SMART GLOVE FOR SIGN LANGUAGE CONVERTION

SUBMITTED BY

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IN PARTIAL FULFILLMENT OF REQUIREMENT FOR THE AWARD OF DEGREE OF

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

DIVISION OF ELECTRICAL ENGINEERING

SCHOOL OF ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN-682022

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ABSTRACT

This report is on the implementation of "SMART GLOVE FOR SIGN LANGUAGE CONVERSION". Roughly 27.8% of the total population of India can't either hear or speak. Sign language is a non-verbal form of communication method which is found among all deaf and dumb communities. Normal people do not learn sign language, it causes barriers in communication between deaf and dumb people. Hence to break this barrier we design a system which converts hand gestures into auditory speech as well as text. The system is being proposed with use of flex sensors and android technology. There are 2 modules, first is a glove with flex sensors and Atmel ATMEGA328 PU microcontroller and second is an android app with Google speech API.

CONTENTS

1.INTRODUCTION

INTRODUCTION

About eighteen million people in the planet are dumb or deaf. The communication between a dumb and hearing person becomes difficult because sign languages are unknown to normal people. Also, even the communication among deaf people are a bit hard due the disparities of sign languages from nation to nation. This creates an extremely little house for them, with communication being an associate degree for elementary aspect of human life. The languages haven't got a typical origin and hence are hard to interpret. A dumb communication interpreter is also a tool that interprets the hand gestures to sensible speech.
The primary aim of this paper is to introduce an issue that will efficiently translate hand gestures into its equivalent textual and voice representation. The interpreter makes use of a glove totally based on the technique comprising of flex sensors. For each hand gesture created by the right hand, 5 sets of voltage combinations are formed by the sensors for further processing in the microcontroller. Then the controller matches the gesture with pre-stored inputs. The output is brought with the help of an android smartphone using an android app.

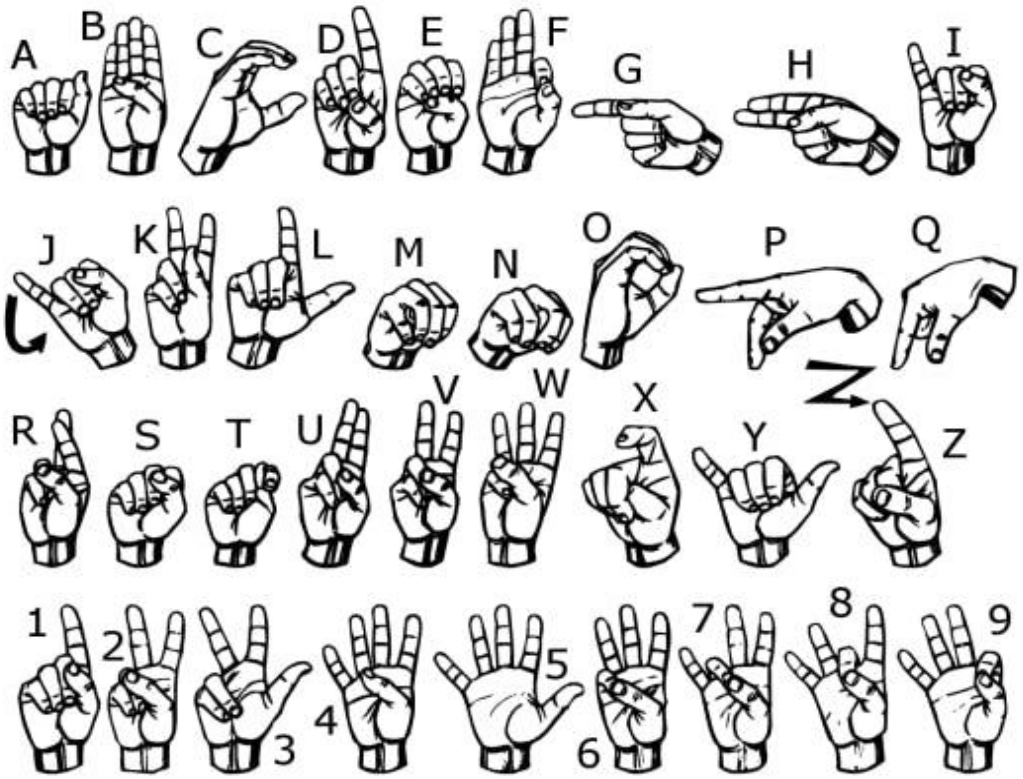

FIGURE 1

2. BLOCK DIAGRAM & DESCRIPTION

2.1) BLOCK DIAGRAM

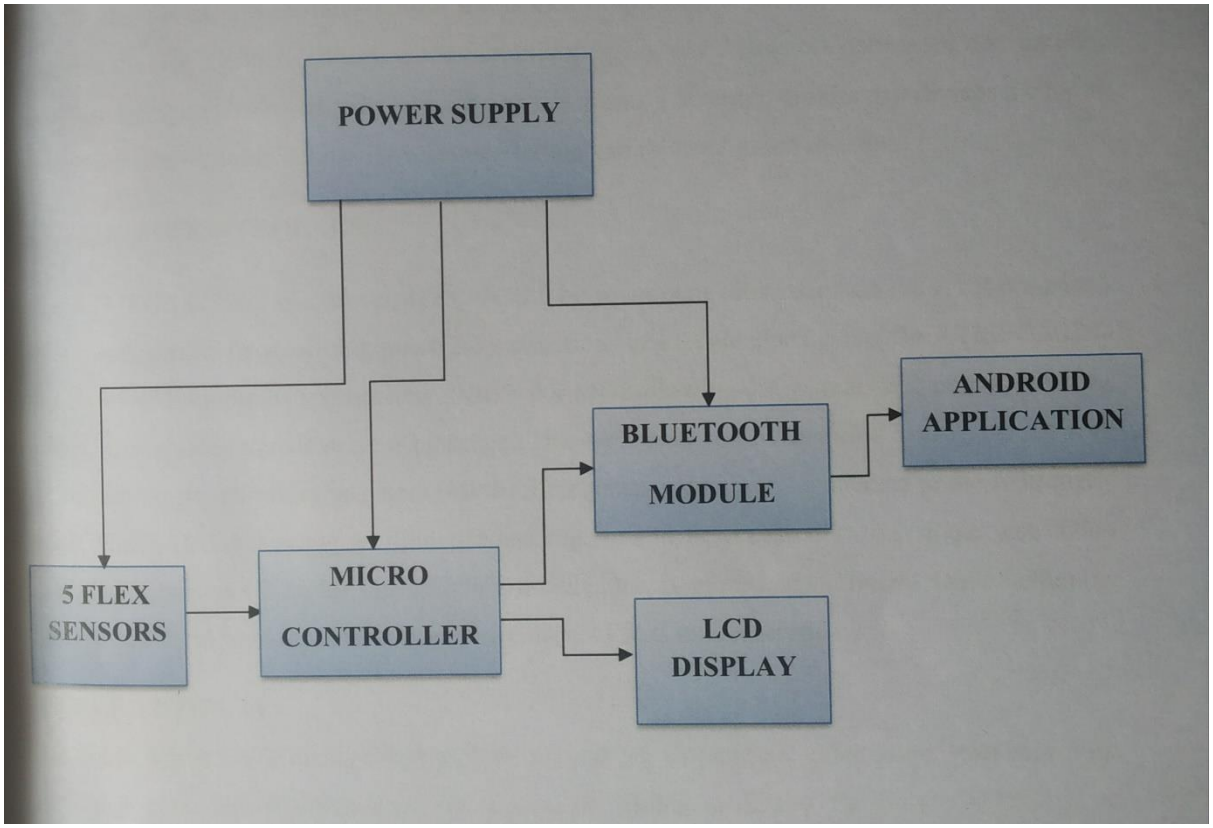

FIGURE 2

2.2) BLOCK DIAGRAM DESCRIPTION

2.2.1) POWER SUPPLY

The power supply is designed to convert high DC voltage to low DC voltage for the electronic devices used in the circuit. The main power source of the circuit is 12V battery. But the most of the devices used in the circuit work on 5V DC supply. So we use 7805 Voltage regulator to covert 12V DC supply to 5V DC supply which in turn powers the Flex sensors and Microcontroller. The Bluetooth module and LCD Display are powered by microcontroller

2.2.2) FLEX SENSORS

Flex sensors are resistive carbon parts. When bent, the device develops a resistance output correlative to the bend radius. The variation in resistance is just about 10kΩ to 30kΩ. A global organization flexed device has 10kΩ resistance and once bent the resistance will increase to 30kΩ at 90o. The device incorporates within the device employing a potential divider network. The potential divider is employed to line the output voltage across 2 resistors connected non-parallel as shown in Figure 2. The electrical device and flex forms a potential divider that divides the input voltage by a quantitative relation determined by the variable and glued resistors.

2.2.3) MICROCONTROLLER

The ATMEGA328-PU is a low power CMOS 8 bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATMEGA328-PU achieves throughputs approaching 1MIPS per MHz allowing the system designed 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 microcontrollers.

2.2.4) LCD.DISPLAY

We come across LCD displays everywhere around us. Computers, calculators, television sets, mobile phones, digital watches use some kind of display to display the time. An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7-pixel matrix.

2.2.5) BLUETOOTH MODULE

It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used

in a master or slave configuration. HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

2.2.6) ANDROID APPLICATION

In this project we are using an Android application for text to speech conversion. The microcontroller interprets the hand gesture and generate respective messages. These messages are send to the Android app through Bluetooth. The app converts these text messages to the respective audio messages which are transmitted by the phone's speakers

3.COMPONENTS LIST AND SPECIFICATION

COMPONENTS LIST & SPECIFICATION

3.1) ATMEGA 328PU

This microcontroller is considered as the heart of the project. **ATmega328** is an 8-bit and 28 Pins AVR Microcontroller, manufactured by Microchip, follows RISC Architecture and has a flash type program memory of 32KB.It has an EEPROM memory of 1KB and its SRAM memory is of 2KB,8 Pin for ADC operations, which all combines to form Port A (PA0 – PA7). It also has 3 built in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer. It operation ranging from 3.3V to 5.5V but normally we use 5V as a standard.

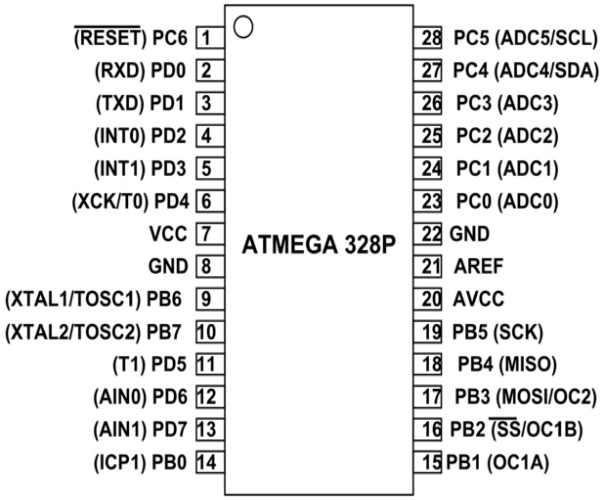

FIGURE 3

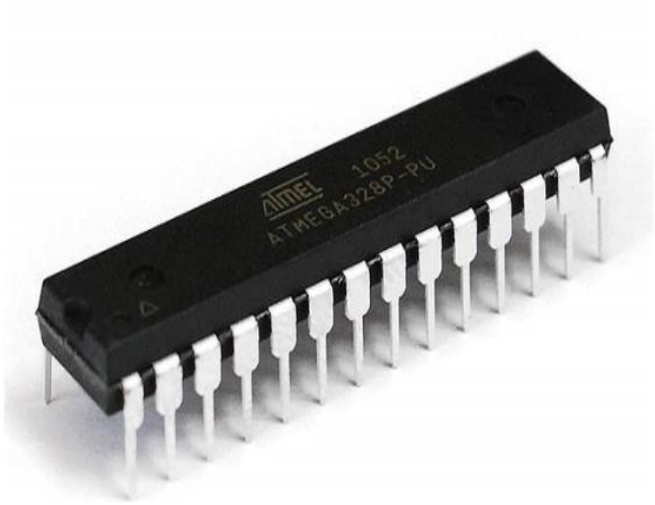

FIGURE 4

We use Arduino nano which is a development board which uses ATMEGA 328PU as the microcontroller. The Arduino Nano is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all Arduino boards and running both online and offline

FIGURE 5

3.2) FLEX SENSORS

FLEX SENSOR is basically a VARIABLE RESISTOR whose terminal resistance increases when the sensor is bent. So this sensor resistance increases depends on surface linearity. So it is usually used to sense the changes in linearity**.** Flex sensors are usually available in two sizes. One is 2.2 inch and another is 4.5 inch. Although the sizes are different the basic function remains the same. They are also divided based on resistance. There are LOW resistance, MEDIUM resistance and HIGH resistance types. Choose the appropriate type depending on requirement. FLEX SENSOR terminal resistance changes when it is bent.

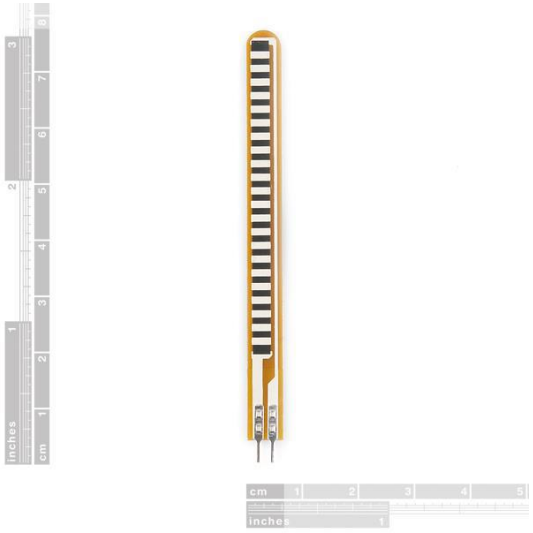

FIGURE 6

3.2.1) Pin description

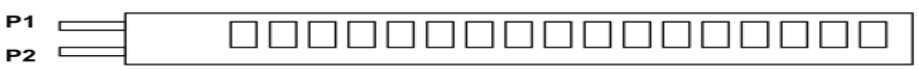

FIGURE 7

PIN NUMBER	DESCRIPTION
P1	Usually connected to positive of power source
P2	Usually connected to ground

TABLE 1

3.2.2) Features and Specifications

- Operating voltage of FLEX SENSOR: 0-5V
- Can operate on LOW voltages
- Power rating : 0.5Watt (continuous), 1 Watt (peak)
- Life: 1 million
- Operating temperature: -45ºC to +80ºC
- Flat Resistance: 25K Ω
- Resistance Tolerance: ±30%
- Bend Resistance Range: 45K to 125K Ohms(depending on bend)

3.2.3) WORKING

FIGURE 8

As shown above figure, when the surface of flex sensor is completely linear it will be having its nominal resistance. When it is bent 45º angle the flex sensor resistance increases to twice as before. And when the bent is 90º the resistance could go as high as four times the nominal resistance. So, the resistance across the terminals rises linearly with bent angle. So, in a sense the flex sensor converts flex angle to resistance parameter.

3.3) LCD DISPLAY

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators.16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD.

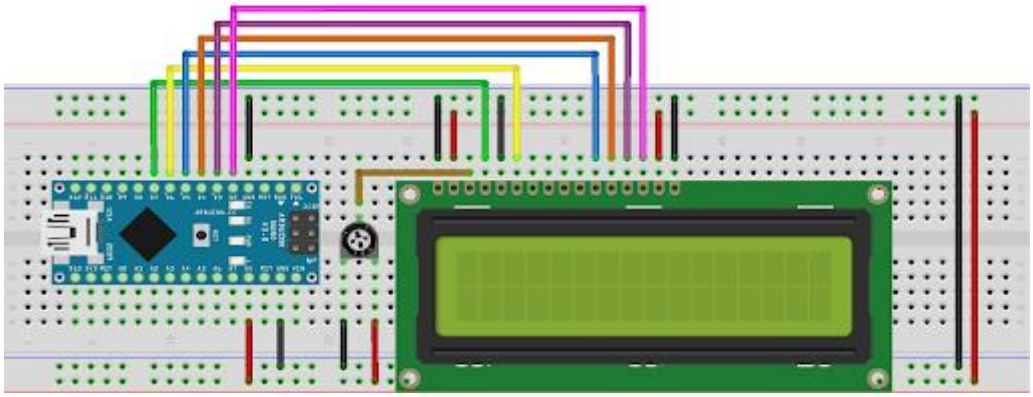

FIGURE 9

3.3.1) FEATURES

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters
- Each character is built by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

3.4) BLUETOOTH MODULE HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

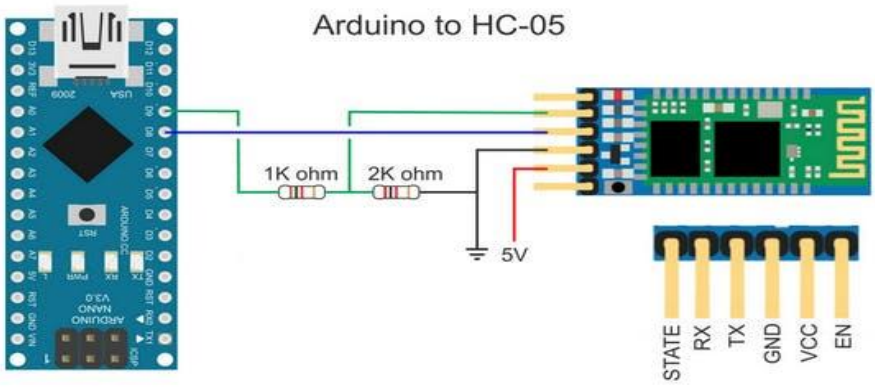

FIGURE 10

3.4.1) FEATURES

- Serial Bluetooth module for Arduino and other microcontrollers

- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30Ma
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode

3.5) 7805 VOLTAGE REGULATOR

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC).7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

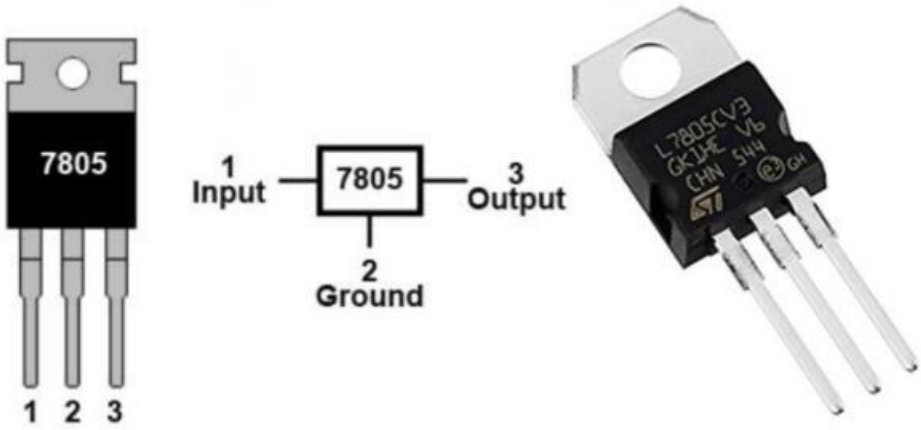

FIGURE 11

3.6) ACCELEROMETER ADXL335

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. Measures acceleration with a minimum full-scale range of ±3g.It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

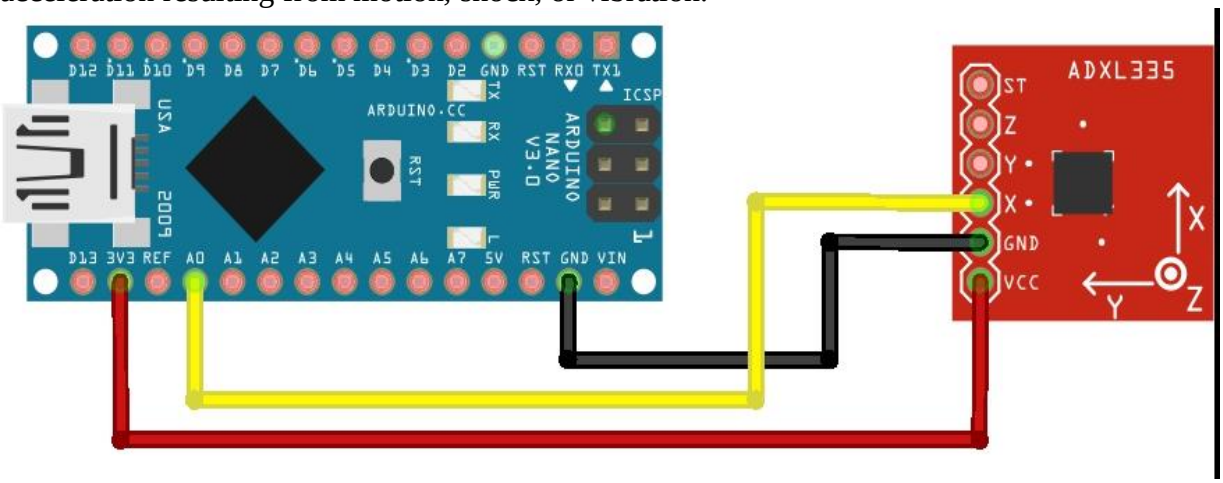

FIGURE 12

4) CIRCUIT DIAGRAM AND EXPLAINATION

4.1) CIRCUIT DIAGRAM AND EXPLAINATION

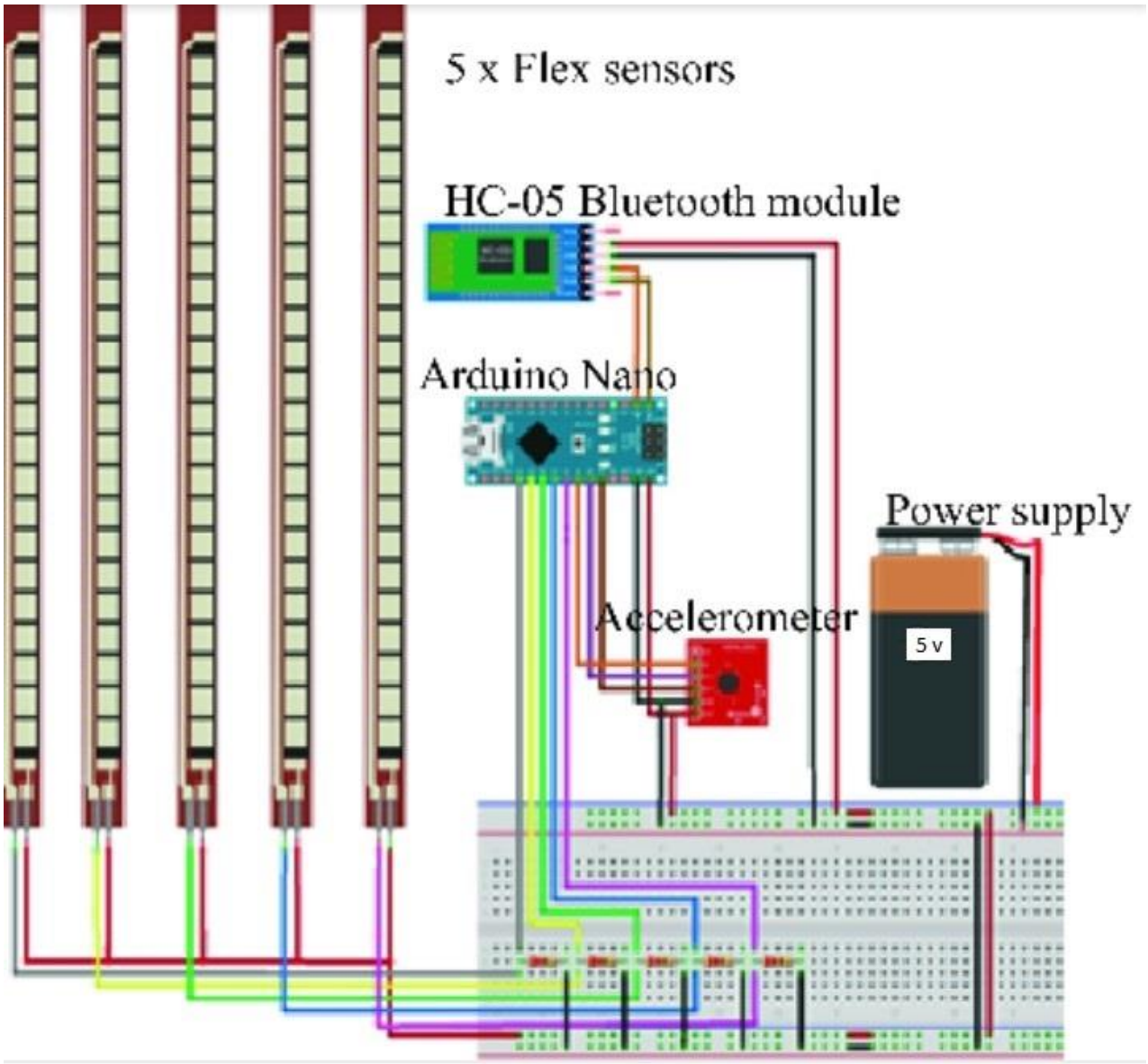

FIGURE 13

5) SOFTWARE SECTION

5) SOFTWARE SECTION

5.1) ARDUINO IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards.
The source code for the IDE is released under the GNU General Public License, version 2.
The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main ( )* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.
The Atmega328p microcontroller, like any other microcontroller, can be quite tasking to use for a beginner. They usually require a certain set of tools, including a programmer (hardware), and a development platform (e.g. Atmel Studio) for writing code. These development platforms, unlike the Arduino IDE usually require high knowledge of C or other programming languages, without the shortcuts and simplified functions which the Arduino provides. To remove this difficulty, the microcontroller is flashed with the Arduino bootloader, which makes it ready for programming using the simpler and easy to use Arduino IDE.
To program the microcontroller using the Arduino IDE, the microcontroller must be connected via some sort of hardware to the computer. This is usually done via two major ways:
1. Using a USB to Serial/TTL Adapter

2. Using an Arduino board
Each of these approaches provides the microcontroller with an interface that enables interaction between the computer and the microcontroller.

5.2) PROTEUS

Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It is developed by Lab Centre Electronics. Proteus is considered as an important tool for computer aided design. It is a complete electronic design system which lets to simulate entire microprocessor design running actual processor machine code a real time. Proteus includes ISIS schematic capturing software, ProSpice (SPICE3FS) including auto placer and auto router and several virtual system modelling including 8051, 8052, PIC16F873 etc. It combines a super mixed mode circuit simulator based on industry standard SPICE3FS with animated components models and provides an architecture in which additional models can created by anyone including end user.
Consequently, the program allows professional engineers to run interactive simulations of real designs and reap the rewards of this approach to circuit simulation. Proteus features range of simulator models for popular microcontrollers and set of animated models for related peripheral devices such as LED, LCD display, keypads and RS232 terminals. The

software also includes various templates such as text styles and graphic colures ability to export graphics (BMP, DXF, EPS, HGL and WMF)

5.3) ANDROID APPLICATION

The app we used in this project is “ARDUINO BLUETOOTH TEXT TO SPEECH”. Arduino Bluetooth CH-05, CH-06 can communicate with the app by sending text. Arduino Bluetooth CH-05, CH-06 can communicate with the app by sending text (new line at the end of each transmission). It will convert the text received to speech.
Text to speech (TTS) makes an android device read the text and convert it to audio out via the speaker. Android TTS supports multiple languages. TTS is a simple but powerful feature. It can also be effectively used in mobile APPs dedicated to visually impaired people or in educational app for kids or can be used in pronunciation learning app, etc. These are some of the ways you can use TTS. Using Text to Speech enhances interaction between the user and the mobile application.

FIGURE 14

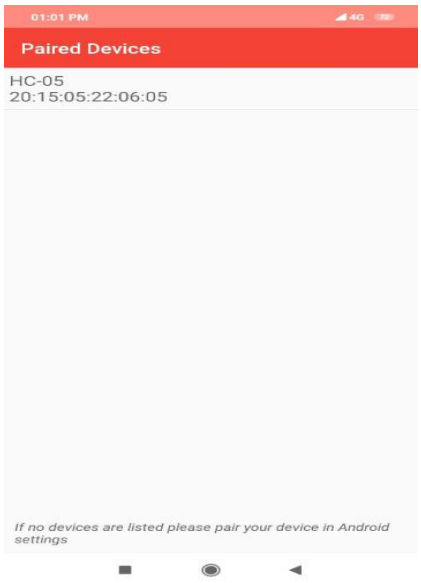

FIGURE 15

6) FLOWCHART

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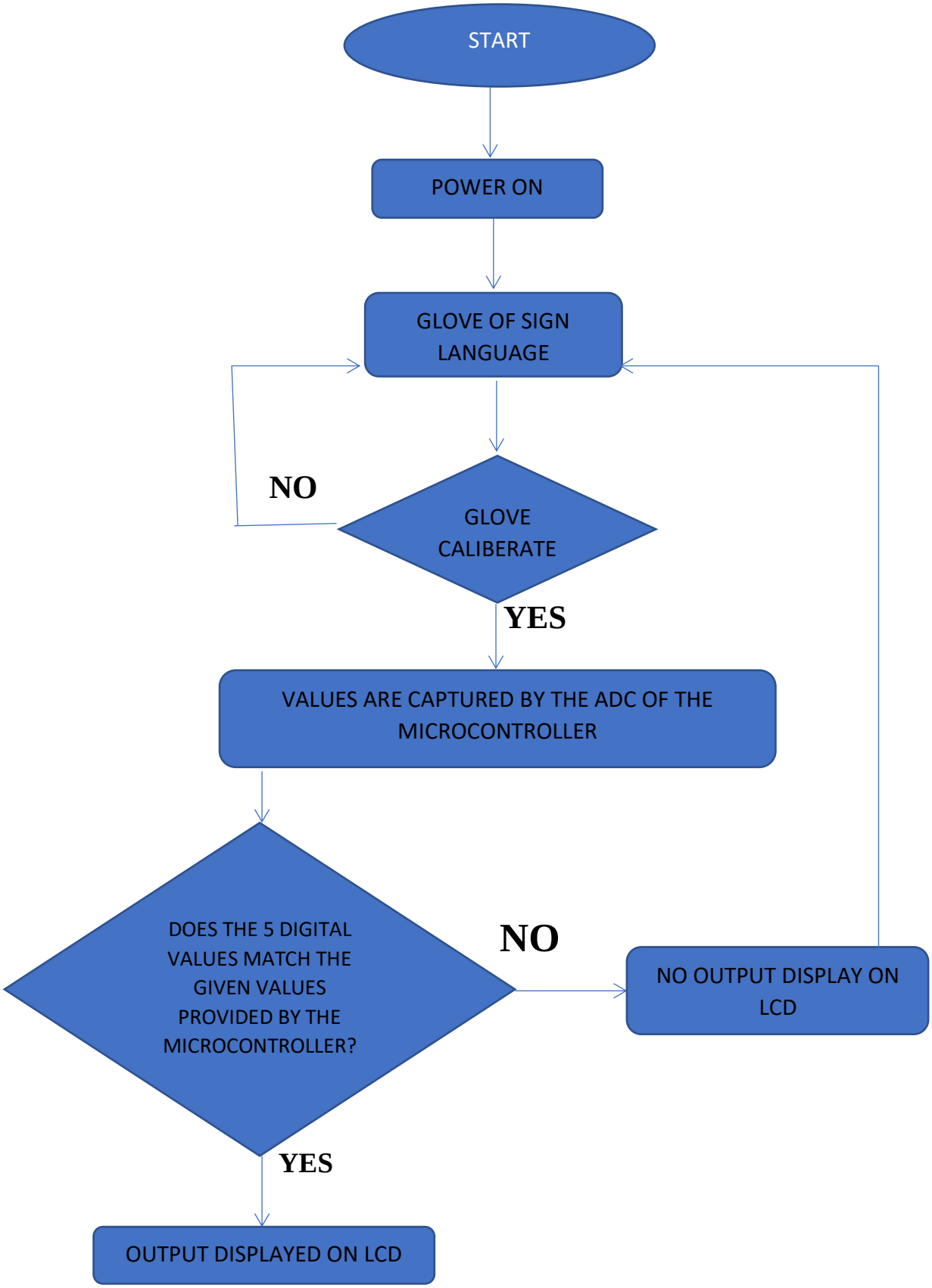

FIGURE 16

7) WORKING

7) WORKING

Disabled use these gloves to convert sign performed by them into speech. From the convenience of simple flex sensors, a user is able to interact with others in more comfortable and easier manner. This makes it possible for the user to not only interact with their community but with others also and they can also live normal life. The end product will have a cheap and simplistic design making it easy for users to interact with. The system is capable of recognizing signs more quickly. Furthermore, real time recognition ratio of nearly 99% can be easily achieved.
The averaging we do at each interval helps to account for any noise or glitches that the flex sensors are sometimes prone to. The accuracy of the glove is also somewhat limited by the size of the person's hands. The accuracy of each flex sensor is limited beyond a certain point. Smaller hands will result in a larger degree of bend. As a result, the difference between slightly different signs with a lot of flex might be too small for users with small hands. The device uses a low voltage environment, and extremely low frequency communication. The sensors are well attached, and there are no sharp edges. As a result, we don't see any large safety issues associated with the glove. Furthermore, since all communication is done via cables, our device does not interfere with other designs. The glove can be used by anyone who fits into it, they would only have to train on it and generate new datasets if they wish for a higher prediction accuracy than the standard or to incorporate new signs.
The message displayed on the "Arduino Bluetooth Text to Speech" app for the hand gesture of 'Hello' is shown in the image below.

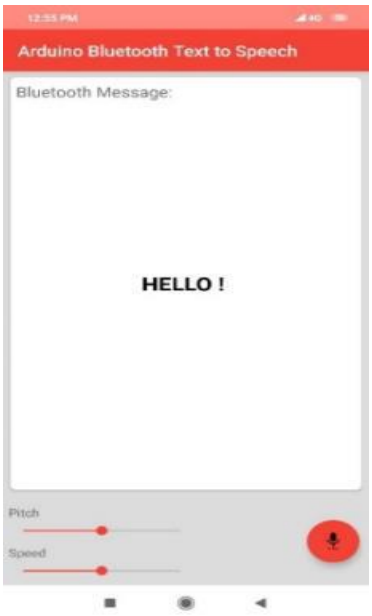

FIGURE 17

LCD display is as shown

1. Hello

FIGURE 18

FIGURE 19

2. Thanks

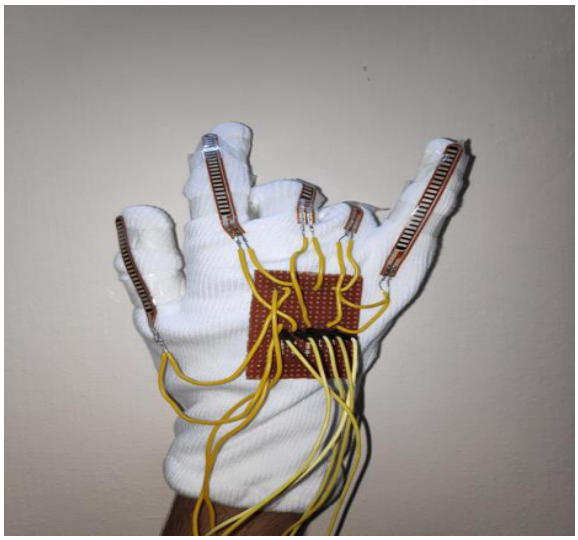

FIGURE 20

FIGURE 21

8) CONCLUSION AND FUTURE SCOPE

8) CONCLUSION AND FUTURE SCOPE

Sign language is a method used for communication by disabled person. Here we are converting sign language into text and speech so that communication is not limited between them only, utilizing data gloves communication barrier between two different communities is eliminated. Using smart gloves disabled person can also grow in their carrier and makes nation grow as percentage of disabled person are millions in count. Making their future better and hence making nation better.

This report gives a brief about the project that is useful for speech or hear impaired patients. This work was able to meet our expectations quite well. This project was meant to be a finished device to check the feasibility of recognizing sign languages using sensor gloves. The completion of this project suggests that sensor gloves can be used for partial sign language recognition.

9.REFERENCES

9) REFERENCES

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10. DATASHEETS

10) DATASHEET

10.1) ATMEGA 328PU

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory
  - 256/512/512/1K Bytes EEPROM
  - 512/1K/1K/2K Bytes 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 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
    - Temperature Measurement
  - 6-channel 10-bit ADC in PDIP Package
    - Temperature Measurement
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Byte-oriented 2-wire Serial Interface (Philips I²C compatible)
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended 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:
  - 1.8 - 5.5V
- Temperature Range:
  - -40°C to 85°C
- Speed Grade:
  - 0 - 4 MHz@1.8 - 5.5V, 0 - 10 MHz@2.7 - 5.5.V, 0 - 20 MHz @ 4.5 - 5.5V
- Power Consumption at 1 MHz, 1.8V, 25°C
  - Active Mode: 0.2 mA
  - Power-down Mode: 0.1 µA
  - Power-save Mode: 0.75 µA (Including 32 kHz RTC)

8-bit AVR® Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash

ATmega48A
ATmega48PA
ATmega88A
ATmega88PA
ATmega168A
ATmega168PA
ATmega328
ATmega328P

Summary

Rev. 8271BS–AVR–04/10

FIGURE 22

1. Pin Configurations

Figure 1-1. Pinout ATmega48A/48PA/88A/88PA/168A/168PA/328/328P

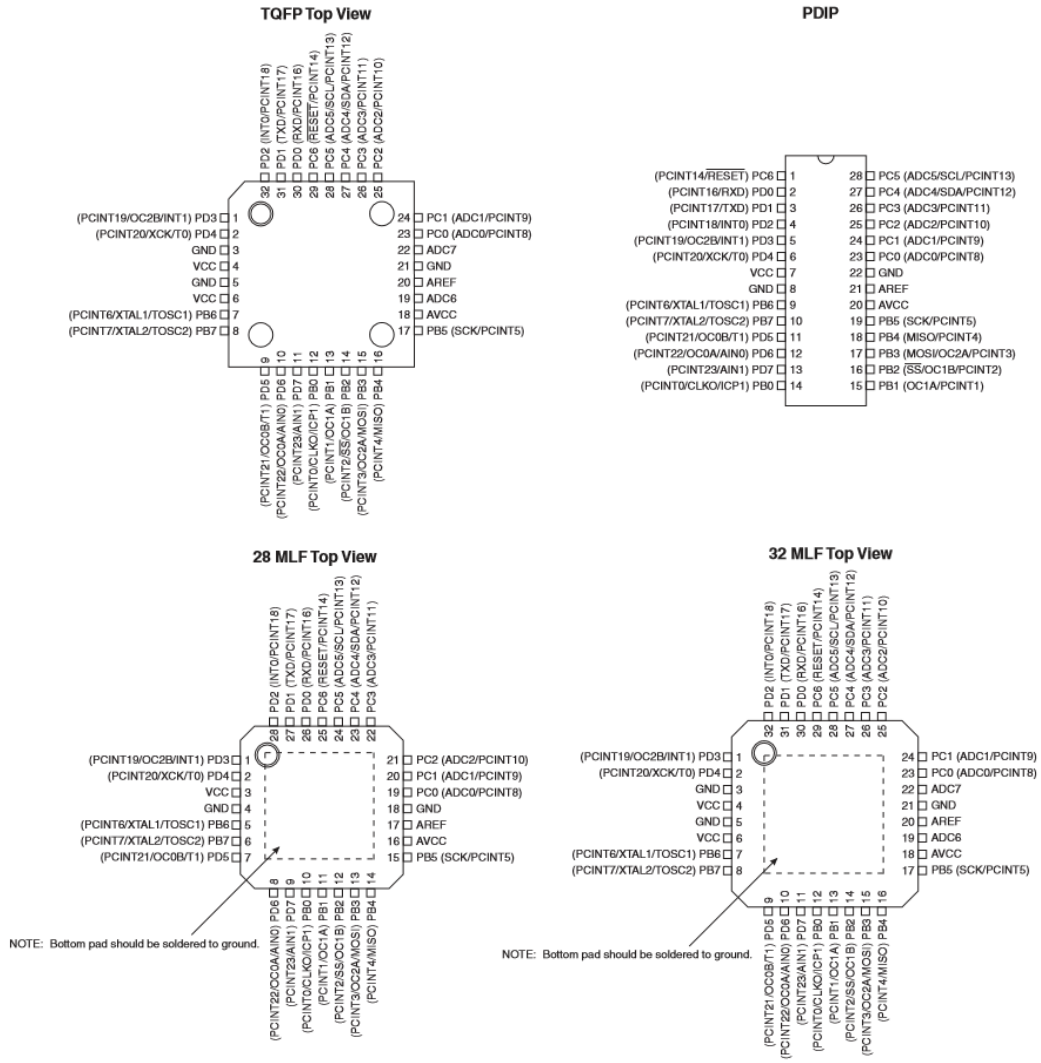


FIGURE 23

2. Overview

The ATmega48A/48PA/88A/88PA/168A/168PA/328/328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48A/48PA/88A/88PA/168A/168PA/328/328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

2.1 Block Diagram

Figure 2-1. Block Diagram

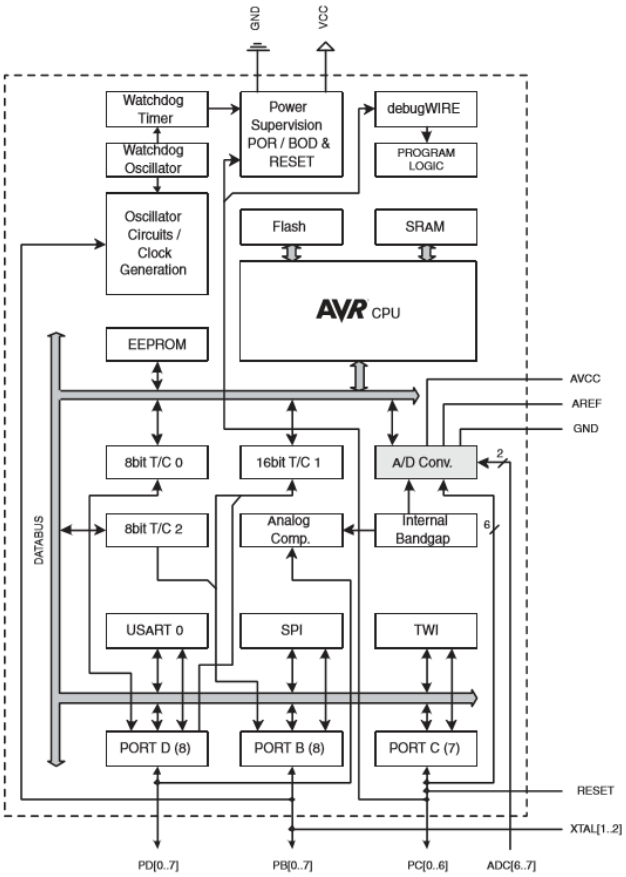
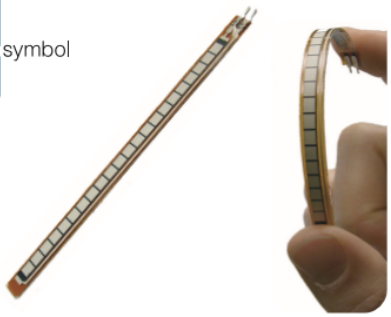


FIGURE 24

10.2) FLEX SENSORS

spectrasymbol



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

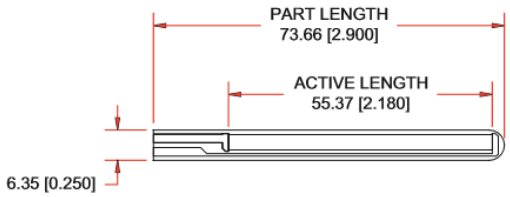
Mechanical Specifications

-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

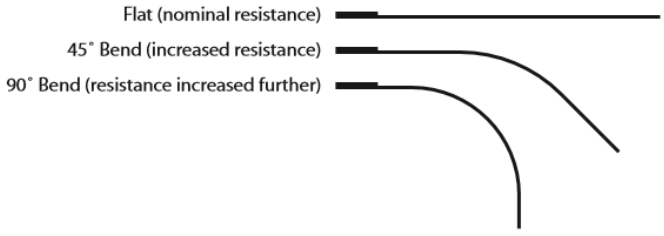
Dimensional Diagram - Stock Flex Sensor



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



spectrasymbol.com Rev A2 - Page 1 (888) 795-2283

FIGURE 25

10.3) HC-05

HC-05

-Bluetooth to Serial Port Module

Overview

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.
Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

Specifications

Hardware features

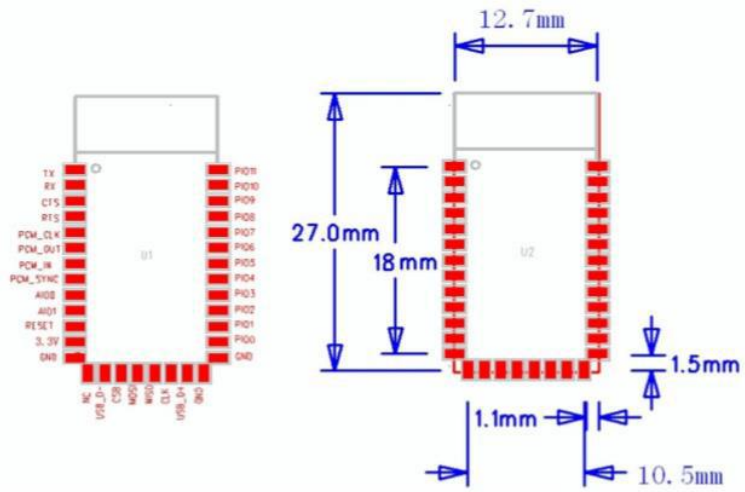
- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector

FIGURE 26

Software features

- Default Baud rate: 38400, Data bits:8, Stop bit:1,Parity:No parity, Data control: has. Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.
- Given a rising pulse in PIO0, device will be disconnected.
- Status instruction port PIO1: low-disconnected, high-connected;
- PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"0000" as default
- Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

Hardware



HC-05 Bluetooth module iteadstudio.com 06.18.2010

FIGURE 27

PIN Name	PIN #	Pad type	Description	Note
GND	13 21 22	VSS	Ground pot	
3.3 VCC	12	3.3V	Integrated 3.3V (+) supply with On-chip linear regulator output within 3.15-3.3V	
AIO0	9	Bi-Directional	Programmable input/output line	
AIO1	10	Bi-Directional	Programmable input/output line	
PIO0	23	Bi-Directional RX EN	Programmable input/output line, control output for LNA(if fitted)	
PIO1	24	Bi-Directional TX EN	Programmable input/output line, control output for PA(if fitted)	
PIO2	25	Bi-Directional	Programmable input/output line	
PIO3	26	Bi-Directional	Programmable input/output line	
PIO4	27	Bi-Directional	Programmable input/output line	
PIO5	28	Bi-Directional	Programmable input/output line	
PIO6	29	Bi-Directional	Programmable input/output line	
PIO7	30	Bi-Directional	Programmable input/output line	
PIO8	31	Bi-Directional	Programmable input/output line	
PIO9	32	Bi-Directional	Programmable input/output line	
PIO10	33	Bi-Directional	Programmable input/output line	
PIO11	34	Bi-Directional	Programmable input/output line	

FIGURE 28

10.4) 16 X 2 LCD

1. Features

1. 5x8 dots with cursor
2. 16characters *2lines display
3. 4-bit or 8-bit MPU interfaces
4. Built-in controller (ST7066 or equivalent)
5. Display Mode & Backlight Variations
6. ROHS Compliant

LCD type	☐TN			
	☐FSTN	☑FSTN Negative		
	☐STN Yellow Green	☐STN Gray	☐STN Blue Negative	
View direction	☑6 O'clock	☐12 O'clock		
Rear Polarizer	☐Reflective	☐Transflective	☑Transmissive	
Backlight Type	☑LED	☐EL	☐Internal Power	☑3.3V Input
		☐CCFL	☑External Power	☐5.0V Input
Backlight Color	☑White	☐ Blue	☐ Amber	☐Yellow-Green
Temperature Range	☑Normal	☐Wide		☐Super Wide
DC to DC circuit	☐Build-in		☑Not Build-in	
Touch screen	☐With		☑Without	
Font type	☑English-Japanese	☐English-Europen	☐English-Russian	☐other

2. MECHANICAL SPECIFICATIONS

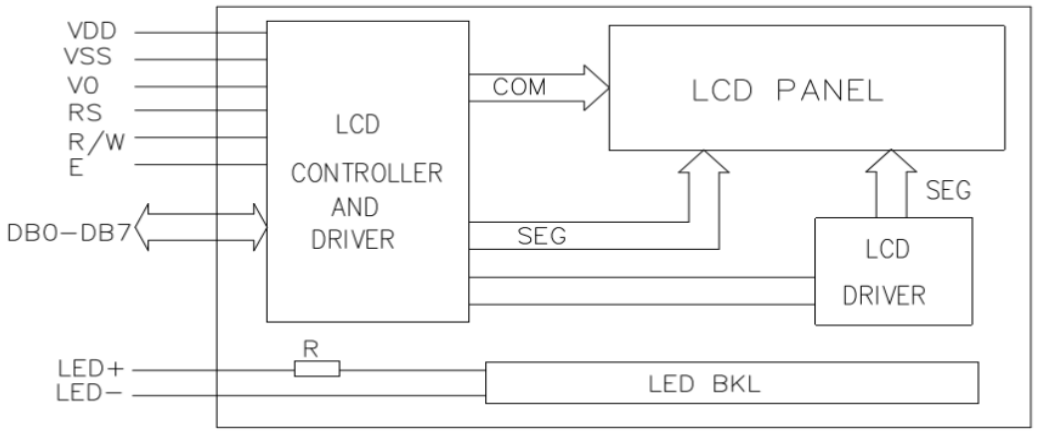
Module size	80.0mm(L)*36.0mm(W)* Max13.5(H)mm
Viewing area	64.5mm(L)*16.4mm(W)
Character size	3.00mm(L)*5.23mm(W)
Character pitch	3.51mm(L)*5.75mm(W)
Weight	Approx.

FIGURE 29

4. Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	V_{DD}-V_{SS}	0	-	7.0	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	V_{OP}	0	-	+50	℃
Storage temperature range	V_{ST}	-10	-	+60	

5. Block diagram



6. Interface pin description

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

3. **Outline dimension**

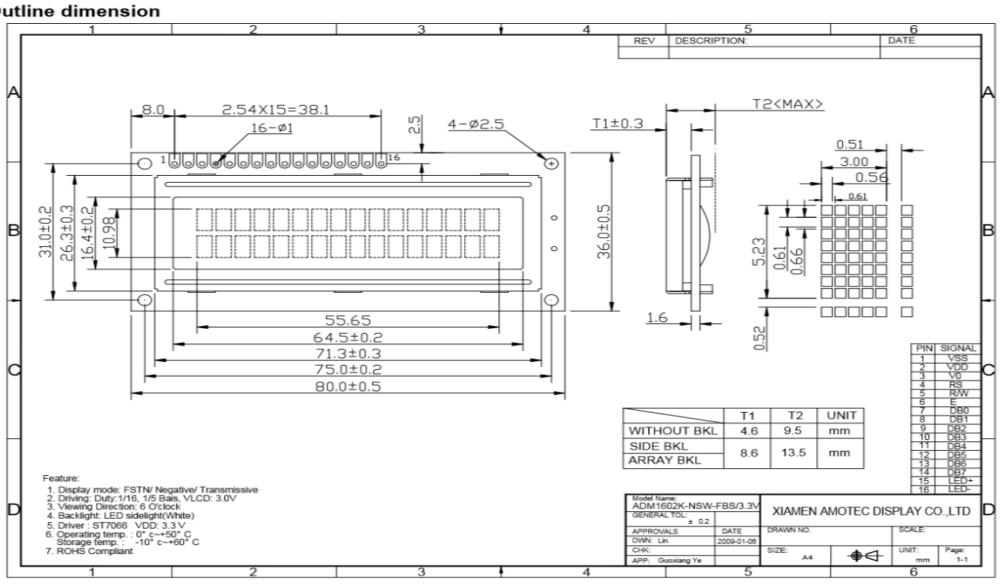


FIGURE 30

10.5) LM7805

FAIRCHILD

September 2014

LM78XX / LM78XXA
3-Terminal 1 A Positive Voltage Regulator

LM78XX / LM78XXA — 3-Terminal 1 A Positive Voltage Regulator

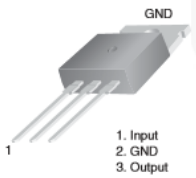
Features

- Output Current up to 1 A
- Output Voltages: 5, 6, 8, 9, 10, 12, 15, 18, 24 V
- Thermal Overload Protection
- Short-Circuit Protection
- Output Transistor Safe Operating Area Protection

Description

The LM78XX series of three-terminal positive regulators is available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down, and safe operating area protection. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed-voltage regulators, these devices can be used with external components for adjustable voltages and currents.

TO-220 (Single Gauge)



Ordering Information[1]

Product Number	Output Voltage Tolerance	Package	Operating Temperature	Packing Method
LM7805CT	±4%	TO-220 (Single Gauge)	-40°C to +125°C	Rail
LM7806CT				
LM7808CT				
LM7809CT				
LM7810CT				
LM7812CT				
LM7815CT				
LM7818CT				
LM7824CT				
LM7805ACT	±2%		0°C to +125°C	
LM7809ACT				
LM7810ACT				
LM7812ACT				
LM7815ACT				

Note:

1. Above output voltage tolerance is available at 25°C.

FIGURE 31

Block Diagram

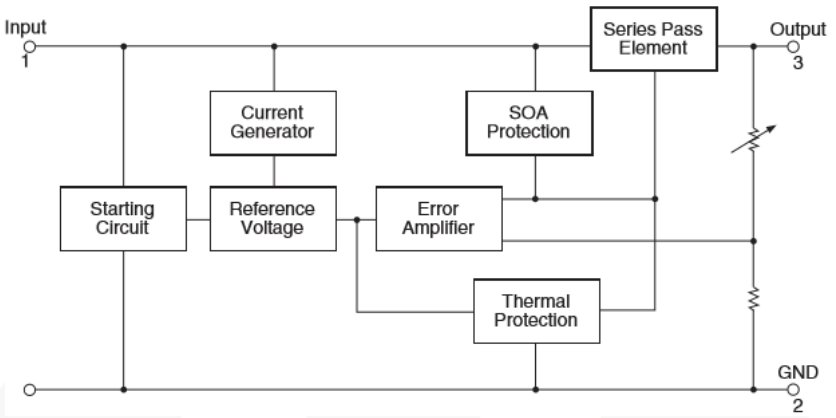


Figure 1. Block Diagram

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter		Value	Unit
V_I	Input Voltage	V_O = 5 V to 18 V	35	V
		V_O = 24 V	40	
$R_{\theta JC}$	Thermal Resistance, Junction-Case (TO-220)		5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-Air (TO-220)		65	°C/W
T_{OPR}	Operating Temperature Range	LM78xx	-40 to +125	°C
		LM78xxA	0 to +125	
T_{STG}	Storage Temperature Range		- 65 to +150	°C

FIGURE 31

11. FIGURES & TABLES

11.1) LIST OF FIGURES

TABLE 2

11.2) LIST OF TABLES

TABLE 3