Design Of Sign Language Interpreter For Specially Challenged Community

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Abstract - A special type of language is used in deaf community across the globe a form of non-verbal sign language. The language interpretation is very difficult because of not derived from the common source of origin. The conversion of hand gesture into auditory speech uses a device called Deaf-Mute language interpreter. Hand movement with particular shape and angle is considered as a sign language. In the meantime, gesture also adds the facial expression. Sign is the static shape or position of the hand to indicate communication. This work focus to provide a glove based smart system to translate deaf-mute communication. The objective is to develop a smart glove that can able to interpret 10 characters from the American Sign Language (ASL).The smart glove is designed in such a way that, LDR sensors are attached to fingers to gather the position of the finger to identify the characters. The design uses MSP430 microcontroller to meet the low power constraints for portable smart glove. The translated character is sent to computer through ZigBee wireless protocol and then pronounces the letter through the text to voice module. The whole translation mechanism takes minimum time to read the finger position and to produce a voice message.
Keyword: Wireless communication, American Sign Language (ASL), MSP 430, Interpreter, LDR sensor, Flex sensor, ZigBee.

1. INTRODUCTION

A language used to convey the meaning in terms of manual and body language instead of conventional acoustic sound patterns is generally taken as Sign language. This language involves various shapes of hand, movement of body, arms or hands and change facial expression to express thoughts of speaker’s. There are some similarities and differences between sign and spoken languages, which helps to analyze the development of such sign language translators from the natural languages [1].

Sign languages are developed across the globe wherever deaf communities exist. The persons who cannot speak physically also can hear and able to do signing. Sign languages require faculty as the spoken languages and shows similar linguistic properties. Many of sign languages are developed and are in use across the globe to the core of regional deaf cultures. Among the existing sign languages some have got recognitions legally like American Sign Language (ASL) and some sign languages have not got any status.

Sign languages complex and rich with respect to linguistic concerns, but there is a misunderstanding that these are not real languages. Fundamental linguistic properties will exist in all sign languages and this factor is studied and found by many professional linguists of various sign languages.

Spoken languages have visual correlation to the referent but sign languages show conventional signs and are arbitrary. Sign languages are widespread and systematic compared to spoken languages and cannot categorize the difference. The connections between forms and meaning are very close in sign languages, which allows the human preferences with sign modality, but fully expressive in spoken languages. Directly sign languages does not consider as visual interpretation of spoken language. Sign languages have their own complexities in terms of grammars and are also used to describe the topics from simple to complex levels.

2. EXISTINGTECHNOLOGIES

In the area of gesture recognition many cutting edge and competent researches are happening. Mainly sign interpretation is categorized into two ways-

Vision-based

The system camera is used as an input device to capture the movements of fingers and hands in vision based systems. The realistic interaction among human and computer is observed through camera in vision based mechanism. The configured system implement the biological vision into artificial vision through hardware and/or software systems [3].This system have many challenges like camera and person independent, light and background to reach the target performance in real time. To make the system more accurate and robust, requirements must be optimized. The complex digital signal processing algorithms are involved in vision based system for gesture recognition and also involve the enormous programming. These technical difficulties make the system response quite delayed. Moreover the system performance is reduced due to interferences like magnetic and electric fields. The overall system cost increases with the use of high resolution camera for image processing.

Glove-based methods

The positions of the hand gestures are accurately measured by using data gloves fitted to hands. The hand and finger movements are digitized as multi-parameter data through sensors [5] mounted hand glove. Hand movement and configurations are collected by many sensors to make the process easy. Existing researches on the work have attempted to recognize the joint angles and positions of the hand using glove based system and the devices used in the configurations are quite expensive in the market. Now the today's technology brought multiple connected cables between the hand fitted device and base computer are eliminated and established communication through wireless mode. The discrete components and other sensors used in the sign recognition system are quite expensive in the market.

This work focused on design of sign interpreter with low cost and compact, hence flex sensors and a compact MSP430 microcontroller [2] are used to make the design simple and compact. Here the space optimization is achieved, hence the device is handy and portable compared to existing systems in the market and also the system performance is not affected due to any sort of interferences. Since the work used one of the low power, MSP430 microcontroller of Texas instruments [7].Here the circuitry for the sensors includes only resistors, the overall power consumed is very less. The outcome product is low cost as the components are minimized and economical compared to existing systems in the market.

3. BLOCK DIAGRAM OFINTERPRETER

The proposed block diagram consists of flex Sensors which are positioned on the every finger of the glove. The captured analog signal is passed to ADC10 of MSP430G2553 to digitize, here totally five sensors are positioned to read the gesture of signing from fingers. The selected microcontroller MSP430G2553 process analog signals through an 8-channel-10-bit Analog to Digital Converter (ADC) in which 5 channels is utilized. Basically ADC converts the signals from analog to digitized form and encodes the digits into ASCII forms. ASCII codes are transmitted by ZigBee module through wireless mode. ASCII codes are received at the receiver terminal and forward to the computer to display the respective character and produce the sound of the alphabet.

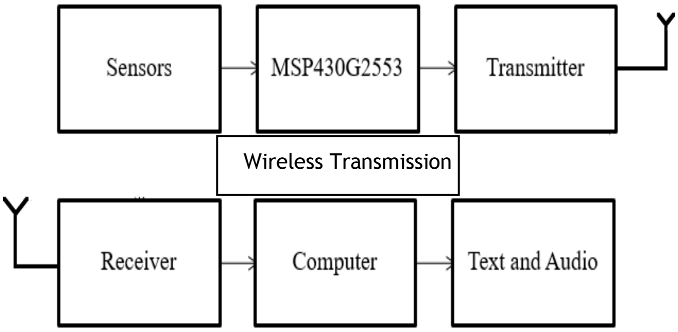

Figure 1: Proposed block Diagram representation of Sign Language Interpreter

In the further sections, let us see about the sensor we have embedded in the glove. Let us also look into the microcontroller used, the ADC implementation and the transmission part. Every system that is built must be put into test. The smart glove was also tested for 10 different English letters. The experimental results of the test are clearly depicted in the result section.

A comparative study of 3 sensors namely flex sensor, passive IR sensor and LDR sensors was done. It was found that there was a trade-off between voltage range and noise level in the sensors. It is important to understand and manage the trade-off effectively.

Voltage range of flex sensor was not distinguishable after it was converted to digital data. There was no significant difference between the digital values for when the flex was bent and not bent. The analog voltage range was from 2.77V to 3.22V. The same can be observed in table 1.The noise was very less compared to the other two sensors. It is shown in Figure 4.

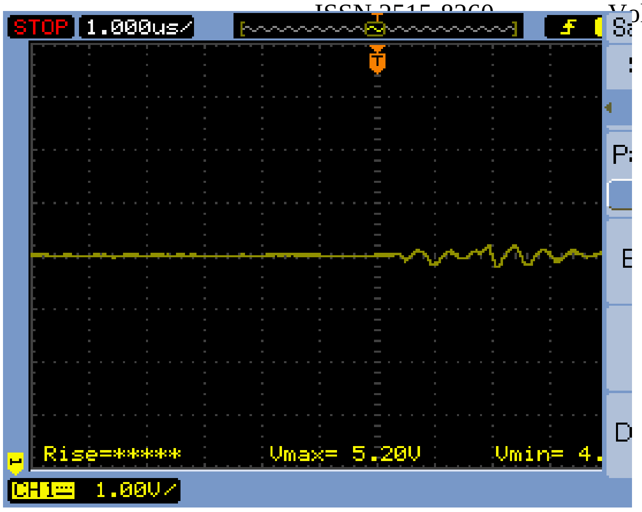

Figure. 2: Noise in LDR Sensor when bent.

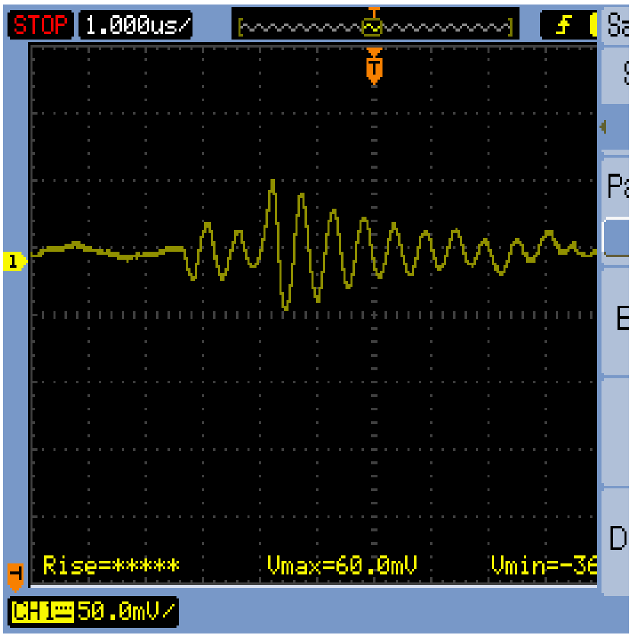

Figure. 3: Noise in Passive IR Sensor when bent

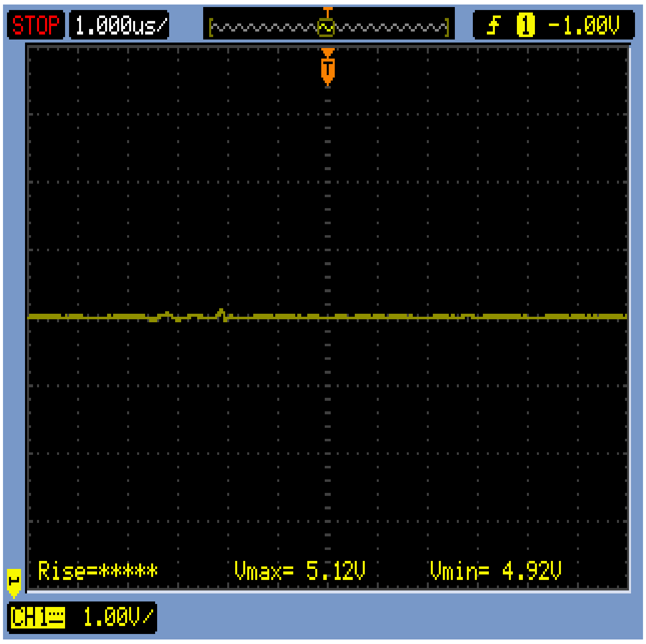

Figure. 4: Noise in Flex Sensor when bent.

Table 1: Table indicating voltage across flex sensor for various degree of bend

DEGREE of BEND	VOLTAGE across FLEX SENSOR in Volts
0	2.78
10	2.80
20	2.86
30	2.94
40	3.00
50	3.07
60	3.11
70	3.17
80	3.20
90	3.22

4. EXPERIMENTAL RESULTS

The smart glove developed to interpret the sign language was tested thoroughly for the 10 English alphabet characters. Further sections will have the experimental results of each character that can be interpreted using the glove are as given below.

Table 2: Characters and their probabilities of occurrence.

CHARACTER	PROBABILITY OFOCCURRENCE
A	0.081
B	0.014
D	0.037
E	0.131
F	0.029
I	0.063
K	0.004
L	0.033
W	0.015
Y	0.019

The smart glove is designed to interpret the above said 10 alphabets. The selection of these 10 characters involves the frequent occurrence in English language. The gestures derived from these 10 characters never involve contact between the fingers or the hand movement.

CHARACTER ‘a’

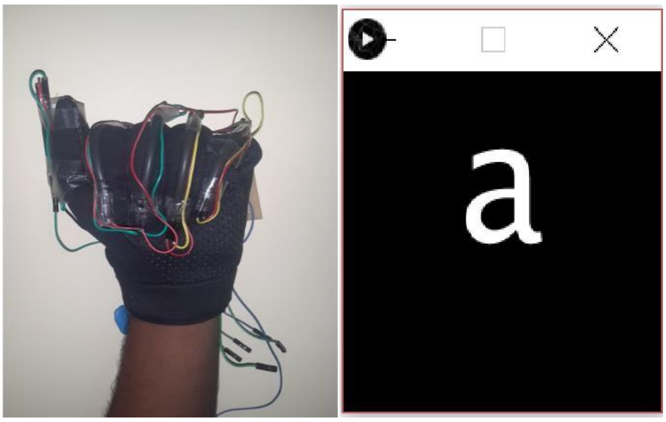

Figure.5: Hand gesture and the position and the respective character.

Figure.5 represents the finger position representation for ‘a’, sensors capture the position and pass to ADC to digitize the values through microcontroller ADC ports.

The ADC will convert analog values to its corresponding digital values. The generated digital values are coded in to zeros and ones, for the letter ‘a’ coded values of zeros and ones are [10000]. The encoded digital values are compared with corresponding ASCII values and carried out a serial communication by passing it on to UART buffer. ZigBee transmitter and receiver are interfaced to microcontroller for wireless operation and encoded data is serially sent through this module. After conversion the corresponding ASCII letter is forwarded to computer and displayed as shown in figure.5. Finally the displayed letter is pronounced through text to voice module.

5. CONCLUSION

This work is mainly focused to develop a prototype to check the feasibility of sign language interpreter using smart gloves. American Sign Language based sign interpretation is performed and it can be used partially for the sign recognition.

The smart glove design is portable and user friendly, internal components uses are supports power optimized design to maintain the long lasting power supply. In design low noise flex sensor is used and compared their performance with other available sensors. Probability of occurrence of 10 characters are also performed and listed for the use. Text to voice based audio output makes the product much more flexible to understand the sign language easily.

Here the sign language considered for interpretation is American Sign Language (ASL) which is widely used and accepted across the globe. This device can be used with the technology advancement by hearing people. An exceptional improvement in performance and power capabilities add more strength to the device.

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