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LIMITATIONS AND ADVANTAGES OF COMPUTER TECHNOLOGY IN COMMUNICATION OF PERSONS WITH IMPAIRED VISION

OGRANIČENJA I PREDNOSTI RAČUNARSKE TEHNOLOGIJE U KOMUNIKACIJI OSOBA OŠTEĆENOG VIDA

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ABSTRACT

Modern society requires a constant keeping up with innovative trends in the field of information literacy and knowledge of new computer technologies. In order for each individual to be fully integrated into social life, to progress in education and to socialize successfully, it is necessary to master the basics of computer literacy. People with visual impairments tend to fit into the educational and social environment with the help of computer technology, but they mostly encounter difficulties due to insufficient knowledge of the individual needs of each individual. It is necessary to ensure accessibility, equal conditions of use for all persons and thus enable them to successfully establish and maintain communication.

Key words: computer technology, advantages, limitations, communication, People with visual impairments

SAŽETAK

Savremeno društvo zahtijeva praćenje inovativnih trendova u području informatičke pismenosti i poznavanja novih računarskih tehnologija. Da bi svaki pojedinac bio potpuno integrisan u društveni život, napredovao u obrazovanju i uspješno se socijalizovao potrebno je da ovlada osnovom računarske pismenosti. Osobe sa oštećenjem vida teže se uklapanju u obrazovnu i socijalnu sredinu pomoću računarske tehnologije, ali uglavnom nailaze na teškoće zbog nedovoljnog poznavanja indiviualnih potreba svakog pojedinca.

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Potrebno je obezbijediti pristupačnost, jednake uslove korištenja za sve osobe i time im omogućiti da uspješno uspostavljaju i održavaju komunikaciju.

Ključne riječi: računarska tehnologija, prednosti, ograničenja, komunikacija, osobe oštećenog vida

THE IMPORTANCE OF COMPUTER TECHNOLOGY FOR THE VISUALLY IMPAIRED

Although there is literature on computer technology and the information needs of blind and partially sighted people in certain settings, for example in universities, very little is known about the information needs for everyday life (Roth, 1989). Technology is embedded in the technical and consumer culture, but for people with disabilities, it is also embedded in the culture of living with certain ideas about disability. This is reflected in the way technology is created only for people with certain abilities (Johnson and Moxon, 1993). Most computer technologies are constructed in accordance with the market, and they are only superficially adapted to blind people (Virkes, 2004). The implementation of information and communication technology, according to user requirements, allows the user to overcome social and infrastructural barriers, which is the basic goal and purpose of assistive technologies (Hersh and Johnson, 2008; William, 2005). Assistive technology, which is available on the market today, enables visually impaired people to be able to use computer technology more than ever before to communicate, access information, and to create written and multimedia materials (D'Andrea, 2010). Although much work has been devoted to helping the blind to use a variety of computer technologies, further research is needed to make it easier for blind users to pursue highly paid and meaningful careers through the use of technology. Computing is potentially attractive as a career choice option because of its rich sound and tactile content, but there is no standardized educational infrastructure to help visually impaired students on the path to success (Stefiki Gellenbeck, 2010). By providing tools and techniques for use, technology contributes to, but also draws from, a knowledge base within which theory and practice are compact and interdependent. It can be said that the technology is a modified, portable problem-solving procedure (Babalola and Haliso, 2011).
Blind and visually impaired people in the community are underrepresented in computing. Students who want to access computer technology must overcome significant technological and educational barriers in order to succeed (Stefik et al., 2011). With the help of technology, people with limited senses can communicate with others whether they speak sign language or read Braille. Experts have presented solutions in the academic and commercial fields, but it is believed that the technology has advanced enough to provide better options than currently available computer technologies and modern software (Ramirez-Garibay et al., 2014). As technology advances day by day, the interaction of man and innovative machines has become necessary in our daily lives (Harsur and Chitra, 2015).

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

Current technology enables efficient distribution and launch of applications on mobile and computer devices, even in cases where computer requirements are more significant and complex.

As a result, computer travel aids, navigation aids, text-to-speech applications, and virtual audio displays that combine sound with haptic channels become integrated into standard devices, enabling a greater degree of interaction and communication.

This trend has opened up a whole range of new perspectives for the rehabilitation and training of people with visual impairments (Csapó et al., 2015). In a world where knowledge and digital inclusion cause a strong IT openness and democratic and social problems, there are situations in companies where the use of technology is necessary for full participation, inclusion and communication. However, some digital divisions in the world of information openness are discriminatory, such as observing the phenomenon of disability. Universal design encourages professionals to shift attention from users to a broader concept, based on reflections on product potentials and their wider application, which would be extremely important for people with disabilities (Gavrilă-Ardelean, 2015).

ADVANTAGES AND DISADVANTAGES OF COMPUTER TECHNOLOGY AND THEIR IMPACT ON THE COMMUNICATION OF PERSONS WITH IMPAIRED VISION

Computers mean much more to visually impaired students than to students with intact vision, because they provide them with the opportunity to independently read professional literature, independently write seminar papers and other written papers. In relation to learning needs, computers mean much more to them for communication by e-mail, communication with peers, professors and other people. In this way, the computer influences the more successful integration of visually impaired students into the school environment (Butorac, 2002). Research was conducted in order to gain understanding of people with visual impairment and their requirements for information technology. Blind and partially sighted people participated in the research to determine their computer and internet experience. This research clearly identified that people with different types of visual impairment have a high level of computer and Internet expertise, but that they have specific barriers, not a lack of willpower, which prevents them from accessing computing and Internet-related technologies. These barriers include issues related to the perception of disability in society, government policy, corporate policy, everyday computer products, assistive technologies, real-time Internet communication, poverty, and lack of educational opportunities. Solving problems in these areas will significantly reduce the impact of the division on visually impaired people and normal sighted people, enabling people who are blind or visually impaired to participate more effectively in the information age (Hollier, 2007).

An increasing number of people are taking advantage of information technology. In blind and partially sighted people, this trend is even more present.

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

There are several reasons for this: computers have advanced and are capable of speech synthesis without additional equipment, they are more affordable to an increasing number of people and make it easier for visually impaired people to integrate into society (Tupek, 2010). It is important to emphasize that despite the progress of information technology, there are many limitations faced by visually impaired people in the desire to freely and independently use innovative computer technologies and thus establish better communication with the environment.

Because web experiences are visual in themselves, the Internet is full of websites, tools, and applications that are virtually unusable by people with visual impairments. For example, it's not uncommon to see websites that use combinations of background and foreground colors, making them virtually unreadable for visually impaired users. Despite all this, people with visual impairments use the web on a daily basis to search, read and write emails, and search for various content on the Internet - in order to communicate with the world (Berners-Lee, 2010). Children with disabilities face extreme disparities and daunting challenges in enjoying academic development, social life, and community participation, socialization, and communication, especially in low-income countries (WHO, 2011).

The advent of computers and speech technology has opened up opportunities for the development of completely new applications that can make the education and life of the blind and visually impaired easier. The world pays a lot of attention to the inclusion of people with disabilities, and as part of that many computer audio games of educational and entertaining character have been developed that help in the process of inclusion in the social environment and establishing communication (Cruz-Cunha et al., 2011). There are a number of accessibility issues that blind people have if they use rich internet applications. These are dynamic principles in which the exchange of information takes place in real time. Due to their higher information density and diversity, providing access to these systems to blind people is difficult because the content is constantly changing (Giraud et al., 2011). Few research studies focus on how the use of assistive technologies affects social interaction among people. Research has shown that certain assistive devices used by people with disabilities are designed so that their functional approach takes precedence over their sense of self-awareness. The research also found that two misperceptions prevailed regarding the perception of the use of assistive technology by visually impaired people: that assistive devices can functionally eliminate disability and that people with disabilities would be helpless without their devices. Such research results provide additional evidence that accessibility should be embedded in conventional communication technologies. When this is not feasible, assistive devices should incorporate the latest technologies and strive to be designed for social acceptability as well as include a new approach to design (Shinohara and Wobbrock, 2011).

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

Children with visual impairments experience various forms of distancing, which can exclude them from the health care system, education and social services and thus limit their participation in the family, community and society. This isolation can have a lasting effect on future employment opportunities and participation in civic life.

Support services and technology can enable children with disabilities to take their place in society and contribute to their family and community (UNICEF, 2013). When considering persons with disabilities in the field of information literacy and technology, this should be done by establishing laws and public policies that seek to ensure their rights.

Although the field of computers plays an important role in this context, enabling the development of technologies that promote greater independence and autonomy of persons with disabilities, many tools and technologies used in this field are still unavailable, making it difficult to engage in computer education programs as well as industry (Luque et al., 2014). Among the various technologies used, computer-based solutions are emerging as one of the most promising options, mainly due to their accessibility and ease of use (Jafri et al., 2014). Advances in computing, and increased use of Smartphones, give technology system designers greater flexibility in using computer vision to support visually impaired users. Understanding the needs of these users will certainly provide insight into the development of improved usability of computer devices and overcoming limitations (Terven et al., 2014). Assistive technology helps visually impaired people by giving them greater independence - allowing them daily activities such as internal and external navigation, detecting obstacles, locating doors and lost objects, better communication, etc. Although various assistive technologies are available to blind people, most of them have a complex design that has been developed for a specific purpose. In addition to all of the above, technology designed in this way is expensive for commercial production (Sivani Darsan, 2016). Blind and partially sighted people face many difficulties in communication because they cannot always notice and react in a timely manner when they are not sure whether the person is talking to them or someone else. Computer-based technologies have advanced so much in this domain that they can improve the communication of blind people, make it easy and efficient (Hashmi et al., 2020). Blind people face a number of challenges in performing daily activities, such as reading product labels, identifying banknotes, exploring unfamiliar spaces, identifying the appearance of objects of interest, interacting with digital artefacts, communicating, managing Smartphones, and selecting non-visual items on screen. The advent of assistive technologies based on Smartphones promotes independence and ease of use, resulting in improved quality of life, but presents several challenging opportunities for the visually impaired (Khani Khusro, 2020).

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

COMPUTER TECHNOLOGIES THAT HELP IN OVERCOMING DIFFICULTIES IN THE COMMUNICATION OF VISUALLY IMPAIRED PERSONS

In the past twenty years, many experts have dealt with the use of computer technology and modern aids in order to facilitate the daily life of people with sensory impairments. In order to inform the general public about the selection of adequate aids, software and available platforms, the authors present many solutions for easier and more efficient communication of people with visual impairments.

Voice portal "Contact" was developed for the PC platform with Dialogic CTI (Computer Telephony Integration) card of Springware technology that performs voice signal processing and communication of the PC platform with the telephone line, thus realizing the telephone part of the portal with Internet Information Server (IIS), with PHP and MySQL that hosts web portals on the Internet (Greenspan and Bulger, 2001). There was a tendency to investigate the importance of knowledge of information and communication technology (ICT) in people with disabilities when establishing employment and communication with employers. Such considerations led to the conclusion that information and communication technology must be considered economically, socially and culturally dependent in order to establish the desired employment relationship (Michailakis, 2001).

The study, which looked at the impact of computer-mediated communication on teamwork, examined 40 teams of 4 people working in a face-to-face environment, compared to teams that communicate with computer systems. The results were consistent with the belief that computer-mediated communication teams have difficulty maintaining mutual knowledge, indicating the importance of direct communication and the shortcomings of computer communication technologies (Thompson and Coovert, 2003). Haptic technology has great potential in many applications. Multimodal interactions in the process of creating and exploring graphs are provided using a low-cost haptic device, a Logitech WingMan Force Feedback mouse, and web audio. The Internet-based tool also provides blind people with the convenience of receiving information at home and facilitates communication with the same profile of professionals (Yu et al., 2003). It is stated, that in the haptic and tactile domain, when it comes to communication via messages using mobile devices and various computer technologies, there is a difference that is somewhat analogous to the auditory domain. To adapt the technology to the visually impaired, the goal is to create incoming message icons to be more focused on the intuitive level and long-term goal of recognizing the written message, in the blind and partially sighted, rather than on the level of auditory text perception (Maclean and Enriquez, 2003a). In their next publication, the same authors present that haptic or short icons are programmed with the role of easy and simple communication in a manner similar to the visual display of messages in intact vision persons, indicating easier use in visually impaired people (Maclean and Enriquez, 2003 b). "Tactons" and "tactile icons" are defined as adequate replacements for classic ic, stating that both forms of icon display ons, on computer communication technology, are structured for the visually impaired and that abstract

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

messages can be used for effective non-visual communication (Brewster and Brown, 2004). Research in this domain has progressed, leading to the design of a vibro-tactile pen and software for creating tactons and semantic sequences of vibro-tactile patterns on mobile devices (iPAQ Pocket PC). Special games have been proposed to facilitate learning, communication, and easier manipulation of these types of tactons. The techniques are based on gesture recognition and spatio-temporal mapping for the presentation of vibro-tactile signals (Evreinov et al., 2004).

Information and communication technology has become an indispensable tool in the fight against poverty in the world. Statistical analyzes show that there is an empirical link between poverty factors and the adoption of online communication in different countries (Kamssui et al., 2004).

Associations of blind and partially sighted people seek to initiate the development of computer games for blind and partially sighted children to facilitate their inclusion (IGDA, 2009). In such ways, it can directly and indirectly influence the creation of a better social climate and communication with peers in an inclusive environment. AudioDoom, a virtual environment that interacts and successfully communicates with blind children through a 3D Audio system, was conceived, designed and tested in practice (Sánchezi Lumbreras, 2009).

Verbal dialogue is required for effective conversation between two people. Most human communication, however, is made up of nonverbal cues such as gestures and facial expressions. Blind people are thus deprived of opportunities to interact. Considering this problem, a computer vision system with algorithms for facial recognition and speech expression was designed to transmit nonverbal messages to a blind user. The device will improve communication and recognize the identities and facial expressions of communication partners (Astler et al., 2011). The advent of touch-based computing devices has brought new and exciting possibilities. They came at the cost of a significant number of new challenges for people with sensory impairments. They are especially visible in the blind population, because these devices lack tactile signs and are extremely visually demanding. Existing solutions resort to screen reading aids to compensate for the lack of vision, but not all information still reaches the blind user, making it directly difficult for him/her to communicate with the environment (Oliveira et al., 2011). Text-to-speech is a modern application that converts text into spoken word, analyzing and processing text using natural language processing, and then using digital signal processing technology to convert this processed text into synthesized spoken text (Isewon et al., 2012). People who are completely blind are absolutely unable to communicate via computer without assistive technologies. To overcome this barrier, they mainly use screen reader software and Braille. The screen reader system speaks all the information, in human voice, that appears on the screen, even the text typed on the keyboard. Braille makes all information appear on the Braille line so that blind people can read with their tactile senses (Singh, 2012).

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

Mobile computer vision is often advocated as a promising technology to support blind people in their daily activities and to interact with the environment (Manduchi, 2012). Based on the 21st detailed interview, it was shown that people with impaired vision and hearing use the Internet mainly to gather information and communicate with friends and family. Meeting new people online has not been a priority need of these people with sensory deficits, although this has been the focus of attention lately (Abeele et al., 2012). The voice assistant makes the Smartphone or tablet very personalized with the help of user settings and his individual language habits.

This technology is still evolving rapidly. Manufacturers are improving mobile assistants to work with multiple national languages. Google is working to recognize children's voices.

Children at different ages have different pronunciation patterns. Intelligent assistants that support visually impaired people when using mobile devices are not solutions limited to mobile technologies; they are also available on personal computers, mainly within web browsers thus directly improving accessibility and interaction (Crossland et al., 2014). Nowadays, computers and the Internet are often used in the preparation, development and practical implementation of English language tests. Many nationally and internationally recognized tests, such as TOEFL, CAE, CPE, APTIS and the like, are already mostly focused on Computer Based Testing (CBT), where the preparation material is in electronic form in the form of an application that allows interaction with the user and greatly facilitates work and saves time (Kovačević, 2014).

Innovative technologies help in the process of learning and striving to communicate in other languages, and this method is especially easy to use for people with visual impairments. For new ways of displaying information during communication, with the use of computer technology, a preview has been created on devices that includes displays with speech or emotional characteristics (such as auditory emoticons and spemoticons), as well as displays used specifically for navigation and warning information (Csapó and Wersenyi, 2014). The function of the intelligent voice assistant is most powerful within the modern technological accessibility for the visually impaired. Google is developing it under the name Google Now, and in iOS it is known as Siri. The personal assistant for the devices used is constructed in natural language for answering questions, giving recommendations and performing actions by transferring requests to special web services (Arati et al., 2015). An analysis of the use and non-use of social media platforms by low-income blind users in rural and suburban India was made. Using an approach of mixed methods, semi-structured interviews, and observations, the benefits that low-income blind people get from Facebook, Twitter, and WhatsApp were examined. Restrictions that hinder their participation in social networks and communication were also examined. The results showed that there are many weaknesses of these social platforms for the communication of blind persons (Vashistha et al., 2015). Research was conducted on motivation, challenges, interaction and experiences with the visual content of blind people on social networking services.

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

An analysis obtained from interviews with 60 individuals with visual impairment was presented. All respondents have little or no functional visual ability. Compared with respondents without visual impairment, blind respondents faced profound accessibility challenges, including the prevalence of photos without sufficient textual descriptions and communication difficulties (Voykinska et al., 2016). In addition to applications that are designed for communication only, there are some models that include software for everyday activities. Using these models, it is possible to discuss current topics with people with intact vision, to lead meaningful and interactive communication.

Colour ID helps with visually shaped colour discrimination in various objects. The colour ID works by recognizing the colours around the user and speaking those colours aloud.

A visually impaired user could use this app when choosing clothes, and many other things and talk about it with sighted people. Smart Braille allows Android users to communicate via a version of Braille. Smart Braille has two main units, one that allows users to write text in Braille, and the other that allows the translation of a text. Talking Tags is designed to help blind users create stickers or labels for everyday objects and thus facilitate communication during everyday life activities (Lewis, 2016). The way for the blind and visually impaired to participate in communication in foreign languages is also made possible by innovative computer technologies. A study was conducted on the accessibility of computer technology for blind and partially sighted people in correlation with the method of use and accessibility of specially designed technology, for this type of sensory impairment. Participants rated special applications as useful (95.4%) and available with tools for the visually impaired (91.1%). More than 90% of the middle-aged adult group agree with the claim about the practicality of special applications, which is a significantly higher percentage than the one observed in the younger and older adult group. In addition, visually impaired respondents find that special applications are less accessible to them than those designed for completely blind people (Griffin-Shirley et al., 2017). One of the innovations is a replacement device for the visually impaired, designed using computer vision. Its main goal is to provide users with a 3D view of the environment around them, transmitted by auditory and tactile senses. One of the biggest challenges for this system is to ensure permeation, i.e. to be usable in any indoor or outdoor environment and in any lighting conditions. This type of device will make people safer and give them the opportunity to interact with the environment (Caraiman et al., 2017).

Advances in technology enable people with visual impairments to access many public institutions in order to acquire knowledge and obtain information, communicate with other people and share experiences. Since the middle of the 20th century, libraries have drastically transformed from old book and magazine repositories into powerful centres for knowledge and information. Information and communication technology, which is responsible for this revolution, has drastically changed the organization, management and functioning of modern libraries. Modern libraries are increasingly changing into places where unlimited information can be accessed in many formats, from a large number of sources.

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

In addition to providing materials, they also provide the services of librarians, who are experts in finding and organizing information and interpreting the necessary information (Anis, 2017). Blind and partially sighted people can use computers on their own with the help of special programs. Computers have become a medium through which the blind and visually impaired can independently read, write and use all available literature in digital form, thereby enhancing communication skills. It is necessary to put emphasis on the communication of persons who, in addition to visual impairment, also have other sensory impairments.

Researching in that direction, the experts presented a smart tactile-sensory glove based on movements that people with impaired vision and hearing use for communication and learning.

It is based on the concept of Braille and supports face-to-face communication as well as long-distance communication. The device consists of a smart glove worn on both hands, with a contact on the thumb, middle finger and index finger, and it communicates with mobile devices using Bluetooth technology. Six tactile sensors were used, and one pair embedded in a glove on the thumb, middle finger, and forefinger, on both hands, and represents six cells of the Braille code. The user wears a smart glove and enters by touch the desired combination on the fingers that correspond to Braille. This technology serves efficiently and easily to send messages to mobile devices or other gloves. Messages can equally be received with a glove from a mobile device in the form of vibrations on the fingers corresponding to Braille codes (Ozioko et al., 2017). Visually impaired people are neglected due to many modern procedures of communication and interaction. Assistive technologies such as text-to-speech and Braille displays are the most commonly used means of connecting visually impaired people to mobile phones and other smart devices. Both of these solutions face usability problems, so the development of an easy-to-wear solution called “Braille” with haptic technology is being considered, while maintaining affordability. "BrailleBand", i.e. Braille tape, allows passive reading in Braille. The connection between the BrailleBand and the Smartphone (phone) is established using the Bluetooth protocol. It consists of six nodes in three strips that are worn on the hand and serve to map the Braille alphabet, and which are activated to give a sense of touch that corresponds to the characters. Three mobile applications have been developed to train the visually impaired and to integrate existing smart mobile applications such as navigation and short message service (SMS) with the BrailleBand device to facilitate communication of the blind and visually impaired (Savindu et al., 2017). Furthermore, automatic alt-text (AAT) was designed and implemented, a system that applies computer vision technology to recognize faces, objects and themes in photographs as well as to generate photo-alt text. This system is specially designed for users of screen readers on Facebook, they help in communication of visually impaired people in reviewing information on social networks and facilitated communication with the environment (Wu et al., 2017). The most common way to establish communication that is adapted for visually impaired users, in case they use the Internet, is a browser and a screen reader (also known as text-to-

Research in Education and Rehabilitation 2021; 4(2): 93-108. DOI 10.51558/2744-1555.2021.4.2.93

speech software). Some of the most commonly used screen readers are Microsoft Narrator for Windows users and VoiceOver for Mac users (Ratcliff, 2018).
In an effort to examine whether digital technology can cause addiction and difficulties in use for people with disabilities, Masliković and Krstić (2018) conducted research on this topic. The results of the research showed that there is no risk for people with disabilities to develop addiction to the use of digital technology, but also that people with disabilities have difficulties in using digital technology.
The future development of digital technologies should be in the function of removing barriers in the application by people with disabilities, which would affect the improvement of their position in society (Masliković and Krstić, 2018).

CONCLUSION

People with visual impairments should have equal opportunities and full accessibility in the use of computer technology in order to acquire information literacy. The educational process, professional guidance, but also everyday life skills and basic human needs, such as communication, can be facilitated by designing technology tailored to the user. As science advances, innovative technologies and simple solutions are patented to make it easier to overcome the obstacles that visually impaired people encounter when using computer technology to establish communication with the environment. People should be trained to use technology and, according to their own needs, actively use it in order to remove barriers to communication. Affordable prices, universal design, adaptation to specific difficulties are among the basic needs that could ensure full access to computer communication technologies, which further leads to greater accessibility to public institutions, the ability to use the latest software on Smartphones and personalized computers. The outcome of research on this topic should be reflected in new software and applications that will be fully adapted to the specifics of sensory deficit in people with visual impairment and represent a compensatory mechanism for establishing effective communication with the environment.

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