

Smart Glove to Convert Gestures to Speech

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Abstract - This project focuses on developing a **Smart Glove** that converts hand gestures into speech, enabling effective communication for individuals with paralysis or speech impairments. The glove integrates an **ADXL345 accelerometer** and **Combinational Circuit** to detect hand movements, with an **Arduino Uno** processing the data. Signals are transmitted via an **NRF24L01 wireless module** or **Bluetooth HC-05** to a mobile application, which generates speech output.

Designed to be **affordable, portable, and user-friendly**, this assistive device bridges the communication gap, particularly benefiting underprivileged areas. Future improvements may include **machine learning-based gesture recognition** and **multi-language support** for enhanced usability. Unlike costly existing solutions, this system offers an accessible and practical alternative, fostering social inclusion and improving the quality of life for individuals with disabilities.

Keywords : Smart Glove, Gesture-to-Speech, Assistive Technology, Arduino, Wireless Communication, Cost-Effective.

1. INTRODUCTION

In an information-oriented society, all members of the Society have the right to obtain and use the information. Therefore, it is necessary to develop various devices, which can provide information to anyone easily. More than 15.4 million people worldwide were living with a spinal cord injury (SCI) and with other Physically challenged people like visually impaired or deaf-blind people are facing lots of problems while communicating or interacting with other people. To provide a helping hand towards the paralysed society, recent technological growth has been developing different skilled methods to enhance their communication procedures. Illiteracy among this group is very high, much of which is attributed due to the lack of reading material in accessible format. For reading and writing dumb and deaf people always use Sign language representation of different alphabets, symbols (as shown in Fig. 1) and digits (as shown in Fig. 2) etc. Sign language is the language used by the Dumb and deaf to read and write. It is vital for communication and educational purposes.

NEED

Communication is a fundamental human right, yet millions of speech-impaired and paralyzed individuals struggle to express themselves due to physical limitations. Traditional sign language, though effective, is not universally understood, creating a significant communication gap between dumb, deaf, and paralyzed individuals and the rest of society. This leads to social isolation, dependency, and reduced opportunities in education, employment, and daily interactions.

Existing assistive devices, such as gesture recognition systems and speech-generating devices, are often expensive and inaccessible in developing countries like India, where affordability plays a crucial role in adoption. High-cost solutions (e.g., projects exceeding ₹2 lakh) are not feasible for mass deployment, leaving a large portion of the affected population without adequate support. Additionally, many rural areas lack access to computers and advanced technologies, making high-tech solutions impractical.

To bridge this gap, a cost-effective, portable, and user-friendly communication aid is essential. The Smart Glove aims to convert hand gestures into speech, providing a real-time, affordable, and practical solution for individuals with speech impairments and paralysis. By leveraging low-cost sensors, Arduino-based technology, and wireless communication, this project ensures that assistive technology is accessible to a larger population and can be deployed in homes, schools, and healthcare facilities.

2. LITERATURE SURVEY.

2.1 Kshitij Kadam, Sakshi Telange, Krishna Yadav, Ashish Vishwakarma, "Helping Hand : A Glove for Mute People", Published in 2023 at International Journal for Research Trends and Innovation (IJRTI) | Volume 8, Issue 4 | ISSN: 2456-3315.

In today's world the number of deaf and dumb people is very large, so the problems that are faced by those people can't be neglected. The major problem for those disabled people is communication and that too with normal people who can speak. A smart glove for mute people is a revolutionary device that has been designed to help individuals who cannot communicate verbally. This device uses advanced technology to enable people to communicate effectively by converting sign language into spoken language. The smart glove is a wearable device that is equipped with sensors and software that can recognize hand gestures and movements. The sensors detect the movements made by the user's fingers, and the software translates those movements into words or phrases. The disabled peoples use a particular language called as sign language which is not understandable by normal people. So in order to eliminate this problem there is a need to develop a product that can convert sign language to voice and text output which will make communication for disabled people with normal people easier.

2.2 Khushbu Pal, Pradnya Padmukh, Nidhi Patel, "Sign to Speech Smart Glove", Published at International Research Journal of Engineering and Technology (IRJET) Volume: 07 Issue: 02 | Feb 2020.

Every Normal human being sees, listens and then reacts to the situations by speaking himself out. But there are some human beings those who are not able to speak or listen, but they try to react through actions most of time normal people are not able to understand what they want to say. This application will help for both of them to communicate with each other. It consists of several parts, in part one with the help of hand gestures the signs will be detected by the sensors and the output will be given. Dumb people need to communicate with normal people for their daily routine or to express their emotions. The deaf-mute people throughout the world use sign language to communicate with other people. However, people who undergone from sign language training only they can communicate with another peoples. Sign language uses hand gestures and other means of non-verbal behaviors to convey their intended meaning. It involves combining hand shapes, orientation and hand movements, arms or body movement, and facial expressions simultaneously, to fluidly express speaker's thoughts. The idea is to create a sign language to speech conversion system, using which the information gestured by a deaf-mute person can be effectively conveyed

to a normal person. The main aim of this work is to design and implement a system to translate finger spelling (sign) to speech, using recognition and synthesis techniques.

2.3 Khan Sohelrana, Syed Faiyaz Ahmed, Shaik Sameer, Ollepu Ashok, "A Review on Smart Gloves to Convert Sign to Speech for Mute Community" Published in 2020 at 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)

(ICRITO) DOI: 10.1109/ICRITO48877.2020.9197947

The mute community all over the globe facing many problems while communicating. The normal and dumb people can communicate only in one way i.e. sign language, but many times communicating with normal persons they noticed difficulty. Therefore, there always exists communication barrier. This communication barrier is seen because a speech impaired person uses gesture to commune with common human being which is not suitable. We are implementing this project to reduce the barrier between dumb and normal person. This device design is based on the embedded system. Flex sensor and NodeMCU are the key components. The peoples who cannot able to speak they come across many problems while communicating with other persons. The speech impaired person uses sign language instead of speaking to represent themselves. Deaf persons can communicate only by using gestures. The significant drawback of sign language is that only the dumb person can understand gesture but not normal person. This gadget transforms gesture into speech i.e., gives voice to silent community who cannot speak.

SCOPE

We went through all the projects and found the main problem of cost as all the project consisted of similar flex sensor which are at a high cost and are not at all applicable if we want to create help for society we have to eliminate the use of flex sensor which we did by introducing our own combinational circuit which is combination of resistors and metal contact plates which will be connected and disconnected according to the movement of the figures and will send signal to Arduino for further processing.

AIM

This project aims to develop a **cost-effective and user-friendly assistive device** that converts hand gestures into speech, empowering individuals with speech impairments and paralysis to communicate effortlessly. By introducing an **alternative sensing mechanism**, it reduces dependency on expensive components, making the solution more **affordable and accessible**. The goal is to bridge the communication gap and enhance **social inclusion**, ensuring that even underprivileged communities can benefit from this technology.

3. PROBLEM STATEMENT

Paralyzed individuals face significant challenges in communication and independent interaction due to speech and mobility impairments. Existing assistive technologies are often expensive or lack a comprehensive solution for both communication and home automation. This project aims to develop a cost-effective smart glove that translates hand gestures into speech, enables appliance control, and integrates with a mobile application for messaging. By combining these functionalities in a single, user-friendly device, the project enhances independence, improves quality of life, and promotes accessibility for individuals with disabilities.

User: The person with disabilities will be the user to translate their actions.

4. APPLICATION :

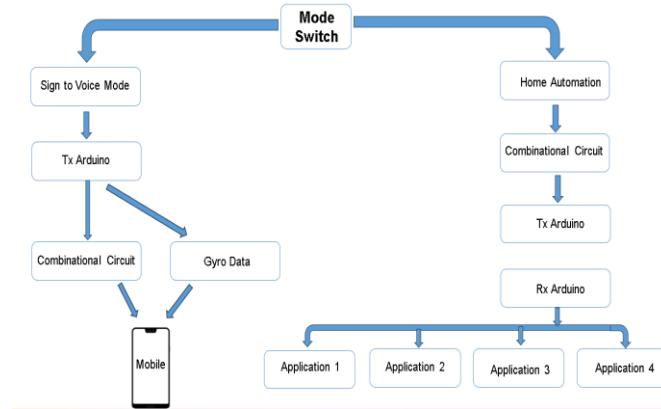
This system works using technologies. This application gives inputs from the user and processes it to find out the proper meaning. Then it gives responses in various formats through speaker and LCD.

5. PROPOSED SYSTEM

- Gesture vocalizer is a project that can convert sign language to human voice. The main idea of creating this project is to convert sign language of dumb and deaf people to understandable human voice available for everyone. Our society is so diversified and we have a community of dumb and deaf people who want to communicate with us, want to convey their thoughts towards us but are unable to do so. Hence we came up with an idea of creating a sign to voice converter without using flex sensor.
- As the flex sensor cost 1000rs for 1 piece and using 5 can cost a lot and the whole project will definitely go very high and our main aim is to reduce the cost so that we can make things available for the society and encourage our dumb and deaf community with us .
- This project will convert their sign language to human voice by using a combinational circuit of open and close contact and along with it. It will also have gyro sensor to measure the deflection in the motion of their hand. This data will further be processed by Arduino and via using Bluetooth module it will be available on our mobile devices and we will get the data as sound form.
- This project also has a home automation section which can be utilized using same gloves. This mode can be activated using a slider switch. We

have connected 2 relay modules for ac devices and 2 dc source for motor and led interfaced to it.

Proposed Block Diagram of the System



6. COMPONENTS USED

1. Arduino Uno

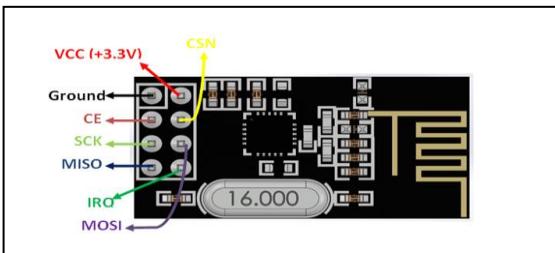
Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong. The worst case scenario is that you would have to replace the chip and start again.



2. NRF24L01 Module

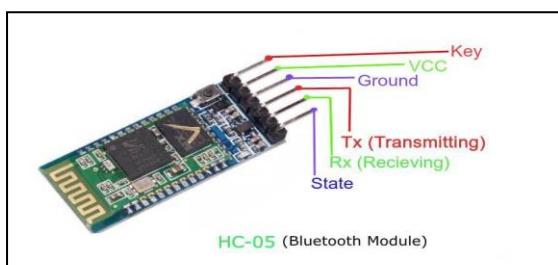
The NRF24L01 module is very popular choice for wireless communication when using Arduino. The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced ShockBurst™), designed for ultra low power wireless applications. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 - 2.4835GHz. An MCU (microcontroller) and very few external passive

components are needed to design a radio system with the nRF24L01.



3. HC-05 Bluetooth module

HC-05 module is an easy to use Bluetooth SPP(Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port



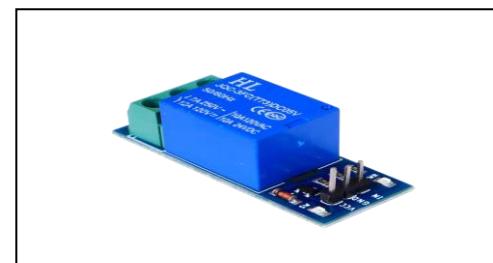
Bluetooth module is fully qualified Bluetooth V2.0+EDR(Enhanced Data Rate)3Mbps Modulation with complete 2.4 GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature).

4. 5V Single-Channel Relay Module

Relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises of components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

7. CONCLUSION

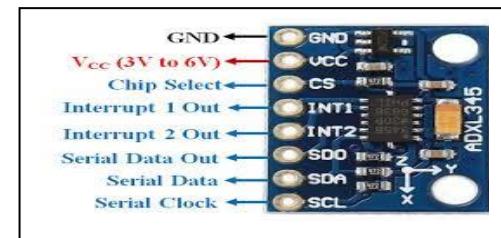
This project successfully addresses the communication and mobility challenges faced by paralyzed individuals through a smart glove that translates hand gestures into speech and controls home appliances. By offering an affordable and accessible alternative to expensive assistive devices, it promotes greater independence and inclusion. The integration of wireless communication and mobile support



enhances usability, making it a practical solution for daily life.

5. ADXL345 Accelerometer

The ADXL345 is a low-power, 3-axis MEMS accelerometer module with both I2C and SPI interfaces. The Adafruit Breakout boards for these modules feature on-board 3.3v voltage regulation and level shifting which makes them simple to interface with 5v microcontrollers such as the Arduino.



8. REFERENCES

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