A Harmonised Methodology for the Components of Software Applications Accessibility and its Evaluation

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Abstract. Accessibility today is gaining more and more ground, becoming a real necessity in daily living and every day needs. Authorities and experts are putting a lot of effort towards accessibility, especially in the software application domain. Despite this fact the ICT applications and systems are still not fully accessible. The main idea of the ACCESSIBLE project is to contribute towards better accessibility for all citizens. This will be achieved by increasing the use of standards and by the development of an assessment simulation environment, as well as, a harmonized methodology that links all the accessibility components. In the current paper we will present to the reader the general harmonised methodology introduced in ACCESSIBLE project to correlate the proposed accessibility components. Attention will be also given to the evaluation of the ACCESSIBLE harmonised methodology, as well as the future plans.

Keywords: Accessibility, harmonization, disability.

1 Introduction

In a world where the mean average of the age limit is exceeding and the population with disabilities is raising continually the accessibility of the software applications is a very important issue. The potential for the software development products to improve people's lives and raise their standard of living is enormous. People with special needs, including impaired motor skills, weak visual acuity, and cognitive and learning disabilities, are a large and growing community with increasing interest in technology. They constitute a large percentage of the on-line community (approximately 10%), with the numbers expected to grow as the online services improve. Disable community is an under-serviced market that demands the same opportunities for Web access as everyone else.

Accessibility and ease of use for the elderly and disabled has attracted a lot of attention during the last few years. This is strongly supported by the fact that an increasing number of governments are legislating towards promoting and enforcing equality of opportunity and of access for everyone within the economy and society (Inclusion)[1], including in terms of access to ICT and the evolving Information Society (eAccessibility)[2]. Soon after the appearance and early developments of assistive technology, such as screen readers, special interaction devices, etc.,

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researchers and practitioners realised, that access to a computer-based system is often denied to large numbers of potential users as a result of the system's design. In the old days, it was widely believed that the interaction ability of an individual is simply subject to his/her functional characteristics. Yet, we now understand that it is the design of system in combination with the functional characteristics of the user that renders the person, able or unable to interact with it.

Based upon this outcome in ACCESSIBLE we tried to correlate and link the characteristics of the disabled users with their functional limitations, the assistive technologies and the design guidance through existing accessibility guidelines within on Harmonised Methodology.

2 ACCESSIBLE Harmonised Methodology Methodological Framework

The Accessible Harmonized Methodology is an attempt of harmonising each ACCESSIBLE area separately by correlating all their components, in the beginning one by one and finally all together. This is a human oriented methodology and that is why the disability type and ICF classification have been placed in the kernel of our framework. Additionally, the current methodology has been developed in a way that can be used in all possible ways and also vice versa, in order to induce the respective results and cover the addressed needs of all users. In addition and according to the aforementioned, ICF classification provides a concrete classification of impairments of the body structures, which ensures no overlapping. To this end, experts in ACCESSIBLE worked on linking user types (e.g., disability types) to certain ICF body structures and their related impairments (e.g., see Fig.1).

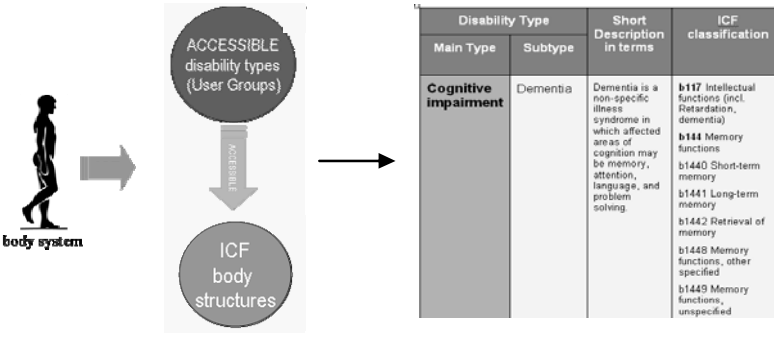

Fig. 1. Using the ICF classification as a base for harmonizing multiple user types

After this first step, experts in ACCESSIBLE have worked on defining a classification of interaction limitations based on the disability type and ICF classification core. The interaction limitations are, in essence, a detailed explanation of the functional limitations that occur from the disability types, and a presentation of the points that should be checked in order for a web site to be accessible for individuals with these disabilities. Following, link between the aforementioned

components and the assistive devices was performed. As it is illustrated in Fig. 2, assistive technologies are correlated with the disability types, the ICF classification and further on with the interaction limitations.

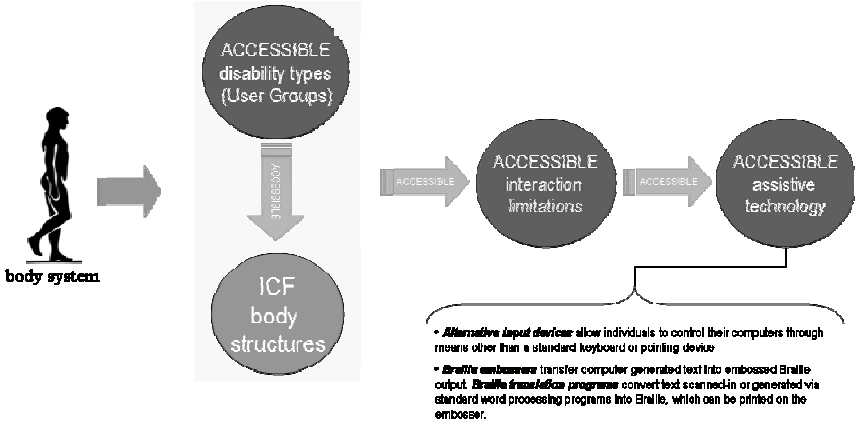

Fig. 2. Towards translating ICF body structures into interactions limitations and there upon relating individual assistive technologies to specific body structures and / or to disability types

In addition, the "translation" of the disability types and the ICF body structure impairments into interaction limitations further facilitates the linking of existing guidelines and heuristics from the literature to specific body structures and thereby to user types (see Fig. 3). Although, it is often very difficult to understand what type of user benefits the most from a given guideline (because it is hard for inexperienced developers to understand a disability or it's the effects), it is much easier to correlate a guideline to an explicitly described interaction limitation.

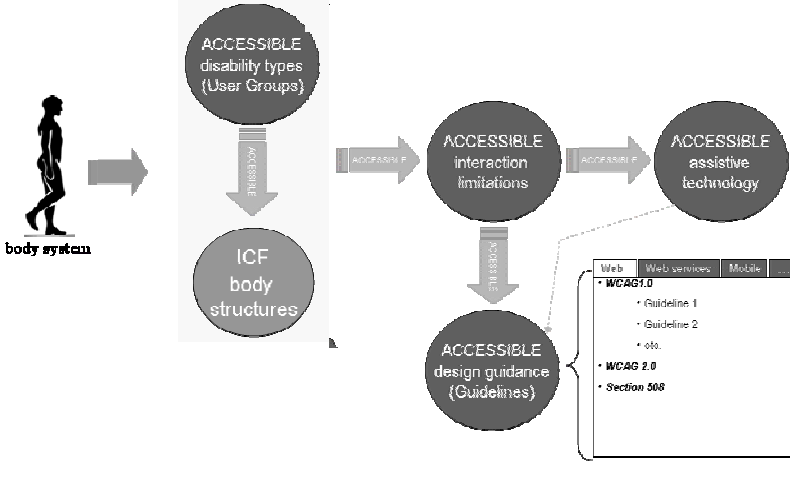

Fig. 3. Towards harmonizing design guidance with assistive technology and user types

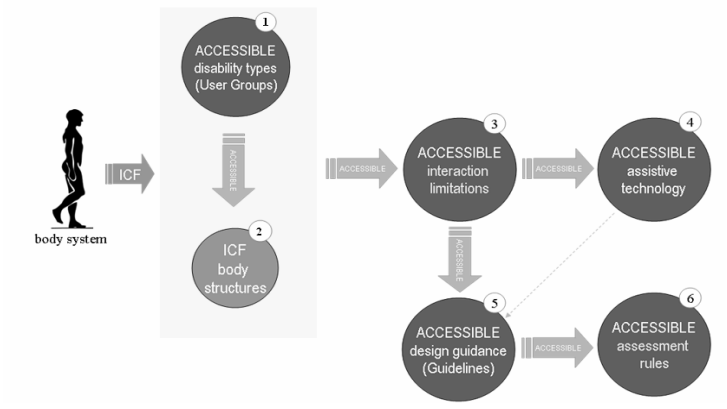

Fig. 4. Overview of the ACCESSIBLE harmonised methodology for measuring accessibility

Last, but not least, the above workplan, allows us to implement assessment rules that have derived from one or more guidelines, and use the above classification (organised into an ontology) in order not to lose track of which user types do benefit and which assistive technologies are affected (see Fig. 4). Ultimately, in this way, a developer will be in the position to initiate an assessment by defining (alone) any one of the following: User Group(s), Guidelines collection(s), Assistive technology (ies), or any other classification that can be integrated into this schema.

3 Harmonized Methodology Components

3.1 Disabilities and ACCESSIBLE User Groups

HAM has been based upon the user groups that have been identified in ACCESSIBLE project. The Target User Groups consists of two main categories. The first category includes the developers, designers, and accessibility assessors and the second category includes people with disabilities and/or older people. The disabilities/ impairments that have been taken into account in the ACCESSIBLE project include the cognitive, hearing, visual, communication receiving and producing and upper-limb impairments.

3.2 HAM Interaction Limitations

The need of an identification of those interaction limitations that exist in the HCI and the barriers caused by them is essential. Lots of efforts have taken place in this field from which we are inspired in order to create an inductive clustering of the possible functional limitation that may each user from the ACCESSIBLE users group confront while trying to interact with any computerised device. In ACCESSIBLE, in order to identify the interaction limitation of each disability type we were based upon the "Barrier Walkthrough Heuristic evaluation guided by accessibility barriers" methodology [3], of the project "Barrier Walkthrough: an accessibility evaluation

method" and adapt it to the HAM needs. The classification of the interaction limitations according to disabilities and later on with guidelines is an adaptation of the heuristic walkthrough method used for usability investigations, where the principles are replaced by barriers. The basic underlying idea is that, for testing and assessment purposes, it is better to start from known types of problems rather than using general design guidelines. Thus, the barriers that may occur while interacting with a device are the first step that is correlated to the disability type and afterwards with the guidelines that should be followed in order to overpass this barrier.

3.3 HAM User and Assistive Technology

Most people with disabilities require assistive or adaptive devices to help them render or view Web content. Those in the disability technology field refer to these devices or software interfaces by many names, including access systems, assistive technology, adaptive technology, and adaptive computing. We will refer to these devices as assistive technologies. An assistive technology device is defined by the Assistive Technology Act of 1998 (ATA), as "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities". Assistive Technology promotes greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing, by providing enhancements to or changed methods of interacting with the technology needed to accomplish such tasks. Likewise, disability advocates point out that technology is often created without regard to people with disabilities, creating unnecessary barriers to hundreds of millions of people.

3.4 HAM4 Design Guidance

Web applications. The most well know and used framework for web content accessibility is the Web Content Accessibility Guidelines, W3C. The Web Content Accessibility Guidelines (WCAG) were created in 1995 by TRACE R&D Centre to prepare a set of recommendations for making HTML pages viewed in web browsers more accessible to users with disabilities. The definitive version was published by the World Wide Web Consortium (W3C8) in May 1999.

Though the WCAG were initially created as recommendations, in many countries they have been incorporated in the legislation because information policy-makers found them to be a convenient tool for determining whether a Web site is accessible. The first country to do so was the USA, which included the guidelines in the Americans with Disabilities Act (ADA). After USA many other European countries followed. After WCAG 1.0, a new more evolved version came from W3C in 11th December 2008, after a slight change of W3Cs orientation. WCAG 2.0 has 12 guidelines that are organized under 4 principles: perceivable, operable, understandable, and robust. For each guideline, there are testable success criteria, which are at three levels: A, AA, and AAA [4]. Actually WCAG 2.0 is tanking on WCAG 1.0 which is being replaced by WCAG 2.0.

Mapping Web content guidelines to Disabilities. The guidelines and the checkpoints that were included in the HAM are the most critical ones from a great variety of guidelines that diverse from one country to another and from one standardisation body to another. This variety of guidelines gives to the developers, on the one hand, the opportunity to choose the most appropriate between them, and on the other, to be lost in a chaos of non understandable and difficult to implement terms. This is the reason why the correlation between the guidelines and the other components of the ACCESSIBLE ontology is such a demanding procedure. In ACCESSIBLE harmonised methodology the correlation between the disabilities and the WCAG 2.0 guidelines has been developed. At this end, all other guidelines either official or institutional and research guidelines that have been developed on the basis of WCAG can easily be integrated in this methodological framework.

Mobile applications. Accessible mobile applications imply a novel approach to the construction of both accessible applications and mobile applications: in the first case, the hardware/technological constraints of a mobile device have to be taken into account, as well as how these impose new constraints to different kinds of disabilities; in the second case, accessibility must be intertwined with the existing solutions for the constraints imposed by the device. Consequently, ensuring mobile accessibility to applications requires taking into account the dichotomy between the constraints imposed by both domains to each other. The approach proposed for the ACCESSIBLE HAM4 on the Mobile Applications domain is focused on the aforementioned dichotomy. By ensuring mobile & accessible applications, the different disabilities specified in HAM4 are mapped into the mobile and accessibility constraints.

Mobile Application Guidelines. It has been noted for several times that the constraints imposed by accessibility are akin to those imposed by the limitations of mobile devices (c.f.)[5]. Examples such as properly structured information, correct (and linear) labelling of forms, or media equivalence of contents, are landmarks that illustrate this assertion. Consequently, striving for an accessible application is (partially) striving for a usable mobile application. Thus, a starting point to define a way to evaluate the accessibility of a mobile application is ensuring that in fact the application is usable in a mobile-centric environment. This solution though, hinders problematic situations due to the diverse ecosystem of mobile devices. However, abstracting away from these constraints, there are general-purpose usability guidelines that can be applied to the mobile applications domain, as well as mobile-specific development guidelines that help building usable mobile applications [6].

Another set of guidelines for mobile applications concerns those targeted to the Web. Mobile Web applications have been gaining momentum in the last years, due to the ever-increasing proliferation of Web-enabled mobile devices (especially smartphones). The W3C, through its Mobile Web Initiative [7] has been created for "Making Web access from a mobile device as simple as Web access from a desktop device." This motto has been conducted in several directions, such as studying social developments (e.g. the increasing usage of mobile devices in developing regions and its intersection with the Web), and easing the task of creating Web sites that are usable on mobile devices.

MWBP define a set of checkpoints (akin to WCAG's) that developers must/should take into account, to ensure that a Web page or Web site is properly functional and tailored to mobile devices. There is a two level structure that narrows MWBP into a subset of checkpoints that are machine verifiable, called MobileOK Basic Tests [8].

Mapping MWBP to Disabilities. In ACCESSIBLE, we propose a new approach for Mobile Accessibility Guidelines (MAG) that is based on leveraging existing guidelines from both WCAG and MWBP. We followed a three-step methodology to define MAG: first, MWBP is mapped into WCAG; then, we leverage this mapping in order to associate MWBP to different disabilities (so as to support personalised accessibility assessment, as defined by ACCESSIBLE); and then we define a subset of checkpoints from MWBP that can be applied/transposed to non-Web scenarios.

Web services . An accessible service should include the following

1. be well-defined, well-working and easy to integrate within client applications,
2. provide content which can be accessed by impaired users and
3. provide content with information which is actually useful and helpful for the impaired users accessing it.

These requirements provide the three accessibility layers which form the basis for the Accessible Web Service accessibility evaluation. Three service accessibility classes (A, AA and AAA) build upon the three accessibility layers (the concepts of core, basic and extended accessibility respectively), thus providing the means for service categorization based on service accessibility features.

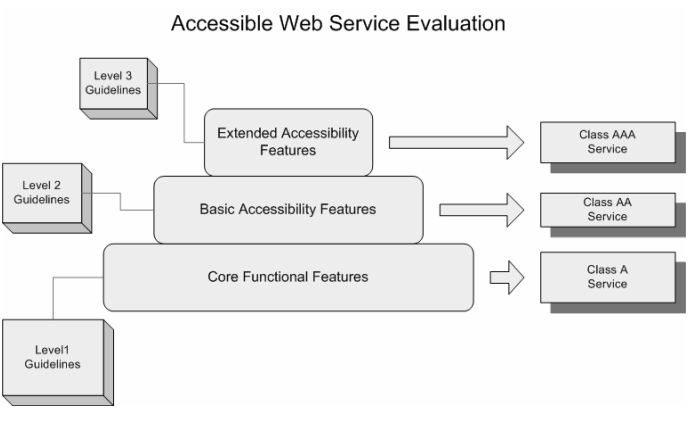

Fig. 5. Accessible Web Service Evaluation framework base

As shown in Fig. 5., for each accessibility layer a set of guidelines (of importance Level 1, 2 and 3 respectively) is defined. These guidelines, if followed, are able to provide a developed service with functional and accessibility features (core, basic and extended) that will enable it to belong to the corresponding accessibility class. Furthermore, for each guideline proposed, a set of specific techniques are defined, which can be used to check whether an already developed service belongs to a specific accessibility class or not.

In order for a Service to be considered as "fully Accessible", it has to:

1. Be accessible to developers of client applications, who want to use the service's functionality and/or provided information within their application's operational context. This requirement defines the concept of the core functional layer.
2. Have accessibility features that will enable the client applications invoking the service to show the delivered content in an "accessible for all" users way, in respect to the special needs of impaired user groups. This requirement defines the concept of the basic accessibility layer.
3. Provide data which contains enough information, in order for the content itself to be helpful for impaired users, containing information adapted to their special needs. This requirement defines the concept of the extended accessibility layer.

Description Language. An accessible SDL application is the one that operates well satisfying the needs of both impaired and non impaired users. The application must be able of processing the user inputs and providing them with appropriate output content which is easy to interpret, useful and helpful for them. The above requirements define two accessibility layers which form the basis for the Accessible SDL application evaluation.

The two accessibility layers are the basic accessibility layer and the extended accessibility layer. In order an application to be basically accessible it must follow a set of rules-guidelines defined for this level of accessibility and in order to be fully accessible it must be a basically accessible application (satisfy the set of rules of the basic accessibility layer) that also follows the rules-guidelines defined for the extended accessible SDL applications.

Furthermore, for each guideline, a set of techniques that can be used to check whether an already developed SDL14 application belongs to a specific class or not have been defined.

4 ACCESSIBLE Harmonised Methodology Evaluation

The evaluation of the HAM was a process that took long time to be completed and included the following actions:

1. Create a contact list among the partners with experts in the field of accessibility.
2. Create a template for receiving feedback on the methodology, the mapping, the ontology and the tools (these templates are included in Annex 13 of the current Deliverable.)
3. Organise an open call for experts via the project web-site, where experts in various fields are invited to participate and validate the ACCESSIBLE HAM.
4. Create one separate document for each ACCESSIBLE field, –web applications, web services, mobile-web applications, SDL- and send it to the experts. The documents included the following parts of the current Deliverable:

    a. *Contents*
    b. *Short description of the followed methodology and its components*
    c. *Presentation of the respective domain and Mapping domain guidelines to Disabilities*
    d. *Presentation of the HAM table for the respective domain*

5. Distribute the documents accompanied with the evaluation template to the experts.
6. Receive feedback.
7. Organise the 1st ACCESSIBLE Workshop in coincidence with ICCHP 2010 in July 2010 in Vienna and focus on the validation of the HAM, having an open discussion upon this issue (the results of the Workshop are noted in the minutes of the Workshop).

Following these steps, we conducted a thorough evaluation of the HAM that brought very positive comments an results to the project. The point where the most positive comments were made and has been highlighted from all the reviewers, is the description of the disability types and their sub-categorization in type, subtype, ICF, functional limitation, etc. Even the creator of the Barrier Walkthrough methodology, Giorgio Brajnik, that the HAM was based upon stated "*I like a lot the way in which in HAM you characterize a disability type (type, subtype, ICF, functional limitation, etc). I think I'll try to import that in my next description of the BW method.",* along with other promising comments like, *"the idea of correlating all these components is of a great importance. It can assist us-developers in all the steps of developing to assessing our applications."*

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