



# International Journal of Innovative Research in Computer and Communication Engineering

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## Speech Based Writing Robotic Arm Using Arduino

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**ABSTRACT:** Nowadays more and more individuals are turning to robots to do their work, because robots are more versatile, accurate, reliable and also reduce human efforts. Robotic arms are programmed robot with similar function of a human arm. Aim of our project is to develop a robotic arm which helps the physically handicapped person to write. The mechanism is programmed with speech recognition system and makes the user to write what he speaks. The robotic arm is programmed to write down the words that patient or individual pronounces to the microphone. To perform the writing operations, the robotic arm will be fitted with a pen. It can also make you draw small sketches. It will be a low cost device that can be programmed to enable the people who are physically challenged to write. This paper describes the basic design of writing robotic arm.

**KEYWORDS:** Robotic arm, Arduino Uno, MATLAB, Servo motor.

### I. INTRODUCTION

With the technological advancements in robotics field, efforts are being taken in researching, designing and development of robots for different practical purposes. Robots designed to assist human in their work and reduced human efforts. Nowadays, robots are designed to mimic human behavior and perform tasks similar to human. Many research companies are developing robotic arm for performing basic functions like human arm. Among different functions, writing skills is one of function. The proposed robotic arm can be used by physically challenged person for writing operation. The main aim of developing the proposed system is to facilitate the physically challenged persons to write what they speak. Presently, the physically challenged persons need a scribe/paper writer during exams to write their examinations. It is very hectic work to find out the writer. The proposed system will proved helpful to physically challenged people in such situations.

The proposed system will consists of microphone to receive the speech signals of user which are being fed to computer. The computer will compare the speech signals with database of words already stored in library and passes the control signals to robotic arm equipped with arduino to control the servo motor if the match of spoken word is found in database. The robotic arm consists of arduino board with three servo motors acting as a actuators. Human arm basically moves in three axis. This movement of human arm is achieved by using three servo motors moving in three different directions. The working of our robotic arm basically involves two parts. The first part consist reception of speech signal and converting it into text and other part involves mechanical action of motor to obtain written text.

### II. RELATED WORK

Robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm. Types of robot arms depend on their range, working capability and reach. A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. There are various ways in which a robotic arm may be controlled. In the past there have been many researchers working to control robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be controlled from anywhere in the world. Usually most of the robotic arms are controlled by a central controller which makes uses of values taken in from the terminal that are entered by the user at the terminal to move the arm to a particular coordinates in space. This paper represents a writing robotic arm controlled using arduino. It acts like a human machine interface as writing is based on what user speaks.

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## III. BLOCK DIAGRAM

The main objective of our proposed system is to make arm write the letters according to the speech. Microcontroller unit used is arduino which is powerful means for controlling robotic arm real time operations. To convert the speech signal into text and text into digital, MATLAB software acts as a speech analyzer. The 3 dof robotic assembly is employed to position the arm. the speech signal is feed via microphone to the computer having MATLAB. Using speech recognition algorithm, speech signal is converted into text as per user input. This converted text is given to arduino board in the form of digital stream of data using serial cable. Arduino controls the servo motor which acts as actuators to control the movements of robotic arm. The end effector of robotic arm is attached with tool head to hold the pen for writing.

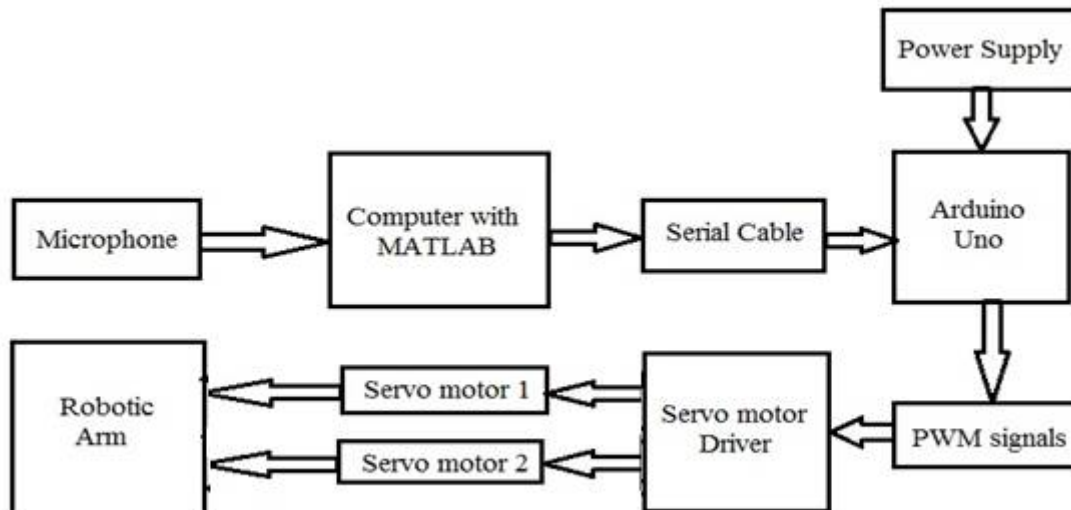


Fig. 1 Block diagram

### A. Arduino Board:

The Arduino Uno is a microcontroller board based on the ATmega328. It achieves throughputs close to 1MIPS per MHz. The ultimate aim of the arduino is to increase the processing speed. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. . It has an operating voltage of 1.8 to 5.5 volt. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from other preceding arduino boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

### B. Servo motor:

A servo mechanism or servo is an automatic device that uses error-sensing feedback to correct the performance of a mechanism. The servo motor has advantage that its speed and linear or angular position can be control precisely. In our system servo motor is connected to arduino which operates based on the PWM signals receive. Pulse width modulation (PWM) is technique used to control the motion of servo motor based on controllers digital output. The text or image form is converted into digital form and is applied to servo motor to draw the text or image.

### C. Serial cable:

Serial cable is required to transmit the data from computer to arduino board. The data is transmitted in the form of digital pulses between the peripherals and data processing equipments. Serial communications is frequently used



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between computer and other peripherals for data communication. serial communication involves transmitting data over a single data line and one bit at a time.

## D. MATLAB:

MATLAB is the high-level language and interactive environment used by millions of engineers and scientists worldwide. The matrix-based language is a natural way to express computational mathematics. It is a high-level language for numerical computation, visualization and application development. It also provides an interactive environment for iterative exploration, design and problem solving. It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.

In our system, MATLAB is used for speech recognition and processing as it contains libraries of audio processing algorithms (such as filtering, equalization, dynamic range control, and reverberation), sources (such as audio oscillators), and measurements. the speech recognition and converting the recognize the speech in respective text form or image form is done using MATLAB.

## IV. SPEECH RECOGNITION

Speech recognition (also known as voice recognition) is the process of converting spoken words into computer text. Speech recognition is the process of converting an acoustic signal, captured by microphone or a telephone, to a set of words. There two important part of in Speech Recognition - i) Recognize the series of sound and ii) Identify the word from the sound. This recognition technique depends also on many parameters - Speaking Mode, Speaking Style, Speaker Enrollment, Size of the Vocabulary, Language Model, Perplexity, Transducer etc. The user speaks into a microphone and the computer creates a text file of the words they have spoken. Speech recognition (SR) is the interdisciplinary sub-field of computational linguistics that develops methodologies and technologies that enables the recognition and translation of spoken language into text by computers. It is also known as "automatic speech recognition" (ASR), "computer speech recognition", or just "speech to text" (STT). It incorporates knowledge and research in the linguistics, computer science, and electrical engineering fields. The process of a machine's listening to speech and identifying the words is called Speech Recognition System.

In our system, microphone acts as a input source for speech signal. Microphone performs the function of converting obtained analog signal into suitable digital form for further signal processing. The obtained is signal is compared with the already stored signal or data using MATLAB. For speech recognition, following techniques are used:

### A. Mel's Frequency Cepstral Coefficient:

Mel-Frequency Cepstral Coefficients (MFCC) is the most commonly used feature extraction method in automatic speech recognition. To extract a feature vector containing all information about the linguistic message, MFCC mimics some parts of the human speech production and speech perception. MFCC mimics the logarithmic perception of loudness and pitch of human auditory system and tries to eliminate speaker dependent characteristics by excluding the fundamental frequency and their harmonics. Most speech signal recognition systems use the so-called Mel's frequency cepstral coefficients (MFCC) and its first (and sometimes second) derivative in time to better reflect dynamic changes.

### B. Dynamic Time Wrapping:

Dynamic time wrapping is an algorithm for measuring similarity between two sequences which may vary in time or speed. DTW is used in automatic speech recognition to cope up with different speaking speeds. DTW is one of the algorithms for measuring similarity between two temporal sequences, which may vary in speed. DTW algorithm compares the parameters of an unknown word with the parameters of one reference template. This algorithm is used to differentiate the speech signals of different users depending upon the tone, speed, frequency, etc. of the speaker.

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## V. SYSTEM OPERATION

The operation of the system can be well explained with help of following flowchart.

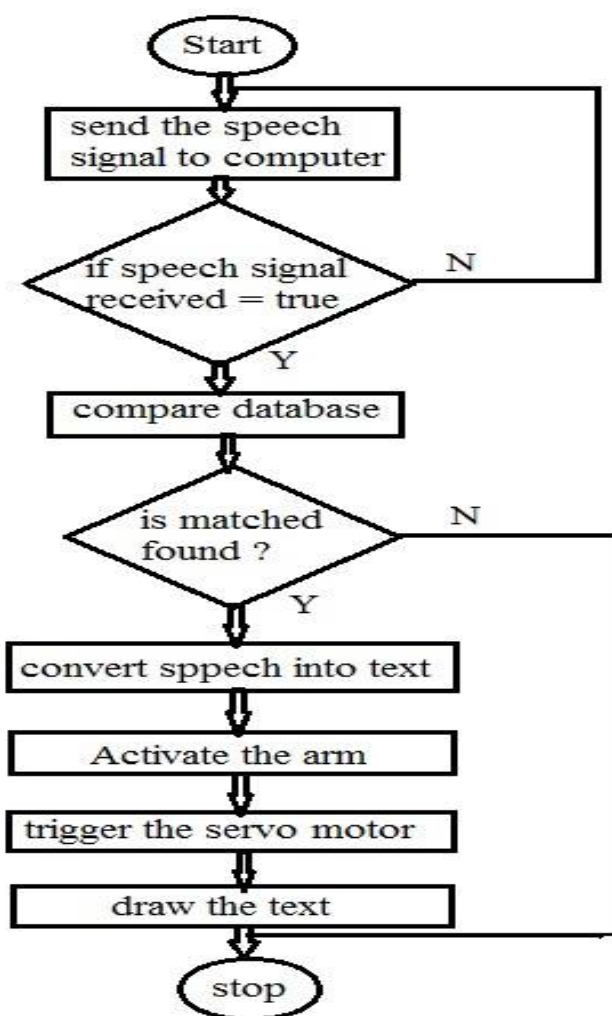


Fig.2 Flowchart of System

The user pronounces the character what he wants to write. The system is equipped with the microphone and the computer having matlab installed n it. The speech signal received through the microphone is given to the computer where the data is recorded to create the database of the speech signal. The recorded signal is cropped to eliminated the the noise signal present. Artificial neural network algorithm is used to provide the training to system for sound classification purpose. The ANN compares the received speech and database and provides the respective signal. Speech processing is done using Matlab. Mel's frequency cepstral coefficient i.e. MFCC algorithm is used for feature extraction of signal. Matlab is used to store the databsse of the sound signal in the .wav format.

After receiving speech signal, it is check whether the the received is valid or not and if found valid then it is compared with the already stored speech database. If the signal matches with the database then the respective signal is converted to text and applied to the arduino board. Based on the signal received, arduino activates the arm and triggers the servo motor for drawing the character. Servo motors are used drawing character.

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## VI. SYSTEM TESTING

System testing is carried to test the functionality of the developed system. Designing of the robotic arm having writing skills is very complex process. It involves the development of the software and hardware functionality. The software part involves speech recognition and speech processing programmed in matlab and arduino programming done in arduino ide while hardware part consists of robotic arm controlled using arduino board.

Speech processing of the signal is done using matlab. The speech processing is performed using GUI develop to test the system. The different stages involving software evaluation are shown in following figures.

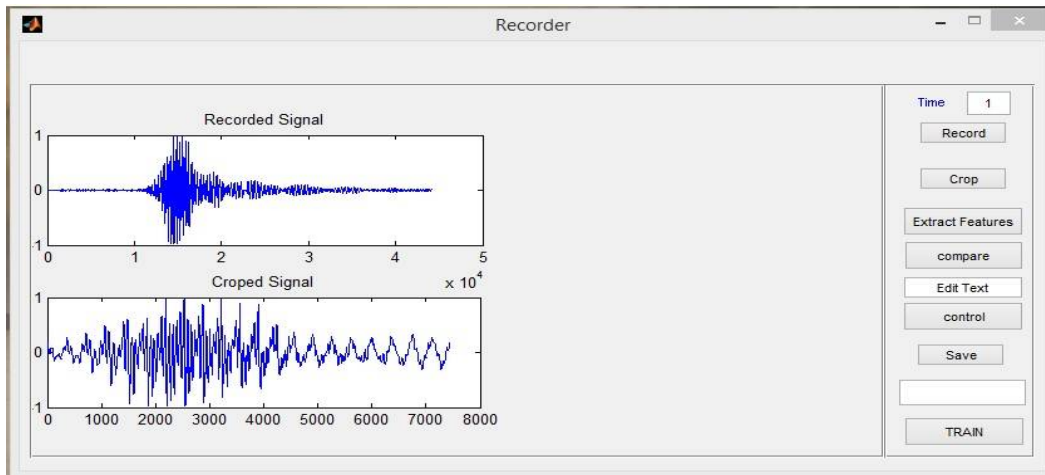


Fig. 3 Recorded and cropped signal

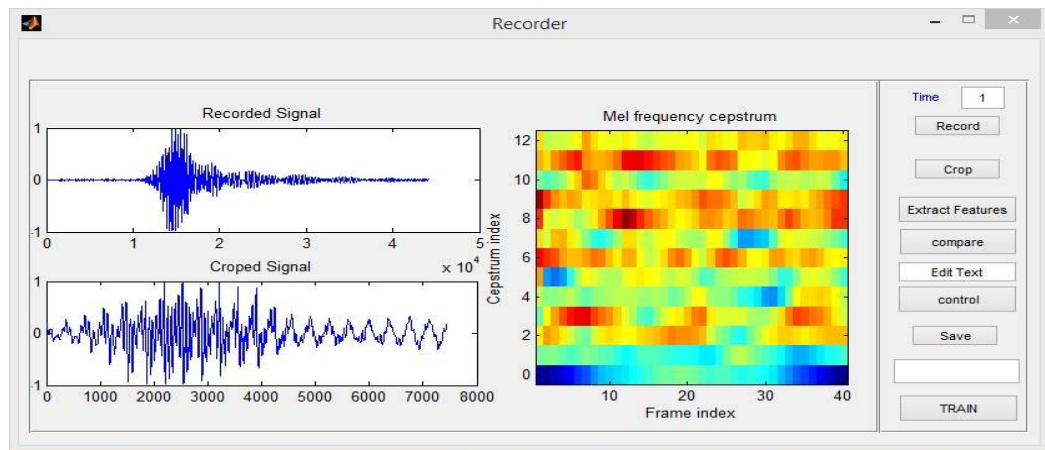


Fig. 4 MFCC feature extraction

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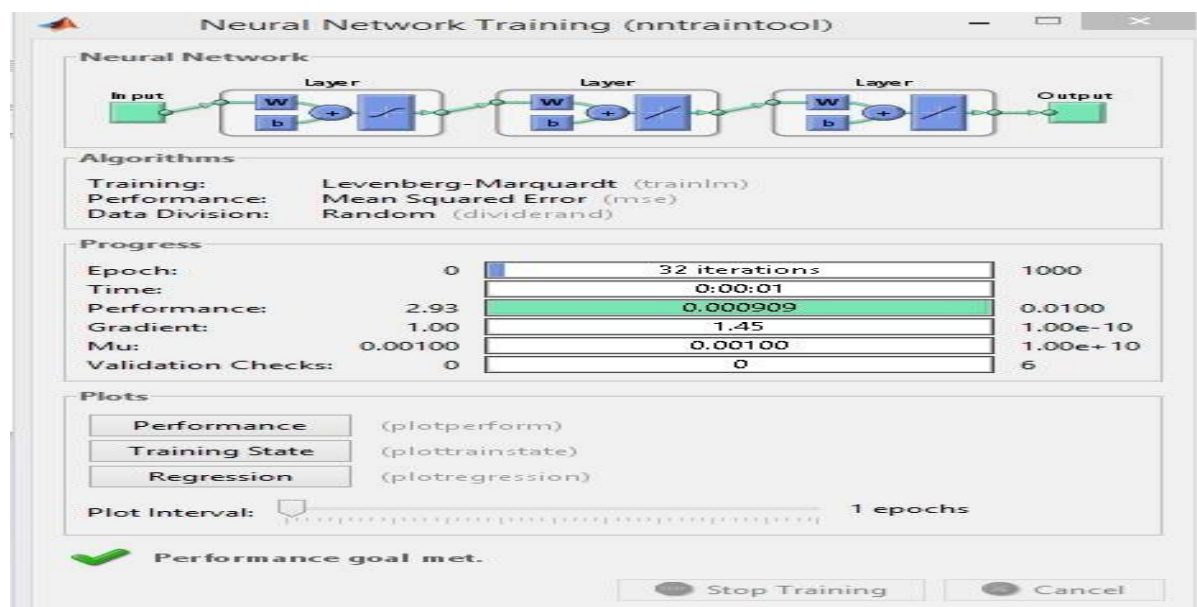


Fig. 5 Neural network training

Speech processing was carried out by repetitively recording the voice signals and training. For better results, large amount of samples should be recorded.

## VII. RESULTS AND DISCUSSION

The proposed system was designed and implemented successfully. Based on the results, the robotic arm was capable to write what user pronounces. The mechanical movements were used to draw the desired character. The project was designed using arduino microcontroller and was successfully draw the characters such as 1,2,3 and I, L, etc. for better results and accuracy, larger database having maximum number of voice samples is required.

## VIII. CONCLUSION AND FUTURE WORK

The paper proposes the design of writing robotic arm by speech recognition. The objective of the system to build a robotic arm that would showcase the writing skills based on speech recognition is successfully implemented. The developed system can prove helpful for different categories of people, specifically for physically challenged persons to write and express their thoughts in written manner. With the advent of new technology, additional facilities like pick and place, can also be embedded into it.

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