Towards *micro-groupware*: Supporting Small Group Activities Around Assistive Technology

Bruno A. Chagas, Hugo Fuks, Clarisse S. de Souza

Departamento de Informática – Pontifícia Universidade Católica do Rio (PUC-Rio)
R. Marquês de São Vicente, 225, Gávea – 22453-900 – Rio de Janeiro – RJ – Brazil

{bchagas, hugo, clarisse}@inf.puc-rio.br

Abstract. Assistive technology (AT) aims at compensating for motor, sensory or cognitive functional limitations of its users. Severely disabled users typically need to rely on family and caregivers to setup and manage the technology they need to use on a daily basis. We propose a conceptual blueprint for an assistive technology micro-groupware platform for users with severe motor limitations. Stakeholders can address the definition of roles and forms of participation for a small group of people with situation-dependent configuration tasks at different levels and dimensions.

Keywords: Assistive Technology · Configuration · Groupware

1 Demo proposal

We propose a conceptual solution for configurable assistive technology (AT) platforms based on a real case prototype. The AT platform is designed for users with severe motor limitations for supporting them at everyday work and leisure activities. In our experience, the system should be frequently adapted to different situations of use, such as work, study or leisure, a combination of them or to some specific task or an unexpected event (e.g. a meeting or a phone call). Given the kinds of assistance end-users typically need from caregivers and family members, some coordination and management activities are required along with other features that these may entail such as, for example, privacy management (e.g. loud speaker and microphone control during calls, permission control to access information, etc.). This suggests that we can apply a groupware approach to support both the main users (*i.e.*, the AT end-users) and the group of people around them with the activities related to the AT configuration and use on a daily basis. Our goal is to investigate the social requirements and impact brought about by an AT platform conceived as a *micro groupware* application case. Among these, we think, issues of “participation overload” may arise if design is not flexible enough, because of the new tasks and concerns that the whole group may want to deal with.

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

2 Related work

AT configuration. We are currently investigating the territory of AT configuration needs and opportunities to support the design of this kind of technology. One of the reasons AT is hard to design, produce and be used is the variability of kinds and degrees of disabilities and individual characteristics among users (physical, psychological, cultural, and environmental, etc.). Even when we look at a single type of disability, there is a great variability in the levels of limitations (a continuum between "some difficulty" and "cannot in any way"), causes (genetics, accidents, aging) and personal characteristics (physical, such as height and weight, their social and psychological condition, etc.). This has been referred to as a "universe-of-one" problem, where a solution for one person will rarely work for another [1]. These variations in users' unique skills and needs constitute a challenge not only for the design process, but also for the subsequent adoption and continuous use. Potentially, HCI-accessibility literature suggests that to improve the design, production and adoption this variability can be addressed by means of configurations. Lewis [2] has pointed out at configurability needs and some aspects of design in the domain of cognitive disabilities. Kane et al. make recommendations for increasing configurability in the design of mobile accessible devices for users with motor impairments [3]. Carrington, et al. explores different design configurations – wearables and "chairables" – for improved mobile devices accessibility to wheelchair users [4]. Recently, Malu & Findlater stated that a personalized wearable approach offers one promising direction for providing mobile computing access to users with upper body motor impairments [5]. However, what this configurability is and how it can be achieved is far from clear.

In a related work, we studied implicit and explicit configuration needs and opportunities of AT configuration suggesting that we must address both hardware and software configuration, some to be done by the end user, some by assistants [6]. As a result from our study, we propose three dimensions with which to organize the AT configuration problem space: the psycho-social dimension, concerning the different form and behaviors that are desired in different situations; the carrier dimension, concerning the means by which a configuration can be done and the substratum (hardware, software or hybrid) where it will reside; and finally, the persistence dimension, concerning how long a configuration will last. In this paper, we want to explore how multiple persons around the technology do these configurations, and how we can support this process.

Cultures of participation. Cultures of participation promotes systems in which everybody is provided with the means to participate and to contribute actively in personally meaningful problems. Cultures of participation strive to increase social creativity, put domain professionals in charge of exploring ill-defined problems, and make owners of problems independent of high-tech scribes [7]. In the AT domain, accessing and addressing these variations in users' unique skills and needs requires an intimate knowledge of the client that, usually, close relatives and caregivers are in the best position to provide [8]. Each user is a unique domain and the group of people around him or her are the real domain experts. Some research include their requirements in the design process of AT (such as [9]). Medicine 2.0 [10] proposes a series of promising

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

applications that leverage socio-technical systems to support personalized needs in the healthcare domain, but how to support all users' needs and participation in such a context needs further investigation.

Collaboration. Kintsch & DePaula propose a framework for the adoption of AT which identifies the following participants in the adoption process: the users, those involved with the user on a daily bases (caregivers), designers and assistive technology experts. Each of these parties must bring certain attributes to the process in order for adoption to occur. Together, a complex and often difficult collaborative process of designing, selecting, personalizing, learning and integrating must be accomplished [11]. We are concerned here with the collaborative process where many configuration activities take place.

The design and deployment of configurable AT systems was investigated by Carmien & Fischer applying the meta-design framework in systems for helping people with cognitive disabilities [12]. They proposed, designed and evaluated a system called "Memory Aiding Prompting System" (MAPS) to support people with cognitive disabilities to accomplish activities of daily living (ADLs), such as cooking, housework, or shopping, which can be difficult for them because of their memory or reasoning limitations. They say a unique challenge in this domain is that the end-users themselves cannot act as designers because of their disability; the caregivers must perform the role of "end-user developers". MAPS was based on End-User Development (EUD) and was divided into two parts: one for the caregivers, in which they create multimedia scripts to support their patients with particular tasks; another to be used by their patients, which presented them the pre-programmed multimedia scripts with a step-by-step guide to accomplish some task.

A different approach in a different domain has been researched by Bigham & Ladner who propose a collaborative scripting framework that web users, web developers and web researchers can use to improve collaboratively web accessibility for blind users [13]. They called it "Accessmonkey" because it was derived from Greasemonkey, a popular EUD extension for the Firefox web browser. Usually, blind web users access the web using screen readers, but these present a web experience destituted of the rich visual structure of modern web sites (because of problems in the web sites' HTML codes and/or dynamic web content.) Using Accessmonkey, web users and developers on different platforms can collaboratively adapt web content according to user needs, which usually depends on the screen readers' specific features and are not available to the developers when coding and testing web pages. Later, Bigham, et al. proposed a technology they called "Accessibility by demonstration" [14] that enables end-users to guide developers to correct web accessibility problems by retroactively recording the real accessibility problems they face at the time they experience them. In this approach, the users are in charge for defining and requesting the changes that they need (actually, corrections in this case) in their context and during use time, even though they will not be the ones who will code the system changes.

Both works suggest a common requirement in the AT domain: usually, some collaboration will take place around the technology being proposed or used to the benefit of a main user – the disabled one. However, how does this collaborative process happens

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

and how to support it is usually considered apart from the AT itself, or not considered at all.

3 Research approach

We are currently working with a single tetraplegic participant who is male, 33 years old and injured due to an accident he suffered more than ten years ago. We are conducting an action research in a typical spiral of plan-act-observe-reflect cycles [15], applying a mix of ethnographic, participatory design, meta-design, prototyping and evaluation techniques. Firstly, we observe him in his home and real situations of life, which has lead us to an AT proposal that we have implemented and deployed as the outcome of our first "act" step.

The platform is described elsewhere [6] as well as our first evaluation scenario and results. It aims to support him for interacting with multiple devices in smart connected environments and has three main components. The first is a wearable – an electronic cap – to detect body movements and simulate a mouse. The demo cap can be plugged to a maximum of four exchangeable switches to handle clicks. It communicates wirelessly with mobile phones via Bluetooth. The second is a dock station for mobile phones – in our case, Android – to control other equipment. The dock controls a lamp, a TV set and a wireless dual connection headset (switching between phone and computer). Finally, the third one is a mobile phone – an Android device. It connects with the dock station via USB. The phone is equipped with an app that controls each device individually and keeps native Android system features.

4 *Micro-meta-groupware*

Even though we are currently working with a single tetraplegic user, our research had to deal with much more than one person from the very beginning: as a severely impaired user, he depends on his caregivers and family members to support him in most of the things he wants or needs to do, including the interaction with any surrounding devices. He usually counts on one professional nurse who takes daily care of him during the day and family members who can occasionally support him out of this period. His condition enforces a situation where he needs assistance for performing all physical manipulation on the objects around him, that includes common tasks like moving himself and moving things around, preparing to a specific work, study or leisure activity, turning on a computer or any other device and changing their setup. This also holds to those devices that are assisting him – that is, the AT devices as is the case of the platform prototype. The immediate consequence of that is that even though the AT targets a (disabled) main user, many other people with different roles, functions and responsibilities will interact with it in order to fulfill the main user daily needs. In such context, AT is a component of a collaborative system. This will be true in most cases where the end-user depends on other person's help due to his or her functional limitation, which is true especially when dealing with severe cases, where the degree of assistance needed by the end-user is presumably higher.

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

Micro groupware. If a single disabled user can be seen as a "universe-of-one" problem, all the people around him or her represent a "micro universe" which include him or her at the center. This group of people is small and cohesive: relationships are highly based on confidence and trust, including the professional relationships, developed over time and on which depends, most of all, the survival of the main user. Somehow, everybody inside the group seems to be very conscientious about it, in a positive and not deluded way. We can identify seven different profiles involved in this collaborative interaction:

1. The main user, the disabled subject to be supported;
2. Family members, who are emotionally (in "good" and "bad" ways) involved and concerned with his welfare;
3. Caregivers, both formal, such as professionals nurses, and informal ones, such as home employees;
4. People with similar needs, such as others tetraplegic friends, with whom he can talk about problems and concerns at a deeper level of empathy and mutual understanding;
5. Friends and colleagues, who occasionally and unwittingly become helpers and supporters in daily social situations such us group meetings and group work;
6. Therapists and doctors, whose opinions from the clinical and medical perspectives poses a distinct level of importance; and
7. Technical specialists who may have knowledge of tools and facilitate many decision making processes regarding technology, such us the developers/specialized manufacturers, retailers and assistive tools service suppliers.

Each person is a potential user, many times unwittingly, and brings certain requirements to the process of configuring AT, and to the design thereof. But more than that, each person is potentially a designer too that can input changes that shapes the system, each one having different motivations and levels of engagement, generating changes and change requests to be addressed with different levels of priorities.

Meta groupware. The collaboration process will take place *around* the assistive technology, but it is also a collaboration *about* the technology itself, since there would not be any collaboration if there were not an AT to configure. It puts such AT in a position where it is, at the same time, the target and the support of a collaborative system. The former because it triggers a series of new activities that simply will not exist without it being there, such as wearing, fitting and adjusting a wearable device, like the electronic cap. The later because any configuration can only happen in features previously provided by the technology itself, like its hardware and software adjustments. Once that is understood, we may think about how to better support these activities. For example, this would include the appropriate mechanisms for allowing individuals inside the group to be able to configure different parts of the AT, both locally and remotely (from one's personal mobile phone or a web system, for example). At the same time, the main user must have the appropriate means to be in control for allowing and disallowing individuals' actions, asking for changes and blocking undesired interventions in the system. Finally, some of the configurations may change the system in more significant ways (e.g. a new software release or upgrade by the manufacturer), implying significant

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

changes not only to the main user, but also to the other individuals in the group that will have to deal with new demands to learn the new system features at some level.

Groupware systems are already known to be evolutionary because the composition and the characteristics of workgroups change with time, as well as the tasks that need to be executed [16]. Cultures of participation may support this evolution appropriately because it promotes that “the real” domain experts engage in the design, adoption, and adaptation of technologies to their needs and in collaborative knowledge construction. However, issues of collaboration and participation overload can appear and be harmful in such a context. For example, equipment may break or malfunction and dependence may appear between group members because of the technology. To avoid undesired configurations, main users must have the appropriate means to manage the group, while other participants must be able to manage their desired level of engagement. The former will have to manage the group permissions and access to information in order to ensure the equipment usability and his own safety. The later will have to deal with equipment details (either by professional, personal or social reasons) he or she is not able or not willing to learn and though must be able to select the desired level of participation.

5 Conclusion and future work

In this paper, we present an initial conceptual scheme of an assistive technology groupware platform for users with severe motor limitations. The AT platform is under continuous design and evaluation in an action research process with a single tetraplegic participant and the people around him. Our first evaluation raised collaboration as an important aspect to be considered that we now start to investigate by means of this proposed framework. Our framework takes into account that such a technology demands and promotes a collaborative process *around* and *about* its configuration. Cultures of participation put domain professionals in charge of exploring the technological solutions that may work better for them independently of high-tech scribes. In our research, we are investigating how it can be done in such a way that: (1) the system effectively and safely support the main user in his final goals and needs; and (2), the system support the participation of all stakeholders at the desired level of engagement. Our contribution is to propose a conceptual structure of a collaborative system *around* and *about* itself, which we call *micro-meta-groupware*. Such scheme hasn’t been proposed to date and we believe it can be a starting point for the incorporation of collaborative features into the design and deployment of AT systems and devices. We plan to implement and evaluate this framework into a concrete instance of groupware platform in subsequent research cycles to check for its applicability and validity.

Acknowledgements

The authors thank the volunteers that participated in this study, as well as CNPq and FAPERJ for supporting them with research grants and scholarships.

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).

References

1. Carmien, S., Dawe, M., Fischer, G., Gorman, A., Kintsch, A., Sullivan Jr, J. F. Socio-technical environments supporting people with cognitive disabilities using public transportation. ACM Transactions on Computer-Human Interaction (TOCHI), 12(2), 233-262 (2005)
2. Lewis, C. Simplicity in cognitive assistive technology: a framework and agenda for research. Universal Access in the Information Society, 5(4), 351-361 (2007)
3. Kane, S. K., Jayant, C., Wobbrock, J. O., Ladner, R. E. Freedom to roam: a study of mobile device adoption and accessibility for people with visual and motor disabilities. Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility (Assets '09), pp. 115-122. New York, NY, USA: ACM. (2009)
4. Carrington, P., Hurst, A., Kane, S. K. Wearables and chairables: inclusive design of mobile input and output techniques for power wheelchair users. Proceedings of the 32nd annual ACM conference on Human factors in computing systems, pp. 3103-3112. ACM. (2014)
5. Malu, M., Findlater, L. Personalized, Wearable Control of a Head-mounted Display for Users with Upper Body Motor Impairments. In: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15), pp. 221-230 (2015)
6. Chagas, B. A., Fuks, H., de Souza, C. S. Lessons Learned in the Design of Configurable Assistive Technology with Smart Devices. In: End-User Development, IS-EUD 2015, Proceedings, LNCS, 9083, pp. 180-185 (2015)
7. Fischer, G. Understanding, fostering, and supporting cultures of participation. interactions, 18.3, 42-53 (2011)
8. Cole, E., Dehdashti, P. Patient-centered design as a research strategy for cognitive prosthetics: Lessons learned from working with patients and clinicians for 2 decades. In: CHI 2006 Workshop on Designing Technology for People with Cognitive Impairments (2006)
9. Hwang, A., Truong, K. N., Mihailidis, A. Using participatory design to determine the needs of informal caregivers for smart home user interfaces. In: Pervasive Computing Technologies for Healthcare (PervasiveHealth), 2012, 6th International Conference on, pp. 41-48 (2012)
10. Eysenbach, G. Medicine 2.0: social networking, collaboration, participation, apomediation, and openness. Journal of medical Internet research, 10.3 (2008)
11. Kintsch, A., DePaula, R. A framework for the adoption of assistive technology. In: SWAAAC 2002: Supporting learning through assistive technology, pp. 1-10 (2002)
12. Carmien, S. P., Fischer, G. Design, Adoption, and Assessment of a Socio-Technical Environment Supporting Independence for Persons with Cognitive Disabilities. Proceedings of CHI 2008 (pp. 597-607). Florence, Italy: ACM. (2008)
13. Bigham, J. P., Ladner, R. E. Accessmonkey: a collaborative scripting framework for web users and developers. In: Proceedings of the 2007 international cross-disciplinary conference on Web accessibility (W4A) (W4A '07), pp. 25-34 (2007)
14. Bigham, J. P., Brudvik, J. T., Zhang, B. Accessibility by demonstration: enabling end users to guide developers to web accessibility solutions. In: Proceedings of the 12th international ACM SIGACCESS conference on Computers and accessibility (ASSETS '10), pp. 35-42 (2010)
15. Anderson, G., Herr, K. The Action Research Dissertation: A Guide for Students and Faculty. SAGE (2005)
16. Fuks, H., Raposo, A. B., Gerosa, M. A., Lucena, C. J. Applying the 3C model to groupware development. International Journal of Cooperative Information Systems, 14.02n03, 299-328 (2005)

Proc. of Third International Workshop on Cultures of Participation in the Digital Age - CoPDA 2015
Madrid (Spain), May 26th, 2015 (published at http://ceur-ws.org).