# CNS PEN PLOTTER USING ARDUINO NANO

## INTRODUCTION:

The plotter machine executes its functions based on special instructions or commands known as the G-codes. The G-code gives the direction to the tool for the movement of all three axes. It can be a marker pen, laser cutting, milling etc., and it can be utilized for a diverse range of applications. The axes have the potential to create 3-D or 2-D images on plain surfaces or any other material. The plotter machine is so versatile that it can be used for everyday simple tasks to the most specialized, complex tasks as well. The position of the tool is controlled by a stepper motor to provide high accuracy in movements. The plotting area can be increased for commercial purposes as per requirement. The closed-loop control system is most preferable in providing the reliability, speed, and accuracy needed for commercial machines.
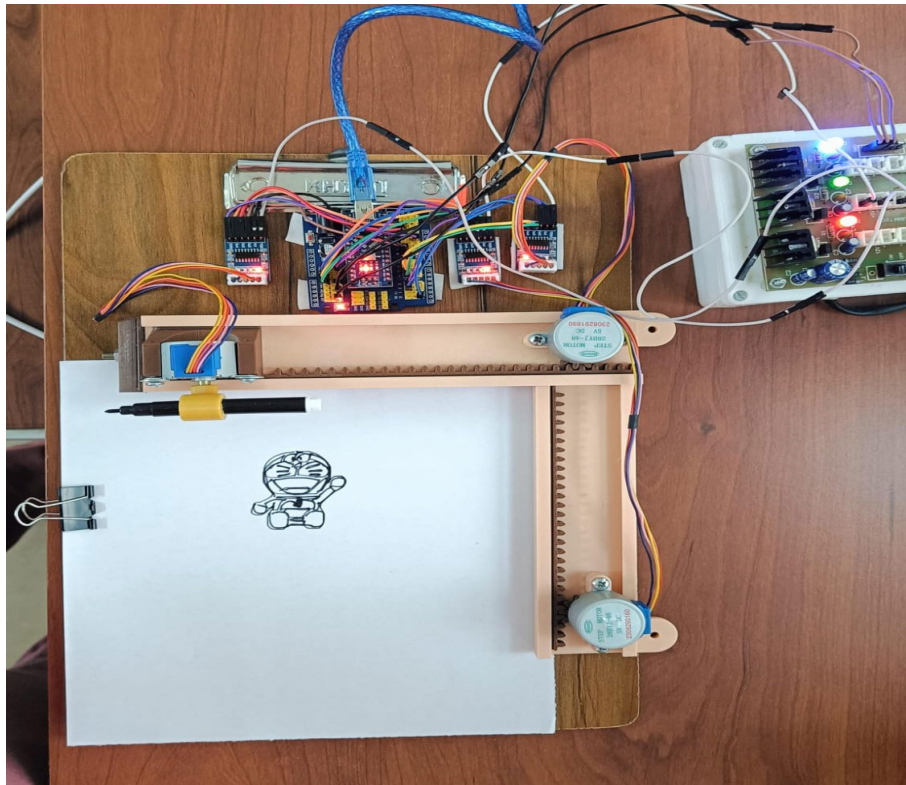
OBJECTIVE:

The major purpose of the CNC plotter machine is to create 2-D, and 3-D images on a plain surface or any other material by using a 3-D printing mechanism and microcontroller. . The plotting operation can be replaced by any other tool like a laser cutter or milling cutter. The distinctive feature of this machine lies in its flexibility as it is capable to execute a wide variety of applications.

## MATERIALS REQUIRED:

1) **Arduino Nano R3 = 1**
   The Arduino Nano R3 is a key component in CNC pen plotters, serving as the brains behind precise movements. Its compact design, compatibility with stepper motors, and ample GPIO pins make it an ideal choice for controlling the intricate motion required in CNC pen plotting applications.
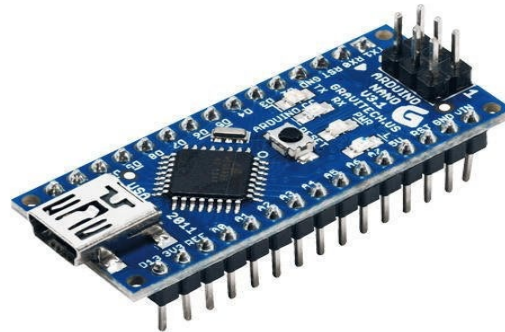


2) **28Ybj-48 DC 5V 4 Phase Stepper Motor = 3**
   The 28YBJ-48 DC 5V 4 Phase Stepper Motor is commonly used in CNC pen plotters for its compatibility with Arduino and precise control capabilities.



3) **ULN2003 Stepper Motor Driver Board Module = 3**

the ULN2003 Stepper Motor Driver Board Module plays a vital role in CNC pen plotters by translating control signals from the Arduino Nano into precise movements of the stepper motor. Its simplicity, reliability, and compatibility make it a popular choice for driving stepper motors in various projects, including CNC applications.



4) **Bearing**



5) **Wires**



## SOFTWARES USED:

# GRBL - A high-performance G-code interpreting firmware for Arduino.

In the realm of CNC pen plotters, GRBL (G-code Real-time Adjustable Block Length) stands out as a high-performance G-code interpreting firmware tailored for Arduino-based systems. Specifically designed to run on Arduino Nano and similar microcontrollers, GRBL serves as the intelligence behind the CNC pen plotter, translating G-code instructions into precise movements. It optimizes real-time control over stepper motors, ensuring accurate positioning of the pen on the drawing surface. With its open-source nature and widespread adoption, GRBL empowers CNC pen plotters with versatility, making it a preferred choice for enthusiasts and professionals seeking reliable and efficient G-code interpretation in pen plotting projects
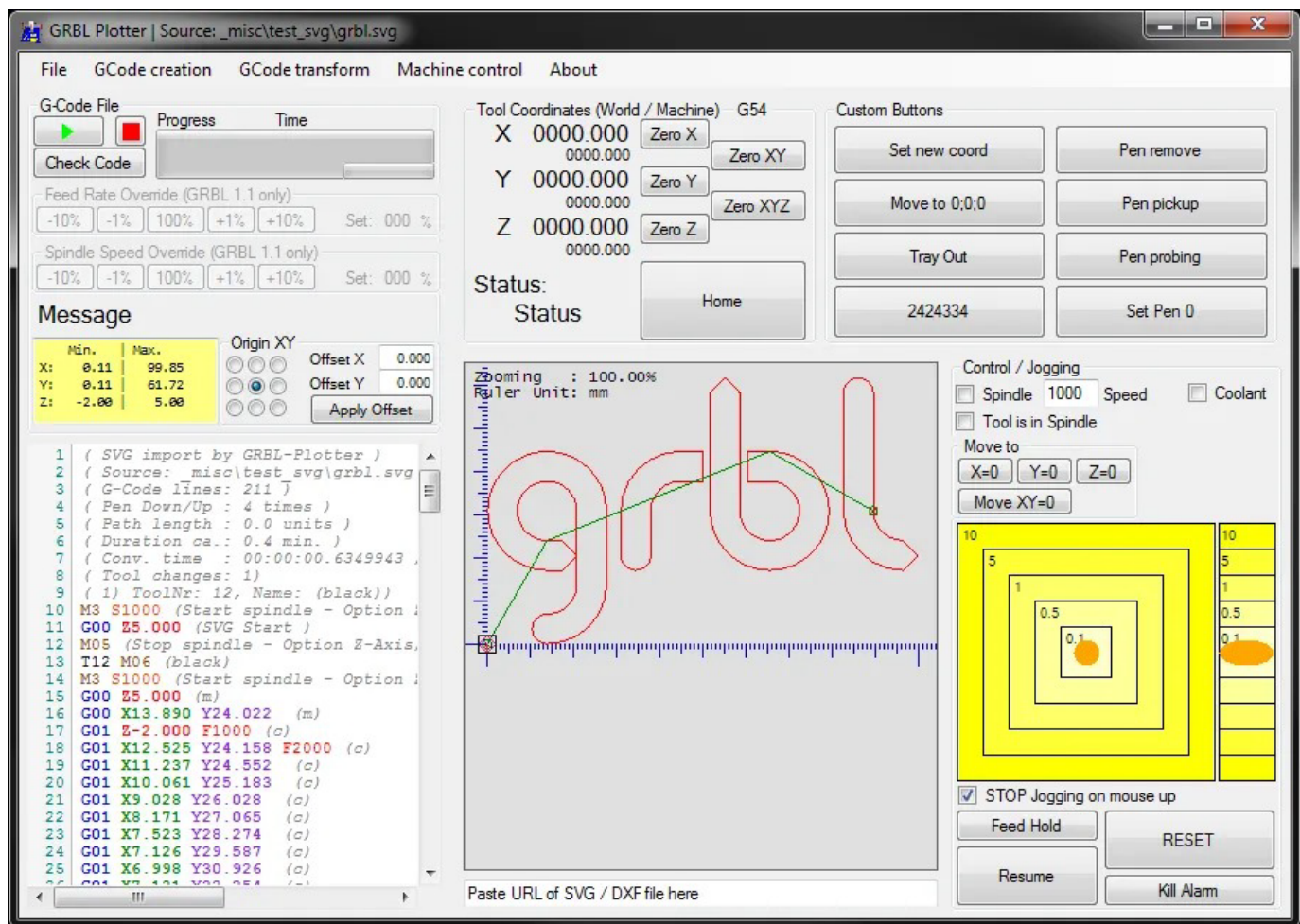


# JSCUT - A web-based utility for converting SVG to G-code.

JSCut is a web-based utility that plays a pivotal role in the CNC pen plotter ecosystem by providing a seamless solution for converting SVG (Scalable Vector Graphics) files into G-code. Tailored for ease of use, JSCut simplifies the pre-processing stage of CNC pen plotting projects. Users can upload SVG files through the web interface, and JSCut efficiently generates G-code instructions that dictate the precise movements of the pen on the plotting surface. This tool enhances accessibility for users, eliminating the need for manual G-code generation and ensuring compatibility with a wide range of CNC pen plotters. Its web-based nature makes JSCut a convenient choice for enthusiasts and hobbyists engaged in CNC pen plotting, streamlining the workflow from design to execution
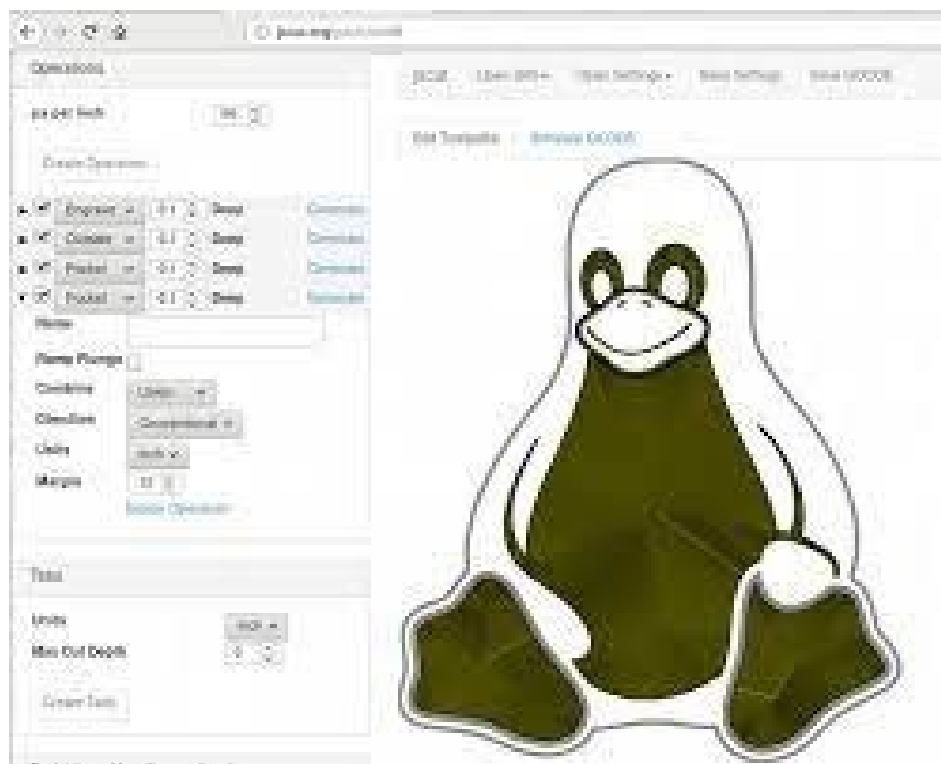
**Universal-G-Code-Sender -Java-based grbl-compatible cross-platform G-code sender.**

In the realm of CNC pen plotters, Universal G-Code Sender (UGS) assumes a pivotal role as a Java-based, cross-platform G-code sender tailored for compatibility with GRBL firmware. Acting as a user interface, UGS serves as the intermediary link between the operator and the CNC pen plotter system. Users can effortlessly load G-code files, generated from design software or utilities like JSCut, onto UGS. This versatile software interprets the G-code instructions and transmits them to the CNC pen plotter, which is typically controlled by an Arduino Nano running the GRBL firmware. UGS features an intuitive graphical interface, enabling users to execute commands such as homing and jogging, while also providing real-time monitoring of the plotter's status. Its cross-platform nature ensures accessibility, making Universal G-Code Sender a user-friendly and indispensable tool for controlling CNC pen plotters with precision and ease



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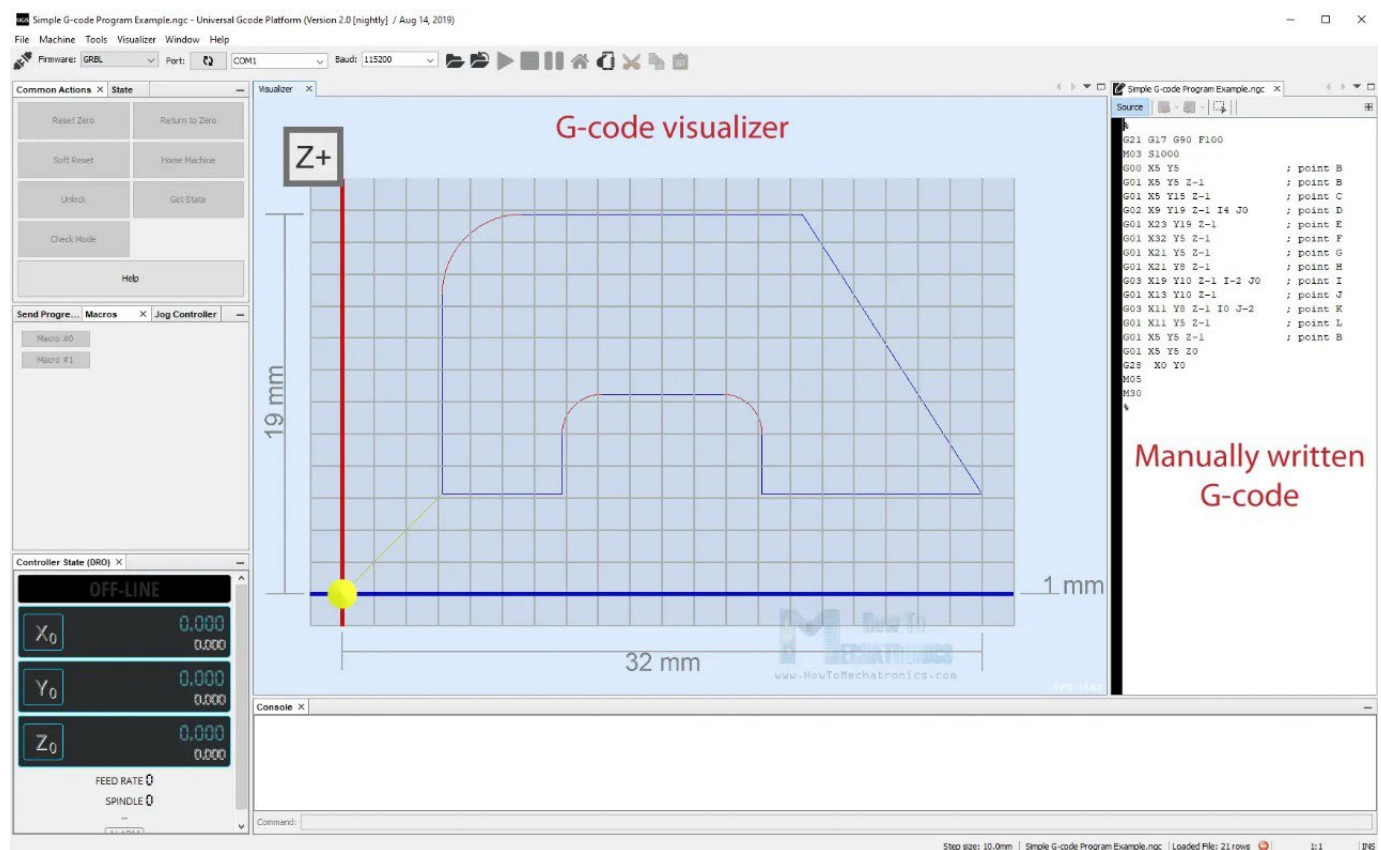
## BLOCK DIADRAM:

The CNC machine works with input as a G-code file. The G-code file is obtained from Inkscape software and further, the G-code file would be sent to the Arduino controller over Universal Serial Bus (USB) by the Processing IDE. The input functions as an electrical signal to the stepper motor and servo motor. The X, Y, and Z axes work according to the instructions given to the control unit. The controller unit also determines the drawing speed and the tool cutting and depth speed.
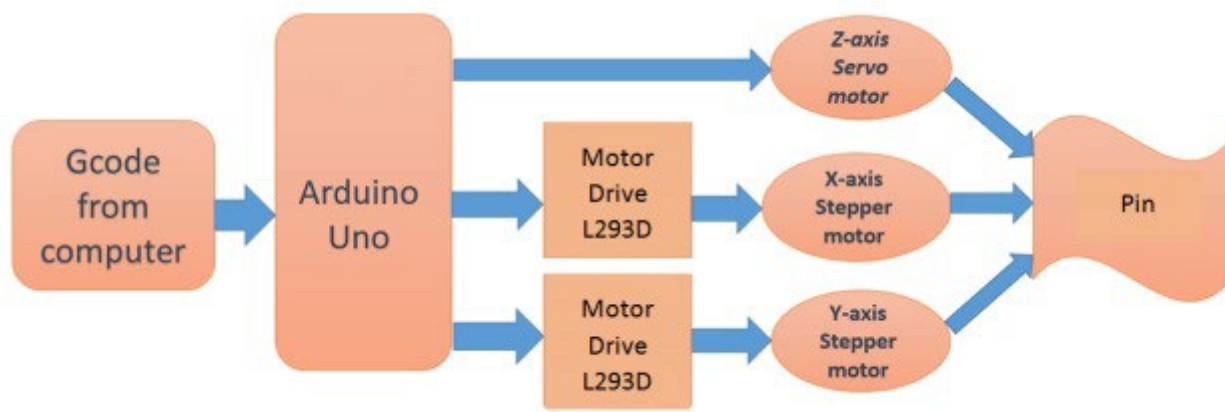


## **IMPLEMENTATION DETAILS:**

**Hardware Assembly:**

1. Arduino Nano R3:

Connect the Arduino Nano to your computer using a USB cable for programming and power.

Establish connections between the Arduino Nano and other components:

Connect the stepper motor driver boards to the appropriate pins on the Arduino Nano. Usually, these connections include step, direction, and enable pins for each motor.

2. 28Ybj-48 DC 5V 4 Phase Stepper Motors:

Connect each of the three stepper motors to individual ULN2003 Stepper Motor Driver Board Modules.

For each motor, connect the wires from the ULN2003 module to the corresponding pins on the Arduino Nano (step, direction, and enable).

3. ULN2003 Stepper Motor Driver Board Modules:

Connect the input pins of the ULN2003 modules to the Arduino Nano, ensuring that each module corresponds to a specific motor.

Connect the output pins of the ULN2003 modules to the respective stepper motors.

4. Bearings:

Integrate bearings into the linear motion system of the CNC pen plotter. Mount them in positions that support smooth movement along the X and Y axes.

5. Wires:

Use wires to establish connections between components:

Connect the power supply to the Arduino Nano and the stepper motor driver boards.

Connect the ground (GND) of the Arduino Nano to the ground of the stepper motor driver boards.

Connect the wires from the stepper motor driver boards to the stepper motors.

Ensure proper insulation and organization of wires to prevent signal interference.

6. Power Supply:

Connect an appropriate power supply to the CNC pen plotter, providing power to both the Arduino Nano and the stepper motors. Ensure the voltage matches the specifications of the stepper motors and other components.
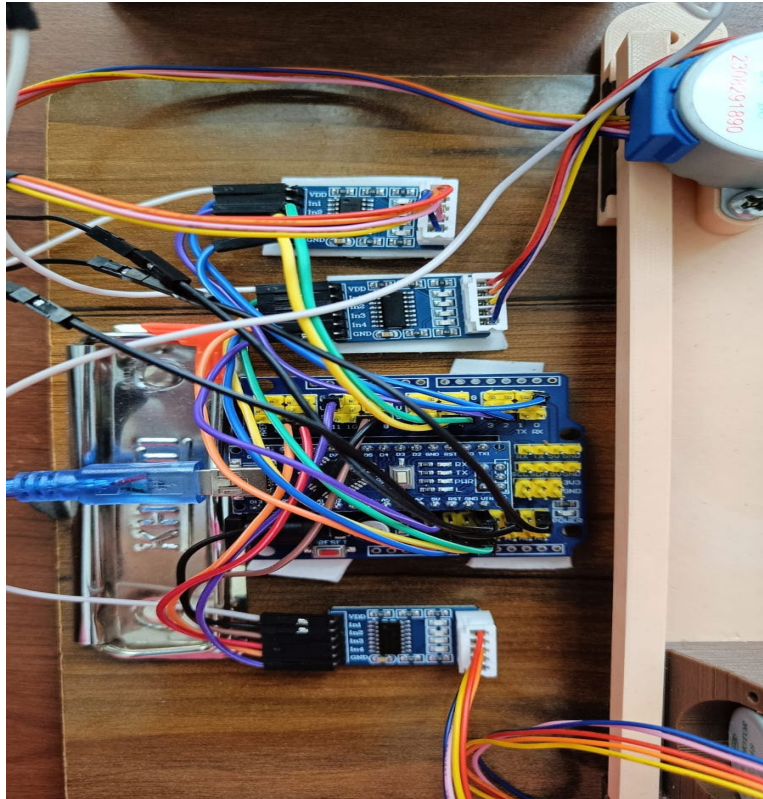


**<u>Software Configuration:</u>**

GRBL Firmware: Configure the GRBL firmware on the Arduino Nano. Adjust settings such as steps per millimeter and motor direction to match the specifications of your CNC pen plotter.

JSCut: Utilize the JSCut web-based utility to convert SVG files (vector graphics) into G-code. This G-code will contain instructions for the CNC pen plotter's movements.

Universal G-Code Sender (UGS): Download and install UGS on your computer. Use this Java-based software to load the generated G-code, control the CNC pen plotter, and monitor its real-time status.

**Testing and Calibration:**

Power Up: Power up the CNC pen plotter and ensure all components are functioning correctly.

Homing: Use UGS to home the CNC pen plotter, ensuring that the stepper motors return to their initial positions accurately.

Test Runs: Execute simple G-code commands to test the movement and precision of the CNC pen plotter. Adjust settings in the GRBL firmware or UGS if necessary.

Fine-Tuning: Calibrate the CNC pen plotter by adjusting parameters like steps per millimeter until the desired accuracy is achieved.
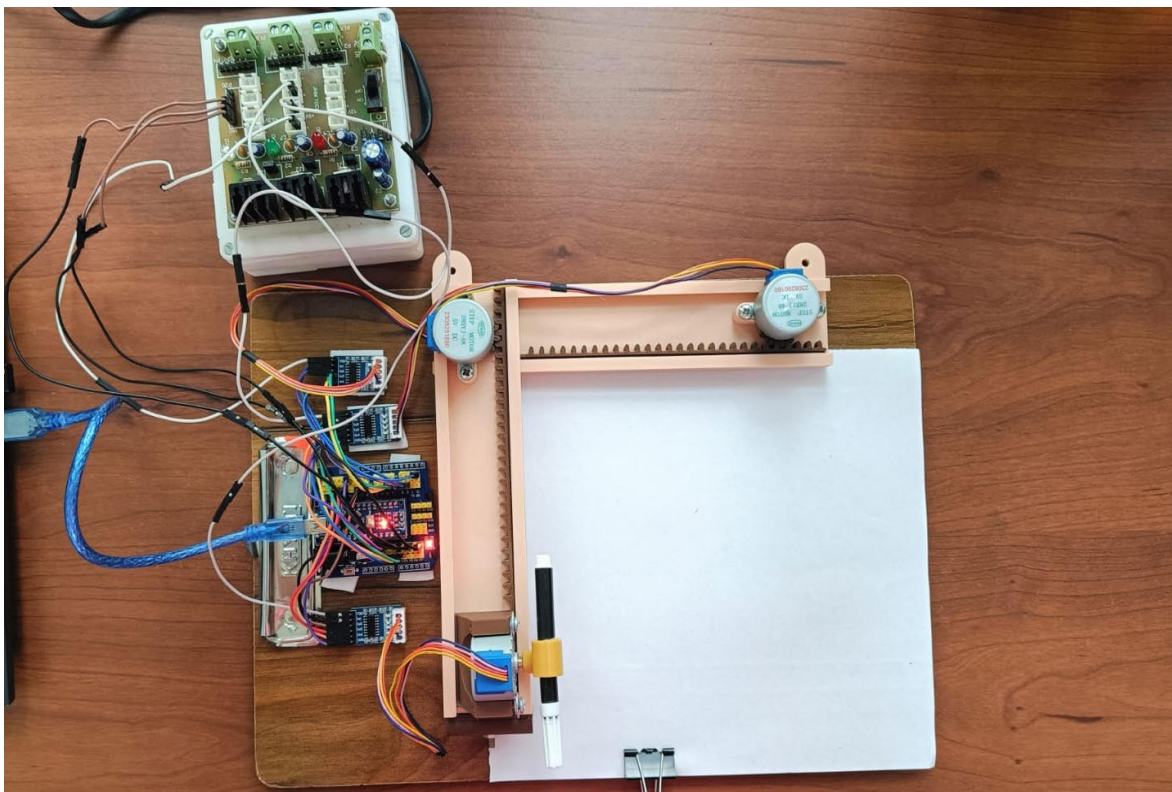


## CONCLUSION:

The pen plotter finds its application in many fields. It is a useful device in field of graphics. Letters and images can be drawn by taking the input from computer. Further additional improvement can be done by incorporating the graphical user interface for making the arm more user friendly and developed application interface so that arm could be controlled in remote place by the bandbox application.