

## G-Code Controlled 2D Robotic Plotter

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**Abstract**—2D Robotic Plotter is implemented based on the principle of Computer Numeric Control (CNC). Normally, Computer Aided Design software (CAD) can be used as the replacement for manual drafting with an automated process. A 2D Robotic Plotter basically works with two stepped motors and a Servo motor with the control of ATMEGA168p Microcontroller. In our proposed methodology an ARDUINO IDE platform controls the Motor Driver Shield (L293D) for the movement of the pen in the x and y direction to the rotation in stepper motors. The servo motor is used for raising and lowering the pen in vertical directions. Ink-scape and G-Code is used for converting the drawing into control signals used by Microcontroller. In Ink-scape (0.48.5) is an open source software that binds the program along with the diagram for the efficient plotting. Also G-code is a numeric control programming language which is used mainly in computer aided manufacturing to control automated machine tools. The 2D robotic plotter is a low cost embedded equivalent CNC controller and can be widely used in areas where the accuracy is considered

**Keywords**—Motor Driver Shield (L293d), Atmega 168p, Stepper Motor, Servo Motor, Inkscape.

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### I. INTRODUCTION

Robotics is the improved technology, it is used for productivity, safety, and in saving time and money. In the stream of robotics, a 2D robotic plotter is used in which a plotter that offers the works based on the principle of CNC which render a wide variety of uses like cutting, Lathing, extruding, milling, fabrication of electronic parts and drawing. To obtain 2D printing a complex design circuit is used and it leads to cost overhead. It includes the machining technology that covers a wide range of aspects. To utilize this machine technology a proper understanding and selection of a given machining technology is too needed. Tooling accessories, and the machine tool itself determine the nature of machining operation used for a particular function [1,2]. A machining operation based on the robotic arm movement is involved in electronic printing. SCARA which refers to Selective Compliance Assembly Robot Arm is used to make a robot to draw by the input plot given by the Computer. The SCARA robot is an X-Y Plotter. The plotters available in the market are 2D Cartesian robots, cylindrical robots and Spherical robot/Polar robots [3]. To provide low cost Robotic arm based printing an Arduino based X-Y Plane movement is performed. The Arduino microcontroller is an easy to use as it is equivalent to powerful single board computer and the design steps for 2D printing is based on the choice of plotter used. The software that is to be programmed for the effective functioning of the CNC machine includes C# as a programming language and dot NET platform for user interface [4, 5, 6, and 8].

The future technology involves the proper fabrication of PCB for complex circuit design. A 2D Plotter is mechanically supported and electrically connects the components using conductive signal engraved from copper sheets laminated onto the non conductive substrate [7]. CNC systems depends on rectangular coordinates, by which the programmer can locate the point exactly [9]. This robotic plotter is an embedded system which consists of the hardware components like stepper motor for the movement (x and y axis), servo motor for the movement along z axis, motor driver (L293D) and the software components like Inkscape (0.48.5), Arduino IDE and Processing (3.0.2). With the wide-spread use of CNC machines across the world, the difficulties faced in Production downtime, product loss, and expensive repair bills have been reduced to many CNC machine users. However the CNC machines have become expensive now-a-days because of complex controller involved. To eliminate this complexity a 2D G-Code controlled robotic plotter is involved. Machine language is to control the machine by a computer, an Arduino microcontroller is used along with IDE software, stepper motor and servo motor is used for rotation in automatic crack detect [10]. The rest of the paper is organized as a section-II reviews the existing methodology utilized. Section-III elaborates the proposed methodology and section -IV demonstrates the results obtained. Finally, section-V concludes the proposed work.

### II. EXISTING METHOD

Arduino GRBL CoreXY Servo Drawbot is works based on CNC. It uses Arduino UNO (Atmega328p) as the brain of the robot and a special GRBL firmware for G-Code Interpretation

and motion control. Core [X, Y] Cartesian movement to control both X and Y axis. The Z axis is controlled by a servo motor to lift a pen up and down. This Drawing Robot is a simple CNC Drawing Robot, it has the capability to draw or write on any flat surface. Writing implements such as gel pens, markers can be used for endless applications. Its writing head extends beyond the machine, so it is possible to draw bigger than the machine. It is similar to Axi-Draw. In existing technology the conversion from image to code is critical which leads to separate interfaces for this process. However, it can be useful in the areas where the largest production is required. A low cost 2D-G Code controlled robotic plotter can be involved for simple as well as complex plotter applications.

### III. PROPOSED METHODOLOGY

Our proposed work involves a mini CNC plotter which is constructed at a low cost. An INKSCAPE tool along with Arduino IDE is used for programming part. The 2D image as well as writing is loaded through Inkscape and a G-Code is generated. This G-Code is interfaced with Arduino IDE which in turn operates the motor controls and performs the specific drawing. To develop this model the stepper motors from CD drives are used. These stepper motors are arranged perpendicular to each other in order to control the movement of the plotter. The servo motor is attached to the x-axis and the pen is interfaced with the servo motor shaft. The y-axis is designated as a plotting area and the paper size is 5x5 cm is utilized. External supply of 12v, 3A is provided to the motor driver shield which is mounted to the Arduino board.

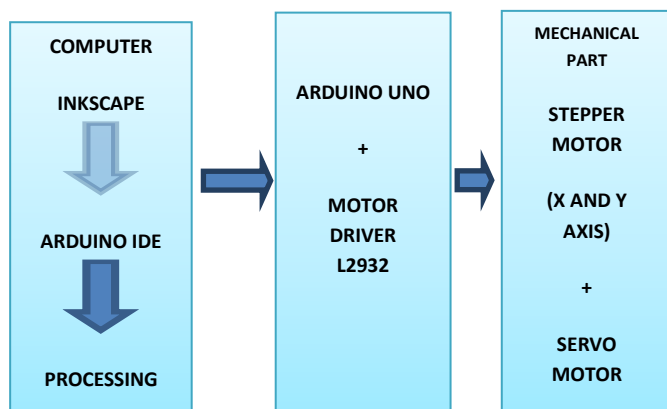


Figure-1: Block Diagram for the Implementation of CNC Plotter Proposed Method

Necessary connections for servo motor and stepper motor are done and the Arduino controller is connected to the computer port. The program is compatible with Atmega168p by interfacing with Arduino IDE and the image to be plotted is provided by the inkscape program which in turn provides a gcode. The gctrl.pde processing program extracts the necessary images to the CNC plotter.

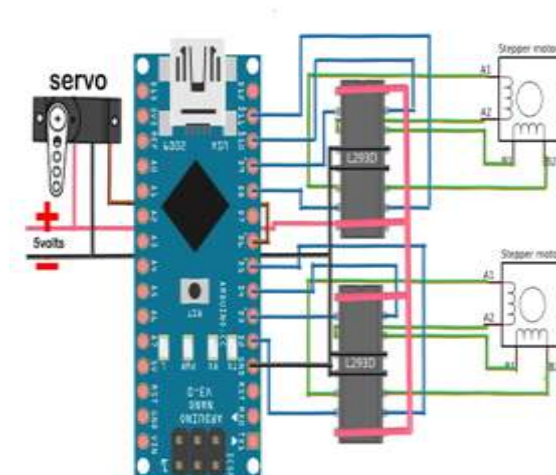


Figure-2: Control Diagram for Implementation of CNC Plotter

### IV. RESULTS AND DISCUSSION

The utilization of a CNC machine is found in almost all industries, from small scale to large scale industries and there is a great surge in the demand of the CNC programmers. This CNC system is now effectively utilized in most industrial process that can be described as a series of movements and operations. G-code file generation is the heart of a CNC program and INKSCAPE software has many features of adobe illustrator as well as G-Code file generation, as it is an open source it can be utilized effectively for low cost project models. An Arduino IDE utilizes this G-Code and operates the motor and performs the specific drawing in both horizontal and vertical position. In this 2D ROBOTIC PLOTTER the tiny machine draws images with good accuracy and it can also be used extensively in wood working industries to perform various operations like routing similar to milling and drilling. Lettering and engraving systems are used by CNC technology. Electrical industry such as CNC terminal location and soldering machines, coil winders are immense using the CNC technology. It is also used effectively in industries for removing metal and fabricating metals.



Figure-3: Implementation of 2D- CNC Plotter

## V. CONCLUSION

This model 2D robotic plotter provides the low cost drawing in horizontal and vertical directions. Two stepper motor and servo motor control is utilized to obtain this movement. Inkscape tool is effectively utilized to generate this drawing control code. Integrating the software along with the hardware and mechanical systems makes up an effective 2D plotter. This model finds effective application in CNC machine controls.

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The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression, “One of us (R.B.G.) thanks . . .” Instead, try “R.B.G. thanks”. Put applicable sponsor acknowledgments here; DO NOT place them on the first page of your paper or as a footnote.

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