Acknowledgement

This is the most satisfying yet the most difficult part of the project to write gratifying because printed words serve as attestation, difficult because they fail to convey the real influence others have had on ones life or work.

We thank Lord Almighty for having blessed us to do the project well. This project could not have been proper if not for the help and encouragement from various people.

First and foremost, we would like to express our heartfelt thanks to our principal Prof.K.Vidyasagar, whose is the leading light of our institution. We would like to thank Associate Prof. Anwar Hussain, Head of the Department, Electronics And Communication Engineering. We would also like to thank our guide Asst.Prof. Asha Prasad. It was for her support that we got proper guidance for completing the project.Also we express our gratitude to all faculty members and supporting staff of the department for the help and support given to us.

Also, we take this opportunity to thank our friends for their ideas,suggestions and co-operation and our beloved parents for their support and encouragement

Abstract

This project aims at helping the people who are verbally handicapped to communicate with the real world. The people with these disabilities are slow in communicating with others. The system is going to design in the form of a glove. So it is easily wearable and portable too. Using this system people with verbal disabilities can communicate with any other disabled people and to the real world. These blind people use the sign language for communication. They make gestures according to their sign language using their hands into which the glove is attached. These gestures are transformed into audio signals which can be understood by the others. And also it is displayed on a screen as text . This is how the communication of verbally handicapped people is going to happen .Here the sign language symbols obtained from the speakers hand is directed to a microcontroller and after processing , to a speaker through a text to speech conversion module and also to an LCD display . If the listener is an ordinary person he could interpret the message. This system bridges the gap between verbally handicapped people and the real world .

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Chapter 1

Introduction

Communicating with individuals who are deaf and dump is a unique experience. The language, mode, style, speed, and aids and devices used to facilitate communication are different from person to person. If you are interpreting for an individual who is deaf and/or dump you will need to know what adaptations you should be aware of. Usually the deaf and/or dumb people are very slow in communication and many times the others feel it very difficult to understand what they are actually trying to say. So this project is about giving the dumb and/or deaf people a communication aid and hence the ability to convey their messages to the real world.

"Speech" and "gestures" are the expressions, which are mostly used in communication between human beings. Learning of their use begins with the first years of life. Research is in progress that aims to integrate gesture as an expression in Human- Computer Interaction (HCI). In human communication, the use of speech and gestures is completely coordinated. Machine gesture and sign language recognition is about recognition of gestures and sign language using computers. A number of hardware techniques are used for gathering information about body positioning; typically either image-based (using cameras, moving lights etc) or device-based (using instrumented gloves, position trackers, etc.).

This project aims at converting the sign language used by verbally handicapped i.e , deaf and/or dumb people to voice or text which can be understood by a normal person using one of the above techniques for obtaining data from the handicapped person .

However, getting the data is only the first step. The second step, that of recognizing the sign or gesture once it has been captured is much more challenging, especially in a continuous stream. In fact currently, this is the focus of the research. This project aims at helping the peoples verbal disability to communicate with the real world. The people with these disabilities are usually ignored in the society. In this electronic era; we can overcome these disabilities by this system .

Chapter 2

System Overview

2.1 Motivation

In the modern era, everyone is competing for success . But the verbally handicapped people are experiencing difficulty in competing with the normal people only because of their difficulty in communication. So, we decided to take up this topic in order break the walls between them and the normal people . The system we are trying to device is also handy and easy to use system. So, even common people can use the system just by the usage of a wearable speaker system . Also the system doesn't require much room and so can be carried easily. Also, this system can be used in interviews where the candidate is verbally handicapped and at talk events where the person can express their ideas easily to the audience . We are trying to break the barriers between the verbally handicapped and the common people, thereby giving them an equal chance in competing in this world .

2.2 Need Analysis

1. What is the main aim of this project ?
Ans: The project mainly aims at bridging the gap between verbally handicapped people and the normal people.

2. Normally , how does verbally handicapped people communicate ?

Ans: : Normally , they communicate using sign language which uses the fingers and palm.

3. Is there a chance of a problem when people from different parts of the world use this device?

Ans: In that case too , the chance of a problem is very little , because , the sign language is universally accepted all over the world and has the same symbols everywhere . So , when a person from a different part of the world uses this system , he will not find any difficulty .

4. Does there exist any older technologies serving the same purpose?

Ans: By the research conducted by us , we came to a conclusion that no effective means serving the same purpose was introduced before.

5. How was the idea of converting sign language to normal form conceived?

Ans: We obtained this idea from a paper presentation at a tech function , which was in reference to another paper formulated at Cornell University.

6. Does similar systems exist?

Ans: It was a big concern to us and after searching we couldn't find any valid information regarding similar experiments conducted.

7. Is sign language the only medium of communication between verbally handicapped people?

Ans: People who are dumb and/or deaf as well as blind cannot use sign language . They use LORM language . But that language is very difficult to interpret digitally.

8. In the system , how the signs shown by the user are detected ?

Ans: Using a glove which the user wears

9. How does the Glove detects the signs?

Ans: The Glove contains Flex Sensors , Accelerometers and Contact Sensors. These sensors produce output accordingly as signs are shown and feed to the microcontroller .

10. Is this the only method available to detect the signs ?

Ans: No . Other than using a glove , by using a camera , we can detect the signs using image processing technique.

11. How image processing can be used to detect the signs ?

Ans: In Image processing , there is a technique called edge detection . By using that technique we can detect the variations at the edges of the palm and compare it with a stored symbol.

12. Why was the above technique not selected ?

Ans: : For image processing , a camera is essential . Considering day to day activities , carrying a camera always . with such a provision that it can have a view to the users palms and fingers , is less practical.

13. Is the programming part of Image processing easier?

Ans: The programming part doesn't offer much easiness and as well as that, it must have more precision than the programming for the Glove method.

14. In which all scenarios ,this project will become helpful?

Ans: This project is aimed at reducing the difficulty in day to day conversations of verbally handicapped people . Also this can be helpful at interviews, talk events etc.

15. To which all forms is the sign language translated ?

Ans: : To voice and text .

16. How voice according to the signs is interfaced ?

Ans: Through an EMIC 2 Module and Speakers .

17. How text according to the signs is displayed?

Ans: Using an LCD Display .

18. How the data from the microcontroller is given to the EMIC 2 Module?

Ans: The data is given to the module via serial communciation done using Nokia Serial-Usb cable .

19. How does the system becomes more handy?

Ans: Here the voice output device is an EMIC 2 Module and Speakers . These small speakers with a size less than 3 inch diameter are easy to carry around . So the system becomes more handy .

20. Why an extra LCD Display is used?

Ans: At scenarios like interviews , it will be more helpful if we can show the text rather than the voice according to the signs . For this , LCD Displays are used . They can be used in every day conversations also.

21. Is the system easily portable ?

Ans: The system will have a very less weight and also , the Gloves and the small wearable speaker system be easily taken around . So , the system becomes more portable .

22. Is a single glove sufficient for conversations ?

Ans: For showing the alphabets and digits , only a single glove is needed . But for showing words , both palms are needed . Hence 2 gloves are needed .

23. How many gloves are being used in the system ?

Ans: Here , in addition to the alphabets and digits , we are also trying to translate some basic words like hello , thank you etc . But if these words can be shown using a single palm , we will use a single glove . Or else , 2 gloves .

24. What are the difficulties in using 2 gloves ?
Ans: The data from both the gloves are to be processed simultaneously . This increases the processing complexity . Also , there can be clashes due to similar symbols from both the gloves .

25. Which microcontroller is used ?
Ans: The microcontroller we are using is ATMEGA168 .

26. Is a single microcontroller sufficient for both the gloves ?
Ans: ATMEGA168 has enough processing capabilities for handling both the gloves .

27. By this project , what is your contribution to humanity ?
Ans: By this project , we are trying introduce this technology of sign language translation for helping verbally handicapped . By extending the technology further , it can be made more and more user friendly and accurate.

28. What is the expected total weight of the system ?
Ans: 350gms .

29. Is there any harmful effects on the user when he/she uses the system ?
Ans: In our system , the chances of harmful effects by radiation is very less because we don't have to use much radiation producing elements . Also , harm caused by current leakage etc.can be neglected .

30. What is the power supply voltage required for the system ?

Ans: Here we are providing a 9V power supply for the system .

31. What is the operating voltage of the system ?

Ans: Like most of the digital system , this too operates at an operating voltage of 5V . Also some components work in voltage ranges which lie in between 0-5V .

32. How a voltage of 5V is supplied to the system from the power supply ?

Ans: Here , we use a voltage regulator LM7805 . It provides constant 5V output from the power supply side . It makes the power supply side more reilable .

33. What is a flex sensor ?

Ans: The flex sensors are basically variable resistors.

34. What movement in the sign language do they sense ?

Ans: They sense the bending of fingers .

35. How do they sense it ?

Ans: As the flex sensors are bent the resistance will vary in an appropriately linear fashion. The variation in resistance can be used to create a signal which can be fed to the microcontroller .

36. What is the importance of flex sensors ?

Ans:Flex sensors are the most critical sensors because almost all the letters of the sign language can be distinguished based on fingers flexes.

37. How many flex sensors are needed for the fingers of a palm ?

Ans: All the fingers except the thumb has two flexsensors, one over the knuckle and one over the lower joint. This provides two degrees offlexes for the fingers. For the thumb there is only one flex sensor over the lower joint.

38. What is the mechanical structure of a flex sensor ?
Ans: They are usually in the form of thin strip from 1inch to 5 inch which varies in resistance. They can be made unidirectional or bidirectional.

39.How does the flex sensor work ?
Ans:Flex sensors are analog resistors. They work the same way as variable analog voltage dividers.

40. How are they similar to voltage dividers ?
Ans: Inside the flex sensors are carbon resistive elements within a thin flexible substrate. More carbon means less resistance. When the substrate is bending the sensor produces a resistance output relative to the bend radius. The smaller the radius, the higher will be the resistance value.

41. What are the other applications in which flex sensor is used ?
Ans: They are usually applied in robotics, bumper gloves, biometrics, gaming gloves etc..

42. What is an accelerometer ?
Ans: An accelerometer is a device that measures proper acceleration .The proper acceleration measured by an accelerometer is not necessarily the coordinate acceleration (rate of change of velocity). Instead, the accelerometer sees the acceleration associated with the phenomenon of weight experienced by any test mass at rest in the frame of reference of the accelerometer device.

43. What is the application of accelerometers in this project ?
Ans: In sign language , many signs involve the spatial movement of the palm and also different spatial orientations of the palm. So , the accelerometer is

used to detect this .

44. How many accelerometers are needed for a single palm ?
Ans: An x-y axis accelerometer and z axis accelerometer .

45. Which accelerometers are used in this system ?
Ans: Analog devices ADXL203 as x-y accelerometer and MMA1260 as z accelerometer .

46. How does the accelerometer aid to the portable nature of the system ?
Ans: Accelerometers have a small size and can be easily fitted to the glove. Also , they require low amount of input power .

47. What are the operating conditions of an accelerometer ?
Ans: Operating voltage - 2.2V - 3.6V .
Operating Current - 400 A for normal mode . 3 A for sleep mode .

48. What are the other applications of accelerometer?
Ans: Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright.

49. Where are the contact sensors placed ?
Ans: Contact sensors are wrapped around the fingers .

50. What is the reason behind the usage of contact sensors ?
Ans: Many symbols in sign language use the contact between the fingers . This can also be used to differentiate between similar symbols . So in order

to detect the contact between the fingers , contact sensors are used .

51.Why ATMEGA168 is used ?

Ans: It has advanced RISC architecture with 131 powerful instruction set. Also , it has an in-built ADC which allows the processing of analog and digital signals .

52. How the Microcontroller is programmed ?

Ans: The main programming software used for microcontroller programming is ARDUINO ID using USB ASP programmer .

53. Are there any other software used for connecting the microcontroller with other devices ?

Ans: Yes. Connecting software such as MATLAB etc. are used .

54. What is the reason for using Serial Communication ?

Ans: Serial communication using a Nokia Serial-USB cable is used to connect with the EMIC 2 module as the data in/out is through serial communcation .

55. Why EMIC 2 is used in the system ?

Ans: Here the output is voice of the text shown using signs It can be easily translated using an EMIC 2 module. It is compatible with English and Spanish. Also, we can change the voice to male/female/child voices. Also, the interface is simple.

56. Which serial communication system is used in the cable ?

Ans: Serial communication using Nokia Serial-Usb cable is used in the system for connection with the module.

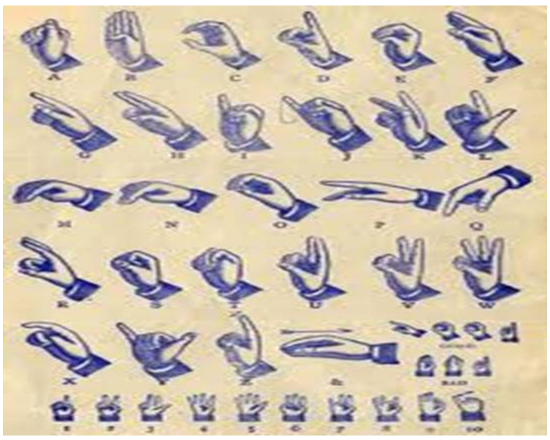
57. What are the drawbacks that you find in this system ?

Ans: Our system being the first of its kind , will have some problems . If the signs are changed very fast , it may be difficult to process and may show false reading . Also, there is a chance that if the fingers are not bend properly according to the stored sign , it may not detect the symbol . Also, there can be some delay between the time of showing the symbols and the time instant when we get the output .

58. What can be done for minimising the errors ?
Ans: By using software like MATLAB , which has provisions for minimising detection errors , system can be implemented using lesser errors . But MATLAB being difficult to implement in such handy portable systems . Here MATLAB is used as a connecting software just to check the symbols produced .

59. How the project can be extended in future ?
Ans: By using better detection techniques , faster processing devices and by incorporating more words and by connecting them to form sentences , a better system can be formulated by extension of this system .

60. What are the basic symbols for sign language ?
Ans:



2.3 Wish Specifications

- Supply Voltage : 9V .
- Operating Voltage : 5V
- Operating Temperature : -10C to +60C .
- Total Weight Of Glove : 150gms .
- Total Weight of Processing and output section : 350gms .
- The system should give output according to 26 English alphabets , 10 digits.
- Output using EMIC 2 Module in male voice connected to speakers using 3.5 MM jack.
- Maximum idle time : 2 seconds

2.4 Specifications

- Supply Voltage : 9V .
- Operating Voltage : 5V
- Operating Temperature : -10C to +60C .
- Total Weight Of Glove :200gms .
- Total Weight of Processing and output section : 350gms .
- The system should give output according to 26 English alphabets.
- Output using EMIC 2 Module in "PerfectPaul" voice connected to speakers through connecting points and availabilty of a 3.5MM jack to connect with a headset or larger speakers
- Output volume of 10Db.
- Maximum idle time : 1 second

2.5 Time Plan

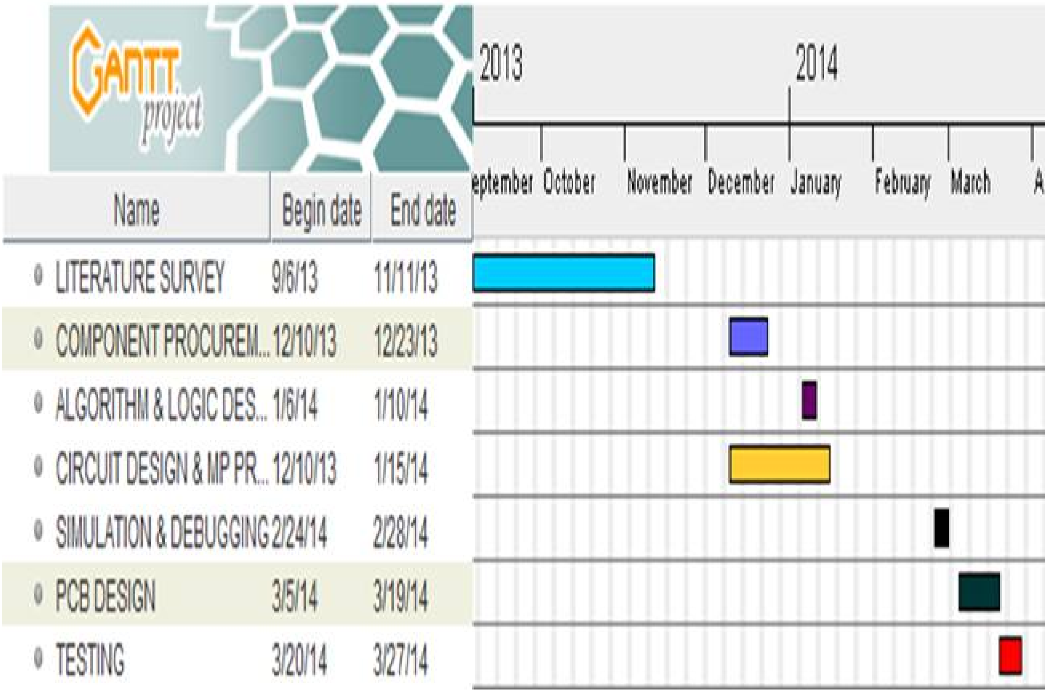


Figure 2.1: Time Plan

2.6 Block Diagram Description

2.6.1 Representation

The block diagram of the system shown below shows the data collection part, i.e, the GLOVE part , the processing part and the output part .

The block diagram can be divided into three sections :-

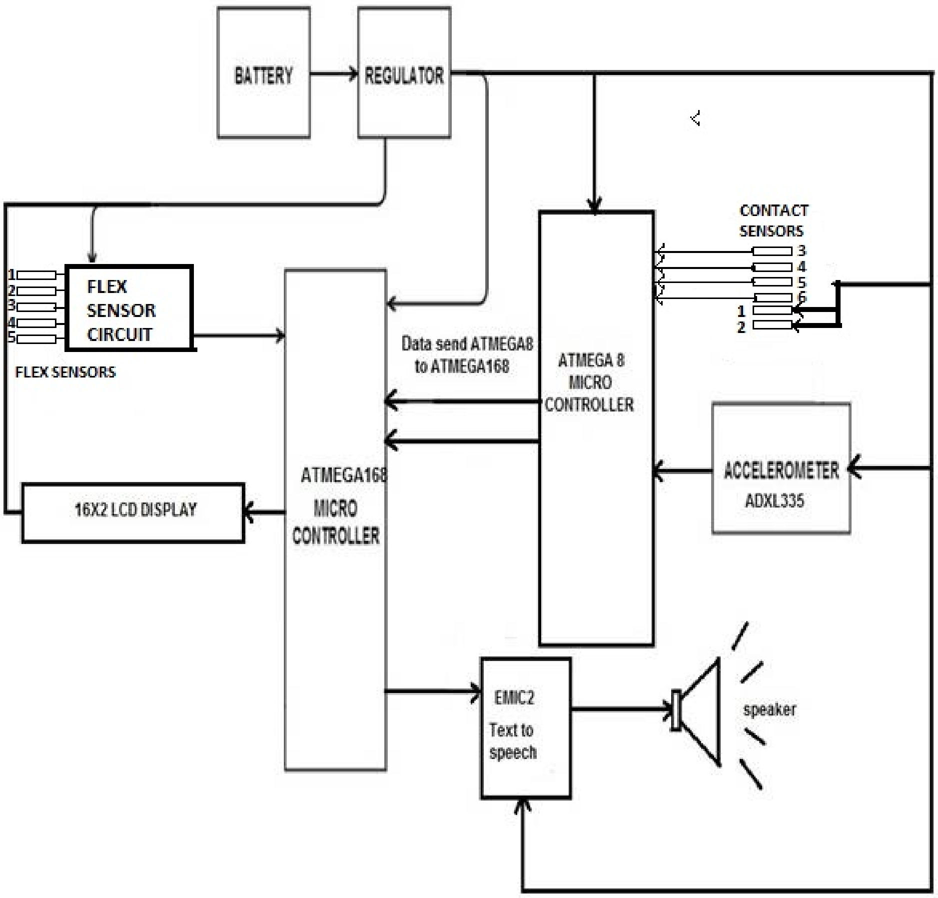


Figure 2.2: Block Diagram

DETECTOR PART:-

The detector part contains the flex sensors, accelerometers and contact sensors mounted on the glove . The Glove or these sensors in the glove detects the signs shown by the user by the bending of his fingers, spatial movement of the palm, contacts of the fingers etc.

PROCESSING PART :-

The processor part contains the microcontrollers which processes the outputs from the different sensors and feeds to the output section. Here we are using ATMEGA168 and ATMEGA8 as the microcontrollers.

OUTPUT PART :-

The output part contains the EMIC 2 module through which we have decided to interface the output side of the system. The module is an efficient text to speech converter and easy to interface. It has a 3.5mm audio jack to which Speakers of lesser size are connected.

2.6.2 Description

FLEX SENSOR

Figure 2.3: Flex Sensor

The flex sensors are basically variable resistors. As the flex sensors are bent the resistance will vary in an appropriately linear fashion. In this project flex sensors are the most critical sensors because almost all the letters of the sign language can be distinguished based on fingers flexes. All the fingers except the thumb has two flex sensors, one over the knuckle and one over the lower joint. This provides two degrees of flexes for the fingers. For the thumb there is only one flex sensor over the lower joint.

Flex sensors change its resistance depending on the amount of the bend on the sensor. They convert the change in bend to electrical resistance, the more the bend the more its resistance value. They are usually in the form of thin strip from 1inch to 5 inch which varies in resistance. They can be made unidirectional or bidirectional.

Flex sensors are analog resistors. They work the same way as variable analog voltage dividers. Inside the flex sensors are carbon resistive elements within a thin flexible 7 substrate. More carbon means less resistance. When the substrate is bending the sensor produces a resistance output relative to the bend radius. The smaller the radius, the higher will be the resistance value. They are usually applied in robotics, bumper gloves, biometrics, gaming gloves etc.

ACCELEROMETER

Figure 2.4: Accelerometer

An accelerometer is a device that measures proper acceleration. Here we use it to detect the spatial movement of the palm as several signs require palms to be oriented in a particular way.

The proper acceleration measured by an accelerometer is not necessarily the coordinate acceleration (rate of change of velocity). Instead, the accelerometer sees the acceleration associated with the phenomenon of weight experienced by any test mass at rest in the frame of reference of the accelerometer device. For example, an accelerometer at rest on the surface of the earth will measure an acceleration g= 9.81 m/s2 straight upwards, due to its weight. By contrast, accelerometers in free fall or at rest in outer space will measure zero. Another term for the type of acceleration that accelerometers can measure is g-force acceleration.

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright.

CONTACT SENSORS

When we consider the sign language , there is only small differences for the signs corresponding to various digits and alphabets which include the contact between the fingers . By sensing the contact between the fingers , the controller can analyse the sign shown . For this purpose , the contact sensor is used . Contact sensors are generally copper tapes wound around the fingers . When the fingers come in contact , the tapes get connected to neighbouring tapes , which can cause a circuit to be open and the microcontroller can read the value corresponding to the contact between those fingers .

MICROCONTROLLER-ATMEGA168

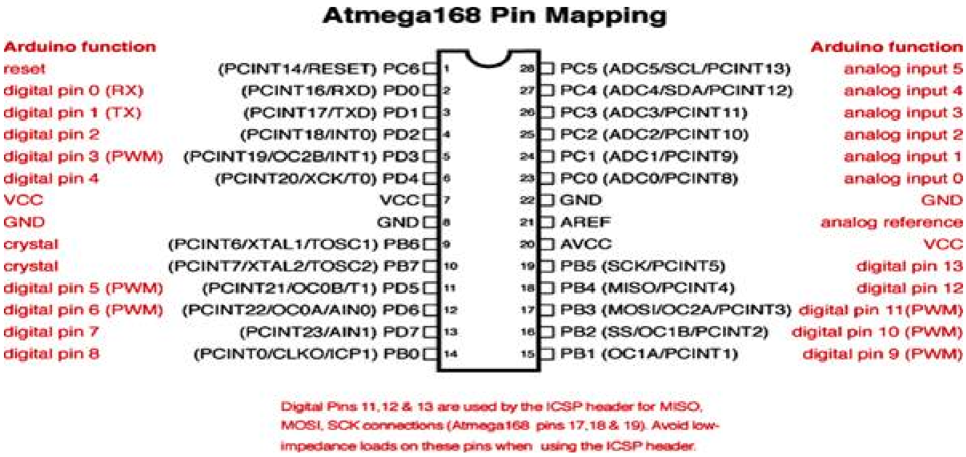


Figure 2.5: Microcontroller-ATMEGA168

We have a large no .of input lines. So in order to include all these input lines we use two microcontrollers. The first microcontroller we use is ATMEGA 168. To this controller, we give the flex sensor outputs, EMIC module connections and LCD output lines.

ATMEGA 168 microcontroller is an 8 bit Atmel microcontroller with 16 K byte programmable flash memory. It gives high performance and has 28 pins. The main features of this microcontroller are

- IC, 8BIT MCU, 16K FLASH, 5V, PDIP40
- Controller Family/Series: AVR MEGA
- Core Size:8bit
- No. of I/O's:32
- Program Memory Size:16KB
- EEPROM Memory Size:512 bytes.
- RAM Memory Size:1KB

- CPU Speed:20MHz10
- Oscillator Type: External, Internal
- No. of Timers:3
- Peripherals: ADC, Comparator
- No. of PWM Channels:6
- Digital IC Case Style: PDIP
- Supply Voltage Range:2.7V to 5.5V
- Interface :J TAG, SPI, USART, 2-Wire
- Interface Type: JTAG , SPI, USART

It has advanced RISC architecture with 131 powerful instruction set with 32 * 8 working registers and 512 bytes EEPROM.

This microcontroller can serve as a powerful processing engine of this system, which should process the signs transmitted by analysing outputs from different sensors .

MICROCONTROLLERr-ATMEGA 8

The second microcontroller we use is to include the connections from contact sensors and accelerometers. The second controller need not have enough performance as the first one but it should have enough no. of pins and moderate performance. So, we have decided to use the low cost controller ATMEGA 8 for this purpose.

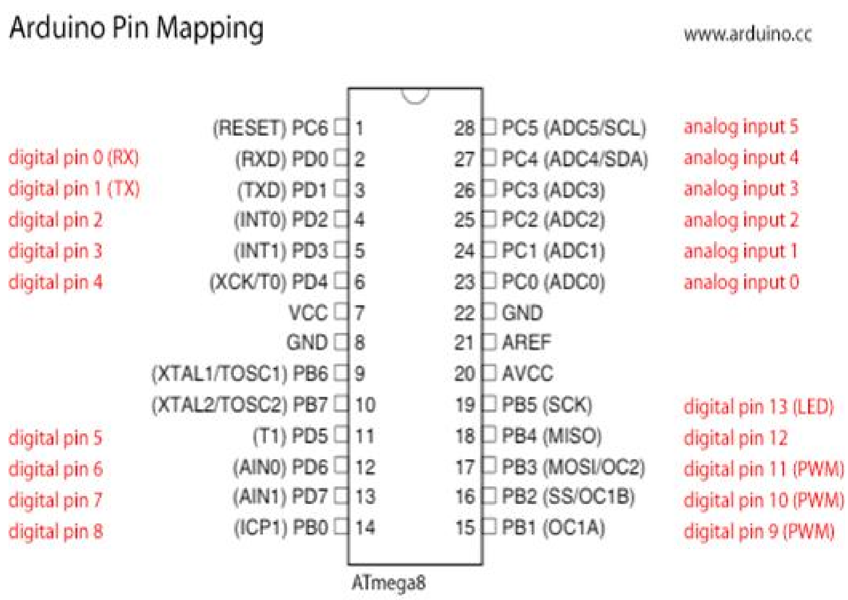


Figure 2.6: Microcontroller- ATMEGA 8

ATMEGA 8 microcontroller is an 8 bit Atmel microcontroller with 8 K byte programmable flash memory. It gives moderate performance and has 28 pins. The main features of this microcontroller are

- IC, 8BIT MCU, 8K FLASH, 5V, PDIP40
- Controller Family/Series: AVR MEGA
- Core Size:8bit
- No. of I/O's:32

- Program Memory Size:8KB
- EEPROM Memory Size:512 bytes.
- RAM Memory Size:1KB
- CPU Speed:16MHz
- Oscillator Type: External, Internal
- No. of Timers:3
- Peripherals: ADC, Comparator
- No. of PWM Channels:3
- Digital IC Case Style: PDIP
- Supply Voltage Range:2.7V to 5.5V

16 * 2 LCD DISPLAY

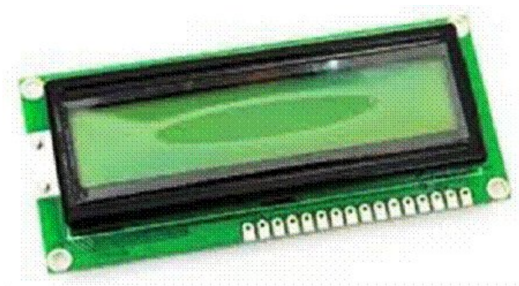


Figure 2.7: 16 * 2 LCD display

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden,such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCD Displays are used here to display the textual format of the sign shown by the user which can be helpful to people having less hearing ability and also it is used because reading text can sometimes be more helpful than hearing voices .

EMIC 2 MODULE AND SPEAKER

Emic 2 Text-to-SpeechModule is an unconstrained, multi-language voice synthesizer that converts a stream of digital text intonatural sounding speech output. Using the universally recognized DECtalk text-to-speech synthesizer engine, Emic 2 provides full speech synthesis capabilities for any embedded system via a simple command-based interface. The EMIC 2 Module is so powerful in text to speech translation that we can even change the voices of the output. The output from this module is obtained by connecting a small 8 ohm speaker to the output 3.5 mm jack of the module. The data travelling through the module is by using serial communication.

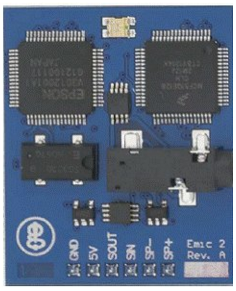


Figure 2.8: EMIC 2 Module

Features:

- High-quality speech synthesis for English and Spanish languages.
- Nine pre-defined voice styles comprising male, female, and child.
- Dynamic control of speech and voice characteristics, including pitch, speaking rate, and word emphasis.
- Industry-standard DECtalk text-to-speech synthesizer engine (5.0.E1).
- On-board audio power amplifier and 1/8 (3.5 mm) audio jack.
- Single row, 6-pin, 0.1 header for easy connection to a host system.

Figure 2.9: Speaker

BATTERY

An electrical battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. Since the invention of the first Voltaic pile in 1800 by Alessandro Volta, the battery has become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges orcomputer data centres.

The battery used is of 9V. It provides necessary power supply to the flex sensors, accelerometers, microcontroller, lcd display.

Figure 2.10: Battery

VOLTAGE REGULATOR

A voltage regulator is used to get a constant output voltage when the input voltage is varied. Here we use a voltage regulator to get an output voltage of 5V.The regulator used is LM7805. A variable regulated power supply, also called a variable bench power supply, is one where you can continuously adjust the output voltage to your requirements. Varying the output of the power supply is the recommended way to test a project having doubled checked parts placement against circuit drawings and the parts placement guide. Most digital logical circuits and processors need a 5 volt power supply. To use these parts we need to build a regulated 5 volt source .Usually you start with an unregulated power supply ranging from 9 volts to 24 volts DC. To make a 5 volt power supply, we use a LM7805 voltage regulator IC (Integrated circuit). The IC is shown below

Figure 2.11: Voltage Regulator

NOKIA SERIAL USB CABLE

Figure 2.12: Nokia Serial USB cable

The cable is used for serial communication between the microcontroller and the EMIC 2 speech to text conversion module. The data in/out of the module is serial data. So, for communication with the module , we use the cable shown above. In the above figure , the USB connection of the serial cable is shown. The connection involves Serial in/out connection , Vcc, Gnd etc. connected to a USB port. We use the serial in connection of the cable to connect with the EMIC 2 module. TX and RX pins of the above cable are used as the serial data transfer pins. The data from the TX pin of the Microcontroller is connected to the input Sin of the module. Data Sout from the module is connected to RX pin of the microcontroller to check the completion of serial transmission. The voice o/p is connected to the 8 Ohm speakers.

Chapter 3

System Design

3.1 Design of Block

Requirements:

- Operating Voltage 5V.
- Output of 26 alphabets.
- Output Volume of 10 Db.
- Three ranges of values of bending resistances of flex sensor.
- Data to be serially communicated between microcontrollers and EMIC2 module.
- Output should be obtained through speakers.

3.2 Detector Section

Detector section refers to that section which detects the signs shown and transfers it for processing. Detector section comprises the GLOVE which the user wears. The glove contains flex sensors, accelerometers and contact sensors.

3.2.1 Flex Sensor Section

The flex sensors are basically variable resistors. As the flex sensors are bent the resistance will vary in an appropriately linear fashion. They convert the change in bend to electrical resistance, the more the bend the more its resistance value. This is depicted in the picture below.

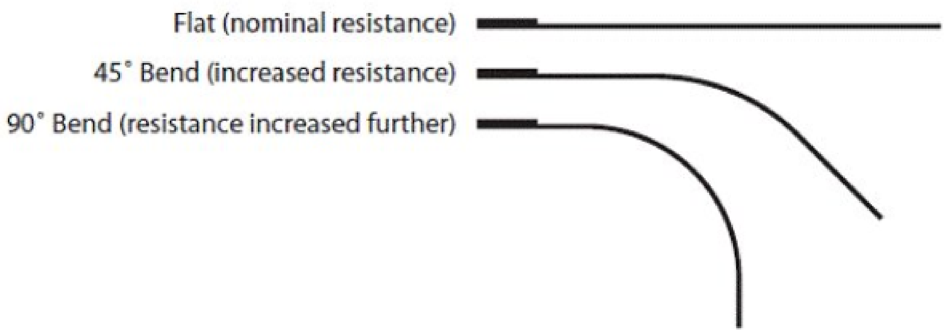


Figure 3.1: Flex Sensor bending

For flex sensors the flat resistance is 25 K ohms and the bending resistance varies from 45 K ohms to 125 K ohms. Its power rating is 0.5 watts continuous and 1 watt peak.

The peripheral circuit of flex sensor according to the data sheet requires an Op-Amp which is used as an impedance buffer. The basic flex sensor circuit is given below.

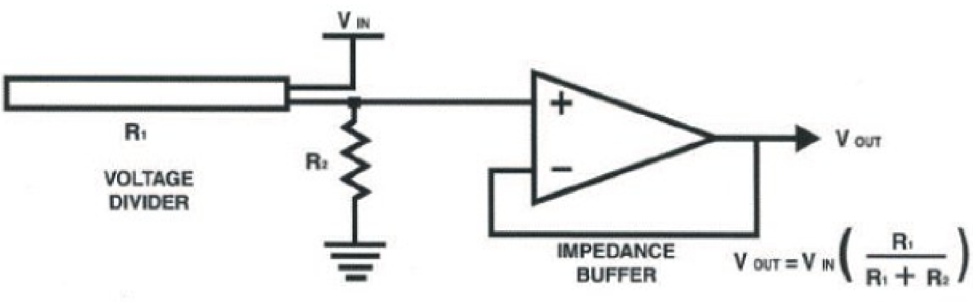


Figure 3.2: Basic Flex Sensor circuit

The impedance buffer here is a single sided operational amplifier used with these sensors because the low bias current of the op-amp reduces error due to source impedance of the flex sensor as voltage divider. The resistance R2 used here is selected as 22 K Ohms because the minimum of flat resistance of the flex sensor is 25 K Ohms and 22 K Ohms is the maximum lowest standard value.

The Op-Amp we have used here is LM358. The flex sensor is connected to ATMEGA168 microcontroller.

3.2.2 Contact Sensor Section

Contact sensors are used between fingers in order to sense the contact of the fingers. Here we use 6 contact sensors. We have built the contact sensors using metal cans by cutting the can to very small pieces and polishing the inside to remove non-metallic coating and attached it to the fingers. Connecting wires are soldered into the pieces which are connected to various digital pins of the ATMEGA8 Microcontroller.

Contact sensors are configured as input to the microcontroller which gives HIGH or LOW values according to contact of the fingers. Two microcontrollers are arranged as output sensors which are connected to the Voltage supply , which, when comes in contact with other sensors, produces HIGH value in corresponding digital pins.

3.2.3 Accelerometer Section

An accelerometer is a device that measures proper acceleration. Here we use it to detect the spatial movement of the palm as several signs require palms to be oriented in a particular way.

Here we use accelerometer ADXL335 . It has 5 pins, 3 pins correspond to the X, Y and Z co-ordinate accelerations and other 2 pins correspond to the supply voltage and ground pin.

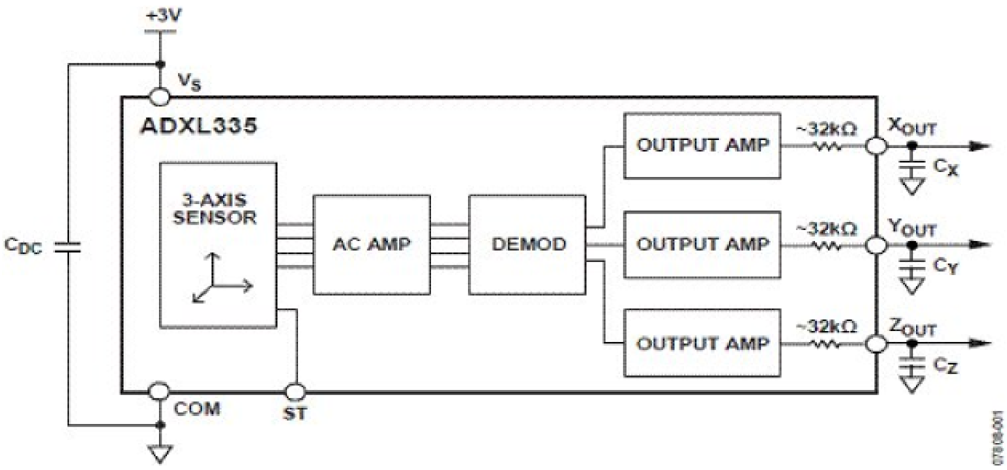


Figure 3.3: Internal Diagram of an ADXL335 Accelerometer

The above given figure is the internal diagram of an ADXL335 accelerometer. By connecting the X-Y-Z terminals , which give analog voltage outputs, to the analog input pins of the microcontroller ATMEGA8 , we can observe and process the orientation values of the palm or exactly the Glove.

3.3 Processing Section

The processor section correspond to the section containing the two microcontrollers ATMEGA168 and ATMEGA8. The two microcontrollers communicate with each other via. serial communication. For this , initialization of new serial TX and RX pins in the second microcontroller is done by using programming in Arduino and converting digital pins 8 and 9 to serial RX and TX pins .

The two RX and TX pairs are used because, in the ATMEGA168 , one of the pairs have to receive data serially from ATMEGA8 and the other pair is used in serial communication with EMIC2 Text to speech module.

The flex sensors are connected to the Analog pins of ATMEGA168 and EMIC2 is connected to the TX and RX of ATMEGA168. Contact sensors are connected to the Digital pins of ATMEGA8 and accelerometer is connected to the Analog pins of ATMEGA8. Further processing is done using programming.

3.4 Output Section

The output section corresponds to the sections which gives us the text and speech outputs. The output section has EMIC2 TTS module and LCD Display .

3.4.1 16 x 2 LCD Display

The LCD Display is connected to the digital pins 12 , 11 , 5 , 4 , 3 , 2 of the ATMEGA168. The text output according to the signs shown and the words produced by combining the characters are displayed on the LCD Display.

3.4.2 EMIC 2 Text to Speech module

The voice output of the words shown by the combination of the fingers and palm orientations is given to the EMIC2 text to speech module by using serial communication. The connection diagram of the EMIC2 module is shown below.

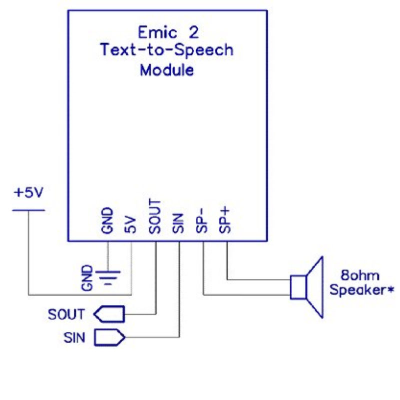


Figure 3.4: Connection diagram of the EMIC2 module

SIN is the serial input to which data is sent serially through the TX pin of the ATMEGA168. SOUT is the serial output which sends acknowledgement data ":" back to the microcontroller through the RX pin. SP+ and SP- are the terminals to which an 8Ohm Speaker is connected from which we get the voice output using predefined Male voice and Volume of 10 Db which is set using programming by ARDUINO IDE. A 3.5mm jack is also provided which can be used as an additional output port to connect headsets or bigger speaker systems.

3.5 Power Supply Section

The operating voltage of the system is 5V. This is provided by using a voltage regulator circuit comprising of IC 7805 which is connected to a 9V Battery. The standard circuit for voltage regulation by IC 7805 is

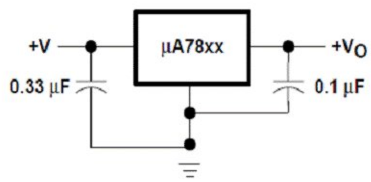


Figure 3.5: Basic voltage regulator circuit

The above given figure depicts the basic voltage regulator circuit comprising of IC 7805 providing a constant output of 5V. We have followed this circuit according to the datasheet of the IC 7805.

As you can see, two capacitors are used in the circuit , at the input section as well as the output section. The capacitor before the IC is filtering the output of the rectifier, so that the minimum voltage dip between diode conduction cycles is greater than the minimum voltage the IC requires. The capacitor after the IC is stabilizing the IC, by preventing it from oscillating, and responding to quick changes in load faster than the IC can.

Chapter 4

Software Design

4.1 Software Selected and Programming Language

4.1.1 Data processing and communication software

For data processing of the data from all the flex sensors , contact sensors, accelerometers etc. and for programming the serial data communication between different components, we have used the programming software **ARDUINO IDE**. We chose this software because the programming language is very much similar to the **C Language** we have studied at lower classes and so studying the language was easier. And also interfacing of different components and different types of data and its processing etc. were found to be very much easier.

We used a USB-ASP programmer which was used to program the microcontrollers using Arduino software.

4.2 Algorithm

4.2.1 Contact sensor and Accelerometer section

Steps :

1. START
2. If acknowledgement for serial transmission send is being received then go to Step 3 else go to Step 2.
3. Read command from other controller as to which value is needed . If contact value is needed go to Step 4 else go to Step 5.
4. Check which contact sensor value is needed and go to Step 6.
5. Check which accelerometer value is needed and go to Step 6.
6. Obtain the particular l value and transfer it to other controller.
7. If next request is coming, go to Step 3 else go to Step 8.
8. STOP.

4.2.2 Flex sensor and Output section

Steps :

1. START
2. If acknowledgement for serial transmission send is being received then go to Step 3 else go to Step 2
3. Send command to other controller as to which value is needed . If contact value is needed go to Step 4 else go to Step 5
4. Obtain which contact sensor value is needed and go to Step 6

5. Obtain which accelerometer value is needed and go to Step 6
6. Store the obtained values to corresponding variables
7. Check for more commands. If present, go to Step 3 else go to Step 8
8. Obtain flex sensor values
9. Combine the values from all the sensors and check for matching letter
10. Check for print command. If received, go to Step 11. Else, save the character to a string , Display it through LCD and go to Step 3.
11. Check for serial communication acknowledgment with EMIC2. If received, go to Step 12 else go to Step 11
12. Serially send the string to EMIC2 module and get voice output. Then go to Step 3.

4.3 Flowchart

4.3.1 Contact sensor and Accelerometer section

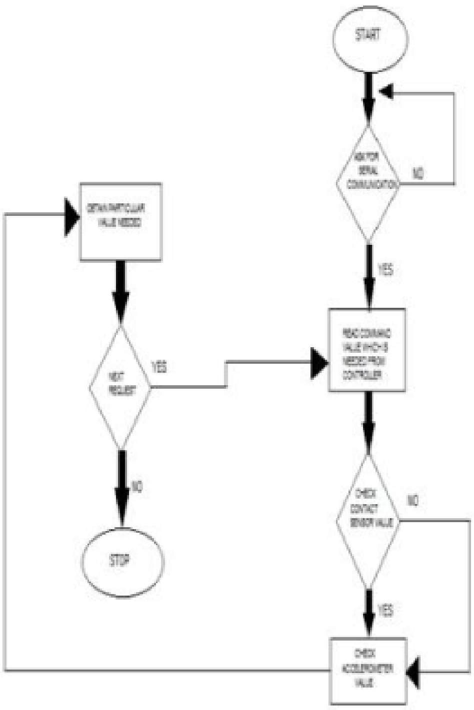


Figure 4.1: Flow chart for Contact sensor and Accelerometer section

4.3.2 Flex sensor and Output section

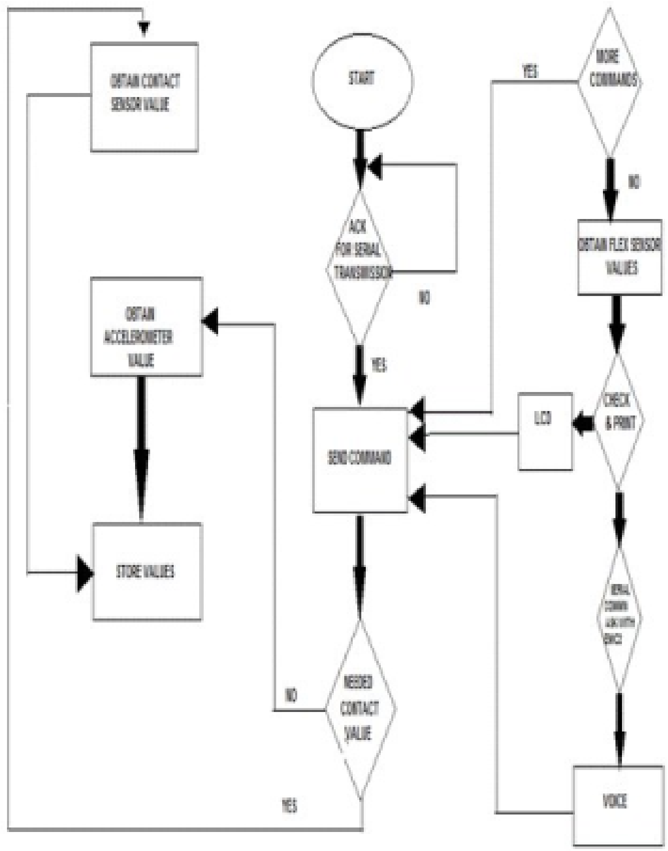


Figure 4.2: Flow chart for Flex sensor and Output section

4.4 Program

(Please refer the compact disc attached)

Chapter 5

System Integration

5.1 Circuit Diagram

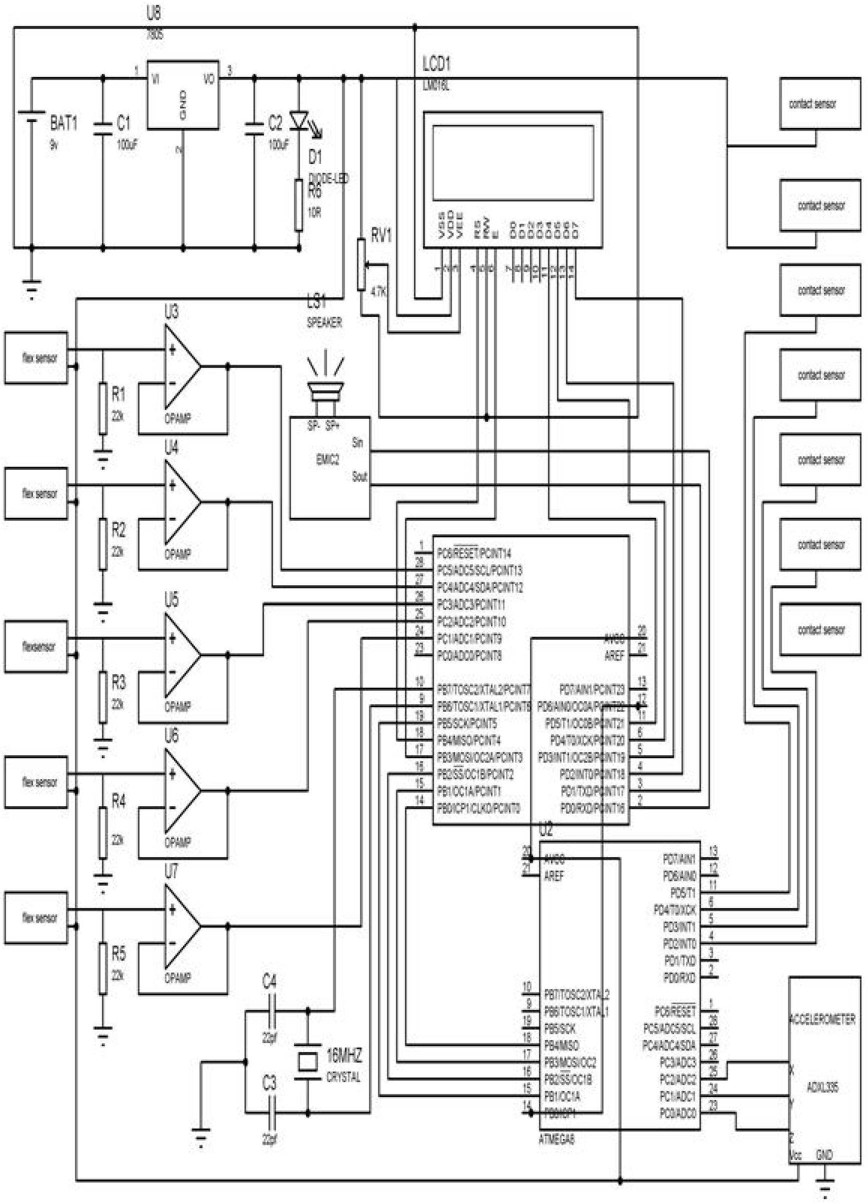


Figure 5.1: Circuit Diagram

5.2 PCB layout

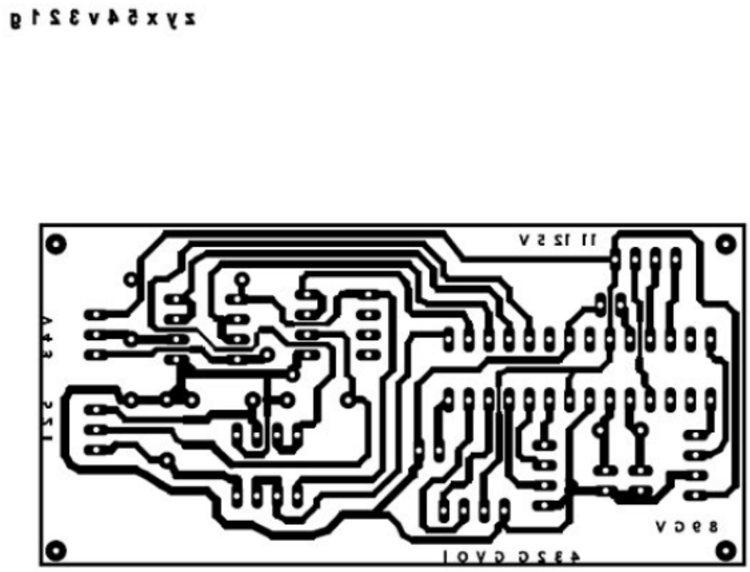


Figure 5.2: PCB Layout of Flex sensor section

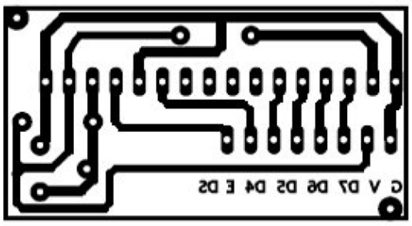


Figure 5.3: PCB Layout of LCD circuit

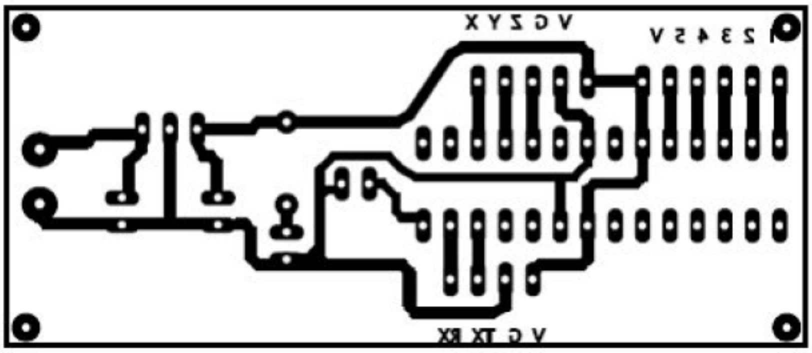


Figure 5.4: PCB Layout of Contact Sensor section

5.3 Product Photos

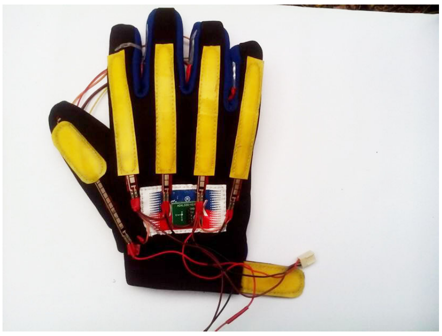


Figure 5.5: Glove which user wears

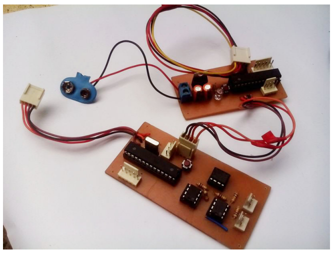


Figure 5.6: Processing part involving 2 microcontrollers

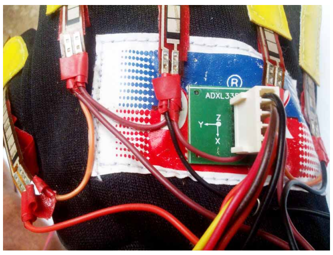


Figure 5.7: Flex sensor and Accelerometer arrangement

Figure 5.8: Contact sensor arrangement

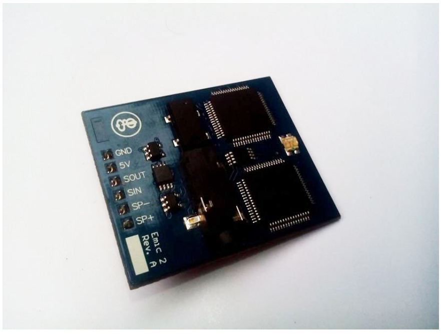


Figure 5.9: EMIC text to speech module

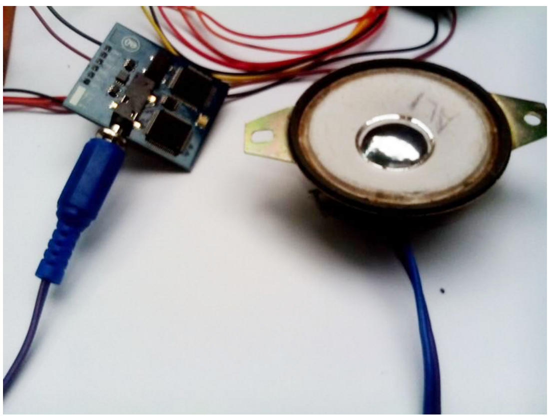


Figure 5.10: Audio output from speaker

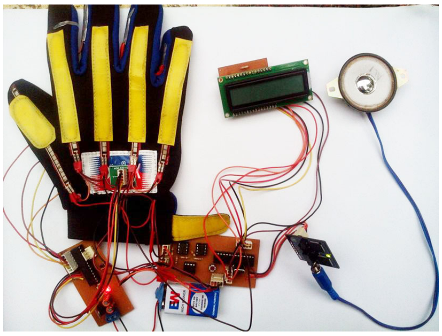


Figure 5.11: The whole arrangement

Figure 5.12: Sign for the letter "L"

Figure 5.13: Letter displayed on LCD

Chapter 6

Conclusion

6.1 Result

The project was successfully completed and a communication aid was developed. Through the glove , we were able to display and speech out 26 alphabets.

At the first section, the contact sensors and accelerometer values were obtained by ATMEGA8 and processed and transferred to the second microcontroller.

ATMEGA168 , after acquiring these values, obtained readings from the flex sensor and processed all the data to produce corresponding alphabets, which were stored to strings. These were serially transmitted to EMIC2 Text to speech module and output was obtained through external speakers.

The output was also obtained through LCD display connected via a 3rd PCB.

6.2 Error Analysis

1. While working with EMIC2 text to speech module, serial data was not being sent to the module correctly and it was a tedious job finding out the fault. The mistake was found to be in setting the fuse bit while programming the module, it the bit was set properly.

2. Serial communication between the ICs was not happening and it created lot of data processing problems. It was cleared when an external crystal of high frequency was used as the oscillator.

3. The number of contact sensors to be used was minimized by considering the symbols to be used, by providing high value of supply to only 2 sensors and others acting as inputs.

6.3 Future Expansion

1. By using more efficient coding of different signs, vocabulary of the communication aid can be extended.

2. By using gloves on both the palms and using more sophisticated microcontrollers etc for processing all these data, gloves capable of aiding day to day conversations can be obtained.

3. By interfacing this system with Mobile phone operating systems, more user friendly applications can be created.

6.4 Advantages and Disadvantages

6.4.1 Advantages

- It is a boon for verbally handicapped people.
- Communication barrier between common people and verbally handicapped people is broken.
- More user friendly interface is provided by providing a wearable glove.

6.4.2 Disadvantages

- American Sign Language is used, which is not common in India.
- Wearing a glove always can be difficult for people.
- Efficient communication just like ordinary people is very difficult to implement.

Appendix A

References

[1]*Real-Time American Sign Language Recognition Using Desk and Wearable Computer Based Video*
Authors Thad Starner and Alex Pentland Publisher:IEEE Computer Society
[2]*The metaDESK : models and prototypes for tangible user interfaces*
[3]https://www.sparkfun.com/products/10264
[4]http://www.parallax.com/product/30016
[5]http://http://www.grandideastudio.com/portfolio/emic-2-text-to-speech-module
[6]*Research Lab Method and apparatus for translating hand gestures*
Author Hernandez Rebollar

Appendix B

Datasheets

Features

- High performance, low power Atmel® AVR® 8-bit microcontroller
- Advanced RISC architecture
  - 131 powerful instructions – most single clock cycle execution
  - 32 × 8 general purpose working registers
  - Fully static operation
  - Up to 20 MIPS throughput at 20MHz
  - On-chip 2-cycle multiplier
- High endurance non-volatile memory segments
  - 4/8/16 Kbytes of in-system self-programmable flash program memory
  - 256/512/512 bytes EEPROM
  - 512/1K/1Kbytes internal SRAM
  - Write/erase cyles: 10,000 flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C[()]
  - Optional boot code section with independent lock bits
    In-system programming by on-chip boot program
    True read-while-write operation
  - Programming lock for software security
- QTouch® library support
  - Capacitive touch buttons, sliders and wheels
  - QTouch and QMatrix acquisition
  - Up to 64 sense channels
- Peripheral features
  - Two 8-bit timer/counters with separate prescaler and compare mode
  - One 16-bit timer/counter with separate prescaler, compare mode, and capture mode
  - Real time counter with separate oscillator
  - Six PWM channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
  - 6-channel 10-bit ADC in PDIP Package
  - Programmable serial USART
  - Master/slave SPI serial interface
  - Byte-oriented 2-wire serial interface (Philips I^2C compatible)
  - Programmable watchdog timer with separate on-chip oscillator
  - On-chip analog comparator
  - Interrupt and wake-up on pin change
- Special microcontroller features
  - DebugWIRE on-chip debug system
  - Power-on reset and programmable brown-out detection
  - Internal calibrated oscillator
  - External and internal interrupt sources
  - Five sleep modes: Idle, ADC noise reduction, power-save, power-down, and standby
- I/O and packages
  - 23 programmable I/O lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating voltage:
  - 1.8V - 5.5V for Atmel ATmega48V/88V/168V
  - 2.7V - 5.5V for Atmel ATmega48/88/168
- Temperature range:
  - -40°C to 85°C
- Speed grade:
  - ATmega48V/88V/168V: 0 - 4MHz @ 1.8V - 5.5V, 0 - 10MHz @ 2.7V - 5.5V
  - ATmega48/88/168: 0 - 10MHz @ 2.7V - 5.5V, 0 - 20MHz @ 4.5V - 5.5V
- Low power consumption
  - Active mode:
    250µA at 1MHz, 1.8V
    15µA at 32kHz, 1.8V (including oscillator)
  - Power-down mode:
    0.1µA at 1.8V

Note: 1. See "Data retention" on page 8 for details.

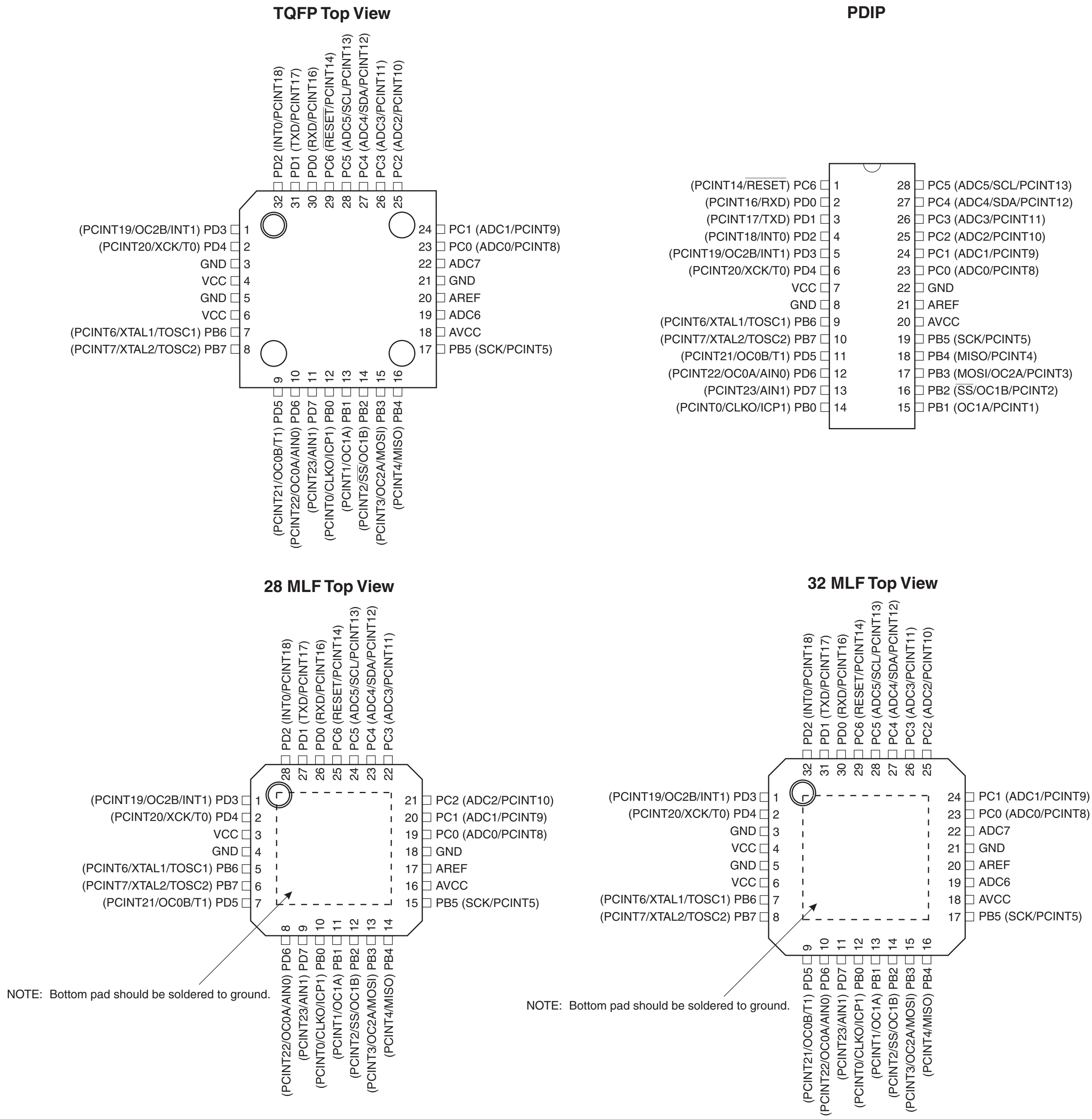
8-bit Atmel Microcontroller with 4/8/16K Bytes In-System Programmable Flash

ATmega48/V
ATmega88/V
ATmega168/V

Rev. 2545T–AVR–05/11

1. Pin configurations

Figure 1-1. Pinout Atmel ATmega48/88/168.



Features

- High-performance, Low-power Atmel®AVR® 8-bit Microcontroller
- Advanced RISC Architecture
  - 130 Powerful Instructions – Most Single-clock Cycle Execution
  - 32 × 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16MIPS Throughput at 16MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
  - 8Kbytes of In-System Self-programmable Flash program memory
  - 512Bytes EEPROM
  - 1Kbyte Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C[(1)]
  - Optional Boot Code Section with Independent Lock Bits
    In-System Programming by On-chip Boot Program
    True Read-While-Write Operation
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Three PWM Channels
  - 8-channel ADC in TQFP and QFN/MLF package
    - Eight Channels 10-bit Accuracy
  - 6-channel ADC in PDIP package
    - Six Channels 10-bit Accuracy
  - Byte-oriented Two-wire Serial Interface
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby
- I/O and Packages
  - 23 Programmable I/O Lines
  - 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
- Operating Voltages
  - 2.7V - 5.5V (ATmega8L)
  - 4.5V - 5.5V (ATmega8)
- Speed Grades
  - 0 - 8MHz (ATmega8L)
  - 0 - 16MHz (ATmega8)
- Power Consumption at 4Mhz, 3V, 25°C
  - Active: 3.6mA
  - Idle Mode: 1.0mA
  - Power-down Mode: 0.5µA

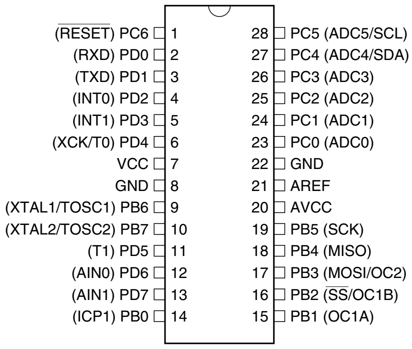
8-bit Atmel with 8KBytes In-System Programmable Flash

ATmega8 ATmega8L

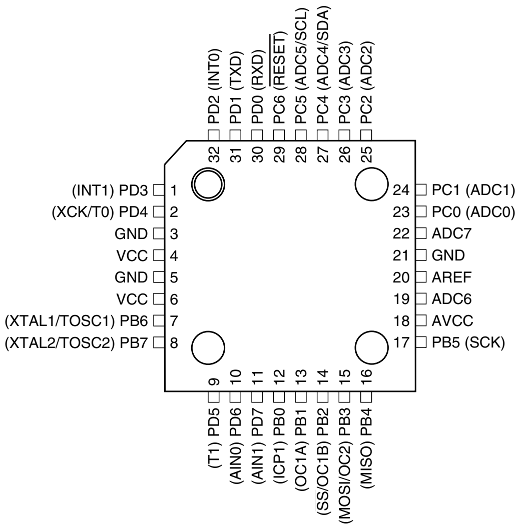
Rev.2486AA–AVR–02/2013

Pin Configurations

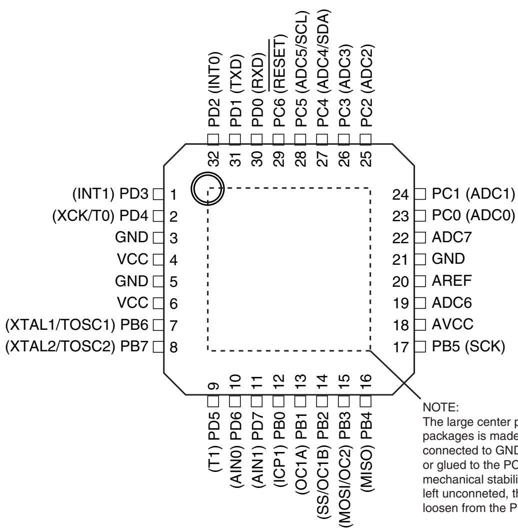
PDIP



TQFP Top View



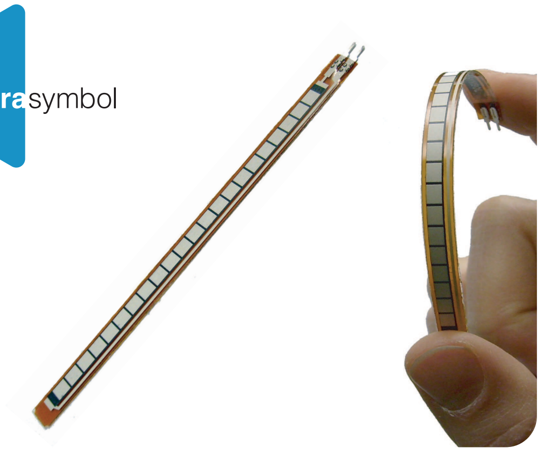
MLF Top View



NOTE:
The large center pad underneath the MLF packages is made of metal and internally connected to GND. It should be soldered or glued to the PCB to ensure good mechanical stability. If the center pad is left unconneted, the package might loosen from the PCB.

FLEX SENSOR FS

Special Edition Length



Features

- Angle Displacement Measurement
- Bends and Flexes physically with motion device
- Possible Uses
  - Robotics
  - Gaming (Virtual Motion)
  - Medical Devices
  - Computer Peripherals
  - Musical Instruments
  - Physical Therapy
- Simple Construction
- Low Profile

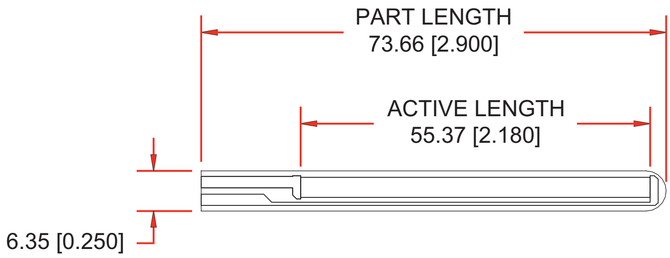
Mechanical Specifications

-Life Cycle: >1 million
-Height: ≤0.43mm (0.017")
-Temperature Range: -35°C to +80°C

Electrical Specifications

-Flat Resistance: 25K Ohms
-Resistance Tolerance: ±30%
-Bend Resistance Range: 45K to 125K Ohms (depending on bend radius)
-Power Rating : 0.50 Watts continuous. 1 Watt Peak

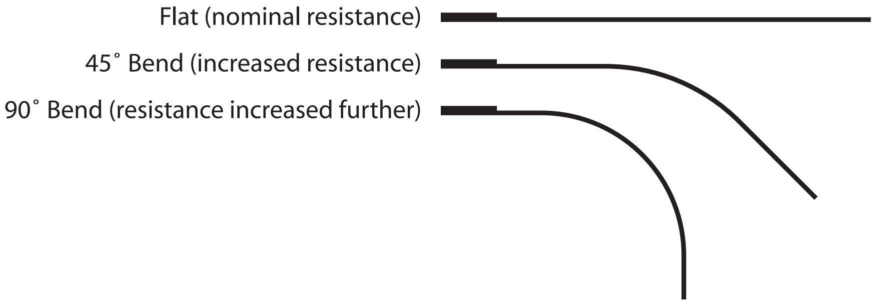
Dimensional Diagram - Stock Flex Sensor



How to Order - Stock Flex Sensor

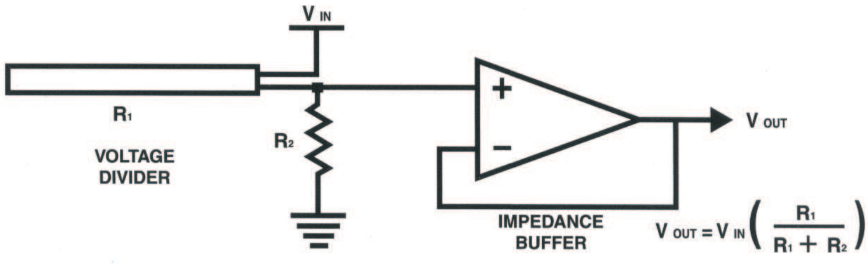
FS	—	L	—	0055	—	253	—	ST
Series		Model		Active Length		Resistance		Connectors
FS = Flex Sensor		L = Linear		0055 = 55.37mm		253 = 25K Ohms		ST = Solder Tab

How It Works



Schematics

BASIC FLEX SENSOR CIRCUIT:



Following are notes from the ITP Flex Sensor Workshop

"The impedance buffer in the [Basic Flex Sensor Circuit] (above) is a single sided operational amplifier, used with these sensors because the low bias current of the op amp reduces errer due to source impedance of the flex sensor as voltage divider. Suggested op amps are the LM358 or LM324."

"You can also test your flex sensor using the simplest circut, and skip the op amp."

"Adjustable Buffer - a potentiometer can be added to the circuit to adjust the sensitivity range."

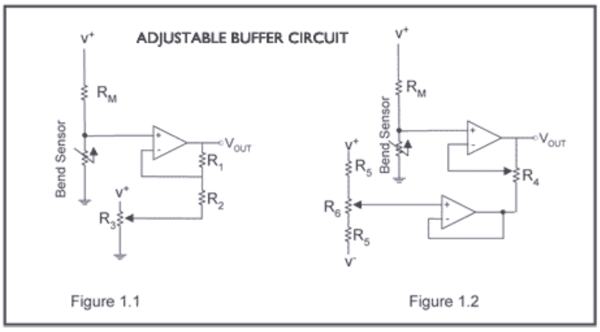
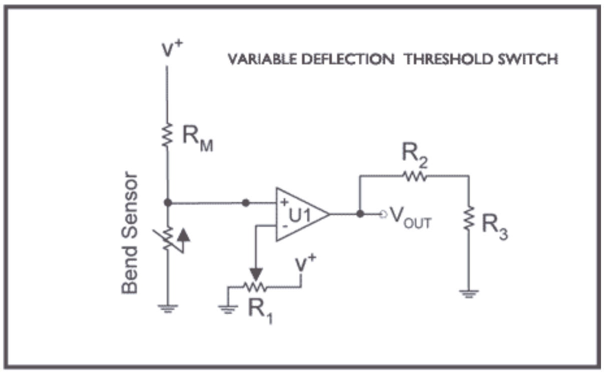
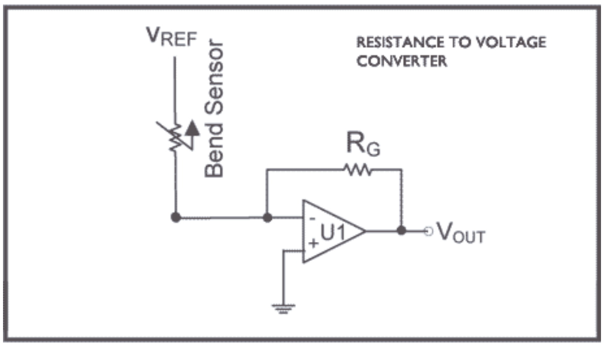


Figure 1.1 Figure 1.2

"Variable Deflection Threshold Switch - an op amp is used and outputs either high or low depending on the voltage of the inverting input. In this way you can use the flex sensor as a switch without going through a microcontroller."



"Resistance to Voltage Converter - use the sensor as the input of a resistance to voltage converter using a dual sided supply op-amp. A negative reference voltage will give a positive output. Should be used in situations when you want output at a low degree of bending."



LM258, LM358, LM358A, LM2904, LM2904A, LM2904V, NCV2904, NCV2904V

Single Supply Dual Operational Amplifiers

Utilizing the circuit designs perfected for Quad Operational Amplifiers, these dual operational amplifiers feature low power drain, a common mode input voltage range extending to ground/V_{EE}, and single supply or split supply operation. The LM358 series is equivalent to one−half of an LM324.

These amplifiers have several distinct advantages over standard operational amplifier types in single supply applications. They can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one−fifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

Features

- Short Circuit Protected Outputs
- True Differential Input Stage
- Single Supply Operation: 3.0 V to 32 V
- Low Input Bias Currents
- Internally Compensated
- Common Mode Range Extends to Negative Supply
- Single and Split Supply Operation
- ESD Clamps on the Inputs Increase Ruggedness of the Device without Affecting Operation
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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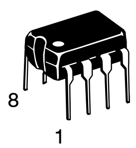
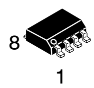
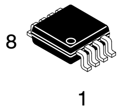


PDIP−8
N, AN, VN SUFFIX
CASE 626

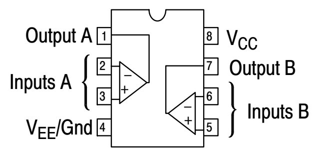


SOIC−8
D, VD SUFFIX
CASE 751



Micro8™
DMR2 SUFFIX
CASE 846A

PIN CONNECTIONS



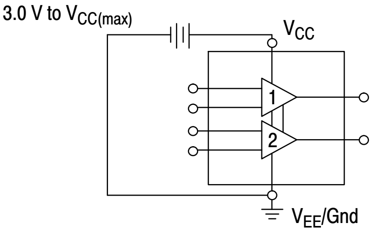
(Top View)

ORDERING INFORMATION

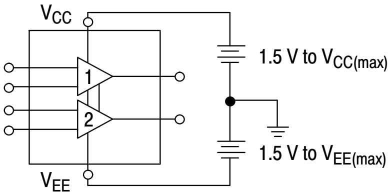
See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 11 of this data sheet.



Single Supply



Split Supplies

Figure 1.

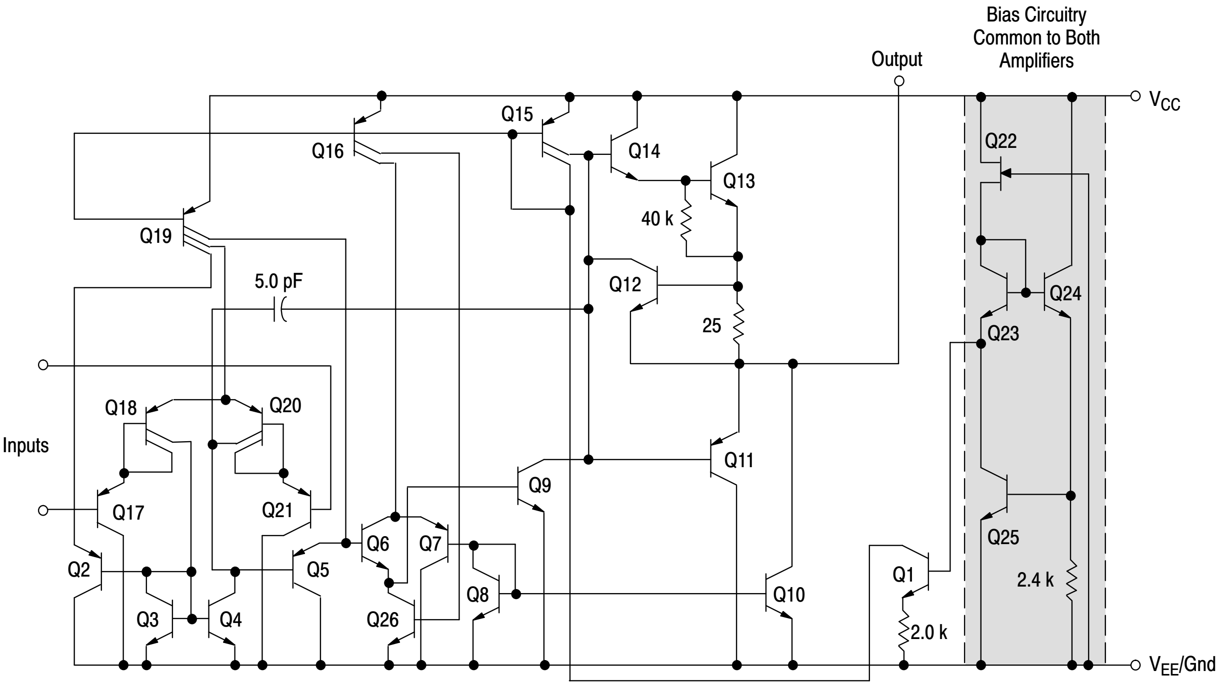


Figure 2. Representative Schematic Diagram
(One−Half of Circuit Shown)

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Emic 2 Text-to-Speech Module (#30016)

Designed in conjunction with Grand Idea Studio (www.grandideastudio.com), the Emic 2 Text-to-Speech Module is an unconstrained, multi-language voice synthesizer that converts a stream of digital text into natural sounding speech output. Using the universally recognized DECtalk text-to-speech synthesizer engine, Emic 2 provides full speech synthesis capabilities for any embedded system via a simple command-based interface.

Features

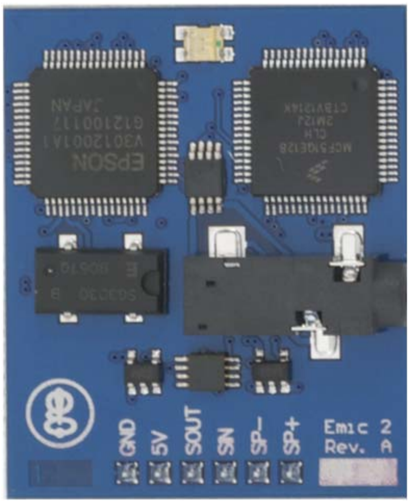
- High-quality speech synthesis for English and Spanish languages
- Nine pre-defined voice styles comprising male, female, and child
- Dynamic control of speech and voice characteristics, including pitch, speaking rate, and word emphasis
- Industry-standard DECtalk text-to-speech synthesizer engine (5.0.E1)
- On-board audio power amplifier and 1/8″ (3.5 mm) audio jack
- Single row, 6-pin, 0.1″ header for easy connection to a host system

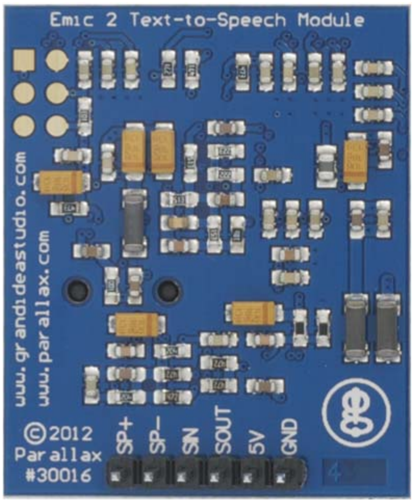
Key Specifications

- Power requirements: +5 VDC, 30 mA idle, 46-220 mA active (depending on speech parameters and output load)
- Communication: asynchronous 9600 bps serial
- Operating temperature: -20 to +70 °C (-4 to +158 °F)
- Dimensions: 1.25″ W x 1.5″ L x 0.37″ H (3.17 W x 3.81 L x 0.94 H cm)

Application Ideas

- Reading Internet-based data streams (such as e-mails or Twitter feeds)
- Conveying status or sensor results from robots, scientific equipment, or industrial machinery
- Language learning or speech aids for educational environments





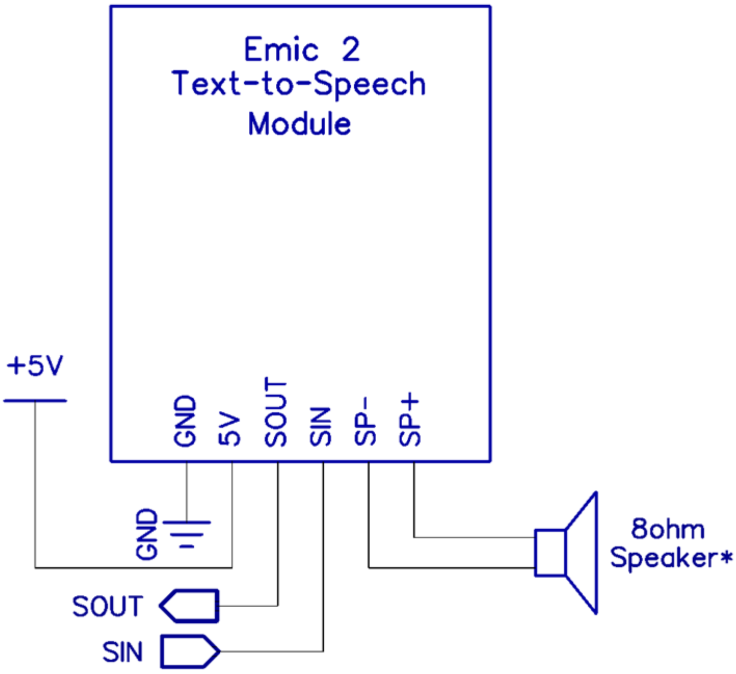
Connections

Emic 2 interfaces to a host microcontroller or computer system using only four connections (GND, 5V, SOUT, SIN). Additional connections (SP+, SP-) are available for direct interfacing to an 8Ω speaker. A 1/8" (3.5mm) audio jack provides a single-ended, monaural output for easy connection to headphones, amplified speakers, or other audio equipment.

Pin	Pin Name	Type	Function
1	GND	G	System ground. Connect to power supply's ground (GND) terminal.
2	5V	P	System power, 5 VDC input.
3	SOUT	O	Serial output to host. 5 V TTL-level interface, 9600 bps, 8 data bits, no parity, 1 stop bit, non-inverted.
4	SIN	I	Serial input from host. 3.3 V to 5 V TTL-level interface, 9600 bps, 8 data bits, no parity, 1 stop bit, non-inverted.
5	SP-	O	Differential audio amplifier output, bridge-tied load configuration, negative side. Connect directly to 8 Ω speaker.
6	SP+	O	Differential audio amplifier output, bridge-tied load configuration, positive side. Connect directly to 8 Ω speaker.

Type: I = Input, O = Output, P = Power, G = Ground

Use the following example circuit for connecting the Emic 2 Text-to-Speech Module:



*Note: For audio output, a connection needs to be made to either SP+/SP- or the 1/8" audio jack. Audio quality may be affected if both outputs are used at the same time.