Design & Fabrication of 2-D CNC Machine

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Abstract- *A 2-D CNC machine is very similar concept of CNC milling machine. In this tool paths are controlled via computer numerical control. The aim of this project is used to reduce cost and complexity of machine. This project deals with the design of automatic CNC machine for drilling, wood engraving and cutting. This work is relate with the design and development of Control unit comprising of the Arduino as the core element in controlling the motion in X, Y direction of the Computer Numerical Control machine. Three unipolar stepper motors are used for controlling the machine axes.*

Keywords- Design, Evaluation, Electrical system, Manufacturing, Mechanical structure, Software system.

I. INTRODUCTION

It has been observed that, the manufacturing of the parts for CNC machine do not exist. The fact for not manufacturing here is that it contains the programming, which is much difficult to update and organize the required programs being used in carving machines. Assembling consists of collecting the manufactured parts, making their synchronization, observing the space requirements for the setup and running the setup according to the required output.

As the programming make the machines, reliable and proficient in their tasks, for major organizations and even for the single buyer. Parts can be worked out and can be observed as the perfect required parts after their machining at CNC cutting, drilling, reaming, milling and Lathe machines. Mostly the CNC machines are made for just single use because these apparatuses are unable to get change in working head parts. Depending upon the fact, that how the design is precise, these machines run with slightly higher speeds to make the surface more finish. Because of very high cost, these machines have become difficult to purchase for the local workshops or markets. In the same way, these can't reach to the small growing units of the market too.

On the base of its important components, CNC machine can be designed and manufactured, like, supporting plates, ball screw, stepper motor, head style and guide rail system. Another design has also been proposed by the James et al., (2010) which is much similar to this design. The project was designed, manufactured and analyzed in order to make its cost little lower than the units being used before. The CNC machine which was designed here in this work, was made for just 650$ whereas, if it is imported from abroad, then it costs as 1600$ minimum.

All of the CNC carving machines consisted of three basic systems and these basic systems were again subdivided into their subsystems. The most important system was consisted of Mechanical structure. After that electrical system was made considering the electrical parts. Last but not least, the important for CNC was software control system. Each system needed to be designed precisely for this machine. Railing system was analyzed and synchronized with the other parts which were needed to join with it. The bearing and shaft assembly was chosen according to the standards keeping in view the load of the system on the rails. The movement was made smoother on the rails. The most important factor in order to design the rails was analyzing the deflection due to applied load.

Ball screw mostly uses the ball bearings in order to get the better movement in threads of nuts and screws. This provides the smooth movement, frictionless support and better rolling contact. Small ball screws are intended to use the large number of ball circuits for proper distribution of load and to improve the efficiency of work being done by CNC carving machine. For the working of CNC carving machine, it was necessary to design the part which was needed. This part could be made on solidworks, Autocad, ProEngineer, or ANSYS.

the drill bits as the cutting tools, and it had some provisions to change the tool and head style. In order to get the more precise cutting and other operations, router was designed as per demand for the work. Efficient routing system is must for the handling of the tool (Broun, Jeremy, 1989). CNC carving machine used the drill bits as the cutting tools, and it had some provisions to change the tool and head style.

II. OBJECTIVES

The main purpose of this project is to develop a low cost automatic mini CNC carving machine for drilling,wood engraving and glass cutting. This system reduces the cost of machine and increases the flexibility.

III. METHODOLOGY

The G code is interfaced with Arduino CNC based controller by GRBL module which is used to convert the code inconvenient controller code i.e serial to USB converter. Hence it acts like interfacing module between PC to Controller.This code is further passed to stepper motor by easy drivers which converts the code and as per instructions the steppermotor moves. We need three axis X,Y,Z which operates as follows X stepper motor move left and right Y steppermotor moves front and back and Z stepper motor up and down as pe the given dimension this axis will move on.
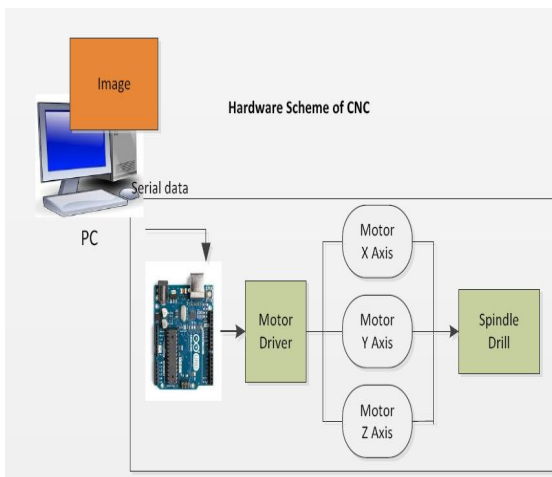
IV. DESIGN

Mechanical Design:

The main tools in mechanical design consist of multiplex board, the stepper motor, linear bearing, ball bearing, linear shaft, leadcrew and nut, coupling beam, power supply and the spindle drill.

Fig: Actual Design of CNC Machine

Electronic Design

V. COMPONENTS

Stepper motor & Accessories:

It's a combination of stepper motor drive connected with GT2 pulley with Grub screw that is mechanical linear bar and linear bearings that drives rotational motion into liner motion with minimum friction. The Traveling bar dimensions 4mm X 250 mm for the Y-Axis and 3 mm X 184 mm for the X-Axis.Geared Stepper Motor with 1:30, 12V. The stepper motor as represented in Fig have 1/30 step angle and the speed is directly proportional to the pulse frequency where it stands of the higher the output voltage from the easy driver the more level of torque drive. Microcontroller Board: Uno r3 it's an Arduino Board it's selected to be the control unit in this project, which it's used as a motion control board. The Arduino Uno is a microcontroller board based on the AT mega328 as shown in Fig. 3. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a powerjack, an ICSP header, and a reset button. It contains everything that needed to support the microcontroller; simply connect itto a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.
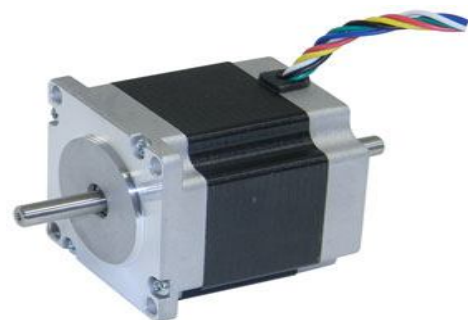

Fig: Stepper Motor

Power Supply:

12V SMPS (Switch mode Power Supply) is used for stepper motor driver. 2V SMPS is used to power the microcontroller board (Arduino Uno3). The microcontroller is flashed with GCODE interpreter firmware written in optimized 'C' language.

Fig: Arduino

Stepper Motor Drivers:

It is kind of driver that receive steps signal from microcontroller and convert it into voltage electrical signals that turn the motor. This driver is called l298n Driver V4.5 as shown in Figure that required 6V – 30V supply to power the motor which can power any type of step motor.
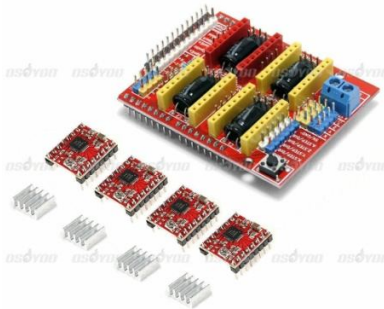

Fig: Stepper Driver

SPECIFICATION

Table size : 500×500×700mm
Microcontroller : Arduino uno R3
Drivers : DRV 8825
Command : G code
Work holding : by fixture
Motors : stepper motor (nema 23)
X,y,z transmission mode : threaded rod linear motion
Spindle : 550 W
Spindle speed : 33000rpm
Diameter of cutter : 3mm – 10mm

VII. FUTURESCOPE

The machine can be replaced by a laser to make it work like a laser engraving or cutting machine. Engraving machine can be used on wood. The pen can also be replaced with a powerful drill so that it can be used for both milling and drilling purposes. The servo motor can be replaced with a stepper motor and the pen with a 3-D pen to make it a 3-D printer which can print objects with dimensions. By extrapolation of the axes, the working area of the machine can be extended keeping the algorithm unaltered.

VIII. CONCLUSION

cncis a computer numerical control machine , it is a form of programmable automation drill drawings on wood which use g coding consist of three motors and their drivers and pic with its basic circuit and body made of wood hold on motors and drill and the wood we want to draw on it.We tried to make cheap fast safety cnc machine that drill on the wood piece according to any drawing we draw to it.

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