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Design of Hand Gesture based Communication System for Speech Impaired Persons

Ashlesha S. Raut[1], Yogesh Motey[2]

[1]Department of Electronics & Telecommunication Engineering, G. H. Raisoni Institute of Engineering & Technology

[2]Assistant Professor, Department of Electronics & Telecommunication Engineering, G. H. Raisoni Institute of Engineering & Technology, R. T. M. N. University Nagpur India

Abstract: ***Now a days, a lot of attention is given to researches based on hand gesture recognition because of its applications in virtual environments and interactive human-machine interface. Hand gesture communication has now become the most common communicating medium amongst dumb people. This paper proposes a novel sign language communication technique that reduces the efforts of dumb persons and makes it easy for the persons who find the sign language difficult thereby producing a voice message based on a particular sign. The advantage of this technique is that every individual can define his own sign for a particular message.***

Keywords: Hand gesture, Human-machine interface, Sign language

1. Introduction

Human Beings communicate each with other through speech which is the best way for communication. But, some people are unable to communicate through speech due to the lack of power of speech. These people are also known as dumb. So the only way for them to communicate is through hand gestures or sign language. But, the disadvantage of this language is that it takes time for the person to frame a sentence and it also becomes difficult for a person to understand if he doesn't know the sign language. Researches on hand gesture based communication can be broadly classified into two categories namely vision based and glove based. Vision based technique has some disadvantages like the system needs to trained first with a number of images which are then used for comparison with the real time data. Wrong object may be extracted if the objects size is larger than the hand. Gestures recognition performance decreases with increase in distance between the hand and the camera. Besides this lightning conditions also affects due to which the portion may be extracted from the image. Most researches classified vision based gesture recognition system into three steps: Image acquisition, features extraction and classification as shown in figure below.

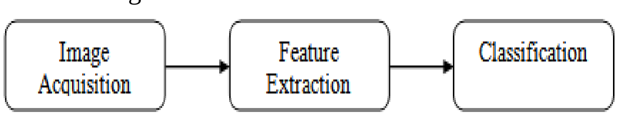

Figure 1.1: Gesture recognition system steps

Considering all the above drawbacks and by taking review of reference1 in this research we have proposed a hand gesture based system that depends on sensors, GSM and mobile. A hand gesture system can be designed using any one of the following techniques:

1) Multimodal
2) Unimodal
3) Contact
4) Non-Contact
5) Dynamic
6) Static
7) One –Handed
8) Gesture location upper
9) Gesture location lower
10) Driver Visual Reminder
11) Driver Feedback Type
    - Visual
    - Audible
    - Tactile

Hand gesture recognition technique may be of any one of the following technologies:

12) Intrusive
13) Non-Intrusive
14) Device-Based
15) Vision-Based
16) Sensor-Based

2. Theory of Techniques

Flex sensor: Fig. shows the flex sensor. As shown in the figure a flex sensor has two terminals. The resistance is measured across these two leads. When the sensor is completely flat its resistance is around 25K and when fully bent resistances increases up to 125K. A flex sensor acts as variable resistor (potentiometer) by connecting one of its lead to the positive terminal of battery and another to negative terminal through a 10K resistor in between. Now the terminal that is common for both the 10K resistor and flex sensor acts as the variable terminal. Voltage at this point V_{out} can be calculated using the following formula.

$$V_{out} = Vcc\ [R1/(R1 + R2)]$$

Where, V_{out} is output voltage or voltage across common terminal.

Vccis supply voltage

R1 is resistance of flex sensor
R2 is external resistor
This, output voltage can then be applied to ADC or controller for further processing.

Figure 2.1: Flex sensor

ATMEGA 16: Atmel is the manufacturer of 8-bit, 16-bit and 32-bit microcontrollers. In the category of 16-bit microcontrollers the AVR series is very popular. There are 3 categories under AVR microcontrollers. These categories are ATTINY, ATMEGA and ATXMEGA. ATTINY microcontrollers come with 0.5 to 16 KB of flash memory with minimum of 6 and maximum of 32 input output pins and maximum clock frequency of 20MHz. ATMEGA microcontrollers come with 4 to 256 KB of flash memory with minimum of 28 and maximum of 100 input output pins and maximum clock frequency of 20MHz.ATXMEGA microcontrollers come with 8 to 384 KB of flash memory with minimum of 32 and maximum of 100 input output pins and maximum clock frequency of 32MHz. Following are the features of ATMEGA 16 microcontroller.

- RISC architecture
- 16 KB ISP flash
- 1 KB of SRAM
- 512B of EPROM
- 32 I/O pins as 4 8-bit I/O ports
- Two 8-bit and one 16-bit timer
- 10-bit internal ADC
- USART
- Max. 16MHZ clock
- 2.7 to 5.5 supply voltage

In ATMEGA 16, 16 indicates the flash memory available in the controller. The compilers used for AVR 16 may be either AVR studio, Win AVR or MikroC Pro.

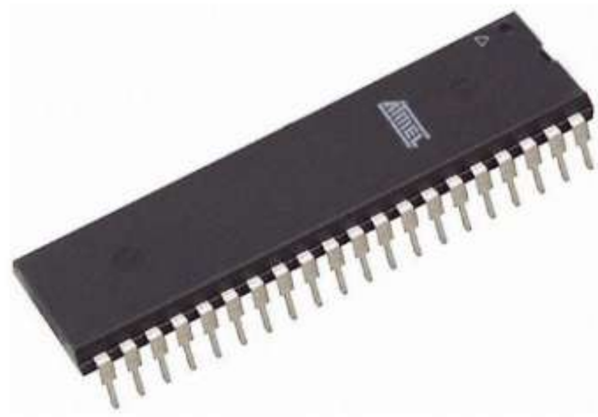

Figure 2.2: ATMEGA 16 microcontroller

GSM SIM 800 A MODULE

GSM stands for Global System for Mobile. A GSM system can be controlled using standard AT commands. AT is the abbreviation for attention. Commands specific to GSM are called as extended AT commands. AT commands are used to communicate with the GSM. To check whether GSM is active type “AT” on hyper terminal. If “OK” is received then GSM is active otherwise not. Similarly, AT-CPIN is used to check whether the SIM is ready? To dial a number ATD command is used and so on. Generally, a GSM modem can process 6-10 messages per minute but with General Packet Radio Service (GPRS), which is an of GSM, about 30 messages can be processed.

Figure 2.3: GSM Module

3. Proposed Work

Fig shows the block diagram of transmitter section. As shown in figure the transmitter section consists of an ATMEGA-16 Microcontroller pin-out, a Flex sensor and a GSM module acting as GSM transmitter. Here the dumb person wears the glove to which flex sensors are attached. Now according to the different gestures of that person a message corresponding to that gesture is sent to the receiver through GSM transmitter.

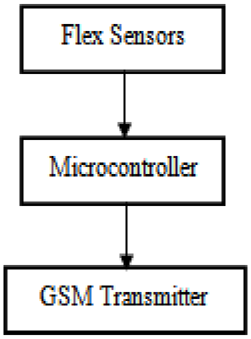

Figure 3.1: Transmitter section

Android application is developed. The application is developed in android studio. The application consist of speech to text conversion. The message transmitted by the GSM transmitter is received by the GSM receiver on the receiving side of mobile. The application works as a text to speech conversion. This received message is then given to the text to speech converter software which the converts the received text into speech and then produces the voice message. Fig 3.3 depicts the text message display on mobile screen.

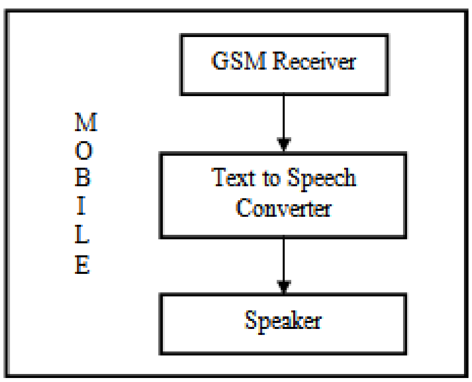

Figure 3.2: Receiver section

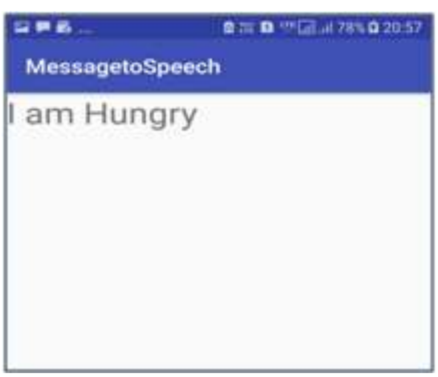

Figure 3.2: Android application text

4. Results

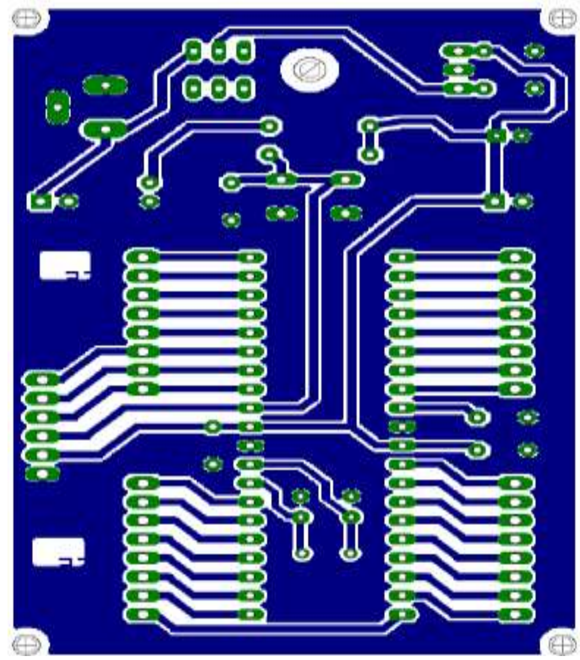

Figure 4.1: PCB artwork for ATMEGA 16 controller

Figure 4.1 shows the layout plan of the hardware circuit used for ATMEGA-16 microcontroller. This layout is designed using eagle software. Figure 4.2 shows the circuit diagram of the proposed circuit hardware. From the figure it can be seen that the flex sensors are connected to analog pins of PORT A that are also called as ADC0 to ADC3. Figure 4.3 shows the actual circuit and its implementation.

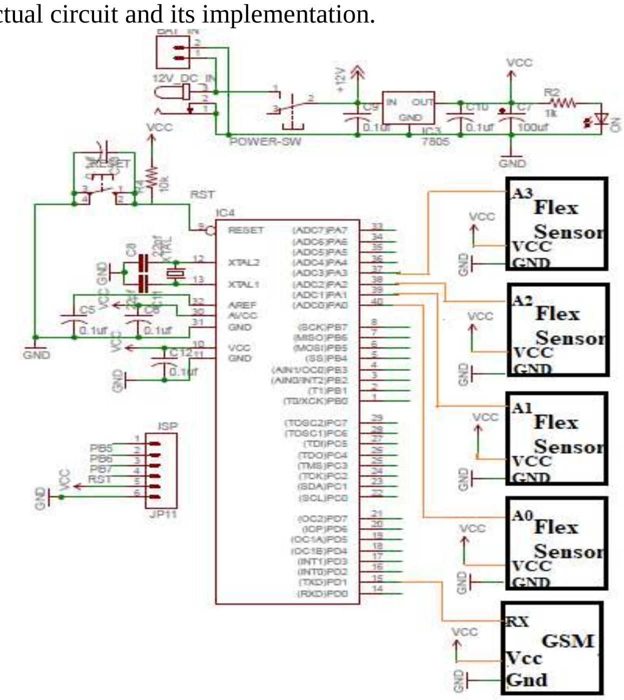

Figure 4.2: Circuit diaram of the proposed system

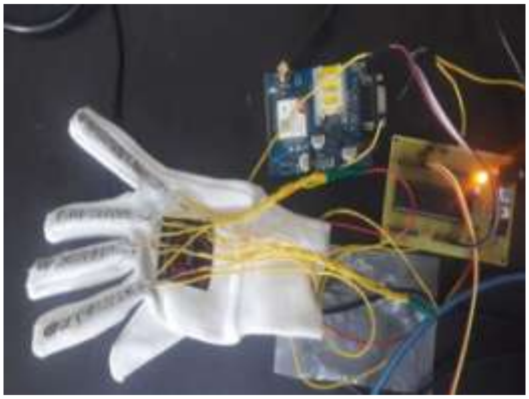

Figure 4.3: Hardware module

Hardware module is shown in figure 4.3 . The structure consist of gloves where flex is weaving interfaced to the AVR board and GSM is connected to the AVR board.For each particular gesture sms is send to the receiver mobile number. Application is installed which provides text to speech facility.

Table I: Analysis of performance of sensor based system.

Sr.No	1	2	3	4	Performance (%)
1					100
2					100
3					100
4					100
5					100
6					100
7					100
8					100
9					75
10					100

In these work the system is trained for a set of 4 Gestures. Based on user interaction with the setup, the experiment is carried out for 10 times and the average recognition rate obtained is 90% across all the gestures. The average recognition rate is found to be 90% for 4 and 100% for rest of the part. Each number is having its own sentence. The number received by phone application converted into sentence. Those sentence is display on Mobile screen and converted into speech.

5. Conclusion

Gesture based communication system using flex sensor is studied and software application is implemented on android studio. Various gesture is recognized by microcontroller and send wirelessly by GSM module. The text to speech application which detect the message and display it on screen. Hardware and software is successfully studied and implemented.

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