IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Multi-Purpose Smart Glove for Differently Abled Community People

[1] Mr. Punit Vora 1st Author, [2] Mr. Bhushan Parab 2nd Author, [3] Mr. Rohit Bandgar 3rd Author,[4] Mr. Rahul Naik 4th Author, [5] Dr. Jyoti Dange 5th Author

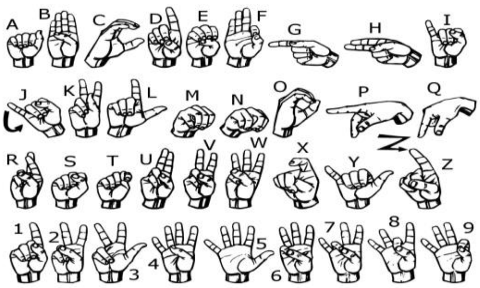
[1,2,3,4,5] Department of Electronics and Telecommunication Engineering,
[1,2,3,4,5] Atharva College of Engineering, Mumbai, India

Abstract: The Smart Glove is primarily intended for interaction between disabled individuals and non-disabled people. Here, disabled refers to deaf and hard-of-hearing people who communicate with one another and with others through sign language. However, because most people are unaware of sign language, communication between the deaf and hard-of-hearing and the general public can be problematic. A mediator is needed to explain deaf and hard-of-hearing people's right. An individual's sign language to general people. So the major goal of this project is to provide a portable and smart solution to meet the demand of turning disabled people's gestures into a text and speech synthesis format that is easily understood by others. This SmartGlove also has the ability to manage home appliances and monitor your health. The user will have an application installed that will assist them in switching between several modes of operation of our Smart gloves make life easier and more independent for people with special needs.

***Keywords* - Smart Glove, Sign Language, Home Automation, Health Monitoring, Flex Sensor, Bluetooth.**

1. INTRODUCTION

Many deaf and hard-of-hearing people rely heavily on sign languages as a means of communication. Since sign languages are typically used by the deaf, they are also used by others who can hear but cannot speak. Hand shapes and hands Movements are used in sign language to express thoughts. They also communicate through a combination of words and symbols. The main idea behind this project is to break down communication barriers between people with special needs and normal people. Our system will enable the user to express words using glove gestures and finger bending with a flex sensor. This data is in the form of an analogue form which is then converted to a digital signal using the Arduino nano and transmitted via Bluetooth to a smartphone for the display of words on screen. These converted digital signals are also sent to the RF module for the home automation aspect. An additional feature of our project is it is also able to monitor one's health. To address this, our project will include a heart rate sensor that will continuously monitor the user's data and output will be visible on the user's smartphone. Existing methods of expressing thoughts include using a vision-based gesture recognition system, which employs a camera module to capture hand gestures. The captured image is sent to image processing, which produces an output based on the captured image-sensor-based gesture recognition is more accurate



American Sign Language Chart

and takes less time than vision-based gestures recognition. It also responds quickly when recognizing gestures. Sensor-based systems require flex sensors rather than camera modules, making them portable and low-cost.

1. LITERATURE REVIEW

Several studies and research have been conducted in the field of smart communication for visually and hearing-impaired people. As per which, for effortless communication among normal people and these specially challenged people, sign language is the most effective medium, apart from writing and drawing, for fluent communication. Numerous patents have been filed in this domain with various methodologies to overcome this issue.

1. An approach was made by Dalal-Abdullah, in his implementation of a sign to speech/text system for deaf and dumb people. In which he proposed the idea of making an electric device having two parts, one as a transmitter and the other part as a receiver. This system was designed to convert the Arabic sign language to speech or text. The idea was simple, to use flex sensors on each finger that are connected to the Arduino. This microcontroller collects the data from flex and, through the RF transmitter, the data is transmitted. On the other hand, the RF receiver takes the output from the transmitter and sends it to the Arduino Mega, which then, after processing, generates the output from the LCD and speakers. For mapping the data to the gestures made, they used the Arduino IDE. The drawback to using the Arduino IDE is its space and speed limitations. Their system is restricted to a limited number of gestures. Another limitation is using flex sensors, as the value of resistance changes with the rigorous use of the system. Due to which, the probability of getting the correct output reduces by some percentage(American University of Ras Al Khaimah & Institute of Electrical and Electronics Engineers, n.d.).

2. Another approach was made by Abhinandan Das in his paper, using flex sensors and gyro sensors for finger and hand movement respectively. He used a flex sensor on each finger and a gyro sensor to detect hand movement in this. This increased the combinations of gestures, thereby increasing the dataset of gestures. The transmission of data is done through Xbee transceivers for effortless data flow. They used the Intel Galileo Gen 2 loT kit to analyse and classify the actions and hand movements in the sign. The need to use this powerful processor was to easily classify the gesture types. As per the system developed by them, the gestures made by a user can be an alphabet or a number for which proper classification is needed. Using this powerful intel processor, the data is processed easily. Once the data is received, it is processed by a microprocessor, and the output is shown according to the text mapping to the sign language. The text generated is displayed on the Grove-LCD. Further, it is converted to speech via the Grove-buzzer sensor. The major drawback to this whole setup is that it can generate around 200 words only. Another downside to this system is the use of alphabets and numbers, which radically slows down communication(Assam Engineering College et al., n.d.).

3. Arslan introduced a glove-based sign language interpreter framework. The framework is made up of five flex sensors, a microcontroller that processes the sensor values, an LCD that displays the individual results, and a speaker that listens to the output. It provided a visual output to be seen on an LCD and an audible output to be heard on the speaker. The drawback to this approach is that it restricts the user's ability to move freely(Nazir et al., n.d.).

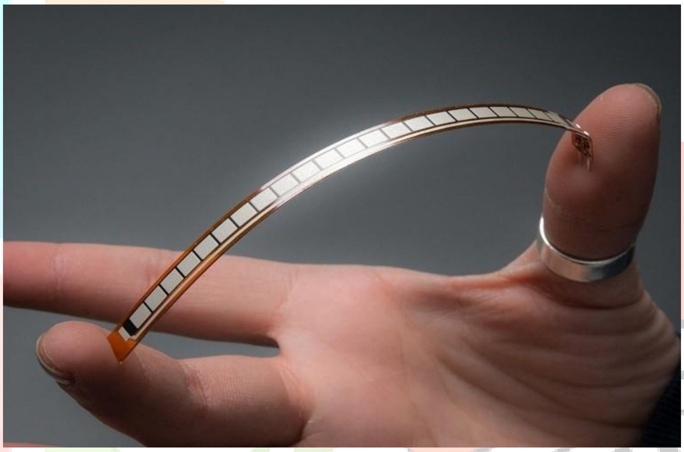
4. The proposed work Hand gestures are a strong medium of communication for the hearing impaired in society. The deaf, blind, and dumb make use of sign language to communicate, which is difficult to interpret by individuals who are not well- aware of it. Thus, there is a need to build a device that can interpret the gestures into text and speech. The main goal of this project is to create a smart glove system that can continuously recognize signs. Language gestures must be translated into spoken words. It is a new technique called "artificial speaking mouth for dumb people." The glove is fitted with a flex-sensor and a magnetometer to sense the movement made by fingers. A low power ARM Cortex-M4 microcontroller recognizes the movement by means of acquiring, processing and running a sensor fusion algorithm. The system translates the signs recognized into meaningful text. This text is then transferred to a smartphone app over a Bluetooth channel where the text will be converted into speech. Another feature that makes this project interesting is that users can teach the system new gestures and add them to the existing standard gesture library(Hemavani, 2017).

5. Ambika Gujrati et al. proposed a system that consisted of flex sensors, tactile sensors, and accelerometers. Their hardware requires Hence, a voltage regulator from the 7800 series (7805) is used. LEDs are used to provide information about the supply is activated. A 330Ω resistor is used to drop the voltage and make it 2-2.5V as required by the LED. The deflection of the flex with a minimum angle of 40° produces a resistance which is increased by bending and voltage is obtained. Four flex sensors along with their connection ports are placed. The voltage is in, so an op-amp (LM358) was used to amplify it. The op-amp used is a non-inverting type with high gain in voltage. The Rf resistor is a variable resistor with a range of (0–10) k and a resistance of 2.2k. A 33k resistor is used at the output of the op-amp which stops the voltage from being grounded. PIC16F877, a peripheral interface controller, is used with flash memory of 8 kb and an inbuilt ADC converter with 10 bit resolution. The microcontroller converts the analogue output into digital and provides a high and low voltage. A crystal oscillator at 12MHz is used, which provides the microcontroller with a high-frequency clock pulse. Two 33pF capacitors are used along with the oscillator. The high or low voltage is then passed to an NPN transistor which gives the output which is further sent for retransmission. Relays used to have an internal magnetic field. They act as an ON-OFF switch. One relay acts as a play button. Then the third flex sensor will act. The forward relay will be forwarded 2 times and then played, and similarly, others will operate. The message is now forwarded to the voice recorder ISD1720, which has a microphone and speaker connected to it. Electrolytic and ceramic capacitors are used, which removes the ripples and cancel out the noise. An RF circuit is used which provides automatic gain control which gives constant output. The voice can be recorded through a microphone and, according to the flex deflected, the output is received from the loudspeaker. Their circuit diagram shows the capability to measure or translate 7 potential sign language words (A, B, C, D, F, K and number '8')(Manoharan S., Ragul R., Ramanathan S. K. S., Vijay M., 2021).

6. A smart glove is a system that comes under the category of augmented and alternative communication. Augmentative and alternative communication (AAC) is a prominent component in the development of support services for individuals with disabilities, especially those with severe disabilities. Technologies such as augmentative and alternative communication (AAC) systems can help to minimize this separation from other people. An AAC system is an―integrated group of components, including the symbols, aids, strategies, and techniques used by individuals to enhance communication‖. These technologies range from relatively low- tech systems (i.e., simple adaptations with no batteries or electronics, such as communication boards). AAC systems may be roughly classified into one of two categories: unaided communication systems and aided communication systems. Unaided AAC systems do not require any sort of external communication device for the production of expressive communications. Sign language, facial expressions, gestures, and non-symbolic vocalizations are all unaided modes of communication. Aided systems require an external communication device for production (*Khushboo Kashyap - Digital Text and Speech Synthesizer Using Smart Glove*, n.d.).

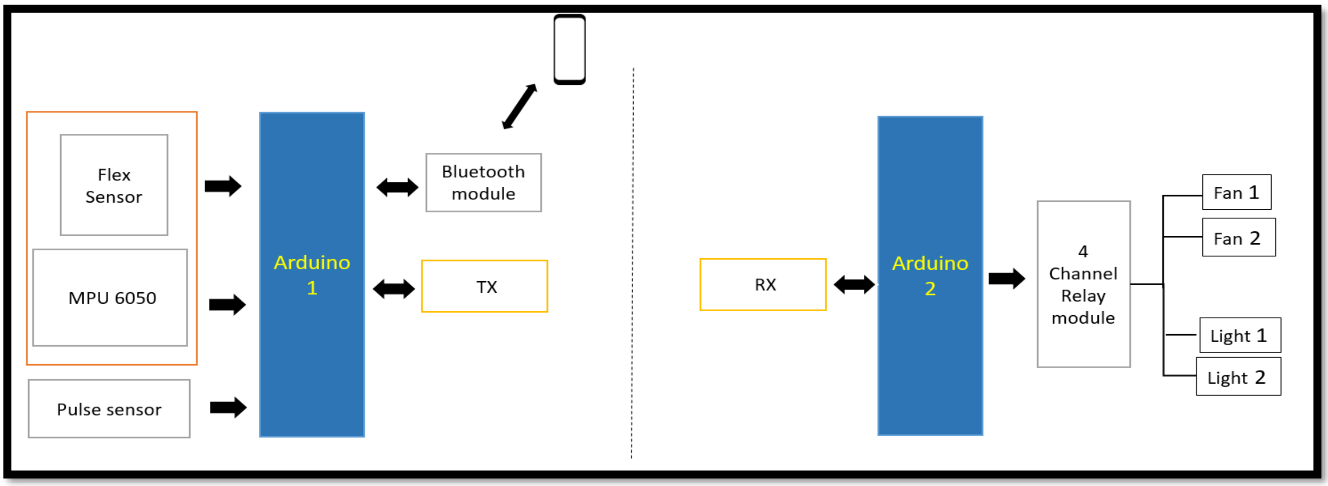
2. METHODOLOGY

The translation of American Sign Language is divided into three main phases: recognizing sensors' values, processing, and displaying/listening according to the sign. The primary part of this project is the flex sensor, which is basically a variable resistor. These sensors are made of carbon on plastic strips, and when this strip is bent or deflected, the resistance of the flex sensor is changed. We used one flex sensor for the thumb and four sensors for the remaining fingers of the hand. The variant of the flex sensor which was used in this project is 2.2 inches long, for accuracy and precision in results. The resistance of the flex sensor increases as the body of the component bends.



Flex Sensor

According to the below block diagram, the Transmitter section (main section) is on the left and the Receiver section (used in only mode 2) is on the right side, the primary input to the Arduino Nano is the values of the flex sensors and accelerometer. When the hand is in a specific position according to the sign language, the values from the flex sensors and accelerometer are obtained. This change in resistance is converted into voltage, which is then processed by the microcontroller. The specific value of a particular sign lies within the range defined for that sign, which helps in the detection of alphabets and words. Once the match is found, the alphabet is transmitted wirelessly and the alphabet/word is displayed and heard on the android application. Home automation and Health monitoring will also follow the same concept, i.e. when the user will perform a gesture this will be processed and sent from transmitter end to the receiver end and the appliance connected to the relay will be turned on or off. Similarly, user's pulses will be measured by the pulse sensor and will be sent to the android application via HC-05 module.



Block Diagram

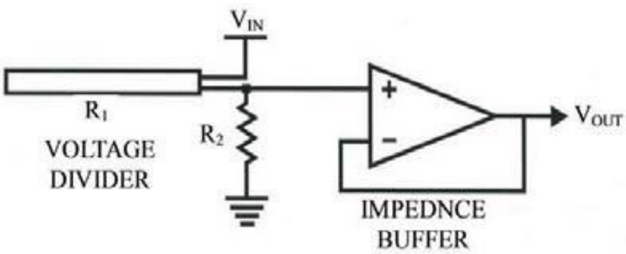
To begin, a voltage divider is used to transform the resistance values of flex sensors into voltage. The accelerometer readings are already formatted correctly. Flex sensors are placed on each finger such that each finger has one flex sensor on it. The flex sensors display change in resistance when bending on the joints, which is then processed to filter out superfluous oscillations so that only useful data is sent into the microcontroller, and the values of both sensors are then compared to the specified data set crafted after multiple scenario experiments. Now, all of the sensor values, including those from the accelerometer, and the Arduino Nano and our system will be compared and once the signs have been identified and a match has been found, the sign is wirelessly transferred to the android device through Bluetooth module to the custom designed mobile android application named “Translator,” which then shows the alphabet or word and may also be toggled for speech output. Because of the audio/visual output, mobility, and cost-effective nature of this user-friendly mobile application, it adds originality to the scope of the project.

3. SYSTEM COMPONENTS

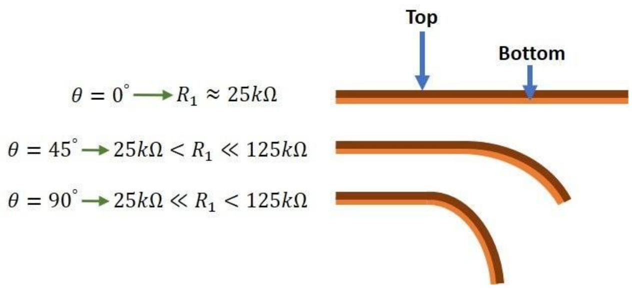
Main components for this project include a hand glove, flex sensors, Accelerometer and Gyroscope (MPU 6050), Bluetooth module (HC-05), 1kΩ resistors, contact wires, Arduino Nano, Arduino Uno, NRF24L01+ transceivers, Pulse sensor and an Android application.

I. FLEX SENSORS

Each finger was fitted with a total of five flex sensors. Flex sensors are piezoresistive sensors whose resistance changes with the bend and the direction of the bent. Each joint has a flex sensor implanted on it to detect bend, as every symptom is a variation on the joints. Flex sensors in combination with a voltage divider design produce the best results, suppressing fluctuating values into tolerable ranges while yet allowing for abrupt fluctuations to be handled by a bespoke filter. The ADC receives the output of this setup.



Flex Sensor Circuit



Bending of Flex Sensor

The voltage divider design uses 5 volts input to ensure cohesiveness between the sensors and the ADC, as the ADC can handle a 5 volts input. To get the best results for flex sensors, utilize 1k as the constant resistance in the voltage divider design since it delivers a reasonable voltage range with the flat and bent resistance of the flex sensor from equation (1) as shown below.

VADC = [*Rflex* / (*Rflex* + *Rin*)] ⍰ *Vin* ---------------------- (1)

II. Microcontrollers

The Arduino Nano (transmitter side) and Arduino UNO (receiver side) was chosen to maximize resource consumption. Both have MISO, MOSI, SCK pins for NRF24L01+ modules. Nano came with the necessary number of analogue and digital pins. It contains SDA and SCL pins for MPU-6050, as well as TX and RX pins for HC-05 Bluetooth module. The flex sensors' output is transmitted to the Arduino Nano's analogue pins, where a 10 bit ADC maps out the sensor readings between 0 and 1023 bits, indicating 0 and 5 volts. If the input voltage is 5 volts, the output is 1023, and if the input voltage is 2.5 volts, the output is 512. The sign programmed is made up of ranges within these distinct ranges. In order to detect a specific sign, these digital values would be employed in a programmed. The ADC has a 5-millisecond step size. All of the values were calculated by the following equations (2) and (3).

Stepsize = [*Vmax* / *2bits*] = [5 / 2^10] ---------------------- (2)

Dout = [*VADC* / *Stepsize*] ------------------------------------ (3)

Arduino Nano

Arduino UNO

III. Accelerometer + Gyroscope (MPU- 6050)

The MPU-6050 is used to recognize signs that need a specific hand position or finger orientation, such as I, J, Z etc. For precision, the values of sensors from fingers and the MPU-6050 were fixed at a precise angle in order to detect the special indicators that involved movement. In the case of words, the MPU-6050 makes dynamic sign identification intuitive and accurate for the user.

MPU 6050

IV. Bluetooth module (HC-05)

This HC-05 Bluetooth module makes it simple to send and receive data wirelessly. The HC-05 is a plug-and-play low-cost, low-resource Bluetooth module that operates at 3.3 volts and can transfer data over distances of up to 20 meters. Its modest profile is ideal for addressing our portability requirements. The signal transmit time of various devices is maintained at a 0.5 second interval in this module, reducing the stress on the Bluetooth chip and allowing additional sleeping time to be set aside for Bluetooth. This module is simple to use and streamlines the entire design/development process.

HC05

V. NRF24L01 + Modules

The NRF24L01 is a wireless transceiver module, which means it can send and receive data wirelessly. They operate at a frequency of 2.4GHz, which is part of the ISM band. We are using two NRF modules for our Mode 2 which is Home automation i.e. one for transmitter side and one for receiver side. When used properly, the modules may cover a distance of up to 100 meters (200 feet), making them an excellent solution for all wireless remote-controlled applications. Because the module operates at 3.3V, it can be utilized with either 3.2V or 5V systems. Each module has a 125-bit address range and may connect with up to six other modules, allowing several wireless units in a given region to communicate with one another. As a result, this module can be used to create mesh networks or other sorts of networks.

NRF24L01+

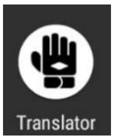
VI. Pulse Sensor

This Biometric Pulse Rate or Heart Rate Detecting Sensor is a Plug and Play type sensor module that we are employing for our Mode 3 which is Health Monitoring. It has a +5V or +3.3V operational voltage and a 4mA current consumption capacity. It features a noise cancellation and amplification circuit built in. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Finger tip or you ear tips, but it should be placed directly on top of a vein. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood we can monitor the heart beats as well. If the flow of blood is detected then the ambient light sensor will pick up more light since they will be reflected by the blood, this minor change in received light is analysed over time to determine our heart beats.

Pulse Sensor

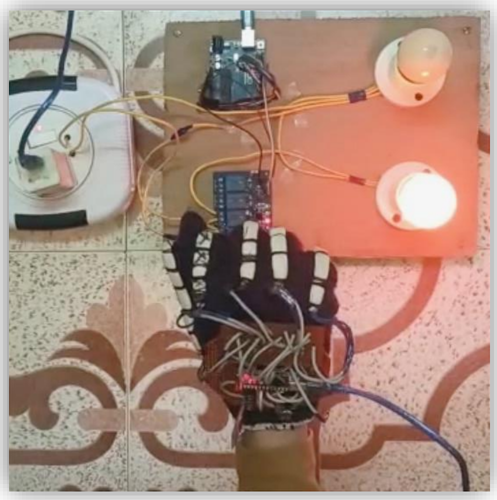
VII. Android Application (Translator)

The application is the glove's response. It not only displays the current letter or word, but also speaks it out. The Android app's text-to-speech capability makes the software more responsive. This feature improves the user experience by playing back the received text through the mobile device's speaker at the same time. The multi-featured program includes a sign chart for visual sign interpretation. It supports several languages and offers a simple interface for switching between different modes of work, increasing user engagement and experience. The application's design is kept basic. It is a user- friendly and resource-constrained Android application. The Massachusetts Institute of Technology now supports App Inventor for Android [10], an open-source web application first released by Google and now sponsored by the Massachusetts Institute of Technology (MIT). We used the block coding feature to create "Translator" on it. Figure 10 depicts a working prototype of the system, complete with modules and an Android application. This comprehensive bundle bridges the communication gap between deaf/mute and normal people.



4. FINAL RESULTS

When mode 1 the Sign Language mode is selected, the flex sensor and accelerometer angles values are used to show letters words or sentences encoded in precise movements as per ASL, on the screen.



In mode 2, the Home Automation section will be accessed, and the gestures we introduced to a specific output will be transmitted and received through the nrf24l01+ module (Transceivers), and that received output will be fed to Arduino, who will then pass the signal to the 4-channel relay module, and outputs, such as turning on/off the fan or turning on/off the light, will be executed.

When mode 3 is selected, Health Monitoring will take readings from an Arduino Nano connected pulse sensor and transfer the data to the app over Bluetooth, where the user's heart pulse values will be displayed.

5. CONCLUSION

This article uses a smart glove to translate American Sign Language by combining flex sensors on the glove with other hardware components in a portable design centered on the user. The user creates an ASL sign, which Arduino Nano then interprets. The data is then delivered to an Android application for visual and audio presentation after processing. The main goal of this project is to recognize ASL-based sign signals and convert them into valuable data so that deaf and hard-of-hearing people and the general public can communicate more effectively. The future this project can be implemented with internet capabilities which will add more applications like storing user's usage data and health data, remote operating etc. to it and adding different languages to the android application will help all type of user to interact with the app.

6. REFERENCES

1. Abdulla, D., Abdulla, S., Manav, R., & Jarndal, A. H. (2016). Design and implementation of a sign-to- speech/text system for deaf and dumb people. 2016 5th International Conference on Electronic Devices, Systems, and Applications (ICEDSA). DOI:10.1109/icedsa.2016.7818467.
2. Das, A., Yadav, L., Singhal, M., Sachin, R., Goyal, H., Tap aria, K., ... Trivedi, G. (2016). Smart glove for Sign Language communications. 2016 International Conference on Accessibility to Digital World (ICADW). DOI:10.1109/icadw.2016.7942508.
3. Arif, Arslan; Rizvi, Syed Tahir Hussain; Jawid, Iqra; Waleed, Muhammad Adam; Shakeel ,Muhammad Raheel (2016). Techno-talk: An American Sign Language (ASL) Translator. In: 2016International Conference on Control, Decision and Information Technologies (CoDIT), San Julian, April 6-8, 2016. pp. 665-670.
4. Gesture recognition to voice conversion using electronic hand glove, K. Hema Vani.
5. Gesture Control of Home Appliances Using Flex Sensor Manoharan S., Ragul R., Ramanathan S. K. S., Vijay M., Palanivel R.
6. Khushboo Kashyap, Digital Text And Speech Synthesizer Using Smart Glove For Deaf And Dumb,ISSN:2278-909 International Journal.
7. Harmeet kaur, Amit Saxena, Abhishek Tandon, Keshav Mehrotra, -A Review paper on evoluation of smart glove, International journal of Scientific Research.
8. B. G. Lee and S. M. Lee, "Smart Wearable Hand Device for Sign Language Interpretation System With Sensors Fusion," IEEE Sensors Journal, vol. 18, 2018.
9. Kanika Rastogi, Pankaj Bhardwaj, "A Review Paper on smart glove coverts gestures into speech and text", Moradabad Institute of Technology.
10. M. G. Kumar, M. K. Gujar, and M. S. Singh, "American sign language translating glove using flex sensor," Imperial Journal of Interdisciplinary Research, vol. 2, no. 6, 2016.
11. Kristen Ellis and Jan Carlo Barca, Exploring Sensor Gloves for teaching Children Sign language, Faculty of Information Technology, Monash University, Clayton Campus, VIC 3800, Australia, 20 June 2012.
12. F.O'Connor, M.E.Fach,R.Mille, S.E.Root, P.P.Mercier And D. J. Lippo, "The Language of Glove: Wireless gesture decoder with low power and stretchable hybrid electronics", PLOS ONE, 12 July 2017.
13. SMART GLOVE USING ARDUINO WITH SIGN LANGUAGE RECOGNITION SYSTEM ,Vis maya A P, Sarita B P, Keerthana Sudesh P C, Manjusha T S, IJARIIE-ISSN(O)-2395-4396, Vol-6 Issue-2 2020.
14. Design of Effective Smart Communication System for Impaired People Article in Journal of Electrical Enginnering And Automation. Dr. Akey Sangeetha, Dr. Rajesh Sharma R,-March 2021 DOI:10.36548
15. Adarsh Ghimire, Smart Gloves, https://www.researchgate.net/publication/330497137_SmartGlove.
16. K.V.Fale, Akshay Phalke, Pratik Choudhari and Pradeep Jadhav, "SMART GLOVE: Gesture Vocalizer for Deaf and Dumb People", International Journal of Innovative reac=search in Computer and Communication Engineering, Vol.$, Issue $, pp. 6800-6806,April 2016.
17. Praveen Kumar, S Havalagi and Shruthi Urf Nivedita, ―The Amazing Gloves that give Voice to the Voiceless‖, International Journal of Advances in Engineering & Technology, Vol. 6, No.1, pp. 471-480, March 2013.
18. Ambari Raja Mohan, Hema vathy R., Dhana Lakshmi M. "Deaf Mute Communication Interpreter" 2013 International Journal of Scientific Engineering and Technology Sri Sivasubramanian Nadar College of Engineering, Chennai, Tamil Nadu, India.
19. Pallavi Verma, Simi S.L., Dr. S. Chatterjee "Design of Smart Gloves" 2014 International Journal of Engineering Research and Technology NITTTR Chandigarh, India.
20. Vajjarapu Lavanya, Akala Pravin, M.S., Madhan Mohan, "Hand Gesture Recognition and Voice Conversion System using Sign Language Transcription System", International Journal of Electronics & Communication Technology, Vol. 5, Issue 4, pp. 145-150, 2014.