Mini CNC Plotter and Laser Engraver

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ABSTRACT
CNC Machine system has been already implemented in industries but at a very greater cost. Now-a-days because of growing technology in various dimensions. CNC system will make it easier for humans. Our idea of implementing Mini CNC Plotter and Laser Engraver is introduces to reduce the man power. This paper discuss the design and implementation of two dimensional CNC router. Mini CNC plotter is designed to create complex designs as well as easy designs by just simple software. We have used CD drives and along with that stepper motors which gives proper provision of axes. This project has Arduino as its brain, through which inputs are given.

KEYWORDS: *Arduino, CNC, CD drives*

I. INTRODUCTION
Computer Numerical Control is used in industries to reduce man power and make work efficient and easy. In CNC machine system machine tools are functioning by a numerical control. In this system, machines are programmed by CNC machine language called as G-Codes. G-Codes controls the speed of the process, efficiency rate, coordination of the axes. Both metal and plastic parts can be used to implement this structure. Our idea is inspired by CNC plotter machine which is used for the job of creating complex designs. Our idea of this project is to create complex images by high watt burning laser machine module. This can be done on any surface. Wooden surface, plastic surface or metal surface. The two stepper motors and one servo motor used, helps in movements of X, Y axes. Two CD Drives are used for the movement on axes. Microcontroller is used to controls the proper synchronization of these three motors during the process. The motors winding voltages were displayed on the oscilloscope during the printing process to investigate the synchronization between the three motors. Arduino bases software language is used to operate this machine. Inputs are given though Arduino. The design of the circuit is simple, inexpensive and can be accomplished using commercially available components. This machine will be implemented in a miniature structure. To keep it low space occupied and light weight we will use wooden or aluminum parts to implement this structure of project[3]

II. RELATED WORK
From this module we describe the design and structure of small two dimensional CNC router, monitoring system and controlling system. Previous systems used three dimensional CNC machines to implement their structures. In old papers CNC machine systems was suitable for designing metallic and non-metallic materials. Using three axis. The three axes are X, Y and Z respectively. The biggest drawback of these systems was complexity of connections, complexity of working of tools and small machines used, difficulty to understand each part, costly, high weight and occupies a bit of more space. To overcome these problems we proposed an idea of designing two axis CNC plotter machine which is low in weight as compared to old implemented CNC plotter machines. It is possible because of two axis and wooden material with compact size. It can be made more light weight by using aluminum parts for construction of this system. In our system we have to convey instructions to the machines by using software which will be installed in computer device or laptops which contains G-Codes to operate CNC plotter system. Inputs will be given to Arduino. Then further operation is carried out by stepper motors and servo motor. As per the commands laser starts to move along X and Y axes and engrave the images on given object. And the laser module is controlled by laser driver[5]

III. SYSTEM DESIGN
The working of CNC plotter can be explained with the following steps.

A. Connecting and assembling.
The first step includes connecting arduino and L293D motor driver properly, connecting CD drivers, stepper motor and servo motor driver shield. A laser or a pen is also added which will help us in the process of engraving.

For laser engraving, the pen is replaced with the laser which will perform engraving operations for engraving logos and trademarks [1]
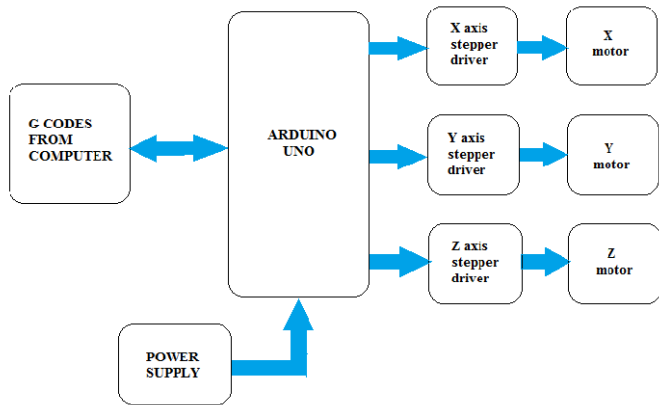

Fig.1 CNC plotter

B. Software processing and Engraving.

For the software part, we use arduino programming and inkscape software. The arduino will read the inputs given to it and convert into an output that is activating a motor while the inksacpe software is a graphics editor which we use to create border and convert image or text into g code files and hence save our g code files. We need to convert this images and texts into codes so that our machine understands. Whenever a code is uploaded, the arduino commands the motors to operate. With the help of stepper drivers, the stepper motor starts working and moving along axis. The laser is connected with the help of a laser screw. This screw helps in the movement of the laser along the axis X,Y or Z. In this way, the laser will start working that is it can start engraving by burning or evaporating the material. During the process of laser engraving, the laser impinges on the material which creates a great amount of heat. This heat can change the colour, create a contrast depending upon the amount of time of heat or the exposure. Hence burning or evaporating the material [7]

IV. DESCRIPTION OF UNIT

1. Power supply:

It is a component which converts one type of electrical energy to other like mechanical or chemical energy into electrical energy. At least one electric load can be operated using power supply. For example, a computer is a device which converts AC power to several DC voltages.

2. Stepper motor:

Fig. 2 Stepper motor

A stepper motor is a synchronous, brushless motor which divides full rotation in number of steps. An electromechanical device which converts electrical energy to mechanical energy is called stepper motor. As long as the motor is sized to application, the position of motor can be controlled without any feedback mechanism. Generally, stepper motors are DC motors which have multiple coils moving in discrete steps.

3. Servo motor:

Fig. 3 Servo motor

A servo motor is a device which allows precise control on the moments like push or rotate. It is a device which operates through servo mechanism. By using servo motor we can rotate an object to desired angles or distance. Servo motor, because of these features is used in many applications like robotics or automated manufacturing.

4. G-codes:

G-codes are used to command any computerized machine how to perform a specific task like simple moves or functions like drilling. Each G-code has a group number each group has commands for specific subject.

5. Ardiuno uno:

Fig. 4 Arduino Uno

It is a microcontroller based on microchip ATmega328P microcontroller. It can be used to interface many shields (boards) and various circuits as it has 14 digital and 6 analog input/output pins. These pins can be programmed using Arduino IDE with USB cable. Arduino provides with the facility of communication with computer or other arduino board where ATmega328P is used for serial communication.

Features of Arduino
A. Microcontroller ATmega 328
B. Operating Voltage5V
C. Input Voltage7-9V
D. Digital I/O Pins 14(of which 6 provide PWM output)
E. Analog Input Pins 8(of which 4 are broken out onto pins)
F. DC Current per I/OPin40mA
G. Flash Memory 32 KB (2K Bused by boot loader)
H. SRAM 2 KB
I. EEPROM 1 KB
J. Clock Speed 16 MHz

6. X-Y-Z axis stepper drivers:
These stepper drivers are used to control the movement over X, Y and Z axis. In X direction the stepper motor will move left and right in Y direction the stepper motor will move front and back and in Z direction the stepper motor will move up and down. These are easy-to-use stepper drivers which are mounted on the arduino. By using these drivers stepper motor current can be controlled. The stepper driver will rotate the lead screw which in turn will control the movement of pen/laser.

7. Laser:
Here the laser used is Focusable Laser Module 200-250 mW 650 nm. The outer metal housing work as a Heat sink for the laser diode. It has focusable lens for the adjustment of laser dot. The laser wire terminal is connected to the laser socket on the driver board.

V. ADVANTAGES
➢ For drawing blueprints on paper surface.
➢ Creating complex designs.
➢ Engraving complex designs on metal or wooden surfaces
➢ To replace human labor.
➢ To increase machine work.
➢ To increase the speed of operation
➢ Negligible proportion of defective items.
➢ Material efficiency – waste minimization.
➢ Flexibility and efficiency of production.
➢ Energy efficiency.
➢ Ability to use shorter production cycles.
➢ Automation and independence of the production process.
➢ Ease of use and manufacture of devices.
➢ Versatility – anything in a form of picture.
➢ Possibility of machining of a variety of materials.
➢ Quick change in manufactured product /design.

A. Laser engraver: By replacing the pen with laser machine we can perform laser engraving operations for engraving different logo, trademarks, benchmarks etc.
B. 3 Dimensional Printing: By replacing the pen with 3 D extrusion pen, we can perform 3 D modeling which is the fastest growing technology.
C. Laser cutter: Instead of using pen laser cutters can be used for high precision machining operations.
D. Milling operations: Different milling operations such as slotting, grooving etc. can be performed provided with over arm and arbor [5].

VI. CONCLUSION
In this project, a small scale CNC Plotter with laser engraver is designed and analyzed. The Special Application CNC engraving machine based on Arduino is designed. The Arduino based CNC machine has 3 axis motions which communicates with the Arduino board which in turn drives the stepper motor drivers which run the stepper motor. The motor load calculations were done on no load condition and suitable allowance for machining is provided. This system functioning on G-codes and Arduino as its brain is possible to engrave complex images and designs on any kind of surface [1]

VII. REFERENCES
[1] Udit Pandey, Swapnil Raj Sharma, "Model and Fabrication of CNC Plotter Machine", International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 6, Issue 6, June 2017.

[2] Harsh B. Panchal, Mayur S. VAJA, Priyanka D. Patel, Uday N. Padia, "ARDUINO BASED CNC MACHINE", International Journal of Research In Science & Engineering Special Issue 7-ICEMTE March 2017.

[3] Aneeta Pinhiero, Beljo Jose, Tinsemon Chacko, Nazim TN, "Mini CNC Plotter", INTERNATIONAL JOURNAL OFINNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING Vol. 4, Issue 4, April 2016.

[4] Kajal J. Madekar, Kranti R. Nanaware, Pooja R. Phadtare, Vikash S. Mane, "Automatic mini CNC machine for PCB drawing and drilling" International Research Journal of Engineering and Technology (IRJET), Volume: 03; Issue: 02; Page No. 1106-1110; 2016.

[5] James Floyd Kelly, Patrick Hood-Daniel, Build your won CNC machine (The United States of America, Paul Manning, 2009)

[6] Advertisement. Home Improvement Made Easy with New Lower Prices | Improve & Repair with The Home Depot. Web. 25 Apr. 2011. htt://www.homedepot.com.

[7] ATmega48A/48PA/88A/88PA/168A/168 PA/328/328P Datasheet, Atmel Corporation, Aug. 2010, http://www.atmel.com/dyn/resources/prod_documents/doc8271.pdf.

[8] Closed, Soldering Sj2. "Easy Driver Stepper Motor Driver." SchmalzHaus.com Brian SchmalzHomepage. Web. 08 Apr. 2011. http://www.schmalzhaus.com/EasyDri ver.

[9] CNC Machine Manufacturers. Photograph. Review about CNC Machine. Web. 25 Apr.2011. http://www.cncmachine-details.info/cnc-machinemanufacturers.html.

[10] "Design Fundamentals for Phototransistor Circuits." Fairchild Semiconductor, 30 Apr. 2002. Web. 25Apr. 2011. https://www.fairchildsemi.com/application-notes/AN/AN-3005.pdf.