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Assistive Technologies: Short Overview and Trends

Abstract

This paper gives a brief overview of currently existing assistive technologies for different kinds of disabilities. An elaborate discussion of all types of assistive technologies is beyond the scope of this paper. Assistive technologies have evolved dramatically in recent years and will continue to be further developed thanks to major progress in artificial intelligence, machine learning, robotics, and other areas. Previously, assistive technologies were highly specialized and were often difficult or expensive to acquire. Today, however, many assistive technologies are included in mainstream products and services. An introduction and state of the art of assistive technologies are presented first. These are followed by an overview of technological trends in assistive technologies and a conclusion.

1 Introduction

Assistive technologies (ATs) are any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities (PWDs). Assistive technology helps people with a variety of impairments, be it difficulty speaking, typing, writing, remembering, pointing, seeing, hearing, learning, or walking. ATs can come in many forms, from low-tech to high-tech. For the context of this paper, we will consider only ICT-based assistive technologies, such as computer hardware (e.g. special switches, keyboards, and pointing devices) and software (e.g. screen readers and communication programs).

Due to the advancement of computer technologies, assistive technologies have become both more affordable and more sophisticated in recent years. For instance, refreshable Braille displays and screen readers for visually impaired users have changed dramatically. The first refreshable Braille display for visually impaired people, called VersaBraille, was developed in 1982, and was very expensive (Van Gerven/Taylor 2009). In 1986, IBM created the first screen reader for DOS computers (Cooke 2004) and in 1989, Macintosh released the first screen reader for graphical user interfaces called OutSpoken. Today, sophisticated screen readers are already embedded into most operating systems and mainstream computer devices for free (e.g. VoiceOver for Apple operating systems).

2 Assistive technologies: State of the art

A great many ATs today are based on existing mainstream technologies, particularly wireless Internet and mobile devices. Some ATs are already embedded into these technologies, such as the accessibility settings on an iPhone. There are also many specialized tools based on mainstream Internet technologies developed specifically for PWDs. For example, assistive mobile apps, also called “accessibility apps,” have sharply increased in number in recent years. Navigation and map apps such as Wayfindr (n.d.), ViaOpta (Novartis Pharma AG 2014), and WheelMap (Sozialhelden e.V. n.d.) allow users with mobility and/or vision impairments to locate and navigate accessible places. Apps such as these might use GPS information to analyse the user’s location and recommend safe routes, or they may rely on crowdsourcing to identify and rate accessibility in various establishments, such as restaurants, shops, or public buildings. Remote person-to-person apps, such as Convo (2017), VEASYT (2018), Be My Eyes (n.d.), and VerbaVoice connect users with hearing and vision impairments to a volunteer or interpreter, who receives a live camera and microphone feed from the user’s device and can then assist the user with a given task or provide sign language interpretation. There is a plethora of other internet-based mobile apps that offer a range of assistive tools.

Webtools and online platforms also offer many services for PWDs, particularly services which are more complex, as these would be less well-suited to the simpler formats of mobile apps.

Examples of webtools for PWDs include Amovil (n.d.), a tool which helps users identify the best-fitted accessible mobile device for them, PAVE (ZHAW ICT-Accessibility Lab 2016), which assists document creators in making accessible PDFs, and Robobraille (Sensus ApS. 2018), an online service which automatically translates text into Braille.

Other types of more hardware-based assistive technologies help people with cognitive and hearing impairments: so-called “social robots,” such as Pepper (Emotion Robotics n.d.), can help people on the autism spectrum to improve their social skills. Specialized hearing devices in combination with Bluetooth and cloud-based services, such as Oticon Opn (Oticon 2018), can help people with hearing impairments to overcome some barriers in their daily lives.

3 Assistive technology trends

Different areas such as cloud-based technologies, the brain-computer interface (BCI), artificial intelligence (AI), machine learning, and the Internet of Things (IoT) are facilitating new types of assistive technologies for people with disabilities.

Cloud-based assistive technologies, as their name implies, are stored in the Cloud and can be used as needed, independent of location. A European Commission-funded project, “Cloud4All,” has launched an initiative called the Global Public Inclusive Infrastructure (GPII), which aims to build a cloud-based system where users can store customized AT software. This initiative would allow users with disabilities to access their preferred ATs from any device and location. For example, a user with a cognitive impairment who uses a simplified computer interface could have these settings saved in the cloud, and could later access them from other devices, such as a library computer or work device. The GPII initiative is still under development, but it could have great potential in making ICTs more accessible for PWDs.

The brain-computer interface is at the cutting edge of AT research, and may have a significant impact for persons with motor impairments. The BCI allows users to bypass conventional channels of communication (such as speech or gestures) by creating a direct connection between a user’s brain and a computer via electrodes or implants (Obiedat et. al 2014). The user can thus control a device, such as a wheelchair or computer, using only brain-generated electrophysiological signals.

Artificial intelligence and machine learning, two distinct but intertwined phenomena (Marr 2016), have become buzz words in recent years. Artificial intelligence (AI) refers to the ability of machines to carry out tasks in a “smart” way, while machine learning refers to the application of AI when computers are given access to data and programmed to learn for themselves. For example, machine learning allows computers to draw from vast databases in order to “understand” certain external stimuli, such as images, text, and sounds.

The increasing ability of computers to understand the world has many potential uses for PWDs. YouTube’s automated closed-captions are one major example of applied machine learning as an assistive technology. As of 2017, YouTube’s closed-captioning algorithms not only recognize speech with a high level of accuracy, but are also able to recognize other sounds such as applause, laughter, and music (Simonite 2017). Another example is Facebook, which recently launched an image recognition feature, allowing the platform to create text descriptions of images in a post, for example. Google has also developed its own algorithm for this task (Vinyals 2014).

The “Internet of Things” (IoT) is expected to gain importance for assistive technologies. The IoT is what allows “smart” devices to operate autonomously via remote communication and data transmission with other devices and systems. For example, a user could use their smartphone to control the lighting in their home. The IoT can be applied to anything from transportation (such as self-driving wheelchairs or Google’s self-driving car), to security systems, to everyday objects such as refrigerators. An emerging field of development is the “smart home,” which combines various smart objects and systems in a domestic setting, allowing a user to have full control of their comfort and safety. Another emerging concept is that of “smart cities,” in which urban infrastructure is connected to the Internet. In this scenario, a PWD could use an app to find a free parking spot, for example, or could use a virtual city guide to find accessible building entrances.

4 Conclusions

Assistive technologies play an important role for the inclusion of people with disabilities. In earlier times, assistive technologies were often highly specialized, expensive, and not widely available. Today, tremendous advances in information and communication technologies have made assistive technologies more affordable and easier to acquire than ever before. Assistive technologies are increasingly ubiquitous, and are frequently included in mainstream technologies. Advances in artificial intelligence, machine learning and computer vision are providing new opportunities to develop novel assistive technologies. Self-driving cars, robotics, and 3D printing facilitate new use cases for PWDs.

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