



# CRAFTING A CNC PLOTTER: ARDUINO AND CNC SHIELD INTEGRATION

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**Abstract:** A CNC plotting machine is a computer-controlled device that automates the process of creating precise drawings or designs on various surfaces. Utilizing a cutting tool or pen, it interprets digital files, translating them into physical representations with high accuracy. This device capable of producing or constructing mechanical components in accordance with design software. The use of CNC machines is increasing quickly as technology in industries advances the purpose of this study is to create a plotter machine that can design and manufacture 2D designs using Arduino and the CNC shield and also to minimize the time spent plotting and to eliminate human participation, which reduces the rate of inaccuracy and boosts output. In this article Arduino uno, stepper motor, servo motor and CNC shield are used for designing three axis CNC Plotter. The designed machine is controlled by three axis, stepper motors are used to control x and y axes while the z- axis is controlled by servo motor. The major goal of this project is to minimize the time spent graphing and to eliminate human participation, which reduces the rate of inaccuracy and increases manufacturing. And this machine can facilitate disable peoples work especially people that suffer from hand less and also can help Architect to draw the 2d drawing. The designed machine can plot any image or text simply and quickly as compared to human sketching time. CNC technology has made significant contributions to industry.

**Keywords:** CNC machine, Arduino-Uno, CNC Sheild, G-code.

## I. INTRODUCTION

A CNC plotter machine is a two-dimensional plotting device that can also be worked in three dimensions. machine a device which utilizes a pen for drawing text or images. upon any hard surface It may be used for a variety of purposes such as PCB design, logo creation, and other purposes. With the growing demand for CNC plotters in universities and labs, a low-cost, simple design is essential. With increasing requests for CNC plotters in colleges and labs, a low-cost, simple design is essential. The small CNC plotter machine is characterized as being Depending on an Arduino microcontroller as well as a CNC shield. CNC stands for computer numerical control machine. G codes instruct the user on how to move the pen in three axis X, Y, and Z. If the plotter head of the machine is constructed in a big size, it may be operated using drilling, laser cutting, and milling equipment. Utilizing computer software to control the movement of the plotting head, these machines can create intricate designs on various materials, including paper, wood, and metal. With capabilities that range from simple line drawings to complex multi-layered engravings, CNC plotting machines are invaluable in fields such as architecture, manufacturing, and graphic design. Their accuracy, efficiency, and versatility make them essential for modern production processes, allowing for rapid prototyping and customization with minimal human intervention.

## II. METHODOLOGY

**Design Creation:** The process begins with creating a digital design using technology CAD (Computer-Aided Design) software. The design is often in the form of vector graphics.

**Conversion to G-code:** The CAD file is converted into G-code, which is a programming language used to control CNC machines. This code contains instructions on how the machine should move to replicate the design.

**Machine Setup:** The CNC plotting machine is prepared by loading the appropriate tools (like pens or markers) and setting the workpiece (usually paper or other materials) in the correct position.

**Calibration:** The machine is calibrated to ensure accurate movement and positioning. This includes setting the origin point (0,0) on the workpiece.



**Execution of the G-code:** The CNC controller reads the G-code and translates it into movements. The plotting machine uses stepper motors to move the pen or marker across the X and Y axes.

The methodology of a CNC plotting machine involves a systematic approach to converting digital designs into tangible outputs through precise mechanical movements. It begins with the creation of a digital design, typically using computer-aided design (CAD) software, where the desired shapes, patterns, or text are defined. Once the design is finalized, it is translated into a format compatible with the CNC machine. The CNC plotting machine uses a computer-controlled system to interpret these instructions. The machine's controller translates the digital data into specific movements of the plotting tool, which may include pens, blades, or lasers, depending on the material being processed. As the machine operates, it precisely moves along the designated paths, executing intricate cuts, engravings, or drawings with a high level of accuracy.

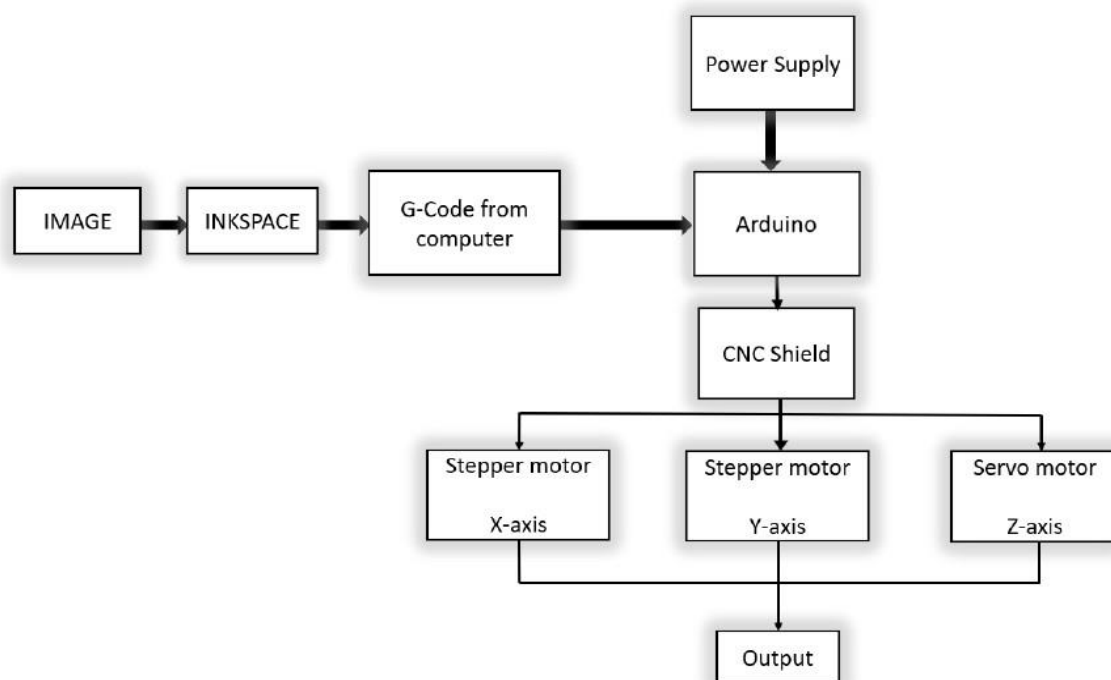


Figure 1: Block diagram of working principle of CNC plotting machine.

### III. IMPLEMENTATION

The implementation of a CNC plotting machine using a CNC shield and Arduino Uno involves setting up the necessary hardware and software components. The CNC shield, which is mounted directly onto the Arduino Uno, facilitates motor control by providing slots for stepper motor drivers. Typically, A4988 stepper drivers are used to drive the stepper motors that control movement along the X, Y, and Z axes. The X and Y axes are the primary ones for a 2D plotter, while the Z-axis can be used to lift and lower the pen, if required. To define the boundaries of movement, end stops are connected to the CNC shield, ensuring that the machine doesn't move beyond its designated area. The pen itself is held by a servo motor, which is controlled by the Arduino to raise or lower the pen depending on the drawing instructions.

Once the hardware is connected, the next step is to install the GRBL firmware onto the Arduino Uno. GRBL is an open-source G-code interpreter that allows the Arduino to receive and execute G-code commands, controlling the movement of the motors and the pen. The control software, such as Universal G-code Sender (UGS), sends G-code files to the Arduino, which the CNC shield interprets to move the plotter along the X and Y axes. The servo motor, attached to a PWM pin, can be controlled through specific G-code commands to lift or lower the pen as needed during the plotting process. The G-code can be generated using software like Inkscape with a G-code plugin or other online tools. After ensuring that all wiring is correct and the software is properly configured, you can run the CNC plotting machine, sending G-code to plot intricate designs with high precision. Troubleshooting may involve checking motor wiring, adjusting current settings on the stepper drivers, or ensuring proper pen control through the servo.

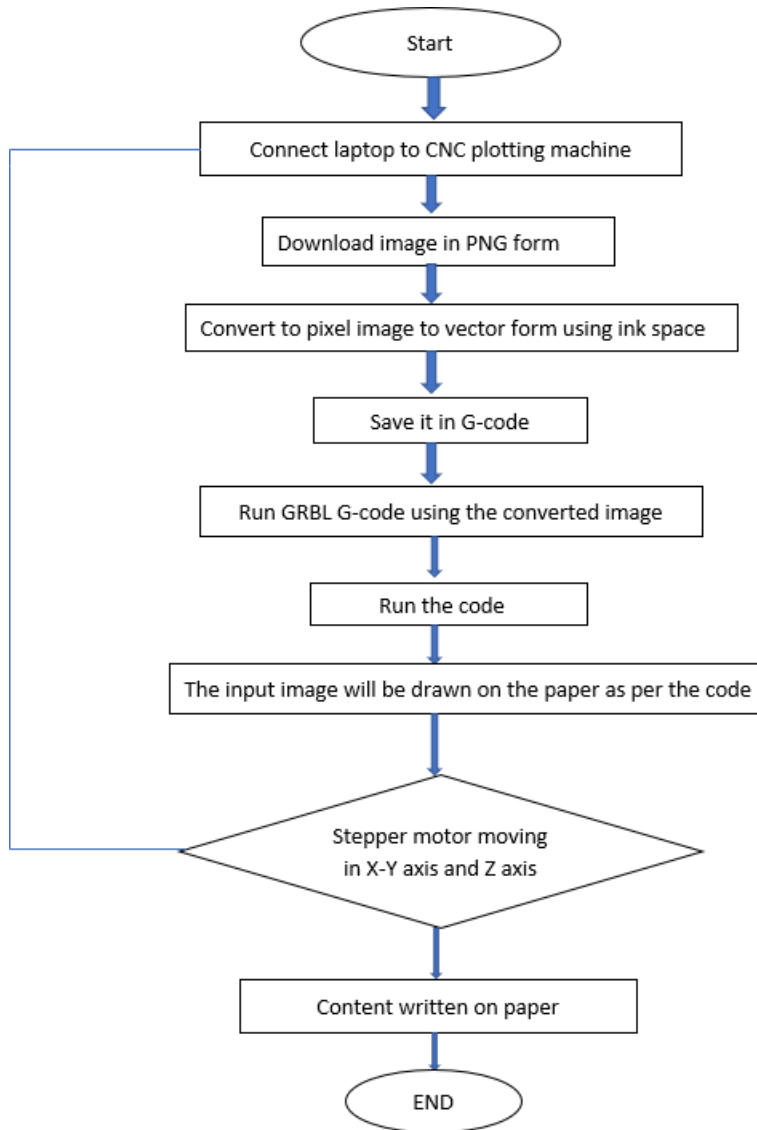


Figure 2: Flow Chart of CNC Plotter.

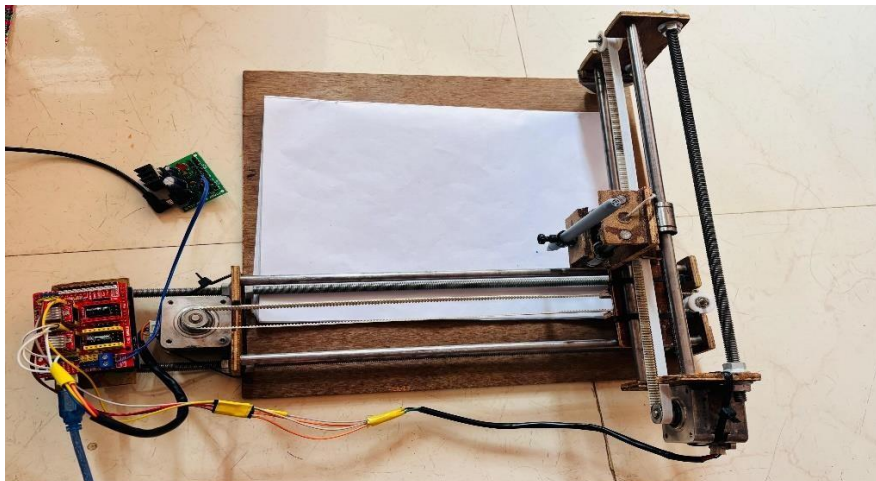


Figure 3: CNC 2D Plotter Machine

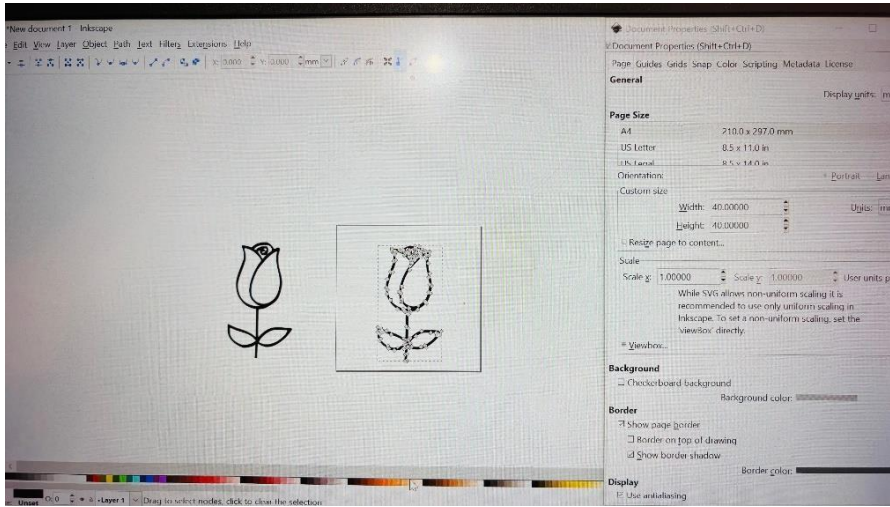


Figure 4: Example of an image converted to vector form using Inkscape

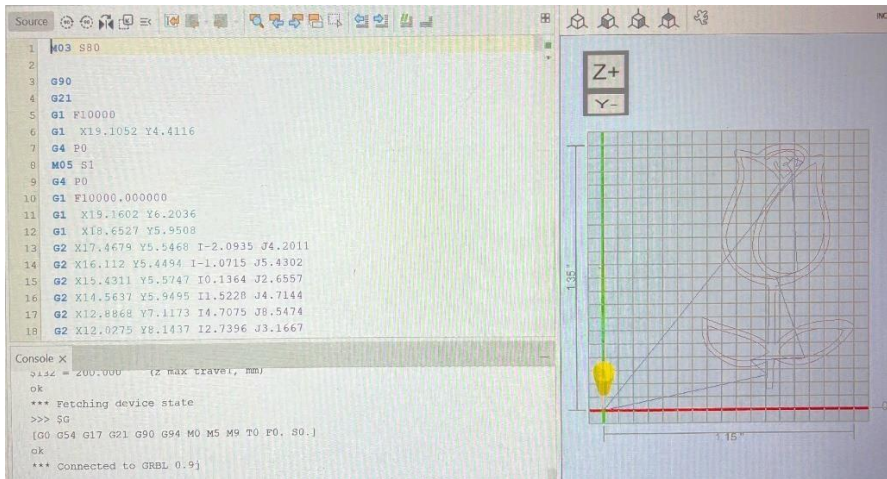


Figure 5: Image inserted to the GRBL Software

#### IV. RESULT

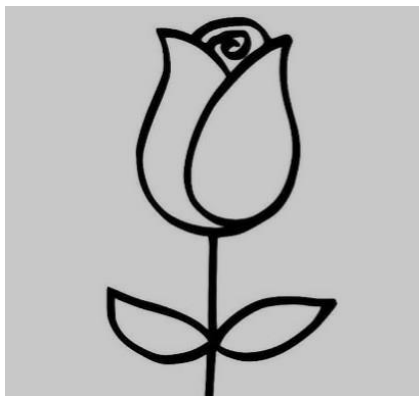


Figure 6: Original Image

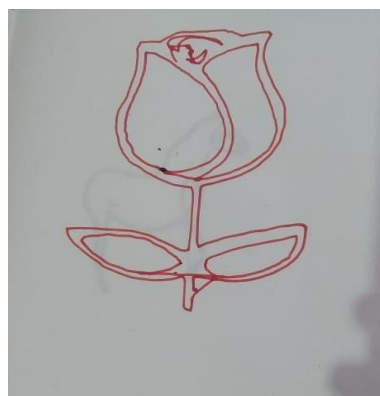


Figure 7: Original Image



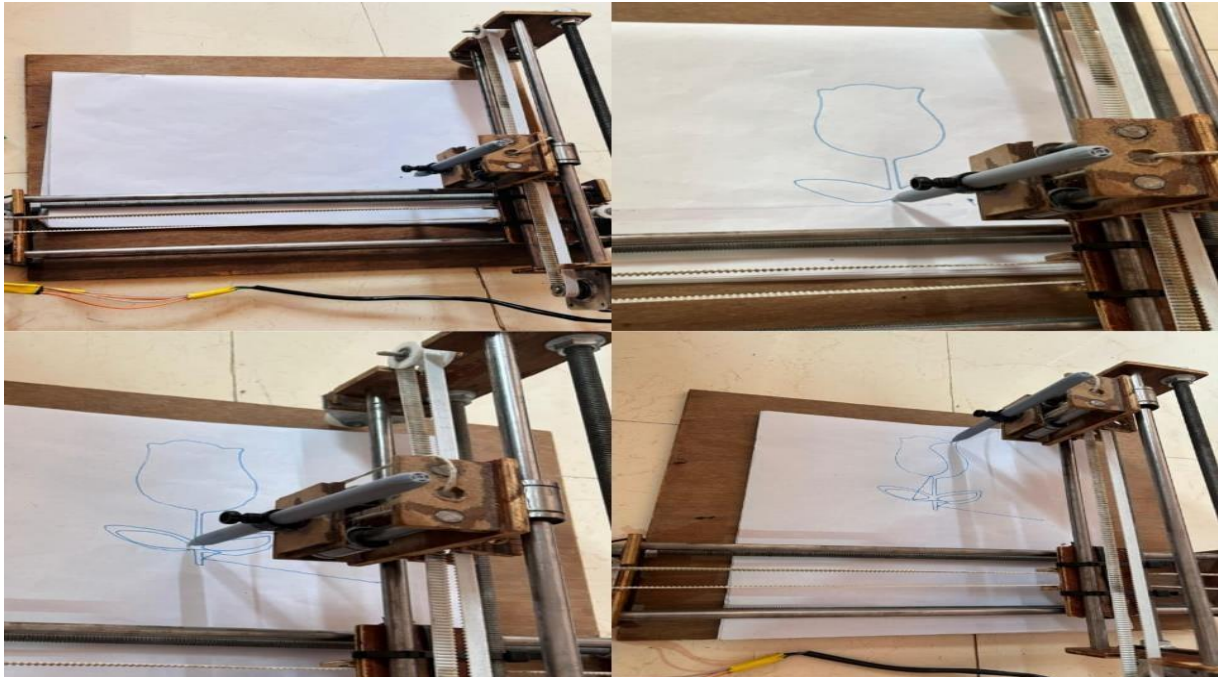


FIGURE 8: THE STEPS OF PLOTTING IMAGE BY CNC PLOTTER

## V. CONCLUSION

We have presented the concept of a low cost three-axis CNC plotter. The existing CNC machines are of high cost, difficult to maintain and requires highly skilled operators.

Our CNC plotter overcomes these problems. It is low of cost and easy to control and there is no need of highly skilled operators. It can be used for long hours at a stretch which is not possible in existing ones. It is hoped to extend this work for future development.

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