

# Modeling of Portable CNC Plotter Machine /3D Printer

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**Abstract**— This work represent the portable CNC plotter to plot any unexceptionable design by CD/DVD driver that should be easily available to make CNC plotter/3D printer .Computer numerical control (CNC) can be used to describe many types of device like Plotter, 3D printer, Milling machines, Vinyl cutter and others. CNC basically means that the physical movement of the machine that must be controlled by any type of controller (like Arduino UNO). The controller must be conducted by any computing device. This whole plotter/printer system is working based on G-Codes. G-Codes are used to give commends or instructions. Computer numerical control is use in any machine that moves in different direction like X-axis and Y-axis and code will instruct it exactly where to go and Z-axis control the depth. The movement in the direction of X, Y will be manipulated by stepper motor of CD/DVD driver and Z-direction will be control by a 3D Pen conducted with a servo motor.

**Keywords**— Arduino UNO board, Stepper motor, A4988 Motor driver, CNC shield, Servo Motor, G-Codes.

## I. INTRODUCTION

In our work the CNC plotter is designed for plotting any dimensional instructed data on a rectangular co-ordinate system from G-Code. The plotter/3D Printer mechanism is totally control by Arduino UNO, CNC shield and two motor drivers. Arduino UNO is controlled by G-code's instructed function. G-code control the motors exactly where to go in X, Y direction. Two stepper motor with lead screw control the X, Y co-ordinate and one servo motor controlled the depth means the nib of the plotter pen or 3D Pen (The pen can plot the difficult design which our hand can't). The CNC plotter can be used to make printed circuit board (PCB) for plotting circuit diagram by the instruction from G-code [1-3]. It can be also use for card printing, writing letters, drawing any logo. It can be used for drilling, grinding and machining if we replace the pen to a drill bit we choose stepper motor from CD/DVD driver, one plastic gear servo motor, Arduino UNO, motor driver, CNC shield, 3D pen for reducing the setup cost and getting the maximum efficiency.

## II. OBJECTIVE

To exhibit CNC plotter/3D printer for the purpose of 2D and 3D printing.

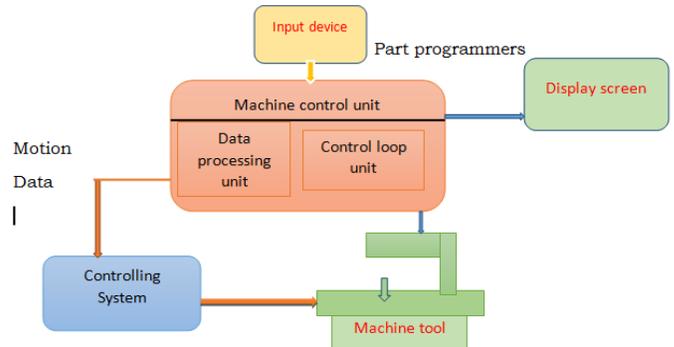


Fig.1 Block diagram of CNC plotter/3D printer

## III. EQUIPMENT DETAILS

1. Two stepper motor from CD/DVD driver.
2. One plastic gear servo motor.
3. Arduino UNO (micro controller) include cable
4. CNC shield
5. A4988 Motor driver. (2 pc.)
6. 3D pen
7. 3s, 20c lipo (11.1 volt.) for power supply
8. Male and female jumper wire

## IV. EQUIPMENT'S

### A. Stepper motor:

Stepper motor is a brushless DC motor. The full rotation of the armature (360 degree) is divides into no. of equal steps. It converts digital pulses into mechanical power output means rotation of shaft. For every step there must have separated pulses. Each separated pulses gives accurate step angle. That's why plotter pen nib knows exactly where it will go [4].



Fig. stepper motor

**B. Servo motor:**

Name of servo is coming from its closed loop servo mechanism. Servo motor is paired with some types of encoder to provide the position and give the feedback of speed to the control board. The difference between stepper over servo motor is that stepper motors never send any movement feedback to the controlling device where servo can [5].



Fig. stepper motor.

**C. Arduino UNO:**

Arduino UNO is an open-source micro controlling electronics platform [6]. Arduino UNO board able to control many electronics components. It have different output voltage points (5v, 3.3v) to give maximum efficiency. It has 14 digital input/output pins. It contains everything which needed to support with this controller like (Bluetooth, IR sensor, ultrasonic sensor etc.)



Fig.2 Arduino

**D. CNC Shield:**

CNC shield board is an open source firmware that will fit on Arduino UNO and convert the G-code commands into stepper signals. It can control A4988 motor driver and DRV8825 is also compatible on it. It can run 12-36 volt DC (where only DRV8825 driver can handle unto 36volt).

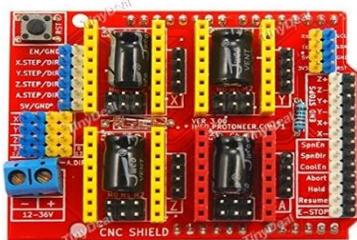


Fig.3 Arduino shield

**E. A4988 motor driver:**

The A4988 motor driver require voltage is 5.5-3.3 volt and it have to be connected across the VCC and GND pin. The motor supply voltage is 8-12 volt and it would be connected across A1, A2 and B1, B2.



Fig.4 A4988 motor driver

**F. 3D Pen:**

3D pen works by extruding heated plastic that cools instantly into solid material.



Fig.5 3D Pen

**G. Power source:**

There are two power source used to control the whole system one 5v power supply on Arduino UNO board and 12 v power supply on CNC shield through 3s lipo battery for getting constant maximum power output.

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G91 (relative)
G21 (mm)
F250 (set Feed rate)
G01 X0 Y0
M03 S32 (set 100% power)
G01 X0 Y10 (vertical line against the grain)
F200
G01 X10 Y0 (horizontal line with the grain)
F250
G01 X0 Y-10 (right side vert line down)
F200
G01 X-10 Y0 (horz bottom line with the grain)
F250
G01 X0 Y10 (vertical line against the grain)
F200
G01 X10 Y0 (horizontal line with the grain)
F250
G01 X0 Y-10 (right side vert line down)
F200
G01 X-10 Y0 (horz bottom line with the grain)
F250
G01 X0 Y10 (vertical line against the grain)
F200
G01 X10 Y0 (horizontal line with the grain)
F250
G01 X0 Y-10 (right side vert line down)
F200
G01 X-10 Y0 (horz bottom line with the grain)
F250
M05 S0 (Servo off)
G01 Y15 Y0 (moves Servo head to next spot for another square cut)
M30
    
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Fig.6 G-Code

### V. METHODOLOGY

At the beginning collect two stepper motor from CD/DVD driver. Use screw driver to uncap one side (upper side) stepper motor with lead screw. Use a cutting board make it T-type as per requirement which is fitted on the CD/DVD driver. First stepper motor will plot the X- axis and other one plot the Y-axis which is fitted on T-type cutting board (you can also find some another attachment to make Y-axis movement on your constricting CNC plotter/3D printer). To stepper motor must have to run in 90 degree angle after fitting two stepper motor, need one servo motor for Z-axis movement [7]. The servo will have to be attach on Y-axis's rail and one pen or marker/3D pen will used on the servo shaft. The pen/3D printer must be able to up and down by this servo motor in very smoothly

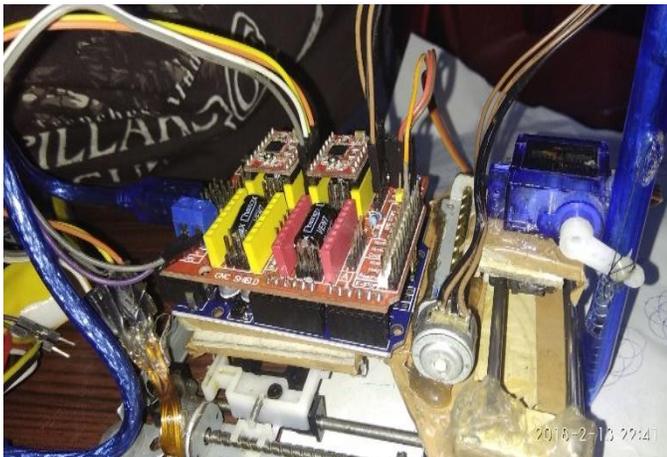


Fig.7 Model of CNC Plotter Machine/3D Printer



Fig.8 In time of plotting

### VI. CIRCUIT DIAGRAM AND CONNECTION

CNC shield will be connect on Arduino UNO on CNC shield fit to stepper motor driver on X and Y (written on CNC shield) . After that connect the four ports of the stepper motor with motor driver (Like B2, B1, A2, and A1 from the down

wards). After connecting X, Y axis's stepper motor, connect the servo ports with CNC shield (Brown port will connect to GND, RED will 5v and yellow port will be connect on (-Z) pin). After that upload G-code on Arduino UNO. At last put on the power maximum 12v.

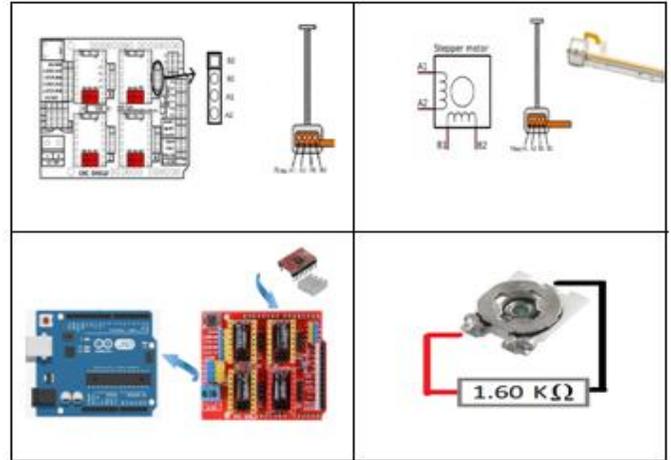


Fig.9 Circuits

### VII. DISCUSSION

At the end of implement the whole system we get a high profile output. This CNC plotter can plot difficult design and print difficult sketches which we have to conduct on it. There must have to see, if there any friction working on rail, give some lubricant and make it proper 90 degree. Because the stepper can't give any feedback to the operating device, if it will jam it burn instantly. Vibration of this two stepper motor can be control by adjusting the pot (on stepper motor driver).

### VIII. CONCLUSION

This project setup with combination of G-code and hardware like controller and driver for getting better accuracy and precise attachment can give the maximum efficiency G-code will help the stepper motor exactly where it will go. This is very low cost project compare to another CNC project on the other hand it is quite slower then printer because of the mechanical motion which is necessary to draw a graphical drawing or a continues printing. Anyone can easily control it because it is control without any programming, except G-code.

### IX. FUTURE SCOPE

The pen on this setup can be replaced by a laser, drill to make it as a laser cutting machine or a CNC engraving machine.

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