

Robotics Arm Showing Writing Skills By Speech Recognition

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ABSTRACT-In fourth industrial revolution, more people are turning to robotics because robots performs most significant role in every field and gives more precise output, which is consistent for different types of tasks. Objective of this study is to build a robotic arm to help the person facing the problem of writing disability; this robotic arm is coupled with a voice recognition system through which the person speaks in to the microphone and robot executes the writing operations automatically. This paper also depicts the essential plan of composing automated arm.

KEYWORDS: Robotic arm, Arduino Uno, Python, speech recognition.

I. INTRODUCTION

A robotic arm is programmable mechanical device, which can perform simple tasks like pick and place, or more complex tasks diligently. Robotic arms are usually designed to simply the human efforts in the performance of a task. In this context, it will be interesting to devise a robotic arm which can assist a human who has a physical handicap for the purposes of writing. This can be achieved through the process of recognition of speech, which has been studied since 1950, and has progressed both in terms of algorithms and the equipment.

Proposed robotic arm is able to use by the physically handicap person for writing operation effectively. The robotic arm assembly consists of condenser microphone. The condenser microphone senses the spoken word from the person and transfers the weak signals. These signals are mandatory to be amplified. Following this signal conditioning, Analog to Digital Converter (ADC) converts the signals useful to the computer system. The central processing unit compares the input signals with predefined records of precise words and sound levels. As the signal levels of vocal word and stored word are matched, the control word passed to the mechanical assembly. The mechanical assembly consists of ARM2148 processor which controls the mechanism by means of actuating arrangement of three stepper motors. The three stepper motors are rotating along three mutually perpendicular axes. In general, human arm while writing moves in the three directions. In this developed robotic arm also, linear movement of the arm along three different directions is achieved by three stepper motors.

The next section presents the review of literature in two perspectives: (a) different algorithms for speech recognition, and (b) application modes of speech recognition.

II. LITERATURE SURVEY

(A)Speech recognition process through GUI can be categorized into the following categories [1-8]:

- [1] **Hidden Markov Model (HMM):** HMM's are used extensively in speech recognition because of their consistency [5].
- [2] **Artificial Neural Networks (ANN):** ANNs are similar to Markov Models, and use weights, connection strengths and functions. ANNs have been reported to have a high accuracy [3, 5]. The major challenge in ANNs is to find the weights.
- [3] **Dynamic Time Wrapping (DTW):** DTW is an arrangement to compare between two different speaking speeds, and is often used to differentiate between the speaking signals of two different speakers. However, it has been reported that DTW have difficulty [6, 7].
- [4] **Vector Quantization (VQ):** VQ is a technique which uses probability distribution functions for the quantization of signals. It has been reported that the VQ method is efficient [4, 8].
- [5] **Mel's Frequency Cepstral Coefficient (MFCC):** MFCC is the most commonly used technique in automated voice recognition, since it is the easiest and simplest [6, 8].

(B)Comparative Analysis:

Speech recognition techniques have been adapted viz. using MATLAB, PIC, using GUI and using IoT. These applications are compared in Table 1. It is found that speech recognition IoT system is more accurate as compared to other three systems.

Table 1: Summary of comparative analysis

Type Parameter	Speech recognition using MATLAB	Speech recognition using PIC	Speech recognition using GUI	Speech recognition using IOT
Accuracy of speech recognition	89%	87%	90%	92%
Degree of freedom	02	02	02	04
Data Rate	9600 Baud rate	9600 Baud rate	3Mbps, 2.4Ghz	54 Mbit/s to 600 Mbit/s.
programming	Matlab	Matlab	C++	.NET
Data Transfer	Serial Port	Serial Port	Bluetooth	Wi-Fi
Vocabulary	Large	Medium	Small	Large
Controller	AT89C51	PIC16F628A	Arduino	LPC2148
Cost	22000/-	25000/-	15000/-	23000/-

The speech recognition using PIC yield poor accuracy as compared to other three technique, speech recognition using IoT technique has got higher degree of freedom, whereas remaining three technique have got same degree of freedom. Speech to text conversion rate of IoT base technique has highest, PIC base system also usage Matlab, whereas speech recognition use C++, Whereas IoT base system using .NET for programming.

Matlab and PIC base system usage serial ports, GUI base system use Bluetooth and IoT base system uses Wi-Fi, Matlab and IoT base system have got vocabulary, whereas GUI base system have got smaller vocabulary, the speech recognition using matlab is use AT89C51 controller, also speech recognition using PIC are PIC16F628A, GUI use Arduino board (AT mega 328) and speech recognition using IoT use LPC2148 controller. PIC

base system is costly among all other technique ,whereas GUI base system is cheapest.

III. BLOCK SCHEMATIC OF PROPOSED SYSTEM

Description -The Function and working of this robotic arm showing writing skills by speech recognition mainly consist of three elements likewise Software, hardware and mechanically assembly.

1. SOFTWARE ARCHITECTURE:

In the first element of the project, condenser MIC acts as the input for the voice signal from the user. A computer sound string in the microphone performs that purpose of converting analog voice signal to a proper digital form for the additional processing. Then the field of the obtained digital signal is compared with the aim of the preprogrammed signal.

The first part of current project deals with voice recognition i.e. recognizing the voice of the user and producing the correct match for the same from pre-programmed array voices. At this point two main methods to perform the voice recognition have been utilised:

- 1) Mel's Frequency Cepstral Coefficient.
- 2) Dynamic Time Wrapping.

1.1 Mel's Frequency Cepstral Coefficient:

Mel-Frequency Cepstral Coefficients (MFCC) is the most commonly used feature removal method in automatic voice recognition. To remove a feature vector containing all information about the linguistic communication, MFCC mimics several parts of the person speech production and speech observation. MFCC mimics the logarithmic perception of noise less and pitch of human audio system and tries to remove speaker dependent characteristics by without the basic frequency and their harmonics. Most voice signal recognition procedure use the so-called Mel's frequency cepstral coefficients (MFCC) [9].

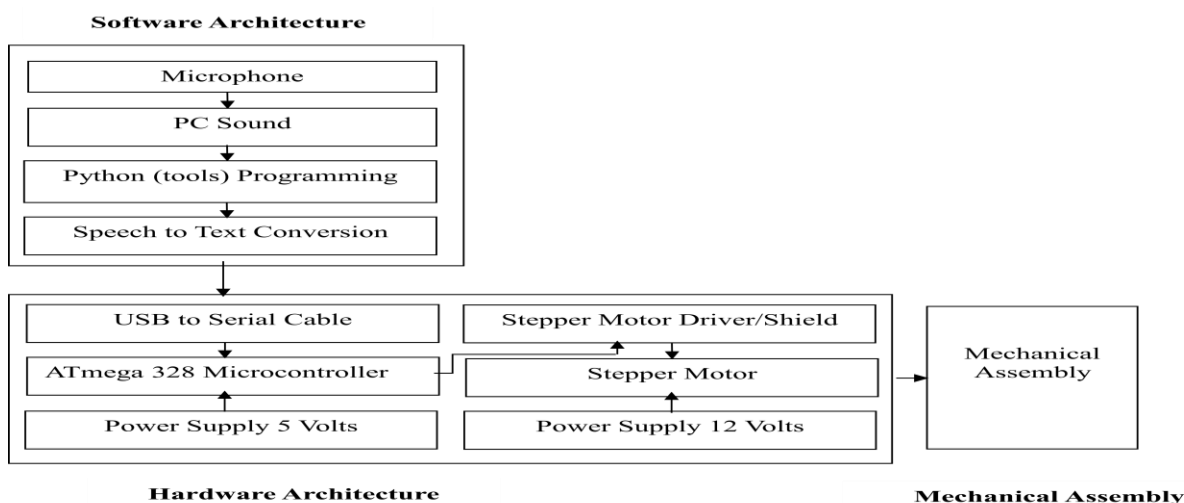


Figure 1: Block Diagram of Robotic ARM

1.2 Dynamic Time Wrapping:

Dynamic time packaging (DTW) is an algorithm for measuring comparison between two sequences which may vary in time or pace. DTW is used in mechanical voice recognition to manage with different speaking speeds. DTW is one of the algorithms for measuring relationship between two chronological sequences, which may fluctuate in speed. DTW algorithm compares the parameters of an unknown speech with the parameters of one orientation template. This algorithm is used to separate the voice signals of different users depending upon the pitch, pace, frequency, etc. of the speaker [10].

2. HARDWARE ARCHITECTURE:

2.1 Arduino:

Arduino UNO is the AT mega 328 microcontroller board; it has 6 analog pin, 14 digital inputs and outputs pins. It receives command and data from central processing unit with the help of serial cable. Shield is mounted on Arduino UNO, for transfer of the data from Arduino to shield and then transfer of the same data to the stepper motor driver [11]. Arduino UNO is the open source platform which controls the speed and step for stepper motor. It has analog and digital input/ output pins; it is interfacing with various sensor and equipment [12]. This Arduino board is used at 5 to 9 volts supply and 20 to 30 mA current, it has separate USB port, power jack and reset button. It is simply connected to the computer with the help of USB port cable and AC to DC adapter.

2.2 Shield:

2.4 Stepper motor driver:

For working of this writing robotic arm, stepper motor driver is essential [15]. In this motor driver the compatible logical power supply of 3.3 to 5.5 volts is given and it is connected through positive and ground pin. The stepper motor supply is 9 to 12 volts; it is connected across A1, A2 and B1, B2.

2.5 Pen:

The writing robotic arm required pen to write the letter and this writing pen is fitted with the Z axis of robot.

3. MECHANICAL ASSEMBLY:

The robotic arm assembly showing writing skill by speech recognition consists of the three different stepper motors and the writing pen which is held along Z axis stepper motor. This robot is mimicking the writing of human.

The Arduino UNO shield is use built the robotic writing arm and it is helpful to control three different stepper motor drivers [13]. It has use 12 volt power supply and shield controls the current distribution of every stepper motor. It also acts as safeguard against the short circuit by limiting the current.



Figure 2: Arduino Shield

2.3 Steppermotor:

The stepper motor transforms the digital pulse in to the movement in X, Y and Z axis [14]. In this robotic arm, bipolar stepper motor or step motor is used which is the brushless motor and this motor rotates in the 5 equal number of steps. In this robotic writing arm, three stepper motors having 12 volt supply are used and motor outcomes will be in the form of rotation in X, Y and Z axis

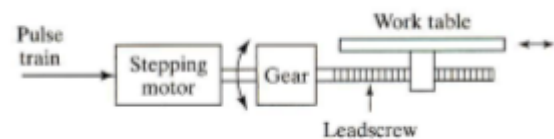


Figure 3: Stepper Motor

Rack and pinion gear arrangement is selected to initiate and control the movement along X, Y and Z axis, as all the motors work simultaneously. One motor is used to perform the function of holding the pen along with moving it vertically in Z axis. Base of the assembly can move in X axis by the second stepper motor. Third motor actuates the movement of the writing pen along the Y direction. The flow chart for robotic arm showing writing skills by speech recognition and steps taken is as shown below.

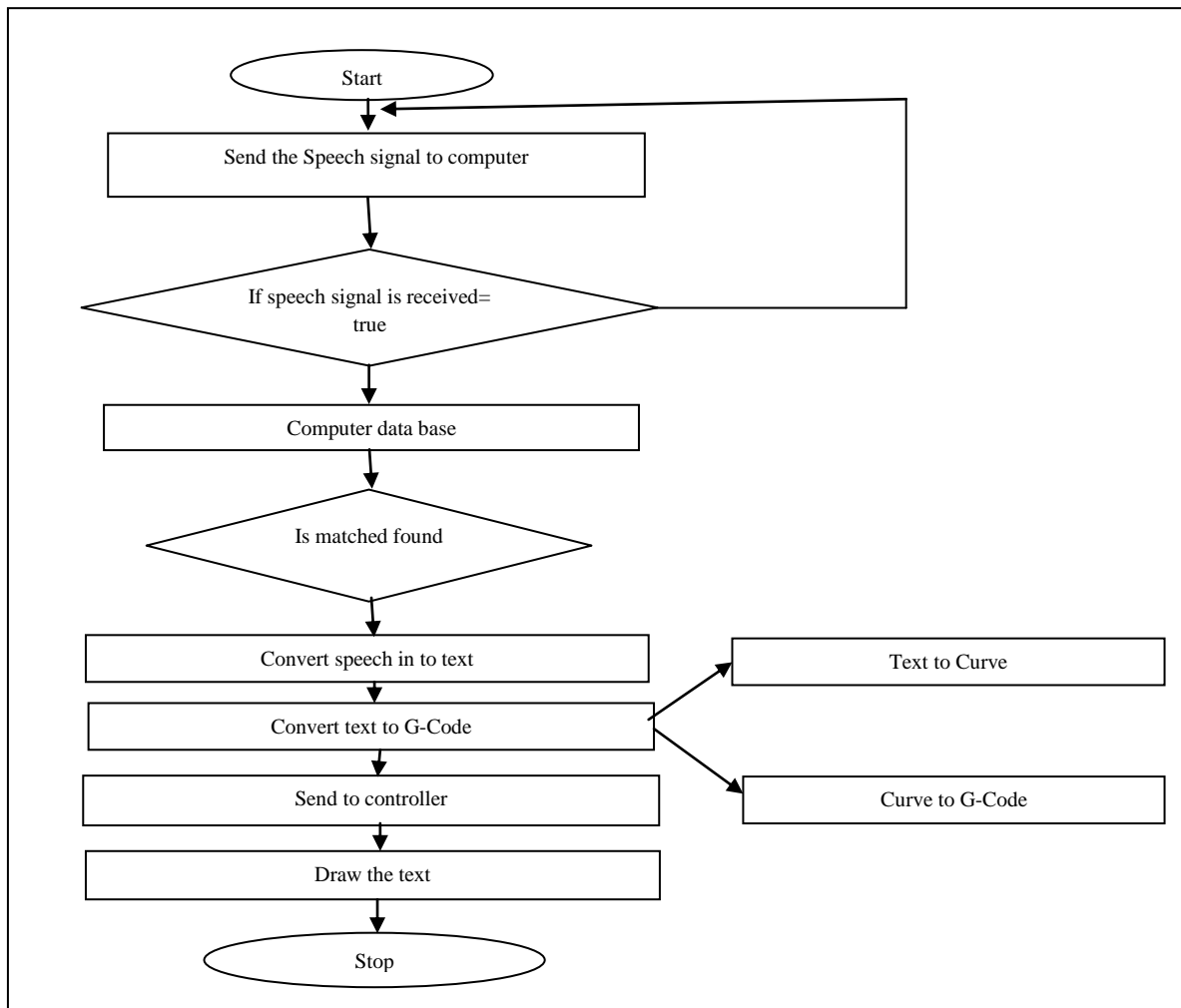


Figure 4: Flow chart on robotic arm showing writing skills by speech recognition

IV. RESULTS

Conversion of speech to text

Python's Speech Recognition package combined with PortAudio was used to write a script on the Linux platform. This script was executed to convert the speech to text. This process has been uploaded as a video at <https://youtu.be/v1Y23XXVsBY>.

Conversion of text to GCODE

The text recognized is converted to GCODE by using the EASEL software. This software is available online.

Sending the GCODE to plotter

The GCODE is sent to plotter using a CNC mode, as described earlier in the text. This process is made available as a video at <https://youtu.be/PzVx7NqLpuU>.

Robotic arm showing writing skills by speech recognition working model was verified and this module is capable to write what they speak, this module is work using speech recognition. AT mega 328 Microcontroller is used for controlling the robot operations. And check out write text and controlled successfully.

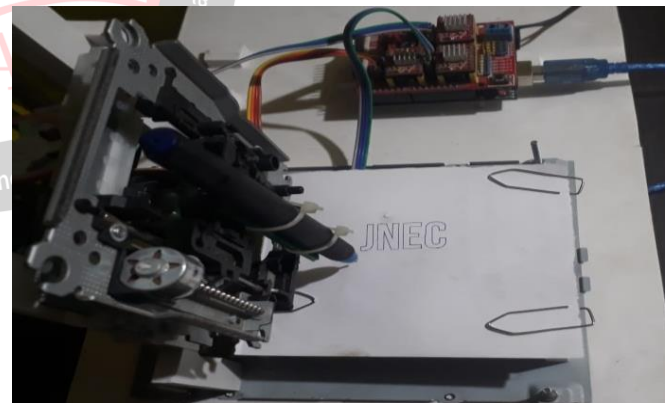


Figure6: Output of propose system

Aim of our project is help physical handicap person; they don't write by their hands, this project will be absolutely helpful for the patients to speech recognition with writing robotic arm.

V. CONCLUSION

In this paper, discuss the robotic arm showing writing skills by speech recognition. The Proposed writing robotic arm is low cost, easy to handle and controlled. This system describes the structure of robotic arm suitable for the physically handicap person to perform writing easily. This

writing robot speed and accuracy is high as compared other speech to text writing robot. This robot uses Mel's Frequency Cepstral Coefficient which is the easy and simplest technique as compared to dynamic time wrapping. In this system most difficult part is to generate suitable computer numerical control code.

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