## LITERATURE REVIEW

**Topic: AI-based assistive technology for the physically disabled and the elderly.**

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Due to significant increases in life expectancy, the world's population is ageing at a rapid pace (Ma et al., 2022). The number of the population aged sixty and over will rise from 1.4 billion in 2030 to 2.1 billion by 2050 (World Health Organization, 2022). However, disability includes a broad group of individuals. Although, majority of disabilities occur in older years, some people have this condition as a result of accidents or serious illnesses and others are born with it. Depending on the disability, individuals require different type of assistance and have different health care requirements (Demiral, D., G. ,2023).

Therefore, it is expected that the overall demand for healthcare personnel and facilities will rise significantly in the future. Simultaneously, governments will face challenges in providing high-quality healthcare along with rising testing and medication expenses. Under these circumstances, encouraging senior citizens and disabled people to take charge of their own health and safeguard is becoming more important.

It is believed that assistive technology (AT) can improve the quality of life for the elderly and disabled people while increasing their independence. In recent years, artificial intelligence (AI) has become increasingly prevalent in assistive technology, providing people numerous opportunities and greater independence (Fotteler et al., 2022). Artificial Intelligence (AI) is an area of computer science that integrate intelligent behaviour of humans with computer systems in order to resolve challenging issues with limited or no human interactions (Ezzaim et al., 2023).

This literature review aims to provide an in-depth review of AI-based assistive technology for the elderly and disabled. Within this document, noteworthy findings in this area are highlighted, and recommendations for future studies are provided. This also discusses issues with efficiency, user experience and outlines research gaps and limitations in this field that require further investigation.

Even though the term ‘assistive technology’ has multiple definitions available in the literature, majority of academic papers share a great deal of similarities.

The UK government (GOV.UK) defines assistive technology (AT) as “any piece of technology which makes it easier for those with impairments, limited mobility, or other limitations to perform tasks that would otherwise be challenging or impossible. These technologies assist individuals to maintain or enhance their quality of life by reducing discomfort or limitations.” Reisinger and Ripat (2014) defined assistive technology as “products and services that support and maintain failing mental and physical abilities caused by ageing and disability”. Similarly, de Freitas et al. (2022) defined this as “products, procedures, techniques, approaches, and systems use to minimize or mitigate any limitations imposed on people due to a disability or incapacity”. The term "ambient assisted living" is also used in reference to assistive technology. It is an umbrella term for the application of digital technologies to enhance living environments for disabled individuals (Andrich et al., 2019).

According to Demiris et al. (2008), some of the widely utilised assistive technological equipment are surveillance and tracking systems, specialised home appliances, toilet assistance, geolocation equipment, pharmaceuticals devices and emergency alarms. Additionally, "smart homes" outfitted with assistive technologies are also being developed to help elderly/ disabled people who live with health-related challenges like sensory issues, impaired mobility, and lower mental capacity. It is fortunate that during the past few years the healthcare industry has standardised best practices for developing, testing, and launching new AT devices into the market. The ISO 9999 is the internationally accepted standard document with an organised classification and terminology of assistive products, covering non-technical options like assistance dogs, surgical devices, and product installations (Smith et al., 2018).

With the advances in artificial intelligence (AI) and automation, research on AI-based assistive technologies has gain more attention among scholars. For instance, Researchers at the University of Glasgow developed RoboGuide, an AI-driven robot dog to improve the independence of blind people in urban settings. The robot was built with AI driven sensors to identify and map outside environment (Bracknell News, 2024).

For those who are visually impaired (BVI), *Be My Eyes* is a well-liked AI based app. Using lenses and audio on the user's smartphone, it connects them with real world and offer assistance (www.toolify.ai, 2024).

In 2022, Heo et al. developed an AI powered pill recognition systems to accurately identifying prescription drugs while minimising medication errors. Similarly, Chang et al., (2020) tested a wearable smart-glasses-based AI pill recognition system called MedGlasses for visually impaired patients.

‘Intelligent Cyber-Physical Systems’ is another popular topic in this field. Technological structures that combine both virtual and physical components are referred to as cyber-physical systems. Using both hardware elements like sensors, control units and virtual elements like networking capabilities, these systems can collect and analyse data to improve living conditions of elderly people (Sahlab and Jazdi, 2020).

AI-powered communication tools like virtual assistants and chatbots have made it easier for elderly and disabled patients to get clinical advice from medical professionals, even after regular business hours. On the other hand, healthcare professionals can also utilize AI based assistive tools to identify patient requirements and to provide individualised treatments (Abdulkader, 2023). However, all these data circulate through wireless channels and sometimes wireless connections have bottlenecks in data transmission. The delay in data transmission delays health centres to respond in real-time, making it difficult to identify and react in emergencies. Therefore, creating technologies that enable real-time communication between the patient and the medical facility can result in improved, more dependable, and responsive care (Maram Fahaad Almufareh et al., 2024).

Alongside well-known AI-powered assistive technologies like Apple Siri and Amazon Alexa, which allow disabled people to control their homes, communicate, and get information, there is another assistive system is available in the market named *Oura Ring*. It can monitor and record user’s neurological signals and offer health status reports (Ramirez, 2023).

Dementia care is one of the health-care segments that is expected to gain from technological booms. Elderly people with dementia requires daily support for their lives and can cause substantial challenges to the future healthcare system, with the forecasted 115 million patients by 2050. Although there isn’t an effective medicine available for dementia until now, advanced AI-driven assistive technologies have potential to improve their condition. Automated audio platforms like “*Life Bio Memory*" has already shown to be successful in assisting dementia patients using pre-recorded videos and summarised life stories (N. Shikha and Antara Roy Choudhury, 2023).

According to the 2019 United Nations Convention on the Rights of Persons with Disabilities, “AI has the potential to enhance inclusion, involvement, and independence for people with disabilities”. Therefore, many organisations are now investing on AI driven assistive technologies to increase their financial and social benefits.

Although assistive technology can provide many advantages for elderly and disabled people, there are also a number of drawbacks that require being taken into consideration when developing and utilizing AI based assistive technologies (Ramirez, 2023). Since assistive technology needs to be customised for each user's unique requirements, it can be expensive and requires certain expertise for testing and developments. Upgrading and fixing assistive technological devises are also essential to ensure their optimal functioning. Timely repairs and servicing can be costly and challenging for elderly and disabled people (Ramirez and Ferreira, 2018).

According to Cobigo et al. (2020), elderly and disabled individuals are at substantial risk related to issues concerning online privacy and security. Therefore, cyber security must be built into these assistive technological devised to ensure confidentiality and security of their users. Specifically, sensitive data must be recorded securely, be encrypted to prevent any unauthorised accesses (Martin, Bengtsson and Rose-Marie Dröes, 2010).

AI-based assistive technology raises a number of legal and ethical concerns, including security and tracking and psychological challenges of the role of human judgement. According to Naik et al. (2022), four main ethical concerns need to be answered for AI in healthcare to reach its full potential: these include proper authorization to use data, security and visibility, algorithmic equity and biases and data privacy.

Specifically, assistive technologies gather and analyse user data that are not strictly medicinal per the applicable laws but can be used by third parties for their own benefit. For instance, home security systems and wearable data, which are not considered medical devices, are among these data types. Insurance firms might use these data against the patients to revoke their coverage or raise the premium (Wangmo et al., 2019).

The safety of elderly individuals using assistive medical robots is an essential concern for robot developers, engineers, and carers. The assistive medical robot performs its duties in compliance with the program(s) that are programmed by robot developers using a variety of codes. Therefore, a small mistake in a robot's programming could have a deadly or devastating effect on the wellbeing of elderly patients (Mansouri, Goher and Hosseini, 2017).

Although there have been major advancements in the field of AI-based assistive technology for the elderly and disabled, there are still plenty of missed opportunities that need to be studied further.

Designing autonomous systems that offer continuous, personalised assistance to elderly and disabled is a challenging without collaboration among various, diverse research fields. The effective implementation of assistive technologies in social contexts is not only a technological task. Ensuring user acceptance does not necessarily rely on technological advancement. Instead, it is important to integrate studies on II based assistive technology with social science field (Cortellessa et al., 2021).

Since AI use historical data to learn, the algorithms may magnify any biases present in the data. Bias can cause disable people to have unfair access to resources or assistive services. It is essential to carefully assess and minimise bias by utilising strategies like algorithm audits, data preparation, and fairness-aware algorithms. AI-driven solutions can provide an increased equitable environment for people with disabilities by continuously monitoring and fixing bias (Maram Fahaad Almufareh et al., 2024).

Although numerous research show that elderly/disabled individuals respond well to assistive social robots, the majority of studies have used only a small number of companion robots, and research methods are typically not dependable enough to allow for replication, and misleading connected characteristics cannot be ruled out. Therefore, the strength of these studies is limited. In order to define the advantages of assistive technologies more clearly, it is important to invest in research methodologies that allow researchers to reach large-scale, dependable, and cross-cultural studies (Broekens, Heerink and Rosendal, 2009).

There are disparities between developers and users when technology is fully integrated into caregiving. Technology may become less responsive to human needs if developers only concentrate on data collecting, sharing and administration. While developers have a separate focus on the technology and implementation of the product, carers are primarily focus on the patient. There are still roadblocks between designers and users of assistive technology, despite research and development efforts to bridge this gap. In order to balance technology with humanity, it is important to recognise different viewpoints of assistive technology designers and carers during development stages (Lee, Cha and Wang, 2023).

In conclusion, emerging technological developments, and their potential to innovate better-quality assistive technological products in the future are limitless (Abdi et al., 2021). However, to ensure that assistive technologies are actively benefitting elderly and disabled people, it is necessary to maintain reliable and diverse data sets provided by well-trained researchers and developers (Fotteler et al., 2022). The development of AI-driven assistive technologies must also be reflected in international laws and regulations. Legislation should sufficiently respect and defend the rights of end users, particularly when they access to sensitive and confidential information (Gerke, Minssen and Cohen, 2020).

The use of AI in assistive technology is revolutionary for the elderly and disabled. The capacity to analyse and interpret data creates new opportunities for independence and accessibility. AI empowers people to overcome challenges, engage with the world, and understand their environment far better. Although there are undoubtedly concerns associated with AI, its potential to support people with elderly and disabled is incredible. The use of AI in assistive technology is only the start of a revolutionary path that will lead to a future where everyone can benefit and enjoy more diversity.

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