*IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)*
*e-ISSN: 2278-2834, p- ISSN: 2278-8735.Volume 19, Issue 5, Ser. 1 (Sept. – Oct. 2024), PP 26-31*
*www.iosrjournals.org*

# Sign To Speech Conversion And Home Automation Control Using Smart Gloves

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***Abstract:***
*In today's world, there are many new technologies changing the way we do things. One interesting technology is the home automation system. It helps people control things in their homes from far away, making life more comfortable, saving money, and being easy to use. But some people find it a bit tricky to use these systems well. To make it simpler for everyone, we can use something called a flex sensor-based home automation system. This system lets you control things by moving your hands, which is really helpful for older people or those who might find it a bit hard to move. It's also great for people who haven't had much learning. And if we add voice help, it becomes even easier. This way, people who are in bed or dealing with physical problems can use it too. This makes technology not just cool but helpful for everyone in different situations.*
*In this paper, we explore the integration of flex sensors onto hand gloves to facilitate a dynamic interaction between hand movements and technological outputs. The flex sensors, akin to miniature potentiometers, are strategically affixed to the fingers, registering changes in value corresponding to the bending action. As the finger bends, the sensor's resistance alters, influencing the output in an inversely proportional manner. This innovative system allows for nuanced control, where specific angles of finger bending lead to calibrated adjustments in output, demonstrating a responsive and intuitive interface between human gestures and technology. The implementation of flex sensor- based gloves introduces a versatile means of capturing and translating hand movements into actionable data. The project leverages the concept of resistance modulation to precisely interpret the degree of finger bending, creating a reliable framework for diverse applications such as gesture-controlled devices or assistive technologies for individuals with limited mobility. The abstracted communication between human hand gestures and technology opens avenues for accessible and intuitive interfaces, promising potential applications across various domains.*

***Keywords:*** *Flex Sensors*

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Date of Submission: 19-10-2024 Date of Acceptance: 29-10-2024

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## I. Introduction

Within the intricate fabric of human existence, encounters with individuals navigating physical disabilities evoke reflections on the myriad challenges they confront daily. Ranging from partial impairments, such as speech impediments, deafness, or limb paralysis, to complete disabilities, these instances underscore the urgency for innovative solutions bridging the gap between abilities and everyday activities. At the nexus of this societal need and technological prowess emerges the Smart Hand Gloves for Disable People project, a beacon of innovation aiming to empower individuals with partial impairments, allowing them to reclaim agency and autonomy in their lives through the fusion of wearable technology and communication solutions.

At the core of this transformative endeavor are Flex Sensors seamlessly integrated into a pair of gloves, strategically placed along each finger and the thumb. These sensors, finely tuned to the degree of bend, translate physical gestures into electrical signals. Anchoring the project is a microcontroller equipped with an Analog-to-Digital Converter (ADC) that processes these signals with precision, facilitating seamless analog-to-digital signal conversion. The resulting digital data embarks on a wireless journey to the receiver section, where gestures are decoded, corresponding outputs are displayed on an LCD, and a nuanced speech output is eloquently played through a speaker, providing a multi-modal means of expression.

The amalgamation of cutting-edge technologies propels the Smart Hand Gloves for Disable People project towards its noble objectives. Flex Sensors act as the sensory receptors, capturing intricate hand gestures. The microcontroller, serving as the cognitive center, processes signals and performs crucial analog-to-digital conversions. The wireless communication aspect liberates the user, as digital data seamlessly traverses to the receiver section. This section excels in recognizing gestures, visually representing them on an LCD, and

simultaneously broadcasting a speech output through a speaker. The combination of visual and auditory feedback creates a holistic communication experience for individuals with partial impairments.

Despite the strides made in technological advancements, a pressing challenge persists in the realm of providing efficient communication solutions and home automation control for individuals grappling with speech and mobility impairments. The current landscape of assistive technologies, while noteworthy, often falls short in delivering a seamless and personalized experience tailored to the unique needs of users with disabilities. Traditional modes of communication and home automation methodologies may not adequately address the diverse requirements of this demographic, creating a noticeable gap in terms of accessibility and independence. The complexities surrounding user interaction, especially for those with varying degrees of impairment, underscore the urgency for a comprehensive and user-friendly solution. The demand for an integrated system that seamlessly combines sign-to-speech conversion with home automation control, utilizing smart gloves, is evident. Such a solution not only has the potential to bridge the existing gaps in assistive technology but also promises to revolutionize the way individuals with disabilities interact with their surroundings. By addressing this multifaceted challenge, we can empower individuals facing speech and mobility impairments, substantially enhance their overall quality of life, and contribute to fostering a more inclusive and accessible environment within the realm of smart home technology. This undertaking aligns with the broader societal goal of ensuring that technological advancements benefit all individuals, regardless of their physical abilities.

## II. Related Work

K V Fale et.al. introduces a "Smart Glove" designed to serve as a gesture vocalizer for individuals facing challenges in speech and hearing. By recognizing and interpreting hand gestures, the technology enables a novel form of communication for those who are deaf and mute. The focus is on providing an inclusive solution that empowers individuals to express themselves effectively.[1]

Pallavi. Et.al. This paper delves into the design aspects of smart gloves, likely exploring the engineering considerations and technological features involved in creating intelligent gloves. The emphasis may be on ergonomic design principles, sensor integration, and overall system architecture to ensure the effectiveness and usability of the smart glove technology.[2]

Harmeet Kaur et.al..This review paper provides a comprehensive overview of the evolutionary trajectory of smart glove technology. It likely explores the historical development, breakthroughs, and trends in the field. The aim is to summarize key findings and advancements, offering readers insights into the evolution of smart gloves as assistive devices.[3]

Rafiqul et.al..Focusing on hand gesture recognition, this literature review critically examines existing research, methodologies, and technologies related to recognizing and interpreting hand gestures. The paper aims to provide a comprehensive understanding of the state-of- the-art in gesture recognition, offering valuable insights into the challenges and advancements within this specific domain[4]

Dhawal et.al..The paper concludes by summarizing key findings and emphasizing the significance of smart hand gloves as a transformative tool for individuals with disabilities. The authors may underscore the positive impact on users' lives and call for continued research and development in assistive technologies to foster inclusivity and independence[5]

Anand Nayyar and Vikram Puri summarize key findings and highlight the significance of the Data Glove as an IoT-based smart wearable gadget. The authors underscore the potential of this technology to shape the future of wearable interactions, providing a tangible example of how IoT can elevate the capabilities of everyday devices.[7]

Kanika Rastogi and Pankaj Bhardwaj likely underscore the significance of smart gloves in converting gestures into speech and text, highlighting their potential to bridge communication gaps and improve the quality of life for diverse user groups. The authors may also advocate for continued exploration and innovation in this dynamic field.[8]

## III. Hardware And Software Requirement

The hardware requirements for the depicted circuit involve several key components integrated with the Arduino Mega 2560 as the central controller. Firstly, four flux sensors are connected to analog input pins on the Arduino, enabling the measurement of analog signals. This allows the system to capture and process data from the physical environment. The Arduino Mega 2560 serves as the brains of the operation, handling the signal processing tasks and interfacing with various peripherals. To enable wireless communication, an HT12E encoder is employed in the circuit. This encoder facilitates the conversion of data into a format suitable for wireless transmission. The encoded data is then transmitted wirelessly using a Zigbee module, which is also connected to the Arduino. This wireless capability enhances the system's flexibility and allows for remote data transmission. Simultaneously, an ARR333A3 Voice Recorder and Playback IC is integrated into the circuit to manage audio recording and playback functions. The speaker is connected to this IC, generating audible output

based on the recorded data. This audio integration adds another layer of functionality to the system, making it capable of handling both visual and auditory information. In summary, the hardware requirements encompass flux sensors for data acquisition, an HT12E encoder and Zigbee module for wireless communication, and an ARR333A3 IC for audio recording and playback. The Arduino Mega 2560 acts as the central hub, seamlessly integrating these components and showcasing the versatility of the Arduino platform in managing diverse functionalities within a single system.

The LCD 16x2 I2C display unit serves as a key component in the overall system, providing a user-friendly interface for information display. The 16x2 configuration refers to the screen size, capable of displaying 16 characters per line with 2 lines. The integration of the I2C (Inter-Integrated Circuit) communication protocol simplifies the connection and control of the display unit, reducing the number of pins required for communication.


**Fig 1:** LCD 16*2 I2C Display Unit

**Fig 2:** ARDUINO NANO

The Arduino Nano is a versatile microcontroller board that packs a punch in a compact form factor. At the core of its functionality is the ATmega328P microcontroller, known for its reliability and performance.

The flex sensor is a crucial component in the realm of sensors, providing a means to detect and measure the degree of bending or flexing in a material. Its fundamental design includes a flexible substrate coated with a resistive material. When the sensor undergoes deformation, the resistance within its material changes in direct proportion to the extent of bending.

**Fig 3 :** FLEX SENSOR


**Fig 4 :** ARP33A3 Voice Recorder and Playback

The AR433A3 is an integrated circuit designed for voice recording and playback applications, offering a compact and efficient solution for adding audio capabilities to electronic projects. Operating as a standalone module, it simplifies the integration of voice-related features without requiring extensive external components.

The ADXL345 is a highly versatile and widely used accelerometer sensor developed by Analog Devices. Renowned for its precision and reliability, the ADXL345 is employed in various applications ranging from consumer electronics to industrial monitoring systems. Featuring a small form factor and low power consumption, this sensor is suitable for battery-operated devices and embedded systems.


**Fig 5 :** ADXL345 MEMS Sensors


**Fig 6 :** Zigbee Transmitter and Receiver

Zigbee, based on the IEEE 802.15.4 standard, is a wireless communication technology renowned for its low-power and short-range capabilities. The Zigbee ecosystem involves transmitters and receivers equipped with Zigbee modules, fostering wireless communication in applications requiring energy efficiency and reliability

In this setup, the relay's low-voltage control circuit is powered by a microcontroller, which sends signals to energize or de-energize the relay's coil. The high- voltage load circuit is linked to the AC bulb and the mains power supply. When the relay is energized, its contacts close, completing the circuit and allowing current to flow to the bulb, turning it on. Conversely, when the relay is de-energized, the contacts open, interrupting the circuit and turning off the bulb. This arrangement offers electrical isolation, ensuring safety and safeguarding control components from potential voltage spikes.

**Fig .6: Ac Bulb with Relay**

## IV. Implementation And Results

The Transmitter block diagram is shown in Fig.7 ,it involves an Arduino Mega 2560 interfacing with various components to create a versatile system. Four flux sensors are connected to analog input pins to measure analog signals. The collected data is displayed on an LCD, which is connected to the Arduino via I2C. An HT12E encoder is utilized to encode data, preparing it for wireless transmission through a Zigbee module interfaced with the Arduino. Simultaneously, an ARR333A3 Voice Recorder and Playback IC is connected to the Arduino to manage audio recording and playback. The speaker is linked to the ARR333A3 to produce audible output. This intricate setup enables the Arduino Mega 2560 to gather data from flux sensors, display it on an LCD, wirelessly transmit encoded information, and handle both audio recording and playback, showcasing the flexibility and integration of various functionalities in a single circuit.

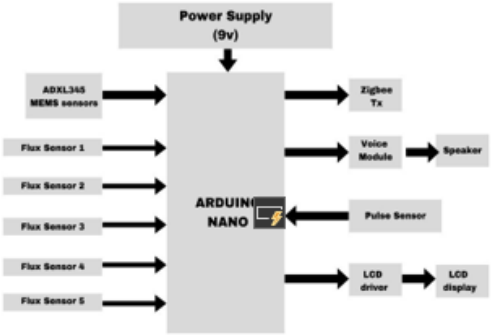



Fig.7:Transmitter block diagram

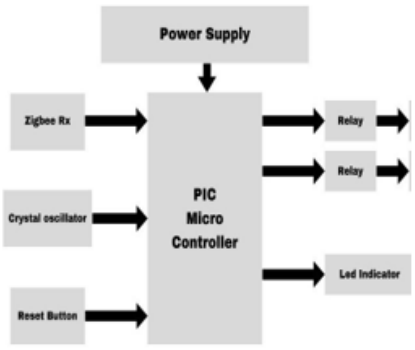
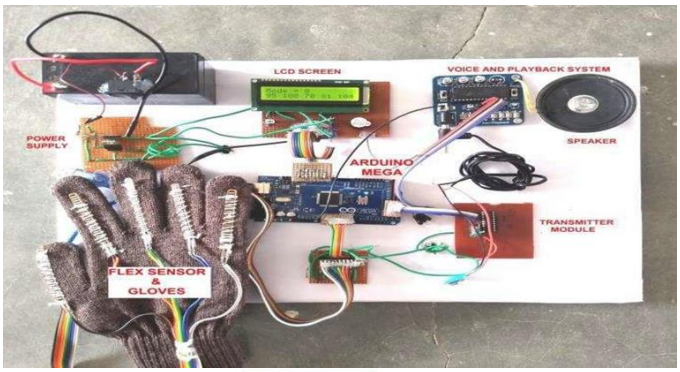



Fig.8:Receiver block diagram



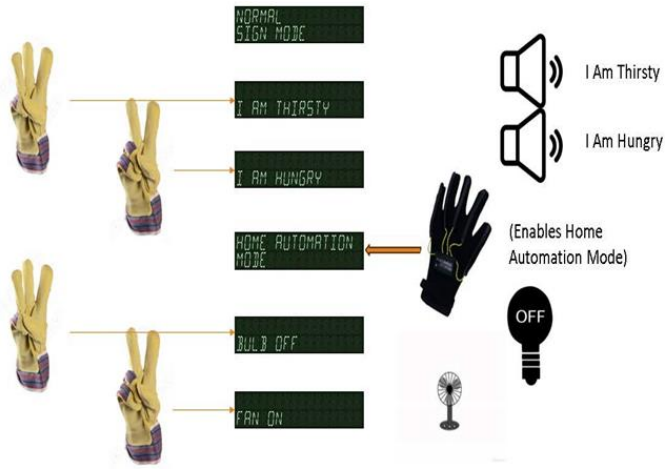




**Fig.7:Transmitter block diagram**
**Fig.8:Receiver block diagram**

The above fig shows us the functions of the wireless smart glove that comes equipped with four strategically embedded flux sensors in each finger, each serving a distinct purpose that can be customized by the user. For example, lifting a single finger can initiate a specialized task, like playing an audio cue for assistance, which is particularly useful for those needing immediate help. Moreover, individuals with hearing impairments can benefit from the glove's ability to display text messages on an integrated LCD screen when a finger is raised, ensuring effective communication. Additionally, the glove offers versatility by seamlessly transitioning into home automation mode when all four fingers are raised simultaneously. Each finger can be finely adjusted for specific home automation tasks, such as turning on lights, activating fans, or executing personalized routines, providing a tailored and user-friendly solution to meet individual needs.

## V. Conclusion

In conclusion, the depicted project represents a sophisticated and versatile system built around the Arduino Mega 2560 platform. By integrating flux sensors for analog signal measurement, an HT12E encoder for wireless data transmission, and an ARR333A3 Voice Recorder and Playback IC for audio functionalities, the project showcases a seamless fusion of diverse capabilities within a single circuit. The Arduino Mega 2560 serves as the central controller, orchestrating the collection, processing, and transmission of data, while also managing audio recording and playback.The multifunctional nature of the system is highlighted by its ability to not only display sensor data on an LCD but also wirelessly transmit encoded information and produce audible output. This amalgamation of features demonstrates the adaptability and flexibility of the Arduino platform, making it a powerful tool for applications requiring integration of various functionalities. The successful execution of this project underscores the potential of Arduino-based systems in creating comprehensive solutions that span different domains, from sensor interfacing to wireless communication and audio processing.

## References

[1] K. V. Fale, Akshay Phalke, Pratik Chaudhari, Pradeep Jadhav. “Smart Glove: Gesture Vocalizer For Deaf And Dumb People”. International Journal Of Innovative Research In Computer And Communication Engineering, Vol. 4, Issue 4, April 2016.

[2] Ms. Pallavi Verma, Mrs. Shimi S. L., D R. S. Chatterji. “Design Of Smart Gloves”. International Journal Of Engineering Research & Technology (Ijert), Issn:2278-0181. Vol.3 Issue 11, November-2014.

[3] Harmeet Kaur, Amit Saxena, Abhishek Tandon, Keshav Mehrotra, Khushboo Kashyap. "A Review Paper On Evolution Of Smart Glove". International Journal Of Scientific Research And Management Studies (Ijsrms), Issn: 2349-3771, Volume 3 Issue 3, Pg. 124-128.

[4] Rafiqul Zaman Khan And Noor Adnan Ibraheem, "Hand Gesture Recognition: A Literature Review", International Journal Of Artificial Intelligence & Applications (Ijaia), Vol.3, No.4, July 2012.

[5] Priya Matnani, "Glove Based And Accelerometer Based Gesture Control: A Literature Review", International Journal Of Technical Research And Applications E-Issn: 2320-8163, Volume 3, Issue 6 (November-December, 2015).

[6] Dhawal L. Patel, Harshal S. Tapase,Praful A.Landge, Parmeshwar P. More, Prof. A. P.Bagade ." Smart Hand Gloves For Disabled People ".International Research Journal Of Engineering And Technology (Irjet).Volume: 05issue: 04 | Apr-2018.

[7] Anand Nayyar And Vikram Puri," Data Glove: Internet Of Things (Iot) Based Smart Wearable Gadget ",British Journal Of Mathematics & Computer Science:1-12,2016, Article No.Bjmcs.24854 Issn: 2231-0851.

[8] Kanika Rastogi, Pankaj Bhardwaj "A Review Paper On Smart Glove - Converts Gestures Into Speech And Text" International Journal On Recent And Innovation Trends In Computing And Communication Issn: 2321-8169 Volume: 4, Issue:5.

[9] Prakash B Gaikwad, Dr V. K. Bairagi "Hand Gesture Recognition For Dumb People Using Indian Sign Language" International Journal Of Advanced Research In Computer Science And Software Engineering Volume 4, Issue12, December 2014 Issn:2277 128x.

[10] Abhijith Bhaskaran K, Anoop G Nair, Deepak Ram K, Krishnan Ananthanarayanan, Hr Nandi Vardhan "Smart Gloves For Hand Gesture Recognition -Sign Language To Speech Conversion System", 2016 International Conference On Robotics And Automation For Humanitarian Applications (Raha),978-1-5090-5203-5/16/ ©2016 Ieee