CNC Router Design

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***Abstract*-Computer numerical control is a process in which computer made programs or designs are converted into numbers. This machine basically can be used for automation of processes or operations like drilling, cutting, carving etc. These operations can be done on various materials like metal, wood , acrylic, foam etc. The main aim of using a cnc machine is to get high efficiency, reliability, speed and time consumption of the operations. Machine is powered by Arduino UNO which is based on ATmega 328p. CNC Router has a large working space and it is also a cost efficient product.**

***Keywords*- CNC, Arduino UNO, G-code, Design, Nema17**

I. INTRODUCTION

Computer numerical control is basically automation of various kinds of machine using different softwares. Nowadays computer numerical control machines are widely used in industrial sector due to its efficiency, accuracy and precision[1]. But if cnc machines are needed on a more domestic level its cost is higher therefore for keeping the cost of the machine as low as possible, major changes are needed in the designing and construction of the machine. This cnc router machine is flexible and allow different kinds of operations like cutting, carving, and drilling of various materials[2]. Different types of rotary tools can be used for different kinds of operations. For cutting down the cost of the machine, wood is used in place of metal for the construction of model of the machine[3]. This also results in reduction of weight as well as the cost of the machine.

II. COMPONENTS USED

1] ARDUINO UNO

Arduinouno is the microcontroller which is the main processing unit which works on atmega 328p.

Figure 1 Arduino UNO

2] NEMA17 STEPPER MOTOR

Three motors are used individually for movement along the three axis

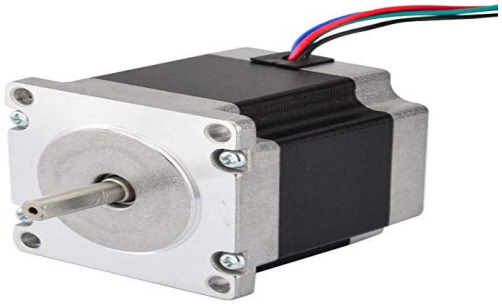

Figure 2 Nema17 stepper motor

3] MEDIUM DENSITY FIBERWOOD

MDF wood is used for the construction of the model

Figure 3 MDF wood

4] 608Z BEARINGS

These bearings are used for allowing linear movement in all the three axis directions.

Figure 4 608Z Bearing

5] ALUMINIUM ANGLE

Four bearings are drilled in the aluminium angle for smooth rolling of the bearing along the pipes.

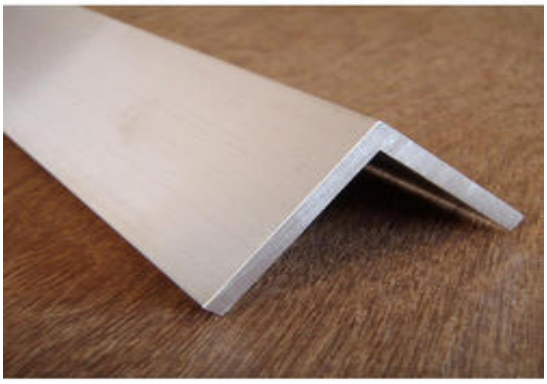

Figure 5 Aluminium angle

6] GALVANIZED PIPE

Pipes are responsible for holding the machine together and also acts as the rail for the movement.

Figure 6 Galvanized pipe

7] THREADED ROD

Threaded rods are used for stabilization of the machine as well as the movement along the 3 axes

Figure 7 Threaded rod

8] NUT BOLT

It is basically used for fastening many parts together.

Figure 8 Nut bolt

9] POWER SUPPLY

A power supply of 24 volts and 5 amperes is provided.

Figure 9 Power supply

10] CNC SHIELD

CNC shield is used to control the stepper motors according to the instructions provided.

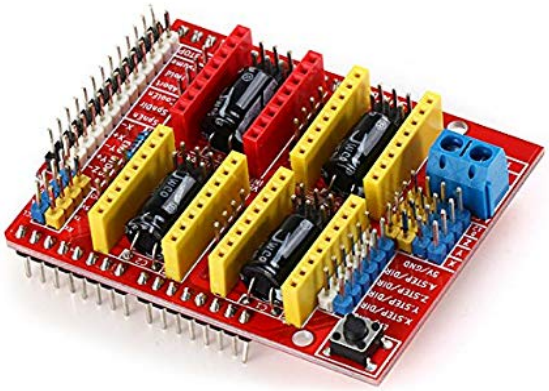

Figure 10 CNC Shield

11] ROTARY TOOLS

It is a tool that consists of rotary tips that can include variety of attachment for different operations.

Figure 11 Rotary tools

III. DESIGN DESCRIPTION

This CNC machine is constructed using medium design fiber wooden material therefore it is quite stable and very light weight when compared to metal. Three nema17 motors are used for three different axis . These nema motors are attached with the wood using nuts and 3d printed parts for its stabilization. Y-axis of the model is in horizontal direction. Z-axis is in vertical direction and X-axis is in perpendicular to both x and y axis.The galvanized pipes are both used as rails and for holding the machine together. The pipes are fixed in holes drilled in the wooden pieces to hold their position. The holes are drilled approximately half way through the wood (i.e. 8 mm) and a center hole of 8 mm is drilled for the threaded rod. The Threaded rods are situated inside the pipes, holding the machine together and also for tightening the pipes. The aluminum angles are kept and fixed in the wooden pieces, where a 1 mm deep carving is done in order to fix the aluminium angles. Using of wood for the construction of the model makes the machine comparatively easily mobile and also reduces the complexity.

IV. WORKING

Power supply is the most crucial and necessary part of the CNC system which converts the AC voltage to DC Voltage and supplies required voltages to the different devices. Microcontroller Board receives 12v supply where as the stepper motor board receives 24v. Atmega328p Arduino based microcontroller development board is chosen here to control the motion of the system[1]. It acts as the mind of the CNC system which receives the commands from the softwares from computer connected through the USB serial port. Arduino development board is flashed with the GCODE interpretor code. It generates the control signal for the command signal from the computer system to the stepper motors which directly controls the motion of the tool path in different directions[2]. The commands software are received and converted to the electronic signals to the Stepper Motor Driver Board. GRBL shield is micro-stepping drive designed for smooth and quiet operation is chosen to drive the NEMA 17 stepper motor[1]. Three NEMA 17 motors are being used for x, y, z axis respectively[3]. Rotary tool is being mounted along the z-axis.which is responsible for carving, cutting, drilling, etc of material.

V. ADVANTAGES

1. Light weight when compared to metal made machines
2. Simple design
3. Easy replacement of parts
4. Stable working

VI. PROBLEM FACED AND SOLUTION

Due to the whole weight of the entire model, there was problem faced in the movement of the machine in the Y-axis. So we removed the bearing which was placed initially inside the hole and then replaced it outside of the Y-axis. Compatibility problem with universal G code sender, inkskape software; so we replaced them by Easel and GRBL controller software which are open source and easy to use.Working on the hard wood was not an easy task so we carved the design on the soft wood as shown in the above figure.Due to the high torque it was very difficult to hold the threaded rod with coupling and nema 17 motor. So we fixed the threaded rod and coupling with araldite for smooth motion of the axis.Nema 17 shaft and U bolt were comparatively longer than the requirement so we cut them for the proper alignment.

VII. FINAL DESIGN

The designing and construction of the CNC router is successfully implemented

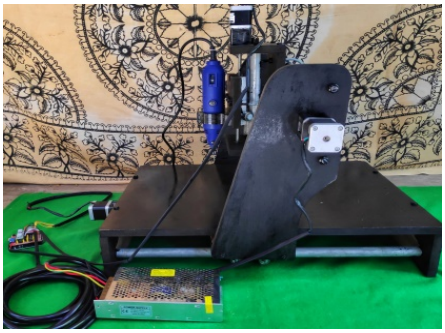

Figure 12 Side view

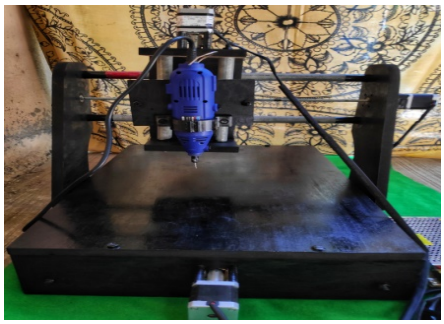

Figure 13 Front view

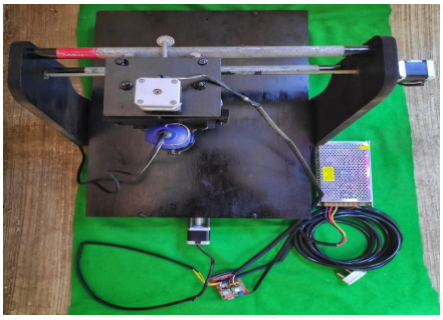

Figure 14 Top view

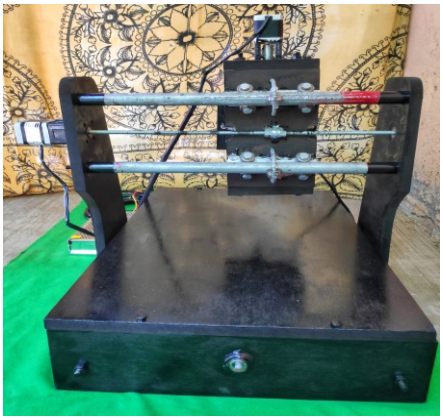

Figure 15 Back view

VIII. RESULT

Following is the output produced on using the CNC router using software called grblcontrol. A SVG format image is given as an input to the software and the output is produced in accordance with the design.

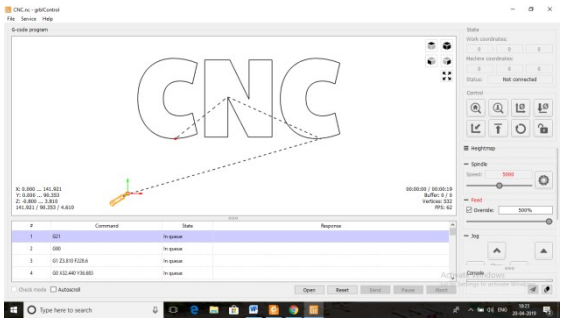

Figure 16 GRBL controller

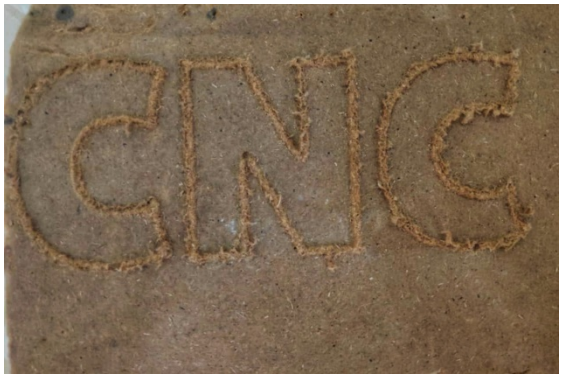

Figure 17 Output

IX. CONCLUSION

The structuring and designing of the model is done in such a way that operating on this machine is very simple for the user having very less knowledge about the machine. One of the most important aspect of any machine is how versatile it can be therefore this machine can operate under different circumstances according to the type of operations required to be done. Different kinds of rotary tools can be attached to the cnc router for different kind of operations. The machine is easily movable as it is light weight due to the use of wood for making the structure of the machine.

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