CNC Plotter Using Arduino for PCB Prototyping

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***Abstract*: With the advanced technology, demand for Computer Numerical Control (CNC) plotter machines in Educational Institutions and Laboratories is rapidly rising. Low cost manufacturing of Printed Circuit Board (PCB) has become a basic need in electronics laboratories. This paper will present a cost-effective model of a CNC plotter machine which is able to draw a circuit layout on PCB or any other solid surface using simple algorithm, some set of open source software and available components. At first the user needs to convert any image file into G code using Inkscape software and then feed it to the machine using Processing software or Universal G-code sender. Arduino uno with a microcontroller named ATmega328P is used as the control device for this project. The ATmega328P converts G-code into a set of machine language instruction that are sent to the motor driver of the CNC plotter.**

***Keywords*: CNC plotter, PCB prototyping**

1. Introduction

A CNC Plotter is a special type of machine that uses a pen to draw text or images on solid surfaces. In Computer Numeric Control, processor is used which is capable of processing logical instructions interfaced with a computer. The instructions are provided with the help of a computer in the form of code or text or image which is then transformed into a machine language by processor to be executed by the machine. A CNC plotter is a 3 dimension controlled 2 dimension plotting machines. This CNC Plotter can be used for the purposes such as PCB Design, logo design, etc. This project is also based on CNC plotter machine. By the increasing demand of CNC plotters for the purpose of using in universities and laboratories, a cheap and less complex design is needed. The parts used for the plotter in our project are easily available at a very low price and spare parts are also used, even the software needed for this project are also available for free i.e. those software's are open source. The construction of this CNC Plotter is very simple and robust.

2. Methodology

This CNC plotter is able to draw complex line drawings. The coordinates are uploaded to the machine controller by a separate program for the movements of motors. The image file is transformed into a G-code via Inkscape Software. Then the code is transferred to the Arduino UNO by which the motor mechanism is instructed to draw the image. In this project, we are showing a simple design for a CNC plotter. Our idea is an Arduino UNO based design using ATMEGA 328P microcontroller. This CNC Plotter will have three motors to implement the X, Y, and Z axis. A servo motor will be used along the Z axis which will position the pen to go up for logic 0 and down for logic 1. Plotting will be done on the X-Y plane where the positioning of the base will be controlled by stepper motors.
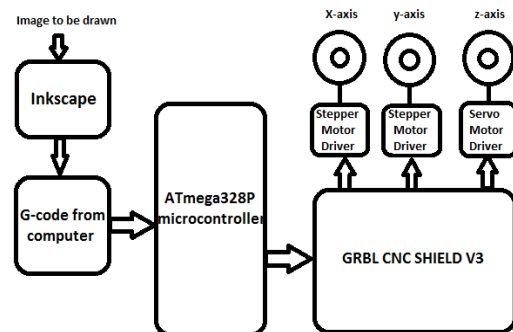

Fig. 1. Block diagram

3. Description

In the software part, an image or the PCB layout in .bmp extension is selected from the computer which is to be drawn. That image is processed in a software named Inkscape which will convert the image into G-code.

Then with the help of Processing software or Universal G-code sender app, generated G-code is selected and sent to Arduino from the COM port to which Arduino is connected. Accordingly the Atmega328P microcontroller controls the GRBL CNC shield v3 and motor driver, were the microcontroller is used for interfacing input and output devices.

Since, the microcontroller generates a very low amount of current in mA, so the motors cannot be directly interfaced with the microcontroller, because motors require large amount of current and if directly interfaced with microcontroller, then it can damage ATmega328P also.

4. Possible outcomes

- Instead of pen, a driller can be attached so as to drill the PCB.

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- This CNC Plotter can be used for laser engraving.
- Cost of machine is reduce-d as compared to other CNC machines.
- Time is reduced as the typical method of PCB prototyping is high.
- This CNC Plotter is user- friendly as this doesn't require any higher skills of G-code.

5. Conclusion

This project is about designing or making a mechanical prototype of a CNC plotter machine which is able to draw a PCB layout of 20x20 to 30x30 cm (or any image/text) on a given solid surface. It consumes low power and works with higher accuracy due to precise controlling of stepper motors by the motor driver and GRBL CNC shield v3. This is a low cost project as compared to other CNC machine. It is made with easily available components, parts and some open source software. It is designed for private manufacturing and designing for small scale applications in educational institutes. The machine is made with a very simple construction design and can be carried anywhere without much effort. The software used is simple. The pen on the z-axis can be replaced with a pinhead or laser head or any other tool for different purpose of use. Software that are been used are open source and user-friendly.

Conclusion

References

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