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Speaking Gloves-Assistive Aid for the Speech Impaired

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ABSTRACT:Assistive technology, is a term which includes rehabilitative and adaptive devices for people with disabilities and also includes the process used in locating and using them. It promotes independence by enabling differently abled people to perform tasks that they were formerly unable to accomplish, or had great difficulty in accomplishing, by providing various methods for interacting with the innovative technology needed to accomplish such tasks. It points to any piece of equipment, or product system, and is used to maintain or improve functional capabilities of differently abled individuals. It is very rare to see a speech impaired person communicating with the ones who speak. For communication to take place between them, it is essential that the other person should know sign language. If not, it becomes difficult for the two to interact which creates a barrier and hampers the growth of a speech impaired person in a corporate world. In recent years, researchers have been focusing on hand gesture detections and been popular for developing applications in the field of robotics and extended in the area of artificial or prosthetic hands that can mimic the behaviour of a natural human hand. Thus, a system that transcribes symbols in sign languages into plain text can help with real-time communication. This device utilizes a similar approach for the detection of the movement of fingers, with a small yet significant application and will be useful for the speech impaired, it can also be used for those with half of their bodies paralysed and who are not able to speak but are able to move their fingers. The aim and objectives of this research work include to design a portable embedded system, developing a simple solution for the detection of finger gestures, reliable data acquiring method and signal conditioning, facilitate an easy communication through synthesized speech for the benefit of speech impaired individuals.

KEYWORDS: Accelerometer, Arduino Board, Flex Sensor, Liquid Crystal Display, Speaker, Speakjet.

I.INTRODUCTION

The Speech impaired people communicate with each other using sign language. But common man fails to interpret what they want to convey thus creating a communication barrier and also thwarting their progress. This project focuses on designing a Glove for speech impaired people that will sense their hand movements and enable them to communicate with everyone thus bridging the barrier. This project is useful for speechless patient; it is compact, flexible system & only takes less power to operate.

1.Problem Statement

Communication is the exchange of information; it can be in any form verbal or non-verbal. A person with partial or complete speech imparity communicates through SIGN LANGUAGE (gesture and specific movements of hand). The problem arises when they try to communicate with a person who does not know this sign language and hence the communication often fails or is miss interpreted, hence creating a COMMUNICATION BARRIER.

2.Approach Towards the Problem Statement

Main aim of this project is the judicial use of knowledge and TECHNOLOGY to bridge the communication barrier by building a portable and efficient device which will convert the GESTURE to more easily understood modes of Communication: AUDIO and VISUAL. This will be done by recording and processing the hand gestures to drive a SPEAKER and LCD display. Thereby assisting the impaired patient with a smooth and better way of communication.

II.LITERATURE SURVEY

The first-Hand Talk glove was designed by Ryan Patterson in the year 2001[1]. His Sign Language Translator consists of two separate components, a leather golf glove that has five flexible sensors sewn into it which monitors the position of the fingers by measuring the electrical resistance created by the fingers as they bend. A small microcontroller on the back of the hand converts the change in the electrical current into digital signals and transmits them wirelessly to a

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computer. The computer then reads the numerical values and converts them into the letters which appear on the screen. The main disadvantage with this model was that a computer or a laptop was always required for its functioning which made it less portable.

Ruize Xu and his co-authors [2], explained how to provide communication between dumb people and normal person based on recognition of hand gestures. The output signals from mems accelerometer are fed to microcontroller. An automatic hand gesture algorithm is developed to identify the individual gestures in sequence. The directions are also transmitted to PC via Bluetooth protocol and finally the gesture is recognized by comparing the gesture code with the stored templates and corresponding hand gestures are obtained.

III.BLOCK DIAGRAM

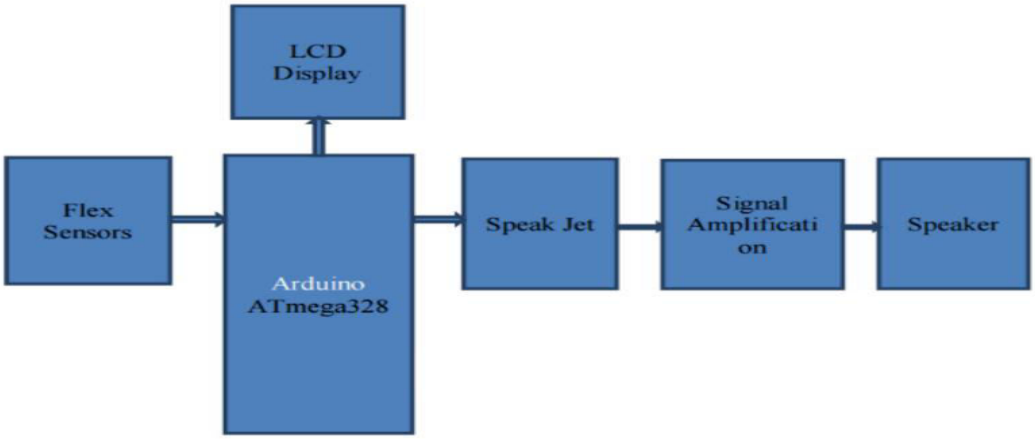

Fig. 1 Block Diagram

IV. HARDWARE

1.Flex Sensor

A flex sensor or bend sensor is a sensor that measures the amount of unidirectional deflection or bending. Usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. The Flex Sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius and the smaller the radius means the higher the resistance value. The straight resistance (0 degrees) is 35k-40k ohms and bent (90 degrees) resistance is 75k-80k ohms. Thus, using a flex sensor for each finger we can get the angle of bend of each finger by mapping a table of resistance vs. bend angle.

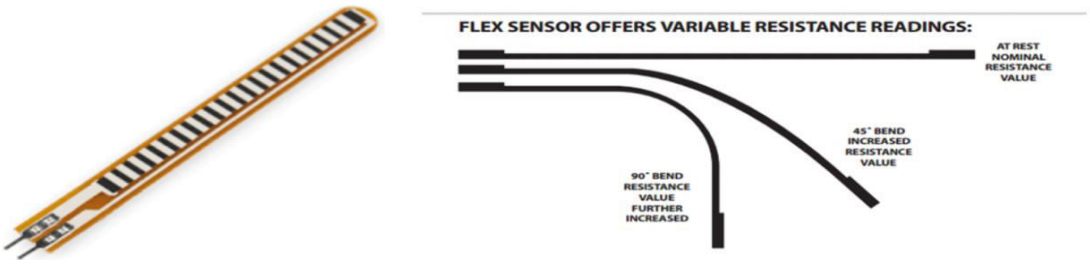

Fig. 2 Flex Sensor and Variation of Flex Resistance with bend.

2.Accelerometer

Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of 3 g. It can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

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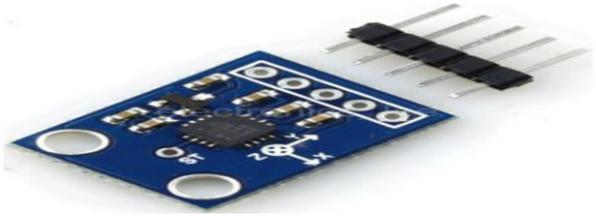

Fig. 3 Accelerometer

3.SpeakJet

The SpeakJet is a completely self-contained, single chip voice and complex sound synthesizer. It uses Mathematical Sound Architecture tm (MSA) technology which controls an internal five channel sound synthesizer to generate on-the-fly, unlimited vocabulary speech synthesis and complex sounds. The SpeakJet is preconfigured with 72 speech elements (allophones), 43 sound effects, and 12 DTMF Touch Tones. The SpeakJet can be controlled simultaneously by logic changes on any one of its eight Event Input lines, and/or by a Serial Data line from a CPU (such as the OOPic, Basic Stamp or PC) allowing for both CPU Controlled and Stand-Alone operations. Other features include an internal 64-byte input buffer, Internal Programmable EEPROM, three programmable outputs, and direct user access to the internal five channel sound synthesizer.

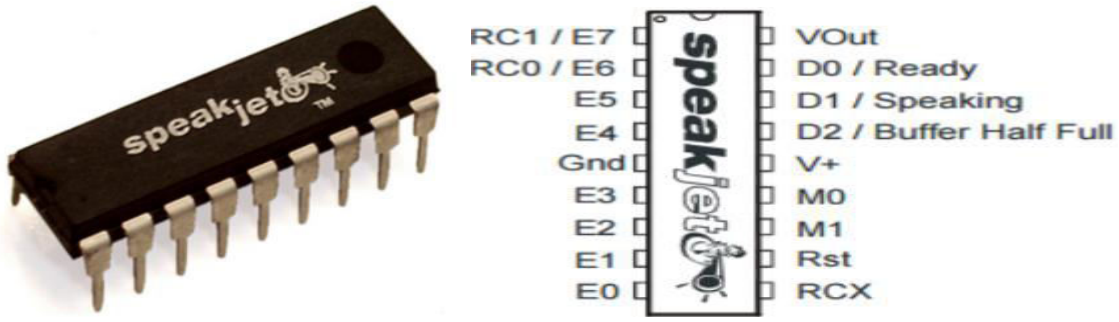

Fig. 4Speakjet and its Pin Configuration

4.Arduino Board

The Arduino Nano [3] is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

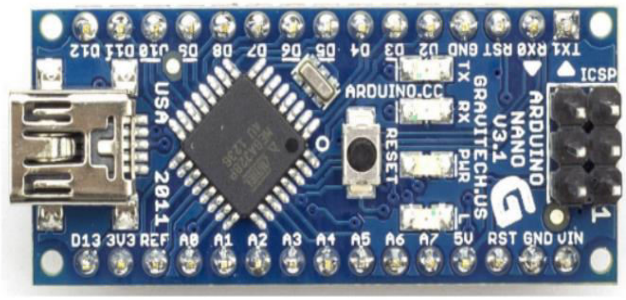

Fig.5Arduino Nano

5.LM386

The LM386M-1 and LM386MX-1 [4] are power amplifiers designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 mW when operating from a 6-V supply, making the LM386M-1 and LM386MX-1 ideal for battery operation.

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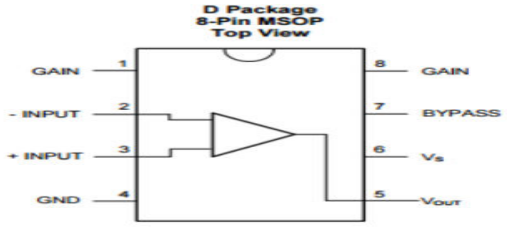

Fig. 6LM386 Pin Configuration

6.Liquid Crystal Display (LCD)

LCD [5] can be interfaced with microcontroller to read the output directly. In our project we used a two-line LCD display with 16 characters each. A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics. LCDs are most commonly used because of their advantages over other display technologies. They are thin and flat and consume very small amount of power compared to LED displays and cathode ray tubes (CRTs).

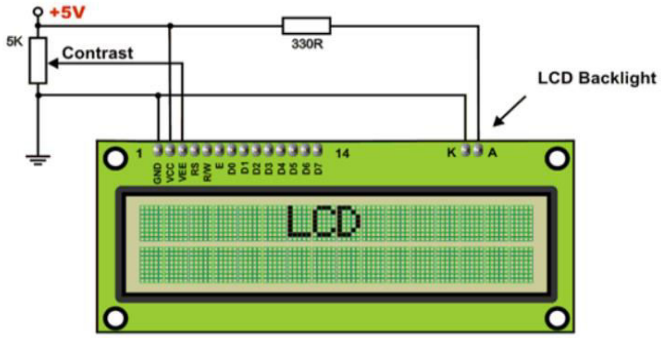

Fig. 7LCD Screen

7.Speaker

Speakers are one of the most common output devices used with computer systems. Some speakers are designed to work specifically with computers, while others can be hooked up to any type of sound system. Regardless of their design, the purpose of speakers is to produce audio output that can be heard by the listener. Speakers are transducers that convert electromagnetic waves into sound waves. The speakers receive audio input from a device such as a computer or an audio receiver. This input may be either in analog or digital form. Analog speakers simply amplify the analog electromagnetic waves into sound waves. Since sound waves are produced in analog form, digital speakers must first convert the digital input to an analog signal, then generate the sound waves. The sound produced by speakers is defined by frequency and amplitude. The frequency determines how high or low the pitch of the sound is. Speaker system's ability to accurately reproduce sound frequencies is a good indicator of how clear the audio will be. Many speakers include multiple speaker cones for different frequency ranges, which helps produce more accurate sounds for each range. Amplitude, or loudness, is determined by the change in air pressure created by the speakers' sound waves.

V. SOFTWARE- ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. It is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with

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buttons for common functions and a hierarchy of operation menus. 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. 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. A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the file extension .ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. A minimal Arduino C/C++ sketch, as seen by the Arduino IDE programmer, consist of only two functions: setup: This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch. loop: After setup has been called, function loop is executed repeatedly in the main program. It controls the board until the board is powered off or is reset.

VI. WORKING

The speech impaired people use hand gestures to communicate. To detect these gestures data of hand movement is collected and processed. There are five Flex Sensors, one for each finger. They are basically used to detect the bend angle for the fingers. An accelerometer is used to distinguish between the various planes. The Flex Sensors are connected in a voltage divider form with a 47k ohm resistor. The voltage applied to the voltage divider block is 5V, this is given from the arduino board. The voltage across the 47k ohm resistor is given as an input to the analog pin of the arduino board. Using this analog voltage, the resistance of the flex is calculated. Resistance of the flex is around 25-40k ohm when it is not bent. Its resistance increases to 60-90k ohm. The resistance value of each flex is measured using DMM (Digital multimeter) for 0-degree bend and 90-degree bend. This defined in the code. The flex voltage is compared with these pre-determined values and correspondingly mapped to a bend angle. Output voltage of Accelerometer for the x, y and z pins is different in different planes hence it is used to distinguish between different planes. This analog voltage is given to the analog pin of arduino. This bend angle and analog voltage of accelerometer is then converted to binary values, and then binary value for all fingers is used to calculate a decimal value. This value is then compared with the pre-determined meaning of gesture corresponding to each decimal value. Speakjet IC is used for the voice part. Phrase a lator software is used to find the decimal values corresponding to phrases these values are sent by arduino to serial input of Speakjet IC. Output of Speakjet IC is an audio signal. To amplify this audio, it is fed to input of LM386. Gain of this IC is 200. The audio output of LM386 is given to speaker using an AUX cable.

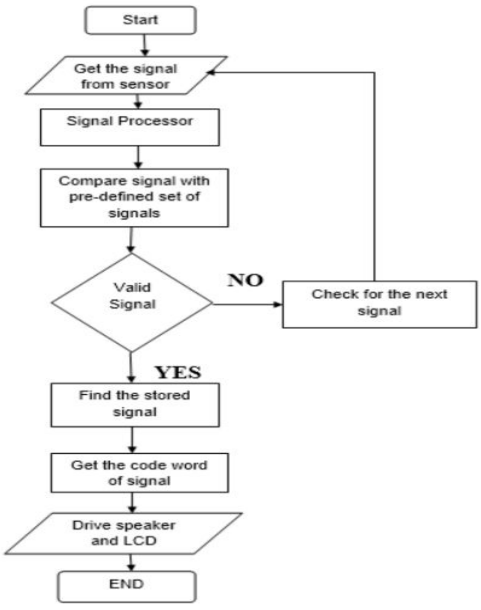

Fig. 8Flow Chart

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VII.OUTPUT

Fig. 9 Gestures

VIII. CONCLUSION

Sign language is a useful tool to ease the communication between the deaf or mute community and the normal people. Yet there is a communication barrier between these communities with normal people. This project aims to lower the communication gap between the deaf or mute community and the normal world. This project was meant to be a prototype to check the feasibility of recognizing sign language using sensor gloves. With this project the deaf or mute people can use the gloves to perform sign language and it will be converted in to speech so that normal people can easily understand.

XI. FUTURE SCOPE

The completion of this prototype suggests that sensor gloves can be used for partial sign language recognition. More sensors can be employed to recognize full sign language. A handy and portable hardware device with built-in translating system, speakers and group of body sensors along with the pair of data gloves can be manufactured so that a deaf and dumb person can communicate to any normal person anywhere with multiple languages. Keeping in mind this basic idea of communication the prototype can be further improved in the following ways: With the help of this proposed hand gloves gives a speech impaired person/paralytic patient can communicate with us normally which helps to bridge the current gap which exists. Currently our proposed hand gloves can successfully voice out 32ˆ (3) signals with the help of accelerometer which can be further increased to 32ˆ (6) with the help of 2 hands. Also, the 2-hand communication will help the speech impaired patient to totally voice over using just the hands.

X. ACKNOWLEDGMENT

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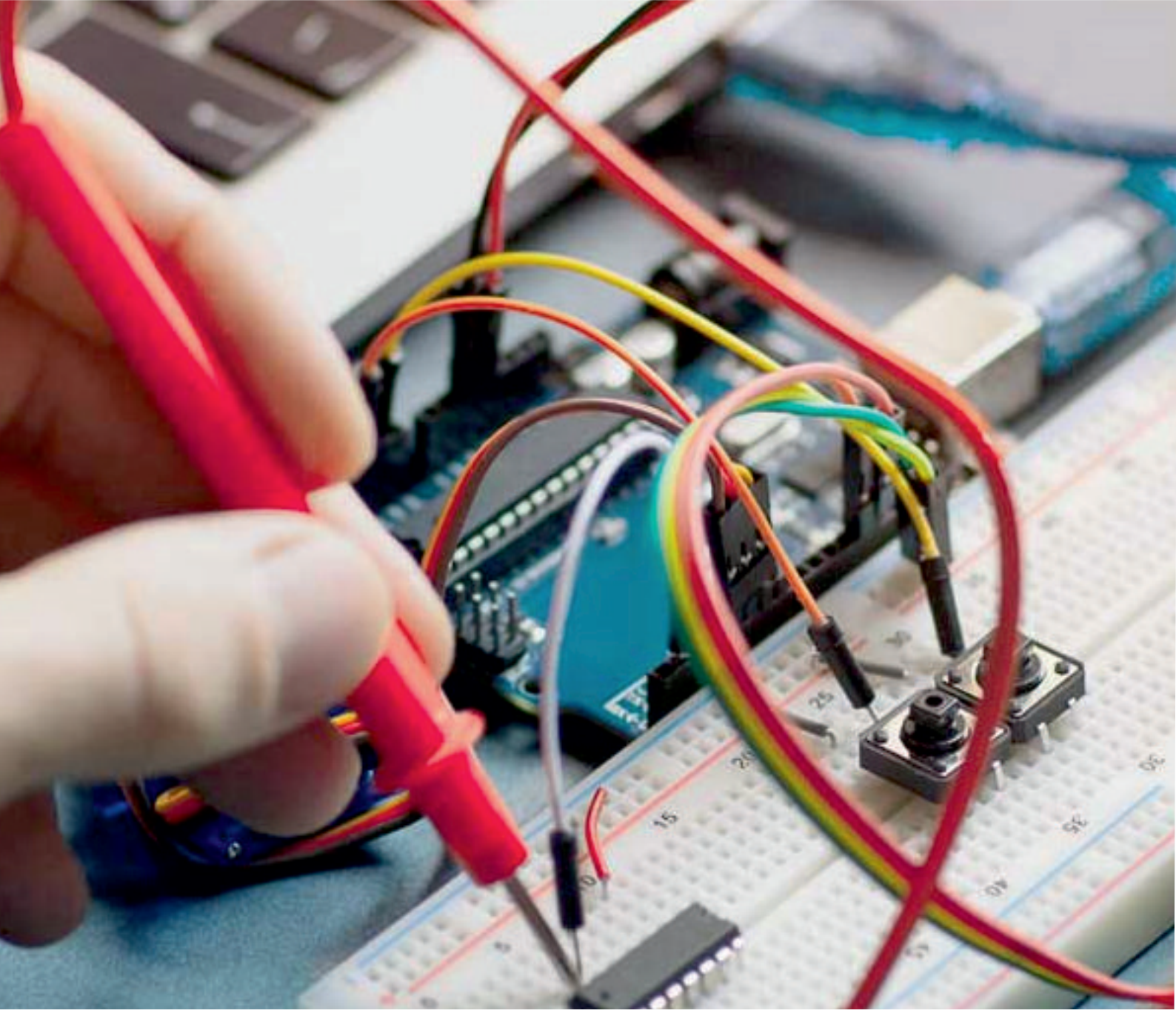
[4] http://www.ti.com/lit/ds/symlink/lm386.
[5] http://whatis.techtarget.com/definition/LCD-liquid-crystal-display.



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