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# Design of a Smart Talking Glove for Dynamic Gesture Recognition

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**Abstract- This paper presents the design of a smart-talking glove for dynamic gesture recognition. The aim is to provide an efficient, ultrahigh reliable with low latency real-time communication system. It is acting as a communication aid device to disable persons such as deaf, deaf/blind, and non-vocal individuals. This is a human interface device that converts the mechanics of hand sign language into alphanumerical characters by transcribing symbols in sign languages into plain text. The flex sensor as a front end device continuously detects the degree of flexion of the patient fingers. The output data will be processed and estimated by using an algorithm that converts it into suitable commands.**

**Keywords- Gesture recognition, Wearable device, Hybrid device.**

## I. Introduction

From the annual reports of the world federation of the deaf and the world health organization, around 466 million people worldwide have disabling hearing loss [1], and 34 million of these are children. It is estimated that by 2050 over 900 million people will have disabling hearing loss. Disabling hearing loss defined as hearing loss greater than 40dB in the better hearing ear in adults and a hearing loss greater than 30dB in the better hearing ear in children. The majority of speech and hearing-impaired people cannot read or write in regular languages. Sign language using hand gestures is the single most important method for the disabled to communicate with others [2]. A gesture is a natural and intuitive form of

interaction and is a function of hand shapes, hand movements, orientations, and pattern creations. Many smart gloves are proposed in recent years where preferred technology was the wireless mode with many distinct features [3]. However, they have failed to fulfill efficiency, ultra-high reliability with extremely low latency, all at the same time. Apart from this device bulkiness and price is major concerns [4]. The major advantages of this smart glove include portability with inbuilt battery, easy to wear, flexible to customize according to the applications. Its simplicity extends its usability to people from all the class and culture.

The instrumented smart-talking glove is an essential electromechanical communication 'hand talk' tool to provide a robust solution to communication disabilities [5]. When the person performs a particular gesture, the predefined message for that gesture is displayed on the LCD screen along with a 1 KHz beep tone, and that specific message is also transmitted in the form of text or call with the help of GSM module to the various registered numbers. The receiver can be placed in any wireless locations depending upon the requirement for example, in doctors' cabin or near to the dependent. Due to the presence of a GSM module receiver can easily configure with the normal GSM-compatible mobile device. All the problems of emergency can be tackled by sending the data to the fitted LCD monitor and SOS signal through the short message service [6]. In a non-emergency situation, all human emotions and expressions can be formulated and convert into a suitable text message. For example, if the wearer performs a gesture of "V" (predefined victory symbol), light can be switched on, and by performing the same gesture again the light will be switched off. Similarly, we can do the same in the case of the air conditioner, fan, or microwave devices.

In this paper, flex sensors are placed on fingers, as the fingers bend it changes the inherent characteristics of the device by changing its resistance and in turn alters the amount of current through the network. The amount of current change depends upon the amount of bend of the finger. The relative change in potential will be detected by the Arduino UNO board. Further, LCD, Bluetooth, and GSM modules are used as an output device to transmit the information to the corresponding receiver. Arduino IDE and Proteus software tools are used for compiling the code and simulating the design. A prototype of the design is made and tested. The outcomes based on the major variables are found to fulfill most of the target requirements.

## II. Methodology

Figure 1 indicates the working flow chart of the smart gloves. The working on the project is based on the connection of the metal contacts with the Arduino and GSM modules. Here one metal contact is connected to the thumb of the hand configuration and the other is connected to the finger of hand configuration. The connection is formed in a close loop when the metal contacts on both thumb and finger are in contact. This close-loop tells the Arduino that the connection has been made and it gives instruction to the GSM module which sends a message to the contact number connected with the GSM [6-9]. The thumb of hand configuration is connected to the trigger unit this trigger unit is connected to the switch unit. This switch unit is subdivided into switch unit I and switch unit II. These two switch units provide relay 6 V DC signal. One of the switches is connected to the microcontroller in Arduino this microcontroller is a 6-bit ATMEL ATMEGA8 controller. The second is connected to the buzzer; it works on 6-12V supply.
The microcontroller needs a 5V DC supply which is provided by an adapter based on switch mode power supply. This power supply is also extended to the switch unit 1 and switch unit 2. The microcontroller and GSM module is connected to each other with different pin connections. The GSM module is working and SIM 900A it can send as well as receive the signal from the microcontroller. The GSM needs a 9V DC supply which is given by another adapter.

This works on a principle of close loop connection [10-12]. Whenever the connection is closed then a signal is generated and the pulse is given to the Arduino. It works automatically according to the program burnt on the device. Then the signals from Arduino are sent to the GSM module. The GSM module is having the SIM which sends a text message to the person whose contact has been saved. At the same time buzzer will ring on the hand configuration so that the patient will get to know that the message has been sent. Fig.2 showing total functionality of the smart glove.

## I. Result Analysis And Discussion

The base material for the smart glove is cotton for comfort and soothing effect. Apart from this a leather glove was tested considering the size of the disabled hand. Electronics are insulated properly with some additional fabric. The flex sensor joints. It is about -47.95 dBm. The flex sensor is chosen to has high sensitivity, especially in the metacarpal phalangeal

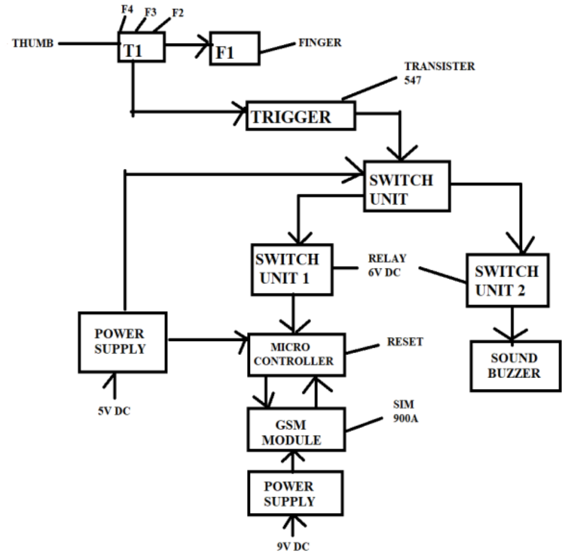



**Fig.2: Total functionality of the smart glove**

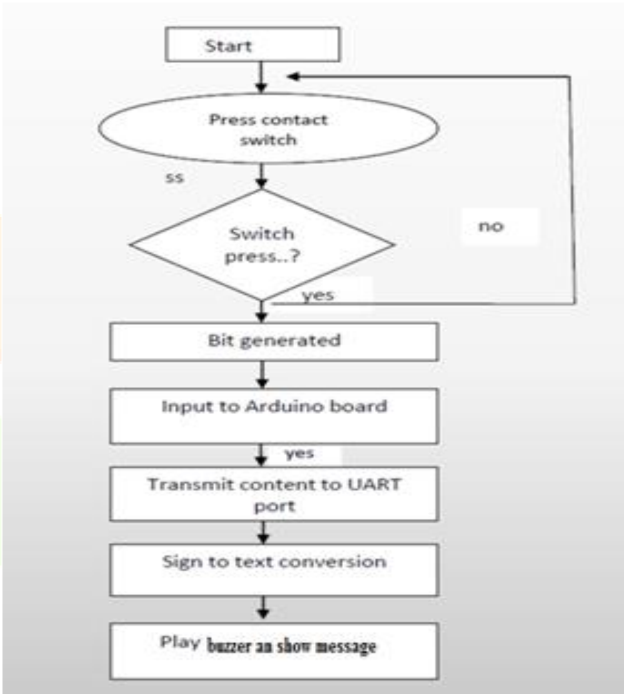



**Fig.1: Working flow chart of the smart gloves**

provide design flexibility and portability. Based on the movement of the finger the spherical coordinate system (r,θ,ϕ) altered both in azimuth and elevation angle [13-14]. Therefore there will be a corresponding change in the resistance of the top and bottom surface of the sensors which is proportional to the known current. This output will be given to the differential amplifier to find the differential voltage ΔV and phase angle. Combination of different finger pattern form different channels which are analogically low-pass filtered (anti-aliasing, cut-off frequency of 10 Hz). The output data were digitally converted (Nyquist rate of 100 Sample/second) and wirelessly transmitted to GSM and LCD module. A part of the analog data through a driver amplifier is applied to excite the buzzer. After getting that excitation current buzzer will oscillate at around 1 KHz. An associated algorithm is designed to detect the pattern of the gesture and continuously monitor the timing and the bending speed of the combination of all the fingers and tries to match them with the earlier specified pattern stored in the memory database. Fig.3: Final product showing all the associated electronics of the smart glove.

**Fig.3: Final product showing all the associated electronics of the smart glove**

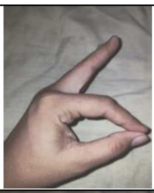
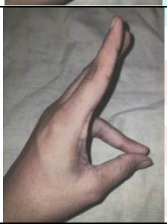
| Sign | Task | Command generated |
|---|---|---|
|  | Medical emergency required | Medical emergency, please approach fast |
|  | Need a glass of water | Water service, please approach fast |
|  | Food required | Food service, please approach fast |
|  | Want to go restroom | Restroom service, please approach fast |

**Fig.4: Table showing all the contacts and their corresponding functions of the smart glove**

## II. Conclusion

This paper reported the design of a smart-talking glove for dynamic gesture recognition. Here flex sensors as front end devices are locally fabricated and the customized algorithm is developed, interfaced to convert gesture into corresponding voice and text. A prototype of the design is made and tested. An experimental analysis carried out to check the response time, power output, generated driving current, and connectivity. The overall efficiency and reliability are found to be well within the limit. In the future, this project can be integrated with the facial expressions modules to add up and convey important sign-languages. With the arrival of 5G, MIMO, and millimeter-wave technology the high-end features of this device can be raised exponentially to improve its efficacy and performance level.

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