

# Sign Language Understandable Glove For Vocally Impaired

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**Abstract** -Sign language is a gesture language used by dumb and deaf people for conveying the information. This information can be expressed as a sequence of gesture patterns to convey messages of daily needs. The main objective of this paper is to design a hand glove which will understand the hand movement so as to convert those movements into their corresponding text and audio. This paper consist of an ARM Processor which has inbuilt analog to digital converters which helps in obtaining the analog values from the contact sensors fitted on the glove. Author's goal here is to recognize a sign language from wearable sensor glove and display it in a suitable text and audio format. This paper addresses the suitability of a low cost glove as a tool for reading the finger movement for translating the sign language in text and audio format so as to lower the barrier and ease the communication with the vocally impaired community.

**Key Words:** Vocally impaired, Sign language, ARM Processor, Contact sensor

## 1. INTRODUCTION

This paper deals with the design of a glove which will be able to understand the hand movements so as to make an alphabet, word or a sentence visible on the LCD display used for vocally impaired people so that their communication with the normal world can be eased. For this purpose the contact sensors are fixed at the tip of various fingers and a few at the palm region on the glove. We are using FRDMKL25Z which has ARM Cortex M0+ processor. The contact sensor used is basically a small sized copper plate which when comes in contact with other copper plate, it will detect a contact with the other copper plate acting as another sensor placed on the glove. Current passing will cause voltage drop across the resistor which will be given to the ADC's of the freedom board. The ARM processor of the board will process and give the desired output in text and audio format based on the programming.

To display text we are using LCD and for audio there is a speaker which will be linked with the memory module so

as to play the corresponding audio of the text displayed on the LCD. The memory card connected to the memory module will be stored with the various alphabets and words in the audio format. The main objective behind using FRDMKL25Z is to make the project cost effective and make the use of its flash memory at the fullest.

## 1.1 Existing Work

The existing work uses three sensors viz. flex sensor, contact sensor and accelerometer for recognizing sign language. Use of these three sensors make the hardware complex adding more cost to the project [1]. Flex sensor is made of velostat piezoresistive material which is costly. It measures the resistance produced due to bending of the sensor and then this information is given to the processor to process and generate desired voltage. Location of flex sensor on glove is difficult. Also data acquisition module is needed to capture the information from the flex sensor [2]. This sensor requires at least 9 analog channels. Data acquired from flex sensor is in analog form which needs to be converted in digital form. Aligning flex sensor along the finger is a complex task and then contact sensor adds more complexity to the designing work. All these process related to flex sensor makes the design process and processor mechanism complex.

## 1.2 Proposed Work

We have proposed a new design approach and algorithm for Sign Language recognition. The proposed system consist of only two sign detecting elements viz. contact sensor and 3-axis accelerometer. The complete project deals with the basic voltage divider concept. When a contact is made between two fingers connected with two different contact sensors. The design is such that only two voltages are given to the contact sensors. Various combination of the contacts are used to represent the different alphabets. The combinations of the contacts are programmed so as to get the desired alphabets. These sentences are displayed on the LCD display which are a combination of various words and alphabets. We have added a combination in order to represent a space, a backspace for any error occurs and a full stop in order to indicate the end of the sentence. A few

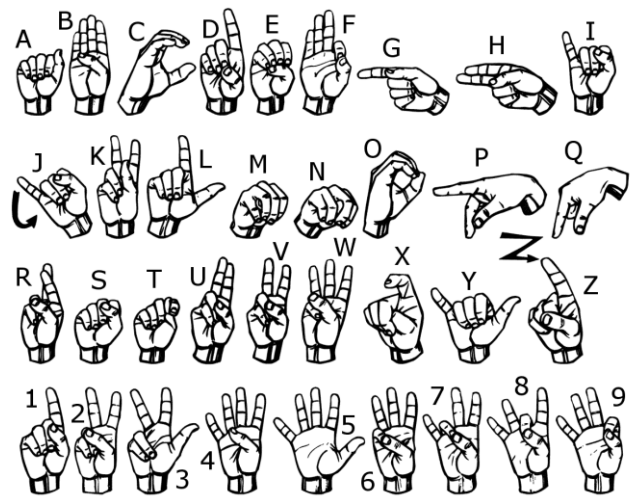
of the alphabets have a similar orientation. In order to differentiate those alphabets from the other we have made use of an Accelerometer. Use of contact sensors and accelerometer makes the design part easy. Once the full stop gesture is recognized, the data on the LCD screen is compared with the audio files stored on the memory module fitted with the memory card containing numerous audio files of various alphabets and words. As sentence is a combination of various words, the audio output will come from the speaker as the combination of various audio files corresponding to the combination of words on the LCD display screen. Thus, Designed glove is flexible and requires less power to operate. By the proposed method we will be able to make sentences and also the numbers from 0 to 9. As compared to the existing method, load on the processor is reduced in the proposed system. Author's proposed system is described in detail in Section 2.

## 2. SYSTEM DESCRIPTION

The system includes one hand glove which will be fitted on the hand of a vocally impaired person. The glove is fitted with contact sensors. Contact sensor is nothing but a copper foil. Copper foil is cut in small pieces and then it is stitched on the tip of few fingers based on design and also on the palm region. Now when a person wearing this glove will perform any sign then few of the sensors on the glove will come in contact with some or the other sensor based on the design considered. When this happens then current will flow through the circuit and there will be a voltage drop across the resistors. This voltage value is given to the freedom board's processor to process the data. Now the processed data will be generated by the processor. The processed value generated will then be checked by the program. The program will compare the processed value with the values written in the program. If the value satisfies any of the condition then the corresponding value to the satisfied condition will be the desired output.

### FRDM KL25Z

The FRDMKL25Z has been designed by the Freescale in collaboration with the mbed for prototyping all sorts of devices, especially those requiring the size and price point offered by CortexM0+ processor and the power of USB host and device. It is packaged as a development board with connectors to break out to strip board and breadboard including a built-in USB FLASH programmer.



**Fig -1:** American sign language displaying the pattern of hand for all 26 alphabets and 0-9 numbers [3]

It has MMA8451Q 3-axis accelerometer, PWM controlled RGB LED, Capacitive touch sensor. Features include easy access to MCU I/O, battery ready, low power operation, a standard based form factor with expansion board options and a built-in debug interface for flash programming and run control. The FRDMKL25Z is supported by a range of NXP and third party development software. You can now use [developer.mbed.org](http://developer.mbed.org) at no charge, with full access to the online SDK, tools, reusable code which means no downloads, installations or licenses and an active community of developers. Easy access to MCU I/O Sophisticated Open SDA debug interface Mass storage device flash programming interface (default) – no tool installation required to evaluate demo apps P&E Multilink interface provides run control debugging and compatibility with IDE tool. Open source data logging application provides an example for customer, partner and enthusiast development on the Open SDA are some of its features.

### 3-AXIS ACCELEROMETER

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full scale range of  $\pm 3g$ . In this paper it helps to differentiate between the similar signs indicating different alphabets of American sign language.

### LCD

LCD (Liquid Crystal Display) screen is an electronic display with two registers namely, Command and Data. The command register stores the command instructions given to the LCD. 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. This device is preferred over seven segments and other multi segment LEDs reason being more economical and have no limitation of displaying special & even custom characters. In the LCD each character is displayed in 5x7 pixel matrix. 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.

#### MEMORY ADAPTER MODULE

Memory Adapter Module when connected with memory card is used to access the audio files stored in the memory card to be accessed by the freedom board. Working voltage is 4.5 to 5.5V and current is 0.2 to 20mA. Interface electrical level is 3.3V/5V. There is onboard 3.3V voltage regulator circuit. It supports micro SD up to 2 GB. Pins available are GND, MISO, MOSI, SCK. These pins can be used for memory interfacing with the FRDM-KL25z board.

Further the functionality of the proposed system is discussed in Section 3 below.

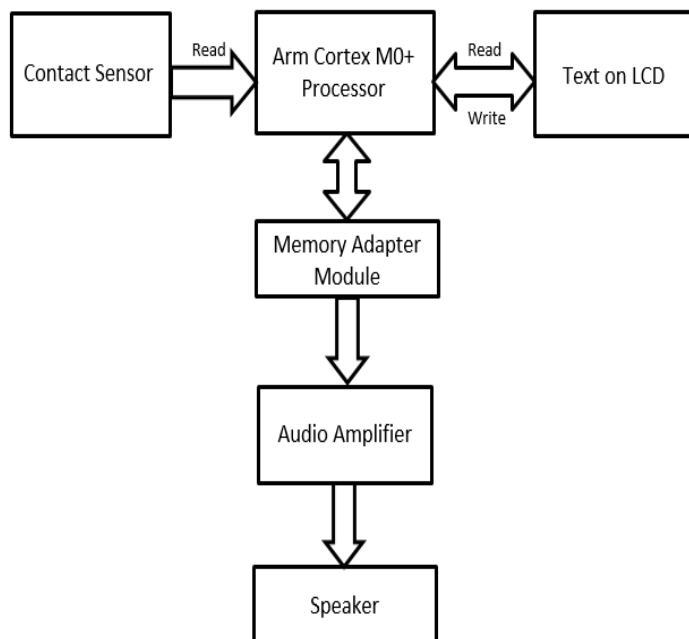


Fig-2: Proposed Block Diagram of the proposed system

### 3. SYSTEM FUNCTIONALITY

At start the contact sensor will sense the contact between the contact sensors and due to contact current will be generated which will cause voltage drop across the resistors. The voltage drop will be the input to the ARM Cortex M0+ processor. The processor will process the input

and the output generated will be given to the LCD. Now the displayed text is to be made available to the speaker with the help of memory adapter module. Memory adapter module has audio files which will be selected when the text is displayed on the LCD for it to be made available to the speaker.

The programming of the ARM processor is done by the mbed C programming. Initially we have to install the libraries for the mbed board, memory module, LCD, and accelerometer which we are using. The programming is based on the online compiler available at developer.mbed.org where we have to select the FRDMKL25z board. On compiling the code, a binary file is downloaded from the web browser. This binary file is then uploaded on the board in connection with the computer. The freedom board has a flash memory size of 128Kb and the size of binary file for the program for this project comes out to be of 24.2Kb. This compiling can also be done on a computer based application called as CodeWarrior.

#### ALGORITHM

- Initialize the Analog Input Pins Grounds and variables on the Freedom board
- Read analog value.
- Expand range of analog voltage value by multiplying with a constant.
- Add the conditions for various alphabets to be displayed on 1<sup>st</sup> line of LCD screen.
- Add the same conditions for various alphabets to be displayed on 2<sup>nd</sup> line of LCD screen.
- Read and process the sentence displayed on the LCD screen.
- Compare the words of the sentences with the audio file names stored on the memory card.
- If the words of the text displayed matches with the filename, audio output is generated.
- Clear the LCD screen and variables which initialised earlier.

FLOWCHART

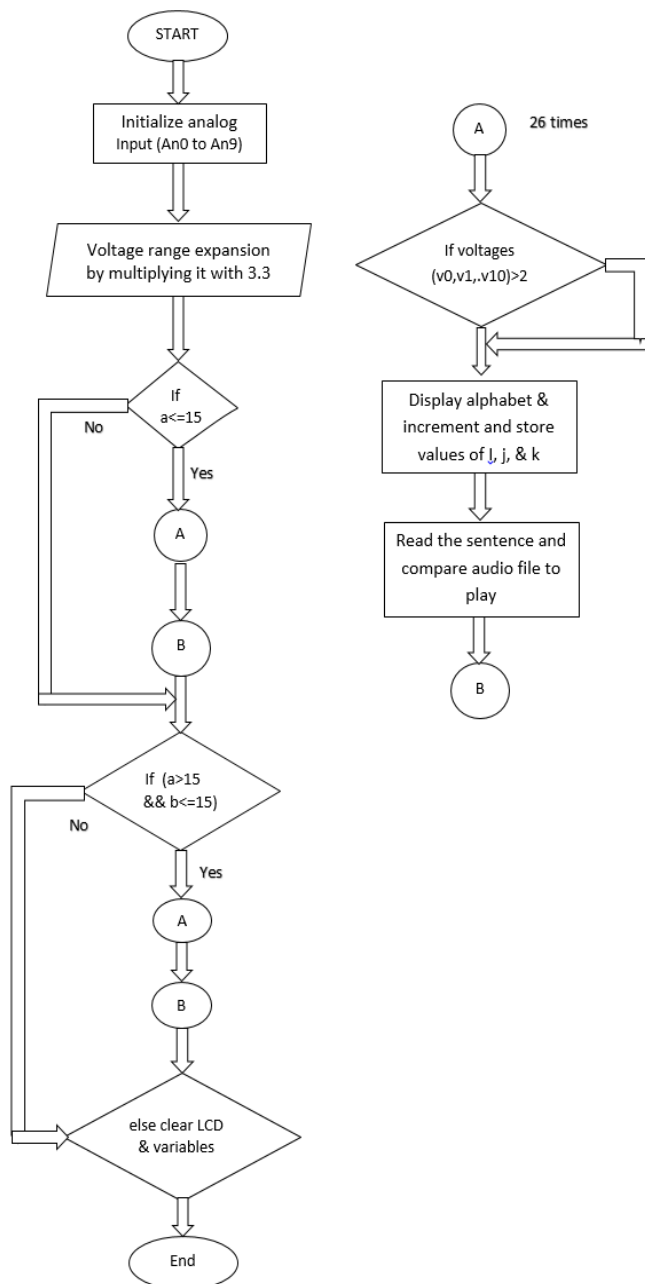


Fig-3: Flow Chart of the proposed system

4. APPLICATIONS

The designed product can be used by physically challenged person. It can be used for conveying information for specific operation by just performing gestures of hand. The product generated as a result can be used at public places like

airports, railway stations and counters of banks, hotels etc. where there is communication between different kinds of people which may include vocally impaired people. In addition to this, a mute person would be able to deliver a lecture using it. Assuming the fact that we would be able to convert whole of American Sign Language gestures into spoken English alphabets. We can manufacture a handy and portable hardware device having this translating system built in as a chip which would further find many applications. This device may be useful for newscasters.

5. CONCLUSION

Sign language is a useful tool to ease the communication between the mute community and normal people. Yet there is a communication barrier between these communities. Thus, this paper aims to lower the communication gap with a help of a prototype to check the feasibility of recognizing sign language symbols using sensor gloves. Along with text format of the output this paper avails conversion of text to audio speech. With further advancement in the project we could use the sign language glove for different signs making it more flexible. Making the glove wearable to any size can also be an important factor to improve. The obtained system can be designed into a small chip which can be incorporated in a portable hardware device [4].

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