Journal of Information Technology and Computer Science
Journal Homepage: https://nicomarcinternationalpublishers.com/index.php/ JITCS/index

JITCS
NICOMARC INTERNATIONAL PUBLISHERS

| RESEARCH ARTICLE

Harnessing AI For Inclusive Security: Addressing Challenges In Deaf-Dominant Areas

Albert Ulutorti Green

Department of Special Education,St. Paul's Theological College Awka

Corresponding Author: Albert Ulutorti Green**, E-mail**:green.albert@sptcawka.com.ng

| ABSTRACT
This study investigates how artificial intelligence (AI) might improve security for Deaf people by removing barriers to communication in emergency scenarios. Security is particularly difficult for deaf populations because traditional institutions are built for hearing people, which leaves them exposed in emergency situations. Barriers to communication, such the use of vocal warnings and aural alerts, increase these hazards and emphasise the need for more inclusive solutions. How can AI enhance security for Deaf people? is the main topic that the study seeks to address. Incorporating AI-driven technologies such as real-time translation, sign language recognition, and predictive analytics, this study suggests a more effective and accessible security framework for Deaf communities. To collect information on current security issues and AI applications, the study uses questionnaires, interviews, and case studies as part of an exploratory research approach. The main technologies covered include real-time translation systems that translate spoken language into text or sign language, predictive analytics to anticipate possible threats and speed up security response times, and sign language recognition, which enables Deaf people to interact with emergency responders. The study also points out weaknesses in the security solutions that are currently in place, most notably the incompatibility of AI technologies with the infrastructure that is already in place. The case studies' results demonstrate how well AI-powered solutions may increase accessibility and user satisfaction, despite ongoing integration and accuracy issues. The study adds to the expanding corpus of research on inclusive security by providing useful suggestions for the creation and application of AI solutions that take into account the particular requirements of Deaf people. Subsequent investigations ought to concentrate on improving these technologies and tackling moral dilemmas in their application.
.

| KEYWORDS

Artificial Intelligence AI, Inclusive Security,Deaf Community, Accessibility Technologies, Emergency Communication Systems , Digital Inclusion

| ARTICLE INFORMATION

ACCEPTED: 17 May 2026 **PUBLISHED:** 15 June 2026

1. Introduction
Deaf populations present particular security concerns, mainly because of communication barriers that frequently reduce the efficacy of traditional security measures (Kushalnagar, et al, 2018: Green, 2024). This communication gap is particularly important during emergencies like fires, medical crises, or criminal activity, when prompt coordination and information can make the difference between life and death. Despite the fact that conventional security systems are made with hearing people in mind, Deaf people have few options that are specifically suited to meet their needs (Leigh et al., 2022). Many current security infrastructures still lack the accessibility features required to be completely inclusive, despite the increased awareness of these issues. This leaves Deaf people feeling more vulnerable. When it comes to security, the main problem Deaf communities face is

the absence of accessible communication methods that can successfully connect emergency services with those who have hearing impairments (Calgaro et al., 2021; Souza et al., 2017). For Deaf people, current security measures like sirens, alarms, and verbal warnings are useless or unnecessary because they are made for the hearing population. Generally speaking, Deaf users are not taken into account while designing and implementing security solutions, which makes communication hurdles worse. Because they are frequently asked to interpret security concerns using their eyes and other senses, Deaf people are more vulnerable in an emergency (James et al., 2021). Deaf people are also left vulnerable during emergencies because, despite the existence of assistive technologies like captioning and video relay services, they are frequently not incorporated into emergency security procedures.

The main inquiry driving this project is: How might artificial intelligence (AI) improve security for Deaf people in Deaf-dominant communities? AI has the ability to provide creative, easily accessible security solutions that will help Deaf people overcome their communication difficulties. By providing real-time translations and sign language recognition, artificial intelligence (AI) technology can enable Deaf people to fully engage in security systems, allowing them to communicate with emergency responders, receive timely warnings, and navigate their surroundings more safely. Investigating how AI can be used to develop a more inclusive security framework for Deaf populations is the goal of this project.

This research holds importance as it has the ability to modify security procedures to better accommodate Deaf people, guaranteeing that they are not overlooked during times of emergency. By tackling accessibility issues and offering AI-driven solutions, this research advances a more just public safety strategy. It also highlights how crucial it is to be inclusive of technology in a future where artificial intelligence is influencing every part of our everyday life. More social inclusion would result from the effective integration of AI into security frameworks, which would also improve the safety of Deaf people and serve as a model for enhancing accessibility in other spheres of life, such as work and education.

2. Literature Review

Deaf communities face numerous challenges that are often compounded by the general lack of understanding and inclusivity in society (Ferndale, 2018; Fisher & Mirus, 2018). The most prominent challenge is communication, as most of the Deaf individuals rely on sign language, a visual and gestural form of communication, rather than spoken words. This reliance on non-verbal communication methods makes it difficult for them to interact effectively in environments designed for hearing people (Khuman, 2024; Kushwaha, 2024; Marshall et al., 2015). In addition to communication barriers, Deaf individuals often experience social isolation, limited access to information, and difficulty in navigating public spaces. These challenges are particularly pronounced in emergency situations, where rapid and clear communication is essential for personal safety. The lack of tailored systems that address these unique needs has led to a growing recognition of the necessity to develop inclusive solutions that empower Deaf individuals to engage more fully in society and enhance their safety.

While conventional security systems such as fire alarms, sirens, and surveillance cameras serve the general public, they do not account for the specific needs of Deaf individuals (Jain, 2022). Traditional alarm systems, which rely on sound, are ineffective for those who cannot hear them. The reliance on auditory signals, which are prevalent in many public and private security systems, leaves Deaf individuals at a disadvantage in situations requiring immediate response. Additionally, security personnel are often ill-equipped to communicate with Deaf individuals during emergencies, further exacerbating the risks they face. While there have been some attempts to create visual or tactile alarms (Green & Nnatuanya, 2024; Meng & Spence, 2015; Redmiles et al., 2016; Smedberg et al., 2022), these solutions are often limited in scope and not integrated into larger security infrastructures. As a result, many Deaf individuals continue to rely on their own vigilance and awareness, which may not always be sufficient in emergency scenarios (Gordon, 2019).

Artificial intelligence has emerged as a powerful tool in improving accessibility, with various applications being developed to assist Deaf individuals in overcoming communication barriers. AI-driven solutions such as speech-to-text systems, real-time translation, and sign language recognition are transforming how Deaf individuals interact with technology, making everyday tasks and communication more accessible. In the realm of security, AI holds significant promise (Akhtar, 2024). AI-powered systems can provide real-time alerts, translate sign language into text or speech (ARUNA et al., 2024; Muhammed Farsin et al., 2024), and even analyze patterns in security footage to predict potential threats. These applications have the potential to create more inclusive security systems that empower Deaf individuals to respond to emergencies promptly and effectively, while also improving their ability to communicate with security personnel.

2.1 Theories

Universal Design for Learning (UDL) by David H. Rose (born 1950)

Developing inclusive systems that can accommodate all students, including those with disabilities, from the outset is crucial, according to the Universal Design for Learning (UDL) principle (Capp, 2017; Gordon et al., 2016). UDL promotes creating learning environments and instructional resources that are universally accessible from the start rather than adapting systems or surroundings to make them accessible afterward. The goal is to promote equality in learning experiences by making sure that everyone can interact effectively with the content, regardless of their physical or cognitive capacities.

UDL plays a critical role in directing the creation of AI-powered technologies intended to improve accessibility and communication for Deaf communities (Bruce & Williams, 2025; Jowallah, 2025). AI systems can be created from the ground up to meet the special requirements of Deaf people by utilising UDL concepts. Examples of these technologies include real-time sign language interpretation, visual alarms, and subtitles. This method guarantees universal access to AI systems, encouraging inclusive engagement without requiring post-development adjustments. Better user adoption can result from the incorporation of UDL into AI solutions, which can also increase the efficacy and involvement of Deaf people with AI security systems.

2.2.1 Acceptance Model (TAM) By Fred D. Davis (born 1954)

According to the Technology Acceptance Model (TAM), a technology's perceived utility and usability are the primary determinants of its adoption (Howard & Hair Jr, 2023; Rahimi et al., 2018). According to the idea, people are more inclined to embrace and use technology if they believe it to be both useful and simple to use. TAM is frequently used to analyse user acceptability of new technologies and has proven very useful in assessing how people use developing technologies in diverse settings.

When assessing Deaf people's acceptance of AI-powered security solutions, the TAM is especially pertinent. TAM is used in this study to determine the variables affecting Deaf people's readiness to embrace AI-powered technologies, like security systems that use sign language or speech-to-text recognition. The AI system has a higher chance of being adopted if the Deaf community finds it easy to use and believes it can enhance security and communication (Kafle et al., 2020; Zdravkova et al., 2022; Zhu, 2024). The model will guide the development of more accessible solutions by assisting in determining whether AI security technologies are helpful and simple for Deaf people to use. The study determines adoption barriers and offer solutions to improve the usability of AI systems for Deaf users by investigating these perceptions.

The use of AI for sign language recognition was investigated in a study by Liang, et al,. (2022)., which concentrated on creating machine learning algorithms that could translate sign language into text in real time. According to the study, AI models had trouble with regional variations and signing style variety, even though they could obtain high accuracy rates in controlled settings. Notwithstanding these drawbacks, the study showed how AI could help Deaf people communicate better, especially in formal and emergency settings. This is in line with the objectives of the study, which are to investigate how AI may be used Practically to enhance security for Deaf populations.

ARUNA, et al. (2024) conducted a second empirical study that focused on Deaf people and examined how AI-powered solutions may be used to increase accessibility in emergency services. Although certain AI systems could provide text-based alerts, the study pointed out that these systems were frequently not linked with the security infrastructure that was already in place, which rendered them useless in practical situations. In order to develop solutions that are both efficient and easy to use, the study also found that emergency service providers and AI developers need to work together more. The difficulties noted in the current study, which will concentrate on closing the gap between AI capabilities and real-world application in security system are echoed in this research.

Although earlier research has looked into the use of AI in emergency accessibility and sign language recognition, there is still a big gap in how these technologies may be integrated into coherent security frameworks that are made with Deaf people in mind. Up until now, the majority of research has been on discrete AI applications, like sign language translation or speech-to-text, without taking into account how these technologies may be combined to provide an integrated security solution. By investigating how AI can be applied not just for communication but also for predictive analytics and real-time security responses, this project aims to close this gap and develop a thorough security framework that takes into account the particular requirements of Deaf people.

3.Methodology

In order to identify the possible applications of AI in enhancing security for Deaf people, the study used an exploratory research design. An in-depth analysis of current AI applications and their suitability for Deaf communities' security requirements is made possible by the exploratory character of the study. Understanding the prospects and practical obstacles posed by AI-powered security solutions will be the main goal of the study, which will also offer insights into how these technologies might be incorporated into actual security systems.

The project will use a mix of questionnaires, interviews, and case studies to collect data. Deaf people will receive surveys to gauge their opinions of AI-powered solutions and their present experiences with security systems. Experts in AI, emergency services, and Deaf advocacy will be interviewed to learn more about the viability of integrating these technologies into current security systems. Real-world examples of both achievements and difficulties will be provided through case studies that look at cases where AI has previously been incorporated into security systems in Deaf communities.

Real-time translation, predictive analytics, and sign language recognition are the three main AI-powered technologies that are the subject of this study. The possibility of sign language recognition technology to facilitate real-time communication between emergency services and Deaf people is being investigated. The capacity of real-time translation systems to translate spoken language into text or sign language in an emergency was investigated. The ability of predictive analytics to spot possible security risks and speed up emergency response times was evaluated. Three main measures were used to assess the efficacy of the AI-powered security solutions: user satisfaction, efficacy, and accessibility. The ease with which Deaf people may engage with and incorporate the AI systems into their daily lives was used to gauge accessibility. The precision and dependability of the AI systems in identifying and reacting to security risks served as a gauge of effectiveness. Surveys and interviews were used to measure user satisfaction, with particular emphasis on the perspectives of security guards and Deaf people.

3.1 AI-Powered Security Solutions

To identify and decipher sign language motions, machine learning algorithms is to be used used in sign language recognition technology (Aktar, 2023; Buttar et al., 2023; Chong & Lee, 2018; Sharma & Singh, 2021). These systems are trained on vast amounts of sign language video material, which enables them to identify distinct hand gestures, facial expressions, and body postures that make up various signs. Through this technology, Deaf people can interact with security systems, emergency responders, and law enforcement without using spoken language in security-related situations. By integrating sign language recognition into security systems, artificial intelligence (AI) can help close the communication gap that frequently places Deaf people at risk in emergency situations (Cate, 2025; Cicharska et al.; Lyu et al., 2024).

Natural language processing and machine learning are used by real-time translation systems to instantaneously translate spoken language into text or sign language (Brongar et al., 2024; Mohammedali et al., 2022; Palla, 2023; Repal et al., 2024). These devices have the ability to instantly give Deaf people access to spoken information, including police commands or emergency notifications. The advantages of real-time translation in security scenarios are obvious: it enables Deaf people to obtain important information in a comprehensible way. However, there are still issues with accuracy, particularly when speaking in noisy settings or with various languages and accents. A major goal of this research will be to make sure that real-time translation systems are swift enough and dependable enough to be helpful in an emergency.

Using past data and machine learning algorithms, predictive analytics forecasts possible security vulnerabilities before they materialize. To find trends in accidents, crime, or other security threats that can disproportionately impact Deaf people, Deaf communities can apply predictive analytics. For instance, predictive models might be used to pinpoint high-crime or violent areas where Deaf people are particularly vulnerable (Asquith & Bartkowiak-Théron, 2021; Asrifan et al., 2025; Selbst, 2017). Through the analysis of these patterns, artificial intelligence (AI) technologies can improve the safety of Deaf communities by enabling security staff to respond proactively and provide early warnings.

3.2 Case Studies and Results

AI-powered security solutions for Deaf people have already been applied in a pilot projects, with encouraging outcomes. In one such initiative, emergency alert systems were integrated with real-time translation and sign language recognition, enabling Deaf people to interact with emergency services via a mobile app and get notifications. It was discovered that this method greatly increased accessibility and reaction times in emergency situations, giving Deaf people the resources they require to remain informed and safe. Predictive analytics has been applied in other case studies to predict possible dangers, enabling security personnel to intervene more quickly and effectively. More of this needs be done and proper development of such project in real time is needed, every nation and security setting should invest in AI to enable an inclusive security, come 2035 (Salau et al., 2022).

While AI-powered security solutions can greatly improve security for Deaf people (Awad et al., 2024), there is still room for improvement, according to evaluations of these systems. In terms of efficacy, it has been discovered that sign language recognition systems perform very well in controlled settings but poorly in unpredictable real-world situations. Although useful, real-time translation systems have drawbacks due to environmental noise and linguistic complexity. Overall, user satisfaction has been favorable, with Deaf people expressing increased confidence in their capacity to interact with security staff and respond to emergencies. But there are also issues with these technologies' accessibility, especially for people who might not be tech-savvy. The deployment of AI-powered security solutions has yielded some important insights. First, it is impossible to overestimate the significance of cooperation between Deaf advocacy organizations, security authorities, and AI developers. These parties can guarantee that AI solutions satisfy the unique requirements of Deaf communities and are smoothly incorporated into current security infrastructures by cooperating. To increase accuracy and dependability, real-time translation and sign language recognition systems also need to be updated and improved on a regular basis. Lastly, in order to guarantee that Deaf people can utilize these technologies efficiently in an emergency, user education is essential.

4. Discussion

The safety of Deaf populations is significantly impacted by the adoption of AI-powered security systems (Alkahtani, 2024). AI can lessen the risks Deaf people face in emergency circumstances by giving them the means to communicate effectively and enhancing their access to vital information. Additionally, society can get closer to greater equity and inclusivity by incorporating AI into larger security frameworks, guaranteeing that Deaf people are not left out of safety precautions based only on their communication needs.

The range and efficiency of the security options available to Deaf people today, such as vibrating alerts and visual alarms, are constrained. Although some accessibility issues are addressed by these technologies, they do not offer a complete answer to the communication difficulties Deaf people encounter in emergency situations. Conversely, AI-powered solutions provide a more flexible and scalable method by combining predictive analytics, sign language recognition, and real-time translation into a single security framework (Awad et al., 2024; Dubey et al., 2024; Özkan & Şahin). This enables a more resilient and adaptable system that can better meet the various demands of people who are Deaf.

In the future, AI may become even more important for Deaf security (Alkahtani, 2024). Future developments in natural language processing and machine learning may result in even more precise and responsive sign language recognition systems, which would facilitate communication between Deaf people and security guards. Predictive analytics could also be improved further to spot new dangers and offer preventative security measures. In order to ensure that Deaf people are not left behind in the pursuit of smarter, more secure surroundings, it is imperative that AI technology development remain inclusive.

5. Conclusion

This study has thoroughly examined the potential of AI to greatly enhance the safety and security of Deaf people. According to the findings, AI-powered solutions can assist in removing communication hurdles that Deaf individuals frequently encounter, especially during emergencies. Deaf people can communicate more successfully and respond to security concerns faster because to technologies like real-time translation, sign language recognition, and predictive analytics. AI can guarantee that Deaf people are not left behind in crucial situations where every second matters by enabling smooth interactions with security systems, public services, and emergency responders. By making the security environment more inclusive and sensitive to the requirements of

Deaf people, these technological developments have the potential to improve the general sense of safety and wellbeing of the Deaf community.

The study also emphasizes how urgently aggressive steps to build a more accessible security infrastructure are needed. AI has the potential to significantly improve the equality of public safety systems by guaranteeing that everyone, regardless of hearing ability, has equal access to safety procedures and response systems. For example, Deaf persons may be able to react to dangers in real-time with AI-enhanced tools that convert spoken communication into text or provide visual alerts, increasing their independence and self-assurance in handling security concerns. By ensuring that Deaf people have the same level of interaction with security services as their hearing counterparts, the application of AI in these settings may also help to lessen the isolation that Deaf people frequently feel in settings where verbal communication is the only means of communication.

The study's accomplishments go beyond merely pointing out the possibilities of AI. It emphasizes how crucial it is to create security systems that are inclusive and accessible in addition to having cutting-edge capabilities. By concentrating on the unique requirements of Deaf people, the study opens the door for the creation of security systems that serve a wider range of people, resulting in a society that is more equal. Incorporating AI into these platforms not only solves technical issues but also supports a larger cultural movement toward universal design and inclusivity. With AI acting as a tool that empowers rather than isolates, this could ultimately result in a world where Deaf people actively participate in their own safety.

Even said, there are a few areas that need more research despite the study's encouraging results. Since present technologies still struggle to comprehend the subtleties of many sign languages and geographical variances, future research should concentrate on improving the accuracy and dependability of real-time translation systems and sign language recognition tools. Furthermore, ethical issues pertaining to AI's application in security, specifically the management of private information, must be carefully considered. To guarantee that the personal data of Deaf people is safeguarded when utilizing AI technology, privacy issues must be resolved. Future research must keep an eye on these issues as AI advances in order to guarantee that AI solutions for Deaf security continue to be efficient, affordable, and equitable, helping to build a more secure and welcoming society for all.

6. Recommendations

1. The creation of AI-powered platforms that enable communication between Deaf people and emergency services, guaranteeing that real-time alerts and responses are available, should be a top priority for governments and tech firms.
2. To offer Deaf people complete emergency solutions, AI technologies like sign language recognition and predictive analytics should be included into current security frameworks.
3. To guarantee that AI solutions are created with feedback from the community they are intended to benefit, researchers and developers must work closely with Deaf advocacy groups.
4. To ensure that Deaf people are equipped to use AI-powered security solutions in an emergency, it is imperative that they receive training on how to use them efficiently.
5. To ensure that current technologies are useful in real-world situations, ongoing investment in AI research is necessary to improve and perfect them, especially in the fields of real-time translation and sign language recognition.
6. To safeguard the rights and dignity of Deaf people, ethical factors like as consent and privacy should be given top priority when implementing AI technologies in security systems.

References

[1] Akhtar, Z. B. (2024). Artificial intelligence (AI) within the realm of cyber security. *Insight. Electr. Electron. Eng*, *1*(1), 1-11.

[2] Aktar, S. F. (2023). *Artificial Intelligence-Based Smarter Accessibility Evaluations for Comprehensive and Personalized Assessment*. Marquette University.

[3] Alkahtani, B. N. (2024). The Impact of Artificial Intelligence on Quality of Life for Deaf and Hard of Hearing Students. *American Annals of the Deaf*, *169*(4), 329-347.

[4] ARUNA, D., SATAVAHAN, B. V., SRINAGH, G. U., NAVEEN, K., & GANESH, K. G. (2024). AI-POWERED REAL-TIME COMMUNICATION SYSTEM FOR PEOPLE WITH DISABILITIES. *International Journal of Information Technology and Computer Engineering*, *12*(2), 212-218.

[5] Asquith, N. L., & Bartkowiak-Théron, I. (2021). *Policing practices and vulnerable people*. Springer.

[6] Asrifan, A., Akbar, A., Nur, M., Amu, R. W., & Pajarianto, H. (2025). AI Integration in Public Administration: Enhancing Efficiency and Accessibility. In *AI Deployment and Adoption in Public Administration and Organizations* (pp. 95-122). IGI Global Scientific Publishing.

[7] Awad, A. I., Babu, A., Barka, E., & Shuaib, K. (2024). AI-powered biometrics for Internet of Things security: A review and future vision. *Journal of Information Security and Applications*, *82*, 103748.

[8] Brongar, A. F., Pinho, J. Z., Simas, G. M., & Barwaldt, R. (2024). Enhancing Education for Deaf People: A Systematic Review of NLP Strategies for Automatic Translation From Portuguese to Brazilian Sign Language. 2024 IEEE Frontiers in Education Conference (FIE),

[9] Bruce, A., & Williams, L. A. (2025). Access and Citizenship for Those With Disabilities: Digitally Enabled Education and AI as a Bridge to Innovative Inclusion. In *Digital Citizenship and the Future of AI Engagement, Ethics, and Privacy* (pp. 31-78). IGI Global Scientific Publishing.

[10] Buttar, A. M., Ahmad, U., Gumaei, A. H., Assiri, A., Akbar, M. A., & Alkhamees, B. F. (2023). Deep learning in sign language recognition: a hybrid approach for the recognition of static and dynamic signs. *Mathematics*, *11*(17), 3729.

[11] Calgaro, E., Craig, N., Craig, L., Dominey-Howes, D., & Allen, J. (2021). Silent no more: Identifying and breaking through the barriers that d/Deaf people face in responding to hazards and disasters. *International journal of disaster risk reduction*, *57*, 102156.

[12] Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. *International Journal of Inclusive Education*, *21*(8), 791-807.

[13] Cate, M. (2025). Enhancing Emergency Communication for Deaf Individuals Using IoT and AI-based Image Recognitionss.

[14] Chong, T.-W., & Lee, B.-G. (2018). American sign language recognition using leap motion controller with machine learning approach. *Sensors*, *18*(10), 3554.

[15] Cicharska, M., Kuśmierek, P., Poński, A., Lewandowski, M., Potakowski, P., Stolarska, H., Rymarska, W., & Mekvan, A. V. AI in Deaf Inclusion.

[16] Dubey, P., Bhagat, P. N., Anjum, G. H., & Akhter, P. (2024). Signs Unveiled: The Power and Promise of AI-Based Sign Recognition Systems. In *AI in the Social and Business World: A Comprehensive Approach* (pp. 118-138). Bentham Science Publishers.

[17] Ferndale, D. (2018). "Nothing about us without us": Navigating engagement as hearing researcher in the Deaf community. *Qualitative Research in Psychology*, *15*(4), 437-455.

[18] Fisher, J. N., & Mirus, G. (2018). IN DEAF COMMUNITIES. *The Oxford handbook of taboo words and language*, 140.

[19] Gordon, D., Meyer, A., & Rose, D. (2016). *Universal design for learning*. CAST professional Publishing Peabody.

[20] Gordon, J. P. (2019). *The lived experience of the deaf and hard of hearing community in Cape Cod, Massachusetts with emergency preparedness and response planning: A narrative inquiry study* Northeastern University].

[21] Green, A. U., & Nnatuanya, C. E. (2024). Anglican church response to gender violence against women with impaired hearing: An appraisal. *Nnadiebube Journal of Philosophy*, *7*(2).

[22] Howard, M. C., & Hair Jr, J. F. (2023). Integrating the expanded task-technology fit theory and the technology acceptance model: a multi-wave empirical analysis. *AIS Transactions on Human-Computer Interaction*, *15*(1), 83-110.

[23] Jain, D. (2022). *Sound sensing and feedback techniques for deaf and hard of hearing people*. University of Washington.

[24] James, T. G., Varnes, J. R., Sullivan, M. K., Cheong, J., Pearson, T. A., Yurasek, A. M., Miller, M. D., & McKee, M. M. (2021). Conceptual model of emergency department utilization among deaf and hard-of-hearing patients: a critical review. *International journal of environmental research and public health*, *18*(24), 12901.

[25] Jowallah, R. J. (2025). Integrating AI in Special Education and Instructional Design. In *Effective Instructional Design Informed by AI* (pp. 203-220). IGI Global Scientific Publishing.

[26] Kafle, S., Glasser, A., Al-Khazraji, S., Berke, L., Seita, M., & Huenerfauth, M. (2020). Artificial intelligence fairness in the context of accessibility research on intelligent systems for people who are deaf or hard of hearing. *ACM SIGACCESS Accessibility and Computing*(125), 1-1.

[27] Khuman, P. (2024). The impact of non-verbal communication in teaching: Enhancing educational effectiveness. *A Global Journal of Humanities*, *7*, 89.

[28] Kushwaha, A. (2024). AI and Non-Verbal Communication: Enhancing Understanding of Emotional Cues for Hearing Impairment Children. *As the editors of Transforming Learning: The Power of Educational*, 13.

[29] Leigh, I. W., Andrews, J. F., Miller, C. A., & Wolsey, J.-L. A. (2022). *Deaf people and society: Psychological, sociological, and educational perspectives*. Routledge.

[30] Lyu, L., Zhang, J., Mu, L., Cui, J., & Chen, W.-C. (2024). Towards participatory and inclusive emergency management: the role of Deaf volunteers in crisis communication in Wuhan during the COVID-19 pandemic. In *Multilingual Crisis Communication* (pp. 147-172). Routledge.

[31] Marshall, C., Jones, A., Denmark, T., Mason, K., Atkinson, J., Botting, N., & Morgan, G. (2015). Deaf children's non-verbal working memory is impacted by their language experience. *Frontiers in Psychology*, *6*, 527.

[32] Meng, F., & Spence, C. (2015). Tactile warning signals for in-vehicle systems. *Accident analysis & prevention*, *75*, 333-346.

[33] Mohammedali, A. H., Abbas, H. H., & Shahadi, H. I. (2022). Real-time sign language recognition system. *International journal of health sciences*, *6*(S4), 10384-10407.

[34] Muhammed Farsin, K., Mohammed Ashfaque, P., Mohamed Abdul Shahid, P., Mohammad Mirdas, C., Anish Kumar, B., & Jemsheer Ahmed, P. (2024). Sign Language Transformation: AI-Enabled Communication for the Deaf. International Conference on Intelligent Communication, Control and Devices,

[35] Özkan, C., & Şahin, S. AI Applications in Real-Time Edge Processing: Leveraging Artificial Intelligence for Enhanced Efficiency, Low-Latency Decision Making, and Scalability in Distributed Systems.

[36] Palla, V. (2023). *Sign language recognition and text-to-speech translation* Dublin, National College of Ireland].

[37] Rahimi, B., Nadri, H., Afshar, H. L., & Timpka, T. (2018). A systematic review of the technology acceptance model in health informatics. *Applied clinical informatics*, *9*(03), 604-634.

[38] Redmiles, E. M., Malone, A. R., & Mazurek, M. L. (2016). I think they're trying to tell me something: Advice sources and selection for digital security. 2016 IEEE Symposium on Security and Privacy (SP),

[39] Repal, P., Pore, N., Pasale, A., Thengal, R., Ambule, S., & Deval, N. (2024). Real Time Sign Language Translator Using Machine Learning. *J. Artif. Intell., Mach. Learn. Neur. Netw.*, *4*, 22-30.

[40] Salau, A. O., Demilie, W. B., Akindadelo, A. T., & Eneh, J. N. (2022). Artificial Intelligence Technologies: Applications, Threats, and Future Opportunities. ACI@ ISIC,

[41] Selbst, A. D. (2017). Disparate impact in big data policing. *Ga. L. Rev.*, *52*, 109.

[42] Sharma, S., & Singh, S. (2021). Vision-based hand gesture recognition using deep learning for the interpretation of sign language. *Expert Systems with Applications*, *182*, 115657.

[43] Smedberg, E., Ronchi, E., & Hutchison, V. (2022). Alarm technologies to wake sleeping people who are deaf or hard of hearing. *Fire technology*, *58*(4), 2485-2507.

[44] Souza, M. F. N. S. d., Araújo, A. M. B., Sandes, L. F. F., Freitas, D. A., Soares, W. D., Vianna, R. S. d. M., & Sousa, Á. A. D. d. (2017). Main difficulties and obstacles faced by the deaf community in health access: an integrative literature review. *Revista CEFAC*, *19*, 395-405.

[45] Zdravkova, K., Krasniqi, V., Dalipi, F., & Ferati, M. (2022). Cutting-edge communication and learning assistive technologies for disabled children: An artificial intelligence perspective. *Frontiers in artificial intelligence*, *5*, 970430.

[46] Zhu, W. (2024). *Quiet Interaction: Designing an Accessible Home Environment for Deaf and Hard of Hearing (DHH) Individuals through AR, AI, and IoT Technologies* OCAD University].