Taking a closer look at user-technology relationships: a network model

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Kurzfassung

Im Gesundheitswesen der Stadt der Zukunft sind viele technische Hilfsmittel im Einsatz. Bisherige Studien dazu betrachten Nutzer und Technik als getrennte Elemente. Wir schlagen vor, die vielfältigen Interaktionen zwischen den menschlichen und technischen Akteuren einzubeziehen: Die Akteure verteilen ihre Verantwortlichkeiten ständig neu untereinander. Das geben wir in einem Netzwerkmodell wieder. Als Anwendungsfall beobachten wir die Entwicklung und Nutzung von augengesteuerten Kommunikationshilfsmitteln.

Abstract

In the city of the future, complex technology will be increasingly in use in the health care system. To this day, research on assistive technology considers technology and users as separate spheres. We suggest to include the multiple interactions of human and nonhuman actors: the actors constantly redistribute the competences among themselves. We represent this in a network model. The case we study in this project is the development and use of gaze-controlled communication aids.

Introduction

In the city of the future, technologies will play a crucial role – at home, in the streets, at work etc. In health care, assistive technology (AT) will be present in many interactions. Health care professionals use devices for documentation and organisation of work (e.g. hand-held terminals for nursing documentation); people with disabilities use AT to live independently (e.g. with environmental control); patients use monitoring systems to send data to the medical practitioners.

Using assistive technology – a network approach

Health care has always used instruments and technologies, but as these technologies become more and more complex, the interactions and the network of responsibilities change: Not only the patients need care, someone has to take care of the assistive device, too [Sab 15]. Design pursues the ideal of intuitive use, but in everyday life, experience shows that this ideal is not yet implemented in every device. In our study, we take a closer look at a complex assistive technology: Gaze control allows people with severe motor impairment, who can't use their hands to write, to use a computer for communication and to manage their household via environmental control. A gaze control system runs on a windows-based PC with an attached infrared camera. The camera tracks the gaze and a software converts it into mouse movements. By moving the eyes, the user can control the PC: she can write on an on-screen keyboard and make use of any standard application (word processing, e-mail, browser, games). It is also possible to use a speech synthesizer on a gaze-controlled computer: a person who lost her voice (for instance due to ALS) can "talk" to others with this device [Mos 03]. We call this a gaze-controlled voice output communication aid (gaze-controlled VOCA).

In the last years, gaze control has become a reliable and stable access method for using a VOCA, and a great demand for this technology has developed. Families often place great hopes in gaze control, because they consider it to be the last chance for a non-speaking person with severe motor impairment [Deb 12]. The great expectation involved in this technology makes it a very good example for analysis: What is necessary to make the communication successful?

How can we learn something from the problems that still occur? Most of the research on assistive technology focuses either on technical improvement, innovation, or on user acceptance [Oud 08]. These traditional approaches consider technology and the user as separate spheres. The dynamics and the transformative power of the interactions as well as the many actors involved in using complex assistive devices are often ignored.

In our project, we develop new concepts to describe user-technology relationships. We take advantage of some concepts that have been developed in science and technology studies (STS). Recent notions like "domestication" [Ber 06] suggest that user-technology relationships are dynamic: integrating technology into everyday life is a process through which both the user and the technology change. Therefore, we consider the relationship between user and technology as interactive: the device includes a scenario for its use, but the user decides how to follow or re-write this "script" [Akr 92]. If we consider how social media technologies have changed our communication, and how our desire for and communication has changed the media vice versa, this mutual influence or interaction becomes obvious. We investigate the interactions of the human and nonhuman (technology, power supply, money, acts and entitlements, ...) actors around the use of assistive technology in everyday life. All actors are redistributing the responsibilities between them, they change routines, meaning, structure, menu.

To investigate these negotiations, we bring together experts from various disciplines and professional backgrounds: designers and engineers, therapists and teachers, counsellors and researchers, VOCA users and relatives. Together, we discuss questions like: How does the designer conceive of the typical user of his device? How do the therapists and teachers think about communication using a VOCA? What do people expect when a relative or friend starts to communicate with a gaze-controlled device? All involved parties gain insights through the discussion: the designers and engineers get a better understanding of how their design influences the use, how the device incorporates a scenario for the user. The therapists and teachers better understand their expectations towards users and devices. Researchers learn more about the necessary qualifications of therapists, teachers, and AT specialists.

Our working hypothesis is: A network model, representing the redistribution of responsibilities between human and nonhuman actors, is more powerful to describe the use of assistive technology than a dualistic user-device model.

Methods

Based on a Grounded Theory approach, we use qualitative research methods such as participant observation and structured expert interviews. Some STS concepts help to shed light on the process of designing, customising and using an assistive device. Science and technology studies focus mainly on the interaction of users with technology. Therefore, observations of use of gaze control seem most appropriate: such observations can make the interactions visible. Up to now, we conducted 14 expert interviews (speech therapists, special education teachers, distributors of AT, users etc.). Additionally, we observed eight people who use their eyes to control a VOCA (age 11 to 64, 2 female, 6 male).

Results

How are designing and using technology intertwined? Designers and engineers develop scenarios for the use of their devices. These scenarios are incorporated in the technical design of the device.

> "Designers [...] define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science and economy will evolve in particular ways. A large part of the work of innovators is that of '*inscribing*' this vision of [...] the world in the technical content of the new object. I will call the end product of this work a 'script' or a 'scenario'." [Akr 92, p. 208]

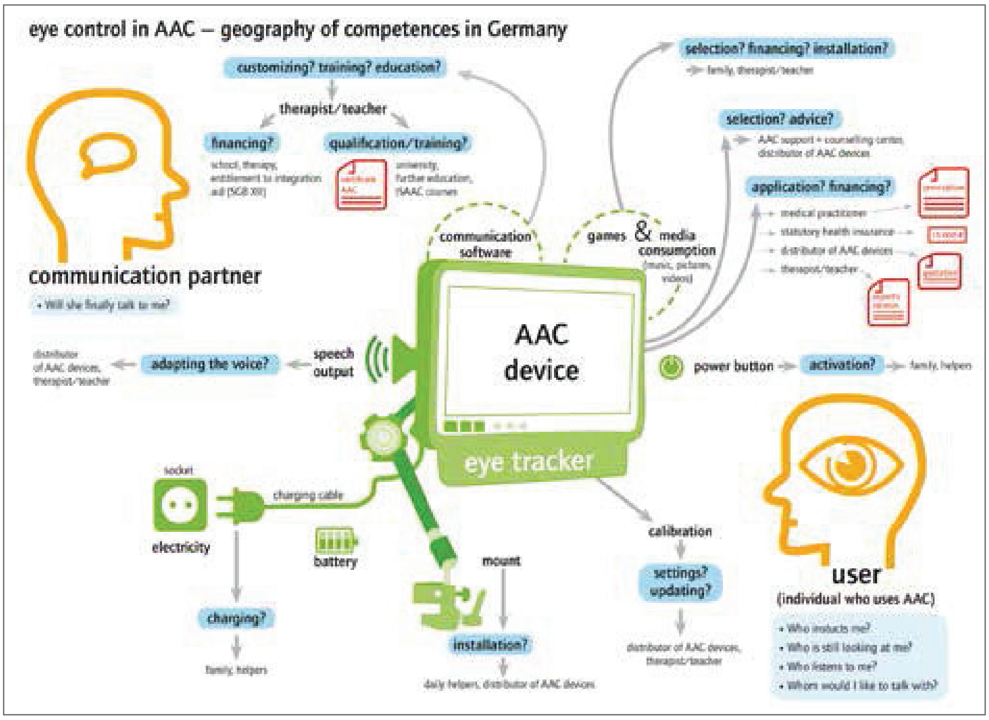

Fig 1: network model with a sharing of responsibilities between human and nonhuman actors

This "vision of the world" includes ideas about the delegation of competences and responsibilities: some competences lie in the device itself (or in its components), other competences and responsibilities are delegated to the user and her environment. In her semiotic approach to the network of actors, Akrich tries to avoid differentiations between nonhuman and human elements in an ensemble: all elements work together in the process in which meaning is built, and all relationships between these actors are equally relevant.

With respect to gaze control, there is a crucial interaction of human and nonhuman actors at the very beginning of using the device: the calibration. It is necessary to individualise the system for the user. The user has to follow a point that occurs at different places on the screen. The software measures the distance between the user's two eyes and other parameters. At the end, it gives feedback on the quality of the calibration. For some people the result might be that they are probably not able to use gaze control because of some features of their eyes, their glasses or the like.

Looking at the process of calibration and mounting, the distribution of competences becomes visible: due to lights and reflections etc. it is quite often the case that the calibration is insufficient or the camera currently doesn't find the eyes of the user. If these problems occur, people react in different ways to explain the results. Some say: "The device is malfunctioning or disturbed" and they delegate the responsibility to the technical object. Someone else might say: "We have to improve the positioning, maybe the distance between you and the camera is not optimal" and he delegates the responsibility to the therapist or teacher or family member who mounts the device to the user's wheelchair etc. Another possible explanation would be: "Maybe your eyes were not really open during this process. Could we try again?" and this delegates the responsibility to the user. Interestingly, in most of the cases we observed, the reason for the malfunctioning was unclear, the professionals didn't find a satisfactory explanation. The malfunction shows how all the involved actors – the user, the professional helper, and the device – are negotiating their competences and responsibilities. We can take this aspect as a starting point to discuss questions as the following: What should the device be able to do? What is the engineer's vision of the features of the device – and what are the users' expectations? Does this fit the competences of the helpers who set up the device?

The network (see fig. 1) represents the geography of competences and responsibilities regarding a person who uses a VOCA with gaze control. This map reflects on the situation in Germany, insofar as financing, health insurance structures, and professional education differ from country to country. With this model we want to prove that the idea of a device simply depending on its technical components is not appropriate. All components (switches, batteries, communication or gaze-tracking software) are directly intertwined with human or social actions (switching, charging, covering the costs, customizing an interface etc.).

Observing the use of gaze-controlled VOCAs, we noticed a significant interaction regarding the eye contact: A lot of the time all people in the room were looking at the screen to follow the actions that the user initiated. This means a loss of immediate contact. We found the same observation in Hélène Mialet's notes from her interview with Stephen Hawking, who also uses a gaze-controlled communication aid: "We don't look at each other; we look at the computer instead." [Mia 12, p. 128]

However, communicating with the device was regularly interrupted by direct communication. Either the communication partner or the user initiated direct eye contact and the communication partner asked something relevant to this situation, e.g.: "Did you trigger this box by mistake?" or "Do you want to stop and have a coffee now?" The user would answer with communication signs like eye movements, vocalisation or facial expressions.

These two observations are very important: At first, you might think it is not natural to control a computer interface with your eyes. But severely motor-impaired people are already familiar with using eye movements to communicate: Their yes-no communication signs are in some cases based on eye movements and they are used to "point" on something with the eyes. That's why gaze control does not demand a new task from them. Furthermore, although the screen receives the main attention of all people involved, the users alternate quickly and fluently between controlling the communication aid with their eyes and having eye contact with the communication partners. This eye contact is especially necessary to make visible emotional aspects of the communication that are not audible in the synthesized voice output.

Conclusion

In our project, we focus on user-technology relationships. Embodied in the technical object are the designer's scenarios of how the user interacts with the technology. Our hypothesis is that the successful use of gaze-controlled VOCAs depends on a complex delegation of competences to many human and nonhuman actors. Our observations have proven this hypothesis to be correct: e.g. in the calibration we see an intertwinement of responsibilities of user, helper and technology. If the calibration fails, reasons for malfunction are often negotiated between several actors. Furthermore, communication with gaze-controlled VOCAs shows that the technical communication aid is not the exclusive mode of communication. We offer these concepts and observations to designers and therapists, and we hope to open up a new perspective on the interactions assisted by technology, keeping in mind how social communication and technology influence each other.

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List of References:

[Akr 92] Akrich, M.: "The de-scription of technical objects." In: Bijker, W, Law, J. (eds.): Shaping technology – building society. Cambridge: MIT Press 1992, 205-224

[Ber 06] Berker, T.; Hartmann, M.; Punie, Y.; Ward, K.: Domestication of media and technology. Maidenhead: Open University Press 2006

[Deb 12] Debeljak, M. et al.: "Eye controlled human computer interaction for severely motor disabled children: two clinical case studies". In: Miesenberger, K. et al. (eds.): Computers helping people with special needs: ICCHP 2012, Proceedings Part II. Berlin, NY: Springer, 2012, 153-156

[Mia 12] Mialet, H.: Hawking incorporated. Chicago: University of Chicago Press 2012

[Mos 03] Moser, I.; Law, J.: "'Making voices' – new media technologies, disabilities, and articulation". In: Liestol et al. (eds): Digital Media Revisited. Cambridge: MIT Press 2003, 491-520

[Oud 08] Oudshoorn, N.; Pinch, T.: "User-technology relationships: Some recent developments", in: E. J. Hackett (Ed.), The handbook of science and technology studies. Cambridge: MIT Press 2008, 541-565

[Sab 15] Saborowski, M.; Kollak, I.: "'How do you care for technology?' – Care professionals' experiences with assistive technology in care of the elderly." In: Technological Forecasting & Social Change, vol 93/2015, DOI: 10.1016/j.techfore.2014.05.006, 133-140

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