

CNC BASED PORTABLE PEN PLOTTER**R.D. Sushir¹, S.S. Bhutada² and P.N. Pusdekar³**

Ex TC Engineering Department, PRPCOEM, S.G.B.A. University, Amravati

¹rupeshsushir18@gmail.com, ²saritabhutada@gmail.com, ³pusdekar.wardha@gmail.com**ABSTRACT**

The term CNC applications refer to computerized numerically controlled machining applications. These techniques are used in manufacturing. Particularly in machining operations involving manufacturing of a wide variety of components with medium to high level of production and small to medium production batches. Added advantages are available when the components to be manufactured can form homologues groups of similar products, that reduces the effort and cost of programming for manufacture of each component. CNC machines are mostly results in lower manufacturing operations only when the above conditions are satisfied. For example, CNC machines are not favorable for very high-volume manufacturing of one standard product. In such cases it is less expensive to use special purpose machines rather than CNC machines. Also, it is undesirable to incur the high overhead cost of programming for manufacture of one-off components. In those cases, manually controlled machines are likely to provide most satisfactory solutions. The main objective is to gain products at a much lower manufacturing cost, compared to the one resulted from conventional applications. CNC applications, by their complexity, allow the obtaining of much more reduced manufacturing times as compared to the conventional ones. The use of modular systems for orientation equipment has reduced substantially the cost of fixtures. Also, the increase of the cutter life, allows the decreasing of tools purchasing costs. Tools magazines which are present in all manufacturing centers reduces need for large warehouse storage for these tools.

Keywords: CNC, 3D printer, G-code, Arduino

I. Introduction

CNC is a generic term which can be used to describe many types of device, this would include plotters, vinyl cutters, 3D printers, milling machines and others. CNC stands for Computer Numerically Control and basically means that the physical movements of the machine are controlled with the help of few instructions like coordinate positions which can be generated using a computer. CNC plotter is a computer-controlled plotting machine related to the machine plotter used for plotting various schematics, such as maps, graphs, diagrams, pictures, circuits, and images. CNC plotter can perform the tasks of plotting on many surfaces such as paper, graphs, sheets and the PCB printing paper. The plotter stands for a computer printer for printing vector graphics. A plotter is capable of providing a hard copy of the output if needed. It is also capable of drawing pictures on a paper using a pen which is been included in this prototype. Pen plotters has mechanism for printing by moving a pen or other instrument across the surface of a piece

of paper. Denotes means that plotters are vector graphics devices, rather than raster graphics as with other printers. Pen plotters are capable of drawing complex line art, including text, but do so slowly because of the mechanical movement of the pens. Mostly they are not capable of efficiently creating a solid region of color, but can hatch an area by drawing a number of close, regular lines. CNC plotter can reduce waste, frequency of errors, and the time the finished plot takes to get to table. Plotters are tool to provide efficient and fastest way to produce very large scale drawings and high-resolution vector-based artwork when computer memory was considerably expensive and processor power was very limited, and other types of printers possessed limited graphic output capabilities. Pen plotters have essentially become obsolete and have been replaced by large-format inkjet and LED toner based printers. These devices are mostly capable of learning vector languages which are originally designed for such a plotter and they offer a more reliable alternative for raster of data.

II. System Organisation

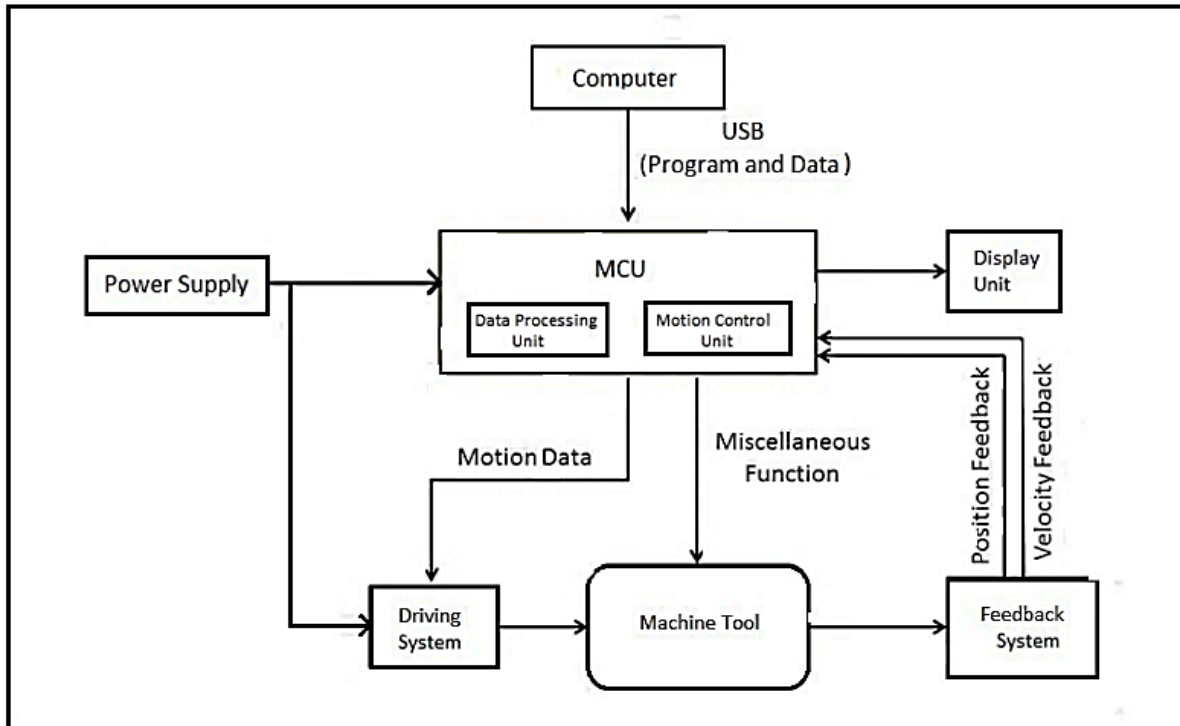


Fig. 1. Block diagram for CNC based 3D pen plotter.

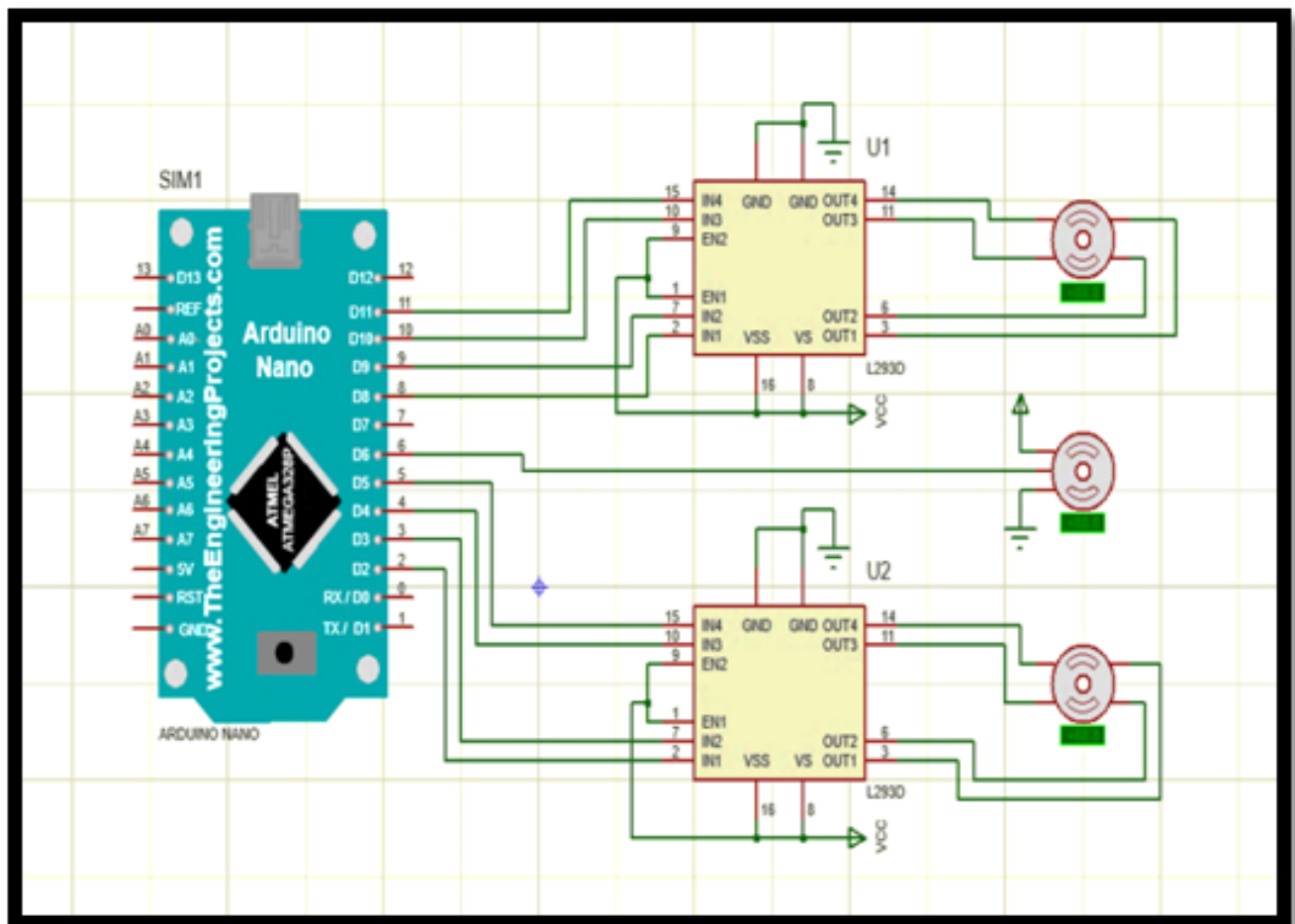


Fig. 2 Circuit Simulation of System.

Steps involved in System implementation are as follows:

1. In the process of building system of CNC machine one must dis-assemble CD drives.
2. The outer metallic cover of CD drive is welded perpendicularly to make the stand holding of X and Y axis.
3. Attach CD drive stepper motor setup as X and Y axis. And make sure that the Y axis is straight to CNC base and X axis vertical to it.
4. Z axis i.e. pen setup is attached to the X axis. The pen setup is made up of HDF, the servomotor is attached to it and the pen is set up inside the fiber using screw and spring.
5. A metallic base is attached to the Y axis for using a paper base. Then a paper is put above it with help of some magnets. The printing area is 4*4 cms.

B. Algorithm for Arduino and stepper motor setup

1. The adafruit L293D motor driver shield compatible with the Arduino board is mounted on it.
2. The Arduino is connected to the computer port.
3. Check the stepper motors and servo motor.
4. The stepper motors, servo motor is connected to the motor shield. The external power is connected

C. Burn source code and generate G-code

The mini CNC plotter sketch is burn to the Arduino microprocessor (ATmega328) by using Arduino IDE. G code is made by ink-scape program. Then use the gctrl.pde processing program. The program sends g-code images to CNC plotter. Plotting of image is done thereafter.

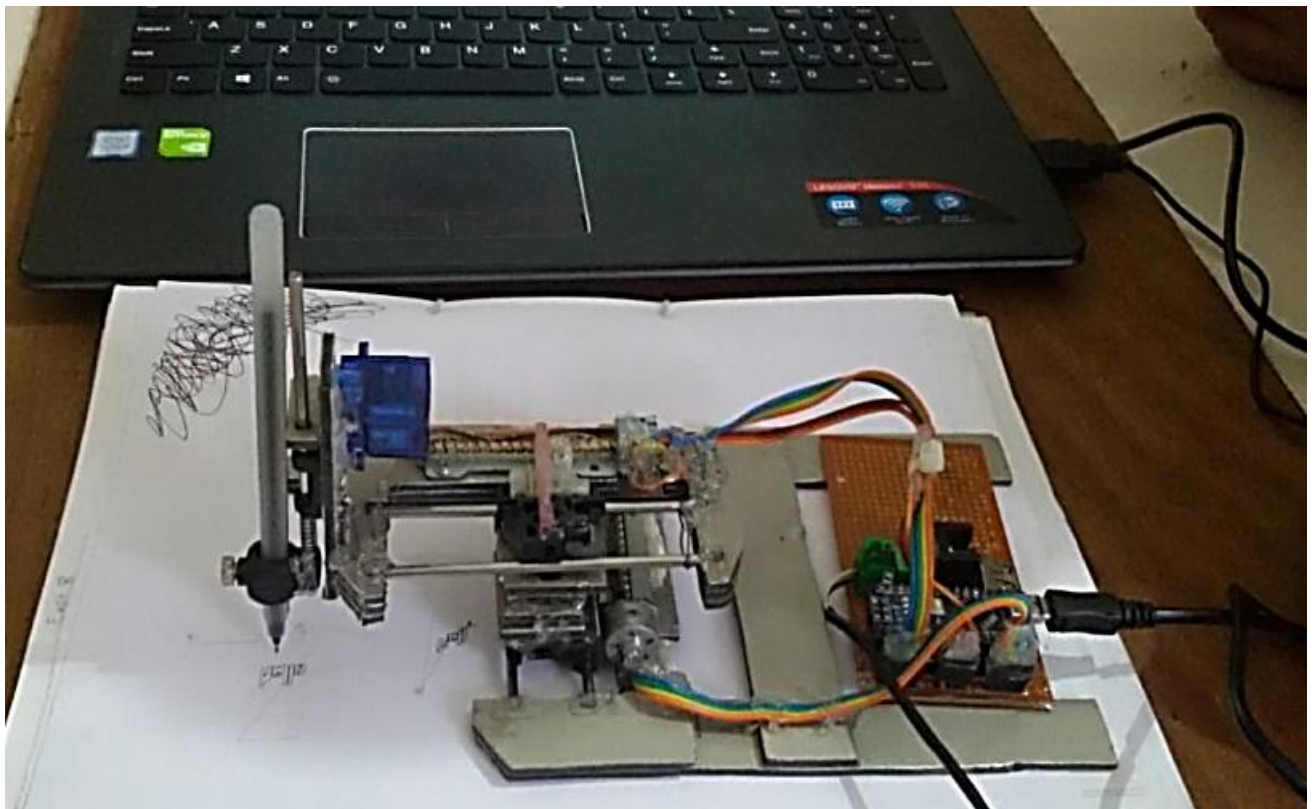


Fig. 3: System Prototype

G-Code is the language used to control CNC plotter. It's one type of CNC programming that we are using, the other type being CAM programming. Our machine's CNC controller executes g-code, although there are other

possibilities--Heidenhain, Mazak, and others have proprietary formats. Some machines having proprietary formats can also run g-code. It is the Lingua Franca of CNC. In order to make a part on a CNC plotter, you tell it how

to make the part using a G- Code Program. A G-Code file is in turn a file containing the X and Y co-ordinates of the images that is to be

plotted. A G-Code processing software in synchronization with the Arduino program makes the plotter running.

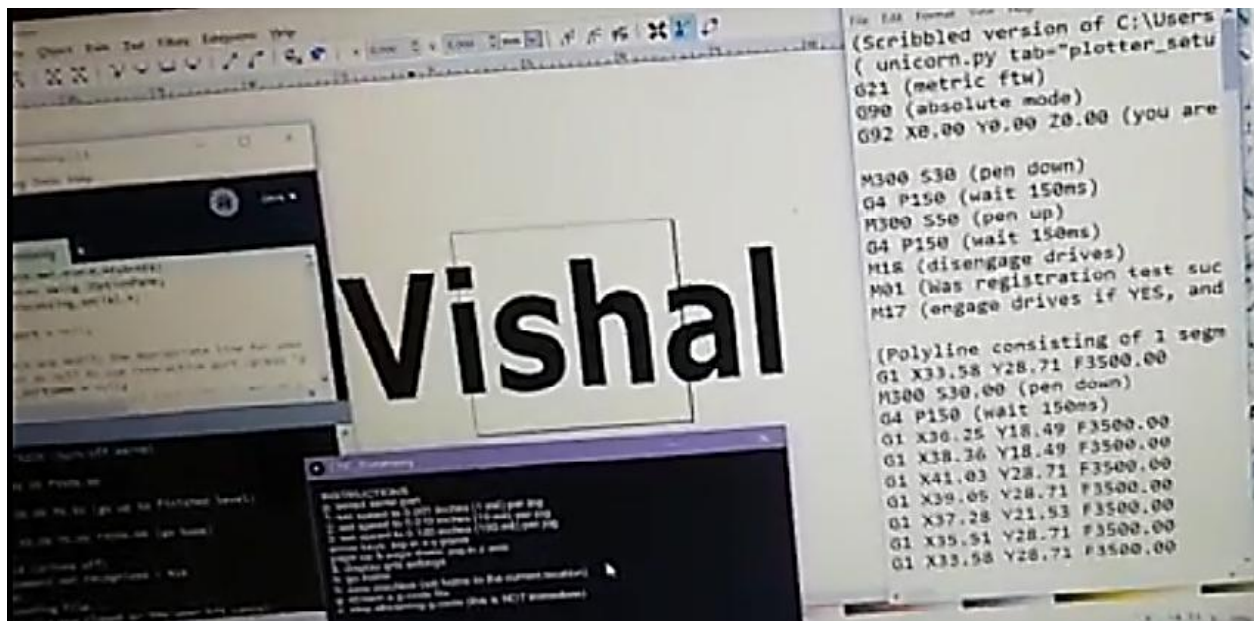


Fig. 4: G-code Generation

The final operation revolves around the processing of the G- Code file as selected by the Software (Processing 3). A user interface is given for the control of the program running, selecting the G-code, selecting the Port, and terminating the program. Processing 3 is an open source programming languages with inbuilt integrated development environment. Processing 3 includes a drawing sketchbook. Processing 3 sketch is actually a subclass of the Applet Java class which implements most of the Processing 3 language's features. When programming in Processing 3, all additional classes defined will be treated as inner classes when the code is translated into pure Java before compiling. Means making use of static variables and methods in classes is prohibited unless you explicitly tell Processing that you want to code in pure Java mode. Processing also allows users to create their own classes within the Applet sketch. Allowing complex data types to include any number of arguments

and avoids the limitations of solely using standard data types such as: int (integer), char (character), float (real number), and color (RGB, ARGB, hex).

III. Circuit Operation

The CNC controller and computer system work along as the —brain for these machines, controls the motors and drive system which direction to move and how far. The computer must obviously have given a design. Almost all designs start in a digital format such as a dxf drawing or some other similar format. User is then supposing use a CAM software package along with the CNC controller software provided. Those types of software convert a 3D or 2D digital image into a tool path code such as G-code. The computer then converts these commands into a digital signal which it relays to the CNC controller which converts the digital signal to varying voltages and currents that control the mechanical drive systems.



Fig. 5: CNC printer printing given Input character

IV. Applications

1. Cabinet making is one of our most popular applications. Affordable, dependable CNC machine make manufacturing of doors, countertops, shelves, drawers and drawer fronts possible for small, mid-size and large shops alike. Cabinetmakers are using our quality CNC routers to increase production and cut costs by reducing material handling and increasing throughput.
2. Sign making is another application of CNC cutter which can be used to carve sign in wood, metal or few other materials also.
3. A CNC machine paired with easy-to-use software can closely mimic the artisan's skills seen in mouldings, arches, carvings, corbels, as well as in columns. This machine offers an Indexing Lathe that makes those difficult 3D carvings on cylindrical parts easy.
4. Wood carving is widely viewed as a hands-on craft, but CNC technology can achieve the quality and repeatability of the cuts. From fine crafted furniture to gifts, a CNC machine can help you achieve any possibility.
5. CNC machines are a perfect way to create prototypes using aluminum, foam, wood and plastics. Using a CNC machine and the right software, you can reverse engineer a 2D or 3D model to effectively and efficiently create prototypes and reproduction parts.

6. Printed circuit board isolation milling is the process of removal of excess copper from a sheet of printed circuit board material. This process recreates the pads, traces and PCB structures in accordance with the pattern by the use of CNC machines. High quality PCB can be produced.

V. Conclusion

In modern CNC a system, end-to-end component design is highly automated using CAD and computer-aided manufacturing (CAM) programs. Selection of optimal cutting parameters for obtaining specified surface roughness is very difficult for any work piece materials. In the currently considered scenario, desired surface roughness can be achieved by trial and error method. But it is time consuming and material is unnecessarily wasted for this purpose. Thus, there is a need to find a technique that can predict cutting parameters for the desired surface roughness. CNC machines are used to is to produce an object that has a very complex design like cars, components, accessories and many more. The advantages of using this CNC machine are the machine is very accurate measuring so it will not have error in measuring the object unless the user enters the wrong measurement. Code used in CNC computer is called g-codes. There are 6 main parts of CNC machine. Input devices getting input the part program in the CNC machine

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