

3D Axis Automatic PCB Drilling Machine

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Abstract- This Project presents the design of a PCB drilling machine, where the drill holes are detected using G-Code generated using Inkspace software. Aim of this project is to design and implement an Arduino controlled PCB drilling machine. Further the drilling machine uses serial communication to fetch G-Code from Computer.

The Use of Arduino and Stepper motor and it's driving circuitry leads the system more stable and accurate.

I. INTRODUCTION

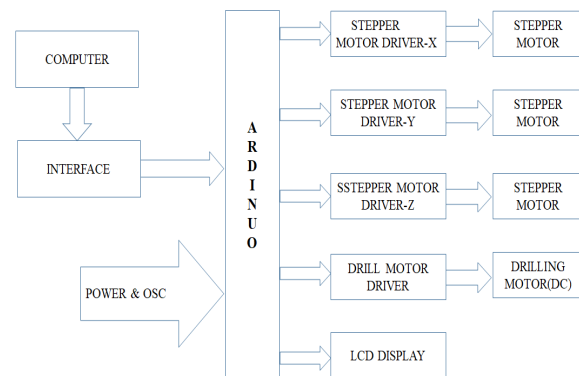
For drilling of holes of PCB which needs both precision and patience. Because of the repetitiveness of the task laborers and particularly the beginners can be lead to countless errors. And the main Problem is the time taken to drill a PCB can have a luminous on the production capability in mass scale production. In Today's world specially in large scale industries the NC and CNC machines are used to in order to drill the PCB hole but such type of machines cannot be preferred by the small scale industries. The Goal of this project is to develop a low cost PCB drilling machine can be used in many applications like the small scale industries and can be helpful to avoid the Workload of human. So such kind of project inspire us to develop low cost drilling machine such that it would provide advantage to the laborers, industries, and beginners from collage level who cannot afford high cost for nominal work. It uses three stepper motors as linear actuators on each axis X, Y & Z. While Drilling, the proper synchronization of all thisthree axis i.e. stepper motors, is mostchallenging task. At present the data to drill is given programmatically i.e. hardcoded in program in binary format. A Drill Bit touches the surface & drills the holefor logic 1 and lifts up in air for logic zero & actuator changes it position for next commands execution. As in future plan, it can use for laser cutting and Printing also.

II. PROBLEM STATEMENT

The PCB is fitted in machine then it is drilled automatically through G-Code. The PC provides X, Y, Z coordinates. And by using the pc software in read the file which is generated by the PCB design software. Another system uses the basic 8051 microcontroller and drilling driver are designed by relays makes system bulky and does not provide high

amount of current in order to drive the motor exactly. The another method uses microcontroller the c programming. The system consist of three 3 stepper motor and one DC motor to control drill. Thus due this the system is complicated and system become instable. The proposed project does not use the path planning method. The G-Code generation algorithm optimizes the use of the inkspace. In this project, the developed software decide the position of the drill hole

III. BLOCK DIAGRAM



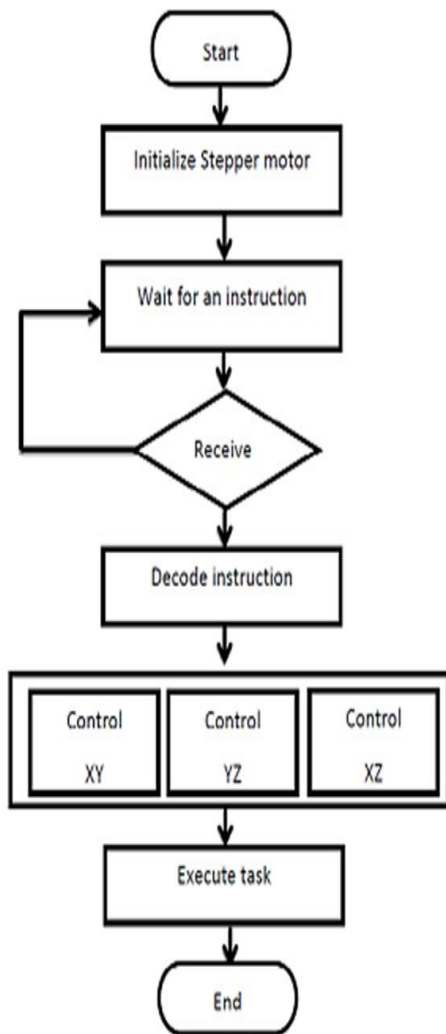
DESCRIPTION

PCBs drilling machine mainly consists of three blocks P.C (for software purpose), Controller Block and the Drilling machine. Computer which has software's like Eagle, FlatCAM, Processing i3 Software for giving directions to the Controller. Arduino Microcontroller is very vital part in controlling the movements' of axis on the drill machine. It also gives orders, when to start drilling and when to stop. There are three stepper motors connected in X, Y and Z axis movement. And they will be controlled or operated by the Atmega328 microcontroller connected to it. Of the three axis, two axis are used to move the PCB platform in x and y directions. And the one remaining that is z axis moves drilling machine in the vertical direction. As the PCB comes at the desired position, the third stepper motor moves the drilling machine along the third z (vertical) axis to drill there. This saves time and reduces errors due to manual handling and also gives much accuracy too. To make graphical sketch of the desired PCB and send all information to the microcontroller through FTDI. To make the .NC file and .GBR file by Using

FlatCAM & Eagle software respectively. And Inkspace Software to generate the G-Code of given pcb board. As we complete the graphical presentation of the PCB layout, the software Inkspace itself creates a .gcode file.

containing all the information about the PCB drilling, hole size, and hole positions on which we are going to make drill. All the data about the point where we have to drill is created in the Inkspace software, this information involves two dimensional details of the point.

FLOWCHART



G CODE FROM PC

G code is nothing but a language in which people tell computerized machine tools ‘How to make something’. The How is defined by instructions on where to move, how fast to move, & through what path to move.

SOFTWARE DESIGN

The design and implementation of these project is divided into two parts hardware design and software design . The main challenges of this project were path planning and obtaining the drill hole coordinates from a PCB layout. We used the Arduino to write the program and the EAGLE PCB layout development software was used to design the PCB schematic. Further we use Inkspace to generate the G-Code and using Processing i3 we sent the code to Arduino.

ELECTRONIC COMPONENT

For this project, the Arduino Uno is used .To control the stepper motor Stepper motor Shiel is used. Arduino Uno is a microcontroller board based on ATmega328.



Fig. Arduino Board

L293D Pin Diagram

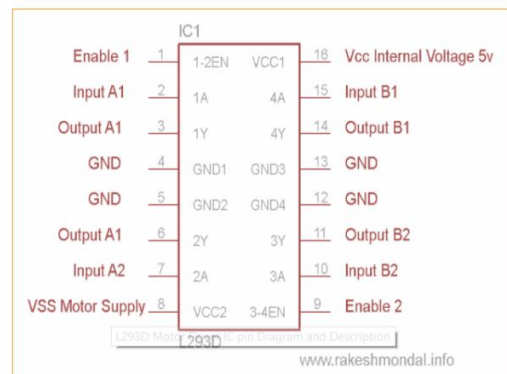
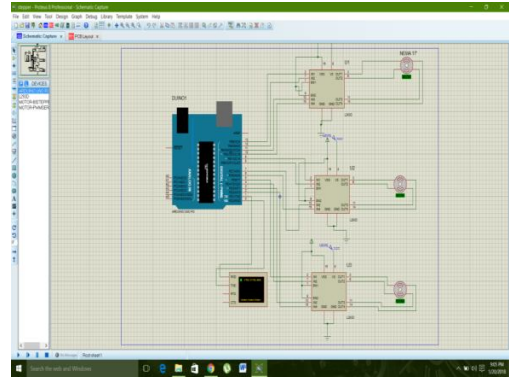


Fig. Stepper motor driver IC



Fig. Arduino Shield for stepper motor



HARDWARE DESIGN

The system is controlled by using Arduino Uno board in order to achieve the control over the movement axis . Several motor drivers are made, two for stepper motor (X- and Y-axis), one for DC motor (Z-axis) and one for the drill. The drivers use optocoupler to isolate the digital system from the analog one.

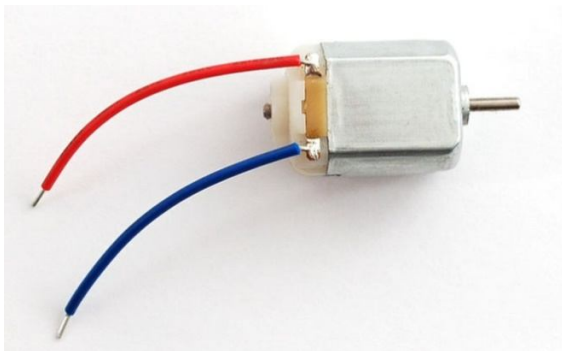


Fig. DC motor

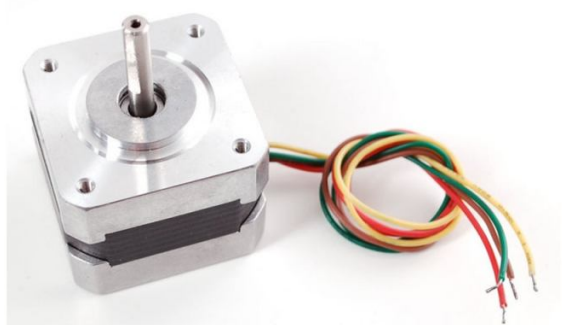
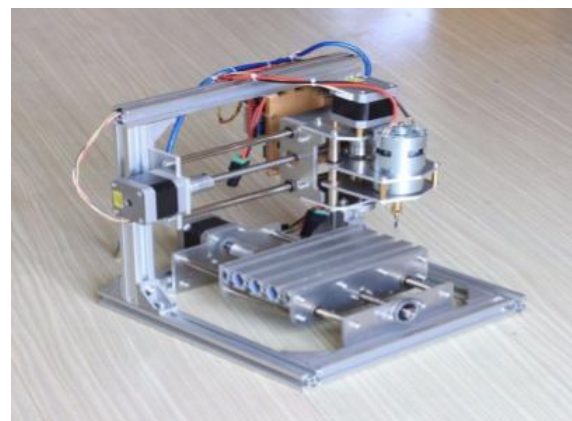


Fig.Nema 17 Stepper motor

The Arduino Uno was chosen rather than other Arduino such as Arduino Diecimila and early Duemilanove because it uses Atmega328 which is suitable to control a stepper motor. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

PROTEUS DESIGN



The machine has been designed with three movement coordinates, X, Y and Z as shown in fig. Hole position consists of X-Y coordinates, and Z coordinate is a parameter to move the drill machine up and down. The drill is moved horizontally to X-Y coordinates of a hole, moved down in Z direction to make the hole, then withdrawn and translated to another place. Drill coordinates are extracted using G-Code and sent to the Arduino Board.

IV. FUTURE SCOPE

The PCB Drilling Machine can be replaced the high cost CNC and NC machines in order to reduce the cost for mass production. Thus by using the path planning the machine drills in a more systematic way. Hence further development can be made in the future in order to achieve more accuracy. In the future,

- ✓ Current system can be improved to reach higher axis speeds.
 - ✓ Variable spindle speed control mechanism can be easily incorporated to the system.
 - ✓ The developed system can be built up for milling PCBs.
 - ✓ Can develop for Laser PCB cutting
 - ✓ PCB Plotting
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V. RESULT

This setup of hardware with a combination of G-Code gives better accuracy and reduce the tolerance. In addition to that the use of Inkspace makes it easy to get the information of holes(position of holes with respect to X , Y, & Z coordinate)

Hence Cost is reduced and system becomes more reliable for beginners and small scale application.

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