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# Electronic Device for Deaf and Dumb to Interpret Sign Language of Communication

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**ABSTRACT**: Communications between deaf-dumb and a normal person have always been a challenging task. Aboutaround billion people in the world are deaf and dumb. The communication between a deaf and hearing person poses to bea serious problem compared to communication between blind and normal visual people. The blind people can talk
freely by means of normal language whereas the deaf-dumb have their own manual-visual language known as Gestures and sign language. Human hand plays an important role while conveying information in between deaf and normal person. Gestures are powerful tools of communication among normal people and deaf and dumb community. This project aimed to developing an electronic support system that can translate sign language into text and speech in order to make the communication take place between the mute communities with the general public.

**KEYWORDS**: Hand Gloves, sign language, flex Sensor,ARM7TDMI, LM386, voice section

## I.INTRODUCTION

Sign language is the language used by mute people and it is a communication skill that uses gestures instead of sound to convey meaning of a speaker's thoughts. Signs are used to communicate words and sentences to audience. A gesture in a sign language is a particular movement of the hands with a specific shape made out of them. A sign language usually provides sign for whole words. It can also provide sign for letters to perform words that don't have corresponding sign in that sign language. In this project Flex Sensor plays the major role, Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. This flex sensor fixed on the five fingers of the glove.System will analyse these gestures and synthesize the sound for the corresponding word or letter for normal people to understand[13]. We have developed a prototype using this process to reduce the communication gap between differentially able and normal people.The Sign language interpreter developed uses a hand glove fitted with flex sensors that can interpret the English letters, numbers and some words in American Sign Language (ASL) & some one-handed letters in Indian sign language (ISL) [1].

## II. RELATED WORK

Traditionally, the technology of gesture recognition was divided into two categories, vision -based and glove-based methods and also the colored marker approaches. In vision-based methods, computer camera is the input device for observing the information supplied by various gestures of hands & fingers. In glove based systems data gloves are used which can archive the accurate positions of hand gestures as its positions are directly measured.

Laura Dipietro et al. [8] proposed an Instrumented (data) glove approaches system in which sensor devices used for capturing hand position, and motion. In this approach, detection of hand is eliminated by the sensors on the hand and it can easily provide exact coordinates of palm and finger's location and orientation, and hand configurations. However using data gloves become a better approach than camera as the user has the flexibility of moving the hand around freely, unlike the camera where the user has to stay in position before the camera. Light, electric or magnetic fields or any other disturbance does not affect the performance of the glove. Nils Karlsson et al. [9] proposed a method where a glove generates commands based on position measurements. When the angles of the fingers change the output of the

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sensors will change. The combined sensor outputs form a pattern that corresponds to different finger flexion's. Different finger flexion's generates different Commands. The glove is simple and it generates sufficient signals for a fuzzy control system.

Kamalpreet Sharma et al. [1] reviewed various methods and techniques which are provided by different authors for recognition of hand gestures. Hand gesture recognition is carried out by the methods like pixel by pixel comparison, edge method, using orientation histogram & thinning method. Present technologies for recognizing gestures are divided into vision based,data glove based, and colored marker approaches. Jonathan Alon et al. [6] proposed a novel gesture spotting algorithm which is accurate and efficient, is purely vision-based. This system robustly recognizes gestures, even when the user gestures without any aiding devices in front of a complex background. Shoaib Ahmed .V et al. [2] proposed the Prototype version, in which system the user forms a sign and holds it for two seconds to ensure recognition. Thad Starner et al. [10] proposed two real-time hidden Markov model based systems for recognizing sentence-level continuous American Sign Language (ASL) using a single camera to track the user's unadorned hands.

Hwan Heo et al. [5] proposed a realistic game system using a multi-modal interface based on gaze tracking, gesture recognition, and the measurement of bio-signals, such as PPG, GSR, and SKT. To calculate the gaze position, designed the gaze tracking module which attached below the HMD. Gaze tracking used for the navigation interaction in a game. The gesture recognition performed by a commercial data glove, which used to perform the selection events in the game. Xu Zhang et al. [4] developed a framework for hand gesture recognition which can be utilized in both SLR and gesture based control. The presented framework combines information from a three-axis accelerometer and multichannel EMG sensors to achieve hand gesture recognition. Vasiliki E. Kosmidou et al. [7] proposed an SL recognition scheme based on the application of the IMEn on sEMG and 3-D-Acc data acquired from the dominant hand. In this system data from five-channel Surface Electromyogram (sEMG) and 3-D accelerometer from the signer's dominant hand is analysed using Intrinsic Mode Entropy (IMEn) for the automated recognition of Greek sign language (GSL) isolated signs.

## III.PROPOSED METHODOLOGY

### *A.BLOCK DIAGRAM OF PROPOSED SYSTEM:*

Fig 1 illustrates the proposed system; it shows the system components and the way each other are connected. The following are major components system is having: Hand Gloves,sign language, flex Sensor,ARM7TDMI-LPC2148, LCD display, and voice section.

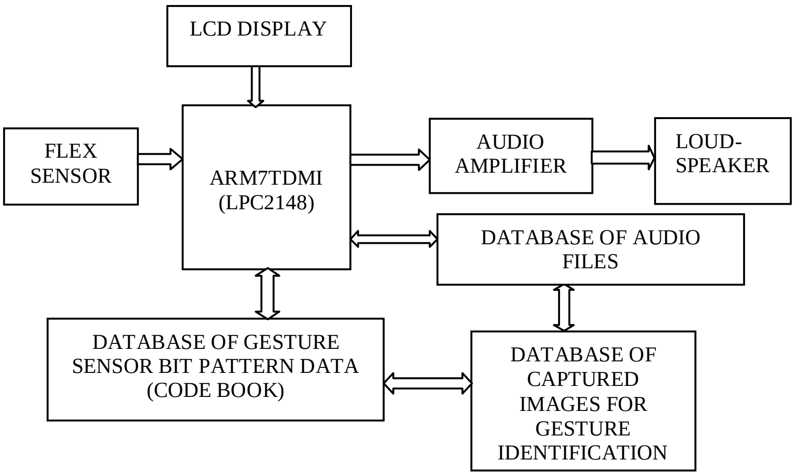


Fig1: Block Diagram of Proposed System

 

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***B. DESCRIPTION OF PROPOSED SYSTEM:***

In this electronic support system data glove is implemented to capture the hand gestures of a user. Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor [2]. The data glove is fitted with flex sensors along the length of each finger and the thumb. The flex sensors output is a stream of data that varies with degree of bend. The analog outputs from the sensors then fed to the ADC section (Analog to digital conversion) of the ARM7TDMI LPC-2148[14]. The ARM will be continuously scanning & receives the ADC value which will be further used for comparison and processing. For each character it checks ADC and tilted value with the closed contact and recognize the corresponding characters.In this section the gesture is recognized and the corresponding text information identified and displayed on LCD display. In the voice section text to speech conversion takes place and speech is play out through the speaker.This information is conveyed to the other users with the help of a text to voice convertor for audible information and LCD for visible information and same process will be repeated all the time.

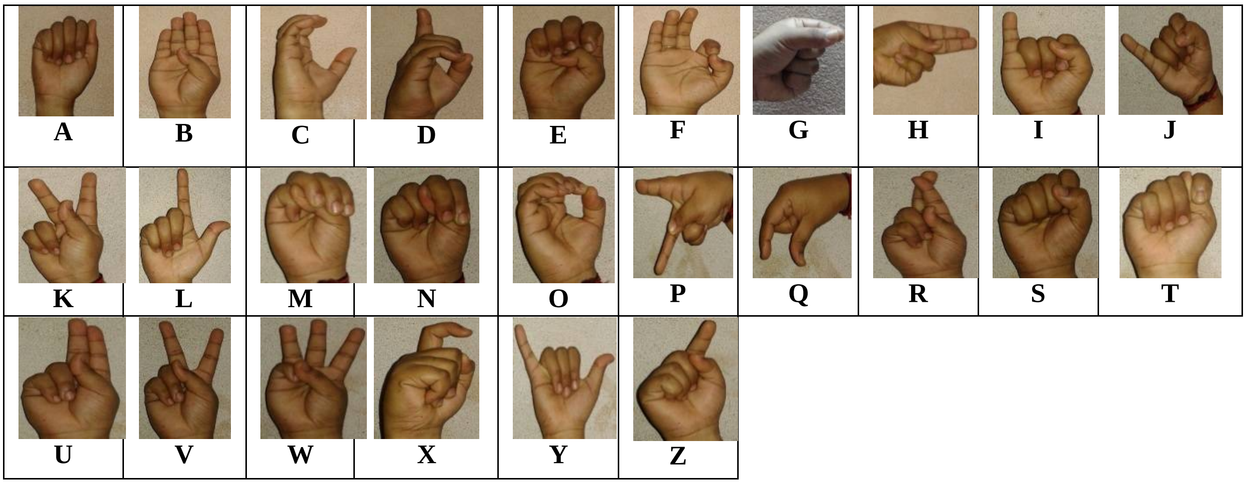
***C. SIGN LANGUAGE:***

Sign language is the language used by deaf and mute people for communication. In our system we are using American sign language which is commonly used. User performs various sign and sensor generated data is used forcorrelating these with specific signs and mapping them to a database. The system stores sensor data in memory. When it matches with the set of values associated with a sign system recognizes that sign and particular output it as text as well as speech.

***a. AMERICAN SIGN LANGUAGE (ASL)***

American Sign Language (ASL) is a one of the sign language which is used by deaf and dumb people for communication. Table 1 and 2 shows the gestures for English letters and number used in American Sign Language[13].

**Fig 2:**Gesture for American Sign Language (ASL) for A-Z letters [13]



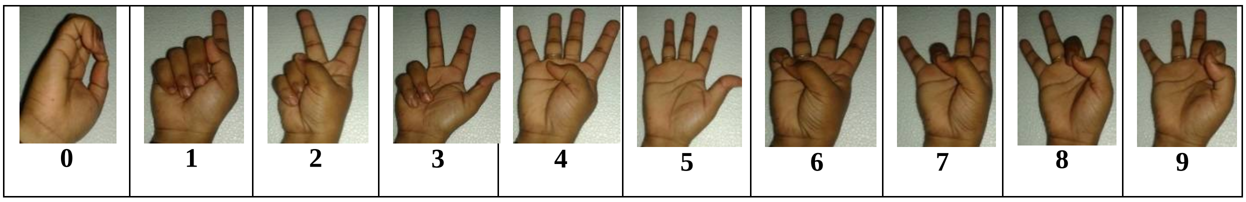




**Fig 3:**Gesture for American Sign Language (ASL) for 0-9 numbers[13]

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***D. FLEX SENSOR:***

Flex sensor is nothing but a variable resistor; it changes its resistance depending on bend. It is an important part of this project. Length of sensor that we are using is 2.2”. In this project total five flex sensors F1, F2, F3, F4 and F5 are used. Flex sensors are attached to gloves which can be easily handled by a deaf and dumb person. There will be change in resistance values and thereby, output voltage of flex sensors corresponding to different gestures that values are passed to the ADC (Analog to digital conversion) section of ARM7TDMI LPC2148.The Flex sensor patented technology is based on resistive carbon thick elements. As a variable printed resistor, the flex sensor achieves great form-factor on a thin flexible substrate. 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. Flex sensor are normally attached to the glove as shown in fig.7. They require a 5 Volt input and output between 0 and 5V, the resistivity varying with the sensor’s degree of bend and the voltage output changing accordingly [15].

Fig 4 shows flex sensor **“FSL0095103ST”**the sensors connect to the device via three pin connector(ground, live and output).

Features

- Angle Displacement Measurement
- Bends and Flexes physically with motion device
- Simple Construction
  - Temperature Range: -35°C to +80°C
  - Resistance Tolerance: ±30%
  - Possible uses
- Robotics
- Medical Devices

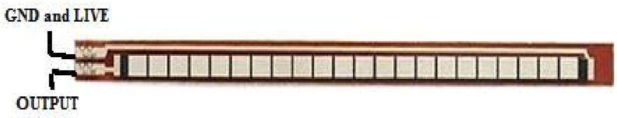


Fig.4: Flex sensor “FSL0095103ST”[15]

***a. FLEX SENSOR CHARACTERISTICS:***

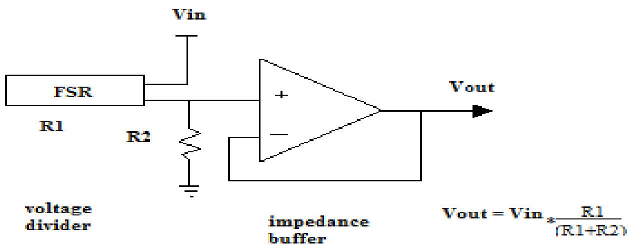


Fig.5: Basic Flex sensor circuit [15]

Flex sensor basically uses voltage divider circuit and the buffer as shown in fig.5Basic flex sensor circuit. Flex sensors output is inputted into non-inverting mode of LM358 op-amps to amplify their voltage. The increase in degree of bending gives lower the output voltage. Fig.5 shows the basic flex sensor circuit which uses voltage divider concept the output voltage is determined and it ranges from 1.35 V to 2.5V. The output voltage is determined based on the equation Vin* R1/ (R1+R2),where R1 is the other input resistor to the non-inverting terminal. Fig.6 shows the flex sensor offers variable resistance readings for different degree of bending of flex sensor[15].

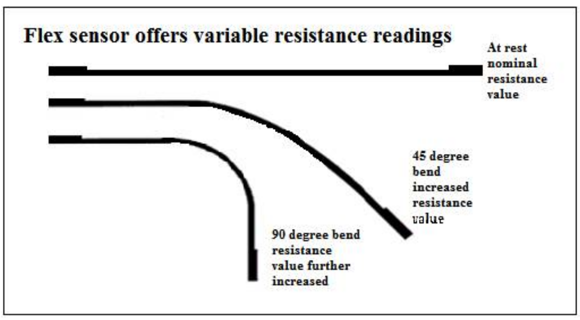


Fig.6: Flex sensor offers variable resistance reading [15]

Fig.7: Hand gloves using flex sensor [15]

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***E. MAGIC DATA HAND GLOVES:***

Fig.7 shows Hand gloves using flex sensor named as "FSL0095103ST", Where FS = Flex Sensor, L= Linear, 0095 = 95.25mm, 103 = 10 KΩ,ST = Solder Tab.

***F. ARM7TDMI:***

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T and ARM7EJ-S processor. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.In our system ARM7TDMI LPC2148 is used which is 32-bit microcontroller[14].

Features:

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package and 64-pin.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
- Two10-bit ADCs provide a total of 14 analog inputs with conversion times as low as 2.44 µs per channel.
- Single 10-bit DAC provides variable analog output.
- Low power consumption.
- Operating temperature range: 40$^{o}$c to +85$^{o}$c.
- CPU operating voltage range of 3.0 V to 3.6 V (3.3 V $\pm$ 10 %) with 5 V tolerant I/Opads.

The output of flex sensor given to ADC of LPC-2148 which produces digital output and compare these output with pre-stored values. After matching these values with values of an alphabet or number or word that particular one is displayed on LCD display.

***G. LCD DISPLAY:***

The LCD (Liquid crystal display) screen is an electronic display module and find a wide range of applications.As shown in fig.8a**16x2 LCD display** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

***H. VOICE SECTION:***

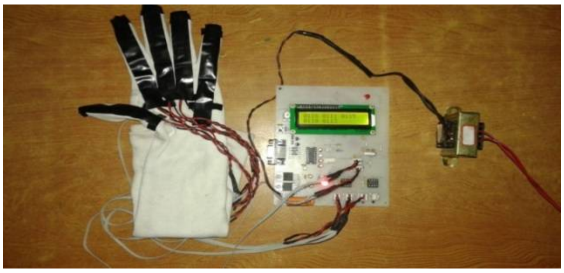

Fig.8: Snapshot of project hardware

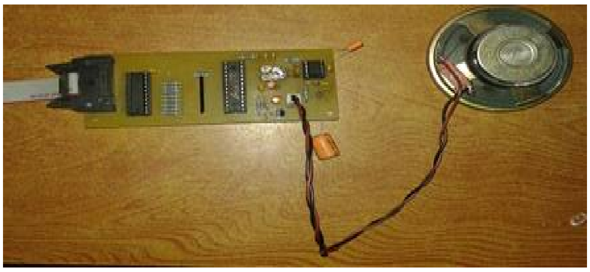

Fig.9: Voice section

In the voice section text to speech conversion is take place. Fig.9 shows voice section which consist of OTP IC AP 89085 and LM 386 is used as Low Voltage Audio Power Amplifier, and speaker.

***a.OTP IC AP 89085:***

The OTP IC AP89085 series high performance Voice OTP is fabricated with Standard CMOS process with embedded 8M/4M/2M bits EPROM. It can store up to 341/170/85 sec voice message with 4-Bit ADPCM compression at 6KHz sampling rate. 8-bit PCM is also available as user selectable option. Three trigger modes, simple Key trigger mode, Parallel CPU trigger mode and CPU serial command mode, facilitate different user interface. User selectable triggering and output signal options provide maximum flexibility to various applications. Built-in resistor controlled oscillator, 8-bit current mode D/A output and PWM direct speaker driving output minimize the number of external

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components. PC controlled programmer and developing software are available. The audio files related to alphabets, numbers and words arestored in OTP IC 89085.

***b. AUDIO AMPLIFIER: (LOW VOLTAGE AUDIO POWER AMPLIFIER):***

The LM386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescentpower drain is only 24 milliwatts when operating from a 6 volt supply, making the LM386 ideal for battery operation.In our system this amplifier is used with 50 gain and the recognized English letter/number is displayed on LCD and the related audio file is played out through this loudspeaker.

## IV.**EXPERIMENTAL RESULTS**

Flex sensors are fitted on hand gloves. As per the hand gesture movement it will bend the flex sensors of all fingers. The value of bending is in resistance. All fingers give different resistance value depending on bending. The output of flex sensor is given to the ADC of ARM7TDMI LPC-2148 which used to convert analog signal into digital signal. The required program written in embedded c language.Depending on code generated by hand movement text is displayed on LCD and also the text is converted into speech by using voice section.

**Table 1:**Hand gesture of sign language for alphabet A,B & C with Logic Levels as per values of Flex Sensor

| SR. NO. | ALPHABET | HAND GESTURE OF SIGN LANGAUGE FOR ALPHABET | LOGIC LEVELS AS PER VALUES OF FLEX SENSOR | | | | |
|---|---|---|---|---|---|---|---|
| | | | F1 | F2 | F3 | F4 | F5 |
| 1 | A |  | 0 | 2 | 2 | 2 | 2 |
| 2 | B |  | 2 | 0 | 0 | 0 | 0 |
| 3 | C |  | 0 | 1 | 1 | 1 | 1 |

As shown in Table 1 it gives information of gesture for English letters A to C with logic levels, similarly we can obtain for remaining English letters like D to Z and as shown in Table 2 it gives information of gesture for numbers 0 and 1 with logic levels, similarly we can obtain for remaining numbers like 2 to 9.

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**Table 2:**Hand gesture of sign language for Number 0 and 1 with Logic Levels as per values of Flex Sensor

| SR. NO. | NUMBER | HAND GESTURE OF SIGN LANGAUGE FOR NUMBER | LOGIC LEVELS AS PER VALUES OF FLEX SENSOR | | | | |
|---|---|---|---|---|---|---|---|
| | | | F1 | F2 | F3 | F4 | F5 |
| 1 | 0 |  | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 |  | 1 | 0 | 2 | 2 | 2 |

The snapshot of project hardware in Fig 8 shows flex sensors are placed on hand gloves and hand gloves are connected to the ADC section of ARM7TDMI. The recognized gesture values are displayed on LCD display. The audio section is used to convert the text to speech, and speech is play out through loudspeaker.

## V.**CONCLUSION**

In the proposed electronic support system we have recognized alphabets (a-z), numbers (0-9) and some words by using hand gloves with flex sensor. The proposed support system is useful for communication between deaf and dumb people with normal person.

## VI.**ACKNOWLEDGEMENTS**

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## REFERENCES

[1] Kamalpreet Sharma, Naresh Kumar Garg, "Hand Gestures Recognition For Deaf And Dumb", International Journal of Computer Application and Technology (s), May - 2014, pp. 10-13.

[2] Shoaib Ahmed .V, "MAGIC GLOVES (Hand Gesture Recognition and Voice Conversion System for Differentially Able Dumb People)", Tech Expo-The Global Summit, London 2012.

[3] DeepikaTewari, Sanjay Kumar Srivastava,"A Visual Recognition of Static Hand Gestures in Indian Sign Language based on Kohonen Self-Organizing Map Algorithm", International Journal of Engineering and Advanced Technology(IJEAT), Vol.2, Dec 2012, pp. 165-170.

[4] Xu Zhang, Xiang Chen, Associate Member, IEEE, Yun Li, Vuokko Lantz, Kongqiao Wang, and Jihai Yang, "A Framework for Hand Gesture Recognition Based on Accelerometer and EMG Sensors", IEEE Transactions On Systems, Man, And Cybernetics—Part A: Systems And Humans, Vol. 41, No. 6, November 2011.

[5] Hwan Heo, EuiChul Lee, Kang Ryoung Park, Chi Jung Kim, and MincheolWhang, "A Realistic Game System Using Multi-Modal User Interfaces", IEEE Transactions on Consumer Electronics, Vol. 56, No. 3, August 2010.

[6] Jonathan Alon, VassilisAthitsos, Quan Yuan, Student Member, IEEE, and Stan Sclaroff, Senior Member, IEEE, "A Unified Framework for-Gesture Recognition and Spatiotemporal Gesture Segmentation" IEEE Transactions On Pattern Analysis And Machine Intelligence, Vol. 31, No. 9, September 2009

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ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

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[7] Vasiliki E. Kosmidou, Student Member, IEEE, and Leontios J. Hadjileontiadis, Member,IEEE,"Sign Language Recognition Using Intrinsic-Mode Sample Entropy on sEMG and Accelerometer Data", IEEE Transactions On Biomedical Engineering, Vol. 56, No. 12, December 2009.
[8] Laura Dipietro, Angelo M. Sabatini, Senior Member, IEEE, and Paolo Dario, Fellow, IEEE,"A Survey of Glove-Based Systems and Their Applications", IEEE Transactions On Systems, Man, And Cybernetics—Part C: Applications And Reviews, Vol. 38, No. 4, July 2008
[9] Nils Karlsson, Bj¨ornKarlsson, and Peter Wide, Member, IEEE,"A Glove Equipped with Finger Flexion Sensors as a Command Generator used in a Fuzzy Control System", IEEE Transactions On Instrumentation And Measurement, Vol. 47, No. 5, October 1998.
[10] T. Starner, J. Weaver, and A. Pentland, "Real-Time American Sign Language Recognition Using Desk and Wearable Computer Based Video," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 20, no. 12, pp. 1371-1375, Dec. 1998.
[11] E. Foxl and L. Naimark, "Vis-Tracker: A Wearable Vision-Inertial Self Tracker," IEEE Virtual Reality Conference, 22-26 March 2003, Los Angeles.
12] VajjarapuLavanya, Akulapravin, M.S., Madhan Mohan, "Hand Gesture Recognition And Voice Conversion System Using Sign Language Transcription System" , IJECT Vol. 5, Issue 4, Oct – Dec 2014
[13] S.B.Shrote,Mandar,Deshpande,Prashant,Deshmukh,SanjaykumarMathapati,"Assistive translator for deaf and dumb people",International journal of Electronic communication and computer Engineering,Vol.5, Issue 4,technovision-2014.
[14] ARM7TDMI LPC-2148 Datasheet
[15] Flex sensor Datasheet

## BIOGRAPHY

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