**Accredited by NBA & NAAC with "A" Grade**
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**Department of Electronics & Communication Engineering**

**Academic Year 2016-17**

**Annexure I**

**Project Title: ARDUINO BASED XY-DRAWING ROBOT**

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# 1. Abstract & Objective

## 1.1 Abstract

XY Plotter is an embedded system that works based on the principle Computer Numerical Control. XY Plotter basically works with two stepper motors and a servo motor, wherein the robot plots the input given from the computer on the drawing board using ATMEGA328p microcontroller on a open-source physical computing platform Arduino. The XY plotter has a two axis control and a special mechanism to raise and lower the pen. Each axis is powered and driven by using an Arduino compactable driver A4988.

The plotter works more efficiently, which is used to recording or plotting two dimensional data on a rectangular coordinate system. In this, Arduino compatible main board with two stepper motors for ease moving of pen holder and servo motor is used to lift the pen. For this we are using the software like Arduino IDE software and G code converter. This improves the efficiency which produces large and complex drawings.

## 1.2 Motivation

Robotic 2D Plotter is a plotter that offers the fastest way to efficiently produce very large drawings. Pen plotters will be able to print by moving a pen or other writing device across the surface of a piece of paper. This means that plotters are vector graphics devices, rather than raster graphics. Pen plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the writing device such as pen. SCARA which refers to Selective Compliance Assembly Robot Arm or Selective Compliance Articulated Robot Arm is used to make a writing robot wherein the robot plots the input given from the computer on the drawing board. The SCARA robot is an X-Y Plotter.
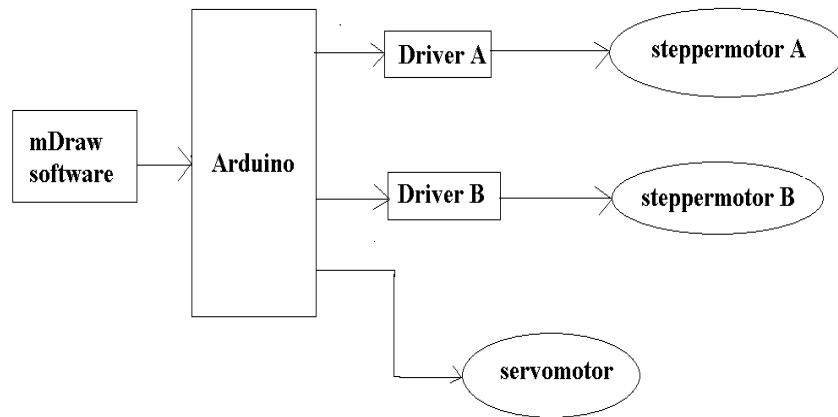
## 1.3 Objective

The main aim of this project is to draw large diagrams efficiently.

# 2. Block Diagram & Working

## 2.1 Block Diagram and Working:

### 2.1.1. Block Diagram:



**Figure 1: Block Diagram of Arduino Based XY-Drawing Robot**

### 2.1.2. Working:

XY Plotter is an embedded system that works based on the principle Computer Numerical Control. XY Plotter basically works with two stepper motors and a servo motor, wherein the robot plots the input given from the computer on the drawing board using ATMEGA328p microcontroller on a open-source physical computing platform Arduino. The XY plotter has a two axis control and a special mechanism to raise and lower the pen. Each axis is powered and driven by using an Arduino compactable driver A4988.

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## 2.2 Technical Specifications

### 2.2.1. Micro Controller ATmega328P:

**The Major Features of Micro Controller ATmega328P:**

High Performance, Low Power Atmel®AVR® 8-Bit Microcontroller Family
• Advanced RISC Architecture
– 131 Powerful Instructions
– Most Single Clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 20 MIPS Throughput at 20MHz
– On-chip 2-cycle Multiplier
• High Endurance Non-volatile Memory Segments
– 32KBytes of In-System Self-Programmable Flash program
Memory
– 1KBytes EEPROM
– 2KBytes Internal SRAM
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

### 2.2.2. STEPPER MOTOR:

A stepper motor or step motor or stepping motor is a brushless DC electric motor which is shown in the fig.2 that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. This is a simple, but very powerful stepper motor with a 4-wire cable attached.This is a Bipolar Motor.



Figure 2: Stepper motor

### 2.2.3 MOTOR DRIVER:

Motor driver or Motor Driver IC which allows DC motor to drive on either direction, which can control a set of two DC motors simultaneously in any direction.

**Features:**

- Minimum operating voltage: 8V
- Maximum operating voltage: 35V
- Continuous current per phase: 1 Amp
- Maximum current per phase: 2 Amp
- Minimum logic voltage: 3V
- Maximum logic voltage: 5.5V
- Micro step resolutions: Full, 1/2, 1/4, 1/8, and 1/16
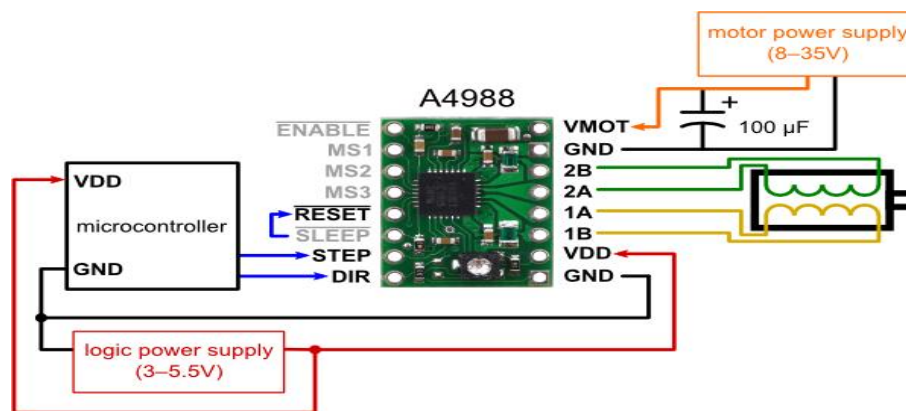- Reverse voltage protection?: No



Figure 3: Drivers connection with Stepper motor

### 2.2.4 SERVO MOTOR:

Servo motors are an easy way to add motion to your electronics projects. Originally used in remote-controlled cars and airplanes, they now crop up in all sorts of other applications. They're useful because you can instruct these small motors how far to turn.

The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in

either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.
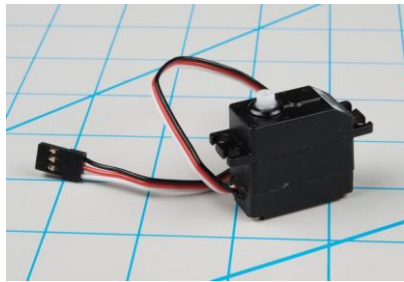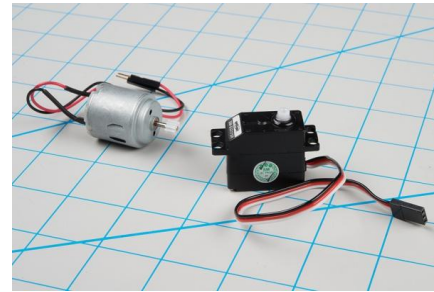


Figure 4: Servo motor



Figure 5: DC motor left and Hobby servo

**Interfacing of servo motor with Arduino:**

The interfacing diagram of servo motor with Arduino is shown in the fig6. In this, we will connect the power and ground pins directly to the Arduino 5V and GND pins. The PWM input will be connected to one of the Arduino's digital output pins.
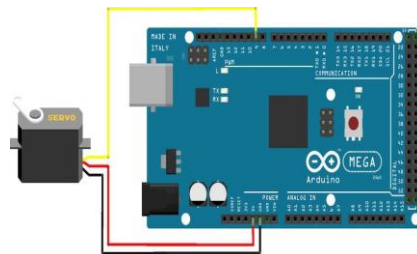


Figure 6: Servo motor interfacing with Arduino

## 2.2.5 SCALAR VECTOR GRAPHICS (SVG):

Scalable Vector Graphics (SVG) is an XML-based vector image format for two-dimensional graphics with support for interactivity and animation. The SVG specification is an open standard developed by the World Wide Web Consortium (W3C) since 1999. SVG images and their behaviors are defined in XML text files.

SVG stands for Scalable Vector Graphics

> ➢ SVG is used to define vector-based graphics for the Web
> ➢ SVG defines the graphics in XML format
> ➢ SVG graphics do NOT lose any quality if they are zoomed or resized
> ➢ Every element and every attribute in SVG files can be animated

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- ➢ SVG is a W3C recommendation
- ➢ SVG integrates with other W3C standards such as the DOM and XSL

**Advantages of using SVG over other image formats (like JPEG and GIF) are:**

- ➢ SVG images can be created and edited with any text editor
- ➢ SVG images can be searched, indexed, scripted, and compressed
- ➢ SVG images are scalable
- ➢ SVG images can be printed with high quality at any resolution
- ➢ SVG images are zoomable (and the image can be zoomed without degradation)
- ➢ SVG is an open standard
- ➢ SVG files are pure XML

**Applications of SVG in industry:**

- ➢ Mobile
- ➢ Embedded Systems
- ➢ Web Applications
- ➢ Design and Interchange

## 2.2.6 Mdraw :

MDraw is a kind of open source cross-platform software developed by make block, which supports Windows systems, Mac systems, Linux systems, fully supports MDraw Bot suite, and also supports servo mode and laser mode of make block XY plot robot.

- ➢ Supported formats:  SVG, BMP turn SVG.

## 2.2.7 ARDUINO IDE:

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. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their

particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.
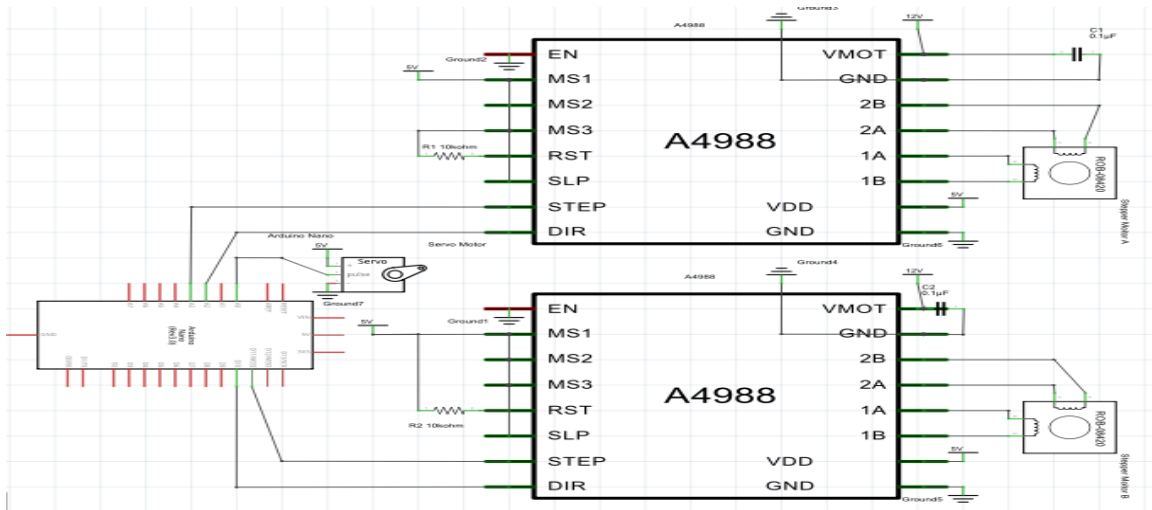
## 2.2.8. Schematic Diagrams



Figure 7: Schematic diagram of motor drivers, servo motor and stepper motor with Arduino

## 2.3. Results & Analysis

Click on the mdraw software icon which is on the desktop of the personal computer.
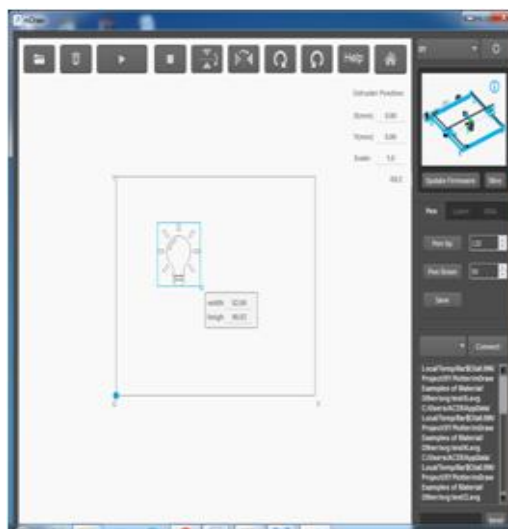
Check whether the COM port is connected or not.



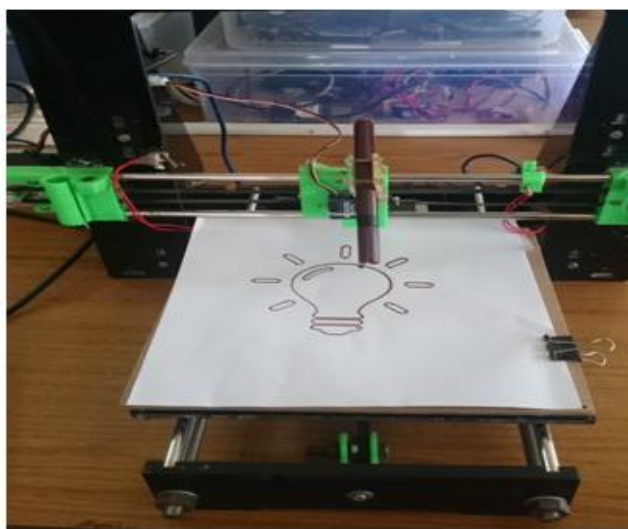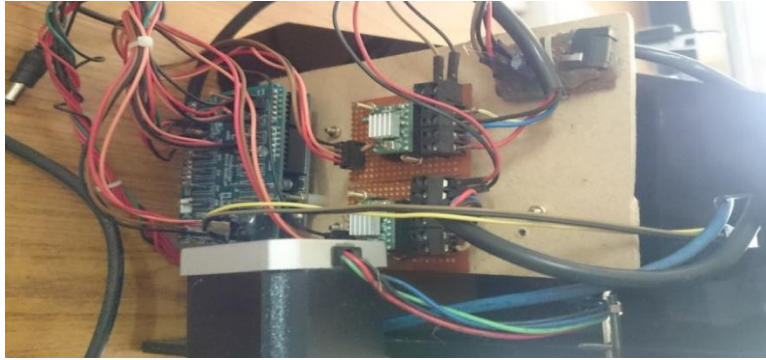Figure: 8.a): Input Given                     Figure: 8.b): Output Displayed

Figure.9: Side View of Arduino Based XY Drawing Robot

The fig.14 shows the physical view of our project Arduino Based XY drawing Robot which shows the interfacing of arduino with the components used.

In this section the fig.14 shows the result obtained on the cardboard fit with a sheet and a pen is used to draw the picture.
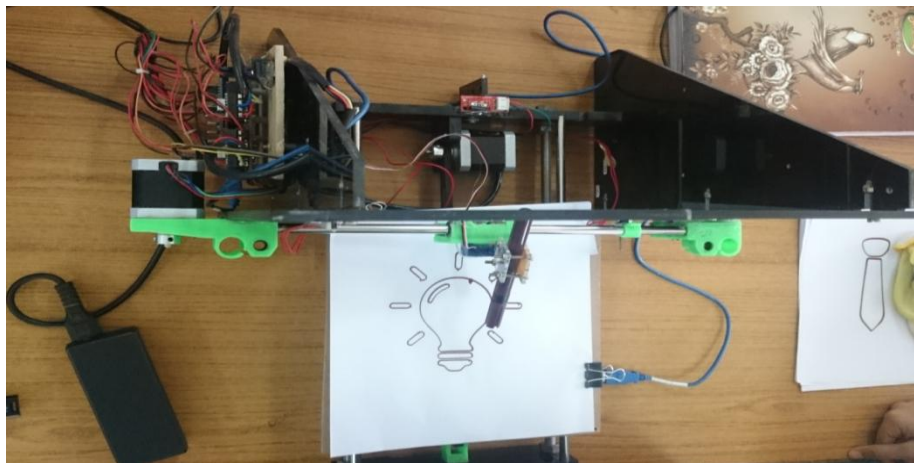


Figure.10: Physical View of Arduino Based XY Drawing Robot

## 3.0. Conclusion

The Arduino based XY drawing Robot using atmega 328 microcontroller is used in the arduino board which is used to draw  fast and efficient drawings or pictures which can be taken from source converted to scalar vecctor graphics (SVG) format given as a input.The input is fed in to the input port of the micro controller. Stepper motors are used to set the position of the pen to the origin and a servo mechanis1m used to lift and lower the which displays the output on the paper.