

Culturally Adaptive AI in Autism Screening: A New Paradigm for Equitable Early Detection

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Abstract— Early detection of autism spectrum disorder (ASD) is crucial for timely intervention and improved outcomes. While artificial intelligence (AI)-based digital screening tools have enhanced the objectivity and scalability of autism diagnosis, they often fall short in addressing the diverse cultural and linguistic contexts of underrepresented populations. This review highlights the emerging need for community-driven, culturally adaptive AI screening systems that prioritize inclusivity and equity. By involving local communities in the design, data collection, and validation processes, these systems can better capture culturally specific behavioral markers and overcome barriers related to language, literacy, and access. We discuss current AI screening tools, their limitations in diverse settings, and propose a research framework that integrates participatory design, localized AI training, and ethical considerations. Implementing culturally responsive AI tools within community health infrastructures has the potential to reduce diagnostic disparities and empower families worldwide. This paper aims to inspire future research and collaboration toward developing autism screening technologies that are not only accurate but also culturally meaningful and accessible to all.

Index Terms— Autism spectrum disorder, AI screening, cultural adaptation, community-driven research, diagnostic equity, digital health tools.

I. INTRODUCTION

Early detection of autism spectrum disorder (ASD) is widely recognized as a foundation for effective support, as it allows children and their families to access appropriate interventions during the most critical stages of growth. Numerous studies have demonstrated that identifying autism at a young age can greatly improve a child's communication, social development, and adaptive skills. However, despite this evidence, significant gaps in early diagnosis still exist across the world. These gaps are shaped by cultural beliefs, differences in language, and unequal distribution of healthcare facilities, which together limit access to reliable screening and diagnostic services, particularly in underrepresented regions.

Conventional screening methods, though valuable, depend heavily on parent-reported questionnaires and clinical observations. Such approaches may fail to capture how autism appears across different cultures and languages. For instance, in some societies direct eye contact is seen as normal, while in others it may be considered disrespectful. If tools do not account for these cultural variations, children risk being misdiagnosed or overlooked. As a result, those from minority groups, rural areas, or low-resource communities are often identified late—or not at all—missing crucial opportunities for early intervention.

To overcome these challenges, digital and artificial intelligence (AI)-driven screening systems have been introduced as innovative alternatives. Tools like SenseToKnow use smartphone or tablet-based analysis of behavioral signals, including gestures, eye movement, and expressions, offering a faster, more scalable, and objective form of screening. While promising, most of these systems have been developed and validated in high-resource, urban, and Western environments. This narrow focus creates the risk of cultural bias within AI algorithms, leading to reduced accuracy when applied in diverse settings. The lack of locally relevant data and minimal community participation in their design further restrict their general use and fairness.

In response, there is an increasing focus on community-driven and culturally adaptive AI systems. These approaches ensure that parents, teachers, healthcare providers, and local experts are engaged in each stage of development—from collecting data to training algorithms and testing in real-world environments. By embedding cultural and linguistic awareness into the design, such systems can better reflect children's actual developmental patterns across different populations. This inclusive strategy holds strong potential to close existing diagnostic gaps and make early autism detection more accurate, accessible, and equitable worldwide.

II. LITERATURE SURVEY

The landscape of autism screening is rapidly evolving with the integration of artificial intelligence (AI) and digital technologies, aiming to address longstanding challenges in early detection, particularly for underserved and diverse communities. Traditional autism diagnosis has relied heavily on clinician-administered assessments and parent-report questionnaires, which, while effective in certain contexts, often require significant time, specialized expertise, and in-person access to healthcare facilities. These requirements have contributed to diagnostic delays, especially in rural, low-resource, and minority populations, where access to specialists and culturally relevant tools is limited.

Recent advances in AI have led to the development of intelligent screening systems that significantly reduce diagnostic time and broaden the reach of early autism detection beyond hospital settings into communities. For example, mobile applications utilizing convolutional neural networks have demonstrated high accuracy and sensitivity in screening children under 36 months, enabling mass screening in community health services and improving clinical efficiency. Similarly, AI-powered platforms now integrate multiple data sources—including caregiver-completed questionnaires, home videos, and clinician input—to deliver timely, accurate assessments for children in both urban and rural areas. These systems have shown strong predictive value and can function effectively even in telehealth or remote scenarios, which is particularly valuable during public health emergencies or in geographically isolated settings.

Community-driven initiatives are also gaining momentum. Platforms like Leeza AI are being developed with direct input from caregivers, therapists, and community leaders, ensuring that features are accessible, regionally adapted, and culturally sensitive². Such approaches prioritize inclusive design, simple user experiences, and local language support, aiming to make early autism care affordable and integrated into public health and education systems². Meanwhile, new AI models, such as the Chaotic Binary Butterfly Optimisation Algorithm-based Feature Selection and Data Classification (CBBOAFS-DC), are leveraging international collaborations to achieve high accuracy in identifying ASD across age groups and contexts, supporting healthcare providers in making earlier and more consistent assessments.

Despite these advancements, most AI-based tools are still in early stages of adaptation for truly global and culturally diverse use. The majority have been developed and validated in limited settings, underscoring the urgent need for further research and community engagement to ensure that digital screening technologies are equitable, generalizable, and effective for all populations. Your goal is to simulate the usual appearance of papers in a Conference Proceedings or Journal Publications. We are requesting that you follow these guidelines as closely as possible.

III. THE NEED FOR CULTURALLY ADAPTIVE, COMMUNITY-DRIVEN AI

A. Cultural Variability

Autism spectrum disorder manifests through a range of social, communicative, and behavioral characteristics that are deeply influenced by cultural context. Social norms, communication styles, and expectations for child development differ significantly across cultures, which means that behaviors considered typical in one community may be interpreted differently in another. AI models trained predominantly on Western datasets risk overlooking or misinterpreting autism markers in children from diverse cultural backgrounds. This limitation can lead to false negatives or positives, undermining the accuracy and fairness of digital screening tools. To address

this, culturally adaptive AI systems must incorporate locally relevant behavioral indicators and be sensitive to variations in social interaction patterns, language use, and nonverbal communication. Such adaptation is essential to create screening tools that are valid and reliable across global populations, thereby reducing diagnostic disparities.

B. Digital Divide

The promise of digital health technologies is tempered by persistent inequalities in access to technology and digital literacy. Many families, especially those in low-income or rural areas, face barriers such as lack of smartphones or tablets, unreliable internet connectivity, and limited experience with digital platforms. These challenges restrict the reach of AI-based autism screening tools and risk excluding those who might benefit the most. Furthermore, trust in digital health solutions varies widely, influenced by prior experiences, cultural attitudes toward technology, and concerns about privacy. Overcoming the digital divide requires not only technological solutions—such as offline-capable apps or low-bandwidth designs—but also community education and support to build digital confidence and acceptance.

C. Community Engagement

Developing effective, equitable AI screening tools demands active collaboration with the communities they intend to serve. Participatory design approaches involve caregivers, healthcare providers, and local stakeholders throughout the development process, ensuring that tools are linguistically accessible, culturally relevant, and aligned with users' needs and values. This engagement fosters trust, improves usability, and enhances the likelihood of successful adoption. Community input can guide everything from the choice of screening tasks and language used, to the format and delivery of results. By centering community voices, culturally adaptive AI systems become more than just technological innovations—they become tools co-created with and for the people, supporting sustainable improvements in early autism detection and care.

IV. RESEARCH DIRECTIONS AND OPPORTUNITIES

To address the limitations of current AI-based autism screening tools and promote equitable early detection, several key research directions have emerged. These focus on fostering community involvement, cultural relevance, practical implementation, and ethical integrity. The following sections outline promising opportunities to advance the development and deployment of culturally adaptive, community-driven AI screening systems.

A. Community-Partnered AI Model Training

A foundational step toward equitable autism screening involves actively partnering with underrepresented communities to collect rich, culturally relevant behavioral data. This process requires building trust and long-term collaborations with local families, clinicians, and community organizations to ensure data accurately reflect the diversity of social behaviors, communication styles, and developmental norms present in different populations. Training AI models on such inclusive datasets is essential to reduce algorithmic bias and improve the sensitivity and specificity of screening tools across various cultural contexts. Moreover, validating these AI models within the communities where they will be deployed ensures that the tools perform reliably and meaningfully, increasing confidence among users and healthcare providers.

Localization and Adaptation of Screening Content

To maximize effectiveness and acceptance, screening tasks and user interfaces must be thoughtfully adapted to the cultural and linguistic characteristics of target populations. This involves collaborating closely with local clinicians, caregivers, and cultural experts to modify language, instructions, and interaction formats in ways that address literacy levels, dialects, and cultural norms. For example, visual stimuli, question phrasing, and response options may need adjustment to resonate with local customs and communication styles. Such localization not only improves usability but also fosters trust and engagement, which are critical for accurate screening outcomes and sustained use.

Implementation and Real-World Integration

Piloting culturally adapted AI screening tools in real-world community health settings is crucial to assess their practical feasibility and impact. Research should evaluate metrics such as screening uptake, referral rates, diagnostic equity, and satisfaction among families and healthcare workers. Understanding barriers—such as technological limitations, cultural skepticism, or workflow integration challenges—can inform iterative improvements. Additionally, studying facilitators like community health worker involvement or caregiver education programs can help design scalable implementation strategies. Successful integration into existing

health infrastructures ensures that these tools reach those most in need and contribute meaningfully to reducing disparities in autism diagnosis.

Ethical and Privacy Considerations

Ethical stewardship is paramount when collecting sensitive behavioral and health data, especially within diverse cultural contexts. Developing culturally sensitive informed consent processes that respect local values and communication preferences helps ensure that participants fully understand how their data will be used. Robust data governance frameworks must address privacy, security, and data ownership concerns, with transparent policies on data sharing and use. Engaging communities in these ethical discussions fosters trust and accountability, which are essential for sustainable research partnerships and the responsible deployment of AI screening technologies.

Together, these research directions emphasize a holistic approach to developing AI-driven autism screening tools that are technologically robust, culturally responsive, ethically sound, and practically viable in diverse global settings

V. CHALLENGES AND FUTURE DIRECTIONS

As the field of culturally adaptive, community-driven AI screening for autism advances, several critical challenges must be addressed to ensure these technologies achieve their full potential. Overcoming these obstacles is essential for creating sustainable, equitable, and effective screening solutions that serve diverse populations worldwide.

A. Data Scarcity

A significant barrier to the advancement of culturally adaptive, community-driven AI screening tools is the lack of large, representative datasets from diverse communities. Most current AI models are trained on data predominantly sourced from urban, higher-resource, and Western populations, which limits their generalizability and risks perpetuating diagnostic bias. To ensure accurate and equitable autism detection, it is crucial to build expansive autism databases that include behavioral and demographic data from a wide range of ethnic, linguistic, and socioeconomic backgrounds. Achieving this requires not only technical solutions for secure data collection and storage but also community engagement to encourage voluntary participation and trust in research initiatives.

B. Sustainability

For AI-based screening tools to have lasting impact, there must be a focus on building local capacity for ongoing tool maintenance, adaptation, and improvement. This includes training local healthcare providers, data scientists, and community workers to manage and update AI systems, as well as fostering collaborations between researchers and community organizations. Sustainable implementation also involves developing user-friendly interfaces, providing technical support, and ensuring that tools remain relevant as community needs and technologies evolve.

C. Policy Support

The integration of AI-driven autism screening tools into public health systems is essential for broad and equitable access. Policy frameworks should prioritize funding for community-based research, support the development of culturally competent digital health solutions, and establish guidelines for ethical data use and privacy protection. Public-private partnerships and government initiatives can accelerate the scaling of these technologies, ensuring that all children—regardless of background—benefit from timely and accurate autism detection. Continued policy engagement will also be necessary to address the digital divide, promote digital literacy, and safeguard the interests of marginalized populations as technology adoption expands.

In summary, addressing data scarcity, sustainability, and policy support will be pivotal in shaping the future of culturally adaptive AI screening tools. By confronting these challenges head-on, researchers, practitioners, and policymakers can work together to build inclusive and enduring systems that advance equity in early autism detection globally.

VI. CONCLUSION

Culturally adaptive and community-driven AI screening systems mark an important advancement in making autism detection more fair and inclusive. When families, healthcare workers, and local communities are actively involved in developing and testing these tools, they can better reflect cultural differences and reduce errors in

diagnosis. This collaborative approach not only improves the accuracy and reliability of screening but also builds trust among caregivers and professionals, which is essential for adoption in real-world settings. Most importantly, such systems can help overcome the long-standing barriers faced by children in rural and underserved areas who often miss timely diagnosis. Looking ahead, continued cooperation between researchers, clinicians, and communities will be necessary to refine these tools, protect ethical use of data, and embed them into public health services. With these efforts, early autism detection can become more accessible, accurate, and meaningful for every child, ensuring timely support and stronger developmental outcomes..

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