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PCB ENGRAVING MACHINE

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ABSTRACT :

There were moments when designing, printing, etching, and drilling took longer than expected when making PCBs. Thus, we are designing this project with less time and effort. The PCB Engraving machine design presented in this paper uses an circuit image in software to automatically determine the layout and drill holes. The overall implementation and structure of an automated PCB engraving machine using any microcontroller are the main topics of this paper. Further to enhance the stability and precision of the machine, the milling machine takes the help of the method called as coordinated measurement machine.

Index Terms—CNC, Arduino UNO, Servo, PCB Milling, G-code, Drill Bits, Drill Chuck

INTRODUCTION:

The manufacturing industry typically uses CNC machines, which use computers to control machine tools. Drilling and milling are among the tools that can be operated in this way. Computer Numerical Control is what the CNC stands for. Here, we present a concept for a CNC bit plotter that uses an Arduino Uno, based on the latest advancements in digital electronics and microcontroller technology—CNC technology. The project's goal is set to develop small CNC machine which can drill and mill on PCB boards. Every CNC machine uses X, Y & Z axes linear actuators, for this linear actuators it makes use of three stepper motors. The accurate alignment of all three axes during printing. The most difficult task is with stepper motors. Currently, the PCB layout data which has to be engraved is given to microcontroller using Universal G-code Sender (UGC) software.[4] A bit lifts up in the air for logic 0 and touches the surface to print the pixel, and the actuator changes its position to execute the next command. It will be able to directly access G-Code from supporting software, such as Scale, in the future. One dimensional (1D) plotter is what is presented. Most people use reasonably-priced strategies like chemical etching that's maximum well-known in small industries to layout PCB circuits, however those strategies lack enough compatibility for surface mount devices (SMDs) and the drilling of holes may be very monotonous because it must be carried out manually. [5-6] In conclusion, the PCB engraving machine project presentedin this report aims to create a powerful and efficient engravingsystem.
Integrating 555 Motor, power supplies, Arduino UNO microcontrollers, CNC Shield module, drill chuck, drill bit, Stepper Motors the system provides clear controland customizability options and security features.

OBJECTIVE

1. To study the previously done research and work on prototyping of CNC machines and PCB drilling machines.
2. To identify CNC machine requirement, appropriate PCB boards for drilling, required
3. To implement software to read PCB layout format files and convert them to CNC readable format.
4. To measure drilling accuracy for different drill bits and making improvements according to it.
5. To compare this PCB engraver with traditional PCB etching methods. Comparing time, cost, efficiency, precision etc. parameters.

LITERATURE SURVEY

We studied various literature materials so it will easy to understand about others' work on various types of milling machines. We found some of the information listed below to be very useful.

- **Prototype CNC machine de-sign:** The generation known as Computer Numerical Control (CNC) aims to develop and carry out sequential action. It makes it possible to develop CNC machines of all sizes, relying mostly on a device that can have conversations through the use of a conversation bus. Additionally, digital devices are needed to operate a CNC device, such as a controller circuit. Lab VIEW software has

been developed to establish communication between the device and the computer. The development of a device that will enable future use for PCB trace designing with more performance than current techniques is the aim of this project. A CNC prototype device was created, with three axes of movement (X, Y, and Z), each measuring 300 mm, 300 mm, and 10 mm, in that order. [1].

- **Automatic mini CNC machine for drawing and drilling:** Software is utilised to connect the G code with an Arduino CNC-based controller and translate it into similar controller instructions. As a result, it serves as an interface module between PC to Controller. Easy Drivers then transfer this code to the stepper motor, which interprets it and moves the stepper motor in accordance with commands. Three axes—X, Y, and Z—are required, and they function as follows: X stepper motor has left and right movement. According to the specified measurements, the Y stepper motor will move forward and backward, and the Z stepper motor will move upward and downward. [2]

- **CNC fabrication and user manual:** Rather than being a paper, this reference is actually a comprehensive user manual that explains how to operate a standard CNC machine for PCB prototyping. It begins with needs and specifications that are comparable to those of the CNC machine that the authors of this paper are developing. The explanation of various software components of PCB design is then followed by a description of the standard and unique techniques employed in CNC machines, like calibrating various critical parts and shifting the tool tip to the origin/soft-home position, to name a few. [3]

- **Prabhanjay Gadhe1, Vikas Jangir 2, Mayur Yede 3, Wasim-Ul-Haq (IRJET):** This configuration can be used in conjunction with Eagle and G-code Arduino software to provide more accurate PCB design and seamless operation. This configuration is meant to shorten the etching and drilling procedures. G-code positions objects based on layout designs so they can move in the right places. You will have to decide when to start and stop the entire process. Making Printed Circuit Boards (PCBs) is made easier and more flexible with the use of an Arduino Uno board. [4].

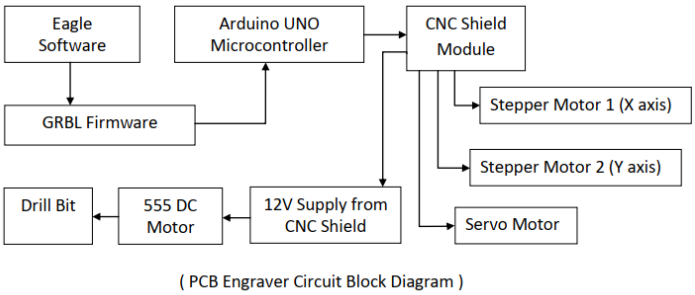
- **Umesh Shinde1, Rahul Somalwar2, Namesh A. Kale3, Ashish J Nandeshwar4 and Antariksh V. Mendhe5 (JREAS):** By maximising the cost of PCB milling using surface mount technology, a cost-effective PCB milling machine is created. The device is built using open source hardware and software that is readily available for purchase, and it can be upgraded and modified to meet changing needs. We can incorporate cutting-edge features like feedback, Internet of Things, human safety, soldering equipment, etc. Additionally, we are able to modify stepper motors to meet specific needs. Additionally, we can upgrade the processor to give the machine extra functions. [5]

IMPLIMENTATION

After studying all this research works we have finalized which technology we are going to used. Required software are identified. Also sorted out how this circuit will be implemented as you can see in fig 1 & fig 2. Below we have listed all the electrical components required and also mechanical tools.

Sr No.	Components	Details	Quantity
1	Stepper Motor 28BYJ-48	4 Kg/cm Torque, 12V	2
2	555 DC Motor	12000 RPM, 12V, 1.2Amps	1
3	Arduino UNO	Atmega328P	1
4	Servo Motor	6v	1
5	CNC Shield		1
6	Power Supply	12v	1
7	Drill Chuck		1
8	Drill Bit	0.5, 0.8, 1, 1.5 mm	4

The Arduino UNO, which powers every function in the system, is its central component. The stepper motor, which is widely recognised for its precise motion with each input pulse., is employed to precisely regulate the 3-axis motion. However, the Arduino Uno microcontroller generates the input signals for the stepper motor.[6] The gantry-mounted, SMPS-powered spindle motor 555 modifies its RPM in response to changes in the operating voltage. The stepper motor, which is powered by a separate source, and the microcontroller communicate with each other through the stepper motor driver. Because the machine was designed using coordinate measurement, as shown in Fig., it was designed with three coordinates: X, Y, and Z. The up and down movement of drilling machine is controlled by Z coordinate, while the X and Y axes are used to move the PCB.[5] Subsequently, it was removed and relocated. Block diagram for circuit is as below:



(PCB Engraver Circuit Block Diagram)

Fig 1. Block Diagram

We are using Eagle Layout Editor to design the PCB. This software offers a platform for designing while taking into account several factors including workspace, material kind, and thickness. The design is converted to G-codes using Ink Space/Universal G-code sender. These G-codes are used by Arduino to activate the stepper motor, resulting in extremely precise milling.

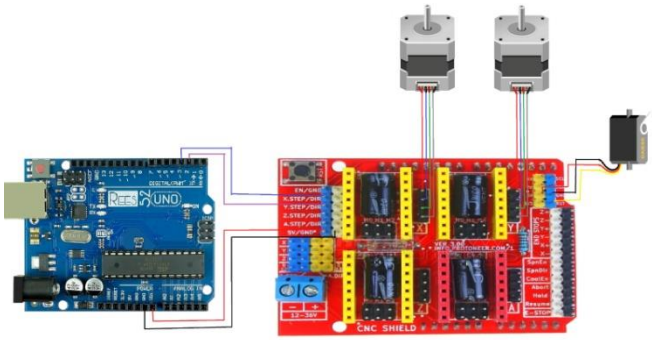


Fig 2. Circuit Diagram

METHODOLOGY:

A range of hardware and software tools specifically designed for three-axis CNC machine control are used for the interface. Eagle Layout Editor is used to send the designed file, and then Ink Space software is used to convert circuit image in G-code. The GBL firmware is required to interpret G-codes because the Arduino UNO is unable to do so on its own. With the Arduino IDE, the G-codes are interpreted by Arduino UNO. The stepper motors used along the X, Y, and Z axes cannot be activated by the output signals sent by the microcontroller. [7] In order to create the actuating signals needed to run steppers motors , a driver of stepper motor known as A4988 is employed. A separate DC power supply that is attached to the stepper motor driver powers the stepper motors that need a high current during the milling operation.

The Arduino UNO and stepper motor driver are connected via PWM pins. On the other hand, the Arduino UNO can receive power via the USB cable, which is also used to load program codes into the device seriallyThe real-time G-codes generated by the designed file supplied to the Arduino UNO drive the stepper motor in line with the predefined path. In proportion to the feed design, this produces the path on the Cartesian plane. The peripheral is now being moved on the proper axis by the stepper motors.[8] The PCB and the required circuit schematic will be milled by a 12000 rpm spindle motor mounted on the Z axis.

RESULT:

Here, we have designed and implemented PCB Engraving machine by using Arduino UNO and G-code generating softwares. Till date this machine is not fully accurate, there is scope to make this PCB engraver more accurate.

Fig. 11. Project Image

CONCULSION :

A cost-efficient PCB milling machine is designed and developed by optimizing the cost for milling of PCB with surface mount technology. The hardware and software used in the machine's construction are freely available commercial products, and it may be upgraded and modified to meet changing needs. We can incorporate cutting-edge features like feedback, Internet of Things, human safety, soldering equipment, etc. Additionally, we are able to modify stepper motors to meet specific needs. In order to provide the machine extra functions, we can also upgrade the processor.

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