

Interacting Device for Deaf & Dumb using Atmega 328 Processor

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Abstract: This interacting device is a large scale microcontroller based system being designed to facilitate the communication among the deaf and dumb communities and their communication with the normal people. This system can be dynamically reconfigured to work as a “smart device”. In this paper, Atmega 328 and sensors based interacting device is presented. The device discussed is basically a data glove and a microcontroller based system. Data glove can detect almost all the movements of a hand and microcontroller based system converts some specified movements into human recognizable voice. The data glove is equipped with two types of sensors: The bend sensors and accelerometers as tilt sensors. This system is beneficial for dumb people and their hands will speak having worn the interacting device data glove.

Keywords: Gesture Recognition, Data Glove, Bend Sensor, Arduino UNO, Atmega 328, Speech Synthesis

1. Introduction

This interacting device is a project for social purpose. We are trying to implement a system which makes a communication gap between deaf peoples and hearing people as less as possible. Deaf people make use of sign language or gestures to make understand what he/she trying to say but it is impossible to understand by hearing people. So, that we come on conclusion to make a simple prototype by taking some of those gesture and convert it into audio and visual form so that they can understand by everyone. For that we are making use of Arduino UNO Board as Atmega 328 Controller board to interface all of the sensors and actuators. This research paper analyses the data from an instrumented data glove for use in recognition of some signs and gestures. A system is developed for recognizing these signs and their conversion into speech

2. Previous work

Many scientists are working in the field of gesture recognition. A wonderful and latest survey of the work done in this field is described in reference [1]. Reference [2] and [3] discuss the gesture recognition for human robot interaction and human robot symbiosis. Reference [4] offers a novel “signal-level” perspective by exploring prosodic phenomena of spontaneous gesture and speech co-production. It also presents a computational framework for improving continuous gesture recognition based on two phenomena that capture voluntary (co-articulation) and involuntary (physiological) contributions of prosodic synchronization. Reference [5] discusses different categories for gesture recognition. Markov models are used for gesture recognition in reference [6] and [7]. A comprehensive framework is presented that addresses two important problems in gesture recognition systems in [8]. An augmented reality tool for vision based hand gesture recognition in a camera-projector system is described in reference [9]. A methodology using a neighborhood-search algorithm for tuning system parameters for gesture recognition is addressed in [10]. A novel method is introduced to recognize and estimate the scale of time-varying human gestures in [11].

3. Methodology

Block diagram of the system is shown Fig.1. The System is consisted of following modules

- Data Glove using ADXL 335
- Atmega 2328 p-pu Micro-Processor
- Speech Synthesis
- LCD Display

Basically an Artificial Neural Network is the concept of our prototype. Some sensors are placed on the hand of deaf people which converts the parameter like finger bend hand position angle into electrical signal and provide it to Atmega 328 controller and controller take action according to the sign.

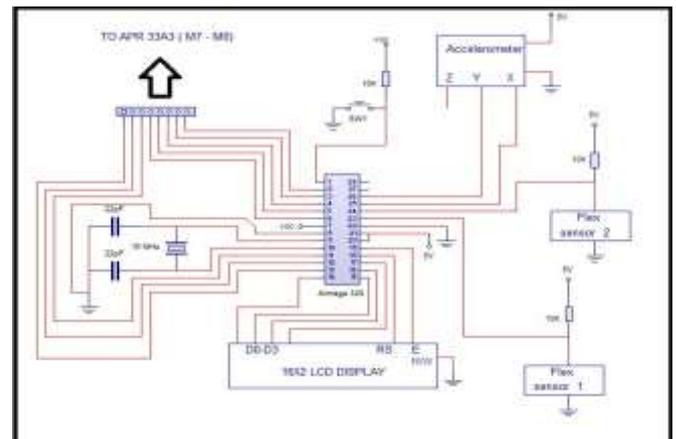


Figure 1: Block Diagram of the System

4. System Description

4.1 Data Glove using ADXL 335

Data glove is consisted of two sensors; bend sensors and tilt sensor

4.1.1 Bend sensor

In this research setup data glove is equipped with five bend sensors, each of the bend sensor is meant to be fixed on each of the finger of the hand glove for the monitoring and sensing of static movements of the fingers of the hand. The bend sensor is made by using 555 timer IC in a stable mode along with a photo transistor. The output of the bend sensor is a square wave. Frequency of this output wave varies with the bending of the bend sensor. Circuit diagram of bend sensor is shown below in Fig.2. Each bend sensor has its own square output which is required to be transferred to the third module of the system where pulse width of the output of each bend sensor is calculated with the help of microcontroller.

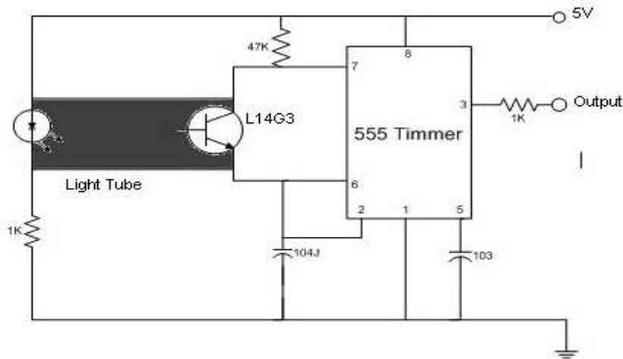


Figure 2: Circuit Diagram of Bend Sensor

4.1.2 Tilt Sensor

Accelerometer in the Gesture Vocalizer system is used as a tilt sensor, which checks the tilting of the hand. ADXL103 accelerometer is used in the system, the accelerometer has an analog output, and this analog output varies from 1.5 volts to 3.5 volts. The output of the accelerometer is provided to third module, which includes pipeline structure of two ADC's. There is a technical issue at this stage of the project that is if we convert the analog output of the accelerometer, which ranges from 1.5 volts to 3.5 volts to a digital 8-bit output the systems become very sensitive. Reason is division of 2 volts range into 256 ($2^8 = 256$) steps is much more sensitive than converting 5 volts range into 256 steps. Now the question arises, why do we need a less sensitive system, the answer if a more sensitive system is used then there is a huge change in the digital output with the very little tilt of the hand, which is difficult to be handled. Solution to this problem is to increase the range of the output of the accelerometer by using an additional circuitry. This additional circuitry increases the range of the accelerometer from 2 volts range to 5 volts range.

4.2 Atmega 328 p-pu Microcontroller

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughputs approaching 1 MIPS per MHz

Here we learn to burn boot loader on blank Atmega 328 chips using Arduino IDE and Arduino UNO.

Here we are using Arduino UNO as an interface to boot load the Atmega 328 microprocessor. We can implement this project using Arduino UNO but we are eliminating the continuous use of Arduino UNO because of high power consumption. Figure 3 will show how Arduino UNO will be connected to empty Atmega 328 micro controller

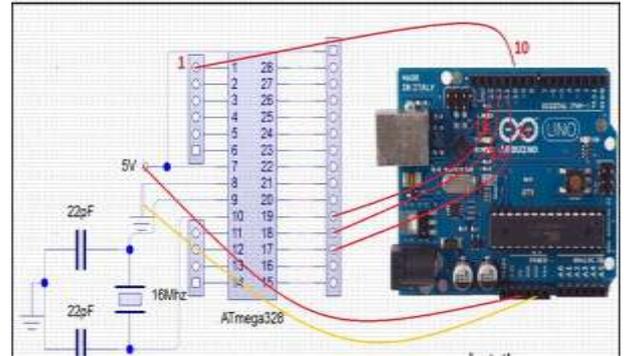


Figure 3: Connection of Atmega 328 with Arduino UNO

The Arduino UNO is connected with empty Atmega 328 controller, We connect Arduino UNO with the PC using USB Cable. Now, we will boot load the Atmega 328 chip using Arduino IDE. Once the Atmega 328 chip is ready, we will upload the code and the chip is ready for the operation.

4.3 Speech Synthesis.

This module of the system is consisted of a APR33A3 Audio Processor IC, and a speaker. The function of this module is to produce voice against the respective gesture. The microcontroller receives the eight bit data from the "bend detection" module. It compares the eight bit data with the predefined values. On the basis of this comparison the microcontroller comes to know that which gesture does the hand make.

4.4 LCD Display

By using the gesture vocalizer the dumb people can communicate with the normal people and with the Deaf people as well, but the question arises that how can the dumb people communicate with the deaf people. The solution to this problem is to translate the gestures, which are made by the hand, into some text form. The text is display on LCD. The gestures are already being detected by the "Gesture Detection" module. This module sends signal to the speech synthesis module, the same signal is sent to the LCD display module. The LCD display module is consisted of a microcontroller and an LCD. The microcontroller is controlling the LCD. A signal against each gesture is received by LCD display module. The LCD display module checks each signal, and compares it with the already stored values. On the basis of this comparison the microcontroller takes the decision what should be displayed, having taken the decision the microcontroller send an eight bit address to the LCD, this eight bit address, tells the LCD, what should be displayed. Figure 4 will represent the LCD Display which we are using for our project

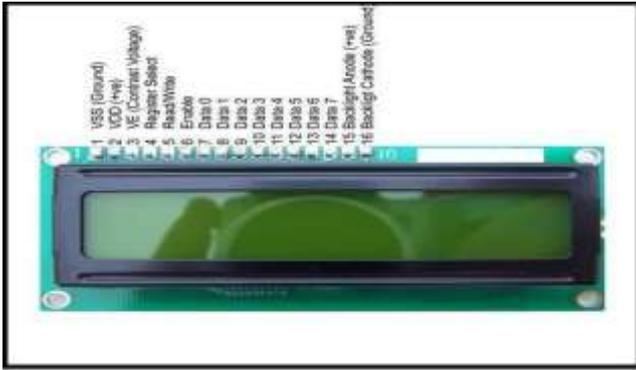


Figure 4:LCD Display

5. Conclusion

This research paper describes the design and working of a system which is useful for dumb & deaf people to communicate with one another and with the normal people. The dumb people use their standard sign language which is not easily understandable by common people and dumb people cannot see their gestures. This system converts the sign language into voice which is easily understandable by dumb and normal people. The sign language is translated into some text form, to facilitate the deaf people as well. This text is display on LCD.

6.Future Enhancements

There can be a lot of future enhancements associated to this research work, which includes:

- 1- Designing of wireless transceiver system for "Microcontroller and Sensors Based Gesture Vocalizer".
- 2- Perfection in monitoring and sensing of the dynamic movements involved in "Microcontroller and Sensors Based Gesture Vocalizer".
- 3- Designing of a whole jacket, which would be capable of vocalizing the gestures and movements of animals.
- 4- Virtual reality application e.g., replacing the conventional input devices like joy sticks in videogames with the data glove.
- 5- The Robot control system to regulate Machine activity at remote sensitive sites.

References

- [1]. Sushmita Mitra and Tinku Acharya,"Gesture Recognition: A Survey", *IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS*, VOL. 37, NO. 3, MAY 2007, pp. 311-324
- [2]. Seong-Whan Lee, "Automatic Gesture Recognition for Intelligent Human-Robot Interaction" *Proceedings of the 7th International Conference on Automatic Face and Gesture Recognition (FGR'06)* ISBN # 0-7695- 2503-2/06
- [3]. Md. Al-Amin Bhuiyan, "On Gesture Recognition for Human-Robot Symbiosis", *The 15th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN06)*, Hatfield, UK, September 6-8, 2006, pp.541-545
- [4]. Sanshzar Kettebekov, Mohammed Yeasin and Rajeev Sharma, "Improving Continuous Gesture Recognition with Spoken Prosody", *Proceedings of the 2003 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'03)*, ISBN # 1063-6919/03, pp.1-6

- [5]. Masumi Ishikawa and Hiroko Matsumura, "Recognition of a Hand-Gesture Based on Selforganization Using a Data Glove", ISBN # 0-7803- 5871-6/99, pp. 739-745
- [6]. Byung-Woo Min, Ho-Sub Yoon, Jung Soh, Yun- Mo Yang, and Toskiaki Ejima, "Hand Gesture Recognition Using Hidden Markov Models", ISBN # 0- 7803-4053-1/97, pp.4232-4235
- [7]. Andrew D. Wilson and Aaron F. Bobick, "Parametric Hidden Markov Models for Gesture Recognition", *IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE*, VOL. 21, NO. 9, SEPTEMBER 1999, pp. 884-900
- [8]. Toshiyuki Kirishima, Kosuke Sato and Kunihiko Chihara, "Real-Time Gesture Recognition by Learning and Selective Control of Visual Interest Points", *IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE*, VOL. 27, NO. 3, MARCH 2005, pp. 351-364
- [9]. Attila Licsár and Tamás Szirány, "Dynamic Training of Hand Gesture Recognition System", *Proceedings of the 17th International Conference on Pattern Recognition (ICPR'04)*, ISBN # 1051- 4651/04,
- [10]. Juan P. Wachs, Helman Stern and Yael Edan, "Cluster Labeling and Parameter Estimation for the Automated Setup of a Hand-Gesture Recognition System", *IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART A: SYSTEMS AND HUMANS*, VOL. 35, NO. 6, NOVEMBER 2005, pp. 932-944
- [11]. Hong Li and Michael Greenspan, "Multi-scale Gesture Recognition from Time-Varying Contours", *Proceedings of the Tenth IEEE International Conference on Computer Vision (ICCV'05)*

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