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Research Article

3 AXIS MULTITOOL CNC MACHINE

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ABSTRACT

The usage and utilization of CNC machine in industries are increased due to the rapid growth of technology. The fabrication of low cost CNC machine is used to reduce cost and complexity of machine. This paper discusses the design and development of 3 axis multitool CNC machine. The idea is to design a low cost multitool CNC system. The low cost is achieved by incorporating features of computer with ATMEGA 328 controller in an arduino. We have used an G code for the system operation. This paper also aims to improve production in order to decrease the production time and also to increase the efficiency in CNC machines by writing the program.

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INTRODUCTION

In recent technology CNC systems with end to end component design is highly automated using CAD tools and CAM processors. This is in contrast to machines that are manually controlled by hand wheels or levers, or mechanically automated. The CNC stands for Computer Numerical Control. The idea behind this project is to make a CNC machine which will draw the layout of a circuit on the PCB (Printed Circuit Board). It uses three stepper motors as linear actuators on each axis X, Y and Z. The most challenging task while drawing the layout is the proper synchronization of all three axes. Motion is controlled along multiple axes, normally at least two (X and Y), and a tool spindle that moves in the Z (depth). The position of the tool is driven by direct-drive stepper motor or servo motors in order to provide highly accurate movements, or in older designs, motors through a series of step down gears.

Objective

To design a low cost multitool CNC machine for PCB drawing and drilling. This system will reduce the cost of machine and increases the flexibility.

In this paper the design of a working prototype 3 axis multitool CNC machine using arduino is presented having specification:

- Low cost
- Easy to operate
- Low power consumption

Hardware Description

Arduino

In this project, we have used Arduino UNO as a control element. We have used the microcontroller Atmega328p on the Arduino board. The Arduino board is connected to the computer via USB cable. It receives the power supply from the computer itself. The output of the universal G code sender is given to the Arduino Software (IDE), through which we can program the Arduino board. Through the Arduino Software (IDE), we load the required program into microcontroller Atmega328p.

CNC Shield, Motor Driver and Stepper Motor

The Arduino board is connected to the CNC shield. To run the stepper motor we often required the large current. But the Arduino board is not capable of providing large current. So to run the stepper motor we required the motor driver. We have used Stepper motor driver A4988 for this purpose. The instructions from the Arduino are fed to the CNC shield. We have connected the three Stepper motor driver A4988 on CNC shield. We have given 24 V external power supply to the CNC shield through adapter. Due to 1 required current production, the large heat is produced. Hence it requires heat sink. We have used three heat sink for three Stepper motor driver A4988.

The output of the each Stepper motor driver A4988 are given to the respective stepper motor. The stepper motor takes one step of 1.8 degree. It requires 200 step for a complete revolution. Due to X axis stepper motor, the wooden board moves front side and backside. Due to Y axis stepper motor, the spindle

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moves left and right. The depth to the spindle is provided by the Z axis stepper motor.

The spindle requires a DC motor for the drilling purpose. We have given 12 V external power supply to the spindle dc motor through adapter. The spindle dc motor is not connected to any system of this CNC machine.

Comparison

In the CNC machine, we have planned to use the LASER gun instead of spindle. The LASER is an acronym for "Light Amplification by Stimulated Emission of Radiation".

By the low intensity LASER gun, it will perform engraving and by high intensity LASER gun, it will perform cutting. By changing the LASER gun, we are able to perform milling, engraving and cutting. Due to this the machine will become multitool machine.

By using LASER gun, the Z axis will not required. Hence due to this the one stepper motor, one stepper motor driver and one heat sink will not required. Also the spindle dc motor will not required and 12 V power supply and adapter will not required. Due to this the system complexity will be reduced. By using drill bit, the machine makes noise while engraving and cutting. This noise will not produce due to LASER gun

METHODOLOGY

In open loop system the machine tool faces the problem of inaccurate machining and undesired positioning. IN our machine we are using a closed loop system so that the position sensor uses correct slide movements and thus achieve higher accuracy with a feedback system. The machine is controlled by G(gerber) and M(machine) code, which are number values and co-ordinates. Each code is assigned to a particular operation.

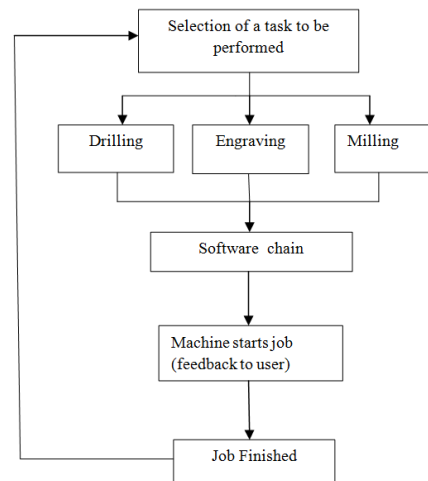
Our tool can operate 3-axis, the three stepper motor(actuator)controls the movement and a feedback is provided by sensors. The design of this project will consist of the three parts as follows:

1. The working of the Spindle will be implemented using LASER gun.
2. At low intensity of the LASER it will perform engraving and at high intensity of the LASER it will perform cutting. Hence in the single device both the task of engraving and cutting will be done simultaneously.
3. The Final stage of the project is to make it wireless, i.e to link the machine with any android mobile using Bluetooth

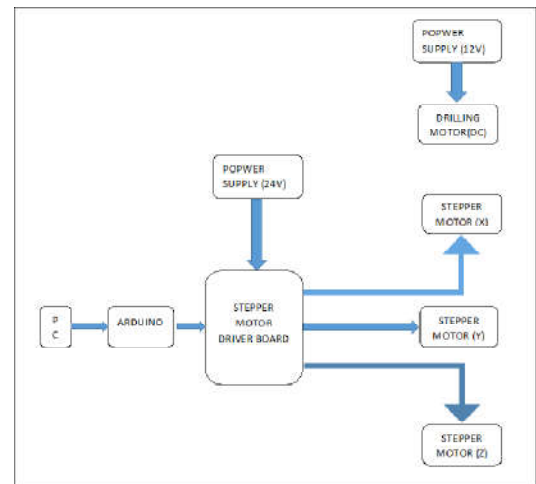
Block Diagram

In this idea of project, Arduino microcontroller platform with ATMEGA 328 core is used.

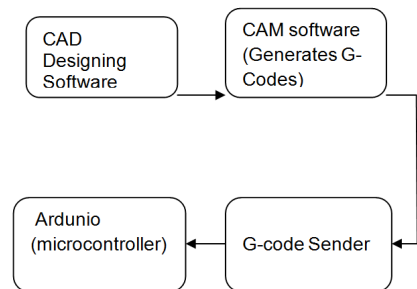
Machine Control



Hardware control



Software Chain



The circuit to be printed is designed on Eagle(CAD) software, whose output is a gerber file in .DXF format. This drawing is then fed to the FLAT-CAM which is a CAM software whose output is G-code in .NC format readable by the machine.

RESULTS

Finally the fabrication of a low cost 3 axis CNC machine considerably gives greater affordability in low budgets with minimum accuracy errors. CNC machine usage gives many benefits of increased productivity and accuracy and time management but the only drawback is its cost.

CONCLUSION

Our project gives greater cost optimization, easy interface, less power consumption.. This setup of hardware with a combination of G-code gives better accuracy and reduces the work load. G code make easy to find the information of locations of all stepper motor moving, as the status of our moving motor are directly seen on computer hence we can start or stop the machine whenever we are needed, Making a small machine brings an flexibility to do work.

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