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# A Review on an Finger Movement Based Smart Hand Glove For Special Peoples

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**ABSTRACT:** Everyday communication with the hearing population poses a major challenge to those with hearing loss. For this purpose, an automatic sign language recognition system has been developed using Random Forest Classifier as a machine learning algorithm, and to translate the sign alphabets and common words into text and sound. A hand glove circuit has been designed with flex sensors or buttons, 4-axis accelerometer and gyroscope to capture the gestures or signs data. The finger bend data has been obtained from flex sensors on each finger while the accelerometer and gyroscope provided the trajectories of the hand motion and button touches with the other finger then give output from this smart hand glove. The data from the sensors or buttons has been passed through the trained model to recognize the gesture. The main purpose of smart glove is to provide an ease of sharing basic ideas, minimize communication gap and an easier collaboration for the hard of hearing people.

**KEYWORDS:** Flex sensor, Ardiuno uno, Gesture to text, Deaf and dumb, Glove.

## I. INTRODUCTION

According to the statistics of the World Federation of the Deaf and the World Health Organization, approximately 70 million people in the world are deaf-mute. A total of 360 million people are deaf, and 32 million of these individuals are children.

The majority of speech- and hearing-impaired people cannot read or write in regular languages. Sign language (SL) is the native language used by the deaf and mute to communicate with others. SL relies primarily on gestures rather than voice to convey meaning, and it combines the use of finger shapes, hand movements, and facial expressions.

This language has the following main defects: a lot of hand movements, a limited vocabulary, and learning 10 difficulties. Furthermore, SL is unfamiliar to those who are not deaf and mute, and disabled people face serious difficulties in communicating with able individuals. This communication barrier adversely affects the lives and social relationships of deaf people. Thus, dumb people need to use a translator device to communicate with able individuals. This can be achieved by developing a glove equipped with sensors and an electronic circuit.

Communication is the only medium by which we can share our thoughts or convey the message but for a person with disability (deaf and dumb) faces difficulty in communication with normal person. Because of this, a person who lacks in hearing and speaking ability is not able to stand in race with normal 20 person. Communication for a person who cannot hear is visual, not auditory.

Generally dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign language. So there is a barrier in communication between these two communities. This work aims to lower this barrier in communication. The main aim of the proposed 25 project is to develop a cost effective system which can give voice to voiceless person with the help of Smart Gloves.

It means that using smart gloves communication will not be barrier between two different communities. With the help of these gloves disabled person can also get chance to grow in their respective carrier. Using such devices by disabled person also makes nation grow.

## II. LITERATURE REVIEW AND OBJECTIVE

### A. Background

Many smart gloves are proposed in recent years where preferred technology was wireless mode with many distinct features, but those were not reliable, light weight, cheap, Easy to use, plug and play type prototypes. It is because of components used for fabrication which are normally available in market such as flex sensors, microcontroller, and wireless transmitter, and these were powered by battery which was little heavy as compare to other components. Therefore, these kinds of assemblies are bulky, and difficult to use it.

According to the analysis done that, one out of every five people is deaf or dumb on this planet is an Indian. In India about more than 1.5 million deaf people utilize Sign Language as a method of correspondence. Normal parents of deaf children or vice versa use gesture based conversation other than deaf population. However, due to this type of complications an automatic Sign-to- Speech/text language interpretation framework could assist to make more details accessible to the hearing impaired. In addition, the framework won't just promote data access; however it can likewise be utilized as an instructive apparatus to become familiar with any communication via gestures. One of the earliest employments of a gesture based communication is from the 5th century BC, in Plato's Cratylus. In 1620, Juan Pablo Bonet proclaimed, Reduction of letters and art for instructing mute individuals to talk which is said to be the 1st present day investigation of communication via gestures vocal, mounting out a strategy for voice training for hard of deaf individuals and a standard letter set. Thomas Pryor and Navid Azodi are UG understudies who made the Gloves that make an interpretation of communication via gestures into text and speech known as signaloud. They had won Lemelson-MIT understudy cost for this venture .The first Hand oration mittens was constructed by Ryan Patterson in the year 2001. This model had constraints that a PC or a workstation was constantly required for its working which made it less convenient and less portable.

Gunasekaran. K. et al in their paper proposed a system using the data glove technique. It consists of flex sensors that used to detect finger gestures and transmit the information to a PIC microcontroller. He also used gyro sensors for providing a signal corresponding to the orientation of the motion of the hand. PIC microcontroller processes the gesture of the user and plays the audio file corresponding gesture. The voice signals are stored in APR9600. It is a single chip used to store high quality voice recording and Non-volatile flash memory, playback capacity for 40 to 60 seconds. APR provides random and sequential multiple messages and designers can adjust storage time depending upon user needs. Basically, he used pre-recorded voice and for communication between the transmitter and receiver side and used RF module. Pallavi Verma, et al [3] in their paper presented a system in which a pair of gloves with flex sensors along each finger, thumb and arm is used to capture the movement of user. With the help of flex sensors, degree of fingers, thumb and arm are calculated in voltage terms using voltage divider rule. PIC microcontroller is used for various functions like analog to digital conversion of data from flex sensors. Then digitized data is encoded in encoder and transmitted. Received data is decoded by decoder and gesture recognition system matches the incoming data with pre fed data. If data is matched then it is given to speaker using voice section. Vajjarapu Lavanya, et al [4] implemented a design using copper plate. This glove can be made using small metal strips that are fixed on the five fingers of the glove. A copper plate is fixed on the palm as ground. It is better to use a ground plate instead of individual metal strips because the contact area for ground will be more facilitating easy identification of finger position. The copper strips indicate a voltage level of logic 1 in rest position. But when they come in contact with the ground plate, the voltage associated with them is drained and they indicate a voltage level of logic 0. Thus necessary gestures are formed.

### B. Objective

The fundamental objective of the actualized venture is to make a lightsheltered, simple toutilize, weight keen hand gloves framework that can diminish obstructions for individuals with incapacities where they can remain with the. Race. By this motivation the project smart hand gloves are developed for disabled. By thi s thought the project Smart

Hand Gloves for Disable People is developed so that disable person can live his life as he wants. In this project, Flex Sensor plays the major role. The glove is fitted with flex sensors along the length of each finger and the thumb. ecological and social impacts on the affected persons due to the lack of proper communication. Sign language recognition (SLR) systems based on sensory gloves are significant innovations that aim to procure data on the shape or movement of the human hand. Innovative technology for this matter is mainly restricted and dispersed. The available trends and gaps explored in this research approach to provide valuable insights into technological environments. Thus, a review is conducted to create a coherent taxonomy to describe the latest research divided into four main categories: development, framework, other hand gesture recognition, and reviews and surveys.

### III. METHODOLOGY

With regard to hardware components, the glove-based recognition system is composed of three main unit: input, processing, and output. Owing to scientific and technical developments in the field of electronic circuits, sensors have attracted attention, which have resulted in investments in sensor features in many small and large applications. The sensor is the main player in measuring hand data in terms of bending (shape), movement, rotation, and position of the hand.

#### A. Sensors Used to Detect Finger Bending:

The most prominent movement that can be performed by the four fingers (pinkie, ring, middle, and index) is bending towards the palm and then returning to the initial position. The thumb has unique advantages over the other fingers, thus enabling it to move freely in six degrees of freedom (DOF). In general, the predominant movement in SL related to fingers is bending. Finger tilt can be detected by using different methods, as shown in the literature. Flex sensor, which determines the amount of finger curvature used by a wide number of researchers and developers, is the most common of these kinds of sensors [21,37,38,39,40]. The Flex sensor technology is based on resistive carbon elements. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value. Thus, the resistance of the flex sensor increases as the body of the component bends. The flex sensor is very thin and light weight, so it is also very comfortable, and the most common available sizes are 2.2 inches and 4.5 inches. The price of the flex sensor is between \$9 and \$15, depending on the size. The optical sensor used to measure the angle of the finger curvature—in order to determine its shape by the amount of light passing through the channel—depends on the optic technology [41,42,43]. Optical sensors are electronic detectors that convert light, or a change in light, into an electronic signal. Furthermore, the combined pair of light-emitting diode-light dependent resistor (LEDLDR) is used but not frequently, to detect bend of the finger. LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it [44]. Both of these optic technologies work on the measure of light intensity so that when the finger is straight, the density of received light will be very significant, and the opposite will be true when the finger bends. Both are suitable for handicapped individuals whose fingers can barely perform even very small motions.

#### B. Sensors Used to Detect Movement and the Orientation of the Hand

Considering that SL postures are made up of hand and wrist movements, they should be considered. Despite the benefits of using sensors to determine the shape of the finger, hand movements cannot be distinguished by these sensors. The features of the ACC sensor enable it to distinguish the movement and rotation of the wrist as another factor in addition to its capability to determine the shape of the finger. Therefore, the three-axis ACC that supplies the differences in acceleration along every axis is used to capture the orientation and movement of the wrist to correctly represent the important function of a sensor glove. The ADXL335 (Adafruit Industries, New York, NY, USA) (Figure 10) is a thin, small, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. It measures acceleration with a minimum full-scale range 3g. This device measures the static acceleration of gravity in tilt-sensing applications and dynamic acceleration resulting from motion, shock, or vibration. The ADXL335 contains a polysilicon surface micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide resistance against acceleration forces. A differential capacitor, consisting of independent fixed plates attached to the moving mass, measures the deflection of the structure. Acceleration unbalances the capacitor, which, in turn, results in a sensor output with amplitude proportional to the acceleration experienced. The price varies from \$9 to \$24 depending on ACC version.

### C. Processing Unit

The microcontroller is the system's mind that is accountable for gathering the data from the sensors provided by the glove and performing the required processing of these data to recognize and transfer the sign to the output port to be presented in the final stage. A highperformance microcontroller with a microchip with 8-bit AVR microcontrollers based on reduced instruction set computer (RISC), which combines 32KB in-system programming (ISP) flash memory with read-write capabilities called ATmega, was used. A micro-controller MSP430G2553 (TEXAS INSTRUMENTS, Dallas, TX, USA), with an 8-channel, 10-bit (analogue to digital converter) ADC was used. The central processor modules ARM7 and ARM9 are used by [54,55], respectively. Furthermore, as found in the literature, an open-source electronics platform called Arduino has been used. Several Arduino boards are available on the market such as Arduino Nano, Uno, Mega, etc.; for instance, Arduino Uno (Arduino, Italy), (Figure 13c) is based on the ATmega328P microcontroller and has 14 digital inputs/outputs, 6 analog inputs, a 16 MHz quartz crystal, and USB connection [6,8,21,37,56,57,58,59]. Odroid XU4 (Hardkernel2, Anyang, South Korea) (Figure 13d), produced by Hardkernel2, uses a Samsung Exynos5 Octa 5410 processor that consists of 4 CPU cores each with Cortex™-A15 cores; it was used for the development of the data glove.

### D. Output Unit

Customarily, a user interacts with the device through output devices, so the output devices play an important role in achieving the best performance of devices implemented in the field of SLR. The main device adopted by researchers as the output was the screen of computer [3,4,35,40,48,60,61,62]. Other devices attracting the attention of researchers are the liquid-crystal display (LCD) [12,35,57,63], speaker [38,46,54,64], or both [6,51,55,65,66,67,68]. Ultimately, the smartphone is another alternative chosen for system output [9,42,48,59,69].

### E. Gesture Learning Methods

Software, which is an essential component of every system, plays an important role in data processing in addition to the possibility of improving system outputs. The development of software for SLR systems is related to the methods used in the classification process to recognize gestures. One of the common direct methods to perform static posture recognition is prototype matching (also known as statistical template matching), which operates on the basis of statistics to determine closest match of acquired information values with pre-defined training samples called 'templates' [3]. In fact, this method is characterized by the lack of a need for complicated training processes or wide calibration, thus increasing its speed. From a pattern recognition standpoint, the artificial neural network (ANN) is the most popular method used for machine learning in the recognition field [67,70]. Therefore, it is possible to train this technique to distinguish both static and dynamic gestures, as well as posture classification, based on the data obtained from the data glove [41,43,54,70,71]. Long-term Fuzzy Logic has been used in many fields that need human decision-making; one of these areas is recognition of sign language [4,21,42,72]. Likewise, there is another useful algorithm; in fact, it falls within the scope of machine learning employed to provide accurate and less complicated classification through dimensionality reduction with improved clustering, which is known as Linear Discriminant Analysis (LDA) [46,61]. Hidden Markov Models (HMMs) is a popular technique that has shown its potential in numerous applications such as computer vision, speech recognition, molecular biology, and SLR [53,73,74,75,76]. Besides the HMM, the KNN is also used to classify hand gestures [63], and the KNN classifier with support vector machines (SVM) has been applied in posture classification in [77]. The KNN is applied in work on the recognition of ASL signs [40].

## IV. BRIEF DESCRIPTION OF COMPONENTS

### A. Flex Sensor

Signed letters are determined using flex sensor on each finger. The flex sensors change their resistance based on the amount of bend in the sensor as shown in figure. As a variable printed resistor, the flex sensor achieves great form-factor on a thin flexible substrate. When sensor placed in gloves is bent, it produces a resistance output correlated to the bend radius the smaller the radius, the higher the resistance value. They require a 5-volt input and output between 0 and 5V. The sensors are connected to the device via three pin connectors (ground, live, and output). In device, sensors are activated in sleep mode. It enables them to power down mode when not in use.



**B. Microcontroller**

Microcontroller is the heart of the device. It stores the required data and make use of if whenever the person uses the device. This device helps deaf and dumb person to announce their requirement. By this the person who is near can understand their need and help them. PIC microcontrollers can be programmed in Assembly, C or a combination of the two . Other high-level programming languages can be used but embedded systems software is primarily written in C. All output signals generated from flex sensors are inanalogue form and these signals need to be digitized before they can be transmitted toencoder. Therefore microcontroller PIC16F877A is used as the main controller in this project. It has inbuilt ADC module, which digitizes all analogue signals from the sensors and inbuilt multiplexer for sensor signal selection. It supports both serial and parallel communication facilities.

**C. Encoder/Decoder**

The output from the PIC microcontroller is encoded by encoder. The programmed address/data are transmitted together with the header bits Via an RF. It is used to correct theerror at the receiver end, if any error had occurred. In the receiver it is decoded by decoder.

**D. Gesture Recognition Action**

The gesture manager is the principal part of the recognition system. It contains data to matchwith incoming data. The system tries to match incoming data with existing posture. The bendvalues of the fingers and for each posture definition the distance to the current data iscalculated. Then, the position/orientation data is compared in a likewise manner.

**E. Voice Section**

After gesture recognition system, data is sent to voice section. In this, data is matched with feeded data. If the data is matched with feeded data then it is given to speaker and display system.

**V. DRAWING**

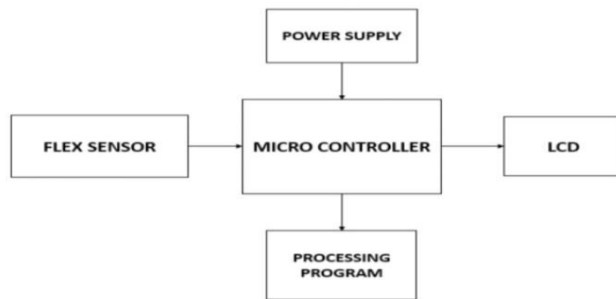


Fig.1: Block Diagram

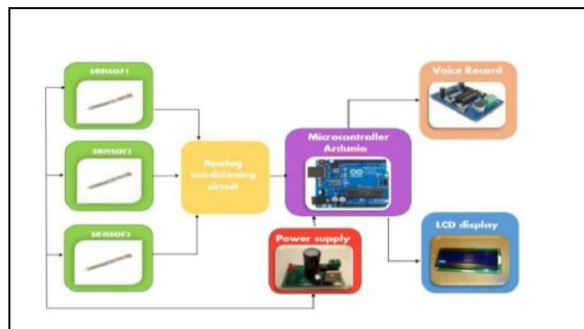


Fig.2: Experimental Diagram

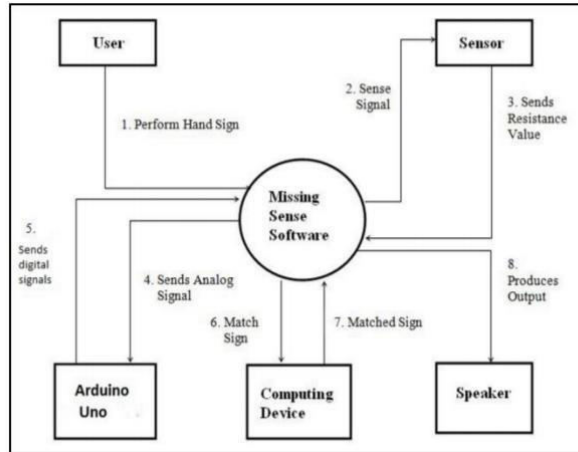


Fig.3: Actual Working Diagram

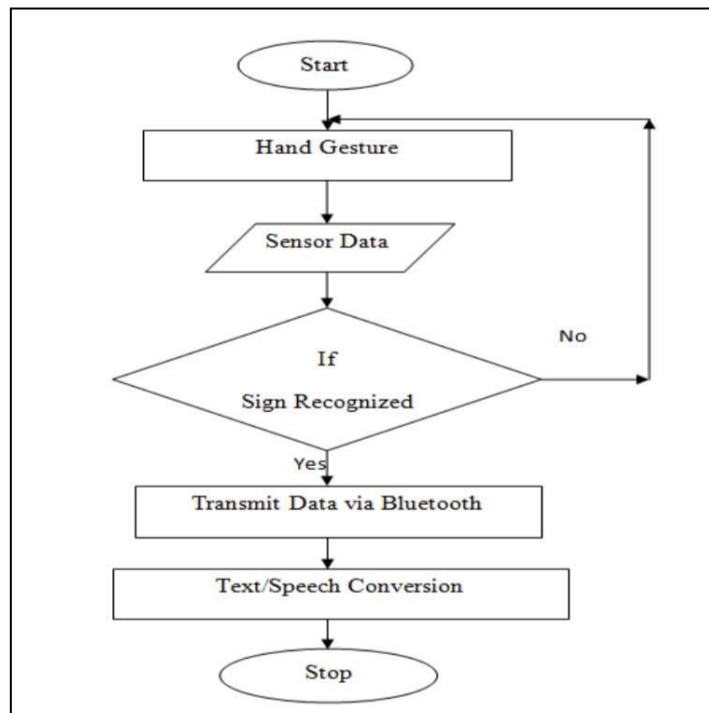


Fig.4: Flowchart

## VI. RESULT

Disabled use these gloves to convert sign performed by them into speech. 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. The system is capable of recognizing signs language more Quickly.



## VII. CONCLUSION

This paper introduced the Smart Hand Gloves for Disable People. It will provide the more reliable, efficient, easy to use and light weight solution sign language is a method used for communication by disabled person.

Here we are converting sign language into text and speech so that communication is not limited between them only, utilizing data gloves communication barrier between two different communities is eliminated. Using data gloves disabled person can also grow in their carrier and makes nation grow as percentage of disabled person are millions in count. Making their future better ,making nation better.

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