

Translating Indian Sign Language to text and voice messages using flex sensors

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Abstract: Communication plays an important role for human beings. Communication is treated as a life skill. Keeping these important words in mind we present our paper to mainly focused on aiding the speech impaired and paralysed patients. Our work helps in improving the communication with the deaf and dumb using flex sensor technology. A brief description about various gestures and the implementation part is discussed in this paper. A device is developed that can translate different signs including Indian sign language to text as well as voice format. Flex sensors are placed on hand gloves for the use of above said people. Flex sensor's resistance changes according to the flexion experienced. Sensors in the glove pick up gestures and transmit that to text data with the help of Analog to Digital convertor and microcontrollers. This converted text data will be sent wirelessly via Bluetooth to a cell phone which runs Text to Speech software and incoming message will be converted to voice. Here device recognises Indian sign language alphabets, numbers and symbols based on sensor movement.

Keywords: Flex sensor, ADC, AT89S52 microcontroller, LCD, Bluetooth module

I. INTRODUCTION

Loss of hearing and speech can cause people to become isolated and lonely, having worse affect on both their social and working life. Looking up the meaning of a sign is not a straightforward task. Sign Language is a well-structured code gesture where every gesture has a meaning assigned to it. Sign Language is the only means of communication for deaf people. With advancement of science and technology many techniques have been developed not only to minimize the problem of deaf and dumb people but also to implement it in different fields.

Sign language is a language which instead of voice or sound patterns uses manual communication and body language to convey the meaning. This involves mostly the combination of shapes, orientation and movement of the hands. Sign language is not only used by deaf but also who can hear, but cannot physically speak. All India Federation of the Deaf estimates around 4 million deaf people and more than 10 million people have hearing problem in India.

Studies say that, one out of every five deaf people in the world is an Indian. Out of those, more than 1.5 million deaf people in India uses Indian Sign Language (ISL) as a mode of communication. ISL is not only used by the deaf people but also by the hearing parents of the deaf children, the hearing children of deaf adults and hearing deaf educators. However, due to the inherent difficulty in their written texts, an automatic Text-to-ISL translation system could help to make more information and services accessible to the hearing impaired. Moreover, the system will not only improve information access, but it can also be used as an educational tool to learn ISL. This work is aimed to develop an automatic Indian Sign Language recognition platform for hearing impaired persons of India. Another important aspect of this work is that, the proposed

system will be able to recognize different hand gestures of Indian Sign Language as well as some of the different signs and the system can give the interpretation of the recognized gestures in the form of text messages displayed on LCD screen. Obtained text will be sent to a mobile as a message with the help of a Bluetooth model or GSM and using text to speech software this message will be converted to voice form.

II. LITERATURE SURVEY

Deaf people have used sign languages throughout the history. One of the earliest written records of a sign language is from the fifth century BC, in Plato's Cratylus. In 1620, Juan Pablo Bonet published 'Reduction of letters and art for teaching mute people to speak' which is considered as the first modern treatise of sign language phonetics, setting out a method of oral education for deaf people and a manual alphabet. There are more than hundred sign languages in the world today for example the American Sign Language (ASL), the British Sign Language (BSL), the Japanese Sign Language (JSL), International Sign Language and so on. Many research works related to Sign Language detection have been done and a lot of techniques to convert sign to text by using American Sign Language and International Sign Languages have already been implemented. It is the Indian Sign Language which needs to be worked upon. Interpreters were used by deaf people to translate the sign language into speech signals. However interpreters were very costly and they are difficult to acquire on a moment's notice. Note writing was used by the non vocal individuals to communicate with someone who is seated nearby, but it is awkward while standing at a distance, walking and when more than two persons are involved in a conversation. So

in order to overcome these we have come up with this novel idea. Some proposed works^[1] present a retype text to Indian sign language (ISL) translation system. The system takes English sentence as input, performs analysis and generates the corresponding ISL structure. Since ISL does not have any written form, the output is represented in terms of pre-recorded video streams. The system uses Lexical functional Grammar (LFG) formalism for representing ISL syntax. One more study^[2] proposes a system using Eigen value weighted Euclidean distance as a classification technique for recognition of various sign languages of India. The system comprises of Skin filtering, Hand cropping, Feature extraction and classification, 24 signs were considered in this stud, each having 10 samples, thus a total of 240 images was considered. Speaker jet sound synthesizer is also used^[3] to convert the letters and numbers displayed to sound. But above research works are insufficient to convert the sign to word and sentence format and to produce sound from it.

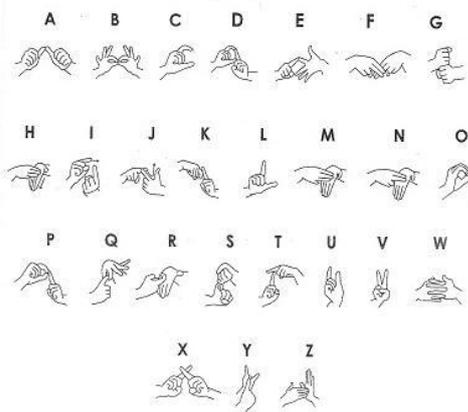


Fig 2.1 Manual Alphabets of Indian Sign Language

III. METHODOLOGY

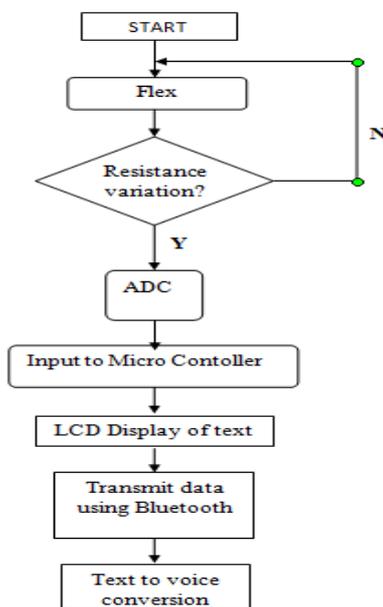


Fig 3.1 Flowchart of the method

Fig 3.1 shows the flow of algorithm used in the methodology of this paper. The gloves are fitted with flex sensors so as to trace the correct movement of the fingers. For each flex sensor the required voltage will be supplied initially. According to the movement of the fingers there will be a voltage drop associated with it because of the variation in the resistance. Variation of resistance is due to bending of the flex sensor. The voltage thus obtained will be analogy in nature. This analogy voltage is converted to digital voltage using an analogy to digital converter (ADC) and this voltage is fed to microcontroller AT89S52.

In power supply circuit the DC pulsating is removed by electrolyte capacitor (1000µF). Our hardware requires 5V DC and hence a voltage regulator of 7800 series is used. A crystal oscillator with 12MHz is used which provides the microcontroller with frequency clock pulse. Electrolytic and Ceramic capacitors are used which removes the ripples and cancels noise. The main electric board will contain a microcontroller that handles the program used to detect the analog voltage levels captured from the sensors, converts them to digital using the ADC of the microcontroller, makes the recognition of the letter signed. Microcontroller will compare the input voltage with pre defined program voltage and accordingly it will display the output characters on the LCD screen. The displayed letters in the LCD screen is transmitted to the Smartphone using Bluetooth Module. The Android app in the smart phone can be used to convert text to speech. The app is obtained from a MIT app inventor. In this inventor, developing app is simple as drag and drop. The text then can be converted to speech by using a text to speech maker software in mobile. Block diagram of the circuit connection is as shown in fig 3.2.

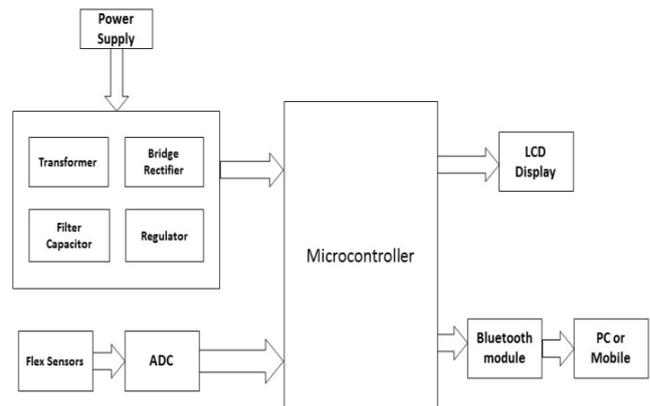


Fig 3.2 Block diagram of sign language detection

A. Flex sensor

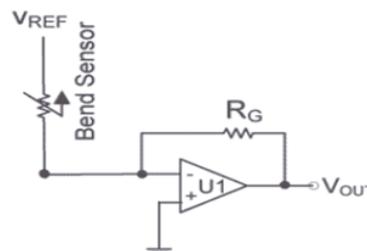


Fig 3.3 Basic flex Sensor circuit

A flex sensor or force sensor is a flexible sensor which change in resistance depending on the amount of bend on the sensor. More the bent, more will be the resistance experienced. When the sensor is kept straight with no force acting on it, it has a flat resistance of around 10 K Ohms. And experiences minimum 2 times greater than the flat resistance at 180° pinch bend. Inside the flex sensor are carbon resistive elements within a thin flexible substrate where more carbon means less resistance. Fig 3.3 shows the basic flex sensor circuit which converts the change in resistance to voltage using a dual sided supply op-amp. A negative reference voltage will give a positive output. and fig 3.4 shows the variation in output voltage according to the variation in input resistance.

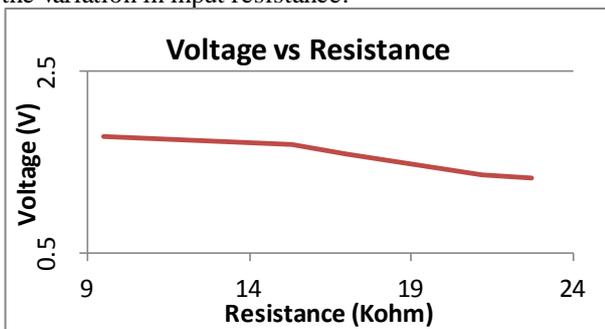


Fig. 3.4 Voltage v/s resistance variation in flex sensor

B. Microcontroller AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes in-system programmable Flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. It provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

C. Analog to Digital Convertor(ADC)

ADC is an electronic circuit that converts a continuous physical quantity like voltage or temperature to a digital number that represents the quantity's amplitude so that the microcontroller can read the data. The ADC0808 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized

comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The design of the ADC0808 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques.

D. LCD

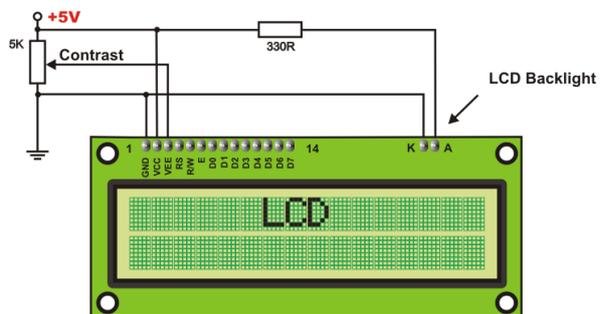


Fig 3.5 LCD 16x2 Backlight.

A 16x2 LCD(Liquid Crystal Display) screen can display 16 characters in each line and there will be 2 such lines. Each character will be displayed in 5x7 pixel matrix format. It contains two registers namely command register to store the command instructions and a data register to store the data to be displayed.

E. Bluetooth

Bluetooth technology handles the wireless communication channel which transmits and receives data wirelessly between serial input and output devices using UART(Universal Asynchronous Receiver/ Transmitter). This module is an easy way to use Bluetooth Serial Port Protocol module, designed for transparent wireless serial connections. UART takes bytes of data and transmits the individual bits in a sequential pattern.

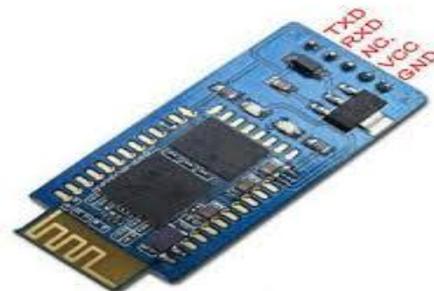


Fig 3.5 Serial port Bluetooth Module

IV. RESULTS

The sign will be converted to letters and it will be displayed on LCD screen and the letters can be transmitted using Bluetooth Module to a smart phone where text to speech conversion takes place using. Hardware setup of the module is shown in fig 4.1 which includes flex sensor gloves, microcontroller, ADC, Bluetooth device and LCD device. Fig. 4.2 shows hand gesture which is converted and displayed in text form in LCD.

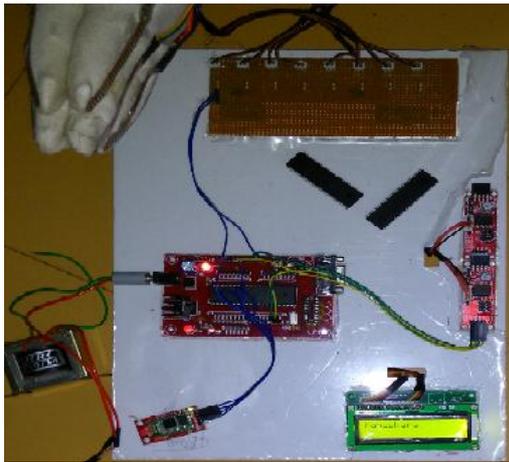


Fig. 4.1 Hardware setup

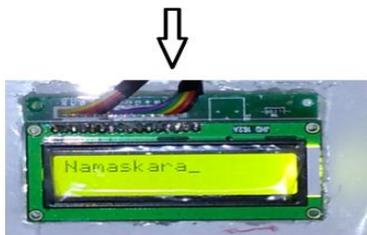


Fig 4.2 Sign to text conversion

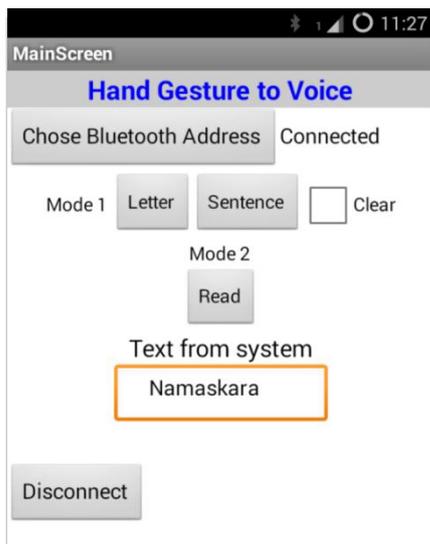


Fig 4.3 Message received to Android App

V. CONCLUSION

The more reliable, user independent and portable system to convert the sign language to text message form which consumes less power because of the low ultra power AT89S52 microcontroller is designed. This text message can be translated to voice using a simple mobile app. It helps to overcome the limited communication between the dumb/deaf people with the rest of the world.

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BIOGRAPHIES



Sachin S Bhat received his B.E degree in Electronics and Communication from AITM, Bhatkal, Karnataka in 2009 and M.Tech degree in Digital Electronics and Communication from NMAMIT, Nitte, Karnataka in 2011. He is having 4 years of industrial and research experience and currently working as an assistant professor in Dept. of ECE, Shri Madhwa Vadiraja Institute of Technology and Management, Udupi, Karnataka. He is having more than 20 publications in national and international levels. His research interests include Digital Image Processing, Pattern Recognition, Neural networks and C++ template design.



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