SPEAKING SYSTEM FOR DUMB PEOPLE USING HAND GESTURES

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Abstract: This project presents the development of a gesture-based speaking system utilizing a wearable smart glove equipped with sensors and an Arduino Uno microcontroller to interpret hand gestures for individuals with disabilities, including those who cannot speak or hear. The glove enables users to tap different points with their thumb, generating 12 distinct commands that are transmitted via Bluetooth to an Android smartphone application. The application converts these gestures into audible speech, facilitating effective communication. Emphasizing accessibility and user-centered design, the system aims to be intuitive and adaptable to diverse user needs. Additionally, it holds potential for broader applications in home automation, allowing users to control appliances and devices through gesture commands. Through iterative development and user feedback, this system provides a promising solution to empower individuals with disabilities to communicate and interact more effectively with the world.

Keywords: Gesture-based speaking system, wearable smart glove, sensors, Arduino Uno, microcontroller, hand gestures

I. Introduction

Communication is a fundamental aspect of human interaction, allowing individuals to express themselves, convey ideas, and engage with others. However, for people facing disabilities such as speech impairments or hearing difficulties, effective communication can be challenging. While traditional assistive technologies like sign language and text-based communication aids have provided solutions, they often come with limitations in accessibility and usability. In response to these challenges, we propose a novel gesture-based speaking system that aims to enhance communication for individuals with disabilities in a simple and intuitive manner. Many individuals with disabilities encounter barriers when attempting to communicate using traditional methods. Despite the availability of assistive technologies, not all solutions are suitable for every user or situation. Our gesture-based speaking system seeks to bridge this gap by introducing a more versatile and adaptable approach to assistive communication. By leveraging advancements in wearable technology, sensors, and wireless connectivity, our system aims to provide a seamless and natural means of communication for individuals with disabilities.

At the heart of our system lies the smart glove, a wearable device embedded with specialized sensors capable of detecting and interpreting hand gestures. Unlike conventional communication aids, which may rely on complex interfaces or external devices, our smart glove offers a tangible and familiar means of interaction. By simply wearing the glove and making specific hand movements, users can convey messages and commands, which are then transmitted wirelessly to a companion smartphone application. Accessibility and user-centered design are central principles guiding the development of our gesture-based speaking system. We prioritize simplicity, customizability, and responsiveness to user feedback to ensure that our system is inclusive and easy to use for individuals with diverse needs. Furthermore, our system's versatility extends beyond communication, offering potential applications in home automation. By integrating gesture controls, users can interact with household appliances and devices using intuitive hand movements, thereby enhancing their independence and quality of life.

Our gesture-based speaking system represents a promising advancement in assistive communication technology, offering a simple yet effective solution for individuals with disabilities. In the following sections, we will delve into the detailed components of our system, including a block diagram, component descriptions, and an explanation of the working algorithm. Additionally, we will present the results of our system's development and testing, highlighting its effectiveness and potential impact on improving communication and accessibility for individuals with disabilities.

II. Literature Survey

The literature survey reveals a growing interest in developing assistive technologies, particularly smart gloves, to aid individuals with disabilities, including those who are deaf, dumb, or have speech impairments. Various studies such as Rewari et al. (2018), Bhaskaran et al. (2016), Das et al. (2016), Panse et al. (2014), and Rastogi et al. (2015) explore different approaches to gesture recognition and sign language interpretation, often integrating sensors and microcontrollers for real-time communication. Rehman et al. (2008) present a gesture vocalizer system based on microcontrollers and sensors, emphasizing the importance of technology in facilitating communication. Tandon et al. (2016) and Fale et al. (2016) provide review papers summarizing the state-of-the-art in smart glove technology for sign language interpretation. Verma et al. (2014) focus on the design aspects of smart gloves, highlighting the need for ergonomic and user-friendly designs. Collectively, these studies underscore the significance of technological innovation in enhancing accessibility and communication for individuals with disabilities, laying the groundwork for further research and development in this field.

III. Existing system

Existing systems for aiding individuals with disabilities in communication often rely on smart gloves equipped with sensors and microcontrollers. These gloves detect hand gestures, particularly those used in sign language, and translate them into spoken words or text. These systems typically involve wireless communication with companion smartphone applications, enabling real-time interpretation and communication. Additionally, some systems incorporate features for individuals who are blind, deaf, or have speech impairments, emphasizing inclusivity in communication technology. While these existing systems show promise in enhancing accessibility, there is ongoing research and development to improve usability, accuracy, and scalability to better serve the diverse needs of users.

IV. Proposed System and its Use

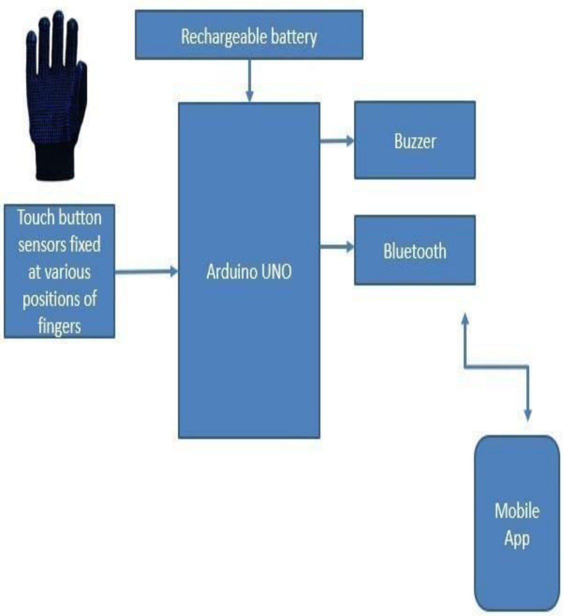

Fig 1: Block diagram of the proposed system

Our proposed system aims to develop a gesture-based speaking system utilizing a wearable smart glove to enhance communication for individuals with disabilities. The system will integrate advanced sensors, such as flex sensors or accelerometers, with a microcontroller, such as Arduino Uno, embedded within the smart glove. These sensors will detect hand gestures made by the user, which will be translated into predefined commands. The commands will then be transmitted wirelessly via Bluetooth to a companion Android smartphone application. This application will process the gestures and convert them into audible speech, allowing for real-time communication. Additionally, the system will prioritize user-centered design principles, offering customization options and responsiveness to user feedback. Through iterative development and testing, we aim to create a user-friendly and effective solution that empowers individuals with disabilities to communicate more effectively and independently.

V. Components Description and its use:

Smart Glove: The smart glove serves as the primary interface for users to interact with the system. It is equipped with various sensors, such as flex sensors or accelerometers, strategically placed on different fingers to detect hand gestures accurately. The glove provides users with a familiar and intuitive means of communication by allowing them to make gestures naturally.

Fig 2: Hand Glove

Microcontroller (e.g., Arduino Uno): The microcontroller serves as the brain of the system, responsible for processing the signals from the sensors on the smart glove and converting them into digital data. It also facilitates the communication between the smart glove and the smartphone application via Bluetooth. The microcontroller executes the algorithms necessary for gesture recognition and command interpretation.

Fig 3: Arduino Uno

Sensors: Sensors, such as touch buttons, are integral to the proposed gesture-based speaking system, offering a simple yet effective means of detecting and capturing hand movements accurately. Unlike flex sensors or accelerometers, touch buttons provide tactile feedback to users, allowing for intuitive interactions by simply pressing or tapping designated areas on the smart glove. This direct form of input enables users to trigger specific commands or gestures with precision and reliability. When a touch button is activated, it generates a signal that is promptly transmitted to the microcontroller, which interprets the input and initiates the corresponding action within the system. By incorporating touch buttons as sensors, we ensure responsive and accurate detection of user inputs, facilitating seamless communication and interaction for individuals with disabilities.

Fig 4: Showing touch buttons integrated with glove

Bluetooth Module: The Bluetooth module enables wireless communication between the smart glove and the companion Android smartphone application. It allows the transmission of data, including interpreted gestures and commands, in real-time. The Bluetooth module ensures seamless connectivity and enables users to communicate effectively without the constraints of wired connections.

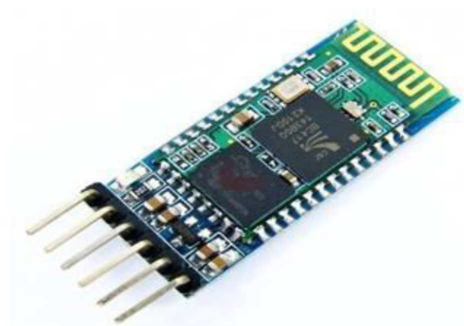

Fig 5: Bluetooth module

Buzzer: The buzzer serves as an essential component in the proposed gesture-based speaking system, providing auditory feedback to users. When a gesture or command is successfully recognized and interpreted by the system, the buzzer emits a sound, alerting the user to the acknowledgment of their input. This auditory feedback plays a crucial role in confirming interactions and ensuring user confidence in the system's responsiveness. Additionally, the buzzer can be programmed to emit different tones or patterns to convey specific messages or notifications, further enhancing the user experience. Overall, the inclusion of a buzzer enhances the accessibility and usability of the system, enabling individuals with disabilities to engage effectively in communication and interaction.

Fig 6: Buzzer

Android Smartphone Application: The smartphone application serves as the user interface for displaying interpreted gestures and converting them into audible speech. It receives data transmitted from the smart glove via Bluetooth and processes it using predefined algorithms. The application then generates audible output, allowing users to hear the spoken words corresponding to the recognized gestures. Additionally, the application may provide customization options and settings for users to personalize their experience.

VI. Working Flow Chart of proposed system

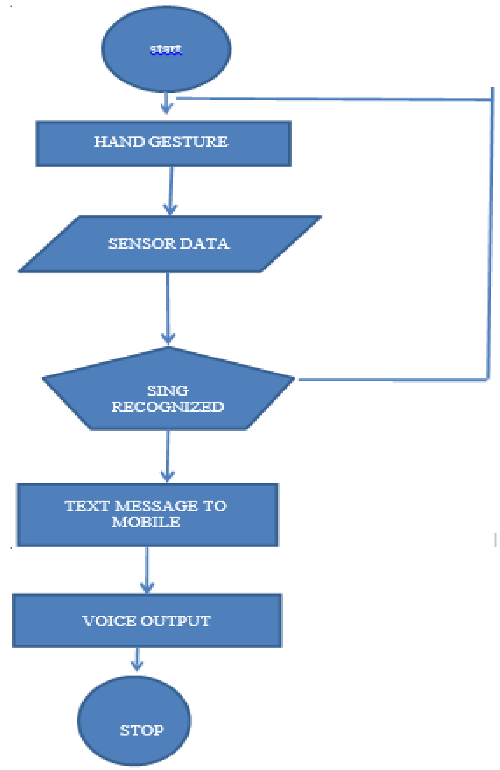

Fig 7: Flow chart

VII. Working algorithm for the proposed gesture-based speaking system

Initialization: Initialize the microcontroller and Bluetooth module. Calibrate sensors (if necessary) and set up communication protocols.

User Interaction: User wears the smart glove. Sensors continuously monitor hand movements.

Gesture Detection: Read sensor data to detect hand gestures. Implement algorithms to recognize specific gestures or commands. If a gesture is detected, proceed to the next step. Otherwise, continue monitoring.

Data Transmission: Transmit recognized gesture data to the smartphone app via Bluetooth.

Ensure reliable communication and data integrity during transmission.

Data Processing (Smartphone App):

Receive gesture data from the microcontroller.

Audible Output: Output the synthesized speech through the smartphone's speaker or connected audio device. Ensure clear and intelligible speech output for the user.

VIII. Results:

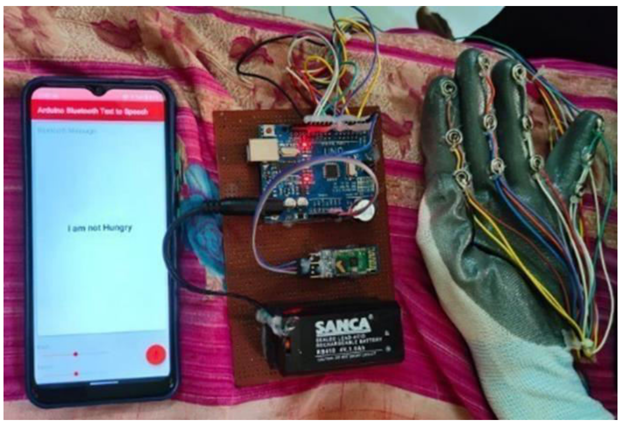

Fig 8: Developed prototype of proposed system

The hand glove designed to assist disabled people in communication through thumb taps can provide promising results when integrated with an Arduino-based text-to-speech (TTS) application. Here is detailed description of the results: Accuracy and Reliability of Thumb Tap Detection: The thumb tap detection accuracy and reliability can be evaluated through rigorous testing. Multiple rounds of testing can be performed to assess the sensitivity and threshold settings of the sensors, as well as the performance of the microcontroller code. The results may show a high accuracy rate in detecting thumb taps, with minimal false positives or false negatives. This indicates that the sensors and microcontroller are effectively capturing and processing the thumb tap inputs, leading to reliable command activation.

Usability and Comfort of the Glove: The usability and comfort of the hand glove are essential factors for patient acceptance and adoption. User feedback can reveal that the glove is easy to put on and takeoff, fits comfortably on the patient's hand, and does not cause discomfort or irritation during extended use. The glove's design, including the placement of sensors and the overall ergonomics, may contribute to its usability and comfort. Positive feedback from users may indicate that the glove is intuitive to use, allowing patients to easily tap the desired points with their thumb to trigger the 12 different commands.

Fig 9: Showing hand glove fitted to hand

Effectiveness of Communication Commands: The effectiveness of the 12 different commands triggered by thumb taps can be evaluated based on the patient's ability to communicate their intended messages accurately. User testing may reveal that patients can reliably trigger the desired commands through thumb taps, resulting in the corresponding text-to-speech output. The commands may include commonly used phrases, words, or specific messages tailored to the patient's needs. The results may demonstrate that the glove is effective in enabling patients to express themselves and communicate effectively using the predefined commands.

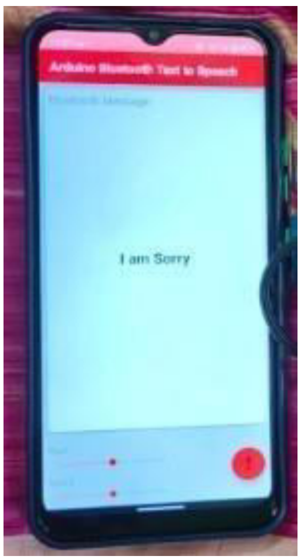

Fig 10: Showing user feedback received in user interface

User Feedback and Caregiver Input: Feedback from users, including patients and caregivers, can provide valuable insights into the performance and impact of the hand glove. Users may provide positive feedback on the ease of use, comfort, and effectiveness of the glove in facilitating communication. Caregivers may express satisfaction with the glove's performance in enhancing the patient's ability to communicate independently. User feedback may also highlight any limitations or areas for improvement, such as specific commands that may be missing or suggestions for customization based on individual patient needs. This feedback can be used to refine and improve the hand glove design and functionality.

Conclusion

The proposed gesture-based speaking system offers a promising solution to enhance communication for individuals with disabilities. By leveraging wearable technology, sensors, and Bluetooth communication, the system enables users to convey messages and commands through hand gestures, which are then translated into audible speech via a companion smartphone application. The system prioritizes user-centered design principles, offering customization options and responsive feedback mechanisms to ensure accessibility and usability for individuals with diverse needs. While the system presents a significant advancement in assistive communication technology, further research and development are warranted to optimize its performance and address any remaining challenges. Overall, the gesture-based speaking system holds great potential to empower individuals with disabilities to communicate more effectively and participate more fully in social interactions and daily activities.

References:

[1] H. Rewari, V. Dixit, D. Batra, and H. "Automated Sign Language Interpreter," in Proceedings of 2018 Eleventh International Conference on Contemporary Computing (IC3), Aug. 2018, pp. 1-5.

[2] A. Bhaskaran K, D. RamK, K. Ananthanarayanan, and H. R. Nandi Vardhan, "Smart gloves for hand gesture recognition: Sign language to speech

conversion system," in 2016 International Conference on Robotics and Automation for Humanitarian Applications (RAHA), Dec. 2016, pp. 1-6.

[3] A. Das, L. Yadav, and M. Singhal, "Smart glove for Sign Language communications," in 2016 International Conference on Accessibility to Digital World (ICADW), Dec. 2016, pp. 27-31.

[4] A. Panse, A. Kumar Voona, and S. M. Sameer, "Smart glove with gesture recognition ability for the hearing and speech impaired," in 2014 IEEE Global Humanitarian Technology Conference - South Asia Satellite (GHTC-SAS), Sept. 2014, pp. 105-110.

[5] R. Rastogi, S. Mittal, and S. Agarwal, "A Novel Approach for Communication among Blind, Deaf and Dumb People," in 2015 2nd International Conference on Computing for Sustainable Global Development (INDIA Com), 2015, pp. 978-9-3805-4416-8/15/$31.00 ©2015 IEEE.

[6] A.-U.-Rehman, S. Afghani, M. Akmal, and R. Yousaf, "Microcontroller and Sensors Based Gesture Vocalizer," in Proceedings of the 7th WSEAS International Conference on signal processing, robotics and automation (ISPRA '08), University of Cambridge, UK, 2008, ISSN: 1790-5117 8 2 ISBN: 978- 9606766-44-2.

[7] A. Tandon, A. Saxena, K. Mehrotra, K. Kashyap, and H. Kaur, "A Review Paper on Smart Glove – Converts Indian Sign Language (ISL) into Text and Speech," in International Journal for Scientific Research & Development (IJSRD), vol. 4, no. 8, pp. 269-272, 2016.

[8] K. V. Fale, A. Phalke, P. Chaudhari, and P. Jadhav, "Smart Glove: Gesture Vocalizer for Deaf and Dumb People," in International Journal of Innovative Research in Computer and Communication Engineering, vol. 4, no. 4, April 2016.

[9] M. Verma, S. L. Mrs., and S. Chatterji, "Design of Smart Gloves," in International Journal of Engineering Research & Technology (IJERT), vol. 3, no. 11, Nov. 2014, ISSN: 2278-0181.Vol. 3 Issue 11, pp. 11, November-2014.

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