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Multi-Purpose CNC Ink Plotter using Arduino

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Abstract: ***The use of CNC equipment in industry is increasing with the rapid development of technology. For lowering the machine complexity and expense the production of inexpensive CNC machine is used. This paper describes an automated micro CNC devices design for drawing printed circuit boards. The basic idea of this paper is to design low cost PCB based CNC hardware and by integrating PC functionality with an ATMEGA328 controller into an Arduino the startup cost was achieved. For completion of machine operation we used G-code. G-code is nothing but a language use to command machine "how to do something". How is that determined by the guidelines on how to transport and how to move fast. computer numerical control, Arduino microcontroller, part program, interpolator. In this project, we are creating a low-cost, easy-to-use, and easy-to-move CNC-based ink plotter. The CNC-based ink plotter is required to plot the diagram and sketch it on paper, but the main requirement is to design the PCB.***

Keywords: CNC, Arduino, G-code, PCB, Plotter.

I. INTRODUCTION

This paper presents the idea to build a CNC ink plotting machine which is Affordable to the small business. A plotter is a printer that makes uses of a pen or marker to draw or plot the circuit on a paper or PCB board. In a CNC, a microprocessor is used to method logic instructions connected to computer.

Logical commands are supplied by pc in the form of code, textual content, or photos and are translated directly into machine language by the microprocessor so that they can be executed on the machine.

It can be used for circuit board design, logo design and other purposes. This command is mainly based on the CNC Ink Plotter gadget.

In manufacturing areas that involves the use of computer systems CNC machining is used to control machine tools. Equipment that can be operated by this method includes lathes, generators, machine tools, and grinders. Here we present the concept of CNC pen plotter using a special PLC, inspired by this CNC era and the innovative changes in the international structure of digital electronics and microcontrollers.

The basic idea for this project is to build a small Computer Numeric Control machine that can draw PCB layouts on PCBs, etc. Three stepper motors are used as linear drives on each of the X, Y and Z axes.The statistics currently to be plotted are given by programming i.e. Hard-coded in software in binary format.

A pen lifts into the air for good zero judgment and the actuator changes its function for further execution of the instruction and touches the surface and presses a pixel of logic 1 . We can use software such as inkscpe to directly access the G-code.The supplied plotter is a one-dimensional plotter.

The CNC is a devise in which the computer can control the plotter numerically. The main purpose to create this project to provide the ink plotter at sustainable prise. According to the various online sellers the cost of CNC plotter is ruffle around 34,000-40,000rs. Computer creates the G Code according to the circuit or diagram and send it to the Arduino to proses. The Arduino is connected to the motor driver to drive the motors.

II. LITRATURE SURVEY

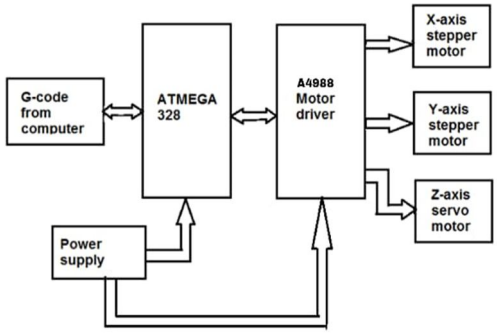
The main reason behind this project is to reduce time of designing PCB and provide it at lowest prise . The CNC plotter works on X, Y and Z axis were the X and Y axis are used to move the marker on paper and Z axis is used for uplift the marker from paper.

We give here an idea of CNC bit plotter using ARDUINO based on CNC technology, the most significant revolution in the field of digital electronics and microcontrollers. The aim of this paper is to develop an affordable CNC device capable of drawing graphics or illustrations on any surface, including paper.

The CNC controller and computer system work along as the brain for these machines, controls the motors and drive system which direction to move and how far. The computer must obliviously have given a design.

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III. WORKING



The multipurpose CNC ink plotter work's on mainly three axis X axis, Y axis and Z axis. The X and Y axis are used to plot on the board Or paper where the Z axis is use to lift up the marker from surface of paper or board. The CNC machine uses numerical signal to plot the circuit on board. Arduino (Arduino IDE) software is use to program the Arduino. To Program Arduino we use C Programing language. The inscape software is use to track the circuit diagram and to convert the diagram into G code. Universal G code sender (UGS) is a software which is used to send the converted G code to the Arduino for further proses. The Arduino work on the Received signal and concert it to Mcode and send it to the motor driver to control and drive the motor.
The Arduino is a hardware that is use to control the operation of CNC machine. The output of the Arduino is given to the CNC Shield V3. The output of Arduino has very low power and the stepper Motor required high power because of the requirement we use CNC Shield V3. The output of Arduino is given to the CNC Shield V3. CNC Shield is provide high power output with is required for stepper Motor. The stepper Motor rotates at high accuracy. Servo Motor rotates only 90° at clockwise or anticlockwise direction. By rotating 90° we lift up the marker from the surface of the PCB board.

A. Software

1) Arduino Software



Fig-1: Arduino software

Today, the less difficult way to develop electronics is the Arduino software (IDE) and the Arduino board (hardware). Using this, we can build digital and interactive tools using various applications. Arduino IDE (IDE) is an integrated development environment created by arduino.CC, an open-source programming tool from the Arduino Forum that enables you to write and integrate Arduino boards. It is made up of numerous collections and tiny sample programmes.

2) Inkscape

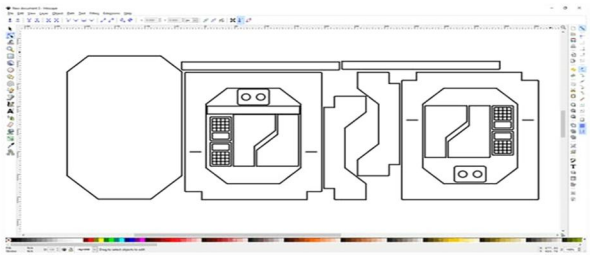


Fig-2: Inkscape

It is a free software to create and edit 2D vector photos. We are using Inkscape to create the following layout for the PCB. As a vector graphics program, Inscape does not store pixel shadows, but a list of widgets in the scene and their properties. It saves photos in SVG (Scalable Vector Graphics) format.

We can open SVG photos in many standard photo viewers which are available on the Internet. Inkscape adds more records to SVG documents it creates, but omits them when using other packages. Inkscape is available to download from inkscape.org. We can also use it in Windows, Mac OS and Linux.

The current model as of July 2021 is 1.1. Everything here applies to both variants, although the more modern model has some differences, especially in the dialog controls. Inscape's window has a large central drawing area surrounded by a number of toolbars. Multiple dialog boxes, like only one for filling and filling slots, will open on the right side of the window.

3) Universal Gcode Sender

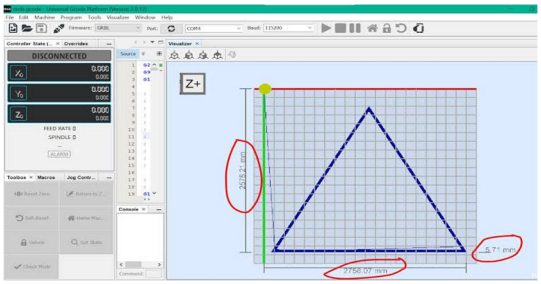


Fig-3: Universal Gcode Sender

Universal Gcode Sender is a free CNC controller software. We use the term "" because it fits well with a variety of alternative firmwares, such as GRBL, TinyG, Smoothieware, and G2core.

The control software is the link between the CNC system and the computer. Instant control of CNC machining technology from your computer has benefits such as increased machine monitoring and a real-time view of the toolpath. This eliminates the need to export recordings to an external power source and then load them into the device, allowing you to see immediate results when changing settings.

B. Hardware

1) ATMEGA 328p



Fig-4: ATMEGA 328p

The ATmega328P is a microcontroller that control the Arduino ATMEGA 328 board. The Arduino board clearly shows the pin interface to the ATmega328P, while adding additional functionality not included on the microcontroller, including a USB serial interface and a sixteen MHz clock frequency. Prototyping is a splendid use of the Arduino ATMEGA 328 board, as it allows for quick and clean iterations on layouts, but is often overkill for the finished undertaking relying on the features used.So, once you are done model your project with the Arduino, you can switch tasks to use the standalone ATmega328P as an alternative.

2) Servo Motor



Fig-5: Servo Motor

Servo motor is a motor that rotate, at very high precision. Servo Motor can operate on low power source so it does not require external high power supply. The servo Motor rotates in exactly 90° clockwise and anticlockwise direction.
In addition to this important type, there are many types of servo motors are available. Servo motors based entirely on gear layout and functioning characteristics. Servo motors are usually equipped with a gear which allows use to obtain servo motors with a high overall torque in small and light applications. Because of these characteristics, servo motor's are used in many different applications such as small vehicle, remote control chopper and planes and many more. The servos are calibrated in kg/cm (one kilogram equals one centimetre)

3) Stepper Motor



Fig-6: Stepper motor

Stepper Motor is a Motor that takes one step at a time. To complete a rotation it requires to take 24 steps. At each step it rotate exactly 15°.The stepper Motor starter has 8 poles and rotor has 6 poles. Shaft of the Motor can be controlled without any feedback mechanism until the Motor is mention the size of the tool.
Stepper motor requires high power supply it won't work on low power which is the output of Arduino board, therefore we require the external high power supply to work with stepper motor.

4) A4988 Motor Driver

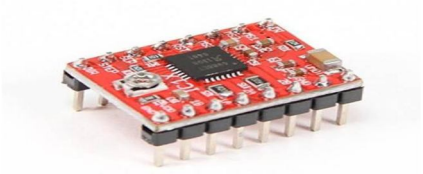


Fig-7: A4988 Motor Driver

For single stepper motor programs, a driver just like the L298N is great, however if you need to construct your own CNC device or three-D printer, you'll need a dedicated stepper motor driver like the A4988.
Due to the simplicity of the stepper motor control and the type of stepping modes provided by using the A4988 driving force, it is a perfect solution for building applications that require specific and reliable stepper motor control, consisting of the movement manipulate of beds, heads, and assemblies in various CNC plotting, milling, and 3-D printer designs.
The fact that it only calls for two pins to manage the speed and route of a bipolar stepper motor like the NEMA 17 is quite neat.

5) CNC Shield V3



Fig-8: CNC Shield V3

CNC Shield CNC Shield V3 is an open source hardware used to control stepper motors. Allows you to controls four motors simultaneously. It uses detachable A4988 stepper controls. Stepper motors are linked thru 4-pin connectors. Its supply voltage is 12-36 V. The stepper motor is good for projects requiring managed rotation. The 42BYGHW609 stepper motors used are designed consistent with the NEMA 17 standard. Those motors are well suited with a huge range of 3-D printers. They've the right torque to deal with the movement necessities of a 3D printer. Stepper motors are frequently utilized in CNC machines. They may be used to force the axes in my view or in pairs. The main characteristic that makes them so unique is the capability to exactly manage the degree of rotation. Each motor is attached to a driver board that powers and controls them. Those motors are well suited with A4988 controllers.

IV. ADVANTAGES

1) Installation of CNC inkplotter is easy.
2) High- skilled workers are not required.

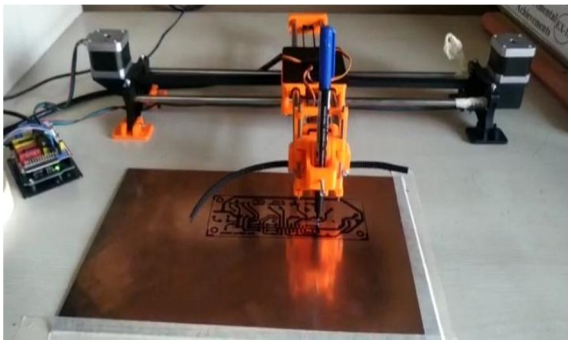
V. APPLICATIONS

1) By using a drill instead of a pen, the user can precisely drill holes in the board.
2) Can also draw tables and graphs.

VI. FUTURE SCOPE

1.A laser can be used in place of the machine's pen to transform it into a laser engraving or cutting device.
2. Wood can be engraved on by an engraving equipment. To be used for both milling and drilling, the pen can also be swapped out for a potent tool.

VII. RESULT



Nowadays the time reduction is necessary thing in any proses. Because of the high demand in market the required time to plot the circuit on PCBs is very high, to reduce the time in this process we build a CNC based multi-purpose ink plotter. The multi-purpose ink plotter can plot the layout or circuit diagram on paper or PCB Board. Reducing the time in the process isn't the only thing to do we have to reduce the cost also so that the small businesses can afford to purchase the multi-purpose ink plotter. This paper conclude that the we build the low cost multi-purpose ink plotter. Which required less time and money to plot the circuit on PCB board.

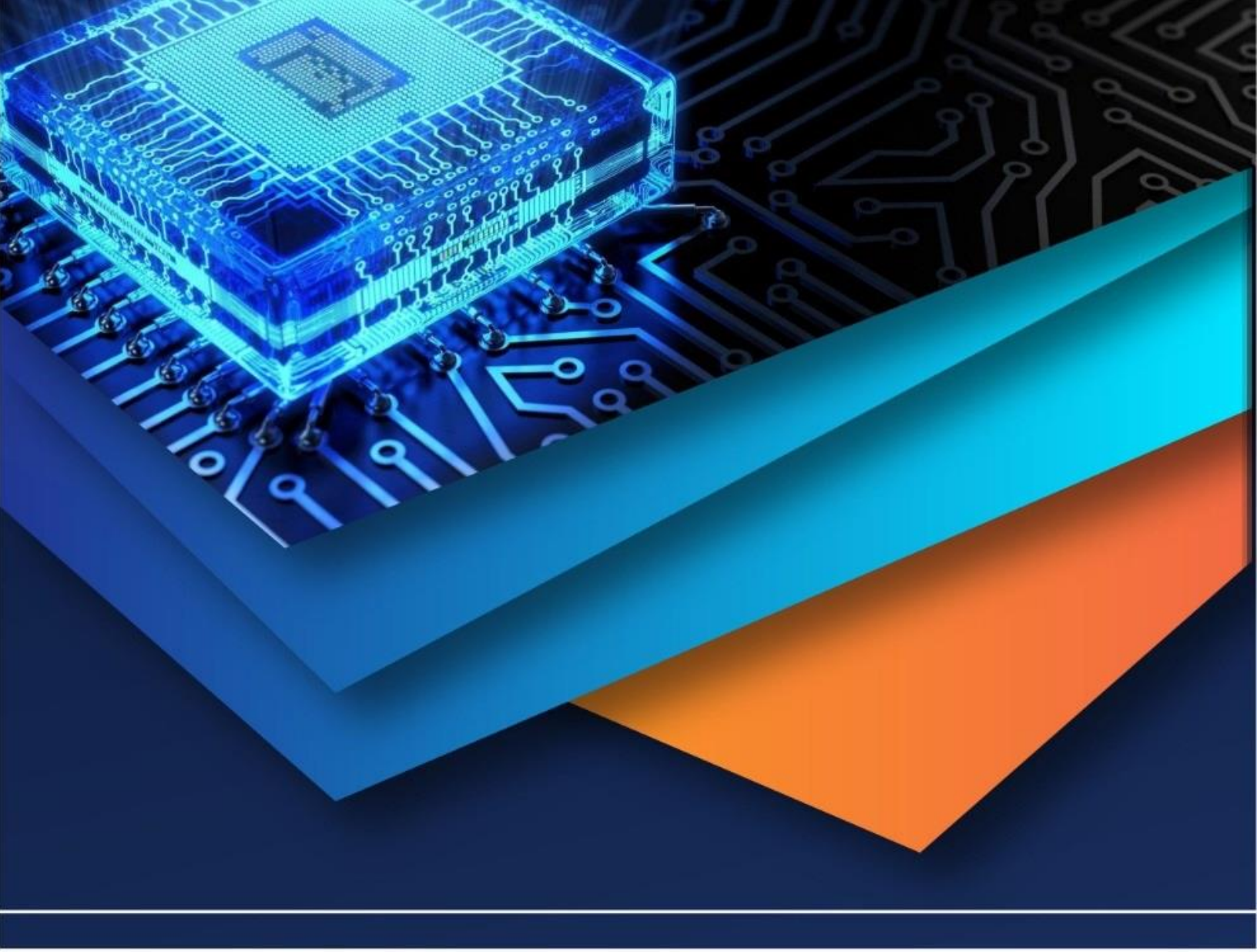
VIII. CONCLUSION

This paper is conclude that the we can build the low cost, easy to use and easy to maintain multi-purpose CNC ink plotter, for small industries or business.

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