Design and Construction of a Mini CNC Plotter Machine Using DVD



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A report submitted to the Department of Mechanical, Sonargaon University of Bangladesh in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Mechanical Engineering.

May 6, 2024

DECLARATION

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We further undertake to indemnify the university against any loss or damage arising from a breach of the foregoing obligation. Supervisor Name

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(Lecturer)	(Professor)

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Abstract

A Computer Numerical Control (CNC) plotter machine is a computerized numerical control machine that can be used to draw anything or design any mechanical parts according to the design program. The utilization of CNC machines has increased rapidly due to the growth of technology in industries. The CNC XY plotter is required to plot two-dimensional continuous or discontinuous data on a rectangular coordinate system. This project is done to fabricate an XY plotter using independent motion along an XY-direction and y-direction, and a microcontroller system (Arduino) to control those motions. Implementation of this project is carried out through the computer linked with the Arduino software, to which the g-code is transmitted by the processing software. This paper represents an Arduino uno and motor driver IC-based automatic technique for the implementation of any text or image to its 2d plotted text or image by a 2d plotter CNC machine. In this, era the technology based on CNC machines increased. The fabrication of low-cost CNC machines is used to reduce the cost and complexity of the machine. The idea behind the project is how to make a 2d plotter CNC machine faster and relatively lower cost than others.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

A CNC XY Plotter Machine is a 2D plotting machine that uses a pen to draw text or image, continuous or discontinuous drawings on any given solid surface. CNC plotting is one of the most common plotting processes used in various applications. Since the introduction of Computer Numerical Control in the 1960s, CNC machines have become an integral part of industrial & commercial manufacturing processes. Computer Numerical Control is a process that uses computers to control tools to create different types of products. These machines require specialized software and consoles for operation. A computer program is customized for an object and the machines are programmed with CNC machining language (G-code) that essentially controls all features of the final product like coordination, location & speeds.

Computer Numerical Control (or CNC) [1] is an advanced form of an automatic machine that is used widely to control the motion of these machine tools. The numerical control machine was first invented around in 19th century to minimize the load of the work [2]. Its advantage ensures higher efficiency, higher flexibility, low production cost, little working time, and little loss in production. It mainly follows three steps receiving data, interpreting them, and reacting accordingly [3].

To direct the machine function, special codes and numbers form sequential commands (instructions) that are used to operate the machine automatically and to produce a specific part with a specific dimension. These instructions (program) are then converted into an electrical signal and act as input to the motors that run the machine and do the basic movements [4].

A machine control unit (or MCU) decides the tool depth of draw, drawing speed, etc. The motion of the tool is based on the Right-hand coordinate system. Three axes of rotation (x, y & z) for three-dimensional motions of the tool and specific roles plus an axis of rotation. The x-axis serves as a height stand and uses two pieces one for the front and one for the back. The

y-axis acts as a motor mount to move the z-axis in addition to the slide mechanism whereas the z-axis controls the depth by allowing the movement of a router in the up and down direction so it is a very important axis [5][6].

1.2 CNC Plotter

The plotter is a computer printer for printing vector graphics. In the past, plotters were used in applications such as computer-aided design, though they have generally been replaced with wide-format conventional printers. A plotter gives a hard copy of the output. It draws pictures on the paper using a pen. Plotters are used to print designs of ships and machines, plans for buildings, and so on.

1.3 Background History of CNC

The concept of numerical control began when an automated device incorporated certain concepts of programmed sense [7]. Originally, the first cars were built in 1940. But in the 1950's, better cars began to appear. It is based on devices with new NC machines, which have been modified by engines designed to transfer machine control. These initial methods were rapidly improved with analog and numerical calculations [8] [9]. After World War II, especially in 1949, John Parsons found ways to improve airplanes by making solid leather. This led to important Air Force research projects conducted at the Massachusetts Institute of Technology (MIT). After the research phases, a test mill was developed at MIT. In this project, Professor J. in the 1960s and 1970s, a common type of CNC machine began to emerge. Digital technology then entered the struggle, and automation in production systems was more efficient than ever [10].

1.4 Problem Statement of CNC Plotter

Nowadays CNC XY plotters are being made all over the world using the CD drive for the scanner mechanism which provides the required motion along X-direction & Y-direction. So, this manufacturing process is not suitable for mass production of plotters. Again, the price of

the plotters in the current market is quite high too. So, to solve these limitations, we designed a CNC XY Plotter suitable for mass production which is cheap as well.

1.5 Objective:

The objectives of this project are:

a) To study about **Design of a Mini CNC Plotter Machine Using DVD.**

b) To design and construct a **Mini CNC Plotter Machine Using DVD**.

c) To test the performance of the **CNC Plotter Machine**.

d) To decrease the cost of the machine by application of a simple mechanism.

CHAPTER 2
LITERATURE REVIEW

2.1 Literature Review:

Various authors have studied the development of such machines. '**Design of a Mini CNC Plotter Machine Using DVD.**"

Sundar Pandian 2014: "Develop low cost 2 axis CNC machine". It is low cost and it is used currently in the laboratory. Stepper motors with drivers, Arduino open source, microcontroller, and open-source motor control software. The author used a ready-to-assemble kit from Zen Tool Works, USA. Kit provided stepper motor, lead screw, guide rod, anti-backlash flans, and spring. He made the Body with high-density PVC. The machine has a fixed gantry and mobile bed so there is a restriction in the working area. The model provides more scope for hands-on learning by the students and therefore better learning outcomes. It is developed for only educational purposes.

Venkata Krishna Pabolu et al. Nov 2010: "Design & Implementation of a two-Dimensional CNC Machine". It increases the demand for flexibility and cutting concerning edge quality. It maintains the accuracy and reliability of complex shapes. In this system, they used visual C# as a language on the.NET platform. In this there are three main kinds of computerized numerical controllers:

1. Multiprocessor with ASIC,
2. PC front end,
3. Motion control card with PC.

The design of this system is user-friendly which gives accurate results and also flexible to users. RTOS is very costlier and not user-friendly and also with such a system it is not possible to implement on any general PC, where the user has to purchase the operating system.

Kajal J. Madekar, Kranti R. Nanaware, Pooja R. Phadtare, Vikas S. Mane Feb 2016 "Automatic mini–CNC Machine for PCB drawing". To develop a low-cost automatic mini-CNC machine for PCB drawing. This system reduces the cost of the machine and increases its flexibility. In this G code is interfaced with ATMEGA 328. CNC-based controller by FTDI module which is used to convert the code in the convenient controller the code i.e. serial to USB converter, x moves to left, Y moves to right and z moves up and down. It gives better accuracy and reduces the workload. G code easy to find the information of locations of all stepper motor moving. The GRBL supports 3 axes of motion X, Y, and Z but does not support rotation axes (X, Y).

CHAPTER 3
STRUCTURE

3.1 History

This mini-CNC plotter machine system is so effective and safe process. It is mainly used in factories and industrial areas. After it is used, we reduce the manpower and time. That's why we get good efficiency. Where very difficult to do this draw manually, but using this machine this work is made so easy. This machine is very easy to use and it works very effectively. A relevant picture is added below –

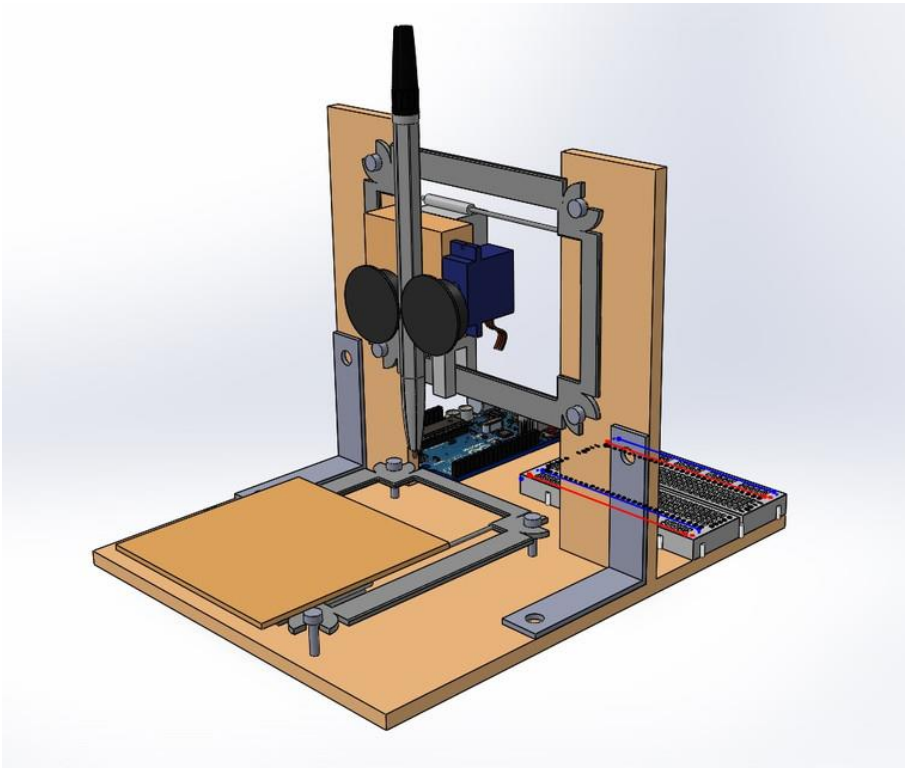


Figure 3.1: Structural View of **Mini CNC Plotter Machine Using DVD**.

3.2 Block Diagram:

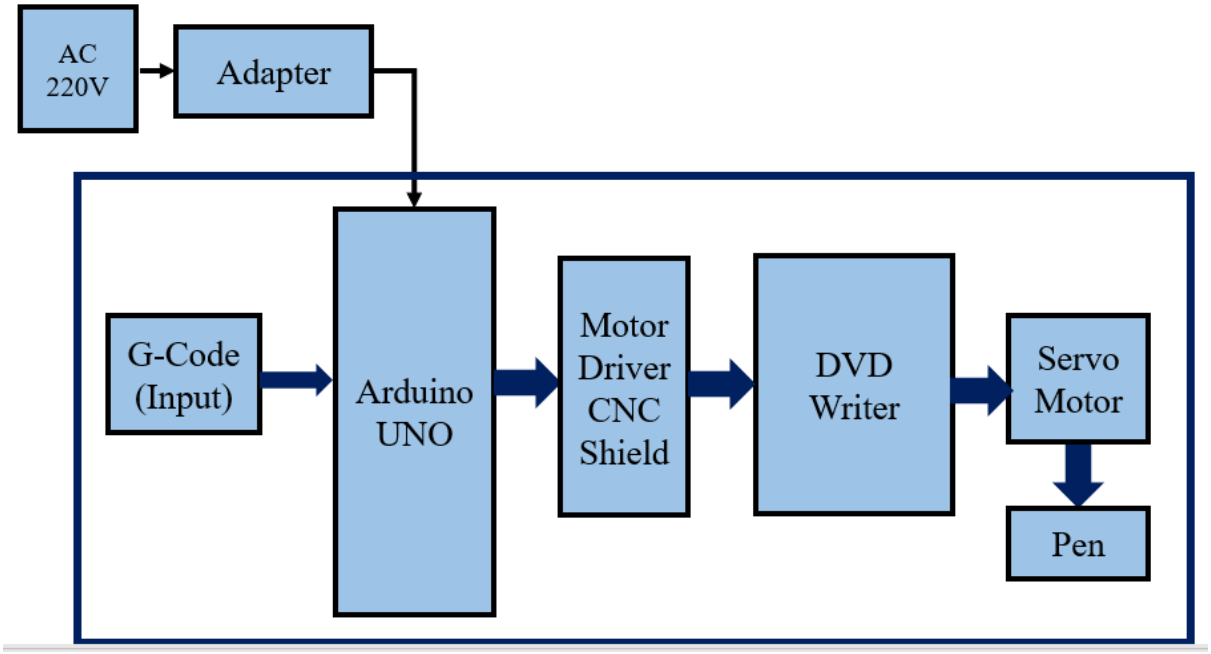


Figure 3.2: Block Diagram of Design of a Mini CNC Plotter Machine Using DVD

3.3 Components List:

1. Arduino UNO
2. Uno Motor Driver CNC Shield
3. Motor Driver IC
4. DVD Writer Mechanism
5. Steeper Motor
6. Servo Motor
7. Adapter

CHAPTER 4
HARDWARE ANALYSIS

4.1 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). 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 contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding 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. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

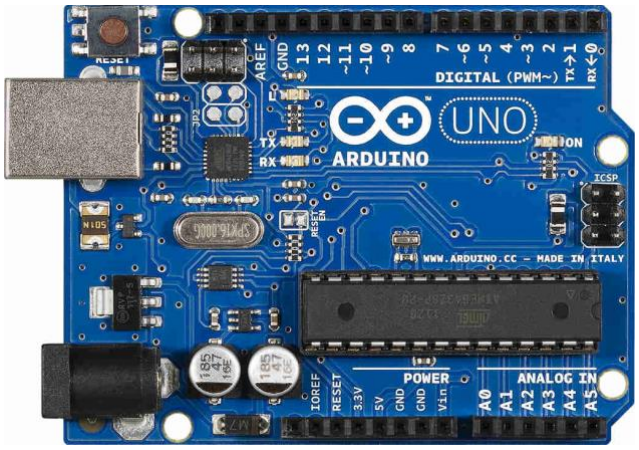


Figure 4.1: Arduino UNO

Arduino Uno Pinout Configuration

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power the microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide a reference voltage for input voltage.

Table 1: Arduino UNO Pin Out

Arduino Uno Technical Specifications

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for the Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

Table 2: Arduino UNO Specification

How to use Arduino Board

The 14 digital input/output pins can be used as input or output pins by using pin Mode (), digital Read (), and digital Write () functions in Arduino programming. Each pin operates at 5V can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 ohms which is disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (TX):** Rx and TX pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to the TTL serial chip.
- **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM Pins 3, 5, 6, 9, and 11:** These pins provide an 8-bit PWM output by using the analog Write () function.

- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with a built-in LED, when pin 13 is HIGH – the LED is on and when pin 13 is LOW, it's off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provides 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using the AREF pin with an analog Reference () function.

- Analog pin 4 (SDA) and pin 5 (SCA) are also used for TWI communication using the Wire library.

Arduino Uno has a couple of other pins as explained below:

- **AREF:** Used to provide a reference voltage for analog inputs with analogReference() function.
- **Reset Pin:** Making this pin LOW resets the microcontroller.

Arduino Uno to ATmega328 Pin Mapping

When the ATmega328 chip is used in place of Arduino Uno, or vice versa, the image below shows the pin mapping between the two.

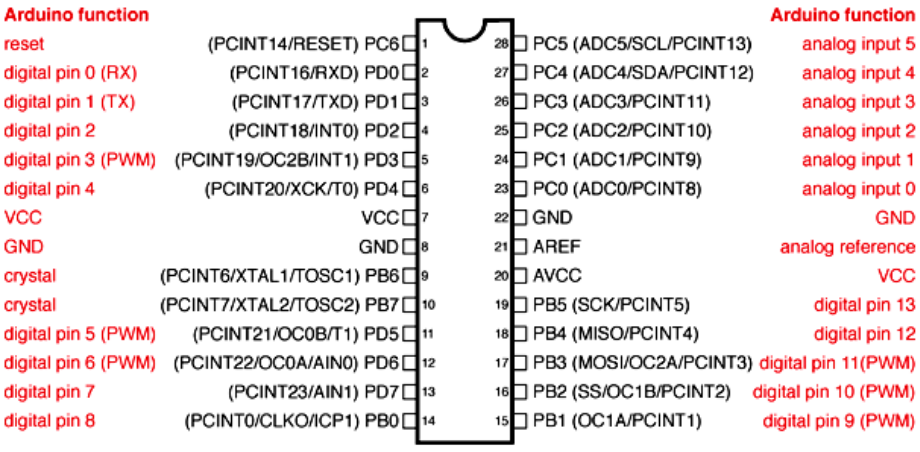


Figure 4.2: Arduino UNO Pin Out

The Arduino Uno can be powered via a USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from

an AC-to-DC adapter (wall-wart) or a battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and VIN pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V. is the regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- 3V3. a 3.3volt supply generated by the onboard regulator. Maximum current draw is 50 mA.
- GND. Ground pins.

4.2 L293D Motor Driver IC

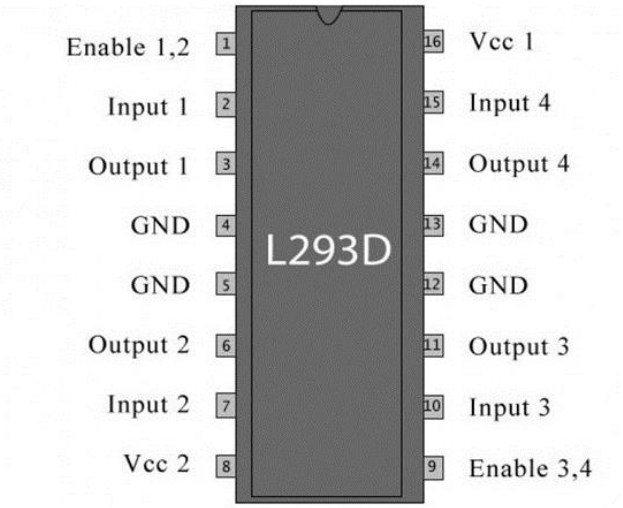


Figure 4.3: L293D

- L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive in either direction. L293D is a 16-pin IC that can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC Dual H-bridge Motor Driver integrated circuit (IC).
- It works on the concept of H-bridge. H-bridge is a circuit that allows the voltage to be flown in either direction. As you know voltage needs to change its direction to be able to rotate the motor in a clockwise or anticlockwise direction, hence H-bridge ICs are ideal for driving a DC motor.
- In a single L293D chip, there are two h-Bridge circuits inside the IC which can rotate two DC motors independently. Due to its size, it is very much used in robotic applications for controlling DC motors. Given below is the pin diagram of a L293D motor controller.
- There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for the right H-Bridge, you need to make the pin 9 to high. If any of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.
- There are 4 input pins for l293d, pin 2, 7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of the motor connected across the left side and right input for the motor on the right-hand side. The motors are rotated based on the inputs provided across the input pins as LOGIC 0 or LOGIC 1.
- In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

L293D Logic:

Let's consider a Motor connected on left side output pins (pins 3, 6). For rotating the motor in a clockwise direction the input pins have to be provided with Logic 1 and Logic 0.

• Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction

• Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction

• Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi-Impedance state]

• Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

In a very similar way, the motor can also operate across input pins 15, and 10 for the motor on the right-hand side.

Circuit Diagram for L293D motor driver IC controller.

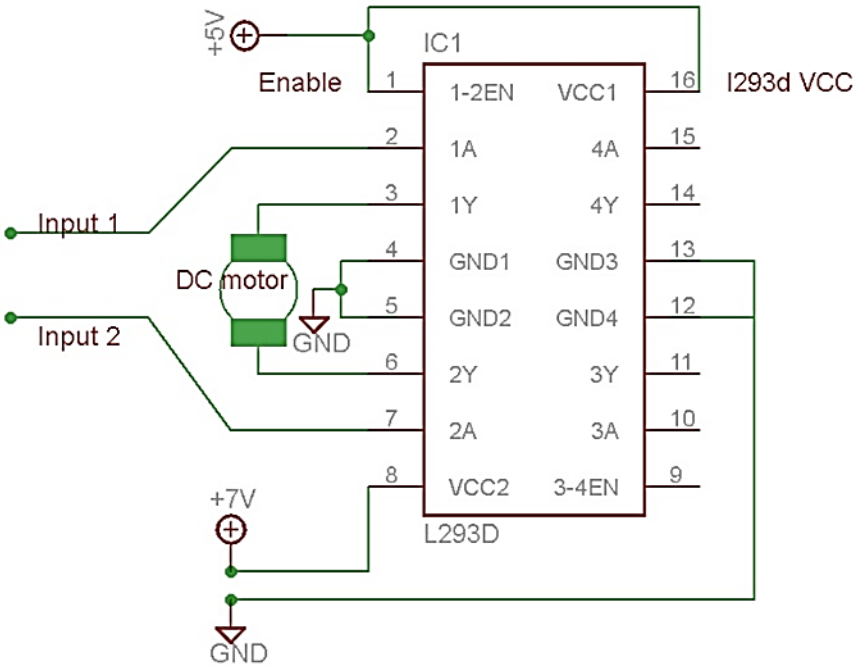


Figure 4.4: L293D circuit diagram

4.3 Servo Motor (SG91R)

The **servomotor** is a closed-loop mechanism that incorporates positional feedback to control the rotational or linear speed and position. The **motor** is controlled with an electric signal, either analog or digital, which determines the amount of movement that represents the final command position for the shaft. **Servo motors** or "**servos**", as they are known, are electronic devices and rotary or linear actuators that rotate and push parts of a machine with precision. **Servos** are mainly used on angular or linear positions and for specific velocity, and acceleration.

Specification:

- High-Quality Micro Servo
- Torque: 1.8kg/cm (4.8V)
- Operating Speed: 0.1sec/60degree (4.8V)
- Operating Voltage: 4.8V

- Dead Band Width: 10usec
- Temperature Range: 0-55ºC
- Cable Length: 25.5cm
- Servo Type: Analog Servo

Description: This is Tower Pro SG-91R Micro Servo for helicopter, 3D-flyer, and F3A. It is very light. It comes with a 3-pin power and control cable and mounting hardware.



Figure 4.5: Servo Motor

4.4 Arduino UNO Motor Driver

L293D is a monolithic integrated, high voltage, high current, 4-channel driver. This means using this chip you can use DC motors and power supplies of up to 16 Volts, that's some pretty big motors and the chip can supply a maximum current of 600mA per channel, the L293D chip is also what's known as a type of H-Bridge. The H-Bridge is typically an electrical circuit that enables a voltage to be applied across a load in either direction to an output, e.g. motor.

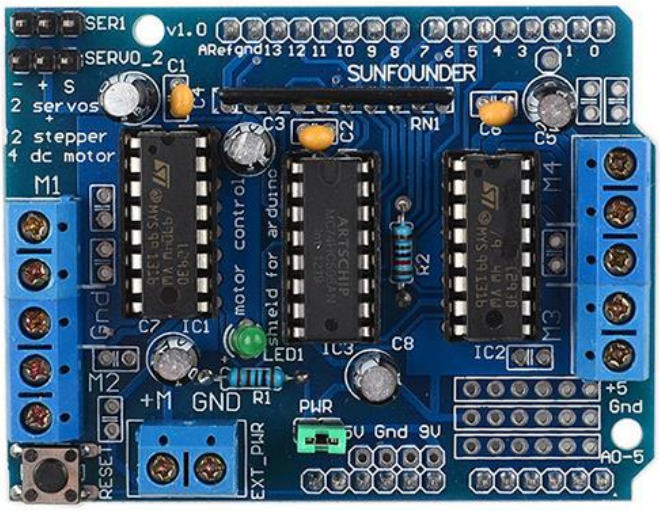


Figure 4.6: L293D Motor Driver Shield

The L293D is a quadruple high-current half-H driver. It is designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC, and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

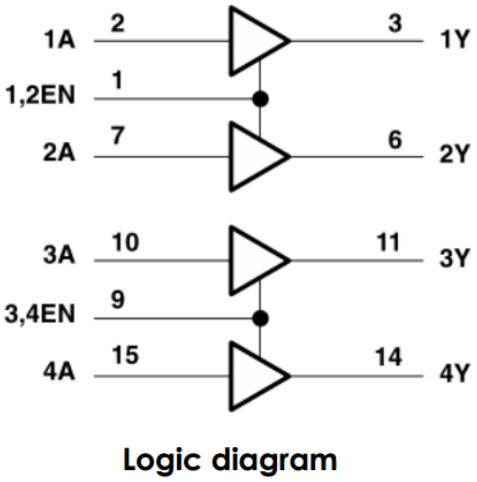


Figure 4.7: Logic Diagram

Pin Function:

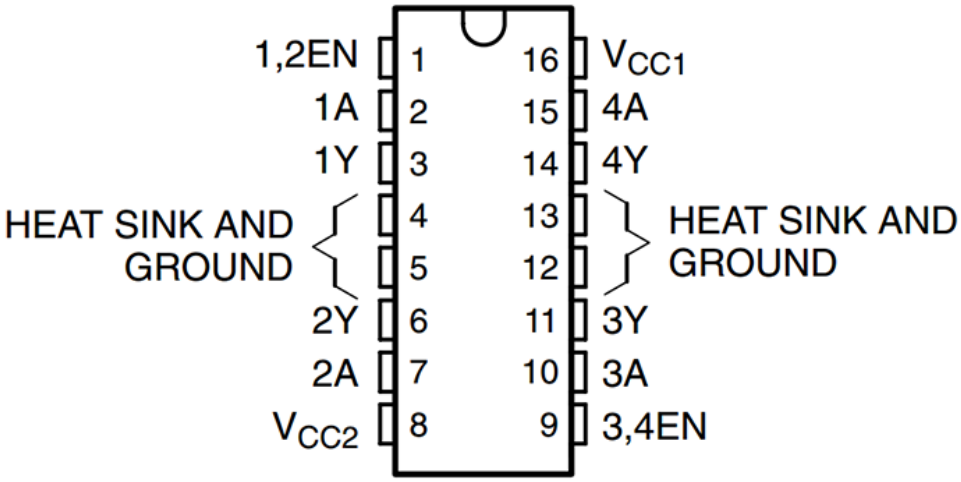


Figure 4.8: IC Pin Out

Pin	Name	Function
1	Enable1,2	Enable pin to control 1,2 driver
2	Input 1A	Input to control 1Y
3	Output 1Y	Output, connect to the motor
4	GND	Ground and heat sink
5	GND	Ground and heat sink
6	Output 2Y	Output, connect to motor
7	Input 2A	Input to control 2Y
8	Vcc2	Output supply voltage
9	Enable3,4	Enable pin to control 3,4 driver
10	Input 3A	Input to control 3Y
11	Output 3Y	Output, connect to motor
12	GND	Ground and heat sink
13	GND	Ground and heat sink
14	Output 4Y	Output, connect to the motor
15	Input 4A	Input to control 4Y
16	Vcc1	Supply voltage (7 max)

Table 3: IC Pin Out

Features

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Output Current 600 mA Per Channel
- Peak Output Current 1.2 A Per Channel

4.5 Stepper Motor

A **stepper motor**, also known as a **step motor** or **stepping motor** is a brushless DC electric motor that divides a full rotation into some equal steps. The motor's position can be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is correctly sized to the application concerning torque and speed.



Figure 4.9: Stepper Motor

Stepper Motor Working Principles

As all with electric motors, stepper motors have a stationary part (the stator) and a moving part (the rotor). On the stator, there are teeth on which coils are wired, while the rotor is either a permanent magnet or a variable reluctance iron core. We will dive deeper into the different rotor structures later.

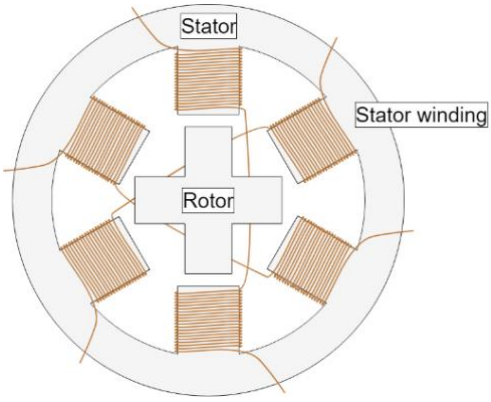


Figure 4.10: Motor Structure Inside

The basic working principle of the stepper motor is the following: By energizing one or more of the stator phases, a magnetic field is generated by the current flowing in the coil and the rotor aligns with this field. By supplying different phases in sequence, the rotor can be rotated by a specific amount to reach the desired final position. At the beginning, coil A is energized and the rotor is aligned with the magnetic field it produces. When coil B is energized, the rotor rotates clockwise by 60° to align with the new magnetic field. The same happens when coil C is energized. In the pictures, the colors of the stator teeth indicate the direction of the magnetic field generated by the stator winding.

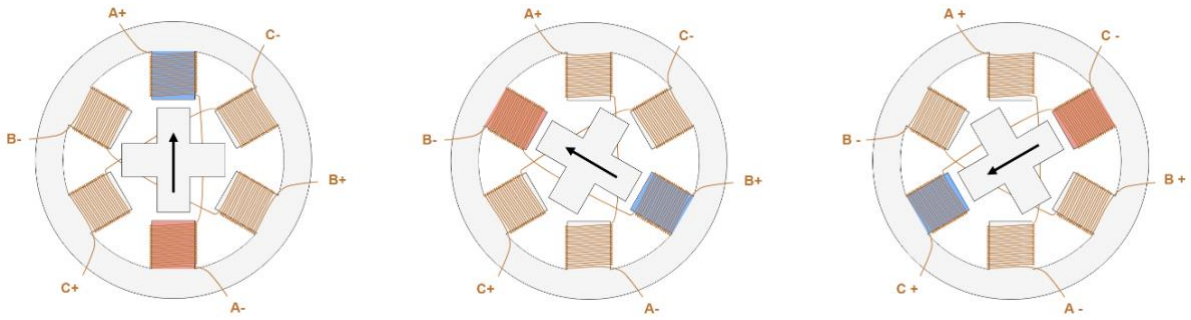


Figure 4.11: Stepper Motor Steps

Stepper Motor Control

We have seen previously that the motor coils need to be energized, in a specific sequence, to generate the magnetic field with which the rotor is going to align. Several devices are used to supply the necessary voltage to the coils, and thus allow the motor to function properly. Starting from the devices that are closer to the motor we have:

- A transistor bridge is a device physically controlling the electrical connection of the motor coils. Transistors can be seen as electrically controlled interrupters, which, when closed allow the connection of a coil to the electrical supply and thus the flow of current in the coil. One transistor bridge is needed for each motor phase.
- A pre-driver is a device that controls the activation of the transistors, providing the required voltage and current, it is in turn controlled by an MCU.
- An MCU is a microcontroller unit, which is usually programmed by the motor user and generates specific signals for the pre-driver to obtain the desired motor behavior.

CHAPTER 5

METHODOLOGY

5.1 Methodology

- Creating an idea for the Design and construction of a **Design of a Mini CNC Plotter Machine Using DVD.**
- And drawing and listing of components/materials to know which components/materials need to be constructed.
- Collecting the all components/materials for constructing the system.
- Finally, we constructed this system & checked it finally that working very well.

5.2 Complete Project Prototype Image :

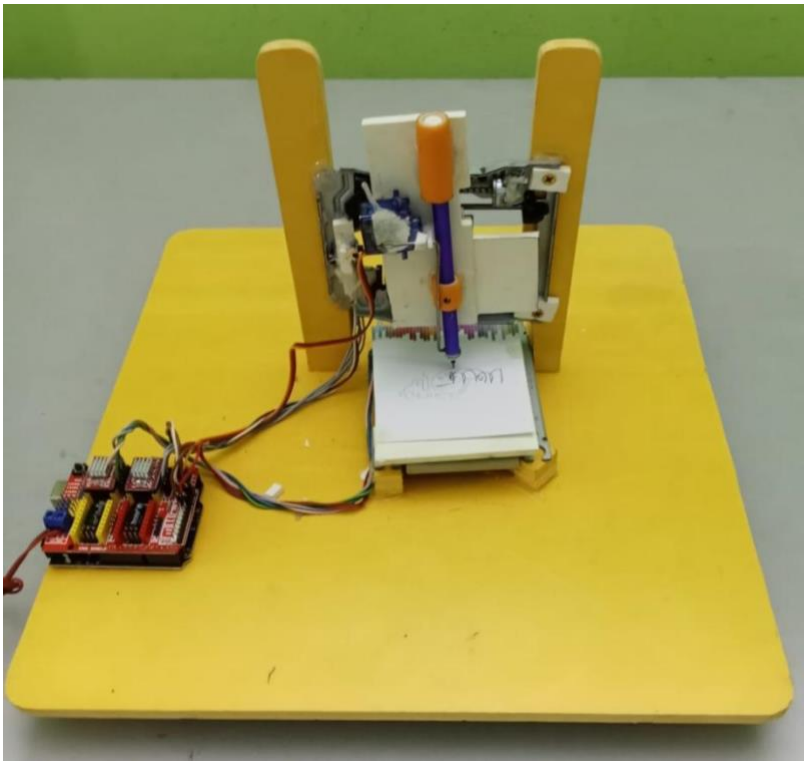


Figure 5.1: Complete Project Picture

5.3 Working Principle

Connecting with the controller here is AC 220 volts coming to the circuit by converting to 9 volts DC via a charging adapter. This circuit has an Arduino UNO microcontroller, Uno Motor Driver Shield, Motor Driver IC, Servo motor, Stepper Motor, etc. The pen holder is mounted on the CNC machine. The plotter movement in the X and Y directions is controlled using motor-coupled gear to move the position left and right and forwards and backward. We use two L293D motor driver ICs to control the DC motor. The overall assembly of the X-Y plotter fabrication is by using DVD drives. This CNC machine is used to fabricate PCBs. The use of Inkscape as the G-code generator enables the users to draw and trace their image before converting it into a G-code file. The file is then attached to the processing software. The processing language enables the user to specify the speed of the stepper, set the (0, 0) location, go home setting, and abandon plotting. The command is sent automatically after the G-code is loaded. The figure shows the original image and its 2D plotted image by the CNC plotter.

5.4 Cost Analysis:

No	Product Name	Specification	Qty.	Unit Price	Total Price
01.	Arduino	UNO	1	1000	1000
02.	UNO Motor Driver CNC Driver	L293D	1	450	450
03.	Steeper Motor		2	350	700
05.	Servo Motor	SG90	1	380	380
06	Adapter	9V	1	400	400
07	DVD Writer Mechanism		1	800	800
08.	Others			1200	1200
Total					4930/=

Table 4: Cost Analysis

CHAPTER 6
RESULT AND DISCUSSION

6.1 Discussion

The **Design of a Mini CNC Plotter Machine Using DVD** works effectively and makes the printing and drawing process easy, more precise, and reliable and is more advantageous than the conventional methods reducing manual efforts, and errors and being much efficient. The proposed prototype allows for achieving economical and low-cost automation. In the beginning, we had a lot of problems to build and run the project. However, with the convenience and effort of everyone, we have been able to run it correctly and accurately

6.2 Result

After following all objectives and plans to build our project. We finally established our project. In this project first, we create our project circuit with sufficient equipment. After that, our mini-CNC plotter machine assembles all the equipment. After making all the structure then we test our project. All the setup is working well with our CNC machine implementation and plan.

6.3 Advantage

- Easy to draw images.
- Able to print 2D images.
- Time-saving machine for industrial work.
- No Oil consumption.
- Time-saving equipment.
- Installation is simplified very much.
- Less time and more profit.
- Simple construction
- Ease of operation.

6.4 Application

The project has a major application in the

- It can be used for Industrial work.
- It can be used in garment factories for print.

6.5 Limitation

It is a demo project so we found some limitations. In the future, we will work to reduce this kind of limitation. These limitations are –

- It is a demo project so it has some errors.
- Our project may be delayed in work.

CHAPTER 7
CONCLUSION

7.1 Conclusion

The primary goal of this project was to find & build a cheaper and mass-producible design of a CNC XY Plotter maintaining accuracy as well. This project is further extendable. Modification of the pen holder component can make this project suitable for a lot of applications. We tried our best in designing and implementing this model. Our lack of expertise & experience, and manual fabrication of various parts sometimes hindered our progress and affected the perfection to be attained. Overcoming these obstacles and reaching fruition was a wonderful experience for us.

7.2 Future Scope

The model can be improved by making some changes in the program and components. Some suggestions are given below-

- We will increase its working accuracy level.
- We will think about adding laser cutting and PCB Design.

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