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Audio/Text Aided System Using Sign Language

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ABSTRACT

This paper presents an intelligent system allowing handicapped aphasiacs to perform basic communication tasks.

It has the following features:A 2-sensor data measures the hand gestures of a patient in terms of the bending degrees of his hands,A hand language recognition subsystem recognizes language components from the hand gestures. It employs multiple regression analysis to automatically extract proper hand features so that the recognition model can be fast and correctly constructed by a radial basis function neural network,A coordinate-indexed virtual keyboard allows the users to directly access the letters on the keyboard at a practical speed. The system serves as a viable tool for natural and affordable communication for handicapped aphasiacs through continuous hand language input.

Keywords - ASL,Atmega328,Accelerometer,proposed gesture based recognition system,Text-to-speech synthesis module.

I. INTRODUCTION

Deaf-mute people need to communicate with normal people for their daily routine. The deaf-mute people throughout the world use sign language to communicate with other people. However, it is possible only for those who have undergone special training to understand the language. Sign language uses hand gestures and other means of non-verbal behaviors to convey their intended meaning [9]. It involves combining hand shapes, orientation and hand movements, arms or body movement, and facial expressions simultaneously, to fluidly express speaker's thoughts. The idea is to create a audio/text aided system using sign language , using which the information gestured by a deaf-mute person can be effectively conveyed to a normal person[2].

Disabled people suffering from severe impairments usually face an acute problem: most common interaction modalities are unavailable and their communication capabilities are limited. In fact, it can be very frustrating for them to interact with the people. They require and expect ASL (American sign language) systems to partly alleviate physical limitations.

In this project we design a useful and fully functional sensor based system that efficiently translates the movement of the hands into the speech.

It contains two modules
1.Sensor based gesture recognition system
2.text-to-speech engine

2. LITERATURE SURVEY

A. Vision -based gesture recognition system

In a vision-based gesture recognition system, a camera is used for capturing the image/video of the gesture and it is shown in Figure. 1. The captured content is sent to the image processing unit where it is processed through image processing techniques. Features are extracted and the extracted features are trained using static images for which the corresponding gestures are recognized using various image recognition algorithms [1].

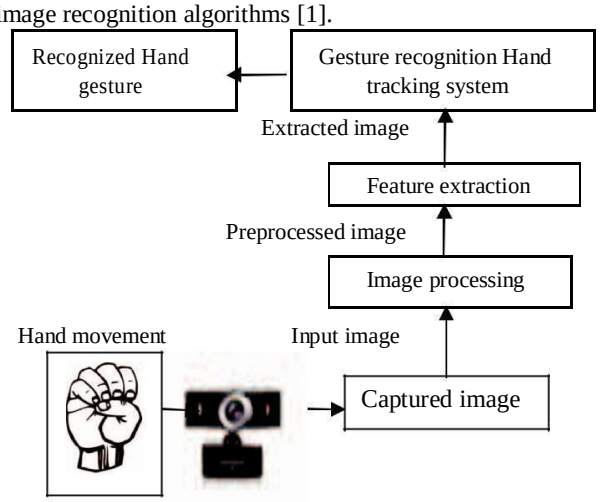


Figure.1 Vision based system

Compared to vision-based system sensor-based gesture recognition system is sensitive and more accurate as it gives full degree of freedom for hand movement. The sensor-based approach is advantageous over vision-based system, since it requires only a motion sensor rather than a camera that makes it as a portable device with low cost. It also provides fast response in recognizing the gestures which in turn reduce the computational time in real time applications[2].

B. American sign language

The block diagram of multimodel ASL recognition system is shown in Figure.2. Two phases are included: training phase and testing phase. In the training phase, the signals from 3-D accelerometer (ACC), 3-D gyroscope (GYRO), and four channel sEMG are preprocessed for noise rejection and synchronization purposes. The sEMG based auto-

segmentation technique obtains the beginning and ending of a sign for both IMU and sEMG. As the segmentation is done, a broad set of well established features are extracted for both IMU and sEMG signals. All extracted features are then put into one feature vector.

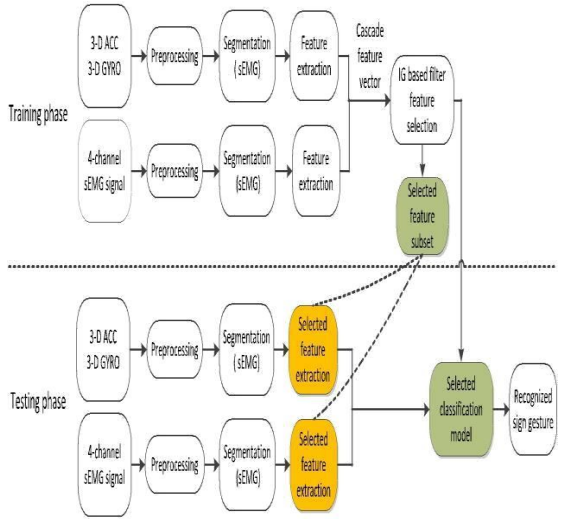


Figure.2 ASL system

The best feature subset is obtained using an information gain (IG)-based feature selection scheme. Four different classifiers are evaluated (i.e., DT, support vector machine, Native, and nearest neighbor (NN)) on the selected feature subset and the best one is selected. In the testing phase, the same techniques are repeated for preprocessing and segmentation. The selected features are extracted and recognition of the sign is achieved by the chosen classifier[3].

When compared to sensor based system ASL provides an array of modern tools and technologies that has been developed worldwide to assist the disabled, they still have some drawbacks,

(a) Most of them are imported and expensive.

(b) They are not tailored to local socio cultural contexts.

3. PROPOSED SYSTEM

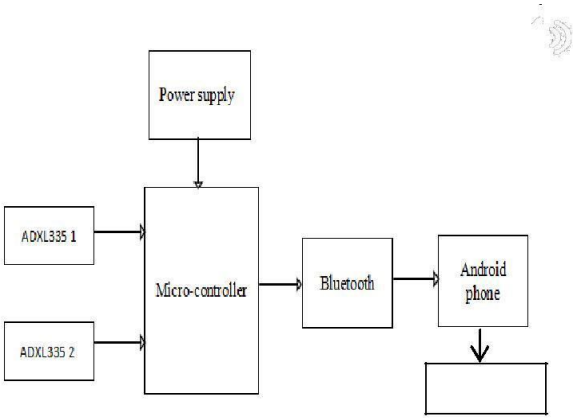


Figure.3 Block diagram of proposed system

In the proposed system,The ADXL335 detects the positions of each hand by monitoring the bending of the TILT sensor. Below is a summary of what we did and why: Accelerometer onto fingers to more accurately detect the bending and movement of the components,Send sensor circuit output to MCU A/D converter to parse the finger positions,

Implement Teach mode. In Teach mode, the user "teaches" the MCU ASL using hand gestures. To prevent data corruption, A/D converter output and the associated user specified word can be trained at any point of time using UART,Pre stored word will be activated while making the hand movements and will be sent to android phone using Bluetooth,Once received the text data is converted to speech using android apk developed with text to speech engine.

4.HARDWARE IMPLEMENTATION

A. *Atmeaga 48 micro-controller*

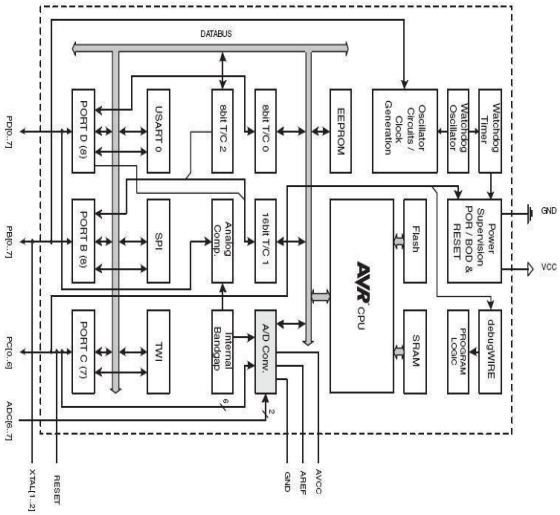


Figure.4 Block diagram of ATmega 48 micro-controller

The ATmega48 is a low-power CMOS 8-bit micro-controller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega88 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC micro-controllers.

B.*Power supply*

Power supply is used to energies the equipments such as micro-controller, relay, level converter, GSM and GPS module. The power supply is used to energies the whole module. The power supply can be in the form of wired or battery. In our project 12V battery is used as a power supply.

C.*LM7805C Voltage Regulator*

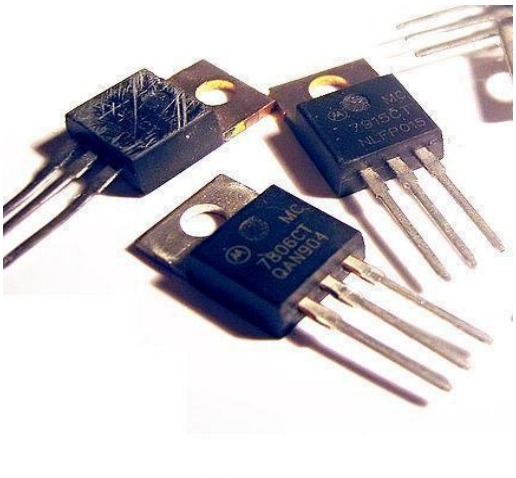


Figure.5 Voltage regulator

A voltage regulator based on an active device (such as a bipolar junction transistor, field effect transistor or vacuum tube) operating in its "linear region" and passive devices like zener diodes operated in their breakdown region.

The regulating device is made to act like a variable resistor, continuously adjusting a voltage divider network to maintain a constant output voltage.

D. Crystal Oscillator-4MHz

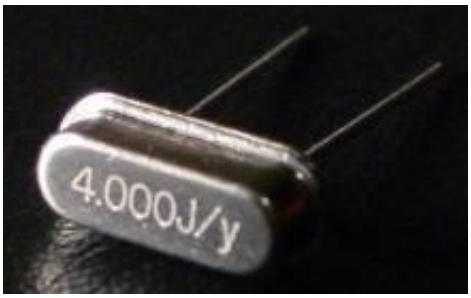


Figure.6 Crystal Oscillator

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers.

The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them were called "crystal oscillators".A crystal is a solid in which the constituent atoms, molecules, or ions are packed in a regularly ordered, repeating pattern extending in all three spatial dimensions.

E.*ADXL335*

Figure.7 Triple Axis Accelerometer ADXL335

Breakout board for the 3 axis ADXL335 from Analog Devices. This is the latest in a long, proven line of analog sensors - the holy grail of accelerometer. The ADXL335 is a triple axis MEMS accelerometer with extremely low noise and power consumption - only 320uA! The sensor has a full sensing range of +/-3g.There is no on-board regulation, provided power should be between 1.8 and 3.6VDC.Board comes fully assembled and tested with external components installed. The included 0.1uF capacitors set the bandwidth of each axis to 50Hz.

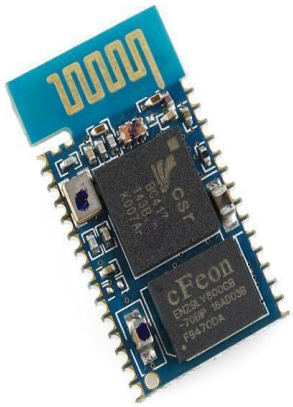


Figure.8 Bluetooth SDM module Rayson BTM-182 **F.Bluetooth**

This module is the Rayson BTM-182. It is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. This is a fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps

modulation with complete 2.4GHz radio transceiver. It uses CSR Bluecore 04 external single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping).

The experimental set-up for gesture recognition is shown in Figure. 3 and the steps involved in sign language to speech conversion are described as follows:

Step1: The accelerometer sensors are mounted on the glove and they are fitted along the length of each of the fingers.

Step2: Depending upon the bend of hand movement different signals corresponding to x-axis and z-axis are generated.

Step3:Accelerometer sensors outputs the data stream depending on the degree and amount of bend produced, when a sign is gestured [10].

Step4: The output data stream from the accelerometer sensors are fed to the Arduino micro-controller, where it is processed and then converted to its corresponding digital values.

Step5: The micro-controller unit will compare these readings with the pre-defined threshold values and the corresponding gestures are recognized and the corresponding text is displayed.

Step6: The text output obtained from the sensor based system is sent to the text-to-speech synthesis module.

Step7: The TTS system converts the text output into speech and the synthesized speech is played through a speaker.

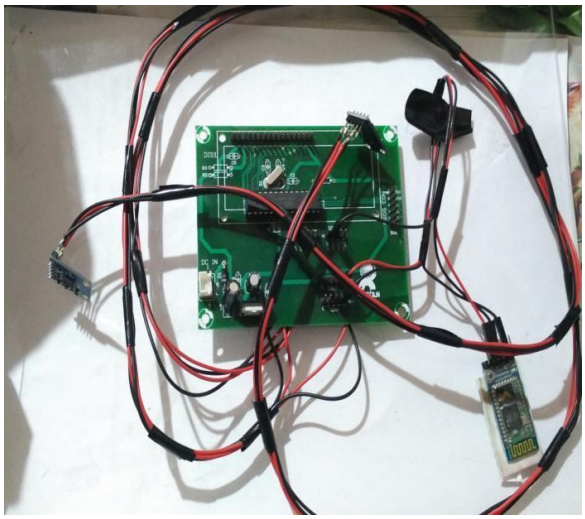


Figure.9 System setup

5.FLOW CHART

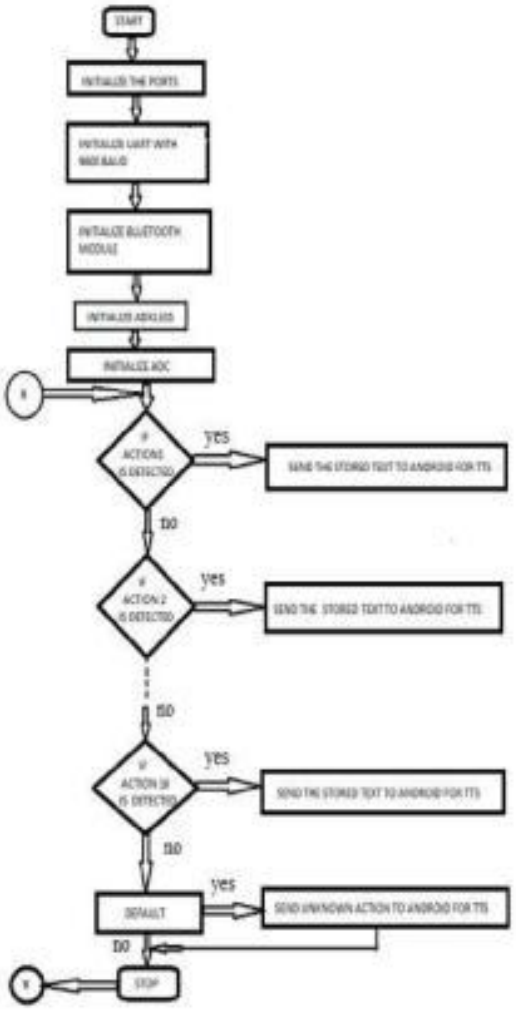


Figure.10 Flow chart

Initialize the ports,the ports are bi-directional I/O ports with optional internal pull-ups

Initialize UART with 9600 Baud,UART is used to connect bluetooth to micro-controller,Baud is a common measure of the speed of communication over a data channel.

Initialize the bluetooth module ,to use it we have to initialize before only,it is easy to use bluetooth serial port profile module designed for transparent wireless serial connection setup.

Initialize ADXL335,it is a triple axis accelerometer with extremely low noise and power consumption.

Initialize ADC,i.e,analog to digital converter,there are total six channels only one sensor can work at a time.

If Action 1 is detected then it send the stored text to android for corresponding sixteen signal sixteen messages are

detected based on that messages are sent .If other action is detected then it send default message to the android.

6. RESULTS AND ANALYSIS

TABLE I. Sensor based values for the predefined gestures

.

HAND1	X1	Z1	HAND2	X2	Z2	Msg
⇕	<310	<340		<310	<340	Msg 1
⇑	<310	<340		>320	>370	Msg 2
⇑	<310	<340	⇐	<345	<280	Msg 3
⇑	<310	<340		>360	>345	Msg 4
⇓	>320	>370		<310	<340	Msg 5
⇓	>320	>370		>320	>370	Msg 6
⇓	>320	>370		<345	<280	Msg 7
⇓	>320	>370		>360	>345	Msg 8
⇐	<345	<280		<310	<340	Msg 9
⇐	<345	<280	⇓	>320	>370	Msg 10
⇐	<345	<280	⇐	<345	<280	Msg 11
⇐	<345	<280	⇒	>360	>345	Msg 12
⇒	>360	>345		<310	<340	Msg 13
⇒	>360	>345		>320	>370	Msg 14
⇒	>360	>345	⇐	<345	<280	Msg 15
⇒	>360	>345	⇒	>360	>345	Msg 16

For the above table the system will go through the following steps to get the proper and corresponding message as output that will be played & view through the android.

1. Gesture Recognition

Gesture recognition is the mathematical interpretation of human motion by a computing device.

When we make hand movement the corresponding gesture will be recognized by the tilt sensor.

2. Gesture Preprocessing

Preprocessing is a procedure of formulating data for another process the hand gestures can be observed with the different kind of interfaces like data gloves.

For the signal which is already sent to the micro -controller which has inbuilt ADC ,it gives the digital count for the signal.

3. *Classification*

For the corresponding gesture,angles in X1,Z1,X2&Z2 are classified with the predefined messages.

4. *Feature Extraction*

The low level information from the raw data is analyzed in order to produce higher-level semantic information and are used to recognize postures and gestures.

Based on readings in the above table signals will be extracted And the corresponding text will be displayed in the android phone through the text-to-speech application and will be played through the speaker.

A.TEXT-TO-SPEECH APPLICATION

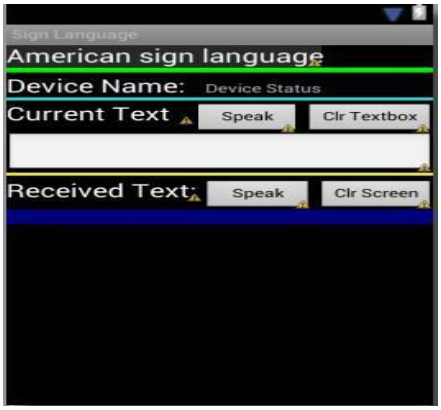
Text-to-Speech application is built in android phone. Android is basically an operating system for smart phones.

But we find now integrated into PDAs, touch pads (tablets), televisions, even cars infotainment system. The OS was created by the start-up of the same name, which is owned by Google since 2005,All the required tools to develop Android applications are freely available and can be downloaded from the Web. Following is the list of software's you will need before you start your Android application programming.

- Java JDK5 or greater
- Android SDK
- Eclipse IDE for Java Developers (optional)
- Android Development Tools (ADT) Eclipse Plugin (optional)

Gesture Acquistion

Based on the gesture the tilt sensor measures the bending angle and single will be sent to the micro-controller



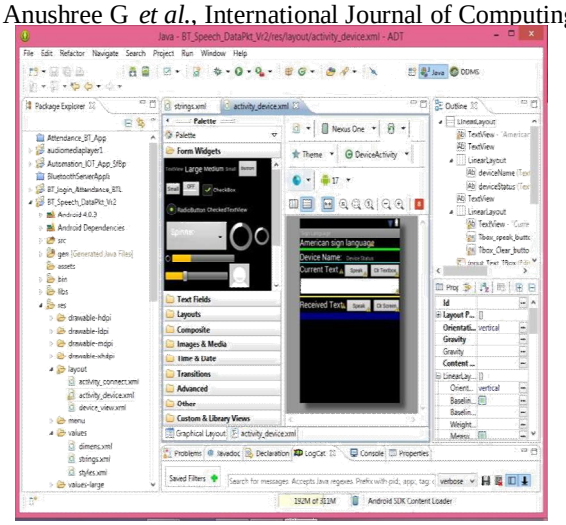


Figure.12 Android SDK Screen

Text obtained from the micro-controller will be sent TTS engine in the android phone via Bluetooth SPP if both the Bluetooth devices are paired then the corresponding text will be converted to speech and will be displayed on the screen and the speech is played through the speaker otherwise it will again check for the paired devices.

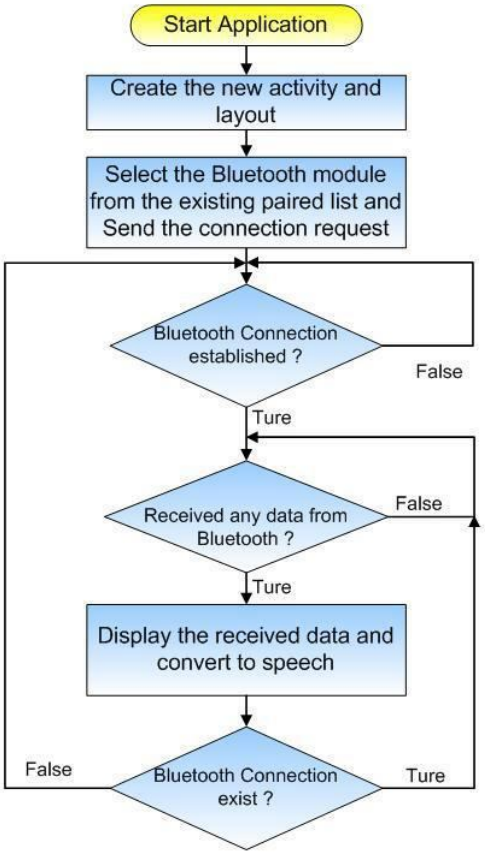


Figure.13 Speech app control flow

7.APPLICATIONS AND ADVANTAGES

Applications are as follows:

1) Used in hand gesture based automobiles
2) Used in war fields
3) Gesture based joysticks

Advantages:

1) Much easier to get control.
2) Both risk and liability is reduced.
3) It is flexible enough to be used from any location.24 hrs/Day and 7 days a week.

8 CONCLUSION

As the saying goes “Necessity is the mother of all inventions”, a need for software which would control process and devices was recognized.

The design approach used here has given satisfactory results and the micro-controller is sufficient for measuring the required parameters. The power consumption has been kept as low as possible and the measurements made by the device are quite reliable. Accordingly a highly interactive user friendly module based embedded technology with micro-controllers was developed to solve the problem. The module which is developed will make the job of process easier. The user module has resulted in reducing work of human also makes more comfortable.

The module is, therefore functioning as a very good tool. Incorporating the future enhancement as specified earlier would make the software a perfect tool, which would help the user.

9 FUTURE ENHANCEMENT

The following modifications can be made to present circuit , which lead to still smarter project.

1. The module can be equipped with a faster and more capable micro-controller to integrate control of many more devices at the same time.

2. Another further intended development is to introduce time controlled devices for use in commercial spaces. This, for example could be the control of a large display in a showroom between two different intervals of time, without the intervention of any user or technician.

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