AI-Powered Assistive Technologies for People with Disabilities: Developing AI solutions that aid individuals with various disabilities in daily tasks

Abstract
In this paper, the viewpoints of people with disabilities are also examined, focusing on the positive impact that modern innovations based on artificial intelligence will have on these people's lives. Currently, more than one billion people worldwide have a disability, and AI offers an opportunity in the areas of mobility, communication and cognitive functions. Mobility assistive technologies with AI, like innovative wheelchairs and exoskeletons, enhance users' independence by providing adaptive self-driven support and control. In interaction, speech recognition and text-to-speech technologies help the physically disabled interact with others. Cognitive support technologies are applications that assist users with memory problems, autism, or learning disabilities and serve to manage activities and train cognition. The paper also identifies major technologies that underpin these innovations, such as Natural Language Processing, Computer Vision and Machine Learning. However, there has not been a total eradication of the challenges associated with using AI, including but not limited to massive costs, data privacy acts, and biased AI models. Other ethical factors should be considered to make access fair for all. The future of AI-enabled assistive technologies is with Smart Cities & IoT: Embracing social connectedness and improving health and well-being. Efforts by policymakers, technologists, and society are needed to develop solutions that are open, cheap, and user-centered.

Keywords: AI-Powered Assistive Technologies, Disability Inclusion, Mobility Aids, Communication Devices, Cognitive Support Tools, Natural Language Processing (NLP), Machine Learning (ML), Smart Wheelchairs, Data Privacy and Security, Social Inclusion.

Introduction

Multiple barriers define the experiences of disabled employees, and they encounter disability-related issues with accomplishing myriad tasks that other individuals assume are simple. People with mobility impairment may need help going about the community, doing chores around the house, or even going from one room to another. Persons with visual or hearing impairment may struggle with social relationships, information access, or mobility. People with cognitive impairments have problems understanding instructions or recalling chores, schedules, or words. The WHO estimates that currently, over one billion persons – about 15% of the world's population – have some form of disability and that this will increase the consequence of population ageing. Disabilities limit an individual's-individual's individual's ability to live independently, interact with others, and even engage in fruitful activities such as learning and earning a living, as well as engagement in activities due to various barriers.However, technology has recently become a solid weapon for combating such barriers. The development of information technology, especially the introduction of new subjects such as artificial intelligence, has new opportunities for individuals with disabilities. For instance, AI-based mobility, communication, and cognitive assistive technology are rapidly revolutionizing the lives of disabled individuals to enable them to deal with their environment in new ways. Not only do these assistive technologies enhance access, but they ALSO enable people to take more control of their lives and daily existences in ways that those of us with able bodies once believed to be simply pipe dreams. Disability is a compelling area where the application of technology to increase the prospects of millions for a more vibrant, more connected life is taking shape.

This article focuses on the opportunities that AI technologies offer people with disabilities, discussing how mobile AI applications are changing the world regarding mobility, communication, and AISmartChair. This unique AI home automation system improves the quality of life for disabled individuals. The goal is a brief description of the various functions that can help a person with a disability and their increased integration into society. Born with impaired mobility, intelligent wheelchairs, or someone who needs help to talk, speech recognition tools: AI is at the cutting edge of including people with disabilities. Therefore, these technologies remove physical and social barriers, leading to enhanced quality of life as the technologies being offered suit individual needs.As AI enhances, assistive technologies are developed and designed to improve and meet various specific needs of persons with diversified types of disability. Health-care-relevant AI technologies like speech recognition, computer vision, and robotic assistance are developed to meet diverse requirements like mobility disorders, actual or perceived communication problems, or cognitive disability. Through the improvement of the capabilities of traditional assistive devices, AI is creating new opportunities for people with disabilities to have an independent, safe, and active life and be able to engage in activities that otherwise would be very difficult or not feasible at all. Such innovations can enhance users' status and independence in all activities, enabling them to lead fulfilling lives.

Understanding Disability and the Need for Assistive Technology

Defining Disability

Disability can be defined as any physical or mental impairment that limits one's ability to effectively accomplish some of the most critical functions in one's life or perform the tasks most people with no disability do. Different categories of disability have different implications for one's daily life. These can be categorized into mobility, Visual and Auditory, cognitive and physically disabled, and many more.

- **Mobility Disabilities:**These involve impairing an individual's strength or coordination to transport or undertake bodily tasks. They can be caused by paralysis, amputations, or neurological disorders like multiple sclerosis. Mobility impairment entails issues

in mobility. To most individuals, joint exercises may prove to be a Herculean task. These included walking, climbing the stairs, or standing for a number of hours (Nyati, 2018).

- **Visual Disabilities:** There are partial-sighted and blind cases of impairment, although they are both called blindness. These disabilities can be due to ageing, macular degeneration, congenital anomalies, or injuries. Visually impaired persons encounter difficulties in performing activities mainly using vision, for example, sight reading, walking around, and identifying persons or objects.
- **Auditory Disabilities:** Specifically, the LDs include auditory impairments that manifest themselves as varied hearing loss, ranging from mild to complete loss of hearing. People with auditory impairment may have difficulties communicating, following instructions via oral communication, or even learning about necessary 'signals' in the environment, like bells or horns (Baldwin, 2012). All these conditions are usually made worse in areas with excess background noise or those characterized by low-light conditions.

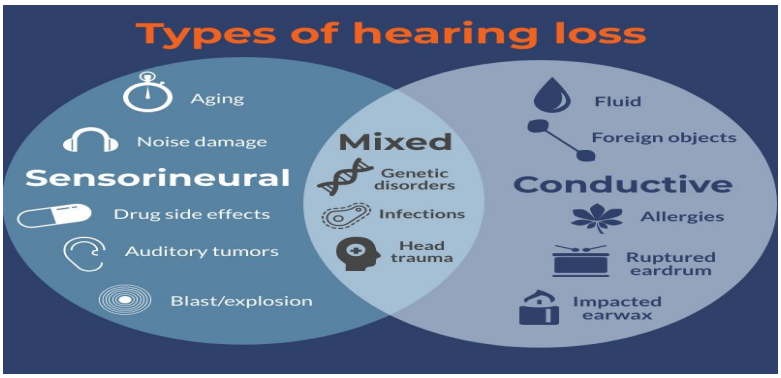

Figure 1: Hearing loss types - Learn about sensorineural, conductive and mixed

- **Cognitive Disabilities:** Learning disabilities denote impairments that capture a person's capacity to learn, think, reason, and remember. These include learning disorders, Asperger's, Livingstone, dyslexia, ADHD, and memory loss issues like Alzheimer's. Learning disabilities cause a great deal of cognitive disability that may affect a person's understanding and retention of information, judgment and even his ability to plan his day.

The daily life of people with disabilities is not without difficulties, and these difficulties are many-faceted. For example, people with impaired mobility are restricted to the kind of space they can freely explore due to poor barrier-free architectural designs. Persons with visual impairment have problems reading—printed material, moving around unknown places or performing intricate work. Thus, the estimated population with impaired hearing may suffer from communication limitations when no sign language or written text can be provided (Kyle et al, 1988). However, people with cognitive impairments may find it challenging to plan for their activities, remember activities or follow detailed instructions. Such barriers may result in a lack of independence and restricted participation in personal and social activities, giving up and being entirely dependent.

Assistive Technology Overview

Assistive technologies are any devices, products, or systems used to enhance the working capacity or improve the quality of life of a disabled person. These technologies help people improve their performance, giving them more independence, productivity, and quality. Technologies for disabled people can be classified as mobility aids, communication aids, computers, and intelligent assistive technology.

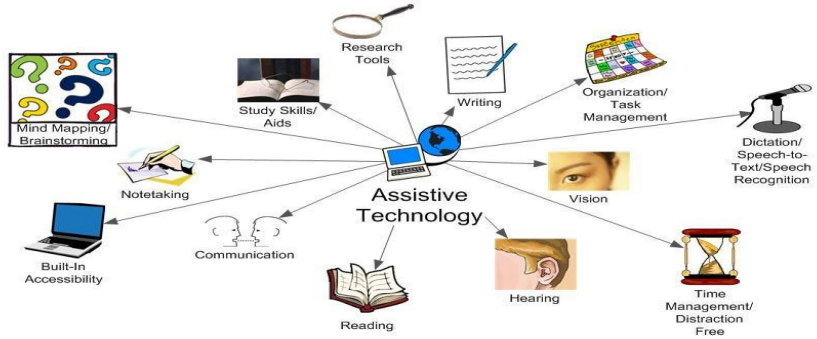

Figure 2: Evolution Of Assistive Technology

- **Mobility Aids:** Some items, such as wheelchairs, scooters, walkers, and prosthetic limbs, aid the mobility-impaired in their daily activities. For example, robotic exoskeletons are more sophisticated mobility devices whose roles include walking, standing and

working. For mobility aids, AI has an indispensable role; the new technologies include self-driving wheelchairs and prosthetic limbs that are adjustable according to a user's requirements (Nyati, 2018).

- **Communication Devices:** They help people with hearing or speaking disorders to speak to others more fluently. Voice output communication aids/communication aids for speech disorders include speech-generating devices and augmentative and alternative communication systems. Speech-to-text real-time translation and voice-activated personal assistants are other examples of AI that help people be more independent in interacting with others in different contexts.
- **Cognitive Support Tools:** Learning disabilities impact time, memory and ability to comprehend intricate information or directions. Some of the technologies in this category include memory and attention apps, devices and software, decision-making apps, devices, and software. Self-organizing and IT-enhanced cognitive aids can provide timely promptings, suggestions, customized approaches, and everything for the person with cognitive impairment to lead an independent life.

Assistive technologies' development process has experienced a transition from mechanical tools to digital and AI solutions (Mann, 2005). The first technologies for people with disabilities were generally straightforward and mainly activated basic needs: talking books for blind people or pulling wheelchairs for the mobility impaired. That notwithstanding, progress in the field of Artificial Intelligence, Machine learning, and sensor technologies has kept improving, resulting in the development of enhanced devices capable of using feedback mechanisms to determine the ever-changing needs of users at given points in time. AI has improved these technologies through personalization; these technologies can learn from the user's behaviours and preferences. For instance, in the prosthetics application area, it is now possible through AI models to adjust the prosthetic movements by the speed at which a person is walking or the nature of the surface they are walking on; in the application area for visually impaired persons, AI models can now identify objects or read text aloud, making the persons more independent.

The use of AI in Assistive Technologies

There are countless numbers of people with disabilities who have had their lives enriched since the incorporation of AI into assistive technologies. Intelligent technologies such as smart mobility, brilliant communication, innovative thinking aids, cognitive aids, and intelligent visualization have been brought about by Artificial intelligence. They help people with disabilities to get around with greater freedom and in a much more effective manner. This section explores how AI improves assistive technologies across these critical areas: walking devices, communication equipment, thinking-helping devices, and print media for blind people.

AI in Mobility Aids

The invention of AI has revolutionized mobility aids, including smart wheelchairs, human exoskeletons, and prosthetics. For example, intelligent wheelchairs integrate one into their interaction and operation to improve navigation and overall user satisfaction. These wheelchairs can adjust themselves in real-time to detect obstacles, and such adjustment comes in the form of sensors and algorithms. AI enables the wheelchair to familiarize itself with its surroundings to manoeuvre through narrow spaces or change terrain independently. Also, intelligent wheelchairs can be connected to other technologies, known as smart devices, like the phone or voice control, which makes control more accessible for the user.Powered by AI, exoskeletons provide vital support to those who lose the ability to move and allow them to walk again (Sharkey & Sharkey, 2012). These walking and moving robotic systems are intended to assist users with arm and leg support. Intelligrated exoskeletons make users' movement patterns learn, making it easier for human beings to walk by making adjustments that make it easier for people to move around. AI allows exoskeletons to be adjusted for the person's requirements, and the outcome is much better than when using one-size-fits-all.

Figure 3: AI In The Mobility Equipment Industry

Artificial limbs have also made significant progress with the aid of AI. Current developments in artificial limbs as prosthetics contain artificial intelligence that the user can study. For instance, AI in prosthetic legs allows the knee and ankle assist to be adjusted

in real-time, making the user feel normal while walking. Likewise, artificial intelligence in prosthetic hands can train how the user services objects and adapt its grip power and flexibility, as per statistics. These AI prosthetic limbs are changing the lives of many people with limb loss by providing a realistic and functional use.

AI in Communication Tools

Facilitating Computers has enhanced information delivery to and from persons with speech or hearing impairments. One of the most evident fields of application of AI in communication tools is speech recognition software. Real-time automatic speech recognition is the technology on which AI-based speech recognition systems are built to convert spoken language to text. Augmented communication is one form of this technology in which a person with a speech impediment can type their message or use an ACS. For example, smartphone applications such as Google Live Transcribe translate speech in real-time to help those affected by hearing loss follow conversations (Gill, 2018). They can also communicate with smartphones and smart devices through different channels.Another critical area of the utilization of AI in communication tools is the translation and sign language translation in real-time. Smart devices today can listen to what people speak and respond by producing sign language and vice versa. That kind of technology helps people who are deaf or hard of hearing and those they interact with, enhancing communication between people with disabilities and the able. AI systems change appreciable hand movements into mechanically deciphered messages and consequently integrate computer vision and machine learning algorithms into sign language and interactively convey it to standard language users. These devices can be helpful in everyday community use, occupational settings, when dealing with service or health care providers, or while socializing.

Text speaking and speaking to writing technologies that use artificial intelligence greatly help the hearing and visually impaired person (Freitas &Kouroupetroglou, 2008). In text-to-process technology, the written text is converted into spoken words to make it easier for visually impaired persons to read articles. This technology has applications in helping people with vision problems to navigate their way through multimedia and computer applications such as screen readers. In contrast, speech recognition technology is helpful to people with hearing impairments because it writes down spoken words. These technologies have helped those with some form of disability communicate with the world, especially with books, the internet, and people.

AI for Cognitive Assistance

AI's technical possibilities for learners with cognitive disabilities include applications and tools to support memory, task completion, and learning. Learning disabilities or disorders and other related diseases like dementia, Alzheimer's disease, or even autism limit the client's capability in carrying out tasks or remembering things. AI-based applications now address the opportunities related to these challenges. For example, some apps use AI algorithms to remind users to do everyday tasks such as taking medicine, making appointments, or doing chores (Kumar, 2019). These tools can adapt to this over time and be able to remind the individual of their schedule.Besides memory and task management, AI has also helped persons with autism and deficit hyperactivity disorder. Special AI learning applications have been created to address their needs, providing content selected to assist these learners in concentrating, learning new information, and acquiring valuable life skills. These tools rely on machine learning algorithms and try to monitor the users' activities in the application, recognize that they are learning slowly, and adapt their materials to accommodate the users' needs better. With such development, AI technologies like these are enabling applicants with cognitive disabilities to be optimally utilized as they receive their education, work, or as they go about their day-to-day business (Mintz et al, 2012).

AI and Visual Impairments

Some outstanding achievements in introducing AI assistance for people with Visual impairments include way-finding and reading. Computerized guided systems for the blind or partially sighted allow people with disabilities to move around freely without risks. Most of these tools employ a blend of sensors, machine learning, and computer vision to identify barriers and offer feedback to the end user in real-time. For instance, when out walking, an audio-based navigation device that comprises artificial intelligence can direct a blind person around the pavement, around obstacles, to the store, or the nearest public lavatory. AI can also assist the user in identifying other changes in his or her surroundings, including curbs or steps, which are very important in movements.Taking vision impairments, one of the most revolutionary advancements in AI is the AI-enabled reading solutions that use OCR. The aloud function is a technology where the OCR takes a snapshot of text from books, signs, documents, and other print media and reads it aloud to the user (Kumar, et al, 2011). With the help of this technology, the orally impaired can easily access printed items, including books, newspapers, or even menu lists in certain restaurants. The use of OCR technology to read text helps to increase the level of independence of a person with visual impairment and the ability to obtain various information from the surrounding world. In addition, there is continuity in the applications of AI to improve the efficiency and accuracy of these reading tools. For instance, AI algorithms can recognize handwritten texts and other difficult fonts, text from which the document is to be read, and so on. These advancements ensure constant improvement in AI-based reading tools, thus making users with visual impairment more independent.

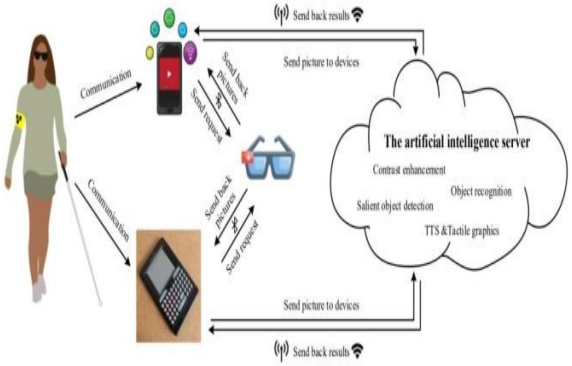

Figure 4: Artificial intelligence for visually impaired

Key AI Technologies Behind Assistive Devices

Advanced technologies, especially AI solutions, are central to creating solutions for people with disabilities. These technologies enhance independence in daily life and assist fort in many daily activities. Some emerging enabling techs disrupt assistive devices, including Natural Language Processing (NLP), Computer Vision, Machine Learning (ML), and Robotics. This section reveals the workings of such technologies and how they are used in instruments used by disabled persons.

Natural Language Processing (NLP)

NLP is the technique by which a computer can read and understand human language and respond as a human would. NLP is important in assistive devices targeting those with disabilities, especially in communication, as it facilitates the interface between humans and technologies (Al-Mubaid& Chen, 2008). Thus, for people with disabilities, NLP can be applied in speech-to-text chatbots and Vin voice assistant applications.Such technologies as speech narration have plenty of advantages for people with speech disorders and are based on NLP. Some available messages can be delivered verbally, and the system then translates the user's username's words into text. It will be particularly relevant to those having cerebral palsy, stroke, or other speech-language impairments. Likewise, voice assistants like Amazon Alexa and Apple's Siri use NLP when interpreting spoken instructions, such as setting reminders, making calls, or managing smart home devices. These assistants have become precious instruments for the impaired, allowing people mobility to control their surrounding environment and help with their daily routines.Chatbots, the other critical application of NLP, are quickly evolving to assist persons with disability better. They can mimic human interpersonal communication and give on-the-spot answers to all the queries concerning health, accessibility, and individual requirements. NLP associated with chatbots can help those with memory or thinking issues or just trying to accomplish something too complicated by explaining the whole process concisely, clearly, and with examples. These technologies support interaction for people with speech difficulties, allowing them to communicate as individuals needing technical support and not as people with disabilities.

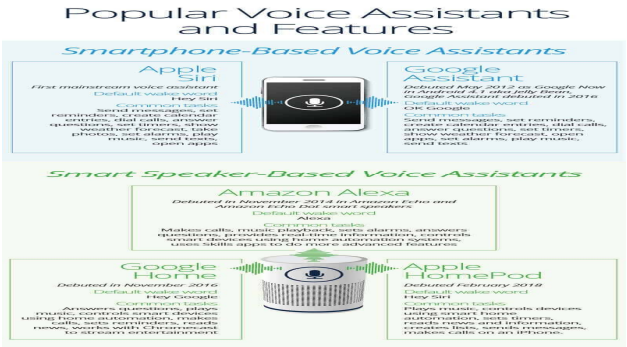

Figure 5: How Voice Assistants Are Changing Our Lives

Computer Vision

Computer Vision, a subfield of AI that teaches computers to analyze and understand videos and images, has found advantages for assistive tools, especially for blind people (Kayalvizhi et al, 2013). This technology enables devices to identify objects, manoeuvre physically within settings, and interpret settings inaccessible in previous technology.Real-time navigation and object recognition may be helpful for blind individuals or those with deficient vision. For instance, experts have smart glasses controlled by artificial intelligence, which assist the visually impaired in their movement. Such gadgets incorporate computer vision to detect objects in their path, signs, and faces and can narrate to their users to make them navigate their surroundings. This increases independence as people can self-maneuver in specific environments or locations without necessitating caregivers or other assistive devices.Other areas include computer vision in object recognition, where the system can detect objects in the environment and describe them to the operator in audio form. For instance, Aira and Be My Eyes are apps wherein a visually impaired user's camera feeds are streamed to sighted humans or AI systems, who can assist in labelling, identifying forms and landmarks, or even searching for an object in the home. The improved capability of this system makes daily life better as it tackles navigation, object recognition, and even social activities for

persons with visual impairment.Besides mobility, computer vision can have different uses, including scene understanding. With the help of AI, moving objects can also map a scene with essential features for a subject, including crosswalk signals, stairs, and potential obstacles. Through feedback, the preceding technologies enable users to avoid such conditions and, therefore, enhance the safety and confidence of the visually impaired.

Machine Learning (ML) and Personalization

ML is a branch of AI that concentrates on creating algorithms by which systems can learn from and from data to make predictions. In assistive technologies, ML is critical in making experiences unique to the user while performing challenging tasks for one with a disability. Learning from humans enables the aids to identify the needs and specific requirements of the specific user, thus making the specific aid much more efficient.Two typical ML uses in assistive technologies are individual proposals and forecasted actions. For instance, in supporting cognition devices, it is possible that ML can continuously acquire the user's behaviour patterns and incongruities (Abdulkareem et al, 2019). This makes it possible for the system to recommend reminders, tasks, or other interventions in a format that best suits the needs of the user case of people with cognitive disabilities like Alzheimer's disease or autism spectrum disorder. The ML solutions that may assist the device in responding to particular actions give more precise results if the device adapts to the user's routine.Drone services also use mobility through AI, which in wheelchairs can enhance movement by using ML to recognize the environment. The wheelchair can memorize the user's preferred everyday routines or the kinds of barriers that can be expected to adjust its movement. This kind of navigation increases autonomy since it relieves users of high decision-making demands, where they must concentrate on manipulating devices.Further, due to the system's self-learning, the effectiveness of assistive systems' self-learning enhancers is enhanced. For example, AI hearing aids apply ML to amplificatiouser's databases depending on external conditions and clients' preferences. Initially, these devices are programmed to afford the user better sound quality in a complex acoustic environment and improve communication; these devices also learn the user's hearing ability and thus enhance the desired result as time progresses.

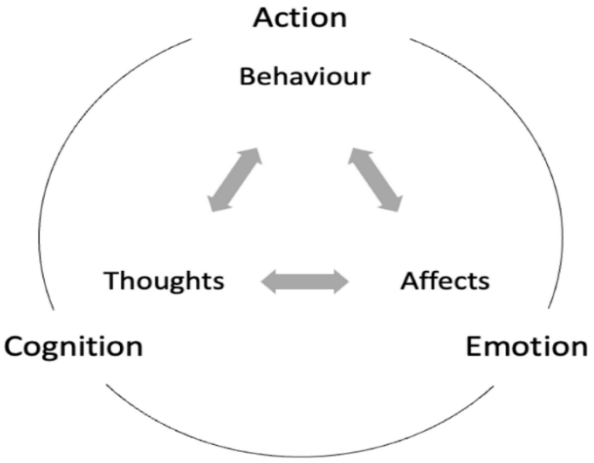

Figure 6: Machine learning for cognitive behavioral analysis

Robotics

Integrated with Artificial Intelligence, Robotic Assistants have begun revolutionizing disability-related physical assistance, locomotive aid, and neuropsychological development. Robots are employed in different situations, including physically helping in various everyday tasks, being friends, and therapeutic tools.In the area of physical rehabilitation, these robots are fabricated to support individuals with motor disabilities in the ability to perform exercises and movement skills. For instance, AI is utilized on exoskeletons to help paralyzed people stand, walk, or move more quickly (Jacob et al, 2021) These robotic devices collaborate with the user's movements and employ AI algorithms to update the assistance they give to the user's progress. In extension, robotic arms and legs are equally employed in rehabilitation using artificial intelligence, where muscle loss is achieved to enable muscle contractions and regain the strength of an individual with restricted movement.Unfortunately, AI-powered robotic assistants are also being proposed for cognitive therapy. In diseases like dementia or cerebral trauma, loved ones can use robots for memory games, communication, and therapy. These robots incorporate artificial intelligence in talking to users, informing them when to do something, or even providing comfort. Some social companion robots can determine a change in mood or behaviours and act appropriately, enhancing both rational and emotional health, for instance, using robots in eldercare.However, companion robots powered by artificial intelligence are being used to cure persons with disability-related diseases such as loneliness. These robots mimic social action and interaction and can act as social partners and therapy robots. Sometimes, they can also help with cleaning, giving medication, and transporting, which raises the independence of those with disabilities a notch.

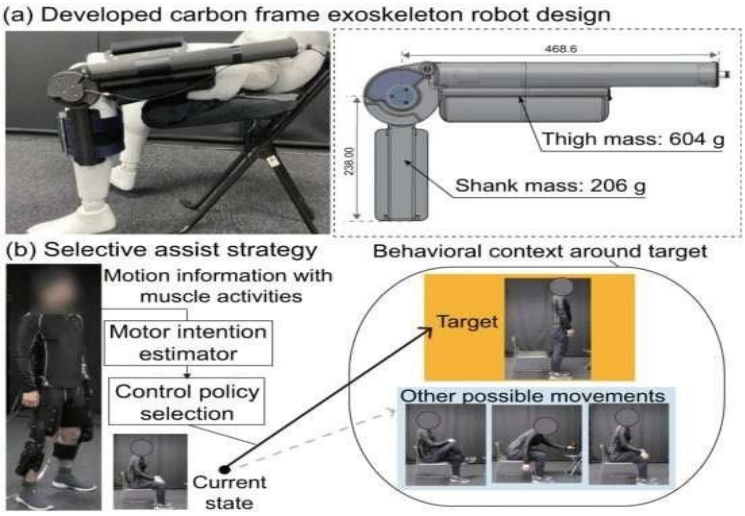

Figure 7: AI-enabled exoskeleton aids users with mobility impairments

Real-World Applications and Case Studies

Smart Wheelchairs and AI-Mobility Aids

Mobility applications integrating advanced artificial intelligence, popularly known as the intelligent wheelchair, have dramatically improved the living standards of mobility-impaired disabled individuals (Alahmari& Noor, 2020). An excellent example is Whill, a start-up firm focused on smart mobility gadgets enriched with AI and advanced technology. Smart wheelchair by Whill is aimed at users using the latest technologies such as sensors, GPS, and obstacle detectability for easy navigation. The algorithms on the wheelchair can digest its environment and respond to changes in the terrain to make navigation easier and safer for the user. Thanks to movable and adjustable parameters and compatibility with other innovative products, Whill enhances the possibilities for users to stay more independent in different scenarios of everyday life, including shopping malls, sidewalks, and residences.Another innovative example is Rollbot – a robotic movement assistance device that helps its user with movement and navigation. Rollbot incorporates artificial intelligence and also machine learning to be in a position to learn the client's habits and course through time. Moreover, thanks to the enhanced sensors, Rollbot can avoid an object, choose paths, pivot to implement them, and manoeuvre through narrow corridors. This device provides both independence and simplicity – a person with mobility difficulties can cover more distance, and a caregiver is not as essential.These enhancements in wheelchairs, scooters, and exoskeletons powered with artificial intelligence are not only enhancing the autonomy of people with mobility disabilities, but also enhance their social participation by ensuring they can participate in activities and live their whole lives.

AI Communication Devices

AI has also benefited people with speech or hearing problems and greatly improved social communication. For example, Google's Live Transcribe app uses artificial intelligence to translate spoken words instantly. In essence, this application is beneficial for people who are deaf or hard of hearing people because it will translate spoken words into written ones immediately, making communication easy with other people. Live Transcribe is based upon speech recognition and natural language processing to transcribe spoken words into text in actual time because it is versatile for loud sounds. The app is downloadable for smartphones. Thus, it is easily accessible to individuals at social events like business meetings or casual conversations.The second type of AIP communication innovation is Text-to-Speech (TTS) products. They are used to translate written text into voice and thus make facially or physically impaired individuals more expressive. For example, Speechify – this application can read any written text in a natural voice, permitting users to read books, documents, and Web pages. Cerebral palsy, autism, or ALS (Amyotrophic Lateral Sclerosis) patients, in particular, will find this helpful tool since they may be able to think and write coherently and intelligently but cannot speak fluently. Consequently, advanced TTS systems based on AI can give different voices and even languages that open opportunities for improving communication and inclusiveness (Danielescu et al, 2023).Many cases exist where individuals received AI communication that significantly changed their lives.. For example, John, a young man aged 25 years with a severe speech disability resulting from Cerebral Palsy, speaks with the help of a Speech Generating Device together with the assistance of Intelligent Software. The specific device of predictive text and voice synthesis helps him interact in conversations and share his ideas more freely. John had difficulties with verbal communication before using AI tools. However, now he can communicate better with friends, families, and co-workers, and as a result, the man has a broader social life.

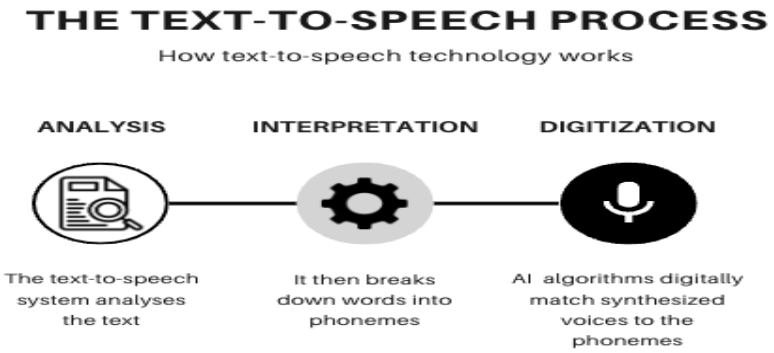

Figure 8: The Text-To-Speech Process

AI Powered Prosthetics and Exoskeletons

AI makes a difference where prosthetics are involved, making it possible to design and create sophisticated and flexible prosthetic limbs or parts that move like natural limbs and can even follow the user's intended action. A company specializing in prosthetics, Ottobock, developed the C-Leg, a prosthetic leg that uses artificial intelligence to manage new walking situations. The C-Leg actively captures ongoing movement information from the user and swiftly uses machine learning algorithms to adapt the knee and ankle to enhance the walking pattern (Anil Kumar, 2021). This makes it easier for the user to move in an area with an inclined plane, such as stairs or slopes, with lesser forces exerted by the user in ways he feels comfortable.Another example is Ekso Bionics, which manufactures an exoskeleton suit that helps people with paralyzed spine or other mobility disorders. The EksoGT is an example of an AI-applied robotic exoskeleton that helps users stand, walk, and ascend and descend stairs. Ekso Bionics also employs AI in gait and balance, allowing patients paralyzed through a spinal cord injury to walk. As for people with such disabilities as spinal cord injury that leads to paralysis from the waist down, the EksoGT is genuinely a significant advancement, providing for the possibility of regaining some of the essential human functions that were thought to be unachievable before. Walking in the exoskeleton is adjusted according to the user's activity, and the movement is personalized depending on the need for and purpose of theuser's actions.Progress in artificial intelligence technology for prosthetics and exoskeletons enables enhanced movement and provides the joy of returning to social interactions that humans may have felt lost forever. Surgeries that provide opportunities to sit, raise a limb, stabilize, and be mobile again create some dignity and power back into the lives of such technologically dependent individuals (Ham & Cotton, 2013).

Figure 9: C-Brace: Computer-controlled leg orthosis From Ottobock

Cognitive Assistance AI Solutions

AI is also seen to be instrumental in enhancing cognitive ability and as a tool for enabling people with cognitive impairment. Cogito is one of the AI-driven applications developed to assist a person with ADHD, autism, or memory issues in planning and focusing. Cogito then uses machine learning to pattern user behaviours to suggest the best time to work, which tasks to work on, and what to focus on. By introducing AI into their system, Cogito can show restored results and some tips to accomplish chores, thus assisting those who struggle with cognitive impairments in creating a schedule for their functioning and enhancing

effectiveness.Another AI-based approach is a cognitive training application called BrainStim, which uses AI to deliver cognitive exercises for differently abled people, including the learning disabled, those experiencing memory loss, or patients with developmental disorders. BrainStim relies on algorithms for the cognitive proficiency of a user and adjusts exercises according to the identified proficiency level so the training remains stimulating and realistic (Machado et al, 2010). The platform consists of games and exercises to strengthen memory, attention, and thinking.

Successful examples from the real world show the extent of the positive change that such AI tools provide. For instance, a teenage high school student who has attention-deficit/hyperactivity disorder (ADHD) has received a significant boost in productivity from an application known as Helping Hands, one of the emerging AI apps for helping people with focus. Thanks to reminders about essential tasks, prioritizing the tasks, and timely support with learning how to avoid distractions when doing tasks independently, the latter has become beneficial for Sarah and has increased her academic performance, apart from decreasing stress. The specific features of the application enable the woman to address the difficulties connected with ADHD in a most personal way (Young, 2015).All these cognitive assistance solutions, backed by artificial intelligence, hold immense possibilities to positively impact people's lives with cognitive impairment. In other ways, specifically, the implementation of AI technologies is helping to improve the lives of people with a learning disability by assisting with task mastery, time management, and learning.

Challenges and Ethical Considerations

Technological Limitations

In the following, the authors outline several technological challenges intrinsic to AI-powered assistive technologies that can jeopardize their impact and applicability: A significant challenge likely to discourage innovation is accuracy. Most AI systems cannot produce 100 per cent results, especially in perceiving and understanding simple and complicated actions of people. For instance, speech recognition-based AI software may not work well when translating certain accents or dialects, leading to communication barriers for such users. Likewise, the autonomous mobirecognition-based struggle with unfamiliar environments or constantly evolving environments results in the mobility aid not helping users with mobility impairments.The other primary constraint is cost: Introducing IT systems into health care delivery and disability support services may entail high capital investment in developing the technologies (Chaudhry, et al, 2006). Therefore, it is common practice for these highly sophisticated tools to be made available at reasonably steep costs to users, most of whom need them. Smart wheelchairs and AI prosthetics are expensive and thus unable to be afforded by low-income earners or families; instead, these gadgets could improve independence.Another issue is access to AI assistive devices. The challenges range from deploying AI assistive devices to public perceptions about their use. Some AI applications can only work with additional hardware like a computer or internet connection and can be impractical in areas with little advanced technology. Further, there are some disabilities like cognitive impairments or sensory processing disorders, which may be best solved by AI that is not always available or easily modified. Such features of artificial intelligence are developed with minimal consideration of how much they will nevertheless be an afterthought as the number of technologies increases, the consequences being that people with diverse disabilities cannot fully partake in the advantages that AI presents.

Data Privacy and Security

Since assistive devices based on AI are gradually becoming an indispensable part of human life, the problem of data protection plays a crucial role (Pesapane et al, 2018). These devices contain personal and corresponding sensitive data, such as individual health records, attending health behavioural samples, or real-time geographic positions. For example, the health monitor constantly records the vital signs with the help of AI, or the mobility aid can register the user's place using AI to navigate. This data can be extremely precious, but when in the wrong hands, stolen, or collected and used without permission, it can become a problem. Some users are unaware of how their personal information is gathered, processed, and utilized, increasing the likelihood of a privacy violation.The problem of ethical considerations in data collection is as complex as possible. AI solutions use user data to learn and then make improvements, but this brings into context issues of consent and agency. For instance, an AI that is being used to help a person with a cognitive disability will possibly be evaluating the responses and actions of this particular person, and, often, this particular person will not be aware of how this data is going to be shared with various third parties, including but not limited to researchers or commercial corporations. The company's function remains to respect this guideline and make users hold their data by letting them, for example, refuse their data collection or delete it afterwards.

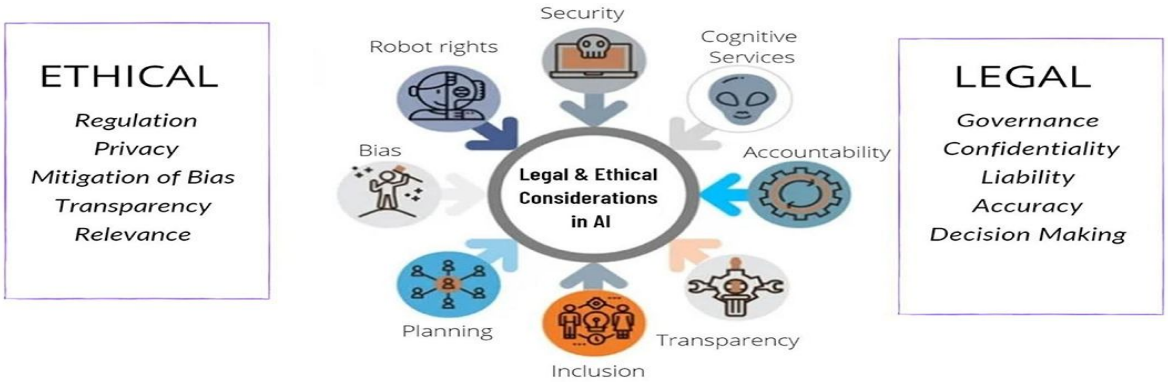

Figure 10: Legal and Ethical Consideration in Artificial Intelligence in Healthcare

Bias and Accessibility

Many AI systems depend on giant training sets of data, but sometimes such sets contain pre-existing sociological biases, and therefore, so does AI decision-making (Williamson, 2017). This has been a particularly huge issue regarding the implementation of assistive technologies, which have otherwise higher chances of being beneficial to disabled users. It means that if AI systems were designed in a certain prejudiced way, they could exploit some categories of disabled people. For instance, a commanding activated assistant trained to capture data from a mainly English-speaking population will be deaf to non-native speakers or people with speech disorders. These locking out or frustrating users do not meet the presumption of the model. Alleviating these biases continues to ensure that data sets encompass all users regardless of cultural, linguistic, and disability diversity.Another major is to design artificial intelligence to gain access for all people with disabilities. While it is notable that AI technologies are gradually helpful to blind or physically challenged people, there is the need to develop interfaces for the stammer, hard of hearing, or those with impaired cognitive ability. The goal of AI solutions is to accommodate people with different disabilities, and bringing that together means realizing that there are individuals with different levels of disability. For instance, communication aids for autistic persons may require features that meet specific users' sensory processing disorder needs; speech generation devices for deaf individuals may require features to accommodate different settings (Saeed et al, 2022). To address the societal questions, AI development must move away from being a domain of merely technical expertise that could reinforce respective national and global strategies but also global inclusion frameworks elaborated for every population group.

Future of AI-Powered Assistive Technologies

Advancements on the Horizon

Assistive technologies have a very bright and progressive future, with enhanced development of methods like mobility, communication, and thinking on the horizon. In mobility aids, aspects such as AI, robotics, and sensor technology are growing. AI-powered intelligent wheelchairs and exoskeletons will enhance the user's mobility and change in response to the surrounding environment. For instance, these devices could change automatically to avoid obstacles or learn from the user to enhance efficiency.In communication, AI has been predicted to revolutionize how people with speech and hearing impairments experience the world. AI in speech recognition goods and services and genetic real-time translation is improving fast; more are improving fast, making it more textual. Renovations will open the possibility for more accessible communication to the speech impaired and provide more complex solutions for the deaf and hard of hearing (Holmström, I. (2022). Also, it has been analyzed that cognitive assistance technologies are becoming more personalized. AI Systems will learn the needs of each user and assist users with cognitive disorders – Alzheimer's, ADHD, etc., by adjusting reminders, task management and memory aids to meet their needs. Prosthetics are another upcoming area that AI could solve; new neuroprostheses may be designed to reconnect the human brain and lost functions. Holding frontiers to stressing a thought-controlled lifestyle, a brain-computer interface could allow people with severe disabilities to control devices or even speak through their minds.

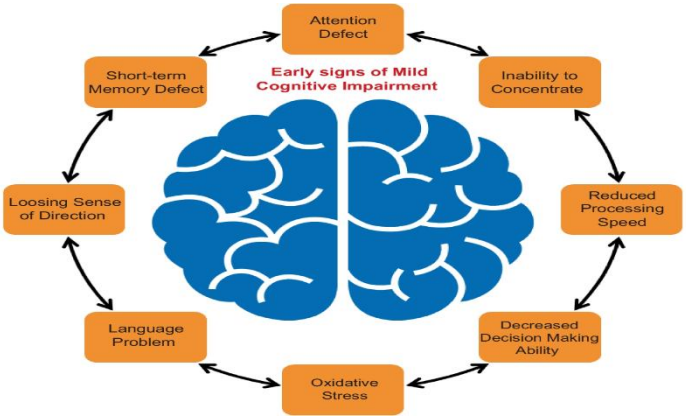

Figure 11: Artificial Intelligence for Cognitive Health Assessment

Integration with Smart Cities and IOT

The future of AI technologies meant to support users will be tightly associated with forming intelligent cities and IoT. Each smart city will optimize the functionality of the urban environment using sophisticated technology, and this will not exclude assistive technology. For instance, smart mobility aids like an intelligent wheelchair will harmonize with an innovative city framework, enabling users to move around the city without difficulties. They will interact with traffic lights, sensors, and other intelligent systems to plan routes, minimize risk, and provide faster access to public transport.The IoT will be of significant importance in enhancing interactions between the community of disabled people and developing a bright environment (Bright, 2022). Smart assistive devices will gather and convey data consistently to help continuously inspect and modify the device's performance. For instance, an intelligent hearing aid may change its function depending on the surrounding sounds, or an AI-controlled prosthetic might alter the movements depending on information collected by sensors installed within the limb. This connectivity will further bolster the ability of technology usability and ensure that end users enjoy a better quality of life.

Role of AI in Social Inclusion

The use of AI will also have an impact on the social participation of disabled people as well as shedding off prejudice towards them. By enhancing communication, mobility, and cognitive/assistance amelioration, AI can further enhance social inclusion for citizens with disabilities, allowing them department participation in this sphere. AI can also be used to design or redesign shared environments, workplaces, or learning spaces in a manner that is more sensitive to D&D considerations. For instance, where applicants have hearing issues, AI technologies and services, for example, captioning and sign language interpretation as a service, can help individuals participate in social events and productivity in their fields.In addition, AI applications can change public perceptions about disability and increase people's awareness of the issue (Chakraborty et al, 2023). In that way, AI can help to remove stereotypical views concerning the possibilities of employment for people with disabilities, as the use of new, enhanced technologies would allow them to work. This technological infrastructure implementation increases the acceptance of disability by individuals and society, building an inclusive society for disabled persons.

Conclusion

Artificial intelligence applications are also increasing the standards of people with disability; the quick, efficient, and personal assistance tools aid mobility, communication, and cognition. Personal transport, for example, intelligent wheelchairs or robotic exoskeletons, assists physically disabled persons to move around and get essential physical services. Technological advancements in communication, such as speech recognition and text-to-speech communication gadgets, have enabled clients with speech and hearing impairments to communicate efficiently. In particular, AI is making a difference in Memory Aid and Information Processing for people with learning disabilities. Object recognition and general navigation aid systems for people with vision impairments enrich user experiences; AI-controlled prosthetic limbs and exoskeletons return certain essential functions to movement and growth in users' lives.Moreover, technologies, including machine learning, natural language processing, and computer vision, are amongst the primary skills through which these assistive devices are designed to meet individual needs. It means that these technologies do not only improve the functionality but also the fact that the assistive devices must be more intelligent, friendly, and customized. So, as AI improves, the ability to learn and apply it incrementally provides even better opportunities to enhance the quality of life for people with disabilities (Bennett & Keyes, 2020).

The increasing development of AI in support technologies highlights the work in progress for disabled people when empowered by technology. However, further advancement requires more funding and the promotion of ideas from all parts of society. The readers need to contribute to the support of causal-shaped organizations and campaigns aimed at developing suitable AI. Supporting these initiatives helps society create better solutions, which disabled persons need.Policymakers have an essential duty to set the rules and policies that facilitate the proper use of such technologies. Technology businesses must be forced into sharing their scarce resources and power to make AI tools better and accessible to the PWDs (Raja, 2016). It is equally essential that the whole society appreciates the need for mainstream accessibility features in existing technologies and innovations.Last but not least, it is high time the general public and communities develop a more understanding community. When the endeavours toward implementing AI

are ensured to be accessible and supportive for people with disabilities, the doors will remain open, and everyone with a disability will be supported and enabled to live freely and integrate fully into society. The shift toward intelligent and autonomous tools driven by intelligence is the next significant step in developing consumer assist devices, for which all of us, legislators, employers, and citizens, must ensure the support and emergence of the new wave.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

References;

1. Abdulkareem, K. H., Mohammed, M. A., Gunasekaran, S. S., Al-Mhiqani, M. N., Mutlag, A. A., Mostafa, S. A., ... & Ibrahim, D. A. (2019). A review of fog computing and machine learning: concepts, applications, challenges, and open issues. *Ieee Access*, *7*, 153123-153140.
2. Alahmari, F. A., & Noor, A. (2020). DETECTME: An IOT Approach for Tracking Wheelchair Positioning in Indoor and Outdoor Environments for Enhancing Healthcare.
3. Al-Mubaid, H., & Chen, P. (2008). Application of word prediction and disambiguation to improve text entry for people with physical disabilities (assistive technology). *International Journal of Social and Humanistic Computing*, *1*(1), 10-27.
4. Anil Kumar, N. (2021). *Towards Better User Customization of Lower-limb Assistive Devices: Data Driven Control Strategies and a Self-Aligning Knee Mechanism* (Doctoral dissertation).
5. Baldwin, C. L. (2012). *Auditory cognition and human performance: Research and applications*. CRC Press.
6. Bennett, C. L., & Keyes, O. (2020). What is the point of fairness? Disability, AI and the complexity of justice. *ACM SIGACCESS accessibility and computing*, (125), 1-1.
7. Bright, D. (2022). An integrative review of the potential of wireless assistive technologies and internet of things (IoT) to improve accessibility to education for students with disabilities. *Assistive Technology*, *34*(6), 653-660.
8. Chakraborty, N., Mishra, Y., Bhattacharya, R., & Bhattacharya, B. (2023). Artificial Intelligence: The road ahead for the accessibility of persons with Disability. *Materials Today: Proceedings*, *80*, 3757-3761.
9. Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., ... &Shekelle, P. G. (2006). Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Annals of internal medicine*, *144*(10), 742-752.
10. Danielescu, A., Horowit-Hendler, S. A., Pabst, A., Stewart, K. M., Gallo, E. M., & Aylett, M. P. (2023, April). Creating inclusive voices for the 21st century: A non-binary text-to-speech for conversational assistants. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (pp. 1-17).
11. Freitas, D., &Kouroupetroglou, G. (2008). Speech technologies for blind and low vision persons. *Technology and Disability*, *20*(2), 135-156.
12. Gill, A. (2018). Developing a real-time electronic funds transfer system for credit unions. *International Journal of Advanced Research in Engineering and Technology (IJARET)*, 9(1), 162-184. https://iaeme.com/Home/issue/IJARET?Volume=9&Issue=1

13. Ham, R., & Cotton, L. T. (2013). *Limb amputation: from aetiology to rehabilitation*. Springer.
14. Holmström, I. (2022). Communication, Information, and Support for Swedish Parents with Deaf or Hard-of-Hearing Children. *Scandinavian Journal of Disability Research*, *24*(1).
15. Jacob, S., Alagirisamy, M., Xi, C., Balasubramanian, V., Srinivasan, R., Parvathi, R., ... & Islam, S. M. (2021). AI and IoT-enabled smart exoskeleton system for rehabilitation of paralyzed people in connected communities. *IEEE Access*, *9*, 80340-80350.
16. Kayalvizhi, S., Roshni, S., Ponraj, R., & Dharshini, S. P. (2023, February). A Comprehensive Study on Supermarket Indoor Navigation for Visually Impaired using Computer Vision Techniques. In *2022 OPJU International Technology Conference on Emerging Technologies for Sustainable Development (OTCON)* (pp. 1-6). IEEE.
17. Kumar, A. (2019). The convergence of predictive analytics in driving business intelligence and enhancing DevOps efficiency. *International Journal of Computational Engineering and Management*, 6(6), 118-142. https://ijcem.in/wp-content/uploads/THE-CONVERGENCE-OF-PREDICTIVE-ANALYTICS-IN-DRIVING-BUSINESS-INTELLIGENCE-AND-ENHANCING-DEVOPS-EFFICIENCY.pdf
18. Kumar, J. A., Visu, A., Raj, M. S., Prabhu, M. T., & Kalaiselvi, V. K. G. (2011, June). A pragmatic approach to aid visually impaired people in reading, visualizing and understanding textual contents with an automatic electronic pen. In *2011 IEEE International Conference on Computer Science and Automation Engineering* (Vol. 4, pp. 623-626). IEEE.
19. Kyle, J. G., Kyle, J., & Woll, B. (1988). *Sign language: The study of deaf people and their language*. Cambridge university press.
20. Machado, S., Araújo, F., Paes, F., Velasques, B., Cunha, M., Budde, H., ... & Ribeiro, P. (2010). EEG-based brain-computer interfaces: an overview of basic concepts and clinical applications in neurorehabilitation. *Reviews in the Neurosciences*, *21*(6), 451-468.
21. Mann, W. C. (2005). Smart technology for aging, disability, and independence. *The State of the Science*, *2005*.
22. Mintz, J., Branch, C., March, C., & Lerman, S. (2012). Key factors mediating the use of a mobile technology tool designed to develop social and life skills in children with Autistic Spectrum Disorders. *Computers & Education*, *58*(1), 53-62.
23. Nyati, S. (2018). Revolutionizing LTL carrier operations: A comprehensive analysis of an algorithm-driven pickup and delivery dispatching solution. *International Journal of Science and Research (IJSR)*, 7(2), 1659-1666. https://www.ijsr.net/getabstract.php?paperid=SR24203183637
24. Nyati, S. (2018). Transforming telematics in fleet management: Innovations in asset tracking, efficiency, and communication. *International Journal of Science and Research (IJSR)*, 7(10), 1804-1810. https://www.ijsr.net/getabstract.php?paperid=SR24203184230
25. Pesapane, F., Volonté, C., Codari, M., &Sardanelli, F. (2018). Artificial intelligence as a medical device in radiology: ethical and regulatory issues in Europe and the United States. *Insights into imaging*, *9*, 745-753.
26. Raja, D. S. (2016). Bridging the disability divide through digital technologies. *Background paper for the World Development report*.
27. Saeed, G., Brown, H. K., Lunsky, Y., Welsh, K., Proulx, L., Havercamp, S., & Tarasoff, L. A. (2022). Barriers to and facilitators of effective communication in perinatal care: a qualitative study of the experiences of birthing people with sensory, intellectual, and/or developmental disabilities. *BMC pregnancy and childbirth*, *22*(1), 364.
28. Sharkey, A., & Sharkey, N. (2012). Granny and the robots: ethical issues in robot care for the elderly. *Ethics and information technology*, *14*, 27-40.
29. Williamson, B. (2017). Big data in education: The digital future of learning, policy and practice.
30. Young, C. (2015). *An exploration of the learning strategies used by women who disclose with a formal diagnosis of attention deficit hyperactivity disorder (ADHD) in the context of higher education* (Doctoral dissertation, Macquarie University).