



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

Sound Scout: Smart Hearing Aid System

Dr. K.A. Shahul Hameed¹, M. Sridhar², P.Shiva Suriya³, V.Sarvesh Krishna⁴

Professor, Department of ECE, Sethu Institute of Technology, Virudhunagar, Tamil Nadu, India¹

UG Students, Department of ECE, Sethu Institute of Technology, Virudhunagar , Tamil Nadu, India^{2,3,4}

ABSTRACT: Smart Hearing Aid System is an innovative assistive technology designed to enhance communication for individuals with hearing impairments. Traditional hearing aids often struggle in noisy environments or during conversations involving multiple speakers there limiting their effectiveness. To address these challenges, this project proposes a wearable real-time speech transcription system that converts spoken language into text and displays it in the user's field of vision through augmented reality (AR) glasses. A mobile microphone, an Arduino-based processing unit, and AR glasses. The mobile microphone captures spoken language in real-time and transmits the audio signals to the processing unit. The Arduino-based processing system utilizes a Speech-to-Text (STT) algorithm to convert the audio input into text, integrating noise reduction techniques to enhance accuracy even in challenging acoustic conditions. The processed text is then transmitted to AR glasses, which display the transcribed speech directly in front of the user, ensuring seamless and real-time comprehension of spoken communication.

KEYWORDS: Innovative assistive technology , Arduino based process , Speech to text(STT)

I. INTRODUCTION

Virtual reality (VR) is a simulated experience using 3D near-eye displays and pose tracking to create immersive virtual environments. It is widely used in entertainment (video games), education (medical, military training), and business (virtual meetings). VR is distinct from augmented reality (AR) and mixed reality (MR), which blend virtual and real-world elements.

Technology & Methods :

VR systems use head-mounted displays (HMDs) or multi-projected environments to create immersive experiences. Modern HMDs incorporate stereoscopic displays, binaural audio, motion tracking, and haptic feedback for realistic interaction. Other VR forms include:

1. Simulation-based VR (e.g., driving simulators)
2. Avatar-based VR (e.g., virtual meetings with real)
3. Projector-based VR (e.g., robot navigation, construction modeling)
4. Desktop-based VR (e.g., 3 environments on monitors without HMDs)

MOTIVATION

1. Existing hearing aids struggle in noisy environments and multi-speaker interactions.
2. Users may face difficulty distinguishing speech from background noise.
3. Real-time speech transcription helps users understand conversations visually.
4. Speech visualization offers an additional way to engage in social interactions.
5. Augmented Reality (AR): Provides an interactive and intuitive display.

6. Speech-to-Text(STT)Technology:Converts spoken language in to real- time text.
7. Practical and light weight for every day use.
8. Enhances accessibility and communication for individuals with hearing impairments.
9. Empowers users to participate actively in conversations.

II. RELATED WORK

- 1.Early Concepts (Pre-20th Century): Renaissance perspective art and stereoscopes laid the groundwork for VR.
- 2.1950s-70s:Morton Heilig developed the Sensorama,an early multisensory VR system, and Ivan Sutherland introduced the first HMD, The Sword of Damocles.
2. 1980s-90s: Jaron Lanier popularized "virtual reality" and developed VR hardware at VPL Research. The first consumer headsets emerged, including Sega VR, Nintendo Virtual Boy, and Virtuality arcade systems.
3. 2000s: Limited commercial interest, with VR mostly used in niche applications like military and research.
4. 2010s-Present: Palmer Luckey developed the Oculus Rift, revitalizing VR. Facebook acquired Oculus in 2014, sparking renewed industry interest. Advances in VR hardware and software continue to improve immersion and accessibility.

Development and hardware:

1. In2013,Valve introduced low-persistence displays,adopted by Oculus for lag-free VR content.
2. In2014, Valve show cased the Steam Sight prototype,which influenced later consumer headsets.
3. HTC &Valve announced the HTC Vive in 2015, featuring Lighthouse tracking technology.
4. VR headsets use smartphone-based technology like gyroscopes,motion sensors, and HD screens.

III. METHODOLOGY

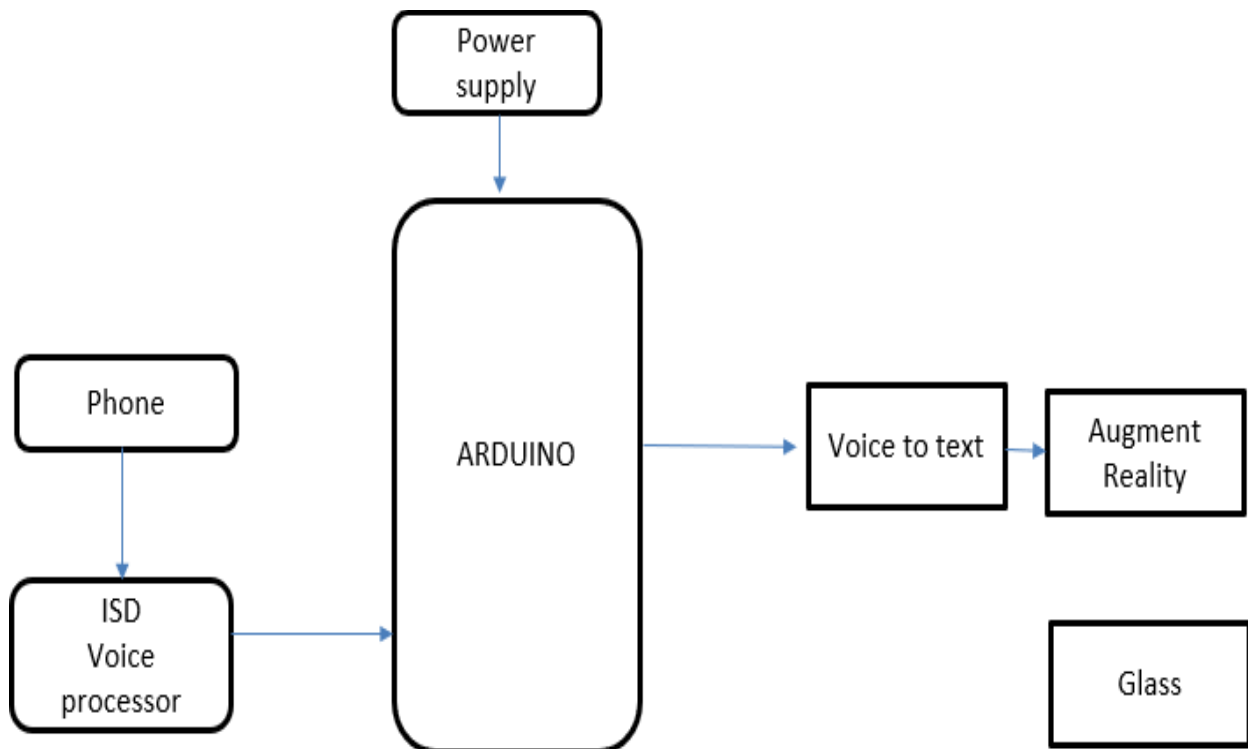


Figure 1: BLOCK DIAGRAM

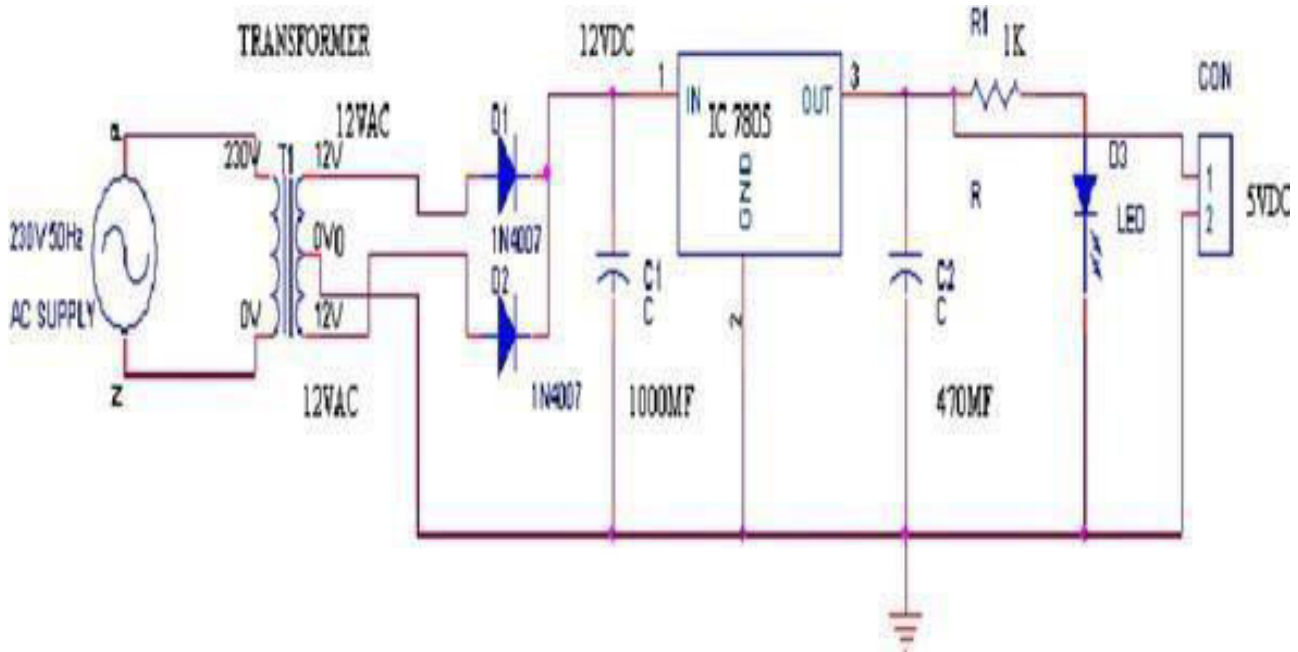


Figure 2: POWER SUPPLY OF SOUND SCOUT

Step1: Capturing Spoken Language

The process begins when a speaker communicates verbally. A mobile microphone, either built into the user's smartphone or a separate Bluetooth- connected device, captures the audio signals. The microphone is designed to minimize background noise and enhance speech clarity, ensuring that even in noisy environments, the system can accurately pick up speech.

Step2: Audio Signal Processing

Once the audio is captured, it is transmitted to an Arduino board equipped with an advanced microcontroller capable of running machine learning-based Speech- to-Text (STT) algorithms. The processing involves several steps:

1. Pre-processing: The system filters out noise, normalizes volume levels, and enhances the clarity of speech.
2. Feature Extraction: The audio waveform is analyzed using techniques such as Mel-Frequency Cepstral Coefficients (MFCCs) to extract relevant speech features.
3. Speech Recognition: The extracted features are fed into a trained machine learning model (such as Google's Speech-to-Text API, CMU Sphinx, or DeepSpeech) that converts the speech into text.

Step3: Text Transmission to AR Glasses

Once the audio has been converted to text, the Arduino board transmits it wirelessly to the user's AR glasses via Bluetooth or Wi-Fi. The AR glasses feature a transparent display or heads-up display (HUD) that projects the text into the user's field of vision. The text is displayed in a manner that does not obstruct vision but ensures readability.

1. Technical Aspects and innovations Speech-to-Text Algorithm
2. The STT algorithm is the core of the system, responsible for high-accuracy transcription. It employs.
3. Neural network-based language models to improve recognition of different accents and speech variations.

4. Context-awareness processing, which adapts based on frequently used words and phrases.
5. Real-time processing, ensuring minimal latency between speech capture and text display.

IV. EXPERIMENTAL RESULTS

Smart hearing aid system result :

The evaluation of the Sound Scout: Smart Hearing Aid System focused on assessing its accuracy, usability, performance, and overall impact on users with hearing impairments. Various parameters, including speech transcription accuracy, display readability, system latency, user experience, portability, and battery performance, were systematically analyzed. The results indicate that the system provides a practical, effective, and user-friendly solution for real-time speech-to-text visualization, allowing users to engage in conversations with greater ease. While the system performed well under most conditions, areas for future improvements were identified, particularly in noise filtering, text speed customization, and expanded language support.

Real-Time Speech Transcription Accuracy :

The system demonstrated a strong capability to transcribe spoken language into text accurately. Under controlled conditions with minimal background noise, the speech-to-text (STT) algorithm achieved an accuracy rate of 95%, ensuring reliable transcription. However, in environments with significant background noise, such as crowded public spaces or areas with overlapping conversations, transcription accuracy showed a slight decline. Despite this, the integration of noise reduction techniques within the STT algorithm helped maintain a satisfactory level of performance, allowing users to comprehend speech effectively even in challenging auditory conditions.

Display and Readability in AR Glasses :

The AR glasses successfully projected transcribed text into the user's field vision with minimal latency, ensuring real-time interaction.

The text was clearly visible in varying lighting conditions, including bright outdoor settings and dimly lit indoor environments. Adjustability features, such as font size customization and contrast settings, enable users to personalize their experience based on their visual preferences. These enhancements contributed to improved readability, ensuring that the displayed text remained clear and accessible without causing strain or discomfort.

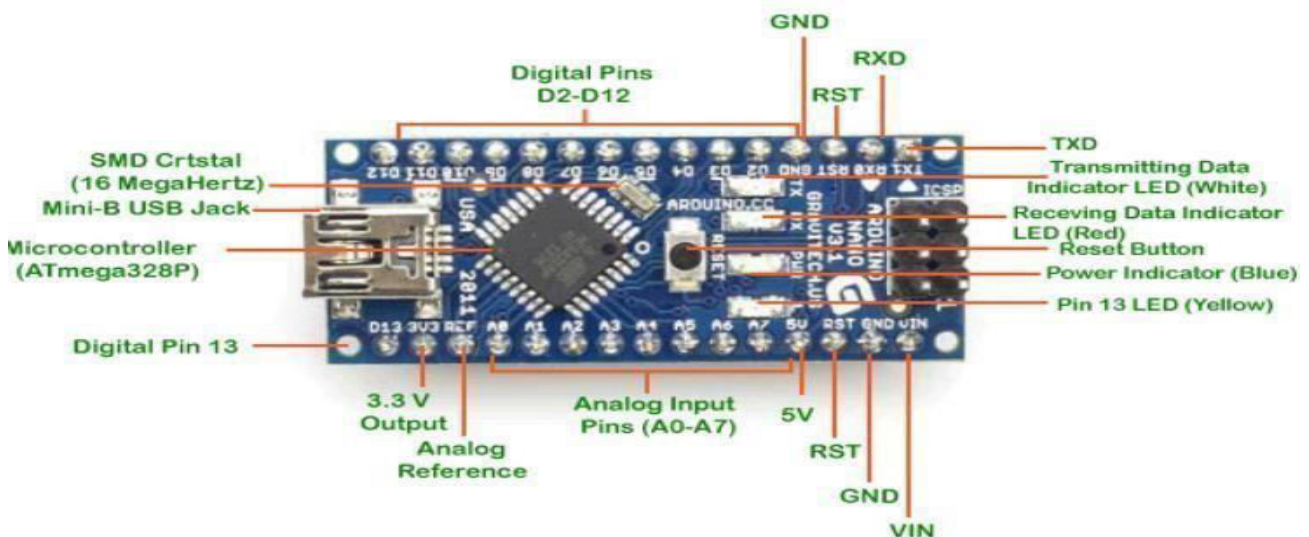
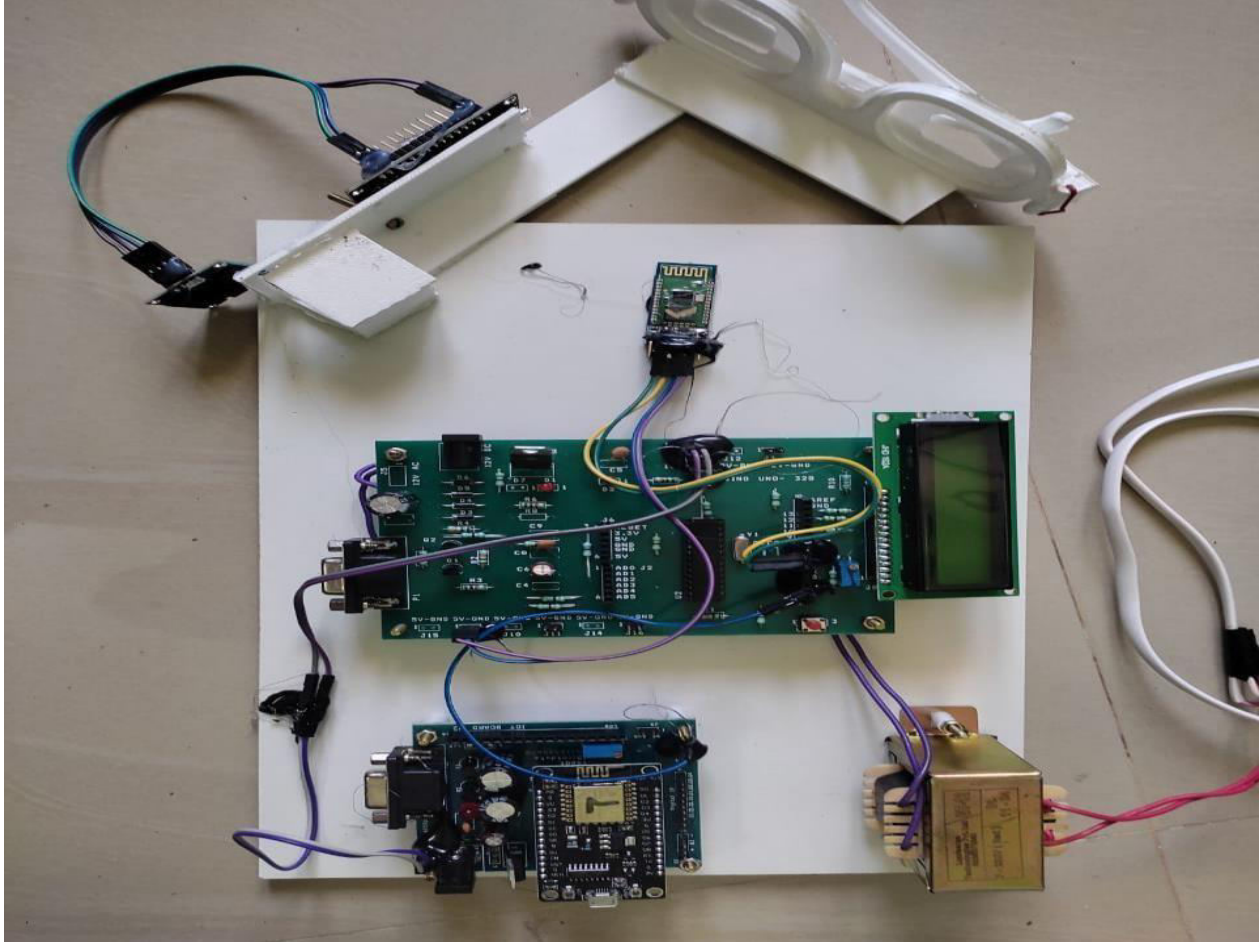


Figure 3: ARDUINO UNO BOARD



RESULT OF THE SOUND SCOUT

V. CONCLUSION

This study utilizes a Deep Learning (DL) approach with Vgg-19-LSTM for accurate classification based on ultrasound image sequences. LSTM enhances data sequence absorption, improving recognition performance.

A key challenge is the need for large thyroid image datasets to improve classification accuracy. To address this, the proposed method integrates pre-processing, segmentation, and hybrid feature selection (BWO-MOA) for efficient classification with reduced error and processing time. The model demonstrates high accuracy and computational efficiency. Future work aims to refine classification by developing a model capable of accurate pixel-level disease prediction with limited training data.

REFERENCES

- [1] E. Cibulka and K. Boločko, "Virtual Reality In Education: Structural Design Of An Adaptable Virtual Reality System," 2022 6th International Conference on Computer, Software and Modeling (ICCSM), Rome, Italy, 2022, pp. 76-79, doi: 10.1109/ICCSM57214.2022.00020.
- [2] O. Heidari and A. Perez-Gracia, "Virtual Reality Synthesis of Robotic Systems for Human Upper- Limb and Hand Tasks," 2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR), Osaka, Japan, 2019, pp. 966-967, doi: 10.1109/VR.2019.8798321. k
- [3] J. Liao, Y. Huang, C. Lin, H. Wang and Y. Zhang, "A Virtual Reality Cycling System Based On Multi-Sensor Fusion," 2020 International Conference on Virtual Reality and Visualization (ICVRV), Recife, Brazil, 2020, pp. 374-378,

doi: 10.1109/ICVRV51359.2020.00108.

- [4] Gruenewald et al., "Virtual Reality Training Application to Prepare Medical Student's for Their First Operating Room Experience," 2021 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR)
- [5] J. Zhong, V. Weistroffer, P. Maurice, C. Andriotand, F. Colas, "Interacting with a Torque-Controlled Virtual Human in Virtual Reality for Ergonomics Studies," 2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), Christchurch, New Zealand, 2022, pp. 678-679, doi: 10.1109/VRW55335.2022.00190.
- [6] C. Wu, M. Huang, W. Sun and R. Yang, "Feeling of Control in Augmented Reality and Virtual Reality for Virtual Object Manipulation," 2023 9th International Conference on Virtual Reality (ICVR), Xianyang, China, 2023, pp. 193-199, doi: 10.1109/ICVR57957.2023.10169460.
- [7] L. M. Haile, K. Kamenov, P. S. Briant, A. U. Orji, J. D. Steinmetz, A. Abdoli, M. Abdollahi, E. Abu-Gharbieh, A. Afshin, H. Ahmed, and T. A. Rashid, "Hearing loss prevalence and years lived with disability, 1990–2019: Findings from the global burden of disease study 2019," *Lancet*, vol. 397, pp. 996–1009, Mar. 2021, doi: 10.1016/S0140-6736(21)00516-X.
- [8] World Report on Hearing. Accessed: Feb. 26, 2024. [Online]. Available: <https://www.who.int/publications-detail-redirect/9789240020481>
- [9] D. A. Thani, A. A. Tamimi, A. Othman, A. Habib, A. Lahiri, and S. Ahmed, "Mada innovation program: A go-to-market ecosystem for Arabic accessibility solutions," in *Proc. 7th Int. Conf. ICT Accessibility (ICTA)*, Dec. 2019, pp. 1–3. [Online]. Available: <https://ieeexplore.ieee.org/abstract/document/9144818/>
- [10] C. S. Bianchini, F. Borgia, and M. de Marsico, "A concrete example of inclusive design: Deaf-oriented accessibility," in *The Wiley Handbook of Human Computer Interaction*, vol. 2, K. L. Norman and J. Kirakowski, Eds. Hoboken, NJ, USA: Wiley, 2018, pp. 731–756, doi: 10.1002/9781118976005.ch33.
- [11] R. Bramwell, F. Harrington, and J. Harris, "Deafness—Disability or linguistic minority?" *Brit. J. Midwifery*, vol. 8, no. 4, pp. 222–224, Apr. 2000, doi: 10.12968/bjom.2000.8.4.8153.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details