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Artificial Intelligence for Improving Accessibility and Availability of Assistive Devices in Low-Income Countries: A Review

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Abstract

Assistive technology is any device or product which helps people with disabilities retain, grow, or enhance their functional ability either permanently or temporarily. They consist of various equipment and devices such as walking frames, contact lenses, hearing aids, wheelchairs, pacemakers and many more. Low and middle-income nations face multiple challenges in improving access to assistive technologies, including manufacturing low-quality devices, financial limitations, and insufficient government funding, resources, and infrastructure. This paper reviewed and discussed the impact of AI in improving the accessibility of assistive technology to people in low-income countries. The review discovered that manufacturers who produce the devices, government support policies, user interface and enlightenment about the devices contribute to improved access to assistive technology by users in low-income countries. This work recommended the adoption of Artificial Intelligence as a tool to aid people with disabilities by presenting new opportunities for improved accessibility, promoting inclusivity and functionality in society.

Keyword: Assistive device, Artificial Intelligence, Low-income countries, Disabilities

1. Introduction

Assistive technologies (ATs) are designed to improve the functional capabilities of people with disabilities either temporarily or permanently. Some are relatively low-tech and very familiar, such as reading glasses, crutches and hearing aids while others are more advanced, using cutting-edge science and technology. These are simply devices that are used to replace a malfunctioning or damaged part of the body to improve the user's functionality. Assistive Technology maintains or improves an individual's functioning and independence to facilitate participation and enhance their overall well-being (Rohwerder & Tangcharoensathien, 2018). According to WHO (2014), Assistive technology comprises any device, piece of product, or product that helps persons with disabilities retain, grow, or enhance their functional abilities. Different devices and equipment such as Low-vision equipment, hearing aids, walking frames, wheelchairs, prosthetic limbs and pacemakers are examples of assistive technologies. All these devices are used temporarily or permanently to replace a malfunctioning or damaged tissue, organ or system in the body.

2. Literature Review

Advancements in technology, particularly in artificial intelligence and community-based solutions, have opened up new possibilities for enhancing the accessibility and effectiveness of assistive devices. This section examines the current trends in assistive devices, the potential for community-based distribution networks, and the emerging role of collaborative manufacturing models. It highlights real-world applications of artificial

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intelligence in assistive technologies and illustrates how AI can transform and personalize the user experience for those in need.

2.1 Landscape of assistive device accessibility

Various classes of people, including those with disabilities, age-related frailties and those in need of rehabilitation all benefit from assistive technologies. While access to these technologies is restricted in low- and middle-income nations, changes in the population and epidemiology will unavoidably increase the already great demand. According to The WHO *Global Strategy and Action Plan on Ageing and Health* in 2016, leveraging advancements like ATs could aid low- and middle-income nations in creating service models that "leapfrog" patterns provided in alternative contexts (WHO, 2016).

Concerns have been raised regarding the development of these technologies without considering the real environmental, societal, and financial limitations that prevent the adoption of technology in settings with limited resources. Eide (2016) discusses that access to AT services is a fundamental human right, guaranteed by the UN through its Convention on the Rights of Persons with Disabilities (UNCRPD), a legally binding document describing disability in a rights-based approach.

2.2 Community-Based Distribution Networks

The establishment and management of community-based networks has the potential to significantly drive the development of Artificial intelligence (AI) applications. Recently, there has been growing interest in researching how AI systems may be used to develop and operate intelligent community systems. For instance, the use of AI to drive public engagement in research has been studied due to its significance and endless possibilities. Some of these include the application of AI for sustaining public participation, prediction of user interests, explanation of data patterns, verification of data quality, and classification and labelling of objects (Hsu et al, 2021). The following studies collectively highlight the potential for AI to enhance community-based networks:

Palsetia (2012) proposes a user-interest-based approach to community extraction based on user-generated content such as comments and tweets from social media networks. This paradigm could be applied to the building and management of community-based networks. Chen (2012) focuses on the facilitation of community-based networks by merging current building technology, computer network technology, and automatic control technology, which improves the safety of the human living environment. Hong (2002) explores the design and management of intelligent community systems, with a particular emphasis on intelligent community management systems based on web technology, by analysing their needs and introducing their primary features.

2.3 Collaborative Manufacturing Models

Collaborative manufacturing emerges as an important solution to drive the innovation and production of affordable assistive devices through collaborative efforts in project planning, product design, forecasting, production systems, and supply chain coordination. Collaborative manufacturing facilitates the sharing of resources, expertise, and capabilities across multiple partners to enhance their production efficiency, sustainability, and competitiveness (Firmansyah & Amer, 2013). One of the ways collaborative manufacturing can be achieved is through collaboration with AI technology to achieve smart manufacturing (Soldatos, 2024). AI tools are capable of identifying patterns based on acquired data, and these patterns can be used for proactive preventive maintenance to prevent unwanted downtime, which can lead to a waste of resources and time. AI can also be used to optimize production efficiency. By processing production-related data acquired across the partners, AI can analyse this multivariate data to identify patterns, root causes, and optimization opportunities that are difficult for humans to perceive. This can also be applied to supply chains to optimize decisions related

to procurement, production planning, logistics routing, etc., to optimize utilization and streamline material flow across partners. (Arinez et al., 2020).

2.4 Impact of Artificial intelligence in assistive technology

Artificial Intelligence (AI) technologies have played a crucial role in enhancing the accessibility and availability of assistive devices to improve the quality of life for individuals with disabilities. AI has been integrated into an array of assistive technology solutions such as hearing aids, memory aids, eyeglasses, wheelchairs, pill organizers, and communication aids to revolutionize their functionality, personalization, and accessibility (Smith et al., 2023). Several real-life examples showcase the potential of AI in revolutionizing assistive technology across various domains.

The Ottobock EmPOWER™ prosthesis is an intelligent transtibial prosthesis that provides active power and functionality to the lost human leg of an amputee. It can adapt to the user's environment and intention to provide a natural human gait, improve metabolic energy expenditure during walking, and adapt to various environmental terrains compared to passive prostheses (Ottobock, 2019). OrCam MyEye™ stands out as a beneficial tool for visually impaired individuals. This assistive device leverages AI and computer vision to read text aloud, identify objects, recognize faces, and provide auditory feedback, facilitating users' navigation around their surroundings (OrCam, 2013). AI technologies can also be integrated into wheelchair systems, as seen in Intel's Hoobox™. This technology provides autonomous control of the wheelchair by recognizing and translating human facial expressions into motor commands. This enhances mobility and independence for physically impaired individuals (Intel, 2019). Google Live Transcribe is another AI-powered solution for making everyday communication more accessible for users with hearing impairment. This AT tool uses advanced speech recognition technology to convert spoken language into real-time text transcripts of conversations (Google, 2019).

These real-life commercialized examples showcase the impact of AI technology in improving the quality of life of people with disabilities. By integrating AI capabilities into assistive devices, these solutions have revolutionized accessibility, functionality, and independence for users with various types of impairments.

3. Challenges and Limitations

Several obstacles and constraints exist when using AI-powered solutions to improve the accessibility of assistive devices. Stoll (2019), stated that while these technologies have become faster, stronger, more precise and reliable, issues remain in adaptation, decision-making, and robustness in adapting to volatile environments. According to Smirek (2016), as progress in this area of study persists, the complexity of offered functionality and dependencies between devices and services increases. The availability and affordability of these solutions are equally pressing issues, especially in low-income nations. When taken as a whole, these studies highlight the need for additional research and advancement in addressing the challenges and constraints associated with integrating AI-powered solutions to enhance the accessibility of assistive devices.

3.1 Policy implications and recommendations

From the reviews above, one of the challenges faced is a lack of adequate knowledge of AT devices on the part of both users and non-users. Proper orientation is required to elucidate the importance and usage of assistive devices to prevent stigmatisation and improve adoption in society. Manufacturers should provide devices that are not only user-friendly but also biocompatible. The government should help improve access to assistive devices by providing financial support to users in need and also provide a strict and measurable policy that would enhance and support the usage of the devices (Hsu et al, 2021).

4. Future directions and opportunities

Currently, many forms of AT are digitally "connected" and AI has the potential to continuously drive the improvement of AT. There is growing interest in the potential that data sciences, including artificial intelligence (AI), hold for the future of the assistive technology sector as a helpful and constructive mechanism in any decision-making process (Ran, 2020). AI is used in the development of autonomous wheelchairs, assistive robots, and visual impairment guide systems. Research has looked into using facial recognition technology to assist those who struggle with social contact. AI technologies are transforming conventional speech recognition systems and their application in AT. AI-powered smart home systems have been demonstrated to improve psychological well-being, quality of life, and independent living abilities (Smith et al, 2023).

5. Conclusion

The potential for AI to improve the accessibility of assistive technology is a promising area for future research. AI-based tools can improve decision-making processes, with principles such as user personalization and self-assessment being key. The advancement of artificial intelligence (AI) has the potential to enable the creation of innovative and highly advanced methods to address the diverse challenges faced by people with disabilities. This review work suggests that artificial intelligence (AI) can significantly improve and enhance assistive technology's effectiveness and accessibility, particularly in the areas of mobility, personalisation, and communication.

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