Two In One CNC Machine

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Abstract - *The Two-in-One CNC machine stands at the forefront of machining innovation, seamlessly integrating pen plotter and milling (laser engrave) functionalities within a single, space efficient unit. This cutting-edge technology optimizes manufacturing processes, reduces operational costs, and enhances workflow agility. Precision and versatility converge, delivering unparalleled efficiency for industries seeking advanced solutions in a compact and user-friendly package.*

Key Words: *CNC, Laser Engraving, Pen, G code, Inkscape*

1. INTRODUCTION

In industries, where machines can be demonstrated automatically. This whole process, which is made and works with the human mind, no need for any human interaction for further production is known as Automation. Similarly in this Two in One CNC machine, we need to upload G-code for the process after uploading the code it performs plotting by itself. The main reason for reviewing is to evaluate existing methodologies and its efficiency to make a pen plotter which reduced the cost under fewer circumstances. After reading this paper there will be a clear understanding of pen plotter with laser engraving and it helps to guide you to build a pen plotter with laser engraving machine. The working principle of Computerized Numerical Control (CNC), which the activities are self-regulated based on the G-codes entered. The working of a plotter and other components used in build for pen plotter with laser engraving are explained in further topics. Since there must be given equal importance for mechanical design, hardware, and software implementation the topics are also framed based on it.

2. WORKING

The block diagram (Fig 1) as a reference of pen plotter with laser engraving machine, the overall technique works, when we upload the converted G-code file into the software in a computer, the signals are passed through data cable which connected to the control panel and from there to motor shield or driver, based on selection of motor shield. This motor driver will help to trigger the stepper motor, Stepper motor X-1 and Stepper motor Y-1 for moving in two cartesian coordinates and for Z-axis Servo motor were used. Writing pen and laser module were attached with servo motor which moves up and down for plotting. This way all types of pen plotter works.

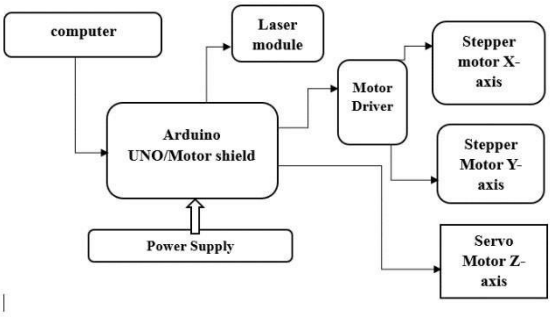

Fig -1: Working of Pen Plotter

3. METHODOLOGY

The main difficulty faced in the production of a pen plotter with laser engraving is choosing the perfect design and proper electrical components. Discussing mechanical design for the Two in One CNC machine must it based on the place where it should be plot. The main factors for designing the plotter where it be plotting, driving mechanism (belt) and the placement of components. As simple plotter can be made using two CD drives and it used for plotting as well as laser engraving can be used area about 80mm*80mm, but its outcome could be small area, and it can also become a prototype for further tasks. Here it focusses on plotting an area of 350mm*350mm. This is the first step designing plotter of output. Upcoming topics will be clear for the selection of components and the uses of them.

4. MECHANICAL DESIGN

For any type of machine, design is a basic or essential need. After the design complete any electrical elements can be placed upon it. This topic also includes actions like manufacturing and assembly. It focused on the available materials. As mentioned before, using CD drives can also be used. But for the area of 350mm*350mm, the design will be like as shown in figures Fig 2, 3.

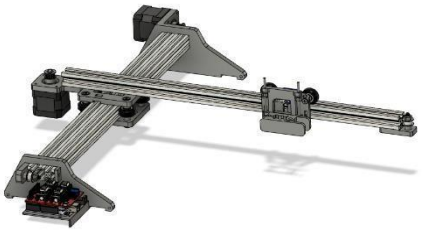

Fig -2: Plotter

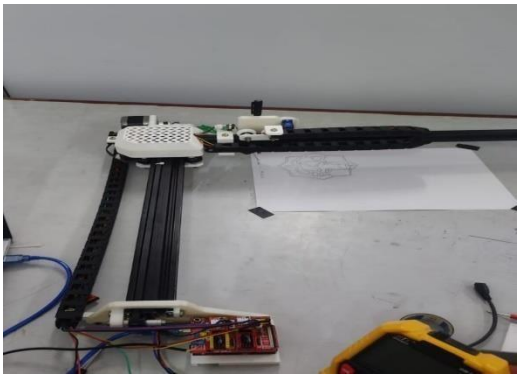

Fig -3: Plotter working image

We can infer from the above image that plotters equipped with laser engraving will be removed. While the output paper base in Figure 2 is fixed, in Figure 3, the base plate to which the sheet is to be connected moves in accordance with the movement of the pen frame. The kind of mechanism that is employed also differs. A lead screw mechanism or a beltdriven mechanism with a pulley is utilized to move along the axis. The belt is less expensive than the lead screw and may be used more easily to adjust locations as compared to the screw. Nonetheless, the lead screw is the greatest option for extremely accurate control and the application of large loads. Aluminum, acrylic, plastic, and wood can be purchased from stores or found online to construct the outside frame. For the outside frame, it is preferable to use accessible material for low cost and good efficiency. Inner components, such as rods and attachments, can be bought once the outside frame has been fixed according to design and the movement mechanism. It is advisable to choose these maintenance and drawing parts with a slightly more sophisticated mindset. The purpose of side rods is to prevent vibration or rotation from disrupting the pen frame while it is sliding. A spring should be used to secure the plotting or pen frame so that it can move freely. Fixing motors and wires should be easy to shift around in order to minimize noise. These are the mechanical design divisions, and they can also be used to produce high performance. But picking the appropriate pen for scheming is equally important. Testing typically uses a 0.7mm ballpoint pen, though other sizes can be utilized as well. laser usage 200–250 mW at 650 nm.

HARDWARE DESIGN

Motors are the first electrical component to be selected, followed by the kind of driver and a controller. Mechanical design is the basis of the motor selection process. The motors are selected depending on the torque needed to rotate after the weight of the design is determined for each motor. Nema 17 hybrid stepper motors, which have a 1.8degree step angle and can hold torque of 4.2 kg-cm, can be used for both axis control in the majority of circumstances. This motor only produces strong torque at 12 volts. It will be beneficial to use different torque stepper motors for various axes depending on the weight each one is carrying, but both must have the same step angle. The next step is to choose a motor to hold the pen and move it up and down at the appropriate angles. The SG-90 servo motor, with its 2.5 kg cm torque and 180-degree rotation, can do this. Considering that the selection and use of motors are complete. The driver can be selected based on how the motor operates and is controlled. In that regard, the ideal combination for any CNC application is the Arduino CNC shield V3.0 and A4988 stepper drivers for PWM signal control. L293D is feasible even with a stepper motor running on a TB6600, but this shield might be more swift and small. When it comes to choosing a controller, the Arduino UNO is great for this use case. Additionally, CNC shield repairs on Arduino flawlessly. Although Raspberry Pi can also be used in place of Arduino, if extra tasks such data scanning and saving are completed, then Raspberry Pi 3 should be used. It is also possible to swap out Arduino with a Raspberry. There are other controllers as well, such as the Mach 3 and MSP430, which are more expensive and primarily intended for demanding applications. It can be used as a motor driver and has a separate interface for programming. The MSP430 runs at a low voltage of 3.5 volts and requires an RS232 connection for communication.

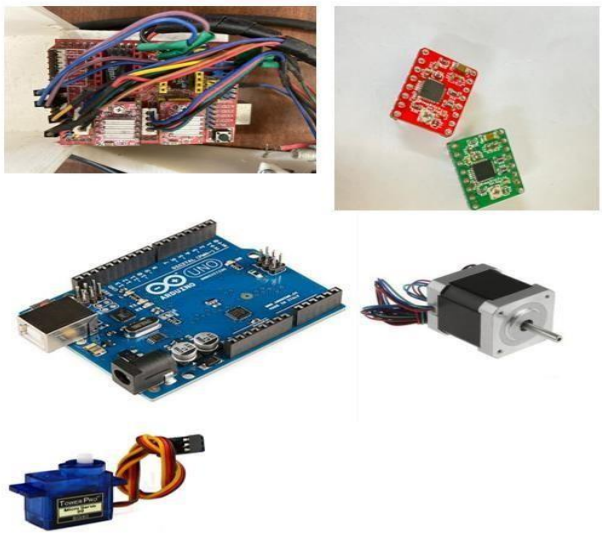

Fig -4: Hardware Components

5. SOFTWARE DESIGN

In essence, G-code is the language used to communicate with this CNC machine. Without these serial connectors, USB ports, parallel ports, and Ethernet cables, this kind of computer-to-hardware communication is not feasible. Coming is just a kind of function that regulates where the tools are positioned. Other codes, such as M-codes and Tcodes for usage with other CNC machines, are also available. These G-code files contain vector graphics that specify the machine's movement in terms of x, y, and z coordinates. Simply drag and drop the needed image or document into the appropriate program to create any of these works. For the majority of the conditions, Inkscape software is utilized as a G-code converter. Opening the program and making a few configuration adjustments—such as adjusting the sheet's area or scaling to millimeters—are the first stages in the conversion process. Adding libraries is particularly important. After that, position the text or picture file and adjust the scaling. Simply save the file in example format after that. Code and upload using the controller that is tied to the IDE. Download and execute the GRBL library for Arduino UNO. For the latter steps, use GRBL software. Here, the vector file will be plotted when the converted file is submitted. Figure Fig 5 is about how the software Inkscape appears and its logo.

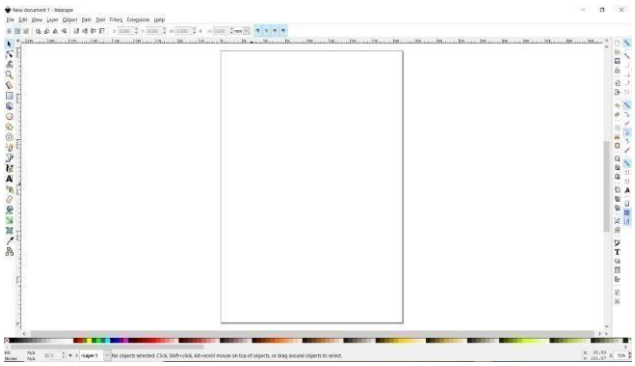

Fig -5: Software Outlook

Other programs that can be used include Mach 3 for loading the G-code in the event that the controller is Mach 3, Lazy CAM for generating. Code, and Coral Draw for converting files. A unique program called Parallel port driver and a session profile called Mach 3 Mill are needed for this. Drawing basic figures, such as squares, is essential after installing any program. You should also measure the size of the plotted picture because it changes depending on the input. The only way to fix this is to experiment with different stepper motor rotation times to find the right one. Figures 6, 7 and 8 display a small number of plotted graphs.

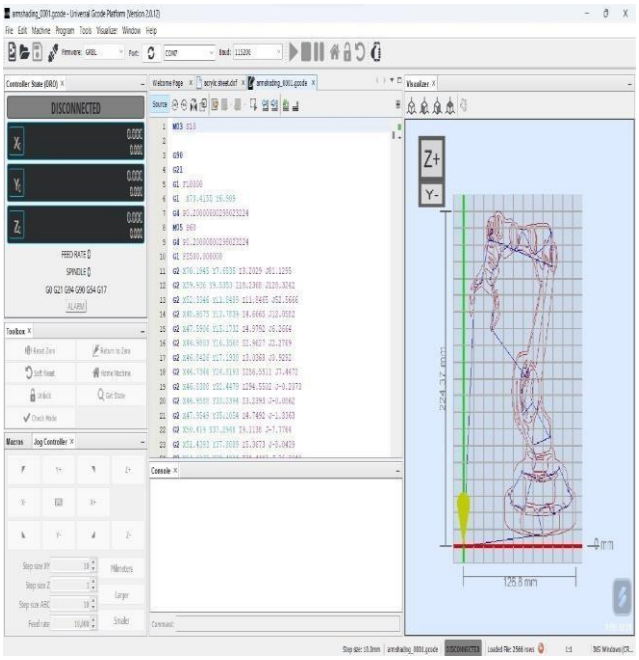

Fig -6: Plotting of Animation

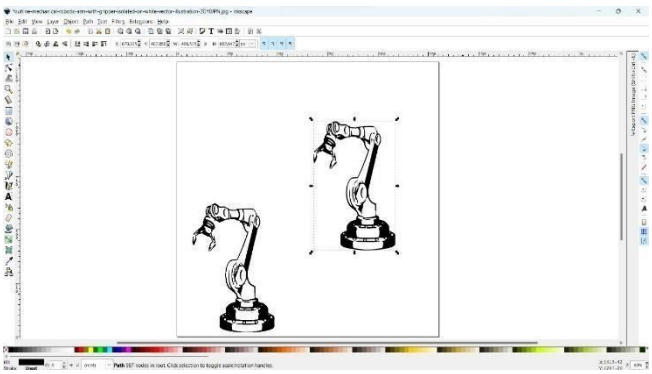

Fig -7: Plotting of Robot

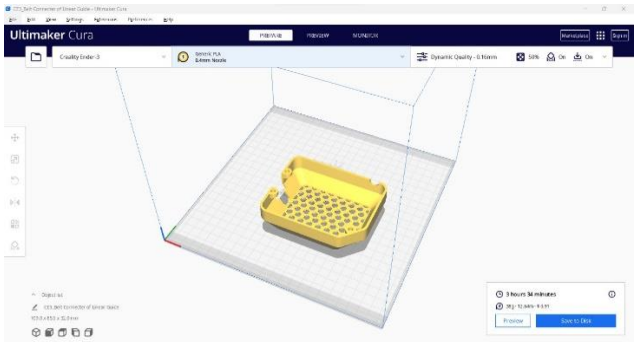

Fig -8: Slicer

6. CONCLUSION

For newcomers, creating a pen plotter will be simple and time-consuming by consulting the themes covered. As previously mentioned, the pen plotter will function properly if the input files are converted to G-code and uploaded into the controller. This study does not address

the usage of this machine for other purposes, such as laser cutting or PCB designing, because its primary focus is on the development of pen plotters, their techniques, and cost reduction through component selection. These tasks are also able to be completed.

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