World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Check for updates

# Ethical Implications of AI-Driven AAC Systems: Ensuring Inclusivity and Equity in Assistive Technologies

Omotayo Emmanuel Omoyemi *

*School of Computing and Engineering, University of Derby, United Kingdom.*

World Journal of Advanced Research and Reviews, 2024, 24(01), 2576–2581

Publication history: Received on 15 September 2024; revised on 27 October 2024; accepted on 29 October 2024.

Article DOI: https://doi.org/10.30574/wjarr.2024.24.1.3310

## Abstract

This study investigates the ethical implications of Artificial Intelligence (AI) integration into Augmentative and Alternative Communication (AAC) systems, focusing on inclusivity, accessibility, and data privacy in assistive technologies. AI-driven AAC systems enhance communication for individuals with impairments by offering features like predictive text, speech recognition, and symbol-to-text translation. However, ethical challenges arise as these systems increasingly rely on sensitive user data, which could jeopardize privacy without strict safeguards. Furthermore, limitations in linguistic diversity within AI training data compromise inclusivity, potentially excluding users from varied cultural and linguistic backgrounds. Accessibility also remains an issue, as AI-driven AAC systems are often financially inaccessible for marginalized communities, exacerbating social inequities. Through a comprehensive analysis of current systems, including Proloquo2Go, Tobii Dynavox and Google's Project Euphonia, this paper evaluates both the advancements and ethical shortcomings in AI-driven AAC technologies. The findings advocate for privacy-preserving AI practices, culturally diverse training datasets, and affordable AAC solutions to foster a more inclusive, accessible, and equitable digital communication environment.

**Keywords:** AI-driven AAC; Inclusivity; Accessibility; Data privacy; Assistive technologies

## 1 Introduction

The integration of Artificial Intelligence (AI) into Augmentative and Alternative Communication (AAC) systems is reshaping how individuals with communication impairments connect with others and the world around them. These systems, enriched by AI-driven advancements such as predictive text, speech recognition, and symbol-to-text translation, provide significant improvements in communication accessibility and efficacy for users with speech and language difficulties [1, 2]. By enabling more efficient interactions, AI-driven AAC systems offer transformative benefits, but they also raise complex ethical concerns, particularly related to data privacy, inclusivity, and equitable access [3, 4].

The rapid adoption of AI in assistive technologies has sparked significant academic and industry interest in the ethical dimensions of such advancements. Existing research highlights the need for stringent data protection measures within AAC systems to safeguard sensitive user information, as these systems often process substantial personal data [5]. Furthermore, inclusivity remains a prominent challenge. Many AI-based AAC tools are limited in their adaptability to diverse linguistic and cultural backgrounds, thereby restricting access for non-native speakers and those from underrepresented communities [6]. Accessibility disparities are also evident; the high costs and advanced technical requirements of some AAC devices limit their usability for low-income users and those with limited digital literacy [7].

Given these ethical challenges, this paper investigates the privacy, inclusivity, and accessibility implications associated with AI-driven AAC systems, aiming to propose solutions that prioritize ethical design and equitable access. By

* Corresponding author: Omotayo Emmanuel Omoyemi

addressing these concerns, the research contributes to the broader discourse on responsible AI development in assistive technologies, emphasizing the need for AAC systems that serve diverse populations effectively and inclusively [8, 9].

## 2 Material and methods

### 2.1 Research Design and Framework

This study adopts a qualitative research design to investigate the ethical implications associated with Artificial Intelligence (AI)-driven Augmentative and Alternative Communication (AAC) systems. Focusing on key themes—data privacy, inclusivity, and equitable access—the study assesses current AAC technologies, their impacts on diverse user groups, and the ethical considerations surrounding their development and deployment [1, 4]. To achieve this, a systematic literature review and case study analysis were performed to identify and evaluate common ethical challenges in AAC systems and to identify areas for improvement [5].

#### *2.1.1 Literature Review*

The literature review was structured to provide foundational insights into the integration of AI in AAC technologies and the ethical issues that arise, including privacy risks and inclusivity challenges. Research databases such as IEEE Xplore, PubMed, and Google Scholar were searched for peer-reviewed articles, conference papers, and industry reports published from 2010 to 2024. Key search terms included "AI in AAC systems," "data privacy in AAC technologies," and "inclusivity in assistive technologies" [2, 6]. This approach resulted in a selection of 30 relevant studies, from which 15 were prioritized based on their focus on AI ethics and inclusivity in AAC systems. The gathered literature informed both the theoretical framework and the methodological approach of this study.

#### *2.1.2 Case Study Selection*

Three widely used AI-driven AAC systems—Proloquo2Go, Google's Project Euphonia, and Tobii Dynavox—were selected for in-depth case analysis based on their diverse user bases, distinct AI functionalities, and unique approaches to privacy, inclusivity, and accessibility. These systems were examined to assess how each address ethical challenges and areas needing improvement. The selection criteria included relevance to the study's core themes, accessibility to related user feedback, and sufficient documentation on their technological and ethical practices. Information sources included published case studies, developer documentation, user reviews, and reports from disability advocacy groups [7, 8].

### 2.2 Data Analysis

Data analysis was conducted through thematic coding, emphasizing ethical concerns identified in the literature and case studies. Thematic codes included "data privacy and protection," "cultural inclusivity," "linguistic diversity," and "accessibility barriers." Coding was conducted manually, and results were triangulated with findings from the literature review to develop a comparative framework for evaluating the ethical practices of the selected AAC systems [4, 9]. This method allowed for a comprehensive assessment of ethical issues and helped highlight both best practices and areas needing further ethical improvement.

#### *2.2.1 Ethical Considerations*

Ethical considerations were central to this research, given the sensitivity of data involved in AI-driven AAC systems. Throughout the study, only publicly available information and previously published research were analyzed to avoid potential data privacy concerns [10]. As no direct user data was collected, the study adhered to established ethical guidelines for research involving secondary data. Additionally, the focus on ethical issues aimed to contribute to the responsible development of AAC technologies and to support advocacy for equitable and inclusive assistive systems.

## 3 Results and discussion

### 3.1 Data Privacy Concerns in AI-Driven AAC Systems

The analysis of AI-driven AAC systems reveals substantial privacy challenges due to the extensive collection and processing of user data, including personal communication patterns and sensitive health-related information [4]. AAC systems like Proloquo2Go and Tobii Dynavox depend on cloud-based services to provide enhanced functionality, such as predictive text and personalized user experience, but at the expense of privacy risk. Griffiths et al. [4] indicate that while these services improve communication efficiency, they also expose data to potential breaches and unauthorized

access. Moreover, the lack of transparent user consent protocols further exacerbates concerns, as users may remain unaware of how their data is stored and shared. To address these risks, stringent data protection policies, such as encryption and anonymization, must be prioritized in the development of AAC systems, fostering user trust and minimizing exposure to potential data misuse [17].

#### *3.1.1 Ethical AI Development and Privacy-Preserving Solutions*

Ethical AI practices are essential for maintaining user trust in AAC technologies. Developers are encouraged to adopt privacy-by-design principles, integrating data protection into the foundational structure of AAC systems. Notably, compliance with global standards, such as the GDPR, has been found to reduce privacy violations in AI applications, as highlighted by Abascal and Nicolle [1]. Thus, incorporating these privacy-preserving strategies can improve AAC systems' ethical framework and support their wider adoption among users with communication impairments.

### 3.2 Inclusivity and Bias in AI-Driven AAC Systems

Inclusivity remains a critical challenge in AI-driven AAC systems, as they often struggle to accommodate diverse linguistic and cultural backgrounds. Analysis of Proloquo2Go and Project Euphonia demonstrates that AAC technologies predominantly cater to English-speaking users, with limited support for other languages and regional dialects [7]. Consequently, users who speak non-dominant languages may face restricted functionality or unintelligible outputs. Raza [12] argues that this limitation stems from insufficiently representative training datasets, which reinforce cultural biases and exclusionary patterns. This bias limits AAC systems' accessibility for marginalized groups, underscoring the need for culturally diverse datasets and customizable features. Table 1 provides a comparative overview of inclusivity metrics across different AAC systems, emphasizing the levels of language support, customization, and dataset diversity.

**Table 1** Inclusivity Metrics Comparison for AI-Driven AAC Systems

| Inclusivity Metric | Proloquo2Go | Google's Project Euphonia | Tobii Dynavox |
|---|---|---|---|
| **Language Support** | Supports multiple languages, limited regional dialects | Limited language support, English focus | Limited to major languages; eye-tracking for physical limitations |
| **Customization Options** | Highly customizable interface; symbols and layout | Adaptive to diverse speech patterns | Customizable interface with eye-gaze controls |
| **Training Dataset Representation** | Limited representation of diverse languages and dialects | Datasets include speech patterns of individuals with impairments | Limited cultural representation in datasets |
| **Accessibility Features** | Supports various disabilities with customizable symbols | Focus on speech recognition for impaired speech | Eye-tracking technology for individuals with severe physical impairments |

This table compares language support, customization options, and dataset representation in Proloquo2Go, Google's Project Euphonia, and Tobii Dynavox.

#### *3.2.1 Customizable Interfaces and Multilingual Support*

The implementation of customizable interfaces and multilingual support could significantly enhance AAC system inclusivity. Pullin et al. [11] suggest that enabling users to adapt the interface based on their language preferences and communication styles ensures that AAC technologies are responsive to individual needs. The integration of multiple languages and culturally relevant symbols can mitigate exclusionary biases, allowing AAC systems to provide more equitable access to diverse populations. As shown in Figure 1, an inclusivity framework for AI-driven AAC systems emphasizes pathways for incorporating customizable interfaces, design elements, and multilingual support, enhancing accessibility for diverse user needs.

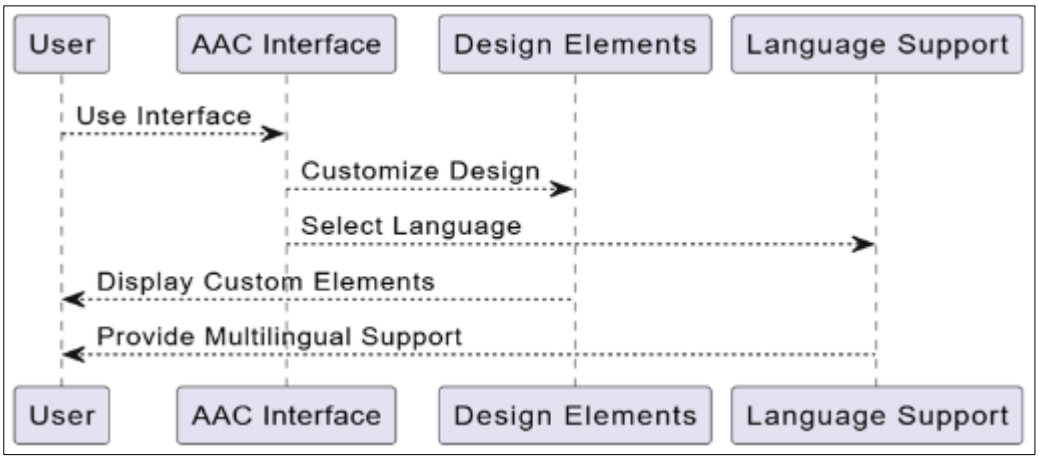


**Figure 1** Inclusivity Framework for AI-Driven AAC Systems

This framework illustrates the flow of user interaction with AAC systems, focusing on customization options, culturally relevant design elements, and multilingual support to accommodate a diverse user base.

### 3.3 Accessibility and Socioeconomic Barriers

The high costs associated with AI-driven AAC systems present a notable barrier to accessibility, particularly for low-income or underserved communities. Tobii Dynavox, while innovative with eye-tracking technology, often remains financially inaccessible due to the high hardware and software costs, limiting access for individuals without adequate financial resources [5, 14]. Additionally, technological literacy requirements pose challenges for users unfamiliar with complex interfaces, further reducing AAC systems' utility in under-resourced communities. Kumar et al. [6] emphasize that this digital divide contributes to inequitable access, as individuals from underserved regions may lack the resources or training needed to use these systems effectively.

#### *3.3.1 Addressing Affordability and the Digital Divide*

To bridge accessibility gaps, policies that subsidize the cost of AAC technologies are essential. Solutions include low-cost, open-source software options and partnerships with tech companies to reduce production costs, as advocated by Zahid et al. [19]. Policymakers and developers can collaborate to develop affordable, user-friendly AAC systems that prioritize accessibility for all socioeconomic groups. Such measures are critical for ensuring that AI-driven AAC systems support users from all backgrounds, thus enhancing the inclusivity and effectiveness of assistive technologies.

### 3.4 Summary of Ethical Recommendations

In summary, addressing the ethical challenges of AI-driven AAC systems requires a multifaceted approach. Privacy-preserving practices, culturally diverse datasets, and affordability initiatives are essential for ensuring that AAC technologies are developed and implemented in ways that are equitable, inclusive, and accessible to all users. By fostering collaboration among policymakers, developers, and disability advocates, AAC systems can be optimized to serve a broader range of individuals and contribute positively to the lives of those with communication impairments [1, 5, 10].

## 4 Conclusion

This study has highlighted the ethical challenges of AI-driven Augmentative and Alternative Communication (AAC) systems, specifically in terms of data privacy, inclusivity, and accessibility. While AAC technologies such as Proloquo2Go, Google's Project Euphonia, and Tobii Dynavox bring substantial benefits to individuals with communication impairments, they also raise concerns that demand attention. Data privacy risks arise from the extensive data collection and cloud-based functionalities that can expose users' sensitive information. Inclusivity remains limited as these systems often fail to accommodate diverse linguistic and cultural backgrounds, resulting in biases that marginalize underrepresented communities. Accessibility barriers persist due to the high costs and technological literacy required, making these systems less available to individuals from low-income or underserved communities.

Addressing these ethical issues requires a comprehensive approach, including implementing privacy-preserving measures, incorporating diverse datasets, and reducing financial and technical barriers. Such improvements are essential for building trust and ensuring that AAC systems are both accessible and inclusive. By fostering collaboration between policymakers, developers, and disability advocates, this study offers a pathway to more equitable AAC technologies that serve a broader range of users effectively.

In conclusion, this research contributes to the responsible development of AI-driven AAC systems, promoting technologies that empower individuals with communication impairments. Through continued ethical enhancements, AAC systems can become instrumental in fostering greater inclusivity and equity in society.

## Compliance with ethical standards

### *Acknowledgements*

The authors would like to acknowledge the support of University of Derby for providing resources and access to research materials necessary for this study. We also extend our gratitude to colleagues and advisors who provided insights that greatly assisted this research.

### *Disclosure of Conflict of Interest*

The authors declare that they have no conflict of interest related to the publication of this manuscript or any affiliations with institutions or products that could influence the outcomes discussed herein. No competing interests exist with products or companies mentioned in this manuscript.

### *Statement of Informed Consent*

Not applicable, as this study does not involve any individual participant data or case studies requiring informed consent.

## References

[1] Abascal J, Nicolle C. Moving towards inclusive design guidelines for socially and ethically aware HCI. Interacting with Computers. 2005;17(5):484-505.

[2] Butt A, Zubair R, Rathore FA. The role of augmentative and alternative communication in speech and language therapy: A mini review. J Pak Med Assoc. 2022;72(3):581-4.

[3] Farahani MS, Ghasemi G. How artificial intelligence plays a role in achieving sustainable development goals? Sustainable Economies. 2024;2(3):66.

[4] Griffiths T, Slaughter R, Waller A. Use of artificial intelligence (AI) in augmentative and alternative communication (AAC): Community consultation on risks, benefits, and the need for a code of practice. J Enabling Technol. 2024.

[5] Johnston SS. Addressing AAC knowledge and skill barriers in rural communities: Strategies for success. Rural Special Education Quarterly. 2024;43(2):91-103.

[6] Kumar A, Nayyar A, Sachan RK, Jain R, editors. AI-assisted special education for students with exceptional needs. IGI Global; 2023.

[7] Lackey S, Watson Hyatt G, Batorowicz B, van Engelen S, Li S, Pinder S, et al. Barriers and facilitators to accommodations in the workplace for adults who use augmentative and alternative communication (AAC): A systematic review. Augment Altern Commun. 2023;39(3):181-97.

[8] Li W, Qiu X, Li Y, Ji J, Liu X, Li S. Towards a novel machine learning approach to support augmentative and alternative communication (AAC). Int J Speech Technol. 2022;25(2):331-41.

[9] Nwafor IE. AI ethical bias: A case for AI vigilantism (AIlantism) in shaping the regulation of AI. Int J Law Inf Technol. 2021;29(3):225-40.

[10] Pampoulou E. Speech and language therapists' views about AAC system acceptance by people with acquired communication disorders. Disabil Rehabil Assist Technol. 2019;14(5):471-8.

[11] Pullin G, Treviranus J, Patel R, Higginbotham J. Designing interaction, voice, and inclusion in AAC research. Augment Altern Commun. 2017;33(3):139-48.

[12] Raza S. Artificial unintelligence: How “smart” and AI technologies perpetuate bias and systemic discrimination. In: Gender, Sex and Tech. 2022. p. 185-205.

[13] Richardson R. Racial segregation and the data-driven society: How our failure to reckon with root causes perpetuates separate and unequal realities. Berkeley Technol Law J. 2021;36:1051.

[14] Shane H, Costello J, Seale J, Fulcher-Rood K, Caves K, Buxton J, et al. AAC in the 21st century: The outcome of technology—Advancements and amended societal attitudes. In: Rehabilitation Engineering: Principles and Practice. CRC Press; 2022. p. 1-19.

[15] Uthoff SA, Zinkevich A, Boenisch J, Sachse SK, Bernasconi T, Ansmann L. Collaboration between stakeholders involved in augmentative and alternative communication (AAC) care of people without natural speech. J Interprof Care. 2021;35(6):821-31.

[16] Vihriälä TA, Ihalainen T, Elo C, Lintula L, Virkki J. Possibilities of intelligent textiles in AAC–Perspectives of speech and language therapists. Disabil Rehabil Assist Technol. 2024;19(3):1019-31.

[17] Wu FT. Defining privacy and utility in data sets. Univ Colo Law Rev. 2013;84:1117.

[18] Yusufali H, Moore RK, Goetze S. Refining text input for augmentative and alternative communication (AAC) devices: Analyzing language model layers for optimization. In: ICASSP 2024 IEEE Int Conf Acoust Speech Signal Process (ICASSP). IEEE; 2024. p. 12016-20.

[19] Zahid A, Krumins V, De Witte L, Zahid A. The development of innovation-sharing platforms for low-cost and do-it-yourself assistive technology in low and middle-income countries. In: Global Perspectives on Assistive Technology: Proceedings of the GReAT Consultation 2019, Volume 2. World Health Organization; 2020. p. 359-72.

[20] Zahid Z, Ali S, Shariq S, Ayaz Y, Naseer N, Yaseen I. RoboCA3T: A robot-inspired computer-assisted adaptive autism therapy for improving joint attention and imitation skills through learning and computing innovations. J Computer Assist Learn. 2024;40(5):2031-48.

## Authors short biography

**Omotayo Emmanuel Omoyemi**

An experienced researcher with an MSc in Information Technology, specializing in areas such as Machine Learning, Computer Vision, and Artificial Intelligence. His research interests lie in leveraging AI to develop assistive communication technologies, particularly augmentative and alternative communication (AAC) systems that enhance accessibility. With a strong background in Educational Technology and over five years of research experience, Omotayo is dedicated to creating innovative, user-centered solutions that improve the quality of life for individuals with communication disabilities.