

# Implementation of 2D Writing Robot

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## ABSTRACT

*Robots can take any form of work like speech, walk, write, lift, balance which a human can perform. Drawing 2D objects mainly aims in creating a desired object with accurate dimensions in a precise manner which is especially true for an engineer. In real time application printing of posters and banners is a real challenge which requires specialized equipments and the expertise workers to use it. Many of the CMOS based design layouts require these drawing techniques in order to build the components that work with more efficiency. It is the key element in architectural design, where the designer finds it difficult to print the layout of any structure. In such case a robot is a best possible way to generate the desired outfit which is required by the designer.*

**Keywords:** *Arduino IDE software, Arduino Uno, Stepper motor, Servo motor, ULN2003A.*

## I. INTRODUCTION

A Robot is an artificial agent, meaning it acts instead of a person, doing things it is designed for. Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science and many others. Robots are usually machines controlled by a computer program or electronic circuitry. They may be directly controlled by humans and look alike as humans and seem to have a life of their own, in which their behavior may suggest intelligence or thought. Most of the robots deal with a specified job like design, construction, etc. The project is entitled as "Implementation Of 2D Writing Robot" which basically aims at writing 2D objects like alphabets, numbers, and many designs which can be sketched by humans on a sheet of paper for the proper analysis of the work during fabrication of the machine tools in real time applications.

In our project we use a unipolar Stepper Motor which consists of 4-phases that plays a key role in the movement of the robot. The 2D designing is basically based on the moment of the robot. A movement of the Servo Motor decides when a pen should start and when it should stop designing. All these are controlled by an algorithm which is coded using software "ARDUINO Integrated Development Environment (IDE)", which is simple and an open source software that make the programmer to interface with the Arduino easily. Here we use a simple arduino program to perform the writing action by the robot. The circuit is simple and placed on the chassis where the driving capabilities of the motors internally are based on the usage of power supplied and the phases of a stepper motor upon which the algorithm of the program depends. This algorithm can be further enhanced in order to design different objects by making change in the looping statements, by keeping in mind the constraints of the chassis and the dimensions of the wheel. By this we will be able to develop an efficient robot to meet the programmer requirements.

## II. METHODOLOGY

The following block diagram in Fig. 1 shows the working of the project which basically includes a stepper motor and servomotor which comes in contact with the Arduino board using a motor drive that makes the robot to work according to the programming logic.

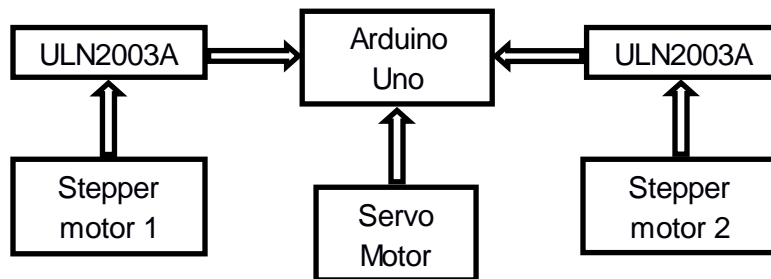


Fig.1 Block Diagram of 2D Writing Robot

The above Fig. shows the model of our project. During uploading of the hardware few of the constraints made us to change the circuit that is actually shown is the circuit diagram. Here if the usage of the chassis is much simple and elegant for the wheel to drive the load. We could observe that, if we can reduce the size of the chassis and increasing the width of the wheel the robot could drive the load easily which helps in easy designing of the objects. The movement of the robot basically depends on the number of steps given to the stepper motor in order to rotate per revolution, whereas the movement of the pen up and down is decided by the programming of a servo motor that commands when a robot needs to write and when it should end the designing. Optional - In order to control any voltage fluctuations to the motor we can use a capacitor. Also we can use a SPDT slide switch to control the driving of the robot. (i.e., when to start and when to end the working of the robot)

## III. HARDWARE IMPLEMENTATION

Though the software code plays a major role in robotics, hardware also has an equal importance. One should keep in mind that the efficiency of the robot depends on the construction of its hardware part. Minimum the circuit size and the length of the programming code maximum is its efficiency.

### 3.1 STEPPER MOTOR

A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments, which has direct relationship when electrical command pulses are applied to it in the proper sequence. The sequence of the applied pulses is directly related to the direction of motor shafts rotation, which is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied. One of the most significant advantages of a stepper motor is its ability to be accurately controlled in an open loop system. Open loop control means no feedback information about position is needed. This type of control eliminates the need for expensive sensing and feedback devices such as optical encoders [2].

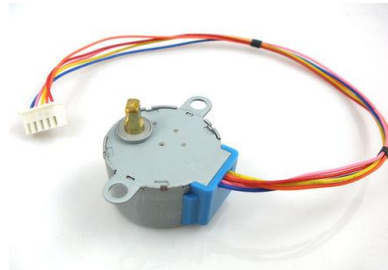


Fig.2 A 5V Stepper Motor with 4-Phase and 5-Wire

### 3.2 ULN2003A

The simplest way of interfacing a unipolar stepper motor to Arduino is to use a breakout for ULN2003A transistor array chip that contains seven darlington transistor drivers and is somewhat like having seven TIP120 transistors all in one package. The ULN2003A can pass up to 500mA per channel and has an internal voltage drop of about 1V when on. It also contains internal clamp diodes to dissipate voltage spikes when driving inductive loads. The stepper motor is controlled by applying a voltage to each of the coils in a specific sequence[2].

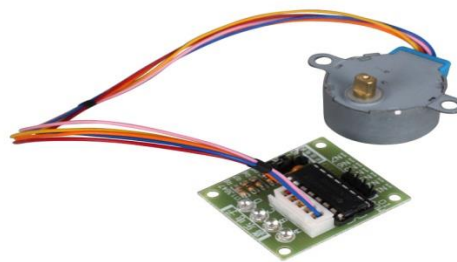


Fig.3 ULN2003A Stepper Motor Drive

Fig.4 Interfacing Stepper Motor with ULN2003A Motor Drive

### 3.3 SERVO MOTOR

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

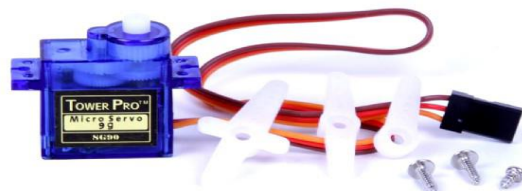


Fig.5 Servo Motor SG90

### 3.4 CIRCUIT DIAGRAM

The following Fig. shows the circuit that has to be connected for the proper working of a robot. Here we use two motor drives ULN2003A to connect to a stepper motor. The input of the motor drive1 of the right wheel of the stepper motor is given to the input pins of the arduino at 3, 5, 6, 7, whereas the other input of the motor drive2 of the left wheel of the stepper motor is given to the input pins of the arduino at 9, 10, 11, 12. (In the Fig. ULN2803A has been used to drive two motors. But it is preferable to use 2003A where the efficiency of the stepper motor increased by the circuit by reducing the voltage fluctuations caused on the stepper.) The micro servo is connected to the 13 input pin of the arduino, given that a 5v dc supply and a ground is connected to it. The programming is done by reading the input pins of the motor drive and the servo motor where the logic of the motor movement depends on the four phases of a stepper motor. The code is written for drawing a simple square or a spiral which is described in section 4.4. The movement of the servo motor is done by giving a specific angle rotation as specified from the datasheet. This helps in the movement of the pen collar to start whenever the programmer requires it to design and to end after completion of the design, by moving the pen collar up which in turn lift the pen up away from the drawing sheet below the chassis.

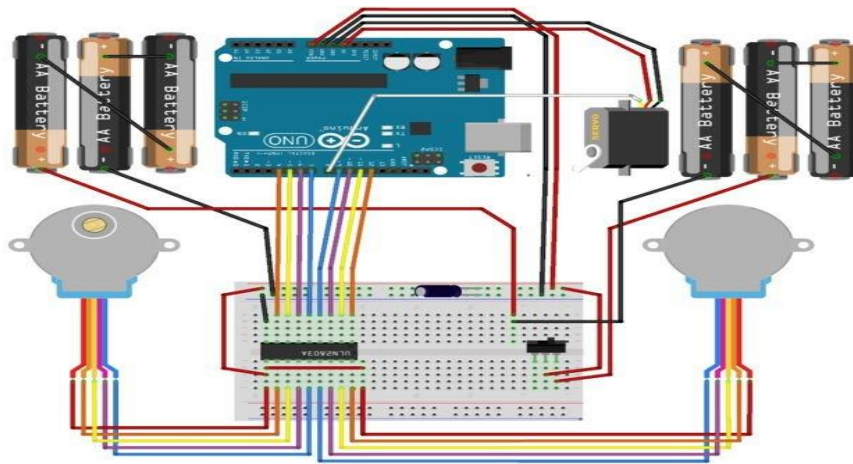


Fig.6 Circuit diagram which uses ULN2803A

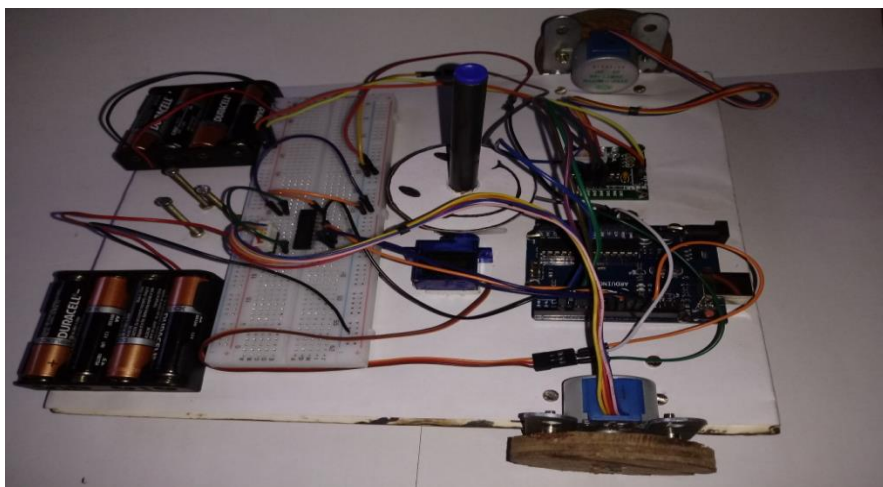


Fig.7 Actual developed Robot Hardware

Fig. shows the model of our project. During uploading of the hardware few of the constraints made us to change the circuit that is actually shown is the circuit diagram. Here if the usage of the chassis is much simple and elegant for the wheel to drive the load. We could observe that, if we can reduce the size of the chassis and increasing the width of the wheel the robot could drive the load easily which helps is easy designing of the objects[1].

#### IV. SOFTWARE IMPLEMENTATION

Arduino was born at the “Ivrea Interaction Design Institute” as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. All Arduino boards are completely open -source, empowering users to build them independently and eventually adapt them to their particular needs. “ARDUINO IDE” is an open source electronics platform based on easy to use hardware and software. Arduino boards are capable to read inputs such as light on a sensor, a figure on a button, or an online message and turn it into an output like activating a motor, turning on an LED, or posting something online. By sending the set of instructions to the microcontroller on the board we can tell the board what has to be done. The Arduino software is easy to use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows and Linux platform. Arduino is a key tool to learn new things where designers and architects build interactive prototypes.



Fig.8 Arduino Uno Board

Step1: Get the latest version from the download page. You can choose between the Installer (.exe) that installs directly everything you need to use the Arduino Software (IDE), including the drivers and the Zip package where you need to install the drivers manually, the Zip file is also useful if you want to create a portable installation.

Step2: Proceed with the installation and please allow the driver installation process when you get a warning from the operating system.

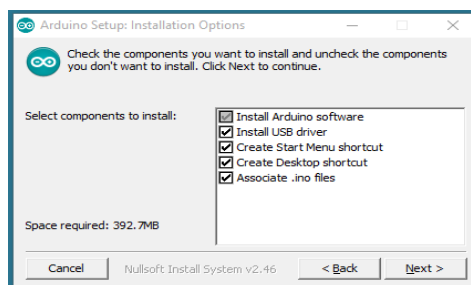


Fig.9 Choose the components to install.

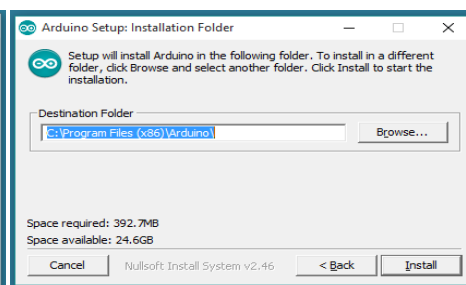


Fig.10 Choose the installation directory.

The process will extract and install all the required files to execute properly the Arduino Software (IDE). If you

want to program your Arduino/Genuino Uno while offline you need to install the Arduino Desktop IDE. The Uno is programmed using the “Arduino Software (IDE), our Integrated Development Environment” common to all our boards. Before you can move on, you must have installed the Arduino Software (IDE) on your PC, as explained in the home page of our Getting Started.

Step3: Connect your Uno board with an A B USB cable; sometimes this cable is called a USB printer Cable. The Uno automatically draw power from either the USB or an external power supply. This USB connection with the PC is necessary to program the board and not just to power it up. Connect the board to your computer using the USB cable, the green power LED (labelled PWR) should go on. By this we select the port through which the board is programmed.

Step4: In order to create a new program code, go to File and select New, where a new file appears. After completion of the program Save the file in a selected folder. Then you'll need to select the entry in the Tools > Board menu that corresponds to your Arduino/Genuino board. This is done to map the arduino to a specified port where the USB cable is connected.

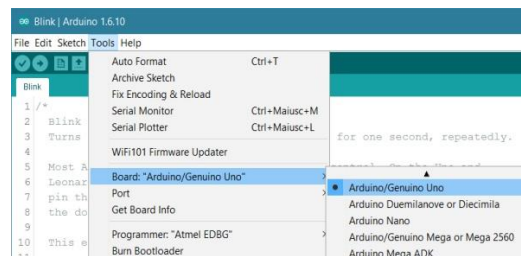


Fig.11 Select board type

Select the serial device of the board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your board and re-open the menu; the entry that disappears should be the Arduino or Genuino board. Reconnect the board and select that serial port.

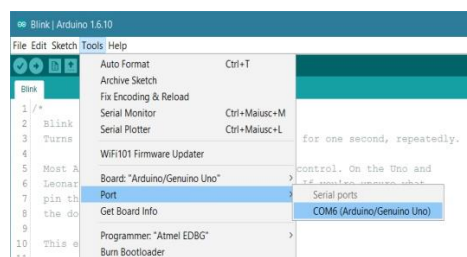


Fig.12 Select the port

Step5: Now, simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX led on the board are flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.



Fig.13 Upload the program

If it does, congratulations! You've gotten Arduino or Genuino up-and-running. If you have problems, please see the troubleshooting suggestions.

## V. EXPERIMENTAL RESULT

After the Implementation of the above circuit and verifying the program code the output is that a robot tries to design the coded object on a sheet of paper. If any error persists in the code you need to troubleshoot it.

Fig. shows the output designs drawn by the robot on its programming.

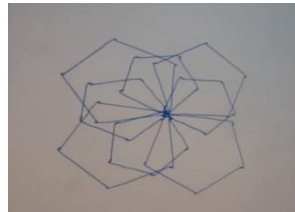


Fig.14 Random design

Due to the circuit and the chassis constraints it will be difficult to draw the higher designs. But the robot makes possible effort to design few of the basic object designs. As it was said earlier that the use of the switch is just to stop the robot by repetitive designing of the designs. Once the robot finishes drawing we have to manually lift the robot out of the page, in case of not using the switch[5].

## VI. APPLICATIONS

It can be used in real time world at places where it is required to design;

- Posters and banners
- With high accuracy and meeting hardware requirements, it can be used to generate CAD designs
- Trial of Architectural Designs
- With the improvement in the following robot, it can be used to generate drawings given by the user on a computer interface.

## VII. CONCLUSION

To implement a 2D writing robot that can design required output designs in real time world which helps to get the on spot pictorial representation of any image which a user tends to build as a machine or a tool in future.

As every electronic gadget has its own disadvantage, in the same way there are a few constraints of this project such as Chassis and other printed parts, Wheel width, Power, less steps of a stepper motor.

## VIII. ACKNOWLEDGEMENT

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