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CNC Router

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Abstract: *Computer numerical control is basically a conversion of designs produced by computer aided design into numbers. This machine is mainly used for engraving, cutting and drilling on materials such as wood, metal, acrylic and PCB objects. The idea behind this machine is that it should be cheap and reduce the working complexity. GRBL is used for running the machine which is an open source and runs on Arduino UNO. It has a work area of 270 × 430 × 100 mm (X, Y, Z) which is reasonably a good working space . The use of Arduino UNO makes this machine cost efficient without limiting the features and overall performance along with high accuracy of design.*

Keywords: *CNC, Arduino UNO, G-code, GRBL.*

I. Introduction

CNC stands for Computer/computerised Numerical Control. Inclusion of CNC machines for the manufacturing of products results in overcoming the limitations or the drawbacks found in manually operated drill machines. It gives higher accuracy, precision, speed, productivity, flexibility and efficiency. The CNC machine provides more adaptability and computational ability. Although the main disadvantage of using a CNC machine is the higher initial expense[1]. Therefore the main challenge is to develop a CNC machine with a good performance and at lower cost. This machine can be used to produce 3 dimensional objects with various designs on materials like wood, metal. The machines which can work normally on CNC are Lathe machine, Milling machine, Drill machine[2]. Other conventional machines which are used manually are handled by experts who are very highly skilled. They have to concentrate very hard and be very precise to develop the material of the specific shape and size required. On the other hand CNC machine is a self-operating machine which only needs to be initiated by the user and the rest of the process and working is done by the machine[3]. The CNC machines are controlled by programming codes called G-codes. The G-codes can be created physically produced. The machine is calibrated before sending the G-codes through the universal G-code sending software. The movement of the machine on the three axes is controlled by the controller and the required design is produced.

II. Block Diagram

The ATmega 328p microcontroller is used as a main controlling unit. GRBL shield helps as a interface between stepper motors and controlling unit. According to instructions provided by the software the rotary tools performs required motion in 3 axes simultaneously.

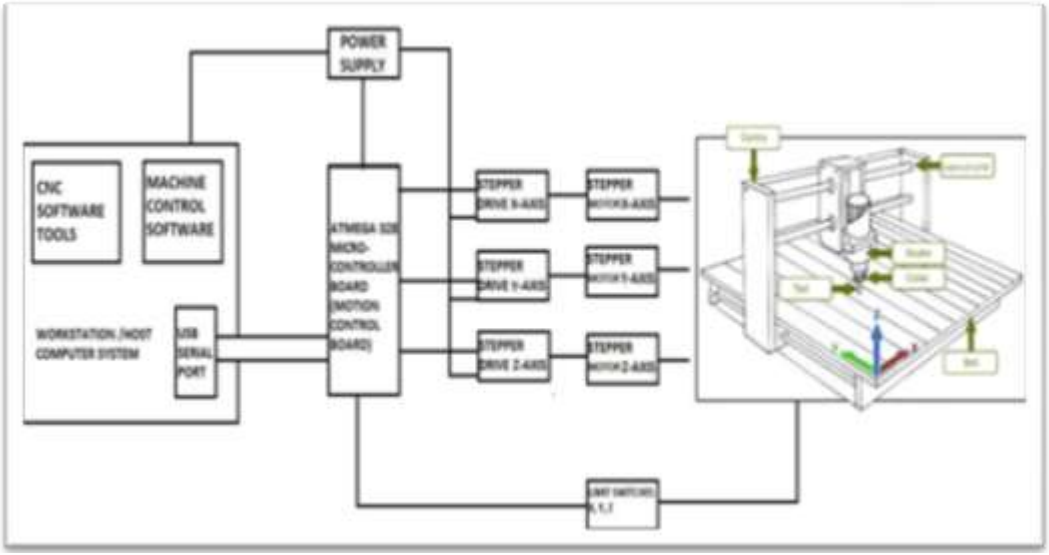

Fig 1: Block diagram of CNC Router

III. Hardware Component

A. ARDUINO UNO:

Arduinouno is a microcontroller which provides a number of facilities for communicating with the computer. An ATmega 16U2 on the board channels the serial communication and appears as a virtual com port to software on the computer. A Software Serial library allows serial communication on any of the Uno's digital pins.

Fig 2: Arduino UNO

B. STEPPER MOTOR:

A stepper motor is a DC motor that divides a complete rotation into a number of segments equally divided. When it comes to powering a CNC machine, the heart of the machine relies in the motor. This machines time needed for completion of operation depends on the type of the stepper motor used. Stepper motors are low cost, versatile and reliable.

Fig 3: Stepper motor

C. A4988 STEPPER MOTOR DRIVER:

The A4988 is a motor driver having a translator which helps in ease of working. It is used for protection in case of excess current or excess temperature.

Fig 4:A4988 Stepper motor driver

D. GRBL SHIELD:

It is a shield for Arduino that fits over the Arduinouno/mega board and can be used to drive **a** CNCmachine. It is done by using the GRBL CNC firmware.

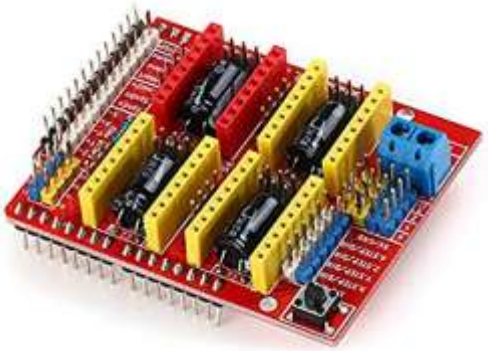

Fig 5: GRBL Shield

E. POWER SUPPLY:

A power supply of rating 24 volts/5 amps is used to run the machine.

Fig 6: Power supply

IV. System Working

The design of the product to be produced which is to be engraved on wood or metal is designed using inkscape. G-codes are generated from the input given to the computer. These G-codes are to be send to the CNC machine. Before sending these G-codes, the machine needs to be calibrated. The machine is then calibrated in accordance with the design given by the inkscape. In order to send the G-codes to the machine, a software is specifically used. The software used for this purpose is universal G-code sender. ATMEGA-328P is being used as a controlling unit .The NEMA 17 motor is being used which is controlled with the help of arduinouno. Three NEMA 17 motors are used along the 3-axes (x, y, z direction). GRBL shield acts as an interface between arduino and G code sender. This code is then sent to stepper motor by universal G-code sender which converts the code and the stepper motor moves according to the given instruction[1].

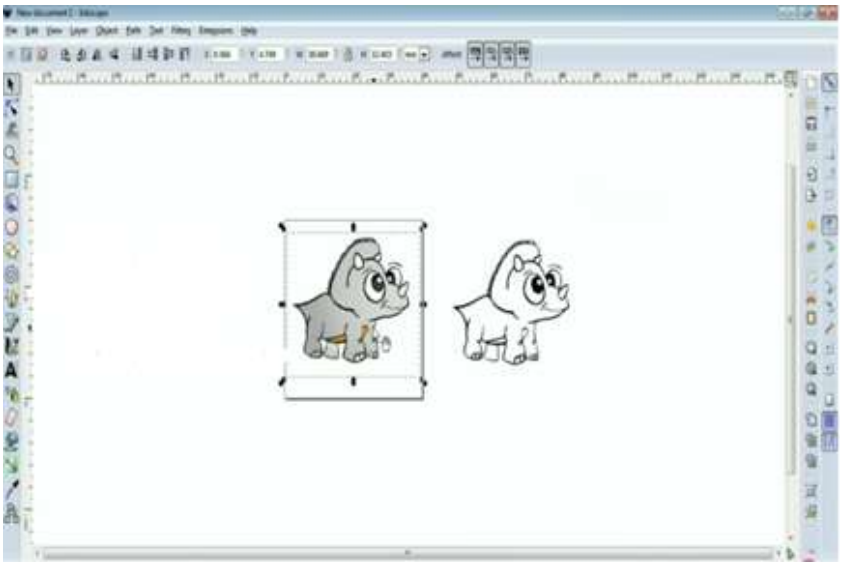

Fig 7: Inkscape

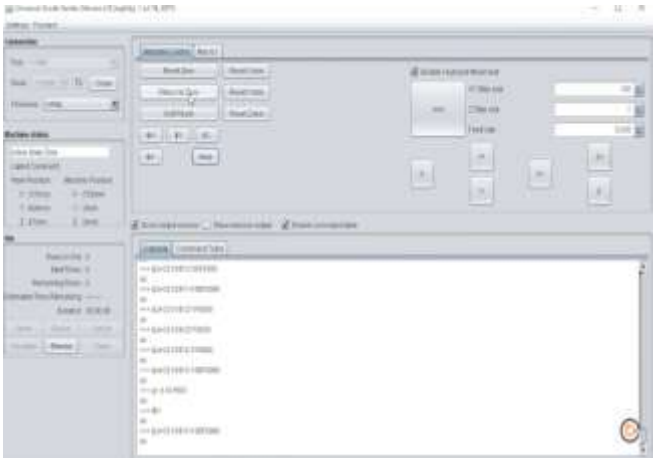

Fig 8: Universal G-code sender

V. Working Model

Model is successfully constructed and implemented according to the design.

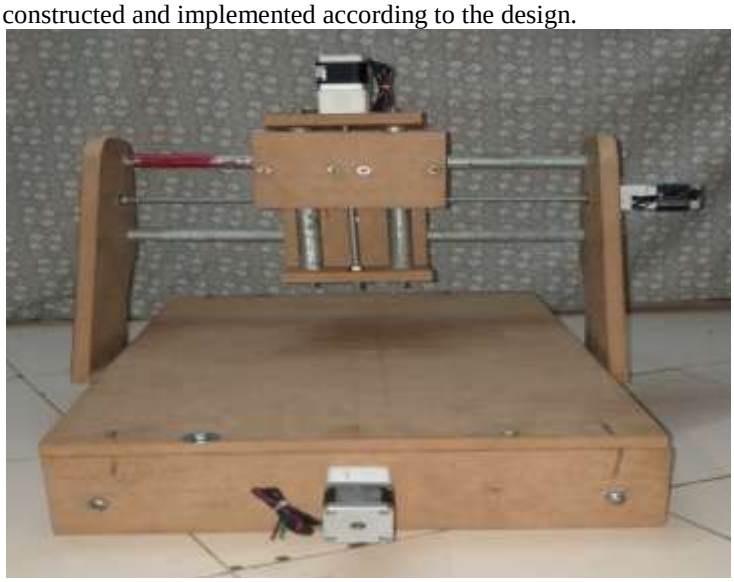

Fig 9: Front view

Fig 10: Back view

VI. Advantages

It is highly accurate which means there are least errors involved. It is light weight therefore easily movable. Replacement of parts is convenient in case of any faults. The design of the machine is very simplistic. The G-codes are produced easily by software called Inkscape. It doesn't require skilled workers for handling the machine. Overall it provides with many features but mostly importantly at a very low cost [2].

VII. Applications

1] Carving of materials like wood and metal.
2] For making of sign boards
3] Drilling
4] Interior and exterior decorations

VIII. Conclusion

Overall this is a machine with lots of features like cutting, engraving, and drilling with a lot of precision at a low cost. Versatility of this machine is good as the tools used for operating various tasks can be changed according to the output required. This machine is highly precise and doesn't involve errors in the output product. Softwares such as inkscape and universal g-code sender are used to generate and send the g-codes respectively. No skilled individual is necessarily needed to work on this machine. The structure of the machine is designed in such a way that working on this machine is very easy for the user.

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