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Motion-Sensing Home Automation with Vocalization

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Abstract:- Effective communication is essential for conveying information and connecting with others. However, for folks who are unable to speak due to physical disabilities, expressing their thoughts and ideas can be challenging. This is particularly true for individuals who are Deaf and Mute. There are a lot of people who don't know.sign language, which further limits communication opportunities for those who rely on it. Whilesome devices exist that can convert sign language into text and speech in English, there is not enough solutions for other devices, that combined this work and give the result. In Our work, we propose a system that recognizes Customized sign language . Thesystem aims to provide a more inclusive communication experience by enabling seamless interaction between Mute individuals and others, fostering better understanding and accessibility. The system will be implemented on an Android platform, allowing for easy access and widespread use.

Keywords:- *Arduino UNO.*

I. INTRODUCTION

In a diverse world where communication is a fundamental partof human interaction, there are individuals who face challenges in expressing themselves verbally. These individuals, commonly referred to as nonverbal or non-speaking, have unique communication needs and experiences. Although they might not use spoken language as aprimary means of communication, It is crucial to understand and support their abilities to connect with others and participate in society.

Talking about statistical data specifically addressing the population of nonverbal individuals is difficult to obtain due to the variety of conditions and circumstances that can lead to non verbalism. However, it is estimated that approximately 1% to 2% of the general population is affected by conditions that result in significant speech and language difficulties.

Nonverbal People may include those who suffer from conditions like autism spectrum disorder, developmental disabilities, neurological disorders, hearing impairments, or physical disabilities affecting speech production. Each individual's communication abilities and needs can vary greatly, requiring a personalized approach to support and accommodate their unique circumstances.

Alternative forms of communication, such as sign language, augmentative and alternative communication (AAC) devices, pictorial systems, or assistive technology, are essential tools for nonverbal individuals to express themselves and interact with others effectively. These tools enable them to convey their thoughts, needs, and emotions, facilitating meaningful connections and can easily socialize with people around them.

Understanding and accepting nonverbal individuals' diverse modes of communication fosters inclusion and makes certain that their opinions are heard. to promote accessible environments, support the development and use of appropriatecommunication strategies, and advocate for their inclusion in education, employment, and social settings.

By embracing the unique communication needs of nonverbal individuals and providing appropriate resources and support, we can make society more diverse and values and respects the various methods in which individuals express themselves.

Basically this problem can be solved there are 2 methods that we can look into.one is the vision based detection and another one by using sensors for the conversion of the sign language.

We have chosen the sensor and given it the utmost priority as the different ways that relevance of vision-based recognition. Poor lighting conditions, visual obstructions, or complex backgrounds can hinder the accuracy and reliability of vision-based systems. In such cases, sensor-based recognition may offer more reliable and consistent results since it relies on other data sources not affected by visual limitations.

In our project, we have incorporated a customized sign language system instead of utilizing an existing, standardized sign language. This decision was driven by the specific requirements and goals of our project, in addition the unique context in which it operates. By developing a tailored sign language, we were able to propose a communication system that directly aligns with requisites and capabilities of our intended users. This customized approach permitted us to create a more accessible and efficient means of communication, taking into consideration the specific gestures, symbols, and expressions that best suit the targeted audience. Through this innovative approach, we aim to bridge communication barriers and empower individuals to effectively express themselves inside the structure of our project.

II. PROPOSED SOLUTION

The schematic block presented in Fig. 1 illustrates the schematic representation of the proposed system, outlining thevarious interconnected components and their functional relationships. The proposed system is based on various sign language, hand actions and customized sentences.In this proposed system different components have been applied like Arduino uno, RF encoder decoder, HC-05 Module, Flex Sensor, MPU-6050 module.

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A. Flex sensor

Flex sensor is a sensor which measures the amount of bendingand its resistance value changes according to bending movement so sometimes it is called a flexible potentiometer. Flex sensor has a range of around 10k -35k.

B. HC-05 Module

HC-05 Module is further known as Bluetooth module.Bluetooth Communication operates on a 2.4GHz frequency, making it a widely utilized RF communication technology. With a range of approximately 10 meters, Bluetooth is often used for a range of applications, including data transfers, audio systems, hands-free devices, and computer peripherals. The fact that it facilitates low range wireless communication is a factor in its popularity.

C. MPU-6050 module

The MPU-6050 module is a popular sensor module used for motion tracking and orientation sensing. It combines a 3-axis accelerometer and a 3-axis gyroscope into a single integrated circuit. MPU stands for Motion Processing Unit. The MPU-6050 module is commonly used in robotics, drones, gaming applications, and other projects that require motion sensing capabilities. It provides accurate measurements of acceleration, angular velocity, and temperature.

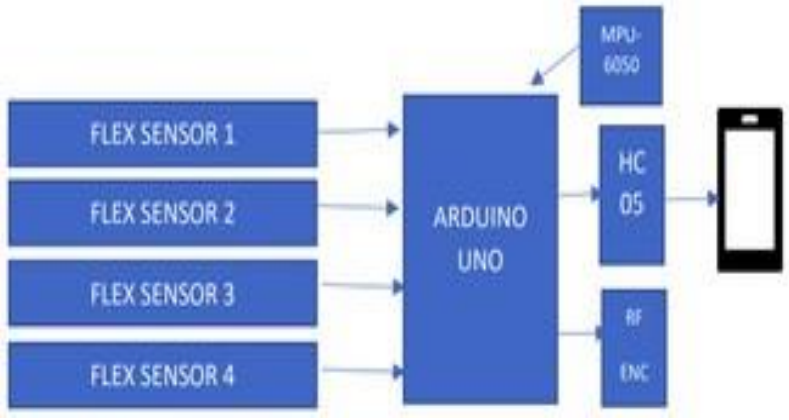

Fig. 1: A block diagram representing the hand gloves side system.

Fig. 1 shows the input side or gloves side circuit block diagram in which Arduino UNO get the data from 4 Flex Sensor and mpu-6050 where mpu-6050 is a module with a 3-axis accelerometer and a 3-axis gyroscope and 4 flex sensor provides four different values and combination of this all values provide unique actions It was coded in accordance to this unique values. In the gloves side Arduino receives data from sensors and process the value accordingly and sends the information to mobile through hc-05 bluetooth module and a built application may be found on mobile devices.

To convert the data coming from gloves into speech data. RF encoder encode the information from an Arduino Uno and sends the encoded data to home automation board which is shown in fig. 2

Fig. 2: A block diagram representing the home auto side system

Whereas fig.2 shows the output side or home automation board side block diagram in which multiple output appliances are connected and it receives the data from gloves through rf encoder. There is rf decoder in home automation board which decodes data receives from rf encoder and there is an Arduino board also connected to automation board which process the facts and turn on or off the appliances which are connected through relay module.

D. Flow chart

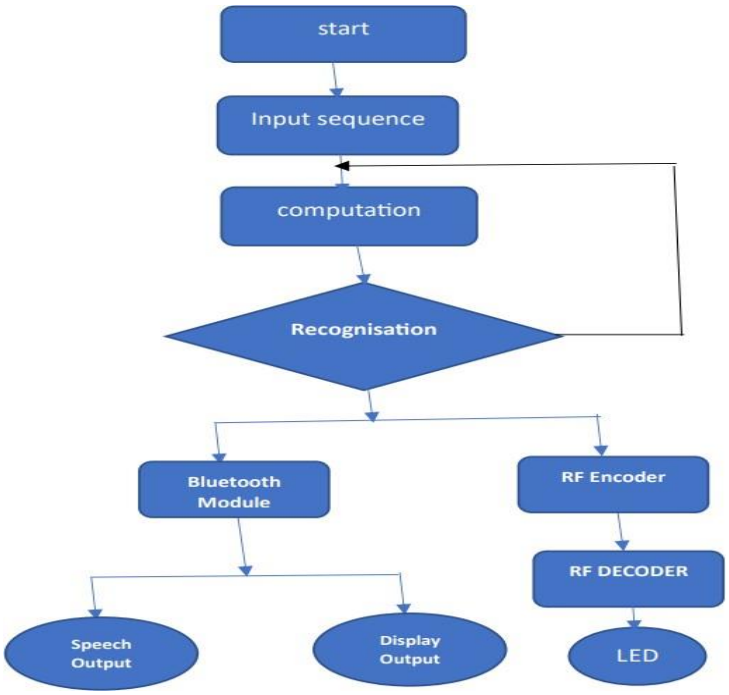

Fig. 3: A block diagram representing the hand gloves side system.

III. LITERATURE SURVEY

Our project aims to review existing research and studies relating to the concept of hand movements which are specifically aimed at converting Customized Sign Language into text and speech. The aim of this initiative is to identify and comment on the status of techniques, algorithms and approaches used in this area.

- "A Survey of Vision-Based Hand Gesture Recognition" by Rahmati et al. (2018)
- The paper focuses on vision-based hand movement recognition techniques. It explores various approaches, including depth cameras, and infrared sensors, for capturing hand movements. The survey covers gesture recognition algorithms, datasets, and challenges. Although not specific to Customized Sign Language, it provides valuable insights applicable to the proposed research.
- Prakash, C., & Kumar, M. (2020). Real-time Customize sign language recognition system using deep learning techniques: A review. Journal of Ambient Intelligence and Humanized Computing, 11(6), 2431-2446.
- Real time Customized/Customize sign language recognition systems that use deep learning techniques are the focus of this paper. It's investigating the use of Deep Neural Networks, such as CNN and LRLSTM networks for recognition of hand gestures. An in-depth analysis of the state-of-the-art methods, datasets, and evaluation metrics has been provided by the author.
- "Customize sign language Recognition: A Comprehensive Review" by Pandey et al. (2021)
- This paper focuses on Customized Sign Language recognition techniques. It discusses various techniques such as including sensor-based systems, vision-based systems, and glove material-based systems. The author has explored various challenges in recognizing Customize sign language gestures and has suggested possible solutions. It serves as a valuable resource for understanding the specific requirements of Sign Language translation.
- Saraf, K., & Gandhi, T. (2017). Hand gesture recognition using computer vision techniques: A review. Journal of Intelligent Systems, 26(2), 351-372.
- Hand movement recognition using computer vision techniques, which recognising hand motions in sign language proposed system, is covered in this paper. The paper gives an insight into progress and challenges in this area through various ways, such as templates matching, appearance-based methodologies or machine learning methods.
- Kumar, A., & Devi, V. (2019). Hand gesture recognition for Sign Language using computer vision: A review. Multimedia Tools and Applications, 78(3), 3699-3724.
- This paper focuses on recognising hand motions in sign language computer vision techniques. It's collecting different methods for extracting features, classifying algorithms related to the recognition of hand gestures.
- Gabel, T., & Lange, B. (2017). A systematic review of wearable sensors and devices for recording hand-specific data. Sensors, 17(12), 2693.
- An overview of sensors and devices to record wrist specific data shall be given in the framework of this systematically reviewed review. It examines a variety of sensor technologies, for example accelerometers, gyroscopes and bend sensors, as well as their application in hand gesture recognition. The design and use of sensors in the proposed system can be influenced by findings from this review.

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- "Hand gesture Recognition Using Wearable Sensors for Sign Language Translation" by Li et al. (2017)
- A system for recognition of movements on the wrist using intrinsic sensors has been described in this paper. Using machine learning, the system records hand movements, finger movements, and recognition of gestures. The study discusses the accuracy of sign language gesture recognition and the possibility of extending the system to Customize sign language.
- Arora, A., & Kaushik, S. (2020). Sign language recognition using deep learning: A survey. Journal of King Saud University-Computer and Information Sciences, 32(3), 285-292.[1]
- The author of this essay has employed various 'deep learning techniques' for sign language recognition. It uses Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) for recognizing sign language gestures, which is the core part of this project. The author has specifically created models to capture the gestures and run them through databases via Image Processing Techniques.
- "Sign Language Recognition using Machine Learning: A Review" by Maheshwari et al. (2020)
- This paper presents an overview of Sign language understanding techniques using machine learning algorithms. It discusses different aspects related to the concept such as such as gloves, accelerometers, and flex sensors, for capturing hand gestures or movements in general. The author has talked about the importance of accurate recognition for effective sign language translation and communication.
- Prasanna, S. R., & Geetha, T. V. (2020). A comprehensive survey on Customize sign language recognition systems. In 2020 2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA) (pp. 519-524). IEEE. Various methods and techniques used in the field of hand movement recognition such as feature extraction vein segmentation and classification are discussed in this paper. The survey also points to the significance of making intercultural considerations part of the design of sign language recognition systems. The author specifically discussed the various technologies and concepts related to 'finger gesture recognition,' as well as presented an insight into how different approaches differ in results.

IV. RESULTS AND ANALYSIS

In the fig below the actual hardware implemented prototype is shown .Till now we have figured out 12 gesture movement which is given customized message provided by us. According to accelerometer (mpu6050) which is used as gyroscope that provide 3 axis x,y,z as the main axis and that can accustomed to provide direction to the hand that accustomed to a different gesture but in our case we have used only 2 axis that is x axis and yaxis. The +ve x,-ve x and +ve y and -ve y axis in this are used for different signals to be forwarded after selecting the angle we have decided on what angle the hardware should give the pre-defined result being set by us.

We typically used 160 and 180 degree as our benchmark and controlling the flex's angle of attack We are giving the required results. The result of this or we can say result is being obtained on android app which converts the signal provided by bluetooth module - HC05 to the application in terms of text is then converted into speech.

The table defined below shows the condition on which the the output of our system is constrained on ,we have pre-fixed the values so that whenever the system triggers the value it show the correspondant output.

Table 1: The Correspondant Output

Sr. No	Flex1	Flex2	X-axis	Y-axis	Result
1	<180	<170	>5	—	Light
2	<180	<170	<-5	—	Fan
3	<180	<170	—	>5	Light 1
4	<180	<170	—	<-5	Fan
5	<170	—	>5	—	Thank You
6	<170	—	<-5	—	Nice to Meet You
7	<170	—	—	>5	Glad To be Here
8	<170	—	—	<-5	Hello I am Shivam this is my Project
9	—	<170	>5	—	Water
10	—	<170	<-5	—	What is your Name
11	—	<170	—	>5	Sorry f
12	—	<170	—	<-5	fine

The figure below is protoype which is need to be wear on the hand so that the actual movements are shared with arduino through Flex sensor and according to the result is transmitted via Bluetooth module.

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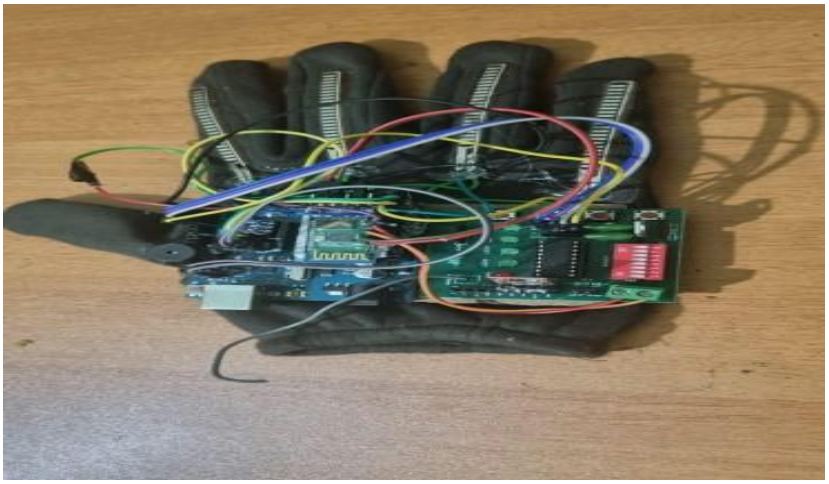

Fig. 4: Hand glove with sensor

We are integrating our model with home automation so thatthe appliances in the home can be controlled by hand gesture below figure represent the home automation circuit consisting of RF encoder and decoder which receives signal and works accordingly.

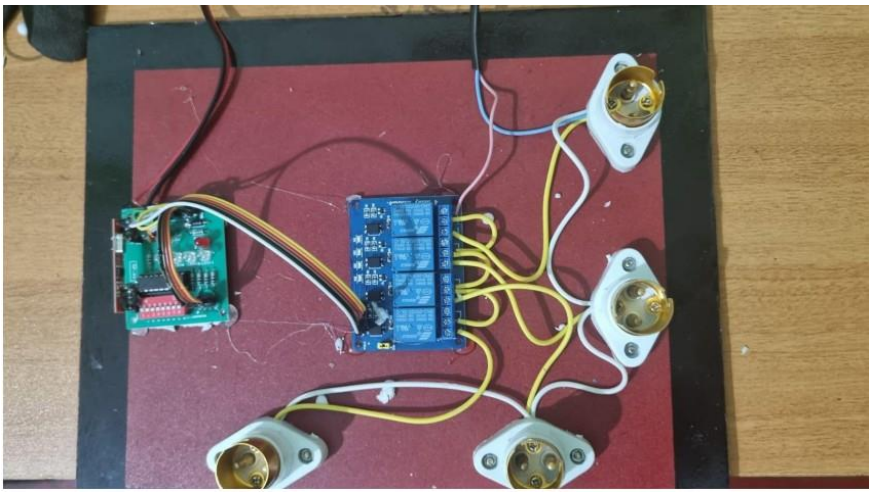

Fig. 5: Home automation

We are displaying our result using an android application which connects through bluetooth module -HC05 ,and recievethe signal than it converts the signal into text which further converts in speech.below figure describe the UI of our application.

Fig. 6: Application view (Bluetooth text to speech)

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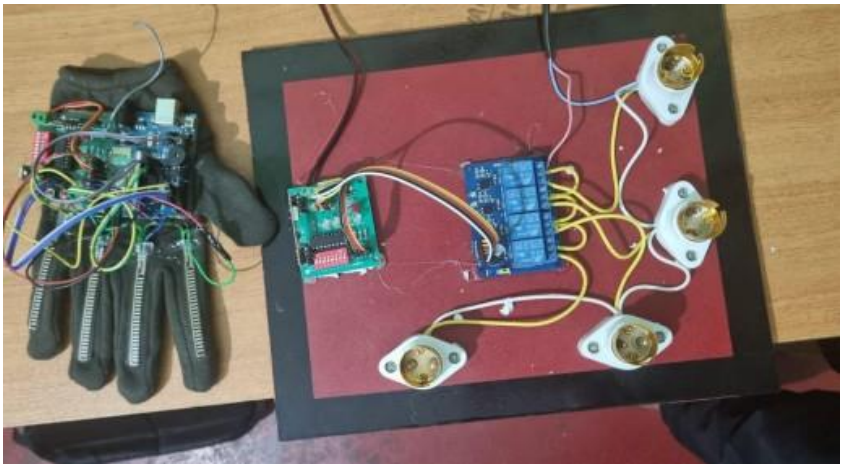

Fig. 7: Glove sensor with Home Automation

Fig. 8: Final Output (flex 1 <180 & y-axis< -5)

Output of our hand gesture it displays on the screen with voicestating “hello I am shivam this is my project” from out android application.

V. CONCLUSIONS

In conclusion, hand gesture vocalization technology holds tremendous potential for individuals who are unable to speak. By providing an alternative means of communication, it empowers those with speech disabilities to express themselves, interact with technology, and engage with the world around them.

For individuals who cannot speak, hand gesture vocalization offers a valuable channel for self-expression and interaction. Itallows them to convey their thoughts, needs, and emotions through intuitive hand movements, enabling effective communication with others. This technology bridges the communication gap that exists for individuals who rely on non-verbal forms of expression.

Moreover, hand gesture vocalization can significantly enhance the quality of life for individuals with speech disabilities. It enables them to independently control various devices and systems, such as home automation or assistive technologies, using intuitive gestures and vocal commands. This level of autonomy fosters a sense of empowerment, enabling individuals to navigate their environment and perform tasks with greater independence.

Additionally, the integration of hand gesture vocalization withother assistive technologies, such as text-to-speech or augmentative and alternative communication (AAC) devices, further expands communication possibilities. By combining these modalities, individuals who are unable to speak can access a broader range of communication tools, enabling themto effectively express themselves and engage in meaningful interactions.

As hand gesture vocalization technology continues to advance, it holds promise for further customization and adaptation to individual needs. This personalization aspect is particularly crucial for individuals with speech disabilities, as it allows them to tailor the system to their specific gestures and communication preferences.

Overall, hand gesture vocalization technology offers a transformative solution for individuals who cannot speak, empowering them to communicate, control their environment,and participate fully in society. By bridging the communication gap and providing alternative means of expression, this technology enhances the quality of life and promotes inclusivity for individuals who face speech-related challenges.

The integration of hand gesture vocalization and home automation has the potential to revolutionize the way we interact with our living spaces. By combining the power of gesture recognition technology with voice control capabilities,individuals can effortlessly control various home automation devices and systems using intuitive hand movements and vocal commands.

This innovative approach enhances accessibility and convenience, particularly for individuals with physical disabilities or those who prefer hands-free interaction. Hand gesture vocalization enables users to seamlessly navigate through different control options, adjust lighting levels, regulate temperature settings, control entertainment systems, and more, all with simple gestures and voice commands.

The integration of hand gesture vocalization and home automation not only enhances the user experience but also promotes a more inclusive environment. Individuals who may have limited mobility or difficulties with traditional control interfaces can now have greater independence and control over their surroundings. Moreover, the system's adaptability to different languages and its potential for customization ensures that it can cater to diverse user needs and preferences.

VI. FUTURE WORK

Future work in the field of hand gesture vocalization technology involves expanding its language capabilities to include a wider range of languages, addressing the communication needs of diverse populations. This would require developing gesture recognition models and language processing algorithms specific to each language, enabling individuals from different linguistic backgrounds to benefit from this technology. Additionally, efforts can be directed towards miniaturizing the system and integrating it into a chip or compact device, making it more portable and easily accessible. Creating a prototype that is cost-effective and user-friendly would further promote the widespread adoption of hand gesture vocalization technology, ensuring that individuals with speech disabilities can utilize it in various settings without significant financial barriers. Overall, future research and development should focus on broadening language support, optimizing the technology for portability and affordability, and conducting user studies to assess its effectiveness and usability in real-world scenarios. By advancing these aspects, hand gesture vocalization technology can become a widely accessible and inclusive tool for individuals who cannot speak, empowering them to communicate and engage with the world around them more effectively.

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