The International Classification of Functioning, Disability and Health as a conceptual model for the evaluation of environmental factors

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Abstract

The concept of Design for All emphasizes the impact of the surrounding environment in the individuals’ functionality. The International Classification of Functioning, Disability and Health brought the concepts of functionality and disability into a comprehensive whole of multiple dimensions of human functioning, such as biological, psychological, social and environmental. In order to contribute to a greater overall functionality of the individual, the use of software and complex systems can be decisive to assist the people with special needs in all areas of life.

The paradigm introduced with ICF is inclusive and universal, so it favors not only the old people, but all others, whether they have a limitation or not. The characteristics of Ambient Assisted Living (AAL) are appropriate to fulfill elderly needs. However, the current state of development is still mostly oriented to a technological perspective, where the individuals’ functionality has not been fully addressed. Under the Living Usability Lab project we have defined a methodology and created some evaluation tools for assessment of AAL services according to a Living Lab perspective, based on the ICF. In this paper we intend to describe the base fundamentals of this proposal, as well as present some results concerning a practical implementation of this methodology.

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Keywords: International Classification of Functioning, Disability and Health; environmental factors, ambiente assisted living, assessibility; living lab; evaluation; Design for All
1. Introduction

The approval of the International Classification of Functioning, Disability and Health (ICF) [1] by the World Health Organization (WHO) has marked a paradigm shift in the way health and disability are understood and measured [2]. The ICF describes the health and health-related states of an individual and indicates the positive and negative aspects of the interaction between the individual (with a health condition) and the contextual factors (environmental and personal). Until ICF publication, disability has been seen as an unrelated entity that imposes restrictions on the individual. ICF has brought these concepts into a comprehensive whole of multiple dimensions of human functioning, such as biological, psychological, social and environmental [2]. Previous concepts, like Design for All, also emphasize the impact of the surrounding environment in the functionality of individuals.

This perspective changes how care is provided, and empowers people as part involved in the care provision and responsible for their own health. This empowerment approach is directly related with the individuals’ motivation to control participation and develop skills to adapt and to influence the environment. This approach underlines the role of participation and control, supporting functionality versus disability [3]. This enabling perspective is one of the premises of active aging, as it corresponds to the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age [4].

In order to contribute to a greater overall functionality of the individual, the use of software and complex systems can be decisive to assist the elderly in all areas of life. These products and services play a key role in the interaction of users with the surrounding environment. In order to make these products and services easily usable and adapted to users, it is crucial that the development and evaluation process happens according to users’ needs and characteristics. In fact, it is essential that the functionality of individuals and the environment where they conduct their lives is contemplated in the development and evaluation of such products or services, thereby insuring their suitability. However, the current state of development is still mostly oriented to a technological perspective, and the individuals’ functionality has not been fully addressed and, in this sense the ICF arises as a possible conceptual model for the development and evaluation of environmental factors such as products or services. In this paper we intend to describe the base fundamentals of this proposal, as well as present some results concerning a practical implementation of this methodology.

This paper consists of four sections: 1) Introduction: exposition of the problem; 2) Background: overview of the conceptual modal of ICF; 3) A practical implementation using an ICF based methodology: brief methodology description and presentation of an illustrative application example using a Tele-rehabilitation service and 4) Conclusions: final considerations and presentation of suggestions for future work.

2. Background

2.1. International Classification of Functioning, Disability and Health

The ICF is one of the international classifications developed by the World Health Organization (WHO). Its general objective is to provide a unified and standardized language as well as a framework for the description of health and health-related states. The ICF is a hierarchical classification based on the perspective of the body, individual and society, organized in two parts; (1) functionality and disability, (2) contextual factors. Each part is subdivided into two components, the first, functionality and disability, includes body functions and structures and activities and participation. The second, contextual factors, is divided into personal factors and environmental factors [1]. In this classification, functionality indicates the positive aspects of the interaction between an individual (with a particular health condition) and the contextual factors (environmental and personal) [1]. On the opposite, in negative terms, disability refers to the generic term for disabilities, limitations in activity and participation restrictions. The utilization of ICF allows a complete and multidisciplinary...
approach focused on the individual [5]. The ICF model replaces the negative focus of impairment and disability, by a neutral perspective embracing all components that promote or hinder the execution of their functions, both biological and social [1, 6]. With this paradigm shift, the disease is no longer seen as the only responsible for disability and impairments, but as one of the factors influencing health, such as environmental factors, social and personal factors [7]. The ICF evidence the importance of interaction between the health condition, the individual and the surrounding environment.

Figure 1 presents the spectrum of interactions between the components of ICF.

![Fig. 1 - Interactions between the components of ICF. The functionality of an individual in a particular area is a complex interaction or relationship between health condition and the contextual factors. There is a dynamic interaction between these entities: an intervention in an element can potentially modify one or more other elements. These interactions are specific and operate in all directions [1].](image)

The environment is crucial in attenuation or elimination of the disability caused by injuries that occur as a result of adverse health conditions. In ICF, an environmental factor is classified as a facilitator if contributes to increase users performance and participation. On the other hand, if an environmental factor restricts user performance and participation, then it is classified as a barrier. Different environments can have a distinct impact on the same individual with a specific health condition. An environment with barriers, restricts the individual's performance, on the other hand, other environments with facilitators improve his functionality [1]. For example, barriers to mobility in the home context may limit an individual's ability to carry out activities (for example stairs or ports), the same happens with the mobility barriers in the community context (for example, irregular sidewalks) that may limit involvement in community activities [8]. Conversely, products to support mobility (for example, canes and wheelchairs) may enhance the person's participation in daily activities by providing physical assistance in performing specific tasks. Similarly, transport facilitators (for example, availability of a car or public transport) can enable greater participation in community activities [8].

Environmental factors are organized in the ICF in two distinct levels [1]:

- The individual level, which refers to an individual's immediate environment, encompassing spaces such as home, workplace, among others. This level includes, apart from environmental materials, direct contact with other individuals, such as family members;
- Community or culture systems that have an impact on individuals, which includes organizations, services, laws and government bodies.
The personal factors are not yet classified in the ICF due to the high social and cultural variety among subjects. Recent studies reveal that there is a growing recognition that the role of environmental factors changed the problematic and, consequently, the focus of intervention, disability is no longer understood as a single category, but rather the result of an interaction between an individual's health condition and environmental factors [9]. It is essential that the environment where an individual lives is inclusive. Ensure full accessibility is an essential aspect of the quality of life for all citizens. A fully facilitator environment enable all people to have equal opportunities for participation in all aspects of life in society. Creating an inclusive environment constitutes a holistic approach and it's an ethical challenge for all planners, administrators, engineers, manufacturers, and political leaders. To achieve this, all that is designed, in particular, the surroundings, the everyday life, culture and information, should be developed considering the concept of Design for All [10].

This concept aims to develop social inclusion and equality considering human diversity enabling all people to have equal opportunities for participation in all aspects of life in society.

Design for All approach should apply to the development of [10]:
- Environment (with regard to intellectual and physical accessibility, sustainability of structures and their impact on mobility, work and leisure within the community);
- Processes (including those regulated by legal standards);
- Interfaces (development of services, products and systems that eliminate social exclusion and functional difficulties of individuals);
- Society (involving integration and social inclusion of all marginalized groups, freeing society from prejudices and other negative social attitudes).

The elderly emerges as obvious beneficiaries of a physical, social and attitudinal facilitator environment. Ageing affects all areas of life of an individual and causes several disabilities, including limitations in terms of mobility, sensory deficits, and increase susceptibility to diseases, particularly chronic diseases such as cardiovascular disease and dementias [11]. The age pyramid inversion and the increased number of elderly, evidence even more the need to make the services and products, and consequently the environment, accessible to this population.

3. A practical implementation using an ICF based methodology

The paradigm introduced with ICF is inclusive and universal, so it favors not only the old people, as well as all others, whether they have a limitation or not [10, 12]. The characteristics of Ambient Assisted Living (AAL) are appropriate to fulfill elderly needs as it refers to concepts, products or services that interconnect and improve new technologies and social systems, with the aim of promoting the quality of life of all people during all stages of their lives [13]. AAL enables the utilization of products and technologies and the provision of distance services such as health care, helping to achieve autonomy, independence and dignity [12].

The Living Usability Lab (LUL) intends to develop AAL services to fulfill some needs that are common to older adults: full participation in society, health and quality of life or living with security [14]. The LUL is essentially an interactive environment to facilitate the research, development, integration, validation and evaluation of multimodal, adaptability and user monitoring technologies, new modes of interaction and new services supported by new generation networks using a strong involvement of users for the specification of new services.

A central idea of the Living Lab concept is a strong involvement of the users in all the development phases, including the conceptual design and, later, the prototypes. This method allows a more realistic validation of environmental factors centered in the user. Therefore, the living Lab approach seems to be a good method to evaluate environmental factors in this perspective because it is in line with the ICF approach as both adopt a holistic perspective of user involvement. Therefore, new evaluation methodologies are required to allow the
generating of new design solutions and the evaluation of design solutions derived from the first phases of user involvement.

A major problem inherent in the development of AAL products and services is its validation. Only through validation it’s possible to assess the adequacy of the products or services to their users, identifying problems and developing guidelines for users and developers [15]. The utilization of AAL products and services aims to improve people's participation and performance in carrying out activities i.e., improve the individuals functionality. Because AAL products and services intent to change the personal environment surrounding, in order to improve individuals participation, they should be considered as environmental factors in an ICF approach. In fact, if an individual is surrounded with services and products tailored to their characteristics, he will be able to reach a higher level of functionality. Accordingly, the ICF may arise as a conceptual model for the holistic development of a methodology for evaluation of environmental factors and, consequently, AAL products and services.

Using the ICF as a framework to develop instruments for the evaluation of environmental factors permits that the terminology, concepts and coded information can be aggregated with the available information, and can also be used as a comprehensive model to characterize users and their contexts, activities and participation [16]. Therefore, the ICF can be used to specify, develop and characterize AAL products and services, as well as to develop appropriate tools to assess them and their impact on user’s daily life [16]. Generally, in the development of AAL products or services, experts define which functions and services should be used and how the user should interact with the product or service. The prototypes, based on those conceptual design ideas, are then evaluated by users. Therefore, this approach is inadequate for the development of such services and products because the initial design ideas are not based on the mindsets, experiences and mental models of the users as in a living lab approach [14].

Under the Living Usability Lab project we have defined a methodology and created some evaluation tools for evaluation of AAL services according to a Living Lab perspective, based on the ICF.

This evaluation methodology assumes three phases of reference. The first phase is the conceptual validation, followed by a prototype test, and finally a pilot test. Those phases are not isolated, and they are based on a spiral approach that follows the development progress since the beginning [14].

Fig. 2. Phases of reference of the Living Lab methodology

The first phase of evaluation, conceptual validation, aims to determine if an idea of a product or service is sustainable in terms of interface and functions. In prototype test, the second phase of the evaluation, it is
intended to collect information regarding the usability and user satisfaction. At this phase there is already a physical implementation of the product or service prototype in order to be tested by users. The prototype test is conducted in a controlled environment. Finally, the third phase of evaluation, pilot test, intends to evaluate, in addition with usability and satisfaction, the meaning that a product or service has on user’s lives. For this reason, this last phase of testing differs from the prototype phase in the context where it happens. The product or service should be installed in user’s homes and integrated into their daily live routines. The phases of reference in the Living Lab methodology are present in Figure 2.

3.1. An illustrative application example using a Telerhabilitation service

The ICF based evaluation methodology was first used to evaluate the TeleRehabilitation service under develop in the LUL project [17, 18]. In general terms, the TeleRehabilitation service allows supervised remote exercise sessions, as a way to maintaining health and prevent illness [18].

The results of a first effort to evaluate an AAL service, the Telerehabilitation service, have showed that it’s possible to use ICF as a conceptual framework to evaluate environmental products in a Living Lab approach. It was conducted an exploratory pretest to assess the evaluation tools adequacy based on the ICF, developed in this methodology. Although the results seemed to point toward a good measure to discriminate facilitators and barriers, the instrument was not sensitive to recognize why a particular component or feature acted as a facilitator or barrier.

Tests held revealed a difficulty in identifying the reason why a particular component or characteristic of a component is identified as a barrier [14]. Thus, we suggest that, whenever a component is identified as a barrier, a set of predefined categories should be presented and the user should mark the ones that correspond to the reason why this component acts as a barrier. This selection should be complete with additional written information. This procedure enables the developers to identify what changes to perform on the product or service in order to make it more adapted to users, and must be performed for all the components identified as a barrier.

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Fig. 3.- Excerpt of the ICF based assessment tool – In the example the component “description of the session status” is
classified as a medium barrier. The reason why this component acts as a barrier is reflected in the category 1 (icons size) and completed in the additional information (small size).

Regardless of the barrier level it’s always important to specify why the component acts as a barrier, because it can be useful to define priority in the development progress of the environmental factors, both in terms of time or in terms of investment, in order to contribute to a higher level of users’ functionality. Another advantage of this specification is the possibility to match the barriers identified with the characteristics of users, verifying possible relationships between the users’ profiles and the identification of certain components or component features as barriers.

The gradation of facilitators may also be important because it permits the definition of good practices regarding the development of environmental factors. If a particular component or feature of an environmental factor is repeatedly identified as a facilitator in similar products or services then it may have the potential to be a good practice for services of the same type.

4. Conclusion

The development of new products and services should promote the participation of all in society, such as people with disabilities, elderly or any other. A holistic approach is necessary to understand these special needs and to contribute to an inclusive society. The ICF describes the health and health-related states of an individual in a holistic way as it permits to identify the level of functionality. AAL aims to improve the person’s participation and, in the context of quality of life, health and security, this products and services can be relevant.

Therefore, developing and classifying AAL products and services, using the ICF language, may facilitate communication between different intervenientes interested in AAL products and services. Since the current stage of development/evaluation of AAL products and services is still very technology-oriented [19] and its functionality has not been addressed adequately, we have developed assessment tools that address the individual’s functionality, assessing environmental factors according to an ICF approach. The first tests held showed that ICF seems to be useful in a first level of screening, discriminating facilitators and barriers. In order to address this, we have completed the instruments with categories that help us to understand the reason why a certain component of the environmental factor acts as a facilitator or a barrier. This allow us to collect more and more significant information in order to understand what changes should be performed in the environmental factor in order to make it more adapted to its users so it can enhance their functionality contributing to a higher participation in the society, a better performance and an improved quality of life. In addition, this methodological option can also be useful to guide the definition of good practices. This is a very important aspect of the development of products and services easily usable and adapted to users’ needs and characteristics. The verification of possible relationships between groups of users and the identification of certain components as barriers or facilitators can also be helpful to characterize users’ profiles and their environment.

The definition of a conceptual model for the evaluation of environmental factors is still in a very early stage of development and the ICF based assessment tools still needs further work in order to verify the general applicability of this methodology and determinate the validity and reliability.

Acknowledgements

This work is part of the Living Usability Lab for Next Generation Networks (www.livinglab.pt) project, a QREN project, co-funded by COMPETE and FEDER.
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