CanIHelp: A Platform for Inclusive Collaboration

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Abstract. Technology plays a key role in daily life of people with special needs, being a mean of integration or even communication with society. By built up experience, we find that support tools play a crucial part in empowerment of persons with special needs and small advances may represent shifts and opportunities. The diversity of solutions and the need for dedicated hardware to each feature represents a barrier to its use, compromising the success of the solutions against, among others, problems of usability and scale. This paper aims to explore the concept of inclusive collaboration to enhance the mutual interaction and assistance. The proposed approach combines and generalizes the usage of human computation in a collaborative environment with assistive technologies creating redundancy and complementarity in the solutions provided, contributing to enhance the quality of life of people with special needs and the elderly. The CanIHelp platform is an embodiment of the concept as a result from an orchestrated model using mechanisms of collective intelligence through social inclusion initiatives. The platform features up for integrating assistive technologies, collaborative tools and multiple multimedia communication channels, accessible through multimodal interfaces for universal access. A discussion of the impacts of fostering collaboration and broadening from the research concepts to the societal impacts is presented. As final remarks a set of future research challenges and guidelines are identified.

Keywords: Accessibility · Collaboration · Inclusion · Interaction · Blind · Elderly · Mobile technologies · Wearable computing · Smart environments · Ambient assisted living

1 Introduction

Recent advances achieved in the fields of information and telecommunications technologies shape a paradigm change, characterised by a synergistic trend of

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basic supporting technologies, targeting a new generation of communication devices and access to information. The World Wide Web is currently an environment for sharing and collaboration, promoting the foundations of social life and mutual support. Proliferation of mobile devices and the increasingly widespread use of wearable technologies, accelerate the changes, anticipating innovative ways of interaction and the growing pervasiveness of technology in the daily live. Technology plays a key role in daily life of people with special needs, being a mean of integration or even communication with society. By built up experience [6,10,12,14,16], we find that support tools play a crucial part in empowerment of persons with special needs and small advances may represent shifts and opportunities. The diversity of solutions and the need for dedicated hardware to each feature represents a barrier to its use, compromising the success of the solutions against, among others, problems of usability and scale. Therefore, there has been the need for developing a comprehensive environment to support the daily life of people with special needs, which is not limited to the availability of technological tools, but combines technological support with people interaction, fostering the social integration, ensuring a higher level of trust and, consequently, autonomy and freedom to its users. This papers proposes and discuss the concept of inclusive collaboration as a possible solution to this problem.This concept advocates a model to boost the mutual interaction and assistance.

The proposed approach aims to combine and generalised the use of human computation in a collaborative environment with assistive technologies creating redundancy and complementarity in the solutions provided and contributing to enhance the quality of life of people with special needs and the elderly. The concept can be demonstrated in the scenario where an elderly helps the blind to recognise an expiration date of a product when the technological solutions cannot, or guiding a blind man in a museum with the reciprocity of the blind showing the exhibition to the bedridden elderly in a first-person view. The CanIHelp platform is an embodiment of the concept as a result from a orchestrated model using mechanisms of collective intelligence through social inclusion initiatives. The platform features up for integrating assistive technologies, collaborative tools and multiple multimedia communication channels, accessible through multimodal interfaces for universal access. For this, sets up a decision triangle of users, context, and devices, governed by a model of interface adaptation fed by a cross-platform meta-language for representation and integration of information. Additionally, strategies for user participation, based on their routines and taking advantage of the ubiquity of technology are introduced. The core of this proposal is the aim to foster collaboration, broadening from the research team to the society.

The future development of the CanIHelp platform has several research challenges to be discussed by the community. A key challenge is related to the privacy the trust of system users'. Somehow associated with this challenge is also the usability of the solution, which requires the use of specific hardware (or at least be able to provide the data required for the operation of the system). Another aspect that has raised in this discussion is the integration and interoperability

ability with different assistive solutions, benefiting the user experience and the richness of information provided and processed.

The structure of the remaining paper is as follows: Sect. 2 describes background and related work. In Sect. 3, the CanIHelp platform is introduced highlighting the concept of inclusive collaboration, and discussing its major requirements. The fourth section focuses on presenting some application scenarios of inclusive collaboration, using the CanIHelp Platform. A discussion is presented in Sect. 5, followed by some final remarks on Sect. 6.

2 Background

Assistive technologies based on computer vision can provide to the blind a remarkable autonomy. Recently, systems have been developed which use Computer Vision to extract information about the surrounding environment. The simplest vision systems to support the guidance of blind users extract this type of information analysing the characteristics of the objects present in the captured image, using classical image-processing techniques [4,8]. Other works explore a multi-sensory approach combining computer vision with location technologies to provide orientation and mobility to the blind [3,24]. These systems typically try to address the problems of user location, navigation and environment recognition in one global solution [2,11,15,20].

However, most of them fail in assisting pedestrian navigation, especially for the blind, because they try to adapt vehicle navigation techniques. Moreover, current image recognition systems are highly specialised constrained by the environment and require expensive expert knowledge restricting its usage. Human-powered services can provide a complementary help needed for filling these gaps.

According to ITU, in 2013, 2.7 billion people, almost 40 % of the world's population, were online. Moreover, the same source predicts 2.1 billion active mobile-broadband subscriptions by the end of 2013. These can represent a huge labour force if technological pervasive solutions can be embedded in their usual online activities. "The rise of crowdsourcing", triggered in 2006, awoke the companies and the research community for this opportunity. The crowdsourcing tenders feature a bidirectional strand when applied to social inclusion. As ageing societies require measures for preventing social isolation, the participation in crowdsourcing initiatives can be motivated by socialisation and avoid elder isolation. The "human computations" performed may be in the scope of social intervention, such as describing a square (as Times Square) with several advertising displays constantly changing, recognise certain obstacles which may pose a hazard to the blind, such as a dog of a dangerous race or even warn blind navigation systems for a car parked in a sidewalk. Moreover, collective intelligence can be explored in many ways as human computation, crowdsourcing and social computing.

Previous studies on human computation and crowdsourcing have been focused on complex cognitive tasks such as accurate text translation, social business process management, fast data collection through "human sensors", disease

control, sentiment polarity analysis, image tagging, questions and answers, OCR correction, video and audio classification, city maintenance and civil protection, and digital repositories using citizen scientists' contributions [13].

Human computation can provide real-time information with extreme accuracy for real problems [9,19]. Collaborative accessibility improvement has been seen as a critical approach to improving the Web navigation experience for humans with special needs [22]. Friendsourcing is a way of having remote friends answer visual questions for the approximately 39 million of blind users worldwide [7]. Design issues, cognitive barriers, accessibility problems, and accurate metadata authoring are some variables that should be analysed including people with disabilities since the early stage of social computing development process [21]. Collaborative book scan and transcription by volunteers show a research possibility for improving blind users? experience (e.g., Bookshare[1]). Moreover, recent community services, such as Be My Eyes[2] allow volunteers all over the world to help blind people through a live video stream using their mobile phones.The mobile computing ecosystem presents several opportunities for crowd labour (work as a service on demand). Ubiquitous use of smartphones and tablets by nomadic and mobile humans in a diversified set of work settings include requirements that vary continuously. In this kind of settings, human crowds can act as cognitive operators performing computation tasks anytime and anywhere, sharing knowledge facts quickly and efficiently. Viz Wiz [5] is an application that lets blind users ask questions to the "crowd" or their friends. More applications of this nature are needed to support blind-world interaction.

WHO [18] defines active ageing as *"the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age"*. Information and communication technologies (ICT) have been explored to assist and support active ageing. The new dimensions of communication made possible by ICT reduce the barriers, either physical or geographical, that often intrude among the elderly and their families [23]. This communication enables older people to participate in social life and thus avoiding loneliness and isolation [17].

3 The CanIHelp Platform

The CanIHelp platform is an embodiment of the concept of inclusive collaboration, promoting integration and mutual aid among people regardless of their special needs or limitations and adding human computing to the latest advances in information and computing technologies. The system results from a orchestrated model using mechanisms of collective intelligence through social inclusion initiatives. The platform features up for unifying assistive technology coupled with a set of collaborative tools associated with multiple multimedia communication channels (image, video, audio, text) and accessible through multimodal interfaces for universal access. It incorporates three real time operating modes:

[1] https://www.bookshare.org/.
[2] http://www.bemyeyes.org/.

automatic (assistive technologies); assisted (human computation); and manual (groupware). These three modes are complemented by an asynchronous mode, for platform refinement, evolution and learning. The automatic operating mode autonomously addresses the needs of users, helping them in most situations, using a high degree of "intelligence" of the supporting tools, enhanced with algorithms developed for specific situations. Using computer vision techniques the platform is provided with algorithms for automatic text reading, recognition of bar and QR codes (for example, medications or packaged foods), recognition of specific objects, for which it will be trained in advance, both in indoor and outdoor environments. The CanIHelp is also a digital assistant for its users, reminding them, for example, tasks that must necessarily perform as taking the medication. In this mode the platform still uses algorithms to search the Internet to provide additional information on a particular product or subject, which the user wishes to gain further knowledge.

In situations where the results obtained by assistive tools are not sufficiently accurate and reliable to help the user, the platform switches to the assisted mode, combining the mechanisms in use with collaboration and communication tools. The result of this switching is the direct mutual assistance between users and the possibility of the system learning with the results of human computation. Therefore, CanIHelp platform features skills of machine learning and advanced embedded technologies resulting from the interaction with users, particularly in the operating modes with alternative mechanisms (assisted and manual). Additionally, the system can learn and evolve based on the validation of the results of interactions with users in automatic mode, being made a post-validation using the same mechanisms of human computation. As an example, one or more users can validate asynchronously the result obtained in the recognition of an object. Thereby the recognition algorithms can have feedback and converge for optimizing results.

In everyday life there are situations in which technology plays only a facilitating role, promoting the person-person computer-mediated interaction. The CanIHelp platform in manual mode allows overcoming these communication barriers and intervening as mediator in this interaction, providing users the means and mechanisms tailored to their needs to overtake the obstacles.

The CanIHelp aims to be a platform that integrates the latest technologies, taking advantage of the latest developments, both in terms of use of mobile devices and wearable devices and sensors, such as miniature cameras (Google glasses, smartphones) and smart watches (Samsung Gears), and the digital platform, using the programming capabilities for cloud computing as well as integration of robust and efficient computer vision algorithms. Users' security and privacy issues are considered of utmost importance and treated as early as the design of CanIHelp. The participants must be registered in the platform and the interaction is only allowed between these persons previously selected and authorised by the users.

The interaction with the CanIHelp platform is available through a non-invasive natural interface, to allow a usage adapted to the characteristics and

limitations of users without the need to change their habits and routines. The main purpose is that CanIHelp is a mutual assistance smart platform that fights digital divide making its users feeling perfectly integrated in the digital society. The user interface is one the system's major challenges. Current diversity of mechanisms and interaction devices allow exploring alternative modes of interaction adapted to each user and situation. Linked to this, is also the ubiquitous use of technology, introducing the contextual factor to the interface requirements. The purposes of the platform and its role of social integration, still require the interface to be universal access, ensuring any person to use and enjoy its inclusive capabilities.

4 Application Scenarios

The blind face major difficulties in their day-to-day needing constant help either in indoor environment with their activities of daily life, whether in outdoor environment, when they want to move from one location to another. On the other hand, older people have sometimes a lot of free time and can use it to help the blind in various day life activities, contributing to enhance their autonomy. These interactions can be computer mediated through the CanIHelp platform, where blind can apply for help and elderly reply to the aid requested and provide remote assistance. These groups represent a wide range of special needs given their physical (vision, hearing, mobility) and cognitive (memory deficits, depression, dementia) limitations. They also represent a universe of users for whom the platform is an asset both in their daily autonomy, either in social integration. The CanIHelp platform behaviour can be illustrated through the presentation of different contexts: the application scenarios. These scenarios allow the evaluation and discussion of the users requirements and their accessibility and usability needs. Moreover, aspects as the social integration and autonomy provided by te platform should also be evaluated, as well as the intrusion of the systems in the daily habits of their potential users. There are two application scenarios of the CanIHelp platform, one indoor and other outdoor, respectively: teaching cooking recipes; and visit to a museum.

The first application scenario is an indoor case combines the knowledge and experience of elderly and cultural heritage, with the inclusion and collaborative potential offered by CanIHelp platform. The cuisine features a culture and is passed from generation to generation. The making of a cooking recipe is linked to a set of activities associated with innate vision that become a challenge for a blind. This scenario can be seen as a distance class for assisted cooking, where an elderly prepares and teaches a particular recipe to a blind, assisting him/her in the work. Finding him/her in a known environment (at home), the scenario is familiar, allowing the blind recognising most of the locations and ensuring a high degree of autonomy. In turn it is intended that the scenario is not technologically intrusive to users, i.e., that the technology used is ubiquitous. Therefore, several possibilities are used to interact with the system using multiple devices and interfaces. Among the devices stands out the usage of a SmartTV (with custom

application and using its videoconferencing voice recognition and gestures capabilities), tablets (Samsung Galaxy 10' as an alternative to SmartTV to increasing mobility) and wearable consumer devices, in particular the Samsung Gears (using various location sensing and object recognition by Near Field Communication – NFC) and Google Glasses (using the integrated camera to allow video streaming for the elderly in a first person perspective, and the elderly as option of augmented reality to provide contextual information in task execution). The interaction is driven to achieve of a set of tasks that serve as a demonstration and testing of the functionality of the CanIHelp platform. The system operates in automatic mode in the tasks of object and text recognition, such as the distinction between a package of flour and a packet of sugar, or reading the weight displayed by the scale. As defined, when the values are not trustworthy, the system switches to assisted mode and the blind is aided by the elderly. In the tasks for implementing the cooking recipe, the system works in manual mode, promoting direct interaction and socialisation between the blind and the elderly. To perform the tasks described CanIHelp object and text recognition assistive tools are used, complemented by collaboration tools, including video streaming (to allow the elderly to see and help the blind) and audio conferencing.

The second application scenario is a visit to a museum. The exterior scenario presents different challenges for the blind user, starting with the navigation and orientation in the environment. Meanwhile, to the elderly who find themselves in their homes, deprived of mobility the interaction is limited, and only the SmartTV is used taking all necessary support functions and communication with the blind. The blind uses the same devices used in the first scenario, i.e., wearable devices to meet the mobility needs. During the visit to the museum, the elderly using audio conferencing and video streaming tools guides the blind. The platform works mostly in manual mode, once during the visit and focusing on a specific piece, can switch to automatic or assisted mode to recognise a piece and provide additional information.

5 Discussion

The user interface and its usability are a major research topics in this domain and associated with the platform development. According to the specifications of the CanIHelp platform, users can interact with the system through contextual multimodal interfaces. The participation model and the natural integration of technology in the daily lives of users, by mechanisms for inclusive collaboration is a key research topic. The success of such a platform and model depends on the reciprocal benefits of both groups of users and their motivation to participate.

The assessment of users' needs proves to be a requirement. Currently, several studies reflect the requirements analysis and evaluation of user needs following different methodologies. One of the most common is the User Centred Design (UCD)[1]. Conceptually, it is clear that requirements analysis and specification of user requirements does not constitute a challenge to the scientific and technological level, existing, however, implications at the system design level.

The challenge itself is the system's ability to respond to needs and requirements that are different to different users and the context in which they are. To meet this challenge, it will be essential to define a model that allows adapting the interface and transforming data to meet user specific requirements and the context. The process can be defined based on a set of rules that take into account issues of context, availability of interaction modes and special needs of the user. If, from the point of view of the user there is the need to ensure the satisfaction of their needs, from the point of view of platform there is the requirement of ensuring the evolution and learning of the system, particularly in modes of assisted and manual operating modes. The ability to represent information so that it may be exchanged between the various processes of the platform and that it can be transformed and adapted to be communicated to the user is another of the technological challenges. This representation of the information should be cross-platform, ensuring interoperability between all components.

The collaborative capabilities of the system and its capacity for social inclusion also present some scientific and technological challenges that have been of interest to these communities. User participation and adherence to technology, as well as online socialising has been the subject of study in recent decades. Several possibilities have been explored, from the clarification of the role of the users in virtual environments and mechanisms of popularity, to gamification techniques. However, despite the numerous contributions, there is no model that can be considered a reference in this field. A natural approach should be followed trying to integrate the participation in daily activities of the user while not breaking their routines, and taking advantage of the ubiquity of technology.

6 Final Remarks

In the work presented in this paper we highlight the need to combine human computation and assistive technologies to enhance the daily life of the blind. We introduce the concept of inclusive collaboration to promote the interaction and assistance in a collaborative assisted environment. The CanIHelp platform is an embodiment of the concept introducing several research challenges that will be addressed in the implementation of the conceptual platform presented.

Therefore, the work presented intends to be a further step to the implementation of the concept of inclusive collaboration. Primarily it is expected that this paper contributes to a more solid and sustained knowledge about the state of the art in domains of assistive technologies for the blind and collaboration.

The paper proposes a conceptual platform for addressing inclusive collaboration. A major research challenge of its future implementation is the adaptation model and the meta-language for representing information. The adaptation model will allow CanIHelp platform to adapt by means of the user needs, context and interaction mechanisms and devices available. The integration between the platform components, data flow and representation freedom (transparency) will be ensured by the meta-language. This representation is also essential to enhance the mechanisms of human computation and machine learning of the platform.

Beyond this contribution, it is expected that the development of the CanIHelp platform produces results and impacts into related scientific areas, and related with the presented challenges, namely: universal access, social inclusion and collaboration.

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