# Arduino Based 3 Axis PCB Drilling Machine

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**Abstract – In this paper, an Arduino based 3 axis PCB drilling machine is implemented using Arduino Controller, CNC router and open source software for controlling the whole operation .The main aim of this project is to reduce the time consumed, hard work required and also to reduce the man power. This can be the new invention in the electronics industries which can increase the production rate with greater percent. We can call it as automation also because once you set all the parameter required, the machine will start working without any human interfere.**

**Inspiring from this CNC technology and revolutionary change in the world of digital electronics & Microcontrollers, we are presenting here an idea of "Arduino based 3 axis PCB drilling machine". On basis of PCB drilling machine the stepper motors are interfaced to the Arduino controller. The stepper motors are used to move plate of PCB in X, Y and Z direction.**

**Index Terms – CNC, Arduino Microcontroller.**

## 1. INTRODUCTION

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 , Universal G-Code sender forms the base for giving directions to the Controller Block. Arduino Microcontroller is very vital part in controlling the movements ofaxis 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 xand 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 machinealong 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 UsingFlatCAM& Eagle software respectively.

As we complete the graphical presentation of the PCB layout, the software itself creates a 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 FlatCAM software, this information involves two dimensional details of the point.
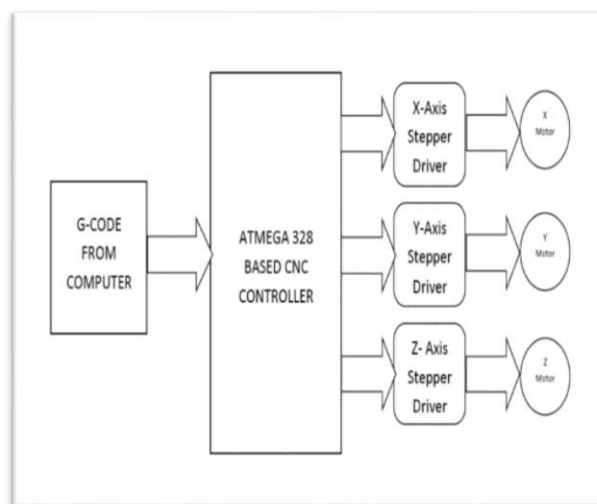
## 2. PROPOSED METHODOLOGY

2.1. Block diagram



Figure 1. Block Diagram

- **Microcontroller ATMEGA 328 :**

    We are using Atmega 328 Microcontroller having a wide range of features.Atmega 328Arduino Development board

is used as the motion control board. Atmega 328 is a 8 bit 28 pin ARM Architecture microcontroller. The microcontroller is flashed with the GCODE interpreter firmware written in optimized C language .Motion control is carried away through output pins connected to the stepper motor drives according to the firmware code in microcontroller.

- **Stepper Motor Driver :**

  Stepper motor driver are used to drive the stepper motor by giving the specified operating voltage. We are using Easy Drivers for driving the stepper motor.

- **Stepper motors :**

  We are using stepper motors of operating voltage of 8-20 V. The aim of stepper motors are to rotate or move the plate of PCB in X and Y direction using a G code.The Stepper motors are interfaced with controller by using Easy Driver

- **FTDI driver:**

  FTDI driver is used to connect the PC to the Microcontroller instead as it is easy to interface

- **Limit switches :**

  A Limit Switch is the simplest type of end stop a simple mechanical switch positioned to trigger when an axis reaches the end of its motion.Limit switches are used to protect the stepper motor. The signal pin from limit switches are connected to the microcontroller board to sense the axes ends.

2.2.  Flow Chart

Fig.2 shows the flow chart of application execution. At start power supply & computer is turn on. After that all stepper motor are initialized to its zero position. This zero position is given through software. The circuit board is ready to accept instructions from computer. These instructions are in the form of G-codes.

It will wait still instructions to be received. After instructions are received, it starts to decode it into its own language that is in voltage & current form. As per instruction, stepper motor move in accordance with it. stepper motormoves according to X-Y Co-ordinates & Z Co-ordinate stepper motor used to drill the hole. Task is completed. Here ends the flow of execution.
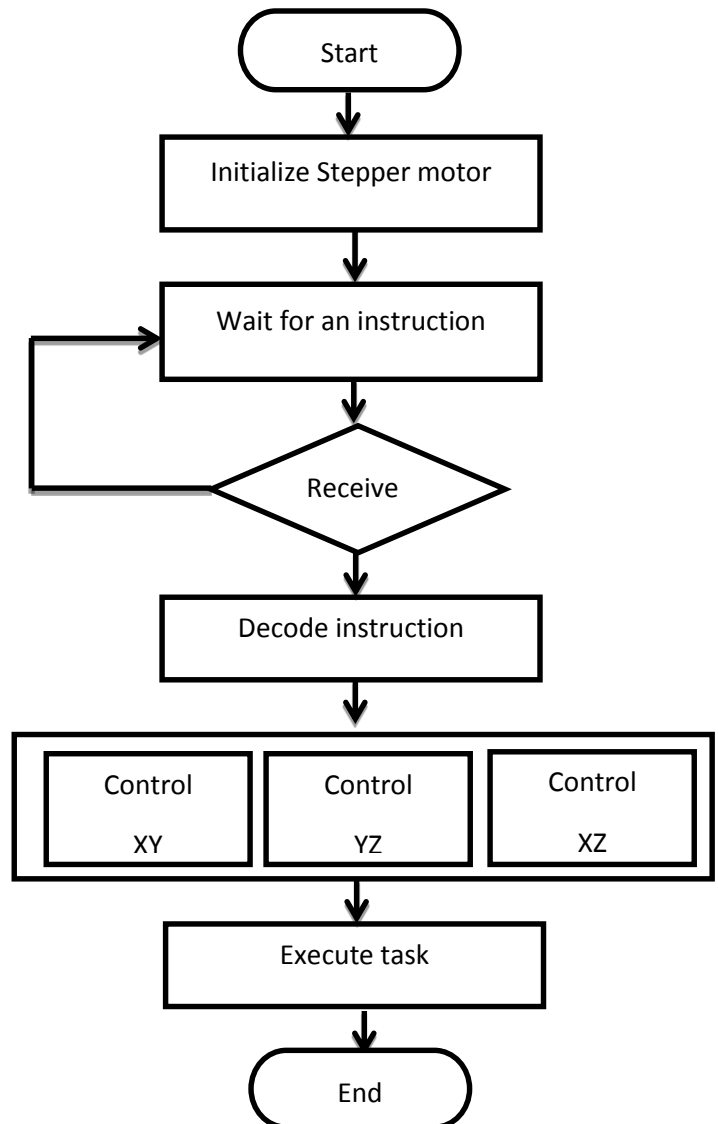


Figure 2 .Flow chart of system
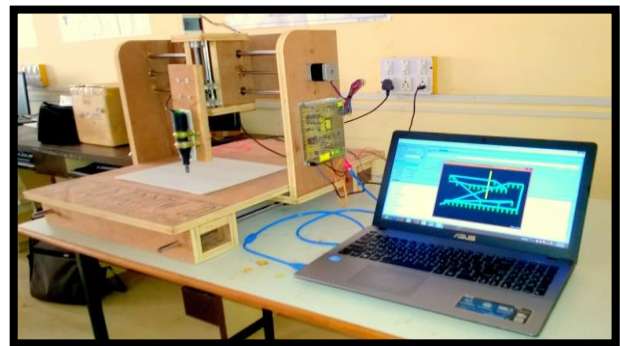
3.  HARDWARE SETUP
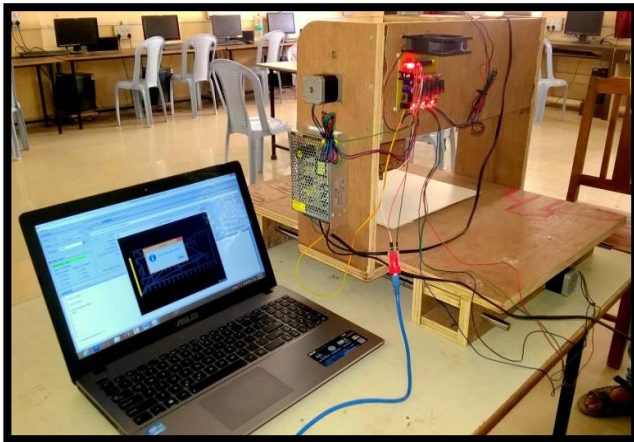


Figure 3 . Hardware Setup

Figure 4 . Electronics Circuit assembly

### 4.  HARDWARE DETAIL

Hardware consist mainly

1. Arduino Uno Controller
2. FTDI driver
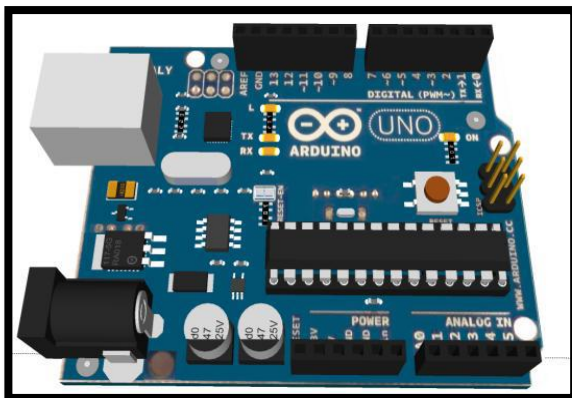3. Easy driver circuit

1.Arduino Uno Controller:



Figure 5 .Arduino Uno Board

The arduino is an open source electronics prototyping platform based on flexible, easy to use hardware and software.

Arduino is best known for its hardware, but you also need software to program that hardware. The software is free, open source and cross platform.

For this project we use Arduino Uno microcontroller board based on ATmega328.The Atmega 328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. This used for controlling stepper motors and for programming.
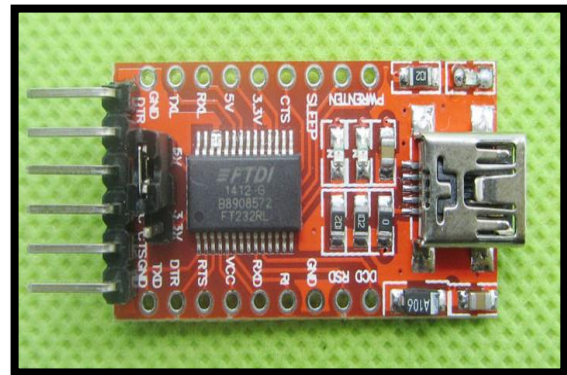
2. FTDI module



Figure 6 .FTDI module

The FT232R is a USB to serial UART interface device which simplifies USB to serial designs and reduces external component count by fully integrating an external EEPROM, USB termination resistors and an integrated clock circuit which requires no external crystal, into the device.
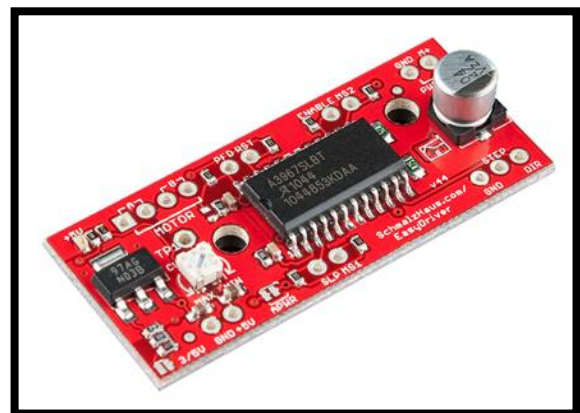
3.Easy driver circuit



Figure 7.Easy driver circuit

Easy driver circuit is used to drive stepper motor.easy driver can drive up to about 720mA per phase of a bipolar stepper motor. It defaults to 8 steps micro stepping mode. It is a chopper micro stepping driver based on the Allegro A3967 driver chip. It can take a maximum motor driver voltage of around 30v, & includes on board 5v regulation.

### 5.  SOFTWARE DETAILS

**Eagle software :**Drawing a circuit through this software . Generate **.GBR** file and one file without any extension.

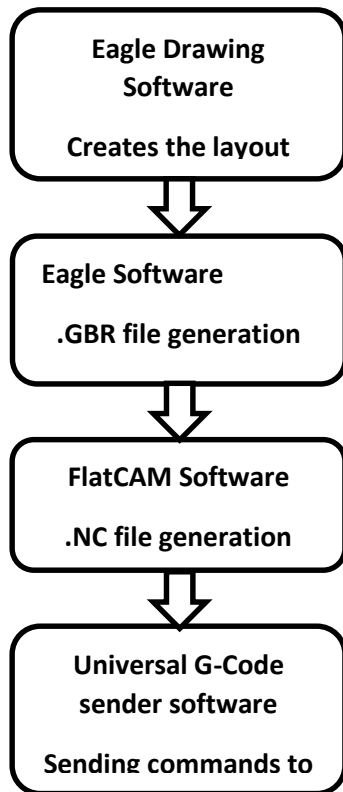**FlatCAMSoftware :**This software is used to generate an **.NC** file .

```
┌─────────────────────────┐
│   Eagle Drawing         │
│   Software              │
│                         │
│   Creates the layout    │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│   Eagle Software        │
│                         │
│   .GBR file generation  │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│   FlatCAM Software       │
│                         │
│   .NC file generation   │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│   Universal G-Code      │
│   sender software       │
│                         │
│   Sending commands to   │
└─────────────────────────┘
```

Figure 8.Software Procedure

**Universal G-Code Sender Software:**This is used to send the G-code files(**.NC**) to an integrated hardware interpreter(Atmega 328).This software will take a G-code program in file and send it line-by-line to the Atmega 328 microcontroller. The Gcodes will send over the serial ports through USB communication between the computer and microcontroller**.** Universal G-Code Sender Software.is software that is designed to send GCode to CNC machines.

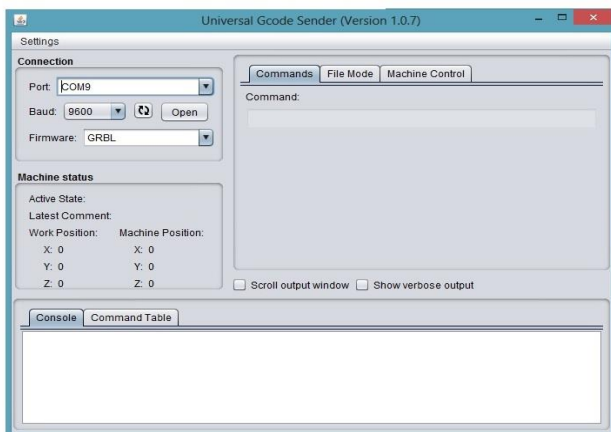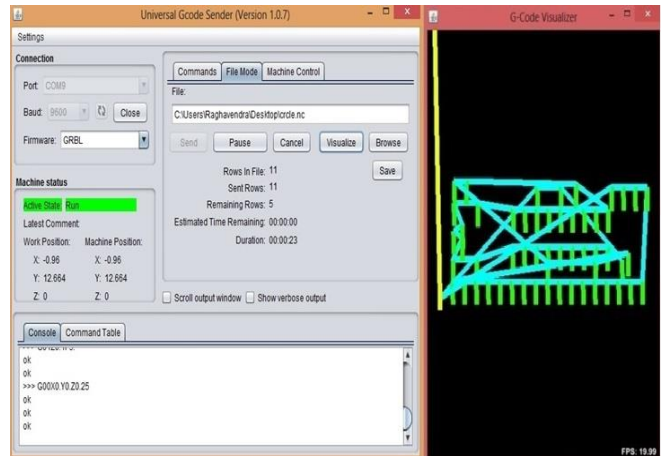Figure 9.Universal G-Code Sender Software window
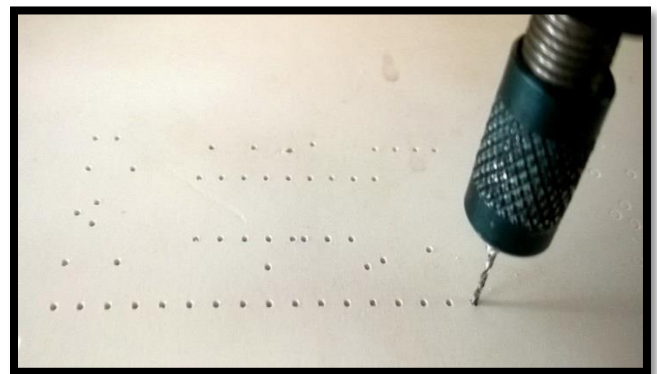
## 6. EXPERIMENTAL RESULTS

Figure10.Software Status

Figure11. drilling operation on PCB

According to X-Y axis co-ordinate position the CNC Router will be moved and whenever it stops then starts the operation of Z axis.Z axis performs Up-down operation for drilling purpose.

## 7. CONCLUSION

Using small machine tools to fabricate small scale parts can provide both flexibility and efficiency in manufacturing approaches and reduce capital cost, which is beneficial for small business. Arduino based 3 axis PCB drilling machine is designed and implemented under very limited budget.

From this paper, we can get a machine which has high accuracy and low cost as compared to large CNC machine.

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