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Design and Implementation of Smart Gloves in need toward the Specially Privileged

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Abstract—

This research presents the design and implementation of smart gloves tailored to address the needs of the specially privileged community, smart glove equipped with flex, PIR (Passive Infrared), and heart rate sensors to augment human-machine interaction. The integration of these sensors enables real-time monitoring of hand gestures, presence detection, and physiological signals, respectively. The flex sensor detects hand movements and gestures, providing instinctive control over connected devices or interfaces. The PIR sensor detects the presence of nearby objects or individuals, facilitating context-aware interactions. Additionally, the heart rate sensor measures the wearer's physiological state, offering insights into stress levels or physical exertion during activities. The combination of these sensors creates a versatile and responsive interface suitable for various applications, including virtual reality, human-computer interaction, and healthcare monitoring. Results demonstrate the efficacy and potential of the proposed smart glove system in enhancing user experience and engagement across diverse domains.

Keywords— Arduino, Flex sensors, PIR sensor, heart rate sensor.

I. INTRODUCTION

The number of speech impaired and hearing impaired people are increasing day by day. About 70 million people in the world are speech impaired and hearing impaired. We often come across these people communicating with the normal world. These people communicate with the help of sign language. When a speech impaired person tries to communicate with normal person and vice-versa, they feel difficult to understand. To bridge this gap, gesture recognition system is being used. Gesture recognition is a widely explored field. A lot of work has been done in the past few years. An electronic device has been used as a language interpreter and provides convenient way for communication between speech impaired, hearing impaired and normal people. Gesture recognition is classified into two main categories i.e. image processing based and sensor based. The main disadvantage of image processing based techniques includes complex algorithms for data processing. Another challenge in image and video processing includes variant lighting conditions, backgrounds and field of view constraints. The sensor Based technique offers greater mobility. Smart Glove for sign language translation is our project which uses sensor Based technique instead of image processing Based technique. First of all, sign language is converted using three flex sensors. Using Arduino Nano the code dumped into it is verified with the gesture recognized. Now, if the code matches to the Gesture it transmits the data through LCD and speaker.

The number of speech impaired and hearing-impaired people are increasing day by day. About 70 million people in the world are speech impaired and hearing impaired. We often come across these people communicating with the normal world. When a speech impaired person tries to communicate with normal person and vice-versa, they feel difficult to understand. To bridge the gap between them and normal masses, gesture recognition system is being used. Gesture recognition is classified into two main categories i.e. 11image processing based and sensor based. The sensor based technique offers greater mobility than the image processing based.

II. LITERATURE REVIEW

A different method had been developed by Archana S Ghotkar, Rucha Khatal, Sanjana Khupase, Surbhi Asati and Mithila Hadop through Hand Gesture Recognition for Indian Sign Language consisted of use of Cam shift and HSV model and then recognizing gesture through Genetic Algorithm, in the following applying cam shift and HSV model was difficult because making it compatible with different MATLAB versions was not easy and genetic algorithm takes huge amount of time for its development.

Manisha U. Kakde1 , Amit M. Rawate2 , et al proposed a paper in which the gesture based communication is a strategy of correspondence for hearing hindered - quiet individuals. The proposed framework is planned in genuine time mode to perceive 9 signals from gesture based communication utilizing MATLAB.

In an attempt to open up the lines of communication and to spark a conversation between people who are hearing-impaired or have speaking disabilities, Adarsh Ghimire designer at Goldsmiths University in London has developed a futuristic smart-glove named "Sign Language Glove" that is capable of translating sign language from hand gestures into a visual on-screen text as well as audible dialogue.

Albert Mayan J developed a glove is embedded with flex sensors and an mem sensor. A novel technique for State Estimation has been produced to track the movement of turn in three dimensional spaces. The model was tried for its achievability in changing Indian Sign Language to voice yield. The Embedded hardware with Flex sensor and micro sensors are placed which helps in reading the gestures performed by the user.

Sambhav Jain developed a glove. Locating objects of daily use is a strenuous task for the visually impaired. The objective is to design a smart glove by using Deep Neural Networks (DNN) and object tracking algorithm which will guide the hand of a visually impaired to the desired object in an indoor environment. The user vocally commands the system to identify the desired object. The camera then detects the object using DNN. Once the object is tagged, object tracking begins. Based on the relative position of the camera and the object, the micro-vibrating motors vibrates accordingly to guide users hand in the required direction.

An additional feature which is incorporated includes differentiation of similar objects by color.

III. DESIGN METHOD AND SPECIFICATION

Glove constructed with the 3 flex sensors, Arduino, speaker, audio amplifier, hear rate senor, pir sensors, DF mini player, regulator, battery, LCD and it is portable and easy to use. The three flex sensors surfaced on three fingers (ring, middle, index). The PIR sensor kept on the front side of glove. The heart rate sensor kept on the outside of glove near to the Thumb finger. Glove can translate 7 sentences. After sensing the gesture using 3 flex sensors all the data from sensors are then processed on node MCU. By comparing results in the code the message is displayed in LCD and voice come through speaker By using PIR sensor the range is increased up to 7 meters. By putting heart rate senor outside the glove, there is no problem with sweat.

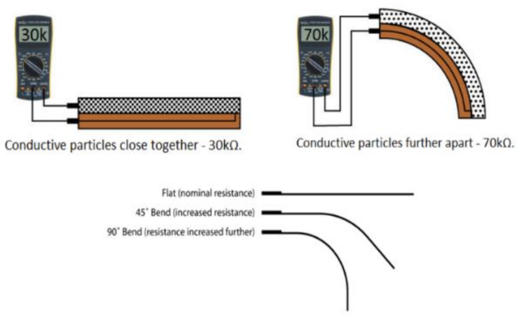

Fig.1 Block Diagram of Smart Glove

Flex sensor Detects and measures the degree of bending or flexing in various applications. Changes in electrical resistance correlate with the amount of bending, providing a measurable output. Constructed with thin, flexible materials for easy integration into a variety of devices.

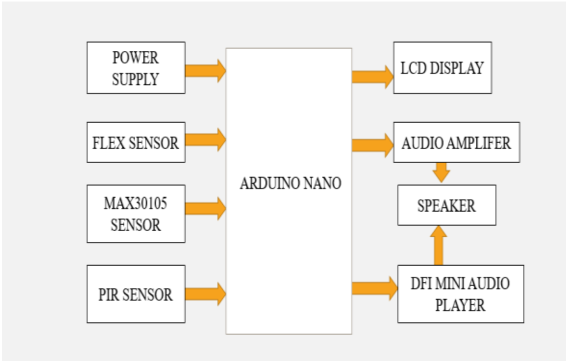

Fig.2 Flex sensor working

Arduino Nano ATmega328P Microcontroller is from 8-bit AVR family. Operating voltage is 5V. Input voltage (Vin) is 7V to 12V. Input/Output Pins are 22. Analog i/p pins are 6 from A0 to A5. Digital pins are 14. Power consumption is 19 mA. I/O pins DC Current is 40 mA. Flash memory is 32 KB. SRAM is 2 KB. EEPROM is 1 KB. CLK speed is 16 MHz Weight-7g. Size of the printed circuit board is 18 X 45mm. Supports three communications like SPI, IIC, & USART.

PIR sensor Detects human or animal movement by sensing changes in infrared radiation. Operates without emitting any energy, relying solely on detecting thermal signatures. Covers a broad area, typically up to several meters, depending on the sensor's specifications. Provides rapid detection of motion, triggering actions or alarms in real-time.

MAX 30105 Features both red and infrared LEDs with corresponding photodetectors for simultaneous measurement of multiple wavelengths. Optimized power management enables efficient operation, making it suitable for battery-powered and wearable devices. Programmable Sample Rate: Allows for customization of the sampling frequency to balance between resolution and power consumption. Tiny Package: Housed in a compact 14-pin optical module, the MAX30105 offers a small form factor for easy integration into portable and wearable devices.

DF mini audio player supports MP3 and WAV decoding.

Supports FAT16 and FAT32 file system. 24-bit DAC output and supports dynamic range 90dB and SNR 85dB.

Supports AD key control mode and UART RS232 serial control mode. Supports maximum 32GB micro SD card and 32GB USB flash drive. Supports maximum 3000 audio files in the root directory of the storage device. Supports maximum 99 folders, and each folder can store 3000 audio files (only first 255 files is valid when the serial command is sent to play one of the audio files in the folder). Supports advertisement insertion. Supports random playback. Built-in a 3 watts amplifier that can direct drive a 4ohms/8ohms 3 watts speaker. 30 levels adjustable volume, and 6 levels adjustable EQ.

2 channels 3 W PAM8403 audio amplifier**.** Output Power is 3 W + 3 W (at 4 ohm). Working Voltage is 2.5 to 5.5 V

Board Size is 24 x 15 mm. High amplification efficiency 85%. Unique without LC filter class D digital power board. Can use computer USB power supply directly.

Speaker Impedance is 8 Ohm impedance ensures compatibility with most audio devices and amplifiers, including Arduino boards. Power Handling Capable of handling up to 0.5 watts of power, suitable for low-power applications where moderate sound output is required. With a diameter of 2.25 inches or 57mm, it offers a compact form factor ideal for space-constrained projects. Designed to work seamlessly with various electronic components, including microcontrollers like Arduino, Raspberry Pi, or audio amplifiers. Offers a balance between performance and cost, making it a cost-effective choice for hobbyists, students, and DIY enthusiasts.

Regulator LM 2596 Module nature BUCK. Rectifier nonsynchronous. Input voltage 4.5~40V. Output voltage 1.3~35V. Output current 3A (Max.). Transfer efficiency 92% (Max.). Switch frequency 150KHz. Output ripple 30mV. Load regulation +/-0.5%. Voltage regulation +/-2.5%. Voltage regulation +/-2.5%. Voltage regulation +/-2.5%. Dimension 1.73 in x 0.83 in x 0.55 in (4.4 cm x 2.1 cm x 1.4 cm). Weight 0.39 oz (11 g)

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels

arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other. Some of the most common LCDs connected to the controllers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

IV. RESULTS AND ANALYSIS

After constructing the glove and giving power supply through battery the messages comes through speaker properly. And text displayed on LCD. According to the code First LCD displays HI message and automatically displays heart rate 0.00 when finger is no placed. When there is no finger detected it shows heart rate 0.00. simultaneously at the same time when

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we do a gesture It displays text and voice through speaker.

Gesture messages. The messages are daily need message we can customize according to our priorities later.

001 – My name is __________ (sai Krishna)
010 – Need water
011 – Time to take medicine
100 – I am Hungry
101 – Take me to hospital for Check up
110 – Thank you
111 – Good Morning, How are you?

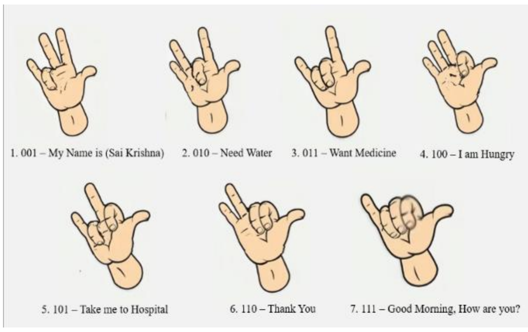

Fig.3 Gesture Messages

Fig.4 Heart rate when there is no Finger Placed

Fig.5 Heart rate when Finger is Placed

It shows 0 for few seconds approximately 10 seconds, until it takes readings and average the readings and display actual readings

Fig.6 Actual reading

When Finger is removed after showing Actual Reading and placed again then it shows the previous treading for 10 seconds to take the new user readings. For example the above picture shows heart rate of the user 79 after removing and placing another finger it shows 79 for 10 seconds

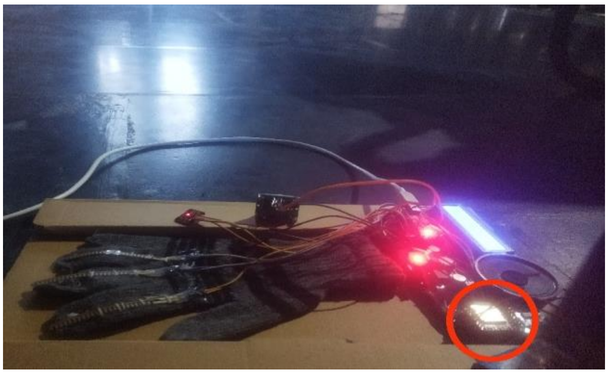

Fig.7 when object is not in front

When there is no Human or Object in front of PIR sensor the DF mini LED not Glowed. It Actually glows when the message is coming through speaker. If human or animal comes in front The LED glows and message comes through Speaker

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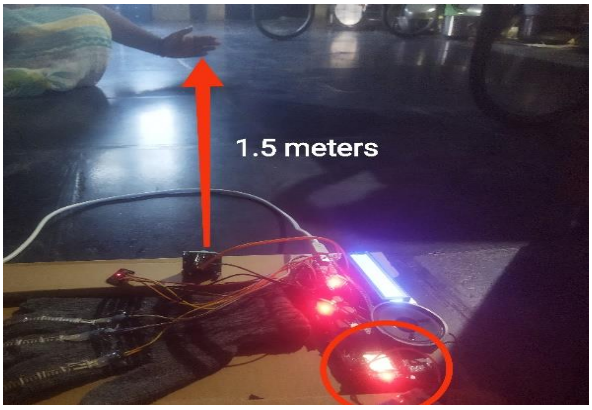

Fig.8 when Object is in front

When object is in front the LED on DF mini player Glows and message is comes through speaker.

We can adjust the range by rotating the sensitivity Maximum Range is 7 meters and minimum range is 3 meters and we canalso adjust how many seconds audio want to play.

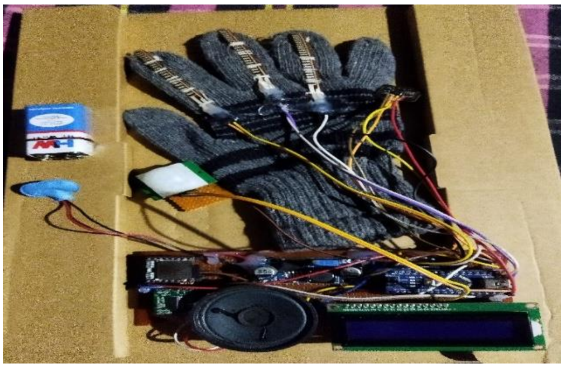

Fig.9 Smart Glove with flex, PIR, heart rate Sensor

V. CONCULSION

Sign language is one of the useful tools to ease the communication between the deaf and mute communities and normal society. Though sign language can be implemented to communicate, the target person must have an idea of the sign language which is not possible always. Hence our project lowers such barriers .The glove is capable of translating their sign language gestures into speech through Speaker. Disabled use these gloves to convert sign performed by them into speech and text. This paper is a useful tool for speech impaired and partially paralyzed patients which fill the communication gap between patients, doctors and relatives. From the convenience of simple flex sensors, a user is able to interact with others in more comfortable and easier manner. This makes it possible for the user to not only interact with their community but with others also and they can also live normal life. It is portable to use and is cost effective. This paper will give dumb a voice to speak for their needs and to express their gestures. It also detects motion is in front and check heart rate for heart patients. Hence this paper is an attempt to make it easy to understand the actions of the dumb people by getting the output in the form of text and voice. The end product will have a cheap and simplistic design making it easy for users to interact easily.

VI. FUTURE SCOPE

Thus the gesture recognition system designed using sensor fusion and gesture recognition techniques in this venture has a lot of future aspects that has to be taken into consideration in order to support the help for this differently abled people more. This smart glove readily banishes the required interpretation between a speech impaired and a normal person. Future implementation can be made by enhancing the quality of the mobile application which can be used to produce a lot of technical quality research as in what is to be implemented to assist them more. In future we can also develop an application so that it can work on any platform.

We can also reduce the number of connecting wires to make it simple to wear.

- It can be implemented in various fields like in airport and railway stations to assist the speech impaired.
- By using two more flex sensors we can increase commands.
- By increasing cost wireless also possible.
- One more technical issue can be handled is to assist multi gesture at a higher speed in which at times this device accuracy fails to reach the peak.
- Keeping in mind the end goal to enhance and encourage the more signal acknowledgment, movement handling unit can be introduced.

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