

# Design and Development of Robotic Arm for Writing Examination Using Speech Recognition.

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Date of Submission: 02-09-2020

Date of Acceptance: 20-09-2020

**ABSTRACT**—The paper presents an approach to a style of a universal robot to perform robot writing arm specially designed for physically challenged people for their examination purpose. Our device works under speech recognition which makes it easier for the physically challenged. On our day to day circumstances, we hire substitutes for writing the exams for a physically challenged person in all schools and colleges which causes various errors and malfunctioning. To perform the task, on-line human signing standards are created first. Robot writing task is performed using these standards then and robot signatures are acquired as a result. Finally, recommendations of robot motion improvement are given.

**Keywords:** Arduino UNO, Power Supply, GSM, GPS, Sensor.

## 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 actuators.

## II. EXISTING SYSTEM

The system will be divided into two sections one will be transmitter section and other will be receiversection. The transmitter section will consists of one Arduino Uno, one 3- axis accelerometer and one RF transmitter module. The receiver section consists of one RF receiver module, one motor driver IC, two PMDC motor, two wheels. Here we will require two separate 5 volt power supply which will be applied to both the sections.

The robot moves forward, backward, right and left when there is tilt in the palm of user in forward, backward, right and left respectively directions. A gesture controlled robot can be controlled by using hand in place of any other method like buttons or joystick. Here one only needs to move hand to control the robot. A transmitting device is used in your hand which contains RF Transmitter and accelerometer. This will transmit command to robot so that it can do the required task like moving forward, reverse, turning left, turning right and stop. All these tasks will be performed by using hand gesture. Here the most important component is accelerometer.

### III. PROPOSED SYSTEM

The writing robot makes to write the examination with the help of wireless communication. The movement -Code file created by the help of Inkscape software then the processing software is used to send the G-Code file to the microcontroller. Then the CNC shield drive sends the controlling signals to the stepper motors and servo motor. Now the XY axis which operates as follows by the instructions given to the controller unit. The corresponding code is send the data to controller block is interfaced with motor driver unit along the DAC provides the pulse width signal to motor unit where it is been processed and final output is written and displayed on the paper from the output unit.

#### A. ADVANTAGES:

- Accuracy.
- Optimized character axis.
- Less delay.
- Low cost.

#### B. DISADVANTAGES:

- Time Consumption high.
- Manual Work.
- Mechanism little much difficult to implement.

#### C. APPLICATIONS:

- Medical.
- Handicapped writing.
- Industrial data.

#### Block Diagram – Transmitter Section:



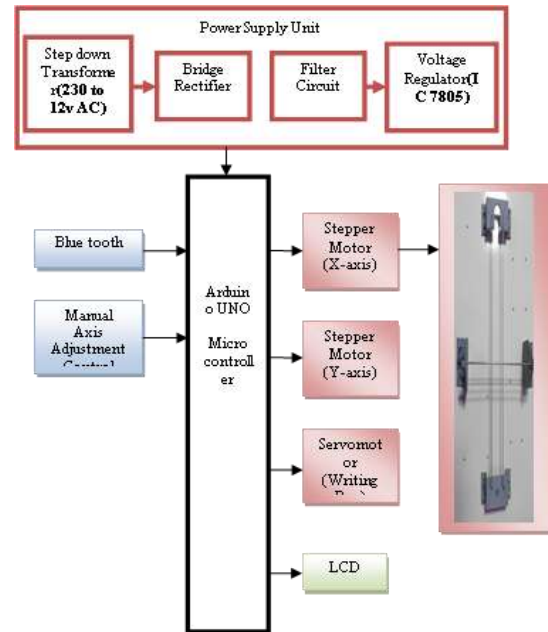
#### HARDWARE REQUIREMENTS:

- Power Supply Unit.
- Arduino UNO.
- Bluetooth Module.
- Liquid Crystal Display.
- Stepper Motor Driver.
- Stepper Motors and Servo Motor.
- Gear and Belt Setups.

#### SOFTWARE REQUIREMENTS:

- Embedded C.
- Arduino IDE.
- Arduino microcontroller programming software.

#### BLOCK DIAGRAM



### IV. MODULE DESCRIPTION

#### HARDWARE REQUIREMENTS:

#### A. POWER SUPPLY UNIT:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

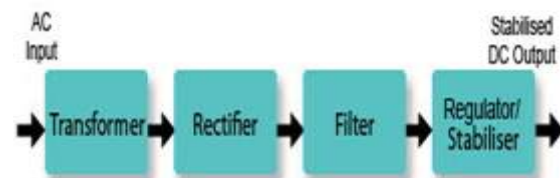


Fig 1. Power Supply unit

#### B. STEP DOWN TRANSFORMER:

Basic power supply the input power transformer has its primary winding connected to the mains (line) supply. A secondary winding, electro-magnetically coupled but electrically isolated from the primary is used to obtain an AC voltage of suitable amplitude, and after further processing by the PSU, to drive the electronics

circuit it is to supply. The transformer stage must be able to supply the current needed. If too small a transformer is used, it is likely that the power supply's ability to maintain full output voltage at full output current will be impaired. With too small a transformer, the losses will increase dramatically as full load is placed on the transformer. As the transformer is likely to be the most costly item in the power supply unit, careful consideration must be given to balancing cost with likely current requirement. There may also be a need for safety devices such as thermal fuses to disconnect the transformer if overheating occurs, and electrical isolation between primary and secondary windings, for electrical safety.

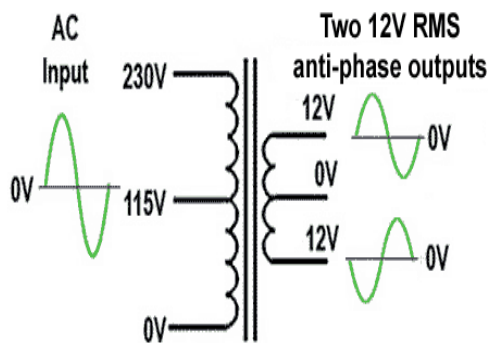


Fig 2. Step down Transformer

### C. THE RECTIFIER STAGE:

Rectifier circuit is used to convert the AC input is converted to DC. The full wave bridge rectifier uses four diodes arranged in a bridge circuit to give full wave rectification without the need for a center-tapped transformer. An additional advantage is that, as two diodes are conducting at any one time, the diodes need only half the reverse breakdown voltage capability of diodes used for half and conventional full wave rectification. The bridge rectifier can be built from separate diodes or a combined bridge rectifier can be used. It can be seen that on each half cycle, opposite pairs of diodes conduct, but the current through the load remains in the same polarity for both half cycles.

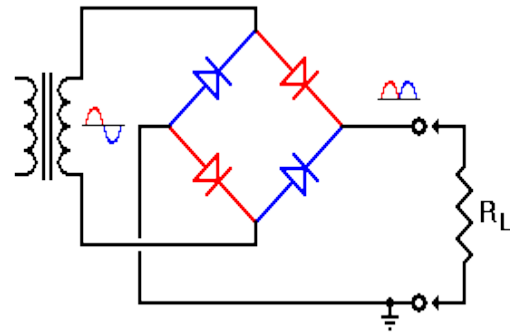


Fig 3. Bridge Rectifier

### D. FILTER:

A typical power supply filter circuit can be best understood by dividing the circuit into two parts, the reservoir capacitor and the low pass filter. Each of these parts contributes to removing the remaining AC pulses, but in different ways. Electrolytic capacitor used as a reservoir capacitor, so called because it acts as a temporary storage for the power supply output current. The rectifier diode supplies current to charge a reservoir capacitor on each cycle of the input wave. The reservoir capacitor is large electrolytic, usually of several hundred or even a thousand or more microfarads, especially in mains frequency PSUs. This very large value of capacitance is required because the reservoir capacitor, when charged, must provide enough DC to maintain a steady PSU output in the absence of an input current; i.e. during the gaps between the positive half cycles when the rectifier is not conducting.

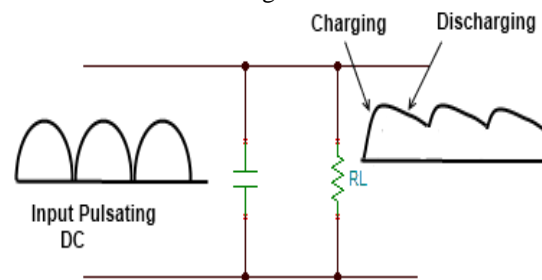


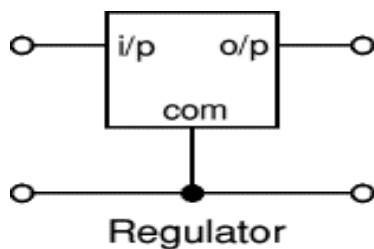
Fig 4. Filter Circuit

Once the input wave passes  $V_{pk}$  the rectifier anode falls below the capacitor voltage, the rectifier becomes reverse biased and conduction stops. The load circuit is now supplied by the reservoir capacitor alone. Of course, even though the reservoir capacitor has large value, it discharges as it supplies the load, and its voltage falls, but not by very much. At some point during the next cycle of the mains input, the rectifier input voltage rises

above the voltage on the partly discharged capacitor and the reservoir is re-charged to the peak value  $V_{pk}$  again.

**E. VOLTAGE REGULATOR:**

Voltage regulator ICs are available with fixed or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current and overheating.

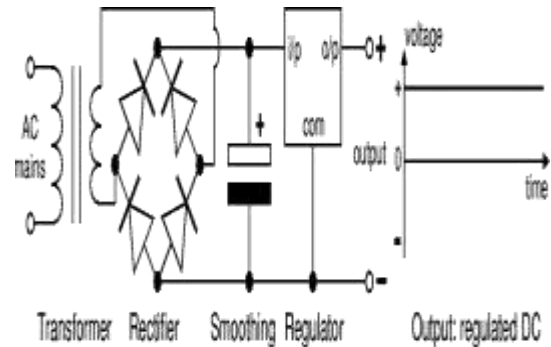


**Fig 5.**Regulator Circuit

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, Hi-Fi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and current.

**1. Positive regulator**

- Input pin
  - Ground pin
  - Output pin
2. It regulates the positive voltage.
  3. Negative regulator.
  4. Ground pin.
  5. Input pin.
  6. Output pin.

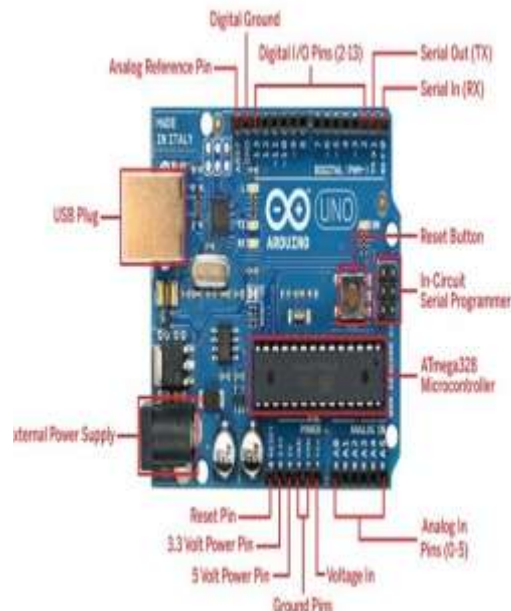


**Fig 6.** Power Supply Circuit

**F. ARDUINO:**

Arduino is a flexible programmable hardware platform designed for artists, designers, tinkerers and The makers of things. Arduino's processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory.

The code is stored in the flash program memory, whereas the data is stored in the data memory. The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader), 2 KB of SRAM and 1 KB ofEEPROM and operates with a clock speed of 16MHz.



**Fig 7.** Arduino Board

The most important advantage with Arduino is the programs can be directly loaded to the device without requiring any hardware

programmer to burn the program. This is done because of the presence of the 0.5KB of Bootloader which allows the program to be burned into the circuit. All we have to do is to download the Arduino software and writing the code. Arduino Uno consists of 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.

### STEPS TO PROGRAM

Programs written in Arduino are known as sketches. A basic sketch consists of 3 parts

1. Declaration of Variables.
2. Initialization: It is written in the setup () function.
3. Control code: It is written in the loop () function.

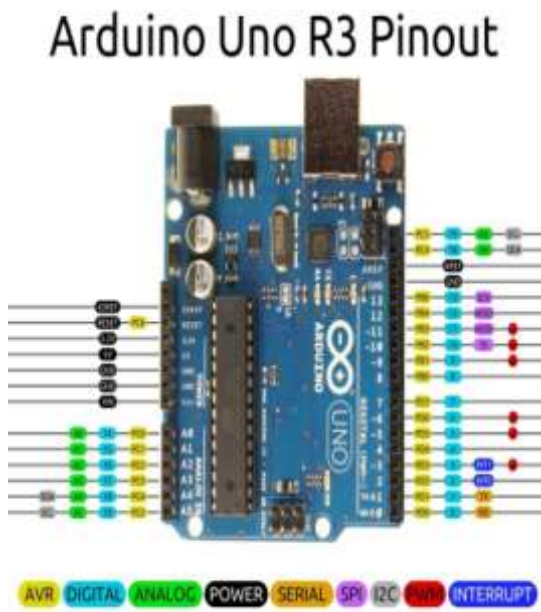


Fig 8. Arduino pin diagram

- The sketch is saved with .ino extension. Any operations like verifying, opening a sketch, saving a sketch can be done using the buttons on the toolbar or using the tool menu.
- The sketch should be stored in the sketchbook directory.
- Chose the proper board from the tools menu and the serial port numbers.
- Click on the upload button or chose upload from the tools menu. Thus the code is uploaded by the bootloader onto the microcontroller.

- It comes with an easy provision of connecting with the CPU of the computer using serial communication over USB as it contains built in power and reset circuitry.

### G.LCD:

Liquid crystal cell displays (LCDs) used to display of display of numeric and alphanumeric characters in dot matrix and segmental displays. They are all around us in laptop computers, digital clocks and watches, microwave, CD players and many other electronic devices. LCDs are common because they offer some real advantages over other display technologies.



Fig 9. LCD Display

An LCD is made with either a passive matrix or an active matrix display grid. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time. Passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

### H. BLUETOOTH:

Bluetooth is a telecommunications industry specification that describes how mobile phones, computers, and personal digital assistants (PDAs) can be easily interconnected using a short-range wireless connection. Using this technology, users of phones, pagers, and personal digital assistants can buy a three-in-one phone that can double as a portable phone at home or in the office, get quickly synchronized with information in a desktop or notebook computer, initiate the sending or receiving of a fax, initiate a print-out, and, in general, have all mobile and fixed computer devices be totally coordinated. Bluetooth requires that a low-cost transceiver chip be included in each device. The transceiver transmits and receives in a previously unused frequency band of 2.45 GHz that is available globally (with some variation of bandwidth in different countries).



Fig 10. Bluetooth module

In addition to data, up to three voice channels are available. Each device has a unique 48-bit address from the IEEE 802 standard. Connections can be point-to-point or multipoint. The maximum range is 10 meters. Data can be exchanged at a rate of 1 megabit per second (up to 2 Mbps in the second generation of the technology). A frequency hop scheme allows devices to communicate even in areas with a great deal of electromagnetic interference. Built-in encryption and verification is provided.

#### Features Of Bluetooth Technology:

- Less complication.
- Less power consumption.
- Available at cheaper rates.
- Robustness.

#### I. STEPPER MOTOR:

Stepper motor (also called as step motor) is basically a brushless DC motor, whose rotor rotates through a fixed angular step in response to input current pulse. That means, the full rotation of the rotor is divided into equal number of steps, and rotor rotates through one step for each current pulse. Stepper motors are becoming very popular due to the fact that they can be controlled directly by computers, micro processors or micro controllers. Stepper motors are used for precise positioning of an object or precise speed control without closed loop feedback.



Fig 11. Stepper motor

Stepper motor is a specially designed DC motor that can be driven by giving excitation pulses to the phase windings. They cannot be driven by just connecting the positive and negative leads of the power supply. They are driven by a stepping sequence which is generated by a controller.

A stepper motor is a type of DC motor which has a full rotation divided in an equal number of steps.

Stepper motors work on the principle of electromagnetism. There is a soft iron or magnetic rotor shaft surrounded by the electromagnetic stators. The rotor and stator have poles which may be teathed or not depending upon the type of stepper. When the stators are energized the rotor moves to align itself along with the stator (in case of a permanent magnet type stepper) or moves to have a minimum gap with the stator (in case of a variable reluctance stepper).

#### J. SERVO MOTOR:

Servo Motors are DC Motors (check out how DC motor works) with a servo mechanism to provide a precise angular motion. Pulse width modulation (PWM) technique is used to set the angle of rotation. Generally RC servo motors have a rotation limit of  $90^{\circ}$  to  $180^{\circ}$  but servos with high rotation angles are also available. A servo motor is one of the widely used variable speed drives in industrial production and process automation and building technology worldwide. Although servo motors are not a specific class of motor, they are intended and designed to use in motion control applications which require high accuracy positioning, quick reversing and exceptional performance.

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which runs through **servo mechanism**. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo

motor. We can get a very high torque servo motor in a small and light weight packages.



**Fig 12.** Servo motor

A servo motor is a linear or rotary actuator that provides fast precision position control for closed-loop position control applications. Unlike large industrial motors, a servo motor is not used for continuous energy conversion. Servo motors have a high speed response due to low inertia and are designed with small diameter and long rotor length. Servo motors work on servo mechanism that uses position feedback to control the speed and final position of the motor.

## V. LITERATURE SURVEY

TITLE:Algorithm For Robot Writing Using Character Segmentation  
AUTHOR:Salman Yussof, AdzlyAnuar, Karina Fernandez  
YEAR : 2005

Currently, there are many ongoing researches that are targeted at making robots more human-like. One of the tasks that can be done by humans easily but is difficult to be done by robots is writing. In this paper, we are presenting a flexible algorithm that can allow a robot to write. This algorithm is based on character segmentation, where the main idea is to store character information as segments and the segment information can then be used by the robot to write. We have also developed a sample application using the proposed algorithm to allow a Mitsubishi RV-2AJ robotic arm to write English characters and numbers. through our experiment, it has been proven that the algorithm developed is able to allow the robotic arm to write.

TITLE:Write Tutor  
AUTHOR:Chembian Parthiban1 and Rishikesan Parthiban2

YEAR : 2011

The article addresses the technical principles of a new interactive Robotic device, called Write Tutor, and gives an overview of its application. In spite of the various measures and efforts taken in terms of improving literacy rate we still have a major section of the population who are not able to read and write. The Write Tutor, a completely autonomous device can teach children and people of any age group the art of writing. The mechanism is programmed with speech recognition system and makes the user write what he speaks holding his wrist. It also can make you draw pictures in the graphical mode. The Write tutor also has built-in modules to teach reading and writing simultaneously using its on board display. The workspace is designed enabling the user to write on a sheet size varying from a post card to an A4 sheet. Therefore the Write Tutor is a low cost device that can be programmed to teach people in different languages, people who are physically challenged, autistic and dyslexic children and children in elementary schools.

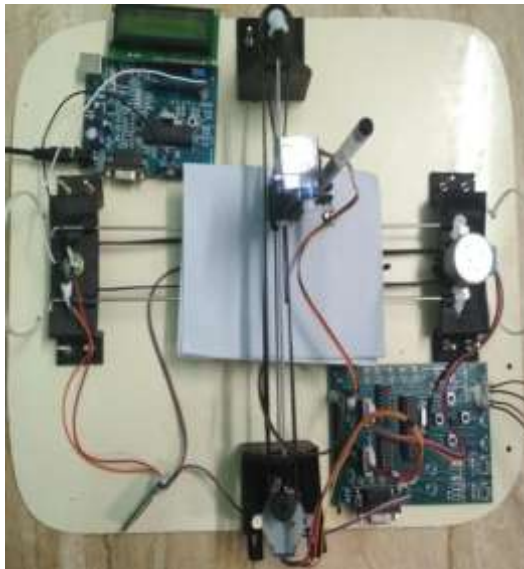
TITLE:Design Of A Human Multi-Robot Interaction Medium Of Cognitive Perception  
AUTHOR:Wonse Jo, Jee Hwan Park, Sangjun Lee, Ahreum Lee, And Byung-Cheol Min  
YEAR : 2019

We present a new multi-robot system as a means of creating a visual communication cue that can add dynamic illustration to static figures or diagrams to enhance the power of delivery and improve an audience's attention. The proposed idea is that when a presenter/speaker writes something such as a shape or letter on a whiteboard table, multiple mobile robots trace the shape or letter while dynamically expressing it. The dynamic movement of multi-robots will further stimulate the cognitive perception of the audience with handwriting, positively affecting the comprehension of content. To do this, we apply image processing algorithms to extract feature points from a handwritten shape or letter while a task allocation algorithm deploys multi-robots on the feature points to highlight the shape or letter. We present preliminary experiment results that verify the proposed system with various characters and letters such as the English alphabet.

TITLE:Sympathy-Expression Method For Educational Support Robots Based On Writing Times.  
AUTHOR :Kenshi Ota  
YEAR : 2018

In recent years, educational-support robots that can assist human learners have been attracting the attention of researchers. However, learners feel that these robots have monotonous behaviors, making collaborative learning with the robot a boring experience. To solve this problem, a previous study proposed using the sympathy-expression method in which the robot expresses its own emotions autonomously on the basis of the answer time. However, we propose the notion that the writing time should also be considered. The writing time is defined as the time taken by the learners to answer the questions. When learners wrote a lot, the answer time became long and the robot (in the previous method) used to express emotions of sleep. To empathize with the learners, it is important for the robot to express emotions of arousal. Therefore, in this paper, we propose the sympathy-expression method, which expresses emotions based on the writing time.

## VI. RESULTS AND DISCUSSION



It shows that circuit for our proposed system. To obtain an acceptable robot writing quality, it is necessary to reach around 15 dB of each quality index. Therefore, the acceptable quality of the trajectory profile (24.4948 dB) can be obtained in the case of 10 writing speed mode. Unfortunately, acceptable quality of speed profile cannot be obtained in present experiment conditions. It looks like it cannot be substantially increased bearing in mind the dynamics of writing speed and correspondent meanings of quality of the speed. Therefore, we suppose that a reasonable way of increasing of quality of the speed profile is the reduction of inertia of robot arm parts in parallel

with optimal task placement in robot workspace. For this aim it is necessary to find an appropriate quality index (e.g. minimum of inertia) to perform an optimization task. That will be one of the directions of our future research. Improving of the effectiveness of dynamic signature verification system is also among the future tasks.

## VII. CONCLUSION

In this paper, we present a method to design rapid and fluid movements of a universal robot to perform robot writing examination using speech recognition. The handwriting specimen acquisition, writing specimen processing, robot writing and comparison of on-line human and robot signatures are the phases of the experimental research performed.

## ACKNOWLEDGMENT

We are personally indebted to a number of persons that a complete acknowledgement would be encyclopaedic. First of all, we would love to record our deep gratitude for our parents for permitting us to take up this course. My sincere thanks and profound sense of gratitude goes to our respected Chairman, Rev. Fr. Dr. J.E. Arul Raj for all his efforts and administration in educating us in this premiere institution. We take this opportunity to thank our Principal Dr. Sujatha Jamuna Anand, for his kind co-operation in completing this Project. We would like to express our gratitude Dr. L. Nalini Joseph Head of the Department of Electronics and Communication Engineering. For his guidance and advice all through our tenure. We convey our sincere thanks to our internal guide S.V. Priya (Associate prof) for valuable suggestions throughout the duration of the project.

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