JACCES

JOURNAL OF ACCESSIBILITY AND DESIGN FOR ALL

Volume 3 - nº1 (2013)
10.17411/jacces.v3i1

Fundación ONCE
UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Accessibility Chair

Journal of Accessibility and Design for All.

Office
Accessibility Chair, UPC-Barcelona Tech.

Av. Víctor Balaguer, 1. 08800 Barcelona.

www.jacces.org
ISSN: 2013-7087

Editorial

EDITORS' LETTER

This volume 3, number 1 gathers a set of articles from 3 different areas. The first article is from the area of domotics and presents the development of an augmentative and alternative digital home interface, also tested by users with cerebral palsy.

The second article is also from the area of engineering and presents a participatory research related to the promotion of active aging.

The final article is centered in educational innovation in higher studies, which presents the importance and added value of including social skills and moral values in the Honors project.

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Journal of Accessibility and Design for All

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DESIGN AND DEVELOPMENT OF AUGMENTATIVE AND ALTERNATIVE DIGITAL HOME CONTROL INTERFACE

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Abstract: This paper describes a Digital Home Interface capable of adapting layouts, styles and contents to device capability, user preferences and appliances' features; designed with a combination of web technologies, standard languages for abstract interface definition and AAC systems. The Home Automation architecture is characterized by devices' independence, combining eXtensible Markup Language and Cascading Style Sheet, web technologies standard languages for abstract interface definition and two basic Augmentative and Alternative Communication systems with a Java based platform. This paper includes the result of a preliminary experiment, conducted with 4 users with cerebral palsy that are daily users of Augmentative and Alternative Communication systems in October 2011.

Keywords: Home Automation, Universal Remote Control, Augmentative and Alternative Communication, User Interfaces, Design for All, Accessibility.

Introduction

An inquiry of the National Statistics Institute of Spain shows that 74% of the Spanish population with disabilities (2.8 millions) suffers some kind of limitation performing daily basic activities (DBA), while about 1.39 million cannot perform DBA at all without the assistance of specialized personnel (Instituto National de Estadistica, 2008) . In this context the most vulnerable people are those who, in addition to mobility problems, could have speech and cognitive limitations. This is, for example, the case of people affected by severe cerebral palsy. Social and health professionals routinely refer to the ability or inability to perform DBA as a measurement of the functional status of a person. This measurement is useful for assessing the elderly, the mentally ill, those with chronic diseases and others, in order to evaluate what type of social and healthcare services an individual may need. Limited mobility and mental diseases usually cause a situation of reliance on other people for self-care, housework and, in general, DBA. In Spain more than the 70% of the Spanish population with disabilities suffers some kind of limitation performing Daily Basic Activities at home. Digital Home Systems could mitigate disabled people's difficulties to carry out those activities, giving the opportunity to manage home appliances through a single control. Digital Home Systems have to provide specific and adapted control interfaces based on Augmentative and Alternative Communication languages in order to be an efficient solution to the problem and to allow most vulnerable groups of people with disabilities to reach the highest level of autonomy.

In this context, the user's home becomes a vital area. The installation of a Digital Home System can make the technology useful for those people with particular necessities, with the purpose of adapting the environment to people needs, improving user's autonomy and making it easier to perform DBA in a private environment despite the user's capability conditions, as long as the systems are designed with accessible parameters. Opening a window, turning on the TV and switching over to your favorite channel, setting the heating to 22 degrees, switching on the light, opening and closing the door or checking the alarms' status are only some examples of Digital Home utilities. Digital Home Systems can minimize users' effort avoiding movement's necessity to control different devices into a house and, if they are conveniently designed, can mitigate difficulties of disabled people for being autonomous, improving their quality of life (Heins, Leroy, & Leo, 2011; Romich & Zangari, 1989; Zangari, Lloyd, & Vicker, 1994). At the Universidad Politécnica de Madrid there is a specific laboratory called Smart House Living Lab, a house where all the appliances and devices are connected through a domotic bus, making this lab a real Digital Home. In the context of this Smart House Living Lab these developments have taken place.

This paper aims at describing the design and the development of a web-based Digital Home Interface, enhanced with Augmentative and Alternative Communication standards in order to accomplish the “Design for all” objective. The designed interface is capable of adapting layouts, styles and contents to device capability, user preferences and appliances’ features. Considering the difficulties of users affected by cerebral palsy to use conventional input devices, the UI has been designed to be compatible with assistive technology (Berry & Ignash, 2003; Miesenberger, Karshmer, Penaz, & Zagler, 2012) such as alternative keyboards, touch screens, electronic pointing devices, joysticks, trackballs, switches or head controlled mouse (Manresa-Yee, Ponsa, Varona, & Perales, 2010).

Materials and Methods

Digital Home is an important scenario in the Information and Communication Technologies (ICT) field, and nowadays it is present in different commercial Home Automation. Most of the existing interfaces in the Digital Home market are not designed with accessibility and “Design for All” properties and, above all, are not compatible with assistive technologies typically used by people with disabilities. If Digital Home Systems pretend to become a solution for people with severe cerebral palsy, they have to provide support for Augmentative and Alternative Communication (AAC) systems, like Blissymbolics (Archer, 1977; Blissymbolics & Process, 2004) or Picture Communication Symbols (PCS)(Fuller & Lloyd, 1991; Mayer-Johnson, 2012; Mizuko, 1987), with their rules and schemes, to create specific interfaces and controls (Heins et al., 2011; Zangari et al., 1994).

This paper describes a Digital Home Interface included in a line of work called “ICT applications for people with special needs” of the Life Supporting Technologies research group. The developed Digital Home Interface is based on web technology. Ubiquity, accessibility properties and spread use of internet are the main reasons for basing this interface on this particular technology. Moreover users do not need dedicated controllers, but only common ICT devices which support various modalities, principally for internet applications (Lee, Helal, & Lee, 2006). Making the user interface easy to use and accessible for people with communication disabilities is the main objective of the project. In this way it is important to create the interface's pages according to the Web Content Accessibility Guidelines versions 1.0 or 2.0 (WCAG) with a minimum level of compliance AA (Caldwell, Cooper, Reid, & Vanderheiden, 2008), which provide strategies, guidelines and resources to make the web accessible to people with disabilities. Individuals living with a disability are able to use their own assistive devices such as Braille terminals, mouse emulators, screen reader or speech recognition software, when web interfaces are correctly built and maintained.

Design and implementation

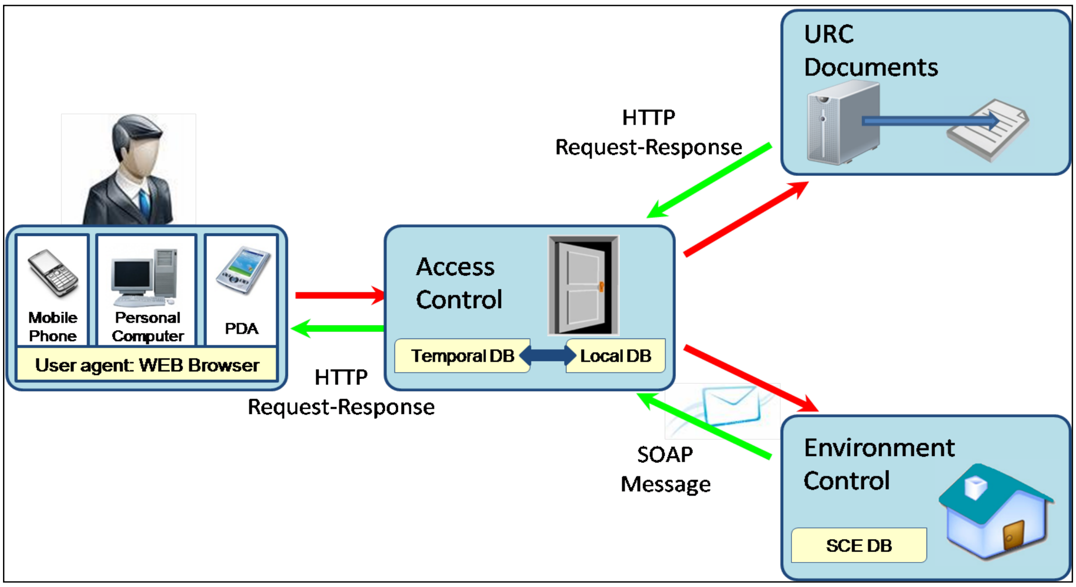
The Digital Home Interface explained in this paper employs a set of web languages and standards, refined by AAC systems to achieve user adaptation. The UI is been designed following the WCAG v2 (Caldwell et al., 2008) and the recommended guidelines described in Poulson et al. (Poulson & Nicolle, 2004). Moreover, the UI design is based on the traditional design approach of AAC boards for users affected by severe cerebral palsy.

The Home Automation architecture is characterized by devices' independence; the user interface has to adapt the accessed pages modifying layouts, styles and contents according to device capability, users' preferences and appliances' features. This Digital Home Interface combines XML and CSS web technologies (eXtensible Markup Language and Cascading Style Sheet), standard languages for abstract interface definition (URC, Universal Remote Console) (Whitepaper, 2005), and two basic AAC systems (Blissymbolics and PCS.) with a Java platform (CEAPAT, 2012). The result is an accessible, multimodal, multi-language and dynamically adaptable user interface. The Digital Home interface consists of three different interconnected modules (Figure 1 show the detailed schema).

- Access Module: that manages user's personal details, how to access and how to create a new user profile.
- Environment Module: that controls the interactions between user interface and devices;
- URC Module: that holds information about devices and services, stored in XML documents.

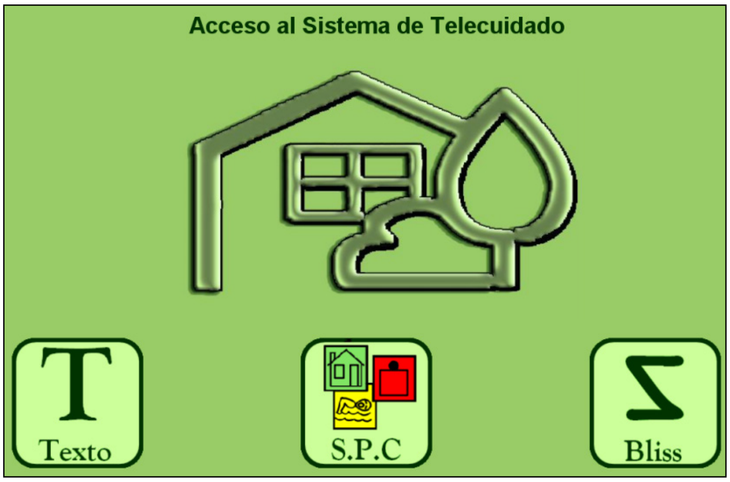
The interface is based on HTTP request-response protocol with typical client-server network architecture characteristics. When the user tries to access to the Digital Home Interface, a connection request is sent to the Information Server that houses the Access Control module. This module handles the interactions between the user and the interface, in order to show the information according to the user's needs and preferences.

Figure 1. Control Interface structure



To obtain all the data about the different rooms (devices and services) and about the system status, every HTTP request invokes a Web Service between the Access Control module and the Environment Control module. When the user decides to manage a specific device, the Access Control retrieves the corresponding URC documents to collect the device's information, which includes how to control it and how to represent it. Once the Access Control has obtained the necessary information, it starts creating the web pages that will compose the final user interface by filling a fixed XML document structure and, afterwards, converts them to XHTML pages through a XSL transformation (Guo, Guo, Chen, & Yang, 2005; W3C, 2012). To control text and layout, a set of different pre-defined CSS is used, whose selection is made depending on user preferences or log-in method. Users can choose which kind of AAC system to use for the interaction (Blissymbolics, PCS or Text) by simply selecting the corresponding button in the initial page (see Figure 2), using the most suitable method, either traditional or through an assistive technology. Now the interface is set with the user's favorite language and the system starts to create dynamically the subsequent web pages with the language's specified characteristics.

Figure 2. Home Page



In the second step users have to log-in themselves through a username and a password. The interface log-in page is an AAC application that adapts itself to the AAC system chosen, so as to make the user interaction easier. Moreover, as it is WAI-compliant, this application is compatible with all kind of assistive technologies used to navigate through the system. In the access page, users can select an image looking through a list of all possible users' pictures, which identify him/her in a unique and absolute way; besides, they have to combine 3 different groups of images to compose the personal password (see Figure 3). These images are simple collections of colours, animals and numbers, so as users can easily remember them. When in the log-in screen a user chooses the personal image and a combination of pictures, the interface puts the relative text into the boxes in order to

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perform the access. Previously each user had to set the image and the password during an initial register phase. In this case some users may need the support of an assistant to fill in the registration form.

Figure 3. Username and Password in PCS Mode

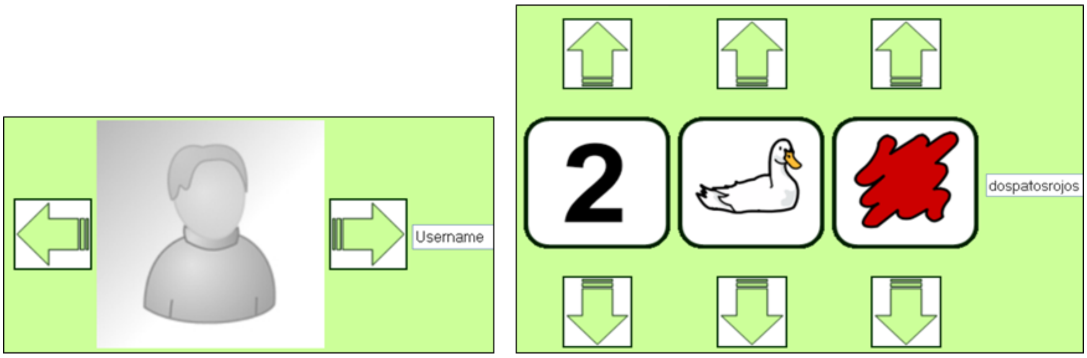
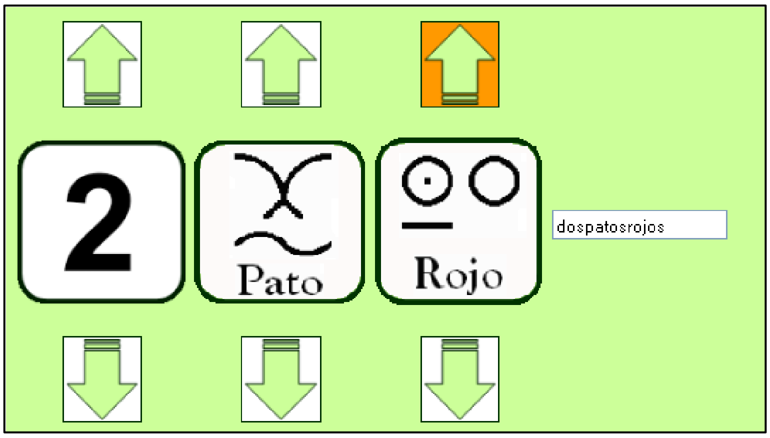
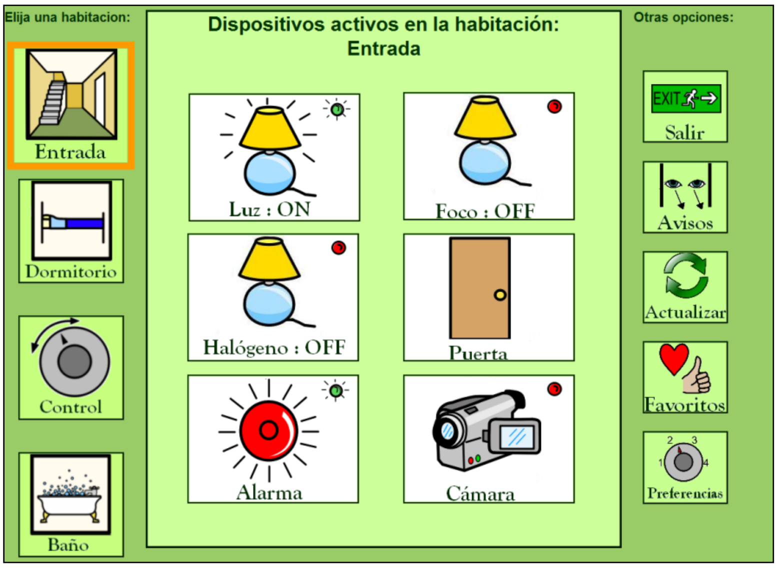


Figure 4. Password in BLISS Mode



Once users have accessed the main interface, they can control all the existing devices of the different rooms using compatible assistive input technology. Using the conventional devices (e.g.: mouse and keyboard) is not mandatory for the correct management of the system interface.

Figure 5. Enter room control in PCS Mode



The main page layout is divided in three parts. The left column shows all the available rooms. The current room is highlighted with a different border style and size. The centre part shows all active devices into the selected room. Every device is identified by an image and a state indicator, both in written and graphical way, to make the interface clear. Users can control directly the devices or verify the state of the appliances; for example to switch on or switch off the light or to verify if the gas tap is closed in order to avoid a gas leak. The right column shows the menu, where users can personalize their profile or verify warnings in case of alarms such as gas leak or flooding. In this case, users assume a passive role, as the alarms are automatically managed by the system.

User experience study

A preliminary experiment has been conducted with 4 users with cerebral palsy that are daily users of AAC systems in October 2011. The users were 2 women and 2 men, with ages between 19 – 28 years. All the users were capable of pointing to a symbol in a tactile screen, placed in their most convenient position, so they could reach it easily. The experiment was conducted in two phases. Before starting the test, the purpose and procedure of the experiment was explained to the user and his tutor or familiar who accompanied the user, and they signed the consent form. Then the user was asked to do two simple tasks through the interface: turn on the bedroom light and open the kitchen blinds. In the second phase of the test, a short interview was conducted in order to gather the users' opinion. The questions were: 1) Are you familiar with the symbols presented? 2) Imagine I am one of your friends at school. Tell me what you like and don't like of what you have seen and interacted with. 3) Would you like this system for controlling your house? The results of the experiment, although cannot be considered very relevant because of the limited number of users, gives some insightful information. Only the interface that used the Pictogram Communication Symbols could be evaluated because the users were not familiar with Blisssymbolic system, and didn't know what to select when looking at the Bliss based interface. With the PCS interface, users had a success rate of 75 %, and all of them were familiar with the symbolic system. The main results of the interviews shows that users like the structure of the web interface, and the symbols they could recognize, while they dislike some of the symbols that were not familiar to them, as were made ad-hoc for the project. This shows the importance of familiarity of the user with the symbols used. Finally all the users would like a system like the one presented to control their home. The feedbacks of the users will be used to upgrade and improve the Interface.

Conclusions

The evolution of ICT makes possible an improvement of quality of life. Design systems following "Design for All" recommendations are the way to make the technology accessible for every group of people. The use of standards such as URC meets all the requirements to facilitate the control of accessible and usable home automation environments. It allows the development of adaptive user interface. The result is an accessible Digital Home interface compliant with the WCAGAA accessibility level adapted to the needs of users of AAC (Bliss or PCS) systems. Digital Home Interface is being incorporated into the Smart House Living Lab, so that users with cerebral palsy can use it in a real environment, simulating DBA.

Acknowledgments

This work has been partially funded through the CIAMI project, by the Plan Avanza of the Spanish Ministry of Industry, Trade and Tourism; and by Cátedra Vodafone supported by the Fundación Vodafone España.

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INVOLVING OLDER PEOPLE IN THE DESIGN OF AN INNOVATIVE TECHNOLOGICAL SYSTEM PROMOTING ACTIVE AGING: THE SAAPHO PROJECT

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***Abstract*:** Active Ageing refers to the optimization process in health, social engagement, and security opportunities as people age. The demand to introduce technology to improve older people's quality of life is progressively increasing. The objective of the SAAPHO project is to support Active Aging by assisting older people to participate in society, preserving their independence and dignity through the application of innovative Information and Communication Technologies (ICT)-based solutions. SAAPHO creates a usable system that covers health, safety and social needs of end-users taking into account their preferences in the design of the system behaviour and architecture. Questionnaires and focus groups were run during the product design early stages to guarantee this. After completing the first year prototype, controlled sessions using the SAAPHO platform were performed with older people to study its usability. This article presents the general results of older people's participation in the design of SAAPHO system after completing the first year prototype.

Keywords: Active Ageing, Older people, Health, Participation, Security, Technologies, Usability, User-centered design.

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Introduction

Challenges to improve quality of life for older people involve the maintenance of their autonomy and independence. According to the recommendations made by World Health Organization (WHO) in the Active Ageing policy framework, this term entails the optimization process in health, participation and security opportunities in order to improve people's quality of life as they get older, including disabled, fragile people who need attendance (Organization & others, 2002).

On the other hand, the demand to introduce technology to improve the quality of life of older people (dementia included) is progressively increasing (Daniel, Cason, & Ferrell, 2009; Cook & Schmitter-Edgecombe, 2009). However, older people face some difficulties when adopting new technologies. Technological receptivity is directly influenced by pre-dispositional, necessity and social support factors, as well as by one's level of concern for problems that could be alleviated through the adoption of technology (Barroso Osuna, Cabero Almenara, & Romero Tena, 2002; Zimmer & Chappell, 1999). Therefore, usability and accessibility are major issues to be seriously taken into account.

Involving older people through participatory research (Ehn, 1990), enhances product´s usability and accessibility (Norman & Draper, 1986; Davies & Nolan, 2003; Mayhew, 1998). Participants were asked about their experiences, requests and preferences while interacting with ICT (interface features included) and their preferences in using health, participation and security technologies. Requirements were extracted from the field studies, specifically and especially from the questionnaire and focus groups results at the early stages of the project, and from the usability testing of the first year prototype of the SAAPHO project (Secure Active Aging: Participation and Health for the Old). Usability testing included think aloud techniques and user satisfaction questionnaires (Sharp, Rogers, & Preece, 2002). Usability parameters were used to assess user experience aspects (Ross et al., 2005; Walker, 2007).

The structure of the paper is as follows: 1) The SAAPHO project, in which details are presented about the goal and scope of the application; 2) Technology tools, treating the ICT tools used in SAAPHO project; 3) Methodology used during end-users' involvement; 4) General results from end-users' participation in the design of SAAPHO system after finishing the first year prototype. This section will be followed by 5) Conclusions and further work.

The SAAPHO Project

The SAAPHO Project aims to enhance the independence and dignity of older people thought novel frameworks that promote Active Ageing involving four countries (Spain, Slovenia, Germany and Sweden). Thus, according to the three main axes of Active Ageing, the services provided will focus on offering intelligent, intuitive and user-friendly tools using a fixed tactile screen and mobile devices:

- Healthcare services: medication management and promotion of healthy habits and practises.
- Participation services: customised access to communication tools to talk, share pictures and play with their relatives, friends, caregivers, etc.
- Security services: monitoring of user's home elements (gas, fire, CO, temperature, presence, etc.) and safety.

The design process of different services to be provided by SAAPHO is supported by user-centered design to guarantee the accomplishment of a usable system. It implies direct participation of target users in the design process from the beginning of the project.

Technology tools

With the objective of providing the services previous presented, different types of ICT tools are included in the SAAPHO architecture. This is done in a transparent way, so the user can avoid a tedious learning process that could make the older person feel uncomfortable and not wish to use SAAPHO. A middleware with different web services based on a Service Oriented Architecture (SOA) is used to make easy the incorporation of more services and the independence of each service. The connection between each service is done with the use of an Orchestrator to avoid the connection between each two services, and the communication protocol is SOAP. The user interacts with an interface connected to the middleware and it is in charge of the access to all SAAPHO services. This interface was designed following the requirements specified by the end users in various meetings and the standards related to user interfaces for older people (see Appendix 1). Also an iterative process was followed, so each generated mock-up was tested by experts in user interfaces for older people, and the changes proposed by them were considered to generate a new one, until a final version was obtained.

The tools employed to give health, social and safety services, are the following:

- Healthcare services: some sensors to take measurements of glucose, blood pressure, pulse, and activity, and to monitor the medication are used to control the health information of the user. These sensors are connected to the middleware with an intelligent backend that decides if an alert or notification has to be sent to the user and his/her caregivers and medical services if there is an abnormal measurement.

- Participation services: to provide the user with access to communication tools, SAAPHO is going to use Facebook (to share pictures and establish friendships), Skype (to allow textual and video communication), and Gmail (as service to send emails). Nevertheless, the type of social tool used in each case is totally transparent to the user. They are integrated to look like the other information in the project, maintaining a coherence of the global interface making its use easier. In this case there is also an intelligent backend to send new mails notifications, etc. and to carry out social mining to detect user patterns, frequent contacts, etc.

- Security services: sensors take measurements of smoke, CO, gas and temperature, they also monitor falls and motion in the indoor environment, and location and falls in any outdoor environment. The backend through which the measurement is sent to the user is also intelligent, and decides whether sending an alert or notification to the user and to the caregivers or emergency service if necessary.

In all cases the information will be presented to the user taking into account the user profile using a web service called User Interface Recommender. This service has an Ontology that contains the user profile and all aspects influencing the way in which to present the information. A motor interference tool is used to generate adaptations (increasing font size if the user has visual problems, change the interface contrast, etc.). Another kind of information stored in the Ontology is the information obtained from the social mining. These user interface adaptations are important when an application is oriented to older persons, because they have to handle the application without any knowledge of what is under the interface (Wojciechowski & Xiong, 2008).

The union of Ontology, Web Service and SOAP have been used in SAAPHO because it is presented as one of the most suitable combinations to satisfy the requirements of the context-aware systems domain in general, and particularly useful in the AAL domain (Baldauf, Dustdar, & Rosenberg, 2007).

Finally, SAAPHO gives the user the option to access more specific information incorporating another web service: a services broker. It is a service in charge of providing the URL of a specific web page. It will consider the user preferences to deliver one URL or another. This information will be provided with all available adaptations but maintain its format and the name of the provider.

In the case of ICT tools employed in the first year prototype, they were limited to be simple (development in the first prototype was centered in the communication between web services) and to focus users attention in the interface's usability and accessibility. Health and safety services were simulated using a web page in which measurements and alerts were generated by an expert, and social services were limited to sending and receiving mails.

Methodology

SAAPHO applies a user-centered design methodology using a participatory design. Questionnaires and focus groups in relation to general requirements of SAAPHO, health, participation and security technologies were run during the product design early stages in Spain and Slovenia.

Regarding the questionnaire, participants were asked about general requirements from SAAPHO system (preferences in relation to ICT and user interface adaptations). For example: 'Do you think a touch screen would be easy to use?'; They indicated their needs and preferences in monitoring their health (medication, activity and location monitoring). For example: 'How would you like to monitor your medication compliance – e.g. buzzer light…-'?; They indicated their preferences in participation using technologies (devices and programs used to keep in touch with friends and relatives and use of the Web to find information of interest). For example: 'Which devices (computer, Smartphone, tablet PC) and which programs (Skype, Twitter, Facebook…) do you use to keep in touch with friends and relatives?; Participants indicated also their preferences in security using technologies. For example: 'What would you like to have at home to feel more secure - video cameras detecting intruders, sensors identifying gas escapes…-'?). Issues such as privacy were also addressed.

201 older adults (Spain, n=101; Slovenia, n=100) completed the questionnaire. Participants were recruited from older people's associations. Participants had an ID number to ensure the anonymization. Participants received an information sheet explaining the aim of the questionnaire and signed an informed consent.

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Based on the questionnaire results, 1 focus group in Spain and 1 focus group in Slovenia were run with 8-12 older people to deepen the knowledge about their needs. The same participants met four times in two hours sessions to discuss aspects related to the different technical issues and to assure consistent results. The main objective was to extract information from older people related to the interaction modes and also about devices' preferences in relation to the general requirements of the system and health, participation and security technologies. A moderator carried out the sessions and an observer took field notes. Moderators followed the same script in both countries. Some images of devices (tablet PC…), programs (Picasa…) and sensors (physical activity, presence and proximity sensors, temperature alarms…) were presented as support. Participants had no previous experience in ICT projects and were familiar with the project since they had previously participated in the questionnaire. The sessions were audio recorded for post analysis. Participants completed demographics and general questions at the beginning of the focus groups and received an information sheet explaining the aim of the focus groups.

After finishing the first year project's prototype, ten participants were invited to perform a 'controlled' session of the SAAPHO platform in Spain (n=5) and Slovenia (n=5). We used a convenient sample of subjects, who already knew the project since they had participated on the questionnaire and focus groups. Having experience using computer was an inclusion criterion for the test. As they had experience using computer, participants did not represent the population of older people without experience.

During the testing sessions, participants had to conduct four tasks studying usability, defined from an end-user perspective and guided by a professional: 1) Writing a message using the touch screen-keyboard of the slate device and sending it; 2) Receiving a notification of fire at home; 3) Checking a health alert; 4) Checking the message when a notification of a new message is received. Participants had to enter into the different pages via icons (health, participation and security) to perform the tasks. Participants were not instructed on how to use the SAAPHO platform.

Sessions lasted 1 hour. Each centre was equipped with a tablet personal computer device. Professionals checked whether the participant was able to use the platform from the usability test parameters: effectiveness, efficiency and satisfaction (Hornbæk, 2006). Effectiveness parameters of the participant usability test were the following: task complexion (accomplished of task yes/no), accuracy (number of mistakes), completeness (% subtasks completed) and grading of perceived quality of product. Efficiency parameters were as follows: time (total time per task), mental effort (perceived ease of use) and usage patterns (number of unnecessary steps taken). Results were obtained by questionnaires after finishing tasks and examiner's observation. A video camera recorded the interactions for posterior analysis. Satisfaction with the system (content, navigation, text size, colours, lay-out and icons) was acquired by a participant questionnaire at the end of the session.

Firstly, participants performed the tasks using the standard adaptation of the SAAPHO platform: bigger size, louder sound and normal colours. During the sessions, participants performed the tasks using aloud techniques (users were asked to articulate all the steps of their actions) and professionals noted their observations while participants performed the tasks. After finishing each task, user satisfaction questionnaires were filled in by participants. Secondly, participants were asked about the ease of use of the other two specific adaptations: size and colour. Size adaptation consisted on decreasing size. Participants entered into the different icons (communication, security and health) using the smaller size. Colour adaptation consisted on the white contrast and the black contrast. Participants entered into the different icons using a white and a black contrast. All participants were informed about the usability testing and signed the informed consent.

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Results

Characteristics of the involved subjects are shown in table 1.

Table 1. Characteristics of the involved participants

	Questionnaires		Focus Groups		Testing sessions	
	Spain N=101	Slovenia N=100	Spain N=10	Slovenia N=8	Spain N=5	Slovenia N=5
Gender						
Male	26%	36%	30%	45%	40%	40%
Female	74%	64%	70%	55%	60%	60%
Age*	68 (61-87)	67 (51-82)	68 (63-75)	68 (58-73)	69 (64-85)	63 (58-75)
Previous use of ICT devices						
None	40%	30%	0%	8%	0%	0%
Computer	58%	70%	100%	92%	100%	100%
Smartphone	2%	0%	0%	0%	0%	0%
Tablet PC	0%	0%	10%	0%	0%	0%

*Median (range)

Questionnaire

General results from the questionnaire showed that older people considered ICT as an opportunity to facilitate their daily life, they felt quite confident with the use of ICT and they preferred easy to use devices and adapted interfaces. Participants reported that data collected by the ICT system should be provided in a secure and simple way, being worried about their privacy and the use of their personal information.

In relation to health services, users believed that an ICT system would be useful for dealing with health issues and they liked to involve health care professionals when taking decisions regarding the use of ICT applied to health. Participants would like to monitor some aspects related to health such as medication compliance or physical activity. Participants also liked the idea of promoting healthy habits through ICT.

Regarding participation services, older people considered that using communication tools would facilitate their contact with relatives and friends. Mobile phones were commonly used. Most of them used the computer to keep in touch with friends and relatives and to find information about topics of interest.

On the subject of security services, participants would use sensors identifying gas leaks at home or registering their location, especially in case of outdoor falls. Participants would like to be warned in a multimodal way (noise, vibration, light or text), adapted to their needs and preferences to alert indoor and outdoor emergency situations.

Focus Groups

General results of the focus groups showed that the SAAPHO system seemed very interesting and it could be very helpful for older people, especially those living alone. Concerns arose about its price and privacy.

In relation to Health Technologies, participants liked the idea of promoting healthy habits through ICT and monitoring their health (medication compliance, physical activity, blood pressure). Medication bottle alarm though light and sound and step counter were highly appreciated. Participants were interested in blood sugar sensors, but only for diabetics.

Regarding Participation Technologies, participants preferred to use the Computer and E-mail; Facebook, Messenger and Skype. They preferred the Picasa program to share pictures with intended target (friends or relatives). Participants were also interested in using a unique password for all communication tools.

Concerning Security Technologies, participants preferred to use as less devices as possible to alert emergency situations indoor and outdoor. They would be warned in a multimodal way (sound, vibration, light, text) adapted to their needs and preferences. Gas escapes sensors and smoke sensors had a very good acceptance. Security cameras at home were not well accepted due to invading personal privacy. Participants were concerned about the economic cost of the sensors and the services.

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First year prototype of the SAAPHO platform

Regarding effectiveness, results showed that all subjects in both countries accomplished all the tasks and performed all the subtasks. Only one participant in Slovenia found difficulties during the process of completing the task 3 ('Checking a health alert'), entering to wrong icons as 'Communication' or 'Security' instead of 'Health'. Most participants perceived that the tasks were successfully achieved.

Regarding efficiency, the duration to perform the tasks was perceived as adequate by participants in both countries. The interface used was efficient since participants did not make unnecessary steps performing the tasks and they found it easy to perform them.

Table 2 shows the usability parameter satisfaction in both countries. Most of the participants reported that content and design were good and navigation was easy. Icons (Health, Participation and Security) were very high scored by all participants. All participants would recommend the SAAPHO system to another person, since they considered it was easy, useful and friendly for older people familiar with technology or interested in using it.

Table 2. Usability test parameters in both countries: satisfaction

Satisfaction	Spain (Mean, range)	Slovenia (Mean, range)
Content (1=Very inadequate; 5=Excellent)		
Text length	4.2 (3-4)	3.1 (3-5)
Understandability	4.6 (4-5)	3.9 (3-5)
Quality of image	4.8 (4-5)	4.8 (4-5)
Navigation (1=Very inadequate; 5=Excellent)		
Quality of navigation	4.6 (4-5)	4.1 (4-5)
Design (1=Very inadequate; 5=Excellent)		
Text size	4.2 (2-5)	3.8 (3-5)
Colours	4.8 (4-5)	4.2 (3-5)
Sound of alarms and notifications	4.4 (4-5)	3.5 (3-4)

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Satisfaction	Spain (Mean, range)	Slovenia (Mean, range)
Layout	4.2 (3-5)	4 (3-5)
Icons	5 (5)	5 (5)
Ease of use (1=Strongly disagree; 5= Strongly agree)		
Ease of use	4.5 (4-5)	4 (3-5)
Engagement (1=Very stressed; 5= Very comfortable)		
Comfortability to use	4.2 (4-5)	4 (3-5)
Enjoyment	4.6 (3-5)	4.8 (4-5)
Grade of the quality of the SAAPHO system reported by participants (1= low quality; 10= excellent quality)	9.4 (9-10)	7.8 (5-10)

Conclusions and further work

During evaluation performed on the SAAPHO platform, it was perceived as an interesting and useful opportunity for participation by older people. It was easy to use according to usability test parameters of effectiveness, efficiency and satisfaction.

Older people involvement at the beginning of the project and during the first year was very helpful for the involved technologists to make decisions about the SAAPHO design in order to meet real needs and preferences. These decisions had a direct impact on the design of the User Interface Recommender Web Service, because the adaptations of the user interface provided by it have to be appropriate for older persons, and not for any type of user. Feedback provided by users was essential to ensure user satisfaction. For example, change in text size is crucial for older people as well as horizontal scrolling avoidance, or reduction in the number of steps per task.

Decisions about services used in relation to health (sensors to control medication compliance and physical activity), participation (social networks and tools -Facebook, Skype, Gmail and Picasa-), and security (gas escapes sensors and smoke sensors) were confirmed after consultation with prospective users.

Older people involvement at the beginning of the project is not enough. It is necessary that older people participate in the project at the end of every iteration in order to detect errors, and to introduce new requirements to be considered in the next prototype. Thus, testing sessions of the SAAPHO system will be conducted to continue creating a usable system that covers the health, safety and social needs of the older people in the next two years of the project.

Acknowledgments

The SAAPHO Project (aal-2010-3-035) is funded by the Call AAL (Ambient Assisted Living) within the Call 3, ICT-based solutions for advancement of older persons' independence and participation in the self-serve society. The authors wish to show their special gratitude to the older people who have been involved into the project.

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Appendix 1. ISO norms applied

ISO 9241-303: 2011. Ergonomics of human-system interaction – Part 303: Requirements for electronic visual displays. International Organization for Standardization (ISO).

ISO/IEC TR 29138-1:2009. Information technology – Accessibility considerations for people with disabilities – Part 1: User needs summary. International Organization for Standardization (ISO).

ISO/IEC TR 29138-2:2009. Information technology – Accessibility considerations for people with disabilities – Part 2: Standards inventory. International Organization for Standardization (ISO).

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ISO/TR 22411:2008. Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities. International Organization for Standardization (ISO).

ISO/IEC 24755:2007. Information technology — Screen icons and symbols for personal mobile communication devices. International Organization for Standardization (ISO).

ISO/IEC TR 19766:2007. Information technology — Guidelines for the design of icons and symbols accessible to all users, including the elderly and persons with disabilities. International Organization for Standardization (ISO).

Journal of Accessibility and Design for All

(CC) JACCES, 2013 - 3(1): 28-43 ISSN: 2013-7087

SOCIAL SKILLS AND MORAL VALUES IN ENGINEERING EDUCATION

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Abstract: All technical degrees in the Spanish Higher Educational System include a mandatory Final or Honours project. This is a technical activity which should lead the student to put into practice most of the skills acquired throughout the whole degree. Only technical skills are usually put into practice, although recent studies have proved that further capabilities, such as those included in the category of "social skills", will also be demanded by employers. Moreover, the introduction of the European Higher Educational System, strongly emphasizes the importance of this sort of capabilities. What we present in this work is a way to include both social skills and moral values in the Honours Project without any loss of its technical character. To do so we have launched a line of projects devoted to the development of technical aids to improve the welfare of disabled people. Collaboration agreements with nonprofit institutions and charities give us access to the needs of these communities and the opportunity to apply the results of the projects. A procedure to manage projects of this kind is also presented.

Keywords: Social responsibility, Social skills, Moral values.

Introduction

In the globalized world we are living, all economic, technological, social and cultural aspects affecting many different countries are strongly connected. From the economic point of view, this has led to an increasingly competitive world where the cost of products must be lowered to find a place for them in the markets. From the technological side, products are bound to be constantly evolving in order to outperform their competitors. Fortunately, this competitive

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vision of the world is not always shared. In some contexts, social and moral values also have a role to play. Moreover, engineers are sometimes identified with environmentally damaging technologies, so they are being forced to become aware of the wider social context in which they are working. This is what has been called "The New Engineer", a professional who is socially and environmentally responsible (Beder, 1998), where social responsibility must be understood as a contribution to an equitable, sustainable and socially just, world. Some authors have written about this relationship between engineers and society (Conlon, 2008) and it is assumed that, at universities, we educate professionals for the future so their mentality and vision of the world will reflect the influence of their trainers. The literature highlights the importance of acquiring non-technical generic competencies in areas such as communication, project management, leadership and teamwork, rather than the acquisition of theoretical knowledge in a range of "socio-economic" subjects (Markes, 2006; Palmer, 2003). It is obvious that in a globalized context, engineers tend to use business considerations as appropriate criteria for engineering decisions and they do not perceive the fair distribution of the benefits of economic activity as their concern (Johnston, Gostelow & King, 2000). Therefore, querying students' conceptions about what an engineer must be is actually a relevant question (Capobianco et al., 2011). Educators are expected to intervene as knowledge producers, in order to promote a socially responsible use of this knowledge. The inclusion of sustainable development into the curricula is just one example of how to adapt engineering education in our ever-changing environment (Azapagic et al., 2005; Lathem et al., 2011). Let us put the spotlight on a European university. For instance, in Spain all engineering students must develop a technical project as a mandatory condition to obtain their diploma. In this framework, it can be stated that the objectives of the project must be such that the student is forced to put in practice all major skills acquired throughout the degree. In this work, we will show how student's technical capabilities can be trained while social skills and moral values are enhanced alongside. This compatibility is achieved by means of an adequate definition of the project's objectives. If we consider Computer Engineering we realize that projects usually consist of application programs. In this scenario it is quite feasible to think of an application program to facilitate access to the computer for a seriously disabled individual. Socially committed projects are as technically complex as any other but with a supportive purpose. However, choosing adequate contents for these projects is not an easy task. There must be a sufficient amount of commitment from the tutor and student to become familiar with the needs of disabled population. For this purpose, the collaboration with associations and charities is fundamental as they will take the role of our customers. The users of the product will be handicapped people but usually they are not able to express their needs and constraints.

Related work

According with the Spanish regulations, as stated in a Royal Decree (Ministerio de Educación y Ciencia, 2007), all university courses adapted to the European Higher Education System must train the students on the rights of disabled people, including the principles of fairness in their syllabus. However, these skills have to share their space in the syllabus with many other personal and professional ones. Therefore, they are usually difficult to spot among the rest when trying to check the compliance of the diploma with that Royal Decree.

The inclusion of these principles in courses not directly related to disability, such as engineering, has already received some attention from other colleagues. In this regard, Godino-Llorente et ali. (2012) describe a course on design for all named “DACIS” (Design for All in the Context of the Information Society), that is included in the syllabus of an engineering master program. This is certainly a good approach that fully complies with the Spanish regulations. Nevertheless, at the time the syllabus is being elaborated it is usually difficult to find a place for courses like this, especially in bachelor programs where we find no precedents of similar experiences.

Although the regulations affecting the disabled population and the design of engineering programs are different worldwide, other valuable examples can be found in literature. Since 1998 de U.S. National Science Foundation encourages the development of custom software and hardware devices for disabled people (Enderle, 1999). The program includes funding for engineering students to carry

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out their projects. In this way, the IEEE program named as Engineering Projects in Community Service (EPICS, 2012) aims to involve high school students along with IEEE students groups to carry out “community service-related engineering projects”.

Our experience takes a pinch of each approach. Our goal is include the skills required by the Spanish regulations in bachelor engineering programs. Since we do not have the opportunity to include specific course as in Godino-Llorente (2012) we make use of existing ones to embed these new skills in the already designed syllabus. To do so, we work with the students on their Final Project which is a mandatory part of every engineering diploma. What we obtain is, similarly to both mentioned before, software and hardware products designed to address the needs of disabled people. Unlike the former experiences, they are not being encouraged by well-intentioned external agents but by the University staff instead.

Honours project tradition

The Final or Honours project is a long lasting tradition among engineering degrees within the Spanish Higher Educational System. It has its origin in the legal capability of engineers to sign technical projects for the Spanish market. According to Spanish regulations, all technical projects have to be signed by a competent engineer or architect depending on the contents of the project. As long as the project demands any kind of knowledge formerly acquired by the student, it is consequently located at the end of the degree. Usually, the student obtains the corresponding diploma right after a public presentation of his Honours Project is performed. As it is a public event, it is attended by class mates, friends, relatives and, in our case, representatives of partner institutions. These projects are carried out in a number of different modalities. Nevertheless, two major categories can be considered:

- Collaborations with enterprises and institutions.
- Internally proposed projects.

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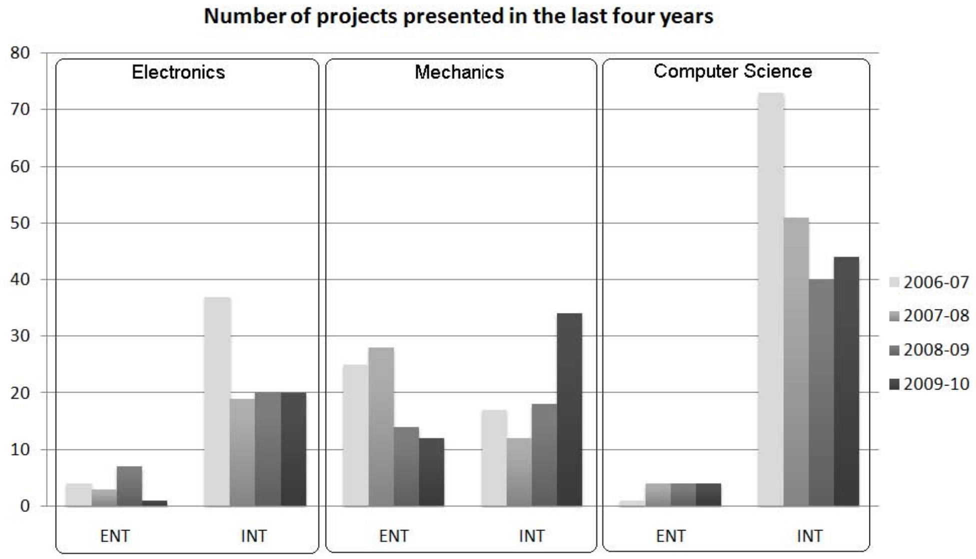
Figure 1. Evolution of the types of Honours Projects developed by the students (Mechanics, Electronics and Computer Science engineering degrees are considered). ENT stands for “Collaborations with enterprises”, and INT stands for “Internally proposed”.



Among all different degrees, we focus our attention on these ones: Mechanics, Electronics and Computer Science. We strongly believe that these are the areas of knowledge where technical aids for the disabled may be proposed. Figure 1 shows how projects have been distributed in these areas from academic year 2006-2007 to 2009-2010. Collaboration with enterprises is a major objective for our Institution and, according to the figures of this period, it will have to be enhanced. This is particularly obvious in both Electronics and Computer Science degrees. Even though the objective may eventually be accomplished there will always be internally proposed projects to accommodate supportive initiatives like ours. Furthermore, this sort of projects can also be developed in some cases in collaboration with enterprises and associations, thus fulfilling the goal of a professional training of the student as well. As a matter of fact, as we state in the conclusions section, it is a future trend to provide an entrepreneurial spirit to this activity.

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Description of the proposal

In this work we present a comprehensive procedure meant to set up and maintain a line of projects devoted to develop different technical aids for disabled people. In addition to the technical characteristics of the aids, a major objective of the projects is to introduce social skills and moral values into the student's curriculum. Most internally proposed projects are very easily managed. They just need to be proposed to the students by the tutors who patiently wait for applicants. Our socially committed projects require a slightly more complex procedure. This complexity has no relation with their supportive character but with the inclusion of more factors in the project. The main innovation of this process is the presence of a single type of client. In most cases, the subject of the aid to be developed is not a certain individual but a profile of disability. Nevertheless, individuals suffering from a certain disease are not usually our interlocutors, but the associations representing them. Close contact with associations and charities allows us to collect the main needs of their members and becomes the best possible benchmark for our proposals. All projects are tested by those who are expected to benefit from them before they are considered as finished.

The flowchart in Figure 2 describes the different stages of the procedure:

- Stage 1: without any student's participation, a meeting between the project's tutor and the association is convened. As a result a proposal for a project is generated. It corresponds to a real demand for a technical aid. In spite of its supportive purpose, the overall amount of work required by the project must not exceed the standards observed in the degree. This is so in order to avoid deterring students from enrolling in this type of projects.
- Stage 2: the proposal is offered to the students who have registered for the Honours Project course. Once a project has been assigned to the students, we then proceed to stage 3.

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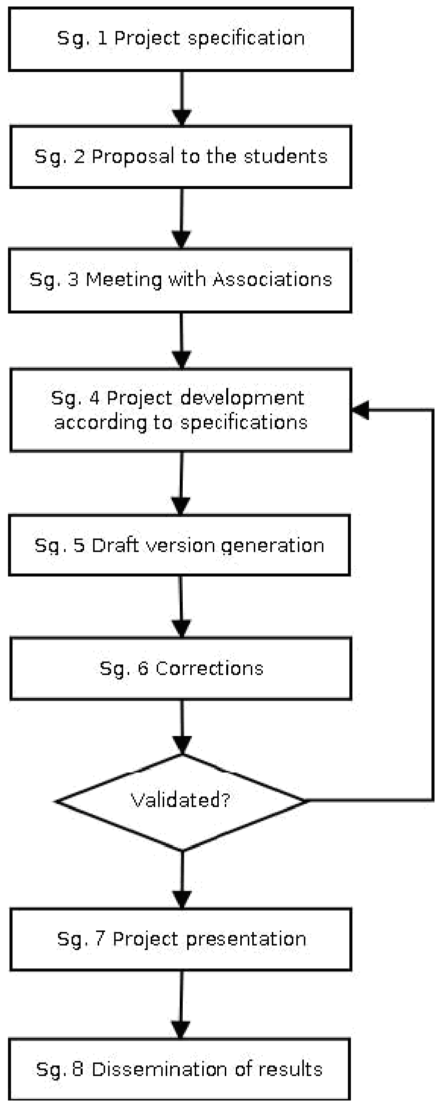
- Stage 3: the students attend a meeting with the association in order to obtain the project's specifications, that is, what kind of technical aid is needed.
- The loop including stages 4 to 6 becomes the bulk of the work. Students develop preliminary versions of the technical solution to be tested by the customer, who suggests corrections and modifications. This process matches traditional software development life cycles such as those presented in (Dawson, 1999). It also takes into account modern methodologies for web application and graphical user interface design, such as those presented in (Pressman, 2010). Usually the association or charity involved in the project takes the role of the customer, suggesting modifications and eventually determining that the project is ready to be exploited. In order to facilitate this interactive process several meetings are held with the attendance of the customer, student and academic tutor. Once the project is fully validated we proceed to stage 7.

Figure 2. Flowchart diagram including all necessary stages to develop a socially committed project.



- Stage 7: all formal aspects of the project are arranged in order to present it to the tribunal who will mark the work. The tribunal is integrated by five lecturers belonging to different areas of knowledge. It will assess only the technical aspects of the work. Its assistive purpose is not taken into consideration.
- Stage 8: this final stage, not usual in other kinds of projects, intends to inform the society about the achievements of the project. Stage 8 includes a number of activities:
  - Reports to the media: TV, radio, press.

- Participation in different kinds of contests.
- Papers and articles sent to conferences and magazines.
- Transmission of the new solution to other associations and charities by the partner association.

In case a commercial exploitation of the project is feasible, the University may award it with a fund intended to support the creation of a spin-off enterprise.

Results

Once we became aware of the social responsibility and sustainability principles that should guide the engineer's activity as mentioned at the beginning, we started an activity meant to introduce such principles in the student's training. This started back in 2000 with some scattered projects lacking from any common guideline. It was not until 2007 that this activity settled down; supportive projects have never stopped ever since. Table 1 shows the projects carried out by our students so far.

Although the scope of our group is wider, they can all be included in two categories associated with their respective types of disability:

- Projects intended to grant access to information technologies to patients affected by cerebral palsy.
- Projects meant to facilitate access to information to deaf people.

Cerebral palsy has been our first and, for the time being, main area of interest. It is also the most challenging type of disease to tackle due to the different types of damage suffered by each patient. Up to the realization of this article, seven projects have been successfully carried out. It is obvious that the figure does not reflect a massive activity. Nevertheless, the bottleneck is not actually on the interest of the students for this activity but on the number of tutors available. This sustained interest among the students in this kind of projects can be considered a sign of success. Furthermore, the projects have been awarded with several prizes, awards and scholarships as was shown in Table 1. These awards are particularly positive as a motivating factor for prospective students. As a

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matter of fact, it is not common that Honours Projects receive an external award. Appearances on the media, very frequent in these cases, are also rare in other types of projects.

Table 1. List of titles and awards won by the commited projects. These titles and awards are originaly in Spanish, but here we provide a translation made for this paper.

Project title	Awards
Software tool to facilitate reading and adaptive learning to disabled adults	Castilla y León Accessibility Awards, 2007 edition (Consejería, 2007)
“WIIMO” (Software tool to facilitate access to computers to users with severe mobility impairments)	Fundación DFA (www.fundaciondfa.es)
“AUREA” (Augmented reality in educational environments)	Scholarship prototype. OTRI-OTC (www.ubu.es/es/otri)
“HADA” (Software package to help hearing impaired people)	Scholarship prototype. OTRI-OTC (www.ubu.es/es/otri)
“Rehabilit-AR” (Augmented reality for rehabilitation)	Scholarship prototype .OTRI-OTC (www.ubu.es/es/otri)
On screen interface	Scholarship prototype; “UBUemprende”. OTRI-OTC (www.ubu.es/es/otri)
Wii console adaptation for use in social networks	Scholarship prototype. OTRI-OTC (www.ubu.es/es/otri)

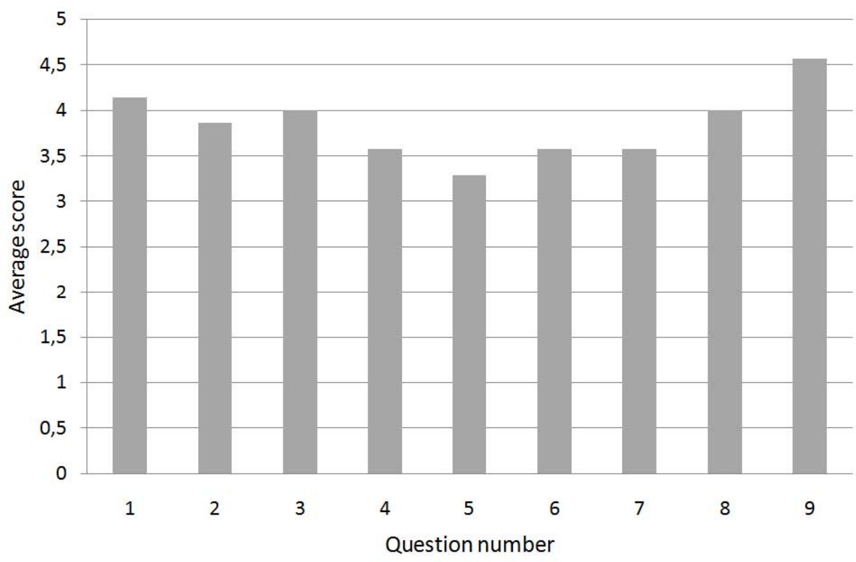
Another extra feature we are able to provide to our students is the opportunity of participating in written articles, conferences, interviews and debates, all of which are very constructive for their personal and professional training. In order to obtain the necessary feedback from the students and then to assess their degree of contentment with this experience, we have issued the survey that is shown in Table 2.

Table 2. Questions included in the satisfaction survey.

Question number	Question text
1	Initial interest for this type of project
2	Degree of satisfaction with the mark obtained
3	Overall degree of satisfaction with the project
4	Did your project stand on equal footing with the rest?
5	Were the contents of the project related to the rest of the degree?
6	Did you have enough time to carry out the project?
7	Did you have adequate tools at your disposal?
8	Is the evaluation procedure appropriate for this type of project?
9	Are the ethical and social objectives of the project achieved?

This survey has been filled by all students involved in the projects described in Table 1 right after their projects have been marked. In question 1, the student must assess the a priori motivation that led him to choose a supportive project. Once the project has been finished and the student obtains a certain mark, the student can assess his contentment (question 2) and the overall satisfaction with the project (question 3). As long as the project is quite different from other projects, we want to know if the student perceives any kind of discrimination on the marking system, the mark itself, resources available and even time (questions 4 to 8). Finally, question 9 tries to verify if the student feels that, in addition to the academic goals of the project, some ethical and social objectives have been addressed and accomplished. They are all scaled questions marked from 0 to 5, where 0 is associated with the lowest possible level of satisfaction and 5 with the highest. Figure 3 depicts the results obtained. All average scores are clearly above the neutral mark of 2.5. That means that students are highly satisfied. Among these positive results, question 5 gets the worst score. Seemingly, the students are not totally convinced that their projects have that much in common with the rest of their studies. Even though the score does not reflect high discontentment at all, it tends to indicate that the initiative have to be explained more carefully. On the other hand, the best score is obtained by question 9. This is an extremely encouraging result. It means that the social benefits of the projects have been well understood and valued by the students. Questions 2 and 3 suggest that the students have a good impression of the work they have carried out and the mark they have obtained for it.

Figure 3. Degree of satisfaction according to responses given by the students to the questions listed in Table 1.



Project WIIMO

Project WIIMO has become an icon of supportive applications managed as Honours Projects. Its development lasted for one year, finishing back in 2009. Its main goal was to allow any patient suffering from cerebral palsy to use a PC. To do so, we needed to be able to transform any movement from the human body into orders to move the mouse and to click on any desired place of the screen. The most challenging part of it, is tracking the patient's movements with enough precision. Fortunately, the vendor's hardware is capable of achieving such accuracy. In this particular case, we have used the remote control provided by Nintendo for its Wii (www.nintendo.com/wii) gaming product. This gaming technology to assist disabled people has been used as an alternative to custom-made devices. This is the case of the work developed by Standen, Camm, Battersby, Brown, & Harrison (2011). In our case, we take advantage of the fact that the device can detect an infrared light signal with admirable precision. The light is generated by a 2-D LED array specially designed for this project. The light is reflected by a sticker attached to the part of the body that the patient can control. Displacements of the sticker are directly converted into mouse movements. There's no way to press a button with a sticker though. In order to click on the screen there are several options:

- Stop on the same place for a configurable amount of time.
- Add a personalized hardware device to be controlled with another part of the body.
- Adapt a standard mouse to facilitate the clicking operation. The resulting product has been successfully tested with several patients severely affected by the disease. Before WIIMO they had to use heavy mechanical devices, thus resulting in a discouraging lack of precision and much higher fatigue. In spite of the fact that we only use the optical capabilities of the hardware, it is worth purchasing the whole device. Developing a customized device to replace it would be certainly be much more costly. For all those reasons the product has been largely praised by our partner associations. The impact of the project in society is also remarkable. Its capabilities have been widespread in the media and specialized forums, such as:
    - A number of citations in local press.
    - Up to 13 articles in newspapers nationwide.
    - Local TV and radio.
    - National radio prime time interviews.
    - Presentations in conferences on disability and innovation on education (Sanchez, 2010; 2011).

Conclusions and future trends

In this work, we have proposed an innovative type of Honours Projects intended to enhance students' social skills and moral values without any loss of technical interest. This leads to a quite complex process involving the students, their advisers and external institutions and charities. We have presented a procedure to ensure an adequate handling of all these interactions. What has been achieved is a line of projects lasting in time and satisfactory in results for all parts involved. This activity can be improved by the addition of new types of supportive projects, providing solutions to other sorts of disabilities. Furthermore, we reckon that we should improve the way disabled people can access the solutions that are being developed for them. Not much more than prototypes have been delivered for the moment. Our goal is to promote the creation of spin-off companies intended to satisfy the increasing demand of our products. In order to facilitate this transition, our University has recently set up a program to provide training, advice and funding to help students become entrepreneurs.

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