General Purpose CNC Machine by Using Nano Aurdino

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Abstract: *The present work is concerned with the design and development of Control unit comprising of the Digital Differential Analyzer Interpolator as the core element in controlling the motion in X and Y direction of the Computer Numerical Control machine. The Control unit designed contributes a little but significant step towards low-cost automation. Software interpolators are designed for performing machining operations on the work by performing an interpolated motion of the cutting tool. The prototype CNC Machine tool is procured from the manufacturer of CNC Machines for performing the work. The Atmega328p microcontroller used in this work is provided with Nano Arduino development board environment for designing the control unit. Three unipolar stepper motors are used for controlling the machine axes. The X and Y axes are interpolated for two-dimensional interpolation. Electronic Industries Association Standard code of part programming is used for implementing the G codes. The paper also discusses the development of an algorithm for interpreters and interpolators as well as the real-time graphical simulation and design of driver cards for unipolar stepper motors. The Control unit is tested for linear as well as a circular interpolation by performing actual machining on CNC machine.*

Introduction

The work includes design & development of prototype modeling of CNC machine tool controller unit. For experimentation, Gantry type CNC Milling Machine is procured from the leading CNC manufacturer having a table size of 20 by 30 mm & resolution 0.025 mm with ball screw mechanism for imparting motion to all the driving axes. Control unit comprises of Atmega328p microcontroller on Nano Arduino platform for providing motion to the machine table in X & Y direction. The present work includes machining of the workpiece.The microcontroller is interfaced with driver IC L293D and the driver ICs are interfaced with unipolar stepper motors. Stepper motors are fitted directly on the ball screws for imparting motion to the work table in X and Y direction. The Software Inkscape is used to convert the image file into G-code. The EIA (Electronic Industries Association) part programming codes (G and M codes) are implemented in developing the algorithm for linear& circular software interpolators [3]. Graphical user interface software is also developed for making control unit interactive& user-friendly. An interpreter is also designed for recognizing various machining commands entered as per the EIA international standard format. It serves as a significant step towards low-cost automation in the field of CNC machine tool manufacturing. The paper discusses mainly the design & implementation of machine control unit using Arduino platform

Methodology

Designing and method to meet the objectives of a project which is to develop multi-purpose CNC machine. By ATmega328p, IDE programming, nano Arduino, a motor driver IC L293D, stepper motor, laser diode, DVD drivers, power supply, connecting wires. Generally, this project is divided into three phases.

• Phase first is a software development using Atmega 328p. For software programming on java environment language will use to construct the command in order to get the best result. We are using processing 3 software for running the java code for controlling x and y-axis of CNC machine.

• Phase two is converting an image into G-code. The image is getting converted into G-code by using software called as Inkscape

• In phase three component identification and buying and hardware building on PCB.

• In phase four we will assemble the hardware parts, we will make connections.

This methodology used for the realization of this document was a documentary and practical investigation, relying on technical documents based on the topics studied to implement modern technology reusing CD / DVD readers.

Literature Survey: Many manufacturing processes and production, in general, are carried out by means of automation, so the use of CNC (Computerized Numerical Control) has been extended to all types of machinery: lathes, grinders, EDM machines, sewing machines, etc. Currently, desktop and laptop computers use mostly USB memories for the exchange of electronic information, with CD / DVD readers being a much less attractive alternative, given their size and the advantages that USB memory has over them. They have become an accessory in the PC and there is no longer an indispensable need for the exchange of information making use of this technology, leaving them in obsolescence, practically in disuse. In this study we will detail a useful and practical way to reuse readers, by implementing a CNC machine (Computerized Numerical Control), which is intended, is to use these readers practically building a simple CNC system controlled by Arduino.
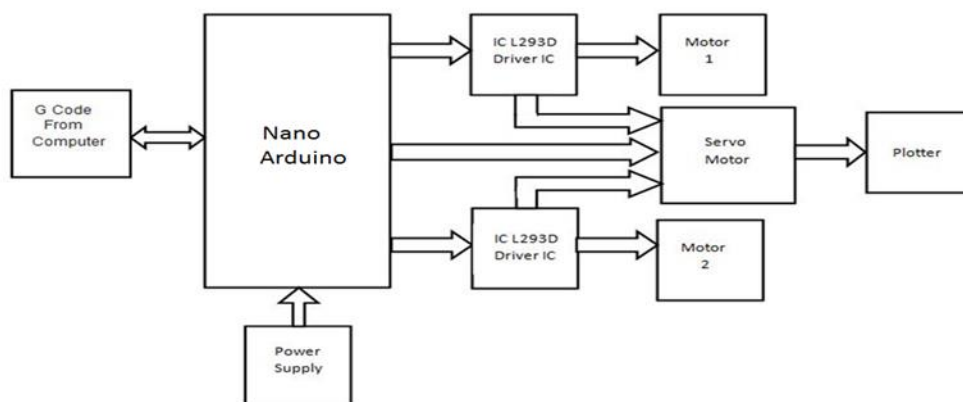
Block Diagram:

Fig. 1 Block diagram of general purpose computer numeric control machine
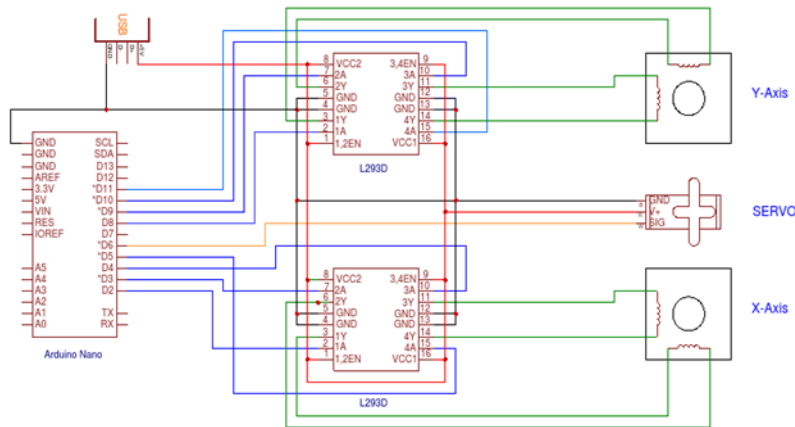

Fig. 2 Circuit diagram of general purpose computer numeric control machine

SOFTWARE AND CODING :

To complete the task of entire project three software is used :

- Inkscape
- Processing

INKSCAPE:

Inkscape is used to design the plotted diagram or text. In this project by using this software G-code file of a selected image or text is created. G-code is a commonly used numerical control programming language which includes X, Y, Z coordinates.

The CNC plotter of our project will work within 20mm×20mm area so we choose the document properties of the Inkscape 40cmx40cm (Width×Height) which is four times the working area of the plotter because the plotter can draw only in the first quadrant. So we have initially kept the axes at the nearest end of the motors which is considered as origin to easily modify the design.
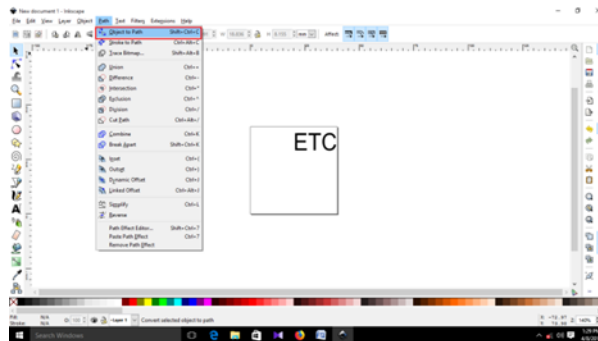
Fig.3 Conversion of Text to G-Code

In Fig.3 The working area of CNC plotter is shown with the text written in the pre-defined area.The text is selected using cursor and then select "object to path" from the drop down window to save the G-code form of the selected text.

To create G-code of an image, the file must have a transparent background. The image should be dragged into the selected area then select "trace bitmap" from drop down window to create a transparent image. Scans are selected as 8 and "Edge detection" is selected to create black & white image. After adding this transparent image in the predefined area we've used "object to path" command to create the G-code file of the selected image by following the steps described earlier.
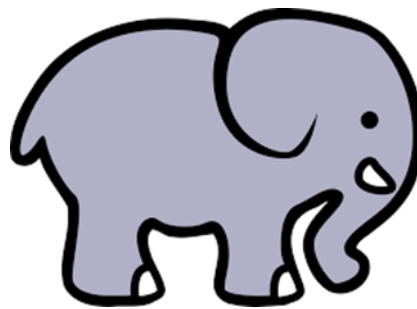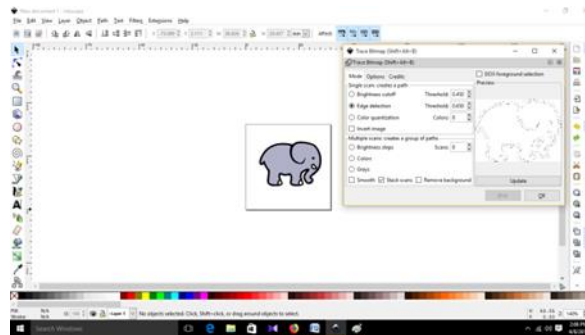

Fig.4 Original Image

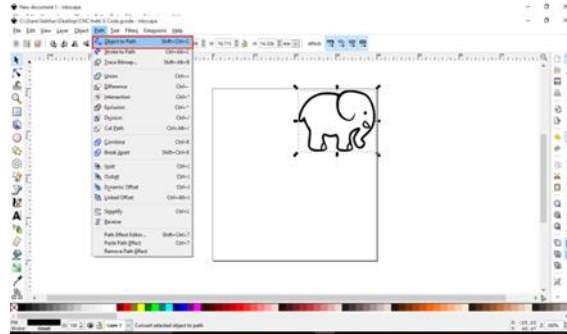**Fig.5 Conversion of image to G-Code**

Fig.6 Creating Transparent Image

PROCESSING 3.2.3:

Processing is for writing software to make images, animations, and interactions. The idea is to write a single line of code, and have a circle show up on the screen. Add a few more lines of code, and the circle follows the mouse. Another line of code, and the circle changes color when the mouse is pressed. We call this sketching with code. You write one line, then add another, then another, and so on. The result is a program created one piece at a time. Processing 3 **is an open source language/ development tool for writing programs in** *other* **computers. Useful when you want those other computers to "talk" with an Arduino, for instance to display or save some data collected by the Arduino.**

To communicate between Arduino and processing software we need a library. This library allows you to control an Arduino board from Processing without writing code for the Arduino. Instead, you upload a standard firmware (program) to the board and communicate with it using the library. The firmware is called Firmata, and is included in the Arduino software.

Processing.js is the sister project of the popular Processing visual programming language, designed for the web. Processing.js makes your data visualizations, digital art, interactive animations, educational graphs, video games, etc. work using web standards and without any plug-ins. You write code using the Processing language, include it in your web page, and Processing.js does the rest. It's not magic, but almost.

Originally developed by Ben Fry and Casey Reas, Processing started as an open source programming language based on Java to help the electronic arts and visual design communities learn the basics of computer programming in a

visual context. Processing.js takes this to the next level, allowing Processing code to be run by any HTML5 compatible browser, including current versions of Firefox, Safari, Chrome, Opera, and Internet Explorer. Processing.js brings the best of visual programming to the web, both for Processing and web developers.
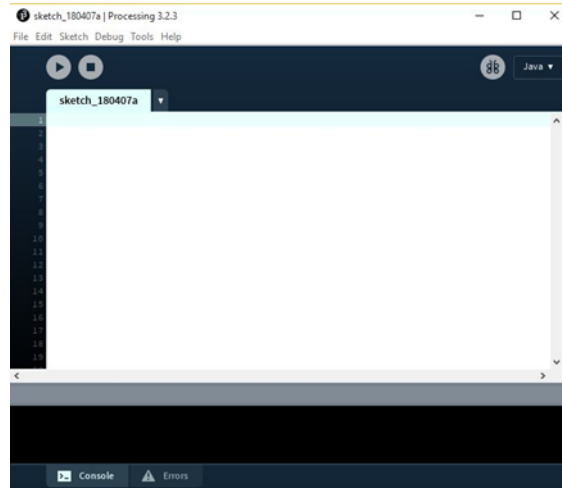

Fig.7 processing3 software

G-CODE:

G-code (also RS-274), which has many variants, is the common name for the most widely used numerical control (NC) programming language. It is used mainly in computer-aided manufacturing to control automated machine tools. G-code is sometimes called Gprogramming language

G-code is a language in which people tell computerized machine tools how to make something. The "how" is defined by g-code instructions provided to a machine controller (industrial computer) that tells the motors where to move, how fast to move, and what path to follow. The most common situation is that, within a machine tool, a cutting tool is moved according to these instructions through a toolpath and cuts away material to leave only the finished workpiece. The same concept also extends to noncutting tools such as forming or burnishing tools, photoplotting, additive methods such as 3D printing, and measuring instruments.

B. Stock Materials
• Wood
• Melamine board
• PVC board
• Metal rod

C. Components Required To erect the CNC plotter machine, the required components are listed below:
• Stepper motor (2 pieces)
• Motor driver module (2 pieces)
• Servo motor
• Power supply
• Arduino uno
• Gears
• Pen
• Hose Clamp
• Bread board
• PCB
• Connectors and Cables
• Diodes

X-axis:

X-axis basically moves the pen to and fro to cover the x-coordinates of the G-code. The X-axis has been placed perpendicular to the Y-axis lifted up by two wood legs of equal length shown in Fig. 10. A distance of 15 cm is kept from the starting point of the X-axis so that the Z-axis, which is mounted on the X-axis and holds the pen, is positioned at the center of the PVC board where both the axes X and Y has been centered.

Y-axis:

A melamine board (40mm*40mm) has been used for the base. The Y-axis has been mounted on the board maintaining a ground clearance of 3 cm because of the height of stepper motor. A black surface paper,plastic material, any solid material of black colour has been placed on the tray with one end fixed on the tray and the The level of the board has been carefully checked with a meter rule so that it is perfectly horizontal with the base. As a result the pen moves smoothly on the board without interruption.
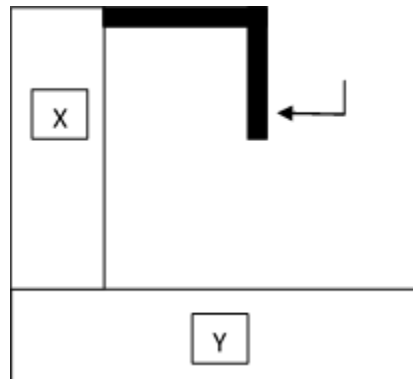
Conclusion:

Due to the little investment it represents to start up the project, it is feasible to implement it in educational centers to innovate in learning issues for students of technical branches or in general. x Caring for stepper motors by modifying the GRBL file plays an important role in preventing damage to the motors. x Implementation with recyclable materials from projects. And it also can be used as multi-purpose CNC machine, so that we can use it as a plotting machine, engraving machine,

cutting machine. Within a single machine just by changing a pointing device assembly.

A text file has been designed and sent to the CNC engraver which is to be engraved the text. The original file and the plotted files are shown in figure below.

Result:

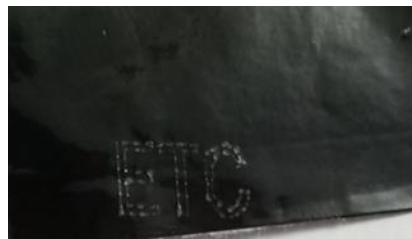**Text file:**

Fig. 8 Original Text

Fig.9 Engraved Text

Colorful Image File:

Fig. 10 shows a colorful image file that has been converted into a sketch through bitmapping and edge detection and then plotted via CNC engraver machine shown in Fig. 11
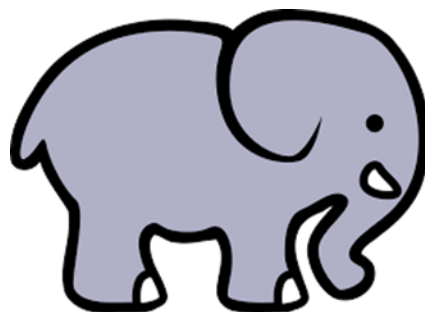
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Fig. 10 Original Image

Fig.11 Engraved Image

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