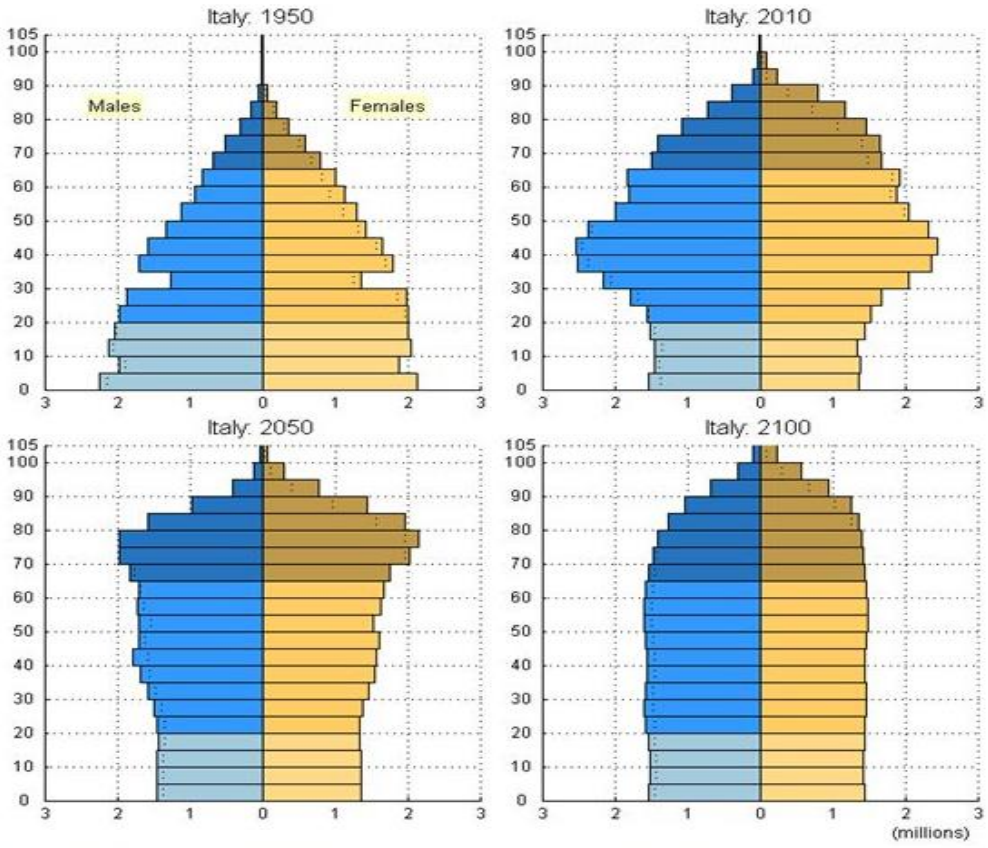


*Ill.1, Population aging in Italy in 1950, 2100 (Ref. United Nation Department of Social Affairs, Population Division 2010)*

The possibility that the community has in terms of medical support to respond to this increase in requests is conditioned by the public economic budgets diffusely unable to support and withstand such condition, and imagining whereas the intervention in traditionally advanced stage of the state of need.

In this situation is often the direct family support and close as possible to the user who replaces social assistance, with the support of workers and service as possible to domestic.

Valori e indirizzi di prevenzione, mantenimento e stimolo all'inclusione sociale delle persone che si trovano nella fascia demografica di età più avanzata, sono presenti fortemente nel dibattito culturale in diverse discipline, ma scarsamente ancora applicati, soprattutto in alcuni paesi occidentali, a livello concreto con interventi sociali di supporto. Prevention values, maintaining and stimulating social inclusion of people who are in the population of older age group, are strongly present in the cultural debate in various disciplines, but still poorly applied, especially in some western countries, a concrete level with social support interventions.

Only some countries of northern Europe, which then are those statistically less affected by this trend in the demographic curve, but traditionally have a particularly strong social sensitivity, you can see systematic steps toward this approach said to "support the phenomenon of active aging population"[2].

In reality, the debate in this scenario is extremely complex and involves multiple disciplines across the board, and is enriched by many visions of intervention designed to effectively support this massive change.



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The margin, the line between maintaining a growing team of people in an active and involving context, also the ability to give a support and an increasingly localized assistance in domestic contexts, to lessen the impact on specialist units on the one hand, and maintain as much as possible the state of dignity and independence of the individual, are the main intervention scenarios.

To this can't escape the discipline of Design that can provide significant support for its expertise in these contexts, both for its natural inclination to the centrality of the user, both for its natural aspiration to be discipline to solve a concrete synthesis need.

The work that we present here is therefore to try to systematically define the scenarios to which the design turns with the objective of identifying the methodological peculiarities of the design discipline in these.

# 2. Ambient Assisted Living the Design scenarios

## 2.1 Research Scenarios

The principles of Active and Ambient Assisted Living aims to foster, enhance, stimulate an improvement in living conditions for older people, even in different physical conditions, allowing their stay as much as possible within the home environment.

The report that is considered critical is that which places man and his traditional environment as a fundamental solution for the maintenance of an overall wellness.

The common characteristic element to the different disciplines that are involved in this strategy is the exploitation, use and innovation of new technologies to favor staying at their own home environment of the elderly.

There are many development programs [3] both in Europe and worldwide that deal with this scenario and are certainly in the broader context of the aging population theme, one of the most productive and cross-scientific contexts to which to refer.

The same program of research and development scenarios envisaged in Horizon2020 programs highlight the section Societal Challenges (SC1) particular attention to the role of technological innovation in favor of solutions which result in an improvement of living conditions for users maintaining these closely related with familiar environments, domestic.

The hypothesis of systematization of this context, corresponds substantially to the definition of a right of Design search scenarios, this being understood as the synthesis and role of stimulus to the definition of the design assumptions that organically contribute to the development of appropriate solution.

The main aspiration is to concretely represent innovation that new technologies are able to develop by means of systems solutions and products that pose the crucial issue, especially in the context of AAL, the humanization of technology.

## 2.2 level of intervention

The solutions that are developed in relation to the research in the AAL area are oriented at different levels of intervention and are addressed in more or less direct way to different types of users. It proposes a definition of the different levels of intervention considering how elements that characterize the ultimate beneficiary:



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First level of intervention is directed to the user by the aid senior who being in more or less difficult conditions can be direct user of a product, system and for its characteristics of technological innovation provides a support function to the user .

Second level is constituted by the possibility to adapt the home environment to the specific needs of the user

Third level is not oriented specifically to the affected user from the different skills provided rather to support operators (caregiver) that using certain technologies may constitute a technologically advanced care when distance.

Fourth level consists of the systems that ausiliano the direct or indirect relation systems of social and affective, that there are in fact a functionally direct aid to specific physical problems solution, rather the maintenance of inclusiveness and Business user through systems that increase potential for relationships between himself and friends, also relatives.

This context is currently strongly influenced by numerous initiatives is research, both economic and trade that stimulate the development of technologically advanced products and systems, resulting from the world of Information and Communication Technology (ICT), the Internet of Things (IoT) [4], robotics and biomedical engineering.

In support of these there are the disciplines of medical sciences, social sciences, which are in fact the main disciplines of reference for technological innovation.

In this context, as also mentioned in the introduction the role that design in fact is doing is clearly traceable and can be contextualized in a structured way for several peculiarities.

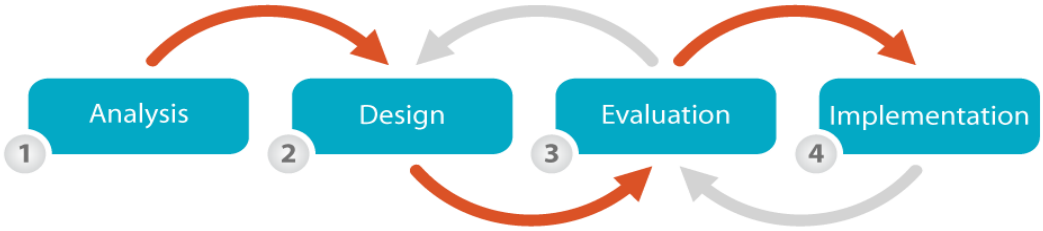
## 2.3 The centrality user

The specificity and the peculiarity that in the context of ALL the user manifests is extremely adjoining a methodological approach that has long design implements in different ideation design contexts.

The design, develops from the time a project approach that puts the user in an active and participatory context of the definition of the project. Underlying this process is a cyclical and interactive feedback during the development phase of the project between the designer and the user.

User requirements, and in particular the specific characteristics of the individual elements are actively participating in the phase of development of the project.

This approach [5] (also the subject of an application ISO 13407) is substantially determined by a general approach which bases the project, or rather his training on 'requirements of the end user.




*Ill.2, The user-centered design process*

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The topic which is the main element of reference between the project and user, is represented as cyclical approach and relationship between the time conceptual and experimental.

These relationships develop through different moments of guided and experimental comparison that puts users directly involved as the protagonist, although not so empowering, in decision-making.

The theme of technological innovation, particularly in relation to information technology, pose a significant problem in their relationship with end users, so with interaction capabilities including innovative products, systems and users that provide cultural and experiential, and adaptability and implementation of their abilities, prove definitely inadequate.

All contexts affected technological innovation a inadequate relationship with users, so the process and the experimental approach in one of its method of design interfaces scenario study is one element of greater attention to the analysis of the factors determining the role of the AAL design in the context of innovation.

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## 2.4 Technological innovation and user references

The discipline of Ambient (Active) Assisted Living does not ignore the peculiarities of the digital computer support of innovation support and assistance systems.

And implementing innovative technologies, products and objects, although already widely available and popular in the context of bio-medical equipment and assistive technology, is to complete the scenario, the major search contexts.

The design indicates there as always methodological approach that on the one hand enhances its inclination towards the enjoyment and comfort of use of the product, on the other hand the ability to synthesize systems and products capable of carrying out functions and meet the needs arising from a framework of needs articulated, where the formal aspects are not relegated to the exclusive fulfillment of the aesthetic role.

The main topic, right in the context of AAL, it is the significant relationship between a scenario of users and their characteristics they both need to find incentives to active involvement to their daily activities, is to be supported so "easy" to the conduct of these activities as well as help for those activities where they lost the sufficient autonomy levels.

In this context, we can then identify different levels of intervention that design implements:

The formal characterization of the product and technologically advanced system based on the study of the interface and integration with domestic contexts and recognition and reference with the user's cultural context.

The recovery of a formal dignity of the assistance in favor of an environment where the use of the assistance poster itself does not constitute an emotional and psychological impact frustrating by you.

The transformation from integrated product of items that can consistently provide a reference network (even intangible or invisible) and the relationship between objects and aids, where the key element is a structured integration of systems and services.

*Ill.3, Supplementary aid for the transport of wheelchair ( M.Grelli 2014)*

User centred in this context is characteristic and design these main reference elements must match, proposing the hypothesis developed which emphasize the role of "humanization" of innovation.

In terms of methodology support it is taken, as noted above, the experience of the User Centred Design, so the scales of action are detailed in relation to different types of products.

The technological innovation form is not sufficient to determine the role of the product in its final configuration.

The design, with reference to a humanistic approach, acts as a stimulus to the broader vision of solutions that are not a result of a problem, rather than looking for new problems (probelm finder) [7] to be placed or better needs to be stimulated enough to determine the role of the product in its final configuration.

The relationship between technological innovation and references with you, considering this a relationship that needs to stimulate its adaptivity, puts the design in an area precisely where the context is basically in the search for a synthesis of behaviors and actions " friendly "between product and user.

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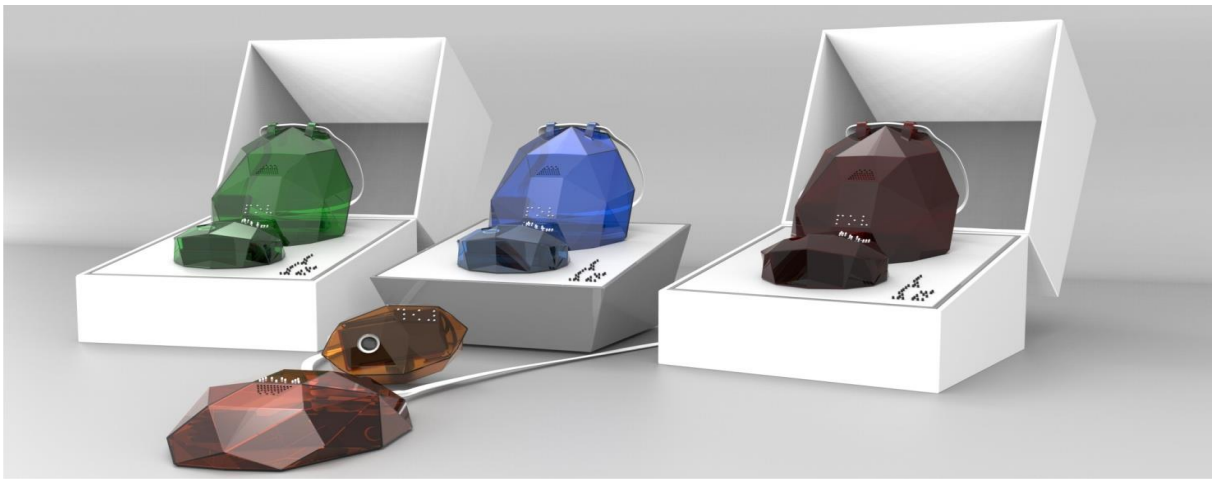

*Ill.4, Jewel for user visually impaired with vibration sensor (A. Garaguso 2015)*

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# 3. Ambient Assisted Living the smart view

## 3.1 The holistic view

Behind the semantic neologism of "Holistic Design" - where, for design is the set of research activities, product conception and design aimed at the realization of any product, whether material or immaterial, and holistic (from the greek holos: 'everything' , 'integer'), referring to the statement that the whole is not the sum of the parts and that the set can not be explained by the analysis of the functioning of its components - it receives and you want to spread a trend that currently , is traveling the world of industrial design: the relative importance and the fecundity of a face orientation of a user satisfaction more and more extended and a design philosophy that has ceased to discrimination between majorities and minorities, including children and seniors, between able-bodied and disabled, as well as between man and the habitats in which they live.

This design approach is essential, when we compare that issues related to enlarged audience to Ageing Society, they see among the primary objectives to be pursued, those optimization capabilities of the elderly in relation to the objective neurological physical change and the absence of stimuli to maintaining their own abilities and try at the same time, to develop intervention models to prevent and slow the mental and physical decline and cognitive.

The Ageing Population, by convention, considered the elderly as those individuals of age or over 65 years, divided then as degrees of users in several subgroups between them clearly distinct, such as the self-sufficient; the dependent to various degrees; the only ones who are still living at home; those with significant pathologies, etc.

This varied landscape made then useful to distinguish two broad areas:

- Elders of the third age: with a better physical and mental abilities, more cognitive-emotional reserves and emotional well-being;

- Elders of the fourth age: marked by loss of cognitive abilities and learning, by the increase in chronic stress syndrome, senile dementia, high levels of emotional fragility and dysfunctionality and relevant diseases.

More pressing is done, therefore, the need to abolish any kind of physical or psychological barrier that may constitute a limit to the free use of the environment; irrespective of age and needs.
One of the main points to be addressed to create a new culture of disability-related is to pursue home care, so as to give the elderly the possibility-opportunity to continue to live as long as possible in your environment, it is can provide ongoing assistance and is plugged into a network of local services, giving rise to a residential unit in which flow together, integrating, architecture, technology and products. The innovative project proposals have recourse to home automation and building automation. It is held in high regard as telemedicine, whose innovations make it possible to take care of the sick directly to home (home care) and not neglect the evolution of aids that still make improvements in daily life.
The Industrial Design, can't ignore cynically by considerations relating to Users of reference both in terms of numbers, psycho-physical and the purchasing opportunities.

## 3.2 Design for All new ergonomic goals

The distinctive features and objectives of the Design for All, are attributable to the crucial contemporary man's conscience before taking to the inherent difficulties of a world that is becoming increasingly complex.
Design for All is also the vanguard able to face those social-problems caused by still ongoing ethical inequalities and retained by a cultural memory that insists to see reality in a reductionist way, the latter approach that focuses the parts well, but loses sight of the whole.

The prospect of Design for All, which has adopted the results of what we might call 'project reductionism', but that has now transcended its limits, thus contributing to neutralize being hierarchical view, the compartmentalization of society and, ultimately, the fragmentation of knowledge.

Finally materialized the opportunity to make a new cultural revolution arising from the replacement of the past have become paradigms, now, old-fashioned to meet the needs of users; one of the first steps that have moved in this direction, was to definitely want to bring down one of the main archetypes of an old way of thinking about the design: one represented by the concept of "middle man" to replace it with the rather more suitable and appropriate, "real individual."

Design for All (DFA) is the design intended to meet the needs of all, not only of the majority; for this is, in some way, trying to chase a utopia also moral and social development. It is a design philosophy that takes into account the diverse set of individuals and users of objects users, environments, systems and services.
If the DFA is a frame that ideally framed and includes the whole community of users, then it means that the distinctions in society, are regarded with the same title and the same importance as a method of project that sees normalcy in diversity: people with disabilities, non-disabled, elderly, children, etc., are all in the same area of relevance.

In DFA it is considered the possibility that in everyone, sooner or later, will establish at least one disability; it is undeniable that the same inevitable process of aging involves functional involution.

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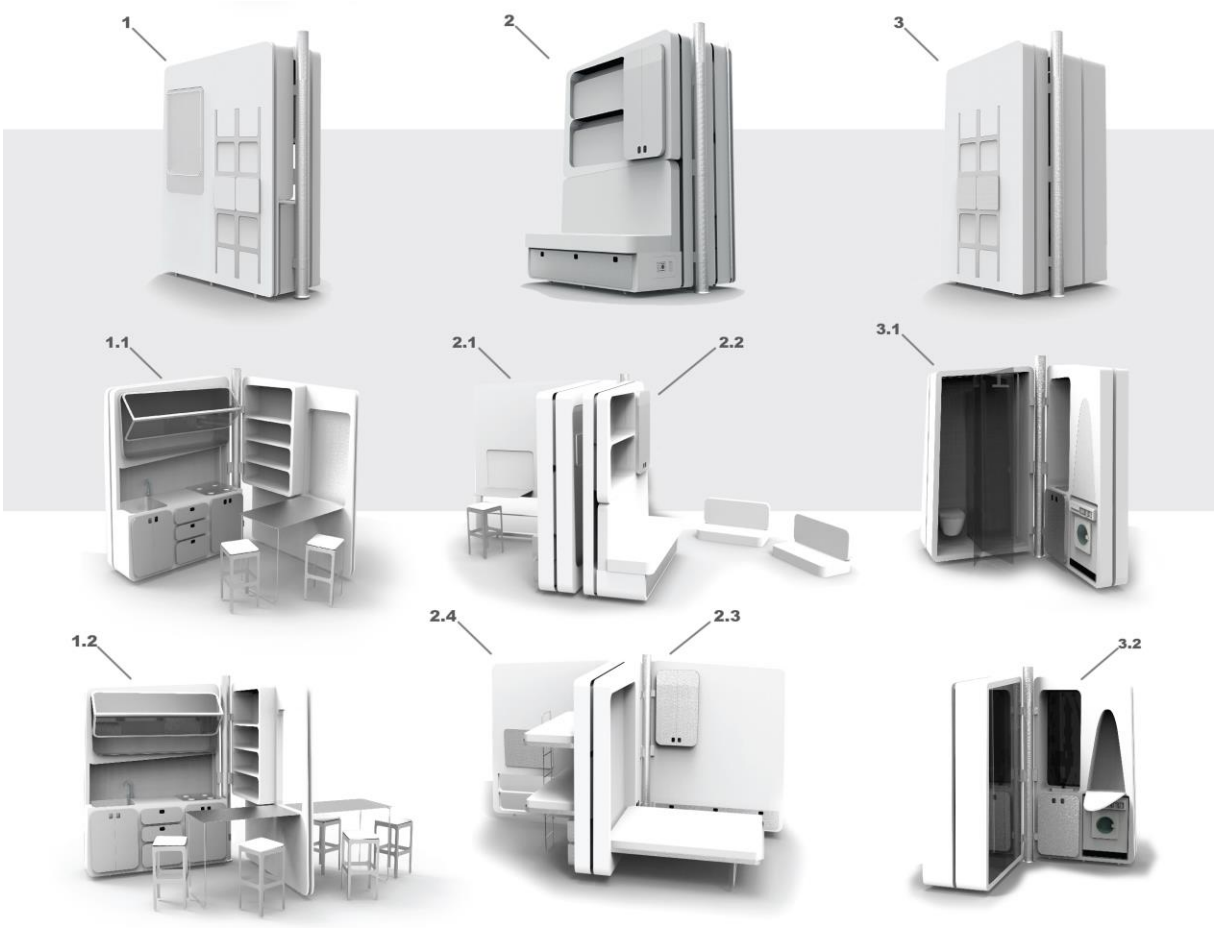


*Ill.5, Smart Furnishings (S.Pirozzi 2013)*

A definition more graphically, which did not include the reference to disability, is certainly the one contained in the Stockholm Declaration, for which "the DFA is design for human diversity, social inclusion and equality. This holistic and innovative approach constitutes a creative and ethical challenge for all planners, designers, entrepreneurs, administrators and political leaders"[8].

This objective, well understood, is reached when the project provides in itself the possibility of independent use, without the application of vaults subsequent amendments to overcome the handicap that the disabilities linked to seniority causes the user's functions. Disability is, in fact, a limitation of the powers possessed by an individual with respect to the rule which, it is worth repeating, has to do with a statistically of the frequency distribution curve: in other words, the rule is in relation to a characteristic the majority of individuals.
A product DFA must simultaneously fulfill the following requirements: fair use; flexible use; simple and intuitive use; perceptibility of the information; fault tolerance; containment of physical effort; measures and space for approach and use.

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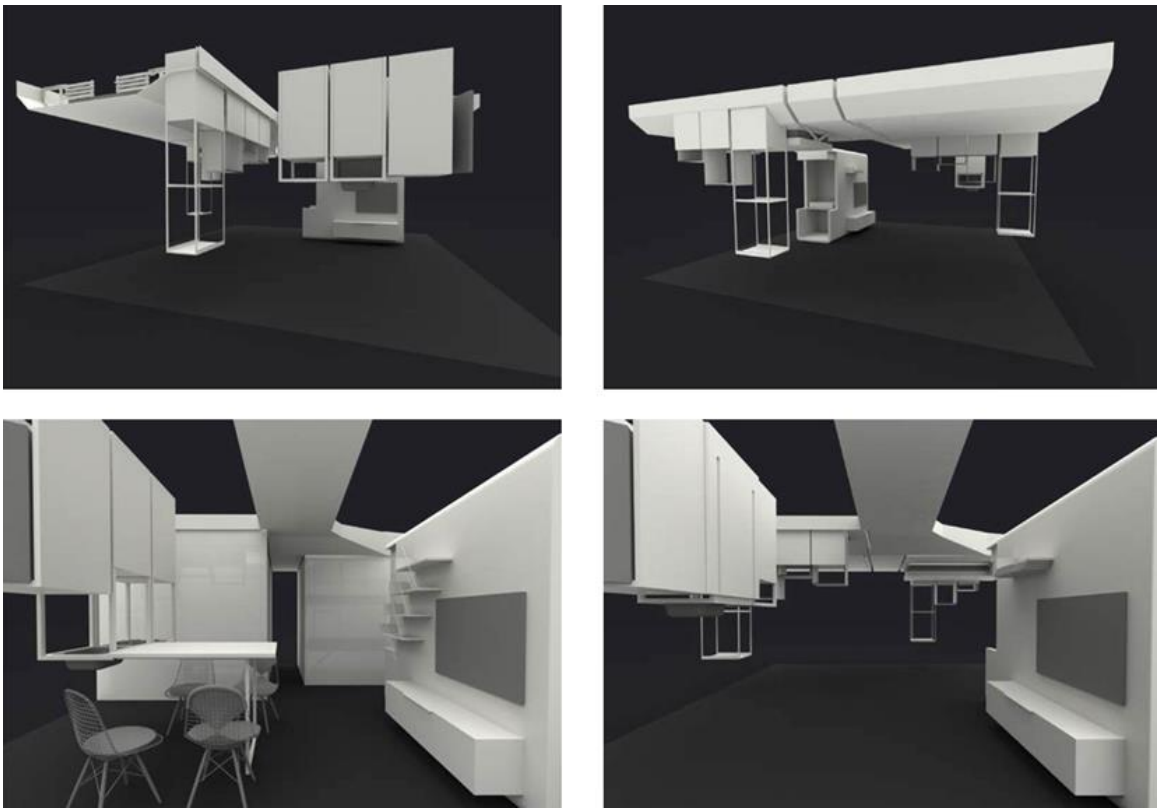

*Ill.6, Smart House Concept for the third age (S.Angeloni, M.Levitikos 2015)*

## 3.3 Smart Living Spaces

Each of us relates the self-perception of the level of quality of their daily lives primarily to the context in which daily lives. In addition, the user of a space is confronted with it immediately, even before you consciously express a positive or negative evaluation, and even before the actual fruition. Consciousness appear lens type estimates as the detection of architectural barriers, physical barriers, sensory / perceptual.

For architectural barriers essentially means the physical obstacles that prevent and / or limit severely the ability to walk unaided and safe. Then there are also the psychological barriers that fall in the domain of the psychic sciences and sociology and identify with the psychological or cultural barriers; In fact, these prevent the full use of their potential and a balanced satisfaction of personal needs.

The psychological barriers are impediments even more difficult in the case of the elderly, which, in general, have more cultural and psychological influences: the environment that surrounds it may have seemed difficult for both reduced physical prowess both in the degree of expertise that he possesses relatively new technological tools.

It should be reiterated that the various types of barriers are in close contact with each other and carry on the same track: the physical removal of the obstacle has a positive effect on the demolition of the psychological. And it is also true: if the individual's self-knowledge is deepened, that is if you discover what their psychological limits, even the removal of architectural barriers will be easier.

The aim is to exercise cognitive stimulation on the part of the home in the form of Smart Space and Smart Object, aimed at the deceleration of the cognitive decline that leads to dementia, urging the not yet damaged functions, thus slowing the course of the disease and the worsening of symptoms.



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Existing housing models are obsolete, since they do not possess that level of flexibility to help them respond to the new challenges of a user enlarged.

In a scenario of this type, there is the theme of living for the elderly and disabled, in a perspective of social integration and improved quality of life.

A Smart House, or rather a Smart House System, should be a complex and flexible housing model, composed of intelligent components, combined and reproducible in standardized modules, designed to be able to realize any domestic living environment.

A smart home, which is closely linked to home automation in the traditional sense, placing the user at the center of the house of the technological solutions developed by integrating the best remote support technologies and realizing the cognitive support, training and assistance necessary to the effective dissemination of smart-object.

The Smart House concept will be based on the interaction of synergistic: systems and automation technologies, ICT, innovative materials and processes with high levels of eco-sustainability, low production costs, containment and optimization of energy consumption, application of the principles of User Centered Design; reaching the highest levels of comfort and efficiency.

The smart house and the smart object he will have to ensure:

- variety of usage scenarios;
- prevent dangerous situations;
- adaptability and flexibility;
- possibility of carrying out non-invasive interventions of remodeling and adaptation;
- home automation and remote support solutions;
- implementation in smart-object functions;
- Media coverage of specific needs , according to an expanded model ;
- customization and adaptability of the solutions;
- accessibility in relation to lifestyle, socio-economic , cultural level, etc.;
- Easy communication with the world;
- reversibility or changeability of the interventions to be carried out;
- reduction of hospitalization improper ;
- "sense of normalcy" of their own living;
- multisensory interaction and multimode;
- the use of intelligent materials (smart material) or functional;
- Portability of some smart-objects that considers mobility and wearability;
- ease of use and interaction.

The Digital Revolution and new technologies have profoundly changed the way we live and interact with others. Technology is now an integral part of our everyday life and the technological nature is the common element in most of the products that characterize our age. The technique has been extended to everyday objects that, thanks to this implementation, have become intelligent.

The objects that define "smart" are mainly those which have been designed to be able to interact with each other and, by connecting to the network, and are able to exchange information about themselves and the environment that surrounds them.

These objects can become new tools for monitoring health, real medical device capable of analyzing the biometric data of persons and contact health, families, and, above all, with the individual

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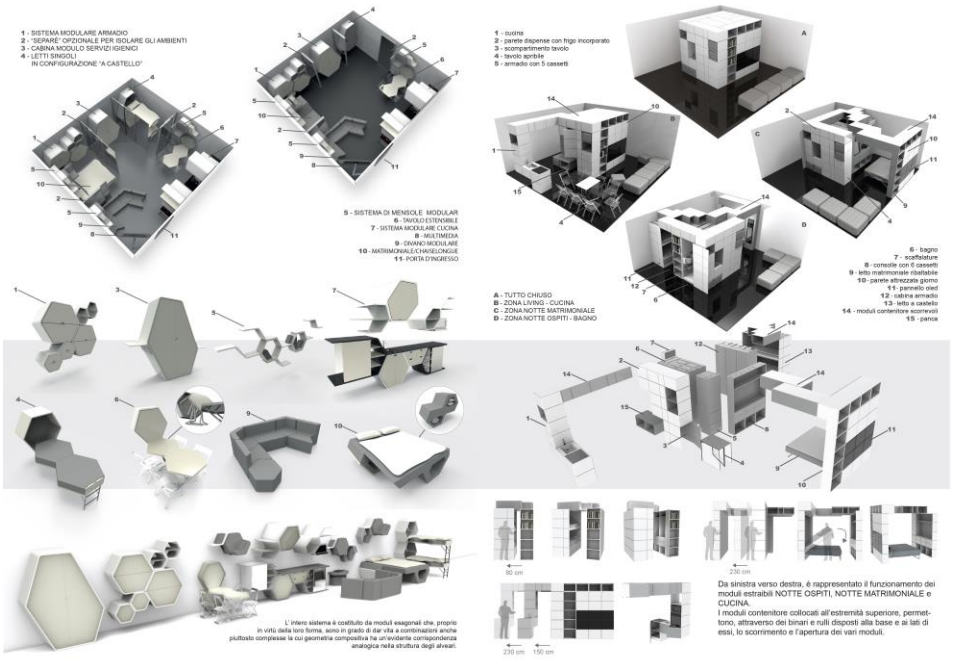
concerned.
The whole world is intended, therefore, to become more intelligent view of the increasing presence of the Internet in the objects around us. "Internet of Things", is now a widespread reality.

Home automation is a multidisciplinary science that deals with the study of all the technologies that can make our homes smart. Through the coordinated, integrated and computerized building services, communication networks and computer networks, it is possible to improve the quality of life in the house, significantly increased safety and comfort.

Make an automated home, therefore, it means to install devices that are able not only to receive from the outside and remote input, but also to understand yourself what actions to take, based on the user's needs and habits.

Accessibility, autonomy, rehabilitation, social reintegration, socialization: they are issues that affect people with special needs.

The house thus becomes a system (ie a set of elements or subsystems interconnected with each other through mutual relations, which behaves as a whole, according to their general rules).
The supporting software systems (softwares tools) for the Green Smart House System will be open, secure, and highly reliable to facilitate collaboration among the various physical and IT assets of the domestic ecosystem.




*Ill.7, Smart Space System (M.Butteri, E.Ventura, G.O.Cicciarella 2013)*

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# 4 Hcd contribute to mobility design

## 4.1 Research Scenarios

The research project proposes the creation of a hybrid system that combines the domestic mobility with the urban mobility, medium-range, allowing better accessibility and usability of lived spaces. The product is the result of technology tranfer systems and components from aeronautical-space sector, automation, robotics, information and communications (ICT). The formal and technological contect deals with the principles governing from Design For All and Human-Centered Design and it is characterized by being an integraded, self-containedsystem, interactive with domestic automation, Home Automation, and interconnected networks, network, reliable, according to the principles of simplicity of use, safety of operation and accessibility for overcoming architectural barriers. For the development of the research it has been taken as model the approach described in the Human Centered Design Toolkit[9], published by the organization IDEO[10].

Inside the volume there are described three main conceps for the correct product development: […]The solutions That emerges at the end of the Human-Centered Design Should hit the overlap of These three lenses; they need to be Desirable, Feasible, and Viable.[…]

From this concept were highlighted three main factors of comparison: the user analysis, the devices currently used and the feasibility of the product. These factors have been developed within the process HCD (Human Centered Design) dividing it according to a timeline in three stages:

- Analysis: addressing issues related to the user starting from the concept of active aging, through the analysis of the typical day, care profiles and devices currently in use;
- Development: assuming in the case study the possible devices for the elimination of architectural barriers and then address the solution of technology transfer;
- Results: highlighting the best design solution coming to a test prototype to address the possible implementations;

*Ill.8, Intelligent mobile device for an active longevity and independent living (D. Paciotti 2016)*

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## 4.2 User Analysis, aging, disability and typical day

The research project is based on the natural processes of aging that takes the user to be progressively with a disability due to the onset of natural conditions, such as physical and cognitive degeneration. These diseases have been translated with the identification of Charitable profiles. According to the definition of the pattern it has been identified the degree of autonomy and independence of the user. The classified charitable profiles have been reported in a series of tabs, which relate the pathology, the effects produced in terms of mobility reduction and the degree of skill . The main diseases were divided into three main classes: temporary disability, degenerative diseases and congenital diseases. The cards which shows various diseases have been included in a summary table, an array, where the user's performance is related to the degree of disability. This result gives us an abutment inside index ADL, Activities of Daily Living, and IADL Instrumental Activities of Daily Living, where the overall score of the assigned indexes to define the type of care user profile, characterizing this process analysis under the aspect of the mobility of both upper limbs of the lower ones. This analysis allowed us to identify the user's profile to be considered, with a low level of support.

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## 4.3 Taxonomy of systems, technologies and existing devices

For a complete definition of the systems, devices and existing technologies for personal mobility both in the home and in the city, it used a taxonomic classification. The catalog has been prepared in relation to the identification of reference organizational and conceptual principles, based on the method examined the Human Centered Design, which made it possible to identify the performance and features of the selected products.

The main factors of the comparison are:

1. The environment of use, domestic or urban, in which you can define the characteristics of dimension and use of system;
2. The type of handling, motor, manual, electric or assisted and the technologies used to support the ambulation;
3. The type of guide and the user's positioning, sitting or standing, analyzed from an ergonomic point;
4. The ability to overcome the architectural barriers, analyzing the technology used for a facilitated access to the two reference environments;
5. The level of industrialization of the product, industrial components, handcrafts, hybrids;
6. Dimensional analysis, the analysis of weight, mechanical characteristics, dimensional relationships between the parts.

The critical study of the state classified in this way has allowed to identify the main critical points common to the various devices regarding the difficulty of use and to their use in a discontinuous manner. A little attention to ergonomic furniture design principals in relation to possible different needs due to the different degree of users skills; the lack of adaptability, transformation and flexibility of the devices in relation to the progression of the diseases and the corresponding adjustment in the course of time of the domestic environments; inadequate, dangerous and often the inability of the devices in urban areas to overcome even modest architectural barriers independently without the possibility of being assisted, they are in fact still an obstacle to achieving greater social inclusion of mobility.

## 4.4 Overcoming architectural barriers

The main feature of the research project is to be able to assume a device that is able to overcome most of the barriers, which an average user can surely find within their own home environment, but also in the urban environment. The first phase, in order to assume the solutions that were able to solve the problem, has affected the analysis of traction systems that they were able, with standalone or external devices, to overcome the architectural barriers. This analysis took into account only the autonomous devices, as the research project involves a fundamental feature complete user autonomy. The degree of difficulty and ways to overcome architectural barriers is influenced by the type of the obstacle to overcome which can range from passing a small step or a street disconnected even up to passing ramps or stairs tiers. This consideration has effectively led at the outset, to identify what was the best method of approach for solving this problem. It is analyzed the possibility of considering whether the crossing of this particular type of architectural barriers may take place in the front and posterior way. This choice of preliminary type will determine the configuration of the product decisively. For the ascent in the front position can be found three main aspects of analysis to promote a level of comfort and safety for the user. The first criticality is represented, from an ergonomic point, the position of the feet respect the steps, as before the device can be positioned for the ascent, they could bump against the steps, causing a collision and a possible trauma. The second and third critical issues, relate to aspects of kinematic type, since the center of gravity of the whole device, in order to encourage the use of less energy, you must have on the top step before the whole body soar on the same, forcing the user to modify its inclination toward the front, causing a feeling of imbalance with the front face of the approach and the torso towards the steps. These three critical points lead to a level of user dis-comfort as they may cause a sense of loss of balance and stability of the product. In the analysis of the slope in the rear position is noted, however, that the displacement of the center of gravity towards the upper step, favors the correct ascent and a use of a lower energy, thereby increasing the comfort with respect to the frontal position, also thanks to the use of an ergonomically correct backrest, which makes the safest uphill. The maintenance of this configuration is also ensured by a series of ultrasonic proximity sensors that assist and guide the device and the user towards a stable and safe ascent. This kind of meta-analysis of the drive system for proper elimination of architectural barriers of the stairs, has identified as the best traction method, through a technology transfer process, that used the Rover Curiosity3 used in space exploration missions on Mars. The traction system, analyzed, studied in its parts and features, has been adapted and shaped to be used in environments of reference of the research project.

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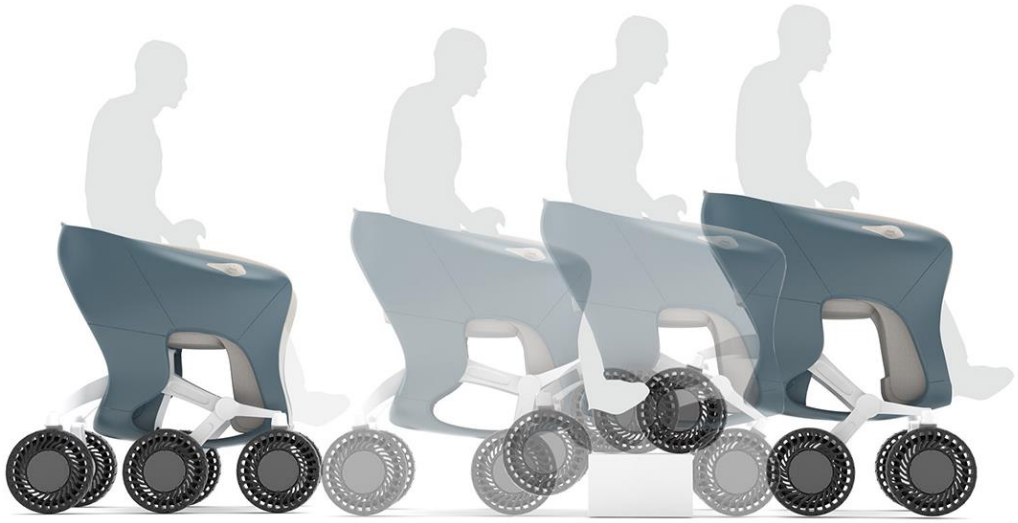

*Ill.9, Overcoming architectural barriers (D. Paciotti 2016)*

## 4.5 Results

The formal synthesis, functional and structural that ensues is a device that is placed inside the analyzed environments, defining a scenario hitherto little investigated, where the device combines the features of means for mobility in the home, then the most compact and agile you can interface user friendly to use and those for a medium-range urban mobility able to move and overcome obstacles and barriers of medium difficulty. The classification of the device between the two scenarios is justified by the redefinition of the traction system, inspired aerospace environment, adapted to a use within the environment both urban and domestic with the simplicity of use for a user with varying degrees of skill . The traction system (pic.3) is formed with a layout of six-wheel drive, appropriate dimensioned in diameter to facilitate the overcoming small obstacles. The four wheels at the front end and rear, have the ability to rotate on its own vertical axis increasing the agility of the vehicle. Thanks to the traction system complies a frame able to adapt to movements, thought a skeletal system, lightweight but with adequate mechanical resistance due the section of it, designed with an outer skin with constant thickness inside a Voronoi tessellation[11].

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*Ill.10, Intelligent mobile device for an active longevity and independent living (D. Paciotti 2016)*

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## 4.6 Conclusions

Research has confirmed the ever-present need for an approach to the project using the principles of Design for All and Human-Centered Design. The methodology proposal demonstrates that the analysis of the state, is crucial to understanding of the performance and functional limitations of existing devices and for the identification of the degree of innovation still possible through the technology transfer of systems from other fields application and critical review and ongoing experimental models, process methods and tools. The research played a key role in the identification of an evolution of the proposed reference scenario, where the complexity of the man-machine relationship has exceeded the idea of artifacts that identify specific categories of users but is instead directed toward devices able to respond dynamically to user need increasing comfort and awareness of greater independence for an active and intelligent longevity.

Note:

[1]Eurostat data 2016

[2]aa.vv. (2012) Il contributo dell'UE all'invecchiamento attivo e alla solidarietà tra le generazioni, Bruxelles ed.Unione Europea

[3] AAL program Innovative tecnology for active and healthy ageing

[4]A.Mcewen , H.Cassimally (2014) Designing the Internet of Things, ed. John Wiley and Sons (UK)

[5] Cos'è lo User-Centered Design (UCD) di Maurizio Boscarol in http://www.usabile.it/

[6] Landauer, Thomas K. ( 1996) "The Trouble with Computers", MIT Press, Cambridge

[7] " In the context of the Designer role is expanding, from that of problem solver, called to optimize production processes and improve products from a functional and aesthetic point of view, to the finder problem, that of the one who asks questions about what people want or do not want" (rif. Bibliografia, Il design per l'Home Care, pg. 23)

[8] Cfr. Avril Accolla, Design for All. Il progetto per l'individuo reale, FrancoAngeli, Milano 2009, p. 216.

[9] Human Centered Design Toolkit is the result of a project funded by the Bill & Melinda Gates Foundation. The BMGF has met four organizations IDEO, IDE, ICRW and Heifer International as a partner in the creation of a method to drive innovation and design for people living under $ 2 a day.

[10] IDEO, non-profit organization, their mission is to improve the lives of people in poor and vulnerable communities through design using the principles of Human Centered Design.

[11] In mathematics, a Voronoi diagram (named after Georgy Voronoi), also called tessellation of Voronoi decomposition of Voronoi, or tessellation Dirichlet (from the name of Lejeune Dirichlet) is a particular type of decomposition of a certain metric space from the distances compared to a certain discrete set of elements of the space. Thanks to this diagram it is possible to optimize the inner material while maintaining the same mechanical properties but decreasing the overall weight.

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