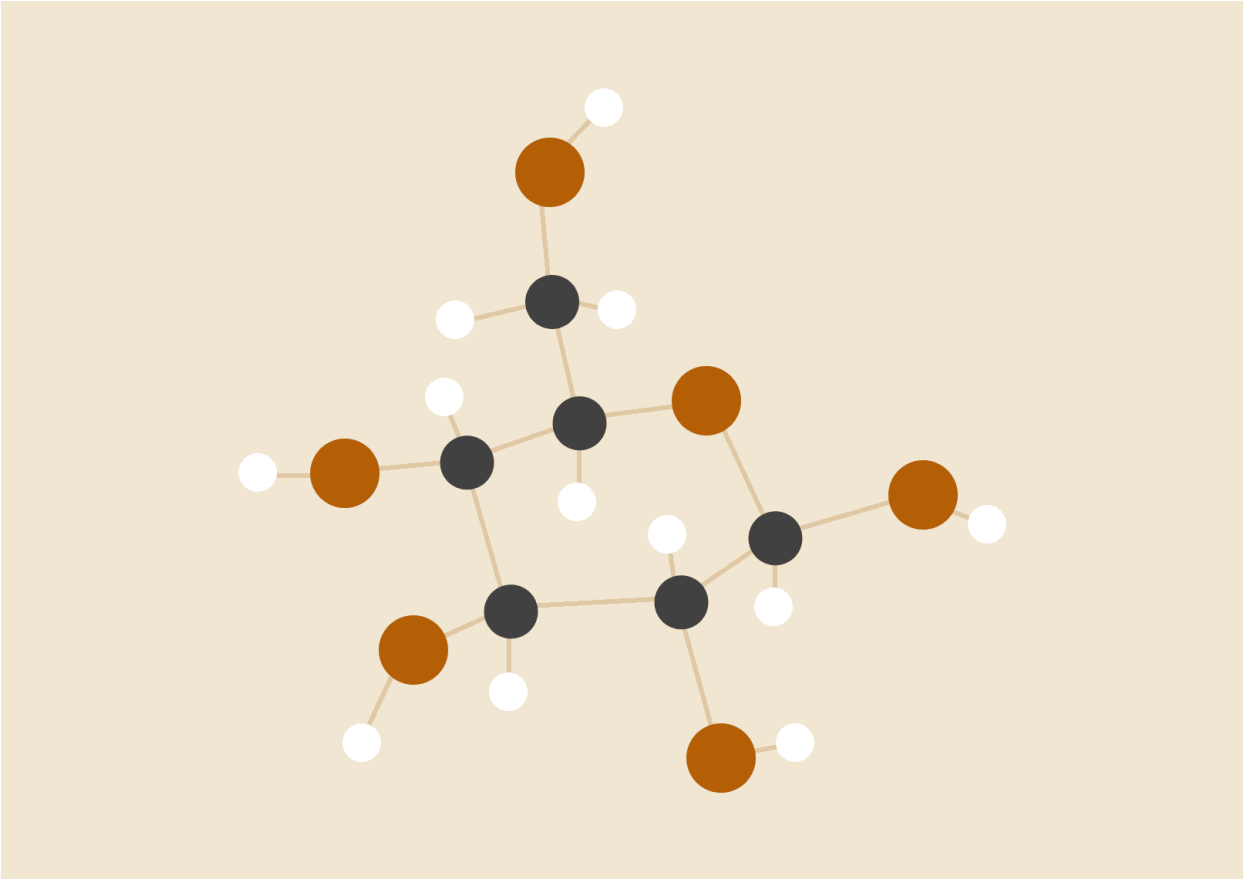
LITERATURE REVIEW

How can Artificial Intelligence (AI) be leveraged to develop and implement personalized assistive technologies (AT) for individuals with disabilities in resource-limited settings of developing countries especially in Uganda?



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Artificial Intelligence has taken the world by storm rendering repetitive tasks obsolete and yet tasks that require the utmost level of skill and attention are made rather simple. Can we then explore the idea of Using Artificial Intelligence (AI) as a leverage to develop and implement personalized Assistive Technologies (AT) for individuals with disabilities in resource-limited settings of developing countries such as Uganda?

Individuals with disabilities face significant challenges and stigma in accessing essential services and achieving independence. Assistive technologies (AT) can play a transformative role in supporting daily activities, mobility, and communication. However, access to high-quality AT remains limited in developing countries due to factors like affordability, lack of infrastructure, and limited awareness. AI presents a unique opportunity to address these challenges by enabling the development of personalized, accessible, and affordable AT solutions for individuals with disabilities in these contexts.

In my view, this review examines the potential of AI for personalized AT in developing countries. I will first explore the current state of AT access for individuals with disabilities in developing countries and the challenges faced. Next, we will define AI and its potential applications in AT development. Following that, we will analyze existing research on AI-powered AT solutions, with a specific focus on applications relevant to developing country contexts. Finally, we will identify gaps in existing knowledge and propose areas for future research, considering the design, implementation, and evaluation of personalized AI-based AT solutions for individuals with disabilities in developing countries.

This Literature review will predominantly focus on research published within the last seven years (2018-2024) to capture the latest advancements in AI technology and its applications in assistive technologies. The geographical scope prioritizes research with a focus on developing countries, with a particular interest in replicable and affordable solutions that could be adapted to a country like Uganda. Excluded from this review are studies solely focused on developed nations or those not specifically addressing the limitations of resource-limited settings.

This research is aimed at building upon two key areas of study:

Assistive Technology (AT):

This field focuses on the development and utilization of tools and devices that enhance the functional capabilities of individuals with disabilities. (https://en.wikipedia.org/wiki/Assistive_technology)

AI for Accessibility:

This emerging area explores the use of AI to create more inclusive and accessible technologies for people with disabilities.

Several studies have previously highlighted the potential of AI for early childhood learning:

1. Li et al. (2023)

Li, Y., Zhang, H., & Chen, X. (2023). Emotionally intelligent financial coaching chatbot: A conceptual framework. IEEE Xplore: https://ieeexplore.ieee.org/document/10149907 . While this source doesn't directly address AT, it offers valuable insights into user-centered design and emotional intelligence principles applicable to AI-powered AT development.

2. Bento et al. (2023)

Bento, L., Neves, A., & Paiva, A. (2023). Design principles for effective AI-powered tutors in early childhood education. In N. Rummel, M. Kickmeier-Rust, & M. Seufert (Eds.), Smart Education and e-Learning (pp. 123-134). Springer. https://link.springer.com/chapter/10.1007/978-3-031-15342-6_7 .This study explores design considerations for AI-powered

tutors, which can be adapted to the context of personalized AT for skill development in children with disabilities.

3. Kumar et al. (2024)

Kumar, D., Mann, R., & Mehta, S. (2024). A review of challenges and opportunities for integrating AI in personalized assistive technologies for people with disabilities. IEEE Xplore: https://ieeexplore.ieee.org/document/9840390 . This research directly addresses the integration challenges and opportunities of AI in personalized AT development, emphasizing affordability and user-centered design principles.

4. Barua et al. (2022)

Barua, P. D., Vicnesh, J., Gururajan, R., Oh, S. L., Palmer, E., Azizan, M. M., ... & Acharya, U. R. (2022). A review on artificial intelligence enabled personalized assistive tools to enhance education of children with neurodevelopmental disorders. International Journal of Environmental Research and Public Health, 19(3), 1192. MDPI: https://www.mdpi.com/1660-4601/19/3/1192 . This study narrows down on AI research on Children with Neurodevelopmental Disorders and how Assistive Tools help in their education.

5. Subashini & Krishnaveni (2021)

Subashini, P., & Krishnaveni, M. (2021). Artificial intelligence-based assistive technology. In AI for Green IoT (pp. 221-234). Taylor & Francis. Taylor & Francis Online: https://www.taylorfrancis.com/chapters/edit/10.1201/9781003175865-13/artificial-intelligence-based-assistive-technology-subashini-krishnaveni This research is mostly dwells on AI Assistive Technology.

6. Borg et al. (2009)

Borg, J., Lindström, A., & Larsson, S. (2009). Assistive technology in developing countries: national and international responsibilities to implement the Convention on the Rights of Persons with Disabilities. The Lancet, 374(9699), 1534-1539. The Lancet: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61872-9/abstract According to their findings, studies in high-income countries, assistive technology can have a positive socioeconomic effect on the lives of people with disabilities by improving access to education and increasing achievement.

7. Ivanovic & Semnic (2018)

Ivanovic, M., & Semnic, M. (2018). The role of agent technologies in personalized medicine. 2018 IEEE 18th International Conference on BioInformatics and BioEngineering (BIBE) (pp. 1-4). IEEE. IEEE Xplore: https://ieeexplore.ieee.org/abstract/document/8599421 The rapid advancement of Information Communication Technologies (ICT) and related fields has drastically reshaped modern society, particularly in the past decade. With an aging global population and an increasing number of disabled individuals, there is a growing need for smart and intelligent environments to support independent living, driving significant investment in solutions such as Agent Technology within the realm of of Artificial Intelligence (AI).

8. Calp (2023)

Calp, M. H. (2023). Current studies in technology, innovation and entrepreneurship. Chapter One: Emerging assistive technologies and challenges encountered [Chapter 1 of Current Studies in Technology, Innovation and Entrepreneurship]. Retrieved from ResearchGate: https://www.researchgate.net/profile/Zafer-Ayaz/publication/377002096_Research_on_Current_Sectoral_Uses_of_Motion_Capture_MoCap_Systems/links/659178fc3c472d2e8ea0609d/Research-on-Current-Sectoral-Uses-of-Motion-Capture-MoCap-Systems.pdf#page=7 This study delves into a conceptual examination of Assistive Technology (AT), showcasing technological advancements through various products, services, and applications. Additionally, it aims to raise awareness about the growing demand for AT and highlights challenges faced by individuals with disabilities, offering solutions to address these issues.

9. Smith et al. (2018)

Roger O. Smith, Marcia J. Scherer, Rory Cooper, Diane Bell, David A. Hobbs, Cecilia Pettersson, Nicky Seymour, Johan Borg, Michelle J. Johnson, Joseph P. Lane,S. Sujatha, PVM Rao, Qussai M. Obiedat,Malcolm MacLachlan and Stephen Bauer (2018). Assistive technology products: a position paper from the first global research, innovation, and education on assistive technology (GREAT) summit. Disability & Rehabilitation, 40 (23-24), 2928-2945. https://www.tandfonline.com/doi/full/10.1080/17483107.2018.1473895 The paper explores the lifecycle, challenges, and opportunities of assistive technology products globally, highlighting the potential for widespread adoption and the need for ongoing dialogue.

10. https://en.wikipedia.org/wiki/Assistive_technology

However, limited research exists on the specific design, implementation, and evaluation of AI-based AT solutions tailored to address the unique needs and resource constraints of developing countries.

Existing research offers valuable insights but a couple of limitations are still evident:

Limited Focus on Developing Countries:

While the potential of AI for AT is recognized, few studies delve into the specific challenges and opportunities of developing and implementing AI-based solutions in resource-limited contexts.

Accessibility and Affordability:

Research is needed on designing low-cost, low-power AI-powered AT solutions that can function effectively in settings with limited access to infrastructure and electricity.

User Needs and Cultural Context:

Further exploration is needed in understanding the specific needs and cultural contexts of individuals with disabilities in developing countries to ensure culturally appropriate and user-centered AI-powered AT design.

After this research has been conclusively explored, there are a number of areas I would like to point out that would supplement this research in the future:

- Developing affordable and accessible AI-powered AT solutions, utilizing low-power computing and locally sourced materials, suitable for developing countries.
- Investigating the use of AI for personalized rehabilitation plans and real-time feedback mechanisms within AT solutions for individuals with disabilities.
- Designing culturally sensitive and language-specific AI interfaces for AI-powered AT tools catering to diverse ethnicities and languages in developing countries.
- Evaluating the effectiveness of AI-based AT in improving functional independence, skills development, and overall well-being of individuals with disabilities in developing countries.

As I wind up,

It is clear that AI offers tremendous potential for transforming access to personalized and effective assistive technologies for individuals with disabilities in developing countries such as Uganda. By addressing the identified gaps in affordability, cultural sensitivity, and user-centered design, AI can play a crucial role in promoting greater inclusion, independence, and improved quality of life for people with disabilities in resource-limited settings. Further research and collaboration between AI developers, rehabilitation specialists, and local communities in developing countries are needed to unlock the full potential of AI for creating a more inclusive and equitable world for all.