A literature review:
AI-based assistive technology for the physically disabled

Abstract

The objective of this literature review is to investigate concepts for incorporating artificial intelligence (AI) into the development of particular assistive technology (AT) for three specific forms of physical disability: 1) impaired eyesight; 2) deaf and hearing issues; 3) absent or injured limbs. These three circumstances all have the tendency for ignorance, which can make them difficult for others to notice or accept. Individuals with undisclosed or non-obvious impairments are at danger of being misunderstood or ignored. They could even be criticized of inventing or feigning their impairment. We want to integrate smart assistive technologies in households and other amenities, enabling contextual intelligence surroundings that will assist and increase the intended consumer community's flexibility in their everyday activities (Cortés, Annicchiarico, Vázquez-Salceda and Urdiales, 2003a).

1. Introduction

Assistive technology is referred to any equipment that may be used to increase, maintain, or improve the skills of people with impairments (IDEA, 1990). For persons with impairments who require particular care, assistive technology may be quite beneficial. There are a variety of assistive technology devices and applications that can support persons with disabilities with proper arrangement and supervision.

About one billion individuals worldwide are in necessity of assistive technology (AT). This figure is expected to rise by 2050. Limitations of exposure to basic assistive technology (AT) such as corrective lenses, ear monitors, wheelchairs, or, progressively, mobile applications restrict disabled people and limits their opportunity to live independently. Given the demonstrated benefits of AT for individuals with physical impairments, their relatives, and community overall, there is yet a large and obstinate discrepancy with both demand and provision; today, barely ten percent of people who require AT get it (Powering Inclusion: Artificial Intelligence and Assistive Technology, 2021).

Artificial intelligence (AI) has impacted or indeed transformed several aspects of people's lives, and this tendency will only keep on going to intensify using modern improvements like machine learning and evolutionary computation. Individuals with physical limitations, such as impaired eyesight, deaf or hearing issues, or absent or injured limbs, will be specifically intrigued in these innovations. They provide handicapped persons with hitherto unreachable chances for integration and involvement in community. Technologies hold the potential to accomplish far better than simply make lives smoother and more comfortable. Rather, the goal is to empower people to achieve things that were formerly challenging or unattainable for them.

AI advancements have the ability to create and improve AT, in addition to providing latest perception about the global scope and behaviour of AT demand. Modern technologies based on advances in machine learning open up a world of possibilities for aiding and assisting people with impairments in their daily lives. While AI-enabled products have the potential to significantly discriminate against individuals with impairments, they are currently being utilized to assist individuals with visual, auditory and mobility challenges. Predictive text, visual recognition, speech-to-text transcription, and captioning have all made significant progress in recent times.

2. Artificial Intelligence in Assistive Technology

Impaired eyesight

Present assistive technologies for visual disability comprise of, 1) haptic assistance, 2) travel assistance, 3) AT for accessing news and interaction, 4) AT for everyday life, 5) software applications for visually impaired individuals.

Low-technology *haptic assistance* include white canes, classic Braille techniques, or imprinted images, as well as touchable charts, while high-technology *haptic assistance* feature enhanced Braille programs, sophisticated canes and haptic assistance for device utilization.

Travel assistance can be classified into: *primary assistance* are that that offer adequate guidance for the visually impaired traveller to freely go anywhere and they can be utilised alone securely; *secondary assistance* are those that do not give enough information for a visually impaired individual to travel around securely and autonomously; they should be utilised together with a primary assistance; *integrated technologies*, which render the surroundings simpler to transverse and operate; and *blended technologies*.

Technology for information and communication access encompasses techniques for specialized objectives such as learning, employment and profession, sport and leisure. They include television, workstation, Internet, and cell phone interaction connectivity technologies.

Low vision devices are designed to help people make the most of their limited eyesight. Blind people's requirements are met by systems that convert optical data into other sensational modes. Moreover, personalized caring, synchronisation, notifications, meal processing and intake, atmospheric monitoring and household appliances, banking, and purchasing are all instances of assistive technologies for everyday life. Gadgets that can interact with nerves in the eye or optical nerve, artificial silicon retina (ASR), augmented reality (AR) eyeglasses, injectable micro telescopes, and telescopic corrective lenses are all examples of developing ATs.

Assistive technology for blind and visual impaired people is determined by: improved flexibility and handiness, determined by diminishment, decreases in resource consumption, and advent of modern, low-cost, and energy efficient resources; breakthroughs in exhibit systems and latest versatile user interactions and entry choices, for example, touchscreens, tactile feedback, brain interfaces, motion recognition; user accessibility to production and creative tools, for example application development tools and 3D printers for blind people.

(Nierling, João Maia, Hennen and Wolbring, 2018a)

Even though assistive technology for the visually impaired person have been available for a while, as previously mentioned, AI has lately contributed to substantial advancements. Text-to-speech (TTS) technology has grown considerably more versatile, allowing digital improvision usage, such as tuning in to an e-book remotely, due to increasingly sophisticated voice reconciliation techniques, cell phones, and specialised assistive devices. Likewise, it is associated to developments in analysing images, particularly the optical character recognition (OCR), rendering the availability of text in voice reconciliation. Here, Google Lens is a fantastic illustration of this, since it can detect and analyse words in an image taken of a road board, for instance. The exact principle pertains to speech-to-text (STT) applications, enabling mobile and seamless textual interaction without the necessity for a keyboard or supplemental program, as was previously the scenario (Matuschek, 2021a).

Nevertheless, the usability, and particularly reliability, is a critical feature that demands much more consideration. Mistaken instruction identification or inability to launch are minor inconveniences for most users, but for a handicapped user who is unable to conduct an urgent call, this could be a serious key barrier or perhaps hazardous. If a speech interface involves a user insert, that a blind individual may not be capable of completing at all in the event of an incident, this is a case of a breach in user interfaces.

Deaf and hearing issues

Auditory technology, notifying technology, and communication assistance system are the three primary categories of ATs for deaf and hearing diseases. *Auditory technology* refers to equipment that increase the sound levels offered to a user but is not intended for persons who are completely deaf. Hearing supplements, assistive listening gadgets, personal sound amplification products (PSAPs), and cochlear implants are among the equipment that fall under this category PSAPs are devices that boost audio volumes while cutting down on ambient noise. The cochlear implant (CI) is a sensor that is surgically inserted and transforms audio into electronic pulses that may be transferred across the acoustic nerve. For deaf infants, CI are indicated with the direct aim of supporting them to learn fundamental oral communicative abilities, with the longer-term intention of improving their interpersonal relationships, academic achievement, and, ultimately, their standard of living.

Notifying technology is a type of equipment that may be used by deaf individuals since it does not demand any retained listening ability. They employ illumination, sensations, or a blend of the two to inform people to an upcoming occasion.

Communication assistance technology, commonly referred as augmentative and alternative communication (AAC), is a collection of technologies aimed at enhancing a handicapped individual's conversation abilities. They are typically divided into two categories: communication channels and person-to-person conversations.

The key prospect of future AT for deaf and hard of hearing people is anticipated to be updated technology that can convert sign terminology into verbal and textual communications and vice versa. The greatest hurdle to be overcome, however, is expected as being the financial expenses and cost-effectiveness of hearing aids.

(Nierling, João Maia, Hennen and Wolbring, 2018b)

Here fore, text-to-speech (TTS) can be utilized to assist those with hearing difficulties. TTS can provide a voiceover to persons who have the cognitive abilities to type. The most well instance is the late Stephen Hawking, who utilised particularly created voice reconciliation program for other to hear him. Such program is currently extensively adopted (Matuschek, 2021b).

Absent or injured limbs

Physical mobility loss makes maximum involvement in intended hobbies burdensome, and in the extreme situation, completely limits involvement. People who have had amputations necessitate a good rehabilitative plan as soon as feasible and, particularly, compensating devices to achieve maximal autonomy. Innovation has the potential to increase movement irrespective of which body part or functionality is affected. Wheelchairs, walking aids, and prostheses limbs are just a few examples of innovations that have helped a lot of people.

Prostheses devices, wheelchairs (electronic, manual, or electronic scooters), and assistive devices are all used to help people move around independently. Canes, crutches, walking canes with connected seats, and rolling walkers with knee support are examples of assistive tools.

Mobility assistive technologies (ATs) are intended to improve individuals' physical function and movement, as well as their accessibility to the outer environment, without affecting the compromised physical form or operation.

As with a cane or walker, assistive technology (AT) can enhance or assist defective body structure or performance, or they can substitute absent or damaged body structure or metabolism, as with a prosthetic limb. In four important technologies, scientists have noticed a tendency toward greater consumer inclusion: motorised wheelchairs, prostheses, functional electrical stimulation, and robotic skeletons.

Traditionally, *motorised wheelchairs* are controlled by a joystick and one or more switches that adjust the functionality regulated by the joystick. Wheelchair mobility, seat inclination, backrest tilt and footrest lift are among these functionalities. Not everyone who may benefit from enhanced movement via the use of a motorized wheelchair has the intellectual and muscular aptitude to manage challenging surroundings with a controller.

The challenges of developing prostheses involve substituting either the neural impulses or receptive neural systems.

Whenever the neural impulses or receptive neural systems are sufficiently restored, effective artificial limb movement can be attained. In Europe, three unique techniques to effectively integrating the consumer and their prostheses have been observed: 1) computer-vision augmented monitor, which enhances both the gadget and the sharable motion control, 2) component nervous software interactions, which enhance the limb fundamentals by program and offers a smarter user experience, and 3) motion analysis-based control, which enhances the limb fundamentals through technology and offers a stronger interaction. The first two techniques focus on prostheses management of the upper extremity, whereas the third focuses solely on the lower extremities.

FES (functional electrical stimulation) is a technique that has a lot of promise for regaining mobility. The duration and dedication necessary to put on the equipment limits its application. Aspects of the technology might be implanted as a treatment. The army, on the other hand, pioneered *robotic skeleton* technology development in the 1960s. Notably, the key feature of an assistive technology is its consumer, which includes acceptability and accessibility, which indicates the AT's success. If a patient finds assistive technology difficult to incorporate or accepts, he or she will discard it.

(Cowan et al., 2012)

This is something that AI should be able to handle effectively. Picture identification technology, for instance, can analyse subtle irregularities in movement and alignment and provide customized workouts, and improvement can be monitored even more precisely, enabling for speedier changes. Fostering boosts morale since the individual undergoing treatment, achieves satisfaction relatively quickly and takes a proactive part in establishing objectives and offering evaluation on what works and what does not (Matuschek, 2021c).

3. Conclusion

Individuals with impairments can benefit from assistive technology in ways that go much above what is now available in healthcare. Doctors are still underestimating AT's potency, and its usefulness as a client aid is being underutilized. Such techniques might be viewed as either a treatment or an asset. There are constraints to how much rehabilitative experts can do to assist injured individuals strengthen their abilities and the circumstances in which they live, and AI offers a great way to get around those constraints. Numerous AI solutions currently available that benefit handicapped individuals, either as consequence of other technology or especially created for them (Cortés, Annicchiarico, Vázquez-Salceda and Urdiales, 2003b).

However, a number of digital technology hurdles remain in the way of AI having a significant influence on this vast and extremely sensitive demographic. To achieve real advancement toward integration, politicians and businesses must pay more attention to disability during equipment creation and, preferably, engage disabled people in the process. This literature review emphasizes the importance of adopting the use of AI-based assistive technologies to help physically impaired people accomplish formerly challenging or unattainable tasks (Matuschek, 2021d).

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