

Deployment of socially intelligent assistive robots within the African context: The challenges and workarounds

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Abstract

The global effort aimed at integration of Socially Intelligent Assistive Robots (SIARs) into healthcare and work life environments presents promising solutions to growing care needs, especially in terms of supporting aging populations and individuals with disabilities. The deployment of these advanced technologies within the African context, presents unique opportunities and challenges that supersedes conventional technical issues. The article explores the major barriers to effective adoption of SIARs in African nations, including economic feasibility, cultural perceptions, infrastructural deficits, and ethical frameworks. A qualitative method was used for this study. A sample size of fifteen (15) persons were used for this study. A focal group of five (5) in the group comprising of three experts in SIARs and two persons with disabilities using a form of SIARs to help them manage their illness were participants of this study.

The critical disability theory (CDT) framework was used to examined current initiatives amidst proposition of practical workarounds, including community-centric design approaches, localized development models, and the cultivation of relevance, to promote sustainability and ethical integration of assistive robots within the African settings. This novel study in the African context has remarkable findings that will address and improve SIARs patients' recovery efforts. This study suggests a limited disability framework within districts and local settings, a significant (70%) patients are not aware of any regulation to support their disability and deficiencies. Culturally, patients are sometimes resistant to using these devices to assist them because they are not use to these SIARs equipment's. Most patients rely heavily on the family support system but this system is weaning and not adequate for some patients. Disable patients requested for increase investment in SIARs equipment to help them get around freely. Most patients (85%) are not able to afford the SIARs devices to help them navigate and access services that are of importance to them. Those who have faulty devices do not know where to rehabilitate them, (15%) patients who knew where to fix their devices thinks it should be free service for persons with disability. 100% of the patients suggested that maintenance of their device should be home service to reduce the burden on them. Ethical considerations which emerged from this study came from female patients who suggested that they are more comfortable with female caregivers than male caregivers and technicians because of privacy health issues. Implications emerging from this study suggest that stronger local involvement of the patients is key to their recovery and support. District and locals' agencies and technicians' caregivers, should be trained, and be closer to these patients to offer prompt and responsive support.

Introduction

Socially Intelligent Assistive Robots (SIARs) are designed to interact and communicate with humans in a natural and socially acceptable manner, while providing functional support such as physical assistance, health monitoring, rehabilitation support, and companionship (Giansanti et al, 2025). These systems combine artificial intelligence, sensor technologies, and human-robot interaction models to enhance the quality of care and independence of users. In many developed countries, SIARs are increasingly deployed to address the growing demand for healthcare services driven by ageing populations and rising chronic health conditions (Aymerich-Franch & Ferrer, 2023).

In the African context, the potential benefits of SIARs are significant. Many countries across the continent face critical shortages of healthcare professionals, limited access to specialised care, and uneven

distribution of medical resources between urban and rural areas. SIARs offer opportunities to bridge these gaps by supporting remote care, assisting persons with disabilities, and reducing the burden on overstretched healthcare systems (Giansanti et al, 2025). They can also improve the quality of life of individuals by enabling mobility, independence, and continuous care monitoring.

However, the deployment of SIARs in Africa presents challenges that go beyond technical design and functionality. The prevailing discourse on robotics adoption often assumes that solutions developed in Western contexts can be directly transferred into African environments. This assumption overlooks key socio-economic, cultural, and infrastructural differences that influence technology adoption and sustainability (Al-Emran, 2023). Factors such as affordability, cultural acceptance, digital infrastructure, policy frameworks, and local technical capacity significantly affect the integration of these technologies.

Moreover, traditional support systems in many African societies, particularly family-based caregiving, continue to play a central role in supporting persons with disabilities. While these systems are gradually weakening due to urbanisation and economic pressures, they still influence attitudes toward assistive technologies. As a result, the acceptance of SIARs is shaped not only by their functionality but also by cultural beliefs, trust, and perceived relevance.

This study, therefore, examines the barriers to effective adoption of SIARs in African settings using a qualitative approach. It focuses on economic constraints, cultural perceptions, infrastructural limitations, policy awareness, and ethical concerns.

The paper further proposes practical strategies for improving adoption, including community-centred design, localised innovation models, and the development of context-specific policy frameworks. By doing so, the study contributes to the growing body of research on inclusive healthcare technologies and provides insights for policymakers, practitioners, and researchers working toward sustainable and socially acceptable deployment of SIARs in Africa.

Literature Review: Challenges of SIAR Adoption in Africa

The barriers to SIAR deployment in Africa are complex, requiring an integrated approach to finding a solution.

Infrastructural and Economic Hurdles

A fundamental challenge is the technological divide: the disparity in technological infrastructure and expertise serves as a barrier. Consistent power supply and high-speed internet connectivity required for the operation and maintenance of sophisticated SIARs remain either nonexistent or uneven in many rural and even urban African regions (Setiawan, 2024). The initial high cost of procurement and the need for regular maintenance of advanced robotics systems confronts limited healthcare budgets and lower average incomes, making large-scale deployment economically unviable in the absence of significant external funding or dramatic price reductions or subsidies.

Cultural and Social Acceptance

Generally, the success of SIARs depends heavily on user acceptance and trust, which are deeply embedded in cultural norms, notions, beliefs, and social expectations. In several African cultures, caregiving is a communal and deeply human-centred activity, often involving extended family and networks of people within the community (Atoyebi, 2022). Obviously, the integration of a non-human entity into these intimate caregiving roles may be met with resistance, perceived as a devaluation of human connection or an affront to established social support systems (Lacy, 2020). For instance, anthropomorphic robots, specifically, can invoke suspicion if their design conflicts with local spiritual or aesthetic norms.

Ethical and Regulatory Void

Regulatory capacity often lags behind, due to the rapid pace of technological development. Africa currently lacks a comprehensive regulatory framework and policies specifically addressing the ethics of assistive robotics, data privacy, and liability in human-robot interaction (Manoj et al, 2024). Questions pertaining to who should be held responsible should a robot malfunction, or how data collected by a

monitoring robot is used and protected, remain largely unsolved. This creates a risky situation for both users and developers.

Author(s) & Year	Focus / Study Objective	Methodology	Key Findings	Relevance to Current Study
Broadbent (2017)	Social robot interactions in the healthcare context	Literature review	Social robots will benefit us greatly in companionship, communication, etc.	Supports the need for culturally sensitive SIAR design
WHO (2022)	Assistive technology deployment	Policy report	Assistive tech can reduce care gaps; infrastructure limits adoption	Highlights infrastructural barriers in African settings
Al-Tamimi et al., (2025)	Enhancing ageing-in-place technologies	Systematic literature review	Emphasis on continental innovation, local capacity building	Support ageing-in-place, digital inclusion, and tech-enabled independence for older adults
Jessica (2024)	Advancing robotics and control systems	Review	Limited tech access, high costs, and inadequate infrastructure in adopting robotics	Robotics can drive West Africa's economic development and improve the quality of life.
Papadopoulos et al (2020)	Implementing social robots	Systematic review	Enablers: usability, personalisation, familiarisation. Barriers: technical problems and limited capabilities.	Gaps evidence on implementing SIARs in care, calling for more research on environmental, organisational, and societal factors
Vernon (2023)	Culturally competent robotics	Conceptual analysis	Cultural competence is pivotal for social robotics success in Africa; diverse social norms impact trust and adoption.	Culturally competent social robotics can drive innovation and adoption in Africa by addressing diversity, equity, and inclusion.
Ad Adams et al., (2025)	Improving rehabilitation robotics access	Workshop in Ghana (March 2024)	Integrate robotics into therapies for individuals.	Enhance access to neurorehabilitation services and robotics in Africa, promoting collaborative efforts.
Mutongi and Rigava (2024)	Robotics in African healthcare	Qualitative study	Africans fear job losses, cultural impacts (Ubuntu concept), power issues, and connectivity challenges.	Highlights the need for culturally-aware robotics development and awareness in Africa to address challenges and leverage benefits.
Johnson et al. (2020)	Medical assistive robotics globally	Conceptual overview	Medical robots aid surgery and hospital care; assistive robots support rehabilitation.	Improving the cost-benefit ratio can enable the global impact of medical and assistive robotics, benefiting healthcare in low- and middle-income countries.
Keet, (2021)	Social robots in Sub-Saharan Africa	Exploratory analysis	Robots can assist in healthcare and education; education requires natural language generation capabilities.	Social robots in Sub-Saharan Africa need tailored language tech to address service delivery and skills shortages.

Table 1.0: Summary of Relevant Literature on SIARs Adoption and Contextual Factors

Theoretical Context: Critical Disability Theory

Critical Disability Theory (CDT) provides a significant lens for investigating how assistive technologies, including socially intelligent assistive robots (SIARs), relate to the existing experiences of individuals with disabilities. The theory contests the old-style medical framework of disability, which views disability mainly as an individual impairment requiring correction or treatment. Instead, CDT argues that disability is largely shaped by social, cultural, economic, and institutional structures that either empower or limit participation in society (Goodley, 2024).

Within this context, technological interventions such as assistive robots must be assessed not only in terms of their technical functionality but also in terms of how they influence independence, poise, and social inclusion for individuals with disabilities. CDT highlights that individuals with disabilities should not be passive beneficiaries of technology; rather, they should be active respondents in the design, implementation, and evaluation of assistive systems (Goodley, 2024). This perception is predominant and appropriate in the African setting, where cultural norms, economic limitations, and community-based caregiving traditions strongly impact how technologies are perceived and adopted.

Applying CDT to the deployment of SIARs highlights several structural concerns. These include unequal access to assistive technologies, restricted policy contexts supporting disability rights, and the affordability barriers that prevent many persons from obtaining or preserving assistive devices. The theory also draws attention to the importance of culturally sensitive design, as technologies developed in other settings may not align with local values, languages, or caregiving practices.

By adopting the CDT perspective, this study frames assistive robotics not simply as technological tools but as socio-technical systems embedded within broader cultural and institutional environments. This approach helps identify both the barriers faced by persons with disabilities and the prospects for designing socially responsive and locally appropriate robotic solutions within African communities.

Research Methodology

Research Design

To accomplish a deeper understanding into the encounters and acceptance of socially intelligent assistive robots (SIARs) within the African setting, this study adopted a qualitative research design. This method was appropriate because the study focuses on human knowledge, sensitivities, and socio-cultural realities that cannot be fully obtained using quantitative approaches.

The qualitative design allowed the researcher to discover how economic situations, cultural beliefs, infrastructural limitations, and ethical concerns impact the deployment of SIARs; and allowed the study to ascertain the lived knowledge of persons with disabilities, and gain a greater understanding from professionals in the field of assistive technologies. By using this method, the study provides a rich, context-specific understanding of how SIARs are perceived, adopted, and managed within African settings. This aligns with the principles of Critical Disability Theory, which focuses on understanding disability within social and environmental settings rather than purely technical perspectives.

Sampling

The study targeted various stakeholders involved in the usage and deployment of SIARs, which include experts, caregivers, healthcare officers, persons with disabilities (PWDs) and relevant institutional stakeholders actively using socially intelligent assistive robotics. A purposive sampling was adopted as the technique for the selection of a total of 15 respondents according to their experience and relevance to the study objectives. This sample involved five respondents, including three PWDs and experts in SIARs. Again, ten respondents, such as caregivers, healthcare officers and other organisational stakeholders, were randomly engaged in individual semi-structured interviews.

Data Collection Methods

A focus group of respondents in various and related fields was conducted to inspire collaborative thoughts and collective knowledge. The remaining respondents were engaged through individual semi-structured interviews using the approaches chosen for the study, such as allowing flexibility in responses, obtaining thorough individual knowledge, and inspiring open dialogue on sensitive subjects, which included the cost and affordability of socially intelligent assistive robots, cultural acceptance and social

insights, accessibility of support and maintenance services, and awareness of policies and regulatory frameworks.

Data Analysis Approach

The collected data were analysed using thematic analysis. This approach focuses on finding, establishing, and interpreting patterns within qualitative data. Interview transcripts and discussion notes were carefully reviewed and coded. Similar responses were grouped together to form key thematic areas reflecting the major issues and realities of SIAR deployment. The analysis again focused on economic barriers, cultural sensitivities, infrastructure and maintenance issues, policy and regulatory awareness and ethical considerations. This method allowed the study to draw meaningful relationships between the recognised challenges and the wider socio-technical setting in which SIARs function. It also reinforced the application of Critical Disability Theory by emphasising on how structural and societal issues influence technology implementation.

Ethical Considerations

Several ethical considerations, such as obtaining informed consent from all respondents, confidentiality and anonymity assurance, secure storage of the collected data and gender sensitivities and cultural norms, were all observed and established as far as this study is concerned. The study again confirmed credibility, dependability, and transferability through triangulation of data, member checking with participants, and detailed contextual descriptions for transparency and replication in African settings.

Findings

The findings from the study are presented based on key evolving themes identified for the study.

Demographic Characteristics of Respondents

The study involved fifteen respondents selected through purposive sampling. The participants consisted of SIARs, PWDs, caregivers, healthcare personnel, and other organisational stakeholders. Out of the total respondents, 60% were male, and 40% were female. The age distribution showed that the majority of respondents (53%) were between 25 and 40 years, while 27% were between 41 and 60 years, and 20% were above 60 years. In terms of professional background, 20% were SIAR experts, 13% were PWDs actively using SIARs, and the remaining 67% included caregivers, healthcare personnel, and other relevant organisational stakeholders. Regarding educational background, most respondents (73%) had a tertiary education, while 27% had a secondary-level education. This demographic distribution provided a comprehensive perspective from both technical experts and end-users of SIARs, ensuring that the findings reflect both practical and experimental perceptions.

Economic Barriers and Affordability

A major result of the study is the high cost associated with SIAR devices. Approximately 85% of respondents in the study showed that they are unable to afford these technologies due to the economic hardship in the African region. The respondents specifically clarified that devices are expensive to own or procure, the cost for maintenance and repair for these devices is very high, and there is no support system in place for SIAR devices.

Policy Awareness and Institutional Gaps

The study discovered that about 70% of respondents were not aware of any policies or regulatory frameworks supporting persons with disabilities or assistive technologies. Several policy gaps, such as policymakers in the healthcare sector not being familiar with disability, impairment or assistive technology issues and deployments, and are therefore not aware of some of the policy challenges in this area, including the significant challenge of cross-sectoral working as well as there was a lack of explicit indicators for monitoring and evaluation, that were disaggregated by disability, or had disability specific concerns (MacLachlan et al. 2018).

Cultural Resistance and Social Norms

Many respondents showed a strong preference for human caregiving, particularly within extended family networks, reflecting the deeply embedded cultural norm of communal support. This reliance on family-based care often results in resistance to external or non-human assistance, especially for intimate or personal care tasks. Some respondents expressed resistance to non-human caregiving systems; they expressed scepticism about robots' ability to provide empathy, emotional support, and culturally appropriate interaction. Many users reported limited exposure to robotic systems, which generates anxiety and hesitation in adoption (Elsheikh et al, 2025).

Maintenance and Infrastructure Challenges

The majority of the respondents significantly stated difficulties in maintaining SIAR devices. Some stated not knowing where to take the SIAR devices for maintenance when they are faulty, which is described as a major issue. About 15% of the respondents knew where or had access to SIAR device maintenance services. Respondents and users of SIAR devices mostly preferred home service maintenance for their device instead of travelling or transporting to various services and maintenance centres, wherever they are located. They cited possibly the stress that comes along with travelling with these devices to service centres.

Ethical and Gender Considerations

Ethical and gender concerns were emphasised, mainly among female respondents, reflecting sensitivities around confidentiality, dignity, and personal comfort in caregiving circumstances. Many respondents showed a preference for feminine caregivers or experts. The findings discovered the importance of gender-sensitive design and service distribution where structures must account for gender preferences in SIAR device interfaces and personnel deployment. Moreover, respect for cultural norms in healthcare interactions requires that care interactions should adhere to culturally appropriate behaviours, language, and protocols (Vozna & Costantini, 2025).

Discussion And Conclusion

Interpretation of Findings

This study shows that economic limitations remain a major barrier to the adoption of SIAR technology.

The cost of access to SIAR devices is significantly influenced by huge financial capacities instead of the actual need. This confirms that economic limitations in our settings remain a major barrier to the adoption of SIAR technology at large. From the perspective of Critical Disability Theory adopted in the study, it reflects large structural variation, where access to assistive technologies is limited by the financial capacity of the users rather than need. The World Health Organisation (2022) noted that assistive technology deserves maximum attention. This affirmed by Smith et al.'s (2024) study, that they promote participation and support access to life experiences and aspects for individuals with disabilities in societies.

The lack of awareness of policies reflects institutional weaknesses and limited government engagement at the local level. This particularly suggests the weaker or no dissemination of policy information, restrained and limited government involvement at the local level of individuals, and a lack of structured disability support systems. This finding again emphasized on institutional gaps that hinder the effective development and deployment of SIARs. CDT explains this as a systemic issue where social structures fail to provide equal support for individuals with disabilities. According to WHO (2020), assistive technology deserves greater attention from policymakers, stakeholders, and the healthcare sector. Assistive technology plays a substantive role in achieving the Sustainable Development Goals and enabling all individuals with disabilities to lead healthy, productive, independent and dignified lives (Shi & Banozic, 2022).

Cultural beliefs and social practices significantly shape attitudes toward socially Intelligent assistive robots (Papadopoulos et al, 2023). The key observation from the study was dependence on family support structures: this, care is traditionally viewed as a family responsibility, and reliance on SIARs may be perceived as undermining these social obligations. This highlights that cultural and social norms are

central to technology acceptance. Successful SIAR deployment must incorporate culturally aware design and participatory engagement with communities. According to Critical Disability Theory, technologies should empower users rather than replace socially meaningful interactions. Interventions like co-design workshops and community education can mitigate resistance and build trust in assistive robots while respecting local caregiving practices (Charlot-Wauquier, 2025).

The report of no knowledge of the local service centres significantly affects the usage of the SIAR devices and preference for home service maintenance instead of travelling to get them serviced, noted by some of the respondents. Maintenance and infrastructure are critical for the sustained socially intelligent assistive robots (Golightly et al, 2022). Feeble support systems increase the probability of SIAR devices being discarded, even among users who initially accept the technology (Shore et al, 2022). This supports the conception from the socio-technical systems model that technology adoption not only hinges on SIARs device design but also on the surrounding infrastructure and support networks. Developing localised mechanical hubs, training experts, and providing available repair services for SIAR devices are important approaches to guarantee serviceability and dependability (Setiawan, 2024).

Ethical and gender considerations highlight the need for all-inclusive and context-aware SIAR design. Deploying assistive robots without consideration for privacy and cultural norms can reduce adoption rates and erode trust (Marchang & Di Nuovo, 2022). Aligning with Critical Disability Theory, the technology should increase user self-sufficiency and self-esteem. Solutions include designing gender-specific selections, guaranteeing privacy controls, and integrating local cultural norms into various robot behaviours. Policymakers and developers must consider these dimensions when creating ethical guidelines and standards for assistive robotics (Gkiolnta et al., 2025)

Across these areas raised in the study, the findings, however, show that issues are surrounded by social, economic, and institutional structures. To ensure the successful deployment of SIARs in Africa, solutions must combine technological development with social engagement, community co-design, policy development, and capacity building. Critical Disability Theory frames these technologies not merely as assistive tools but as interventions embedded in cultural and social realities, emphasising empowerment, inclusivity, and a locally responsive design. Holistic approaches that address these multiple dimensions will enhance the adoption, usability, and sustainability of assistive robots.

Workarounds and Pathways to Sustainable Integration

Addressing the above-mentioned challenges requires a localised, bottom-up approach that gives precedence to adaptability and community engagement.

Promoting Localised Development and Innovation Hubs

Developing locally based robotics ecosystems in Africa is crucial, taking into account local factors and disparities, instead of relying on imported finished products. Initiatives such as the Robotics and Artificial Intelligence Nigeria (RAIN) network or similar hubs in South Africa, Ghana, and Kenya focus on capacity building by encouraging local engineers to design context-appropriate technologies using affordable and readily available, robust materials (Okiye et al, 2023). Efforts of this nature can lead to the design of robots that are naturally tailored to the local environment, offering benefits such as easy repairability, energy efficiency, and compatibility with the existing infrastructure.

Community-Centric Design and Co-creation

To overcome cultural acceptance barriers, the design process must involve all stakeholders, including end-users, caregivers, and community leaders, from the outset (Henni et al, 2022). The collaborative creation approach ensures that SIAR functionalities and interaction styles adhere to local customs, languages (for instance, incorporating Akan, Swahili, Ewe or Yoruba interfaces), and aesthetics. Pilot programmes should be conducted within communities, rather than the final product being imposed upon them. This strategy can build trust and demonstrate the robot's utility as a complementary tool to human care, not its replacement.

Tailored Economic Models and Policy Advocacy

Efficient funding models, such as leasing programmes, subsidised government initiatives, or public-private partnerships, can help to absorb the high initial costs (Oyegbade et al, 2022). Advocating for the development of clear, protective, and contextually relevant data privacy and robotics policies alongside is

essential. Developers (firms) can draw inspiration from the African Union's Agenda 2063 to align technological integration with broader developmental goals, while ensuring that technology serves the continent's vision for inclusive growth.

Conclusion

The deployment of socially intelligent assistive robots (SIARs) in Africa presents challenges related to infrastructure, economics, and culture; however, these can be addressed through localised innovation. The study emphasises the importance of community engagement in the design and implementation of SIAR systems, ensuring they meet user needs and cultural standards. It is also crucial to establish clear ethical and regulatory frameworks for responsible deployment. By aligning these technologies with social realities, African nations can leverage SIARs to enhance healthcare, support independence for individuals with disabilities, and reinforce existing support systems sustainably and culturally appropriately.

Limitations and Future Research

This study acknowledges several limitations in its findings. Firstly, the relatively small sample size of 15 participants affects the generalisability of the results. While the qualitative approach offers detailed insights, it may not represent the diverse experiences across different regions. Secondly, the focus on specific participants, including SIAR experts and selected users, could introduce bias, as it overlooks the perspectives of other stakeholders like policymakers and a broader population of persons with disabilities. Lastly, conducting the study within a narrow contextual scope means that variations in infrastructure, culture, and policy environments across African countries could influence the applicability of the findings.

Future research should extend SIAR adoption studies across more African countries and utilise larger, mixed-method samples for broader insights. There is a need for further exploration into affordable, locally produced SIAR systems and studies on policy frameworks to enhance government support for assistive technologies. Participatory design approaches involving persons with disabilities should be prioritised, along with long-term studies on the sustainability and performance of SIAR systems to ensure their effectiveness.

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