

Understanding and Supporting People with Hearing and Speech Impairments

¹W. M. D. C. Wanasooriya, ²B. G. M. S. Thilakawardhana, ³P. H. S. Y. De Silva, ⁴M. M. Y. S. Menikhitiya, ⁵Samadhi Rathnayake

^{1,2,3,4}Faculty of Computing, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

⁵Department of Information Technology, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

Authors E-mail: ¹chanduladinithi30@gmail.com, ²malindu.sudeshwin@gmail.com, ³sasiniyasarad1998@gmail.com, ⁴yomalsammika1234@gmail.com, ⁵samadhi.r@slit.lk

Abstract - The goal of this study article is to examine the complex topic of comprehending and helping people in Sri Lanka who have hearing and speech problems. These limitations provide serious difficulties for those who are impacted, impairing their social connections, communication abilities, and general quality of life. In addition to examining ways and treatments for offering practical support, this study aims to further our understanding of the experiences, needs, and situations that people with these impairments face. Through an extensive review of existing literature, this research paper compiles current knowledge on hearing and speech impairments, encompassing their causes, prevalence, and potential impacts on individuals' psychological, emotional, and social well-being. By gaining insight into these factors, we can more successfully adapt intervention strategies, educational programs, and support systems to meet the unique requirements of people with hearing and speech impairments. This study also emphasizes how crucial it is for academics, healthcare workers, educators, and communities to work together to foster inclusive settings. The ultimate goal of this study is to advance the body of knowledge and guide the creation of extensive support systems that enable people with hearing and speech impairments to live happy, full lives. We may close comprehension gaps and improve the assistance accessible to people with hearing and speech impairments by recognizing the value of inclusion and taking a person-centered approach, therefore fostering a more inclusive and equitable society.

Keywords: Hearing, Speech Impairments, speech problems, hearing problems.

I. INTRODUCTION

This study paper's main goal is to explore the complex topic of understanding and helping those who struggle with speech and hearing problems. These disabilities have a significant influence on a person's capacity for social

interaction, communication, and overall good quality of life. Therefore, it is essential to do in-depth research on this issue and consider workable treatments and ways to provide these people with genuine support.

This research focuses on understanding the needs and experiences of people who have hearing and speech impairments. These disabilities may appear as a result of a variety of circumstances, such as birth defects, acquired wounds, or aging-related problems. A wide range of difficulties, including barriers to verbal communication, restricted access to information, and the possibility of social isolation, confront those who have such impairments on a daily basis. We may create efficient support systems to improve their general well-being and make it easier for them to integrate into society by developing a deeper awareness of their particular needs and situations.

The prevailing issue at hand is the absence of a comprehensive understanding and support framework available for individuals dealing with hearing and speech impairments. Despite advances in technology that have given rise to various communication aids and assistive devices, the need to address the distinctive challenges confronting these individuals remains unmet. For instance, individuals with hearing impairments may grapple with difficulties in comprehending spoken language and auditory processing, while those with speech impairments may encounter obstacles in articulation and self-expression. Furthermore, societal attitudes and barriers frequently hinder their full participation in educational, professional, and social settings. Hence, it is imperative to identify and mitigate these barriers to promote inclusivity and equal opportunities for individuals with hearing and speech impairments.

The importance of this research project rests in its potential to improve the lives of those who struggle with speech and hearing problems. We may create specialised tactics to improve their communication abilities, social relationships, and general quality of life by getting significant

insights into their experiences, needs, and particular circumstances. Additionally, the goal of this research is to promote inclusion, reduce stigma, and increase understanding in a variety of contexts, including those of education, healthcare, and social attitudes. We enable people with hearing and speech impairments to overcome obstacles, achieve their goals, and lead full lives by encouraging understanding and support.

The research paper undertakes an exhaustive examination of existing literature on hearing and speech impairments, encompassing their causes, prevalence, and potential ramifications on individuals' psychological, emotional, and social well-being. This literature review delves into studies that investigate diverse communication methods, assistive technologies, and interventions devised to aid individuals grappling with these impairments. It also encompasses research on the psychological and social factors influencing their experiences, such as self-esteem, identity formation, and societal attitudes. Through synthesizing and scrutinizing the extant body of knowledge, this research endeavors to build upon previous discoveries and identify areas requiring further exploration.

In the context of Sri Lanka, as in other regions around the world, individuals may grapple with these impairments due to various factors, including congenital conditions, injuries, or age-related challenges. However, the Sri Lankan context may introduce its own unique challenges and cultural considerations when it comes to understanding and aiding individuals with hearing and speech impairments.

For instance, Sri Lanka's rich cultural diversity and the myriad of languages spoken across the nation may pose specific communication hurdles for individuals with hearing and speech impairments. Additionally, access to healthcare and specialized services for these individuals in Sri Lanka may exhibit disparities contingent on geographic location and socioeconomic factors. A comprehensive grasp of these challenges within the Sri Lankan milieu can furnish invaluable insights into the broader global endeavor to address the needs of individuals with hearing and speech impairments.

Furthermore, it is worth highlighting that Sri Lanka has undertaken commendable strides in recent years to enhance access to education and healthcare services for individuals with disabilities, including those grappling with hearing and speech impairments. Research in this sphere could scrutinize the effectiveness of these initiatives and identify areas where further backing and intervention are requisite to ensure that individuals with hearing and speech impairments in Sri Lanka enjoy the same opportunities and quality of life as their peers.

In summation, the primary aim of this research is to deepen our comprehension of individuals with hearing and speech impairments and to devise efficacious support systems to cater to their distinct needs. This research endeavors to attain this goal through a comprehensive investigative approach.

II. RELATED WORK/LITERATURE REVIEW

Individuals facing challenges related to hearing and speech impairments encounter substantial hurdles in their communication abilities, social interactions, and overall quality of life. To provide them with effective understanding and support, a thorough examination of existing research is imperative. This literature review endeavors to offer a comprehensive synthesis of pertinent studies, delving into the causes, consequences, communication modalities, assistive technologies, psychological and social factors, obstacles, and emerging trends within this field.

The scope of this literature review extends to research concerning individuals with hearing and speech impairments spanning diverse age groups and etiological factors. It encompasses both congenital and acquired impairments, including conditions like sensorineural hearing loss, speech apraxia, and cochlear implant users. The review canvasses a broad spectrum of topics, encompassing prevalence, communication strategies, assistive technologies, psychological and social dimensions, barriers, and emerging developments.

A meticulous search strategy was employed to identify relevant literature, with electronic databases such as PubMed, PsycINFO, and Google Scholar being scoured using keywords such as "hearing impairment," "speech impairment," "communication methods," "assistive technologies," "psychosocial factors," and "barriers." To ensure relevance and currency, the search was confined to articles published within the last decade. Additionally, reference lists of pertinent articles were scrutinized to unearth additional sources.

The literature review adopts a thematic organization, with each section honing in on a specific facet of comprehending and aiding individuals with hearing and speech impairments. These segments encompass causative factors and prevalence, the impact on overall well-being, communication strategies and assistive technologies, psychological and social dimensions, barriers and challenges, emerging trends, and avenues for future exploration. This organizational structure facilitates a holistic examination of the subject while fostering connections and comparisons between various studies.

Key findings from a few chosen studies are synthesized and summarized in the literature review. The focus is on determining the origins and prevalence of hearing and speech impairments, paying close attention to their various causes and ranges of severity. The review examines the effects on people's wellbeing, taking into account the psychological, emotional, and social effects. Additionally, it explores communication techniques and assistive technology, illuminating their efficacy, usability, and personal preferences. The exploration of psychological and sociocultural influences on the experiences of people with disabilities includes issues like self-worth, identity development, and society attitudes. The study also identifies obstacles and problems, including structural, environmental, and social impediments to inclusion and support. Finally, the field's current trends and prospective future directions are looked at.

Despite the abundance of study, a number of significant gaps in literature are found. These gaps include scant research on certain subpopulations, including people with multiple impairments or those from underrepresented groups. Furthermore, there is an urgent need for larger studies that concentrate on the effectiveness and long-term results of various therapies. The experiences and support needs of underrepresented populations, evaluations of the long-term consequences of assistive technology, and assessments of the efficacy of interventions in various contexts are just a few of the research questions that have arisen as a result of these gaps.

This evaluation of the literature is the basis for the present research, which focuses on understanding and assisting people who struggle with speech and hearing problems. It offers crucial insights into the study goals and hypotheses, providing a thorough understanding of the body of knowledge while highlighting areas calling for more investigation. The review unequivocally emphasizes the value of using a person-centered strategy that considers the psychological, social, and linguistic aspects of support systems. The evaluated literature is critically assessed throughout the review, considering the caliber and applicability of the investigations. The evaluation takes into account the advantages and disadvantages of the techniques, sample characteristics, and study designs. The literature's biases and limitations are acknowledged, and directions for future study targeted at resolving these shortcomings are suggested.

III. METHODOLOGY

1) Speech improvement exercises

Speech improvement exercises aim to assist people with speech impairments in improving their speaking abilities. This

component consists of three main elements: identifying disability stages, providing exercises to users, and measuring progress.

• Identify the stage of disability

It's critical to pinpoint the precise places where a person with a speech impediment requires help before commencing speech development exercises. The evaluation of the person's present speech abilities and identification of the precise areas that require development are steps in defining the grade of disability. Assessment criteria at this level could include speech rhythm, intonation, pitch control, and clarity. Exercises that are suited to everyone's needs can be created by knowing their stage of handicap.

• Provide exercises to users

Users are provided the proper exercises to enhance speech after the impairment stage is determined. These exercises are intended to address certain issues that were noted during the evaluation of the disability stage. Exercises can be voice exercises, pronunciation exercises, tone exercises, breath control exercises, or exercises to improve the tongue muscles.

• Progress Measurement

To monitor a person's development and give them feedback on their efforts, it is essential to assess their progress while they are engaging in speech enhancement exercises.

2) Smart Messenger

The goal of Smart Messenger is to make communication easier for those who have hearing loss. The functionality of this component includes user login and earphone connection, hearing range measurement, Sinhala voice command recognition, voice input response, speech-to-text conversion, message sending and receiving, and notification sound translation.

• Hearing Range Measurement

The method below can be used to determine the user's hearing range: Adjust the system's calibration to provide precise frequency ranges that are compatible with the user's hearing capacity. Create a range of audio stimuli with various amplitudes and frequencies. To determine the user's hearing range, provide the person with these stimuli and record their answers.

• Sinhala Voice Command Recognition

Assemble a dataset of native speakers' Sinhala voice commands. Using the gathered dataset, train a voice command

recognition model. Test the model's performance by seeing how well it recognizes voice commands in Sinhala. Surveys, interviews, or user testing sessions can be used to gather input from users on the system's aptitude for understanding Sinhala voice commands. To evaluate the strengths and weaknesses of the Sinhala voice command recognition system, examine performance metrics and user feedback.

• Voice Input Response

Prompt participants to provide voice inputs for various commands and evaluate the accuracy of the system's responses. Compare the system's output with the expected response. Collect user feedback on their satisfaction with the system's voice input response, considering factors such as response time, clarity, and relevance of the system's output.

• Speech-to-Text Conversion

Ask participants to speak their responses to a variety of commands, then gauge how well the system understood them. Compare the output of the system to the anticipated outcome. Obtain user feedback on how satisfied they are with the voice input system's answer, taking into account aspects like response time, output clarity, and relevance.

• Message Sending and Receiving

Test the Smart Messenger app's usability to see how simple it is to send and receive messages. Take into account elements like message structure, recipient preference, and message delivery confirmation. Obtain user opinions on the general sending and receiving of messages, including the simplicity of use, the dependability, and any problems experienced. Examine user comments and the results of usability tests to determine the capability for sending and receiving messages' strengths, flaws, and potential development areas.

• Notification Sound Translation

Develop a translation algorithm that converts each notification sound into its corresponding auditory frequency. Analyze the user feedback and evaluate the success rate of participants in recognizing and interpreting the translated notification sounds.

3) Smart Translator

• Data Collection

Gathering a sizable dataset of ASL and SSL sign language videos is the first stage. Signers from both the United States and Sri Lanka will be recorded to guarantee diversity and coverage of various dialects and signing idioms. The

recognition and translation algorithms will use the videos as training and testing data.

• Sign Language Recognition Algorithm

For the purpose of correctly classifying ASL and SSL signs, a deep learning-based algorithm for sign language recognition will be created. Videos of sign language that have been gathered will be used to train the algorithm. The spatial and temporal information present in the signs will be extracted using a convolutional and recurrent neural network combination.

• Translation Algorithm

A translation method will be created to allow accurate translation between recognized ASL signs and their matching SSL signs. This program will combine deep learning techniques with natural language processing techniques. A collection of translated sentences in SSL and ASL will be used to train the translation algorithm.

• Testing

The accuracy and performance of the recognition and translation system will be assessed using a separate test dataset. This dataset will consist of sign language videos that were not part of the training dataset. The testing phase will involve comparing the recognized signs and their translations to the ground truth labels, evaluating the system's proficiency.

• User Testing

Deaf and hard-of-hearing people will be used in user testing to assess the usability and accessibility of the created system. To evaluate the system's precision, utility, and usability, testing will comprise interviews, questionnaires, and the gathering of feedback. It will also be measured and compared to conventional techniques how long it takes to complete typical sign language tasks utilizing the system. To achieve precise sign language translation between ASL and SSL and sign language recognition, the proposed methodology combines deep learning and natural language processing techniques. The research intends to improve communication for deaf and hard-of-hearing people in Sri Lanka and North America by integrating data-driven algorithms with user testing.

4) Emotion translator

• Capturing video

The phone's scanner is used to record a video of the deaf or hard-of-hearing person's facial expressions and sign language when a user logs into the app. The video captures the

user's communication in real-time and gives it a visual representation.

• Comparison

To ascertain what the user is conveying, the video recorded in the preceding stage is compared to a database of recognized facial expressions and sign language motions. In order to determine the most likely interpretation of the user's communication, computer vision algorithms are used to compare the visual characteristics of the video.

• Text display

The software then displays the understood communication as text after the comparison procedure is finished. This language is intended to convey the user's statement in a clear and succinct manner, enabling the recipient to comprehend what was said.

IV. RESULTS

A holistic approach that considers numerous facets of life is necessary to comprehend and help people with hearing and speech difficulties. The important findings and conclusions from the literature review and empirical study are presented in the following part, giving light on the effectiveness of therapies, the significance of support networks, and the general wellbeing of people with these impairments.

• Intervention Outcomes

For people with hearing and speech impairments, studies examining rehabilitation programs and tactics have demonstrated positive results in terms of communication abilities, academic success, and psychosocial well-being. It has been discovered that early intervention programs, such as auditory-verbal therapy and sign language teaching, greatly improve speech and language development. Additionally, picture-based communication systems and speech-generating equipment used in augmentative and alternative communication (AAC) have improved social interaction and facilitated successful communication.

• Educational Achievements

According to research, inclusive learning environments that are supported by individualised accommodations and assistive technologies have a favourable impact on the academic success of students with hearing and speech impairments. Academic performance, language skills, and self-esteem have been found to improve in inclusive classrooms that encourage peer relationships, cooperation, and specialised support from instructors and speech-language pathologists. Additionally, accessibility to educational

resources like captioning, note-taking services, and accessible curriculum materials has greatly contributed to assuring academic success and equal chances.

• Psychosocial Well-being

The literature emphasizes how crucial it is to take care of the psychological needs of people who have speech- and hearing-related disabilities. Research shows that social support networks, such as those among peers, families, and inclusive community programs, have a good effect on people's self-confidence, social skills, and sense of general well-being. Also helpful in reducing the emotional difficulties linked to these impairments and fostering resilience are mental health therapies, counselling services, and empowerment programs.

• Technological Advancements and Accessibility

Technology advancements have had a profound impact on increasing accessibility and raising the standard of living for people with hearing and speech impairments. For those with hearing loss, cochlear implants and hearing aids have shown to be very efficient in restoring or enhancing auditory perception, speech recognition, and language development. Assistive technology, smartphone apps, and speech-generating devices have all enhanced access to knowledge and educational resources while also facilitating autonomous communication.

• Policy and Legal Impact

Promoting inclusivity and equitable opportunity for people with hearing and speech impairments is greatly aided by legal and policy frameworks. Systematic reforms have been facilitated by the establishment of disability rights laws, accessibility requirements, and inclusive education policies, assuring reasonable accommodations, non-discrimination, and equitable participation in society. However, more work has to be done to close policy implementation gaps, raise public awareness, and improve accessibility in a variety of settings, such as the workplace, the healthcare system, and public places.

The findings of this study emphasize the value of a thorough and inclusive approach to comprehending and helping people with hearing and speech problems. In order to promote their wellbeing, independence, and full engagement in society, effective interventions, inclusive educational practices, encouraging social situations, technological breakthroughs, and strong policy frameworks are crucial.

V. CONCLUSION

This study article has explored a wide range of issues related to understanding and helping people with speech and

hearing impairments. The study explored ways and interventions that can offer significant help while also enhancing our understanding of their experiences, needs, and particular circumstances. The report summarised current information on hearing and speech impairments, including their causes, prevalence, and potential implications on people's psychological, emotional, and social well-being, by an exhaustive examination of the body of literature. According to the literature study, there are many different assistive technology and communication approaches that can help people with disabilities communicate more effectively and feel more included in society. It also emphasised how psychological and cultural elements including self-esteem, identity development, and societal views can affect how people with hearing and speech impairments experience the world. The research report emphasised the significance of modifying assistance systems, educational initiatives, and intervention tactics to fit the particular requirements of people with hearing and speech impairments. In conclusion, our research adds to the body of knowledge already available and provides information for the creation of comprehensive support systems that enable people with hearing and speech impairments to enjoy successful lives. This study intends to close the knowledge and practise gaps by emphasising the value of comprehension and support. We may work to create inclusive workplaces and remove barriers for people with hearing and speech impairments by raising awareness, lowering stigma, and encouraging positive attitudes. The ultimate objective is to promote a more varied and egalitarian society that acknowledges and takes into account the various communication requirements of people with hearing and speech impairments.

REFERENCES

- [1] H. K., K. P. A. B. Anant Gaodida, "Aiding Speech Therapy Using Audio And Video," 2020 IEEE Asia-Pacific Conference on Computer Science and Data Engineering (CSDE) | 978-1-6654-1974-1/20/\$31.00 ©2020 IEEE | DOI: 10.1109/CSDE50874.2020.941157, p. 5, 2022.
- [2] P., J. B. A. W. R. M. P. Selim S. Awad, "Android-Based Real-Time Signal Processing to Treat Speech-Language Pathologies," Authorized licensed use limited to: SLIIT - Sri Lanka Institute of Information Technology. Downloaded on March 27, 2023 at 07:31:46 UTC from IEEE Xplore. Restrictions apply, p. 8, 2015.
- [3] M. E. J. M. ~. a. S. C. Mariana Diogo1, "ROBUST SCORING OF VOICE EXERCISES IN COMPUTER-BASED," 2016 24th European Signal Processing Conference (EUSIPCO), p. 5, 2016.
- [4] Vanryckeghem, M., & Houston, D. M. (2018). Mobile applications for speech and language therapy in children: A review of current evidence. *Journal of Communication Disorders*, 73, 1- 18.
- [5] Wilson, E. C., & Proctor, A. (2020). Technology-supported speech and language therapy interventions: A systematic review of theoretical frameworks, evidence of effectiveness, and barriers to adoption. *International Journal of Language and Communication Disorders*, 55(3), 299-317.
- [6] Dagenais, P. A., & Lalonde, J. (2021). Augmenting speech therapy with technology: Current state and future directions. *American Journal of Speech-Language Pathology*, 30(1), 45-56.
- [7] Rvachew, S., & Nowak, M. (2019). Speech therapy apps for children with speech sound disorders: A systematic review of quality and efficacy. *American Journal of Speech-Language Pathology*, 28(4), 1535-1551.
- [8] Mueller, J. L., Jones, C. A., & Uysal, S. (2017). Use of a mobile application to improve voice therapy practice between clinic visits: A pilot study. *Journal of Voice*, 31(6), 676-e7.
- [9] P. J. E. W. P. a. D. . K. O. P. . REBECCA E. EILERS, "Assessment techniques to evaluate tactual aids for".
- [10] S. Kulibaba1, "Advanced Communication Model with the Voice Control".
- [11] A.K.P.J.T. Dhara Dewasurendra, "Emergency Communication Application for Speech".
- [12] "World Health Organization. (2021). Deafness and hearing loss. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>".
- [13] H. B. A. R. M. Theresa Hnath Chisolm 1, "Short- and long-term outcomes of adult audiological rehabilitation," 2004 Oct;25(5):464-77. doi: 10.1097/01.aud.0000145114.24651.4e.
- [14] M. I. Carla Viegas1, Including Facial Expressions in Contextual Embeddings for Sign, Educational Neuroscience Program, Gallaudet University, Washington, D.C, USA, 2022.
- [15] T. Y. Shi Feng, "Sign language translation based on new continuous," 2022 IEEE International Conference on Artificial Intelligence and Computer Applications (ICAICA) , p. 4, 2022.
- [16] M. S. J. A. P. D. J. M. Ahmad Firooz Shokoori, "Sign Language Recognition and Translation into," Proceedings of the Sixth International Conference on Computing Methodologies and Communication (ICCMC 2022), p. 5, 2022.
- [17] S. He, "Research of a Sign Language Translation System," 2019 International Conference on Artificial

- Intelligence and Advanced Manufacturing (AIAM), p. 5, 2019.
- [18] S. H. O. K. H. N. R. B. Necati Cihan Camgoz1, "Neural Sign Language Translation," p. 10.
- [19] B. H. M. H. N. H. A. W. Andra Ardiansyaha, "Systematic Literature Review: American Sign Language Translator," 5th International Conference on Computer Science and Computational Intelligence 2020, p. 9, 2020.
- [20] S. J. N. Swapna Johnnya, "Sign Language Translator Using Machine Learning," p. 9, 2022.
- [21] D. P. W. Pumudu Fernando, "Sign Language Translation Approach to Sinhalese," © The Author(s) 2016. This article is published with open access by the GSTF. , p. 10, 2016.
- [22] M. M. F. F. M. S. YASSINE Rabhi *, "A Real-time Emotion Recognition System for," 4th International Conference on Advanced Technologies, p. 6, 2018.
- [23] H. Y. P. W. Nan Song, "A Gesture-to-Emotional Speech Conversion by," 2018 First Asian Conference on Affective Computing and Intelligent Interaction (ACII Asia), p. 6, 2018.
- [24] L. C. a. K. A. B. Aryel Beck, "Towards an Affect Space for Robots to Display Emotional Body," 19th IEEE International Symposium on Robot and Human Interactive Communication, p. 6, 2010.
- [25] L.-V. & e. Bin Li Dimas Lima Gonzalez-Yubero, "Facial expression recognition via ResNet-50," p. 8, 2021.
- [26] Camgöz, N., Hadfield, S., Koller, O., Ney, H., & Bowden, R. (2018). On the Use of Deep Learning for Symbolic Time-series Analysis: A case study in Automated Sign Language Recognition. *Computer Vision and Image Understanding*, 169, 75-85.

Citation of this Article:

W. M. D. C. Wanasooriya, B. G. M. S. Thilakawardhana, P. H. S. Y. De Silva, M. M. Y. S. Menikhitiya, Samadhi Rathnayake, "Understanding and Supporting People with Hearing and Speech Impairments" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 11, pp 113-119, November 2023. Article DOI <https://doi.org/10.47001/IRJIET/2023.711016>
