Design and Development of Smart Glove for Sign to Speech Conversion and Home Automation

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Abstract: **Every regular human being watches, listens and then responds to things by uttering himself out. But some human beings do not have the ability to listen or speak but attempt to respond by action, most of the time ordinary individuals cannot make sense of what they wish to speak. A smart glove has proved to be an innovative aid technology to fill the communication gap for the subject person with hearing and speech disabilities. This will assist both in communicating with another. It is composed of various components, in part one by the aid of hand gestures the signs will be sensed by sensors and the output will be produced with a speaker as well as a display and another component will be home automation which will drive home electronics equipment.**

Keywords: **sensors, smart gloves, home automation, sign to speech.**

INTRODUCTION

Individuals with speech and hearing impairments face significant communication challenges in their daily lives, often relying on sign language to express themselves. The main need of this project to develop is created after research that is most of the people whose Paralyzed and not able to speak like a normal people. They are feeling uncomfortable in speaking. In paper [1-5] there are many limitations in this project there is only one mode (sign to speech conversion) which is limited for paralyzed people. In our project we use two functionalities, one is sign to speech conversion and another is home automation which makes independent to others. They can control their home electronic equipment by hand gestures. The Smart Glove for Sign to Speech Conversion and Home Automation has vast potential for future enhancements and broader applications. The Smart Glove provides a very practical and life-altering solution for people with speech or hearing impairments. Translating sign language into audible speech in real-time, it breaks the communication barrier between users and non-signers. This facilitates easier conversation in public areas, at home, and in the workplace, increasing confidence and social integration. The Smart Glove provides an extremely useful and life-altering solution for people with speech or hearing impairments. Through real-time conversion of sign language into spoken speech, it bridges the communication gap between users and people who do not understand communication. It makes interactions easier in public, at home, and at workplaces, thereby increasing confidence and social integration.

TECHNICAL DESCRIPTION

The Smart Glove Sign to Speech Conversion and Home Automation is a sophisticated wear-and-use system integrating sensor technology, embedded electronics, wireless communication, and automation that aims to support people with speech and hearing disabilities. The smart glove works under the principle of gesture recognition through the use of embedded sensors, which are subsequently decoded through a microcontroller to produce certain outputs, like the conversion of signs into speech or operation of home appliances. The smart glove is an all-purpose assistive device that not only facilitates real-time sign-to-speech translation but also introduces gesture-based interaction to smart home settings. Sensor fusion, embedded systems, and wireless control integration make it a versatile tool for improving accessibility and independence for individuals with special needs.

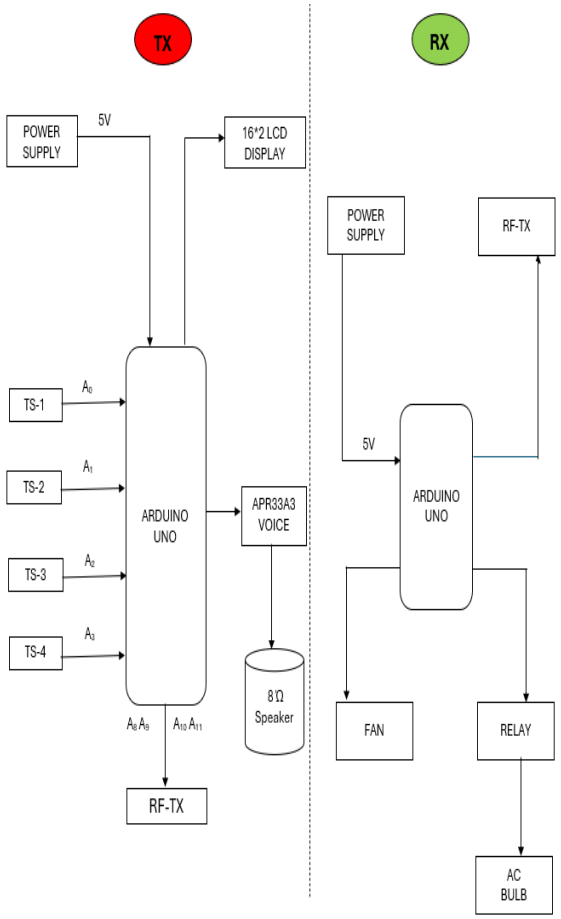


Fig-1- BLOCK DIAGRAM OF TRANSMITTER & RECEIVER

WORKING:

Each finger and glove body are equipped with touch sensors for identifying the tap and finger touching gesture. The sensors output analog signals based on finger tapped, which are read by a microcontroller (Arduino). These signals are matched with pre-programmed gesture data. Once a gesture is recognized, corresponding text is sent to a speech synthesis module (like a speaker) to vocalize the word or phrase.

Home Automation Control

Control home devices like lights, fans, or appliances via specific hand gestures. Specific hand gestures or touch patterns are assigned to control different home appliances (e.g., light ON/OFF, fan control). When a command gesture is detected, the microcontroller sends a signal via RF-TX. The signal reaches a relay module, which then turns the appliance ON or OFF accordingly.

Flow; Gesture → Touch Sensor → Microcontroller → (a) Text-to-Speech OR (b) Relay/Smart Switch → Output (Speech / Device Control)

Key Components:

Touch Sensor, Arduino uno, RF-TX, Relay Module, Glove, MP3 Module, Bridge Rectifier, Transformer, DC Converter Moter, Moter Driver, 16*2 Display, Voltage Regulator, Filter Capacitor.

CIRCUIT DIAGRAM

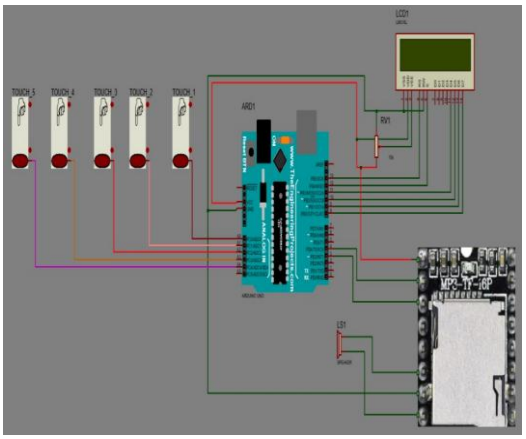


Fig. 2- GLOVE INPUT CIRCUIT DIAGRAM (TRANSMETTER)

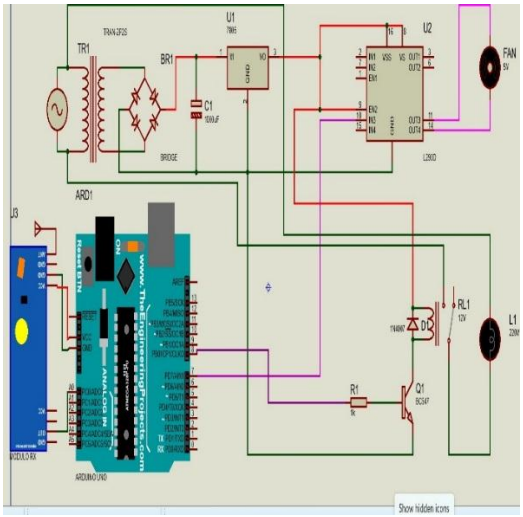


Fig. 3- AUTOMATIO OUTPUT CIRCUIT DIAGRAM (RECEIVER)

PROJECT PROTYPE DIAGRAM:

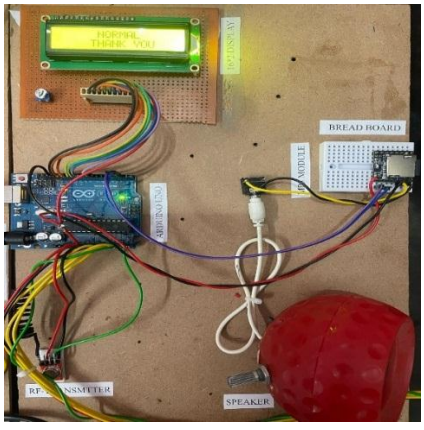


Fig. 4- SPEAKING OUTPUT

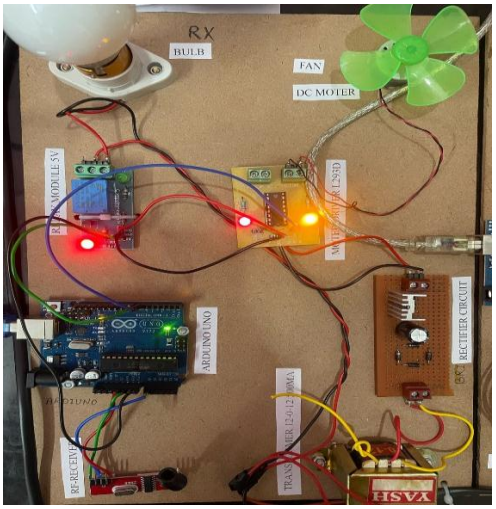


Fig. 5- AUTOMATION OUTPUT

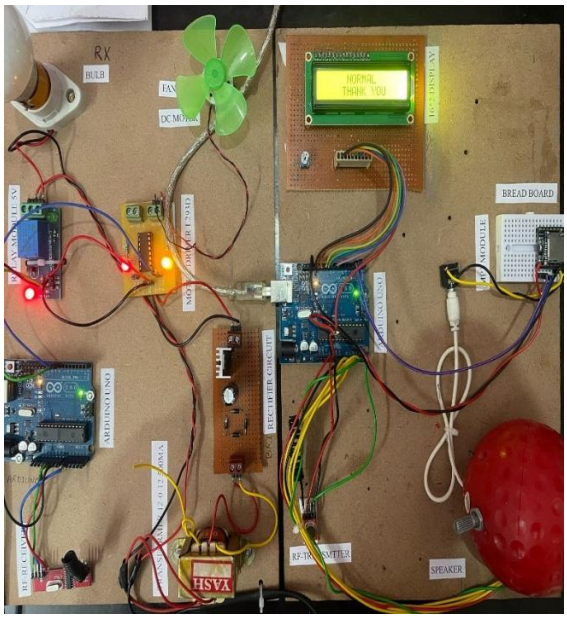


Fig. 6-COMPLETE PROJECT PROTYPE

RESULTS

Mode of Output:

1. Speaking Mode
2. Automation Mode
    1) SPEAKING MODE:
        - In Speaking mode, the smart glove captures hand gestures representing sign language and converts them into corresponding speech output.
        - It translating signs into audible words or sentences in real-time.

Input	Output
Touch Sensor-1	Please Give me Drinking Water
Touch Sensor-2	Please Give me Blood Press. TAB
Touch Sensor-3	Please Give me Food
Touch Sensor-4	I Want to go Washroom

Touch Sensor 1- Output

Touch Sensor 2- Output

Touch Sensor 3- Output

Touch Sensor 4- Output

MODE CHANGE:

Touch Sensor-5

2) AUTOMATION MODE

- In automation mode, specific hand gestures are used to control home appliances like lights, fans, or other smart devices.
- The glove interprets these gestures and sends commands to the connected home automation system, enabling gesture-based control of the household environment.

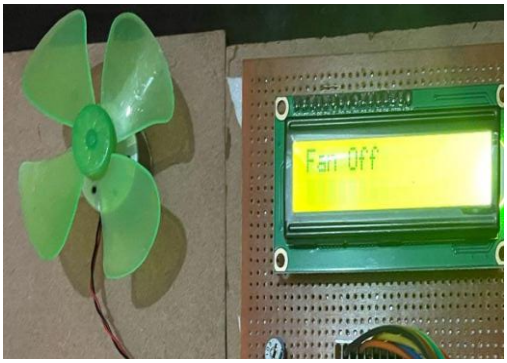
Input	Output
Touch Sensor-1	Bulb On
Touch Sensor-2	Bulb Off
Touch Sensor-3	Fan On
Touch Sensor-4	Fan Off

Touch Sensor 1- Output

Touch Sensor 2- Output

Touch Sensor 3- Output

Touch Sensor 4- Output



OBSERVATIONS

During the development and testing of the Smart Glove for Sign to Speech Conversion and Home Automation, several key observations were made regarding its performance, usability, and efficiency. The glove successfully detected and interpreted a range of hand gestures with reasonable accuracy using the flex sensors and accelerometer inputs. The gesture-to-speech functionality worked effectively in real-time, providing clear and audible speech output that accurately reflected the intended signs. Users with basic familiarity with the system were able to operate it with ease, highlighting its potential for practical everyday use.

CONCLUSION

The intelligent glove is designed and implemented in different applications efficiently, like it interprets the sign language movements into speech and allows simple home automation. It is greatly helpful for an efficient communication assistive tool for people with hearing and speech disabilities. Using sensors, and a microcontroller, the system identifies the hand movements precisely and transfers them to equivalent voice outputs and control signals for household appliances. The prototype proves to have robust gesture recognition and speech translation, rendering it an effective aid. Home automation

further boosts independent living by providing effortless control over indispensable devices. Future improvements could focus on increasing the number of recognizable gestures, refining speech output, and enhancing the glove's comfort and durability for prolonged use.

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