MINI CNC PLOTTER AND ENGRAVING MACHINE

Submitted in the partial fulfillment of the requirements of the degree

of

BACHELOR OF TECHNOLOGY

IN

MECHANICAL ENGINEERING

by

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We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included. We have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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We fill very much elevated in preparing the project report on **MINI CNC PLOTTER AND ENGRAVING MACHINE**. Despite our best efforts it is possible that some errors and mistakes may have gone unnoticed. We shall be great to the faculty who will kindly bring these mistakes to our notice.

Suggestions from the faculties are most welcomed.

Finally, & most importantly, we would like to thank our friends and families for their continuous support throughout all our endeavours.

ABSTRACT

With the advancement of technology, demand for Computer Numerical Control (CNC) plotter machines in Educational Institutions and Laboratories is rapidly rising. The low-cost manufacture of Printed Circuit Board (PCB) has become a basic need in electronics laboratories, for mechanical engineering students and electronics hobbyists.

This report is to highlight the simulation and analysis of our Mini CNC Plotter and Engraving Machine. The design has been done in such a way that minimum deformation has occurred.

Here we have tried to simulate and analyze a mini CNC plotter and engraving machine which is made from wood, stainless steel, and acrylic sheet. It will have a capacity of cutting and engraving different materials like wood, paper, tile, glass, etc.

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INTRODUCTION

1.1 HISTORY

CNC machining uses a machining technique that was developed within the 18th Century. The first turning the machine was invented in 1751. It had a metal frame. The essentials of an all-inclusive arrangement of machines advancing to make more exact activities precisely than is conceivable by carefully assembled procedures. This denoted the start of industrialization.

However, it had been not until the conflict that the event of automation was addressed. At that point, the corporate Parsons Works was commissioned by the U.S. Navy to extend the productivity of its production and assembly line for helicopter blades. John T. Parsons then motorized the axes of the machines for making these blades. Working with IBM, he studied the chances of controlling these machines by computer. This was the beginning line of the CNC machining strategy.

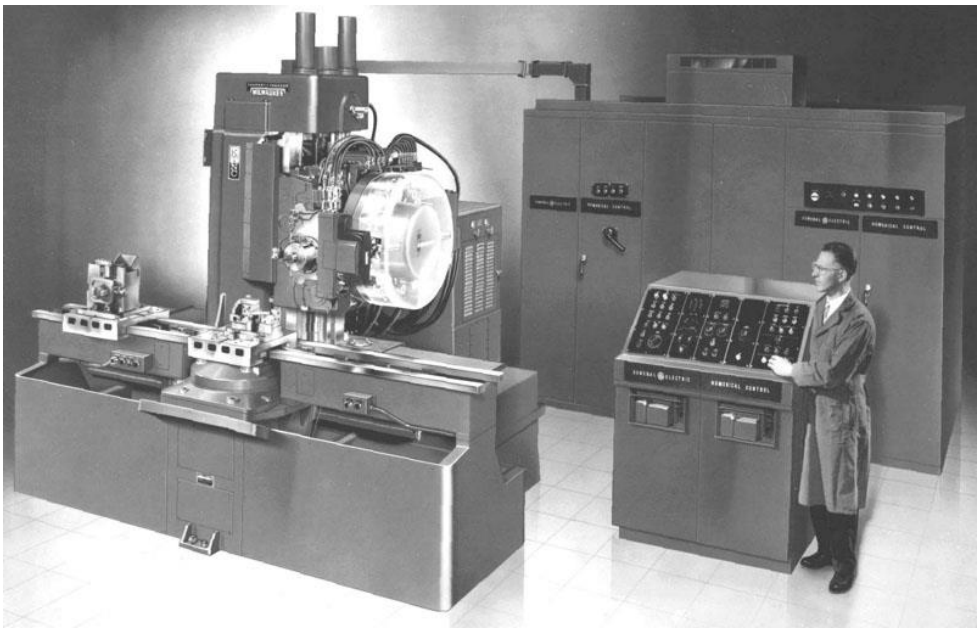


Fig 1: First CNC machine

In 1952, Richard Keg, in a joint effort with Massachusetts Institute of Technology, built up the first CNC processing machine: the Cincinnati Milacron Hydrotel. After five years, in 1958, he recorded a patent for an "Engine Controlled Apparatus for Positioning Machine Tool". This was the business birth of this innovation.

1.2 OBJECTIVES

The fundamental target of this task is to gracefully plotting/drafting activity as a substitute for conventional manual activities done by a worked by hand instrument. The venture is utilized as a rule that despises the plotting activity which may get supplanted by the other cutting apparatuses like Drilling machine, Milling cutters, even Laser cutters, and so forth. Compact disc ROM CNC plotter might be a less expensive CNC plotter and might be effectively made by rejected/utilized equipment parts. The plotter can likewise be utilized for drafting purposes.

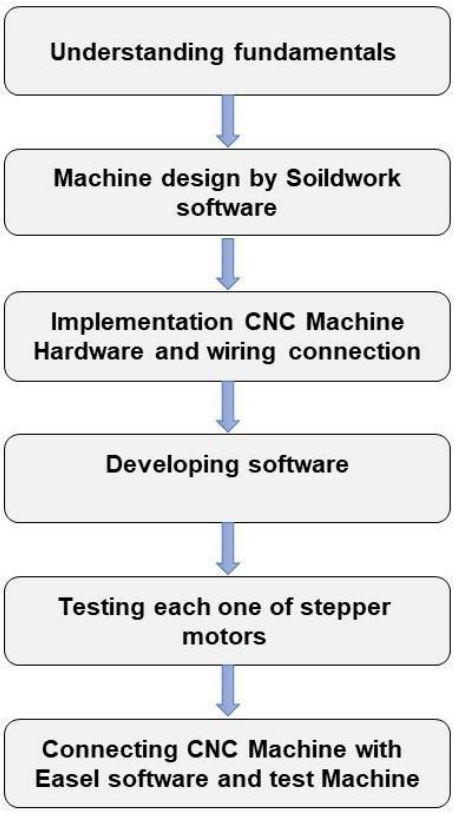


Fig 2: Flow chart to implementation CNC plotter machine

2

LITERATURE REVIEW

2.1 INTRODUCTION

Over the most recent couple of years, part measures have diminished significantly the same number of assembling firms have embraced the in the nick of time producing reasoning. Therefore, the providers of machined parts both hostage machining offices and agreement machine shops to those organizations have required machine apparatuses which will be discovered quicker for the following occupation. They have required machine tools that enable them to respond faster to customer orders and at the same time more readily accommodate part design changes. The machine tool manufacturers have had to fulfill these customer requirements to stay competitive. What follows may be a check out a number of the main improvements that are made to CNC multi-spindle screw machines as a result.

The arrangement of high-creation, multi-axle screw machines has consistently been a tedious procedure. In any case, controls for CNC multi-axle screw machines have improved colossally inside the most recent decade. A significant advantage of these upgrades is a stamped decrease in arrangement times. The present CNCs are as incredible as the most current and best PC. The PC has become an integral part of the machine.

2.2 REVIEWS

I. Linyan Liu et al. (2014) presents an information-driven procedure the board structure for the CNC plotter plan and advancement (D&D) with the coordination of procedure and information. Prerequisites for the structure are created dependent on the idea of the machine apparatus configuration practice. The proposed system comprises of procedure incorporation model, process reenactment, process execution, and information objects the board modules. Every one of these modules is expounded to help the information-driven machine apparatus improvement process the board. The model improvement is additionally introduced by the creator. Aftereffects of this investigation encourage the information joining in CNC machine apparatus D&D, and subsequently increment machine device improvement capacity, decrease advancement process duration and cost, and eventually accelerate the adequacy and guarantee the amazing machine instrument improvement. At last, the investigation includes laid out a system inside which creators are urged to take part in the machine device advancement effectively and advantageously, to help every person and the organization. Contrasted and the current references, the proposed system of information-driven CNC machine apparatus D&D process the board incorporates the accompanying outcomes: -

- Based essentially on the idea of the machine apparatus configuration practice, prerequisites for the information driven casing work with the joining of procedure and information are dissected in light of the structure questions, the D&D

procedure, the information driven interest, and its executing and checking request. At that point, the system of information driven CNC machine instrument D&D process the executives utilized in the CNC machine device industry is proposed, which incorporates displaying, reenactment, and execution and thinks about the information. The plan procedure of the KVC1050N Vertical machining focus is additionally concentrated for instance to exhibit the plausibility and accessibility of the proposed system. The aftereffects of this investigation fundamentally add to endeavors to accomplish information and procedure joining in the CNC machine device D&D. In a word, continuous endeavors are being taken to make the system progressively down to earth in the modern application. Therefore, this arrangement can serve machine device organizations in this significant industry segment by expanding machine apparatus advancement abilities, improving work productivity, and at last decreasing improvement process duration and expenses.

II. Venkata Krishna Pabolu et al examine the plan and usage of ease three-dimensional mechanized numerical control framework (CNC) for mechanical application. In this paper prototyping, an Embedded CNC machine was made. Detail depiction of various modules, for example, programming advancement, Electronic/Electrical turn of events, alongside specialized subtleties of their usage has been given.

III. D.J. Jayachandraiah et al give the plan to build up the minimal effort Router framework which is equipped for 3 axis simultaneous interpolated. The minimal effort is prototyping is accomplished by joining the highlights of the standard PC interface with a microcontroller-based CNC framework in an Arduino based implanted framework. With a restricted financial plan, the creator infers that little machine instruments to create little parts can give adaptability and proficiency in the assembling approach and diminish the capital cost, which is valuable for entrepreneurs.

IV. Ahmed A.D. Sarhan et al. in this paper, an underlying CNC gantry processing machine structure with the possibility to create high surface completion has been planned and investigated. The objective of the creator is to accomplish the most reduced normal recurrence of 202Hz relating to 12000 rpm at all movement amplitudes with a full scope of reasonable recurrence reactions. Modular investigation of the underlying gantry structure configuration was performed and its normal recurrence was 102.36HZ. To improve the dynamic conduct of the gantry structure so it can suffer at frequencies above 200HZ, an alteration procedure was done to expand solidness. The above upgrade, proper conduct was accomplished. Misshapen of less than 10 microns followed at the tip of the shaft when the base characteristic recurrence of the gantry structure transcended 200Hz. An expansion in the structure's weight was a critical factor for the distinguished twisting. In any case, the variety didn't hurt the accuracy of the machine. Subsequently, the weight expanded after adjustments to the gantry structure were made, while the measure of distortion and generally speaking powerful conduct improved. Additionally, the adequacy of the Z-pivot part's situation on the dynamic conduct of the gantry structure was contemplated. By relocation of the shaft position, the dynamic conduct of gantry structures will change. Assessments on the gantry structure's conduct showed that the least common recurrence happened while the Z-pivot part was situated beneath the center of the pillar. This implies the structure was in a basic circumstance. The outcomes are appeared by the creator, that as indicated by the basic condition, the base recurrence of the structure is

worthy. The examination results show that the structured CNC gantry machine is equipped for working at a speed of 12,000rpm.

V. Nikita R. Saharkar et al. plan the CAD Model in Solidworks and done the FEA examination in hyper work device giving the proper imperatives, burdens, and second qualities. As per the creator, he got the pressure an incentive around 14 MPa which is not exactly the permissible pressure estimation of M.S. closing the plan is sheltered. The creator likewise produces the G and M codes by reproducing the CAD document in Power plant programming which is only the CAM programming. Sundar Pandian et al. (2014) grow ease 3 hub CNC machines utilizing off-the-rack parts, stepper engines with drivers, Arduino open source, microcontroller, and open-source engine control programming. The writer utilized prepared to collect unit from Zen Tool works, USA. The unit gave stepper engine, lead screw, manage pole, hostile to kickback spine, and spring. He made the Body with high-thickness PVC. The machine has fixed gantry and a versatile bed so there is a limitation in the working territory. The creator builds up a Low-cost CNC machine just for instructive purposes.

VI. B. Malleswara Swami et al. in this paper creator portray the strategy for static and dynamic investigation. The creator utilized a standard bed for investigation. The examination is conveyed to decrease the weight without changing the basic unbending nature and precision by including the ribs in a reasonable area. The static investigation is accomplished for 1g for example gravitational power is considered with an outer burden on the structure and 5g, for example, gravitational power multiple times 'g' esteem is applied on structure alongside the outside burden. In the modular investigation, the normal recurrence of the body is assessed to discover dynamic and vibration qualities. At that point, the upgraded plan is created utilizing the pick struct instrument. The outcomes which get after advancement lessens the weight by 1.55% with unique worth and normal recurrence moved by appx. 8.8 % with the first common recurrence.

VII. Dhruv Patel et al. studied influences of various parameters like tool speed, tool feed and depth of cut on CNC router and concluded from ANOVA that percentage contribution of feed rate is maximum and it means Feed rate is the most dominating factor for modeling surface finish.

VIII. Monika Nowak et al. detailed strategies for the determination of geometric and physical structures of the portable machine by indicating the plan necessities and the advancement of the end conditions dependent on these prerequisites. The determination technique depended on an investigation of the useful portrayal of the necessary forming developments, cautiously creating proper conditions for the disposal of options utilizing the data concerning the requirements of future versatile machine administrators.

IX. D. Cekus published a paper in which the drive parameters for an arranged machining process have been resolved. For this reason, a powerful investigation of a CNC plotter has been completed in the Motion module of the SolidWorks program. The outcomes have been utilized in the planning phase of a mechanical plotter for a Polish organization delivering CNC machines.

X. Mr. Anil Shelke describes a minimal effort sequential correspondence based scaled-down CNC Plotter Machine dependent on open-source programming and equipment. Smaller than expected CNC Plotter Machine is an installed framework that deals with the Principle of 'PC Numeric Control (CNC)'. The framework works with three stepper engines (two for X-pivot and one for Y-hub) and a miniaturized scale servo controller (for Z-hub). Wherein

Arduino Circuit plots the information given from the PC through 'INSCAPE Software' on the sheet which is put on the planning phase utilizing a small scale controller. The plotter has four-hub control (2 X-hub and 1 Y& Z hub resp.) and a smaller scale servo controller for the development of the pen. This framework diminishes human exertion and furthermore lessens the odds of mistake. The proficient and right mounting of the considerable number of parts and legitimate utilization of programming and the right arrangement of the circuit makes the framework progressively effective.

XI. Sara Raad Qasim portrays in her paper, a minimal effort, medium-size, and precise small scale CNC plotter are planned to utilize straightforward and ease parts: a microcontroller (Arduino), stepper, and servo engines and their control programming. The product has been utilized to deliver a G code for the activity of the framework.

XII. Puja Girhe in her paper manages the plan of a programmed smaller than expected CNC machine for PCB drawing and penetrating. The thought behind our venture is to plan and drill PCB dependent on a minimal effort CNC framework the lower cost is accomplished by consolidating highlights of PC with ATMEGA 328 controller in an Arduino. We have utilized a G code for entire framework activity G code is only a language in which individuals tell modernized machine instruments 'How to make something'. The How is characterized by directions on where to move and how quick to move.

XIII. A S PATIL, the paper is about the CNC Machine PCB Plotter which is utilized to draw circuit format on PCB. For that first, you have to change over the content record or picture document into G code utilizing InkScape programming. At that point, this G code is applied to handling programming. ATmega 328 microcontrollers utilizing Arduino Uno is utilized to control the gadget. The controller changes the given G code and afterward makes an interpretation of them into a machine language guidance. These directions are for the engine drivers to be sent to the engine drivers.

XIV. Prof. Muhammad Asad in his paper ensures an affinity to style a less expensive cost remote CNC smaller than usual plotter three-hub control machine that joined with a microcontroller. CNC machines territory unit prepared numerically and conjointly use for draw animation pitchers and 3D pitchers with ninety-seven.5% precision. The precisely part as indicated by a structured program took care of into their controller unit. The controller unit can be both a PC and a microcontroller. The remote CNC machine has stepper and servo engines to draw any pitchers or signature according to the fed program. This framework basically works with an HC-05 Bluetooth component (for remote correspondence) 2 Stepper engines for the pivot of turn and one servo engine (for z-hub). This procedure diminishes the human exertion and usage of essentialness and time. Because we have the affinity to utilize an HC-05 component for remote correspondence between CNC machine and PC or information gadgets, we have a penchant to deal with a CNC machine with remote correspondence. First matched gadgets and afterward give the G-Codes to Arduino. The conservative and [proper] mounting of the considerable number of segments and appropriate utilization of the product framework and arrangement of the circuit construct the framework a ton of affordable. We have conjointly assessed our monetary machine and have discovered its presentation venerate the current forefront high-ticket machines.

3

PROBLEM DESCRIPTION

3.1 PROBLEM DEFINITION

After analyzing the research papers, we got to know the following points:

- The cost of a CNC plotter was high.
- The plotter lacked accuracy therefore the plotting done on the PCB boards was inappropriate.
- The frame wasn't strong enough to handle the vibrations of the motors which resulted in loosening and breakage of the frame.
- Many faults occurred while performing the tasks.
- The workers were required to be skilled within a particular operation as this machine runs on specific codes.

3.2 PROBLEM SOLUTION

After reviewing the research papers, we found out the problems that needed to be overcome. Hence, to overcome the problems that we had discussed in 3.1 we are presenting here an idea of a mini CNC plotter and engraving machine. The idea behind this project is to make a small CNC plotter which will have the following specifications: -

- It will have high accuracy and precision as it will be fully computer-based and all the easy and high-end software will be used.
- It will be easy to operate.
- We have planned our project in such a way so that the tool could be replaced with different cutters like a blade, laser, milling cutter, etc.
- The important feature of our project will be that it will be cost-efficient and the parts used to make the machine would be easily replaceable.
- This will also be user-friendly and easy to operate.

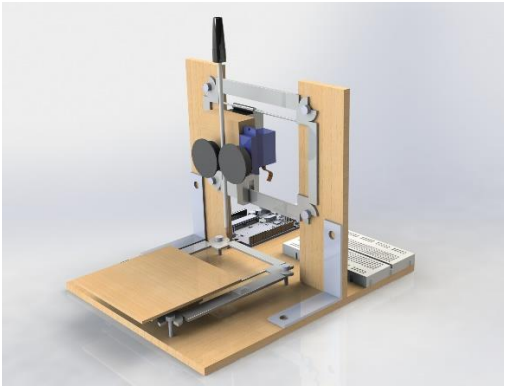


Fig 3: CNC plotter and engraving machine

4

TECHNICAL SPECIFICATION

4.1 Arduino UNO

One of the major components of our project is Arduino. In our project, we have chosen Arduino Uno R3 which just sudden spikes in demand for G-codes. The Uno is a microcontroller board which is completely dependent on the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple data sources, a 16 MHz, a USB association, a force jack, an ICSP header, and a reset button. It contains everything expected to help the microcontroller; basically interface it to a PC with a USB link or force it with an AC-to-DC connector or battery to begin.

We are using Arduino R3 Atmega328P. It operates at 5 V. It has 2Kb of RAM, 32 Kb of ash memory for storing programs. It also has 1 Kb of EEPROM used for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connected to the host computer and a DC power jack for connecting an external power source.

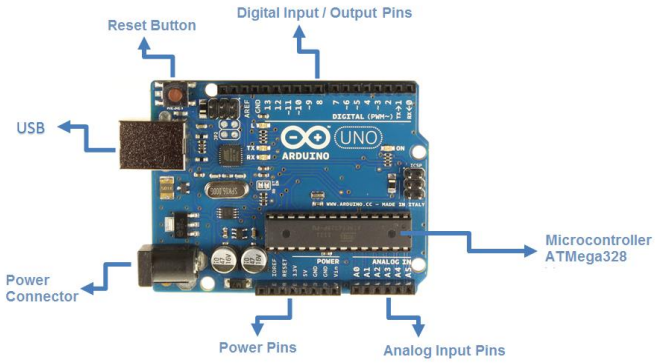


Fig 4: Arduino Uno R3 Atmega 328P

Following are the specifications of "Arduino Uno R3":-

PARAMETERS	SPECIFICATION
Microcontroller	ATmega328P
Operating Voltage	5V
Input voltage (recommended)	7V-12V
Input voltage (limits)	8V-20V
Digital I/O pins	14
DC current per I/O pin	40mA
Flash memory	32kb (of which 0.5kb is used by boot-loader)
SRAM	2kb
EEPROM	1kb
Clock Speed	16MHz

Table 1: Arduino Uno specification and parameters

4.2 CNC Shield

CNC shield functions the controlling axis of our cutter. Considering X-Y axis as linear axis for movement whereas Z- axis functions the cutting motion, though the last axis, for example, A-axis is for the choices for giving the rotational movement to the cutting instrument, for example, a rotational movement for boring activity, and so on.

Each axis will have three jumper that can set to configure the stepping for the axis.

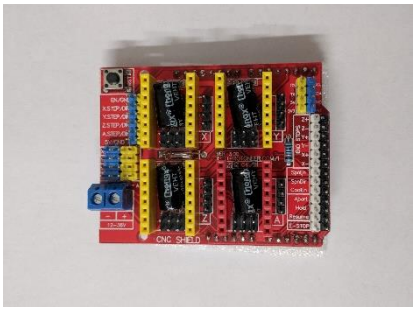


Fig 5: CNC shield

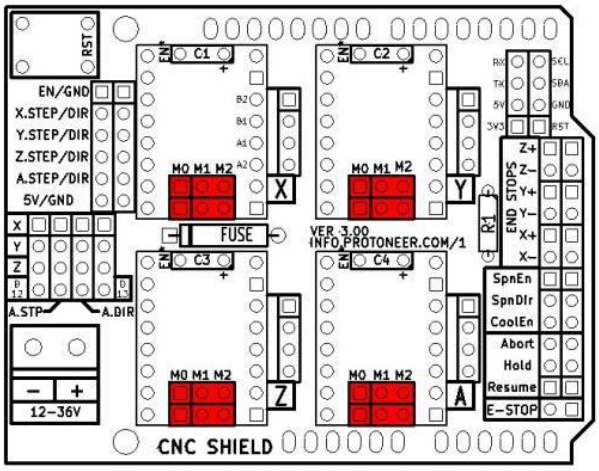


Fig 6: Different connections in CNC shield

PARAMETERS	SPECIFICATIONS
Motor voltage	8V-35V
Logic circuit voltage	3V-5.5V
Current	2A (max)
Five-step resolution	Full, 1/2, 1/4, 1/8 and 1/16
Protection	Under-voltage, Over-current, and Over-temperature

Table 2: Parameters and specifications of CNC shield

4.3 Stepper Motor

The motor stepper is used to achieve the exact position with computer control. The engine operates in direct synchronization with the heart rate from the controller to the main touch. Stepper engines, with their capacity to provide high torque at low speed while minimizing vibration, are ideal for applications that require a faster environment with shorter distances.

The stage car provides direct power to stand without power. They are used in various types of hardware directly on the turning edge and speed control using hit signals. Stepper engines produce high torque that is lightweight and is ideal for quick response and speed. Stepper engines additionally hold their position in the stall, due to their structure.

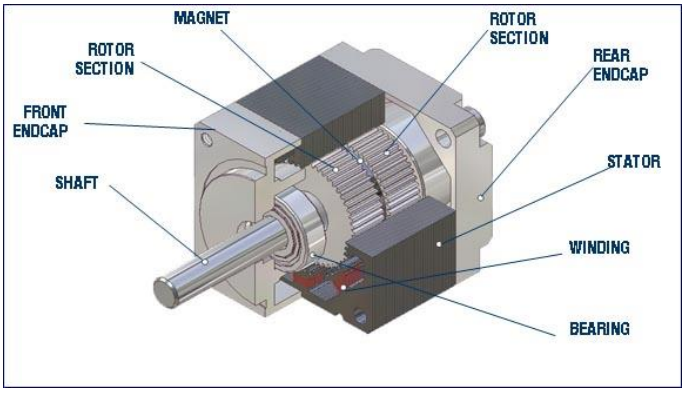
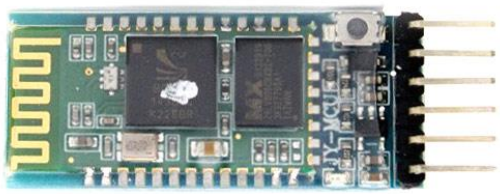


Fig 7: Construction of stepper motor

4.4 HC-06 Bluetooth Module

Bluetooth module is a PCBA board that incorporates Bluetooth capabilities. It is often used for remote transcription of short distances, which can be distinguished from the Bluetooth module and the Bluetooth voice module as indicated by its use. The module is a basic set of circuitry that incorporates Bluetooth power and can be used for remote program transmission. In general, the Bluetooth module can be divided into the following types: data transfer module, remote control module, and so on. Usually, modules are the last-used, customizable dependencies on chips to make the next program easier.

The HC-06 is a Bluetooth module that is intended to set up long-distance short-distance communication between two microcontrollers or a frame. The module works with Bluetooth 2.0 encryption and can act as a slave gadget. This is an inexpensive way to move data remotely compared to different strategies and can transfer records at speeds up to 2.1Mb / s. The HC-06 using a distance-based re-distribution system (FHSS) to maintain optimal distance from being locked by various gadgets and is fully distributed. Gadget gadgets from multiplication range from



2.402 GHz to 2.480GHz.

Fig 8: HC-06 Bluetooth module

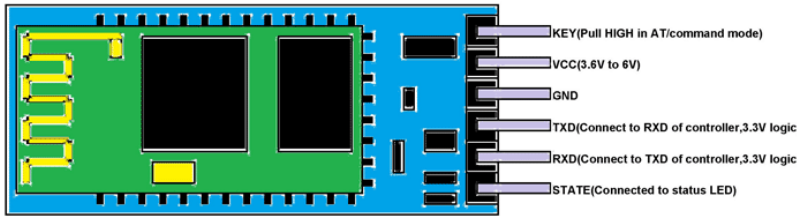


Fig 9: HC-06 Bluetooth module pinout

HC-06 module has six pins as shown in the pinout. The function of the pins are as follows:-

1. **Key**- The pin state determines whether the module works in AT command mode or normal mode [High=AT commands receiving mode (Commands response mode), Low or NC= Bluetooth module normally working].

2. **VCC**- +5V Positive supply needs to be given to this pin for powering the module.

3. **GND**- Connect to ground

4. **TXD**- Serial data is transmitted by module through this pin (at 9600bps by default), 3.3V logic.

5. **RXD**- Serial data is received by module through this pin (at 9600bps by default), 3.3V logic.

6. **State**- The pin is connected to the LED on the board to represent the state of the module.

4.5 Laser

High power laser for Engraving and Cutting accompanies LASER Light intensity of 1 Watt and having the frequency of 445nm accompanies a driver. We can etch plastic, wood, acrylic, PVC, PCB, for the benefit of the wood and different materials. This module doesn't contain pictures on the section and power supply. This likewise has a compatible driver connected to it.

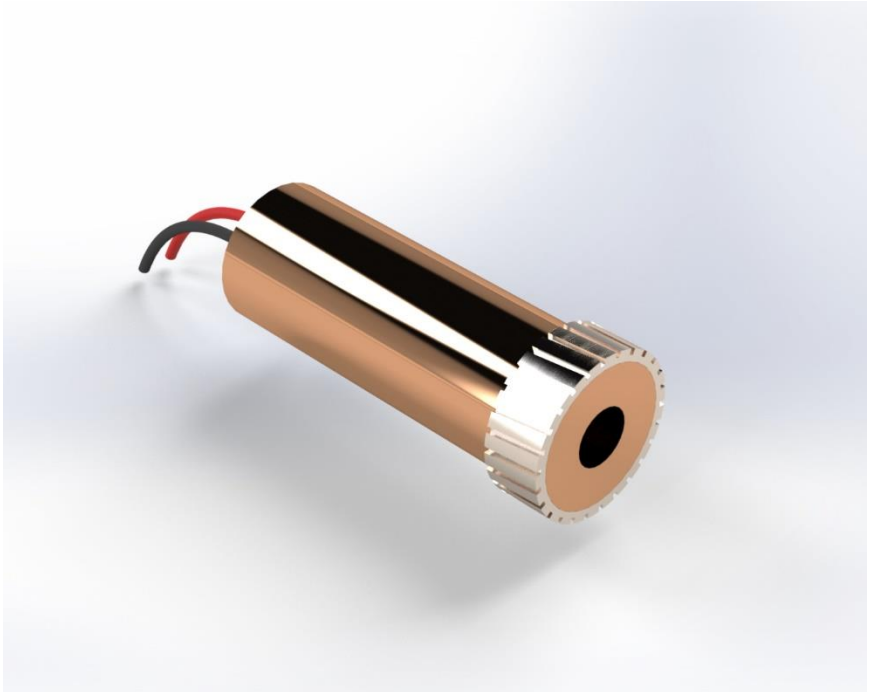


Fig 10: Green Laser

PARAMETERS	SPECIFICATIONS
Laser wavelength	445nm(blue)
Spot type	Dotted
Light power	1W (1000mW)
Cooling method	Air-cooled
Input voltage	5V

Table 3: Features and specification of the laser

5

DESIGN, WORKING & SOFTWARE

5.1 Design

The design of our project will be as shown in figure 9. It consists of several parts such as a wooden base, SS rods, writing pen/laser, stepper motor, Bluetooth module, etc. This design has been created in Solidworks which is a 3d modeling software. There are various types of commands and features in Solidworks like rectangle, extrude boss, extrude cut, mirror, etc., which helped us in creating the 3d model of our design.

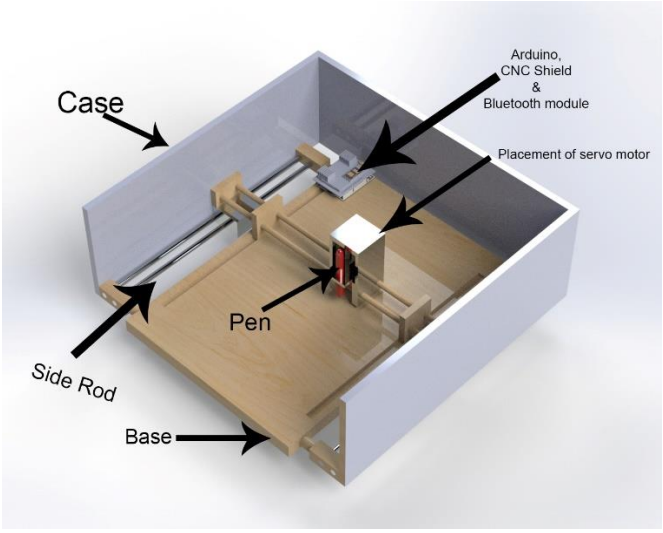


Fig 11: CNC plotter and engraving machine design

The dimensions of the design are as follows:-

PART	DIMENSION
Base	420mm X 297mm
SS Rod	390mm (side rod) 437mm (upper rod)
Pen	9.89mm
Case	419mm X 169.55mm
Laser	12mm dia.

Table 4: Dimensions of main parts

The model is designed in such a way that it will move in 4 directions i.e., X-axis, Z-axis, Y-axis, and (-Y)-axis. The detailed dimension of the model is given in figure 10.

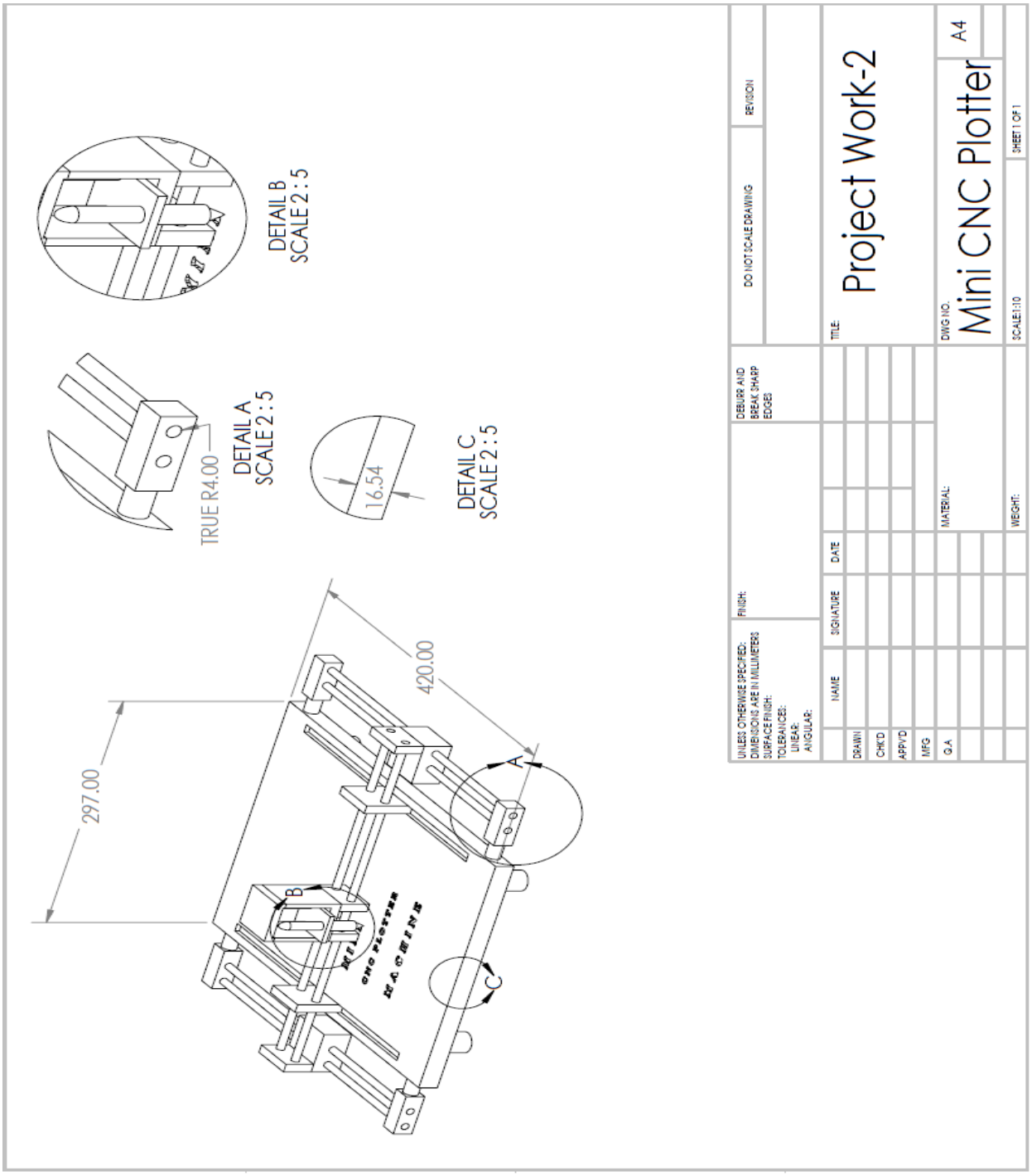


Fig 12: Dimensions of 3d model

5.2 Working

The performance of our machine will be as follows:

1. 1. The CNC layout machine needs three axes to operate the X, Y, and Z-axis. The x and y-axis always work to make a two-dimensional image on paper. These x and y -axis are set to 90 degrees with the final error that any point in an empty space is expressed by the given value of x and y. The z-axis is used to lift and lower the pen, laser, and axle on transparent paper.

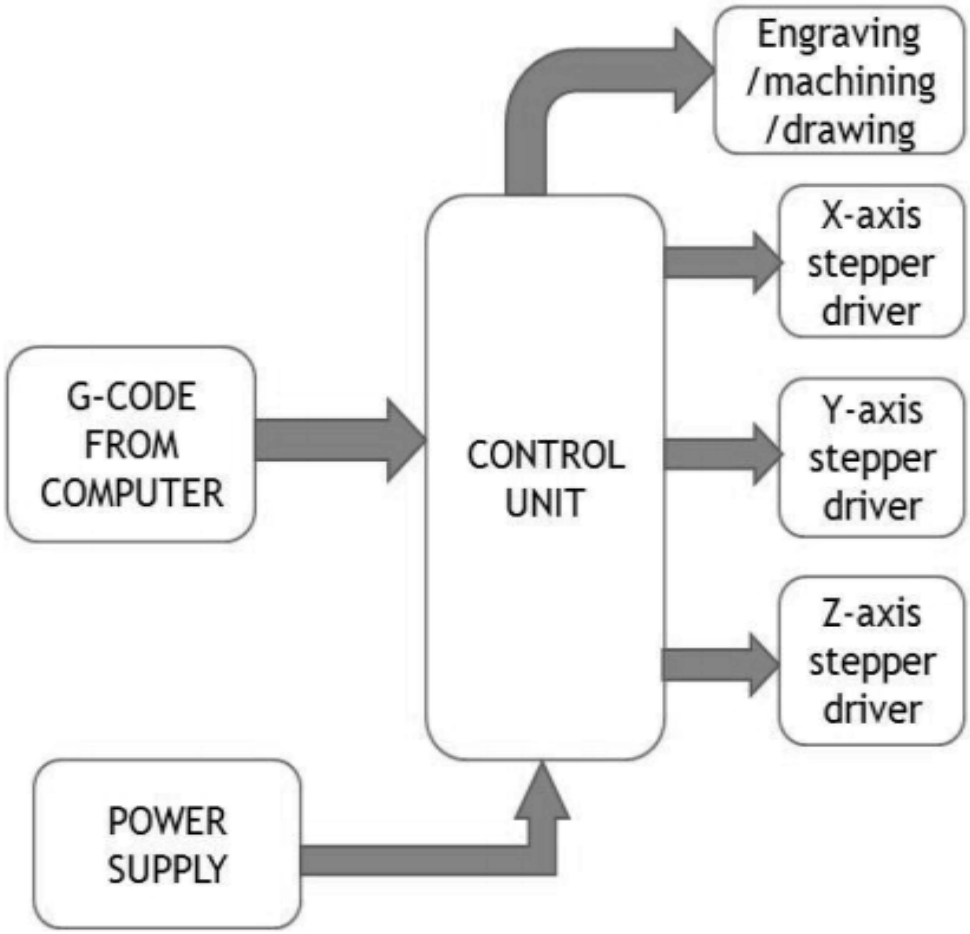


Fig 13: Block diagram of the working of CNC plotter and engraving machine

2. Compatible with the image to be drawn, the software will generate acceptable links and send it to the microcontroller on the USB port. The microcontroller describes these links and then controls the position of the vehicle to create the image. Here we used the Arduino Uno ATmega 328P because it is the Microcontroller used to create the Mini CNC Machines.

3. To make the x and y-axis, two SS rods are used. All of these parts consist of a stepper motor and a part of the drive system that are commonly used to move the cartridge back and forth. On the z-axis, the engine smaller than the standard servo is put into the y-axis input. This servo engine is used to move the pen here and there. A decent tool is being developed that will provide free energy for all development.
4. Due to the large size of this machine, the device is capable of drawing on A3 paper. So we will cut an A3-size platform (297mmx420mm) from acrylic glass and attach it to the x-axis using glue.

5. Insert the shield of the L293D motor driver into the Arduino UNO board. Then connect the two step motors. The ground connection should be left unplugged. Connect the 5V - 7V power supply to the driver's shield port of power.

6. Since we are using the motor shield of the L293D, we need motor library. Then paste it into your Arduino IDE library folder. Rename it as AFMotor. If the Arduino IDE was open then open it again and click on the file -> examples -> Adafruit Motor Shield Library -> stepper. Select the correct port and board for the tools and upload the code to the Arduino board. Other movements should be viewed on the ladder of steps. Stepper gearbox is changed from 2 to 1.

5.3 Software Used

The various software that is used in the modeling and simulation of our machine are as follow:-

1. **SolidWorks**- This is a software that is used for computer-aided design and computer-aided engineering (CAD and CAE). This product helped us in structuring a 3 dimensional model of our venture. It also helped us in analyzing rods.

Fig 14: SolidWorks

2. **Ansys-** This software is used mainly for analysis of the 3-dimensional models. By using this software we calculated Equivalent Stress and Equivalent Strain for different parts that were involved in our machine.

Fig 15: Ansys

3. **Arduino IDE-** Arduino Integrated Development Environment is a cross-stage application that is written in abilities from C and C++. It is utilized to write down and transfer projects to Arduino appropriate sheets.

Fig 16: Arduino IDE

4. **Inkscape-** Inkscape is a free and open-source vector pictures supervisor. Inkscape's main vector pics group is Scalable Vector Graphics; be that as it may, numerous different configurations can be imported and sent out. Inkscape can render crude vector shapes and content.

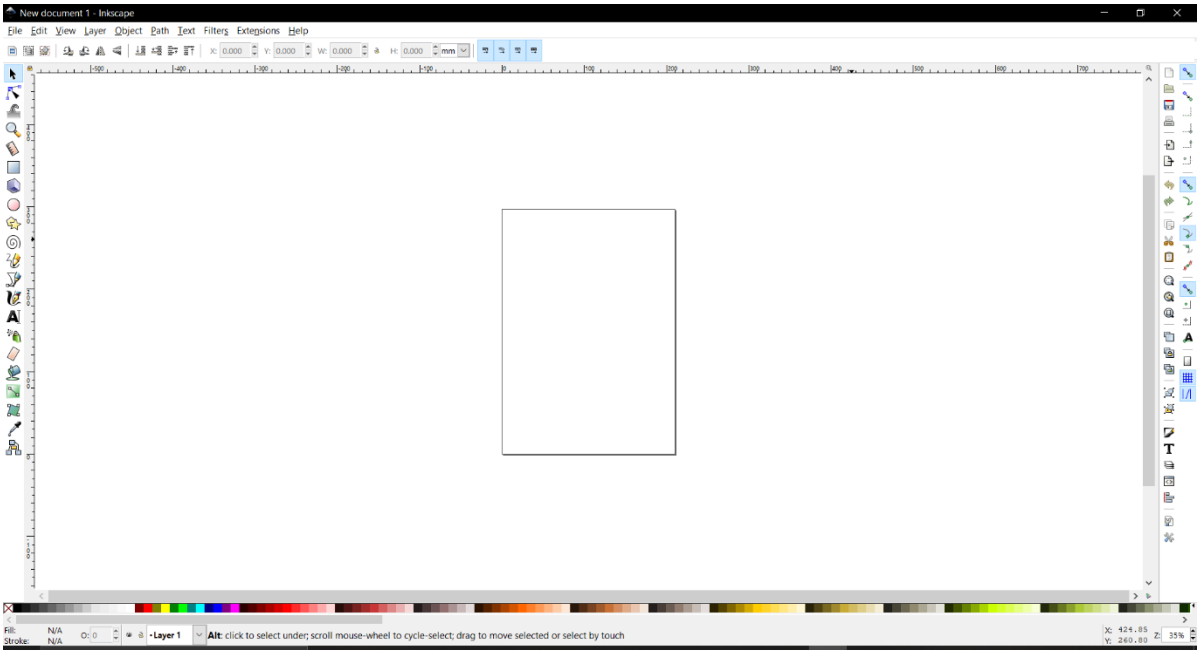


Fig 17: Inkscape

5. **Grbl-** Grbl is a free, open-source, elite programming for controlling the movement of machines that move, that make things, or that make things move, and will run straight on Arduino.

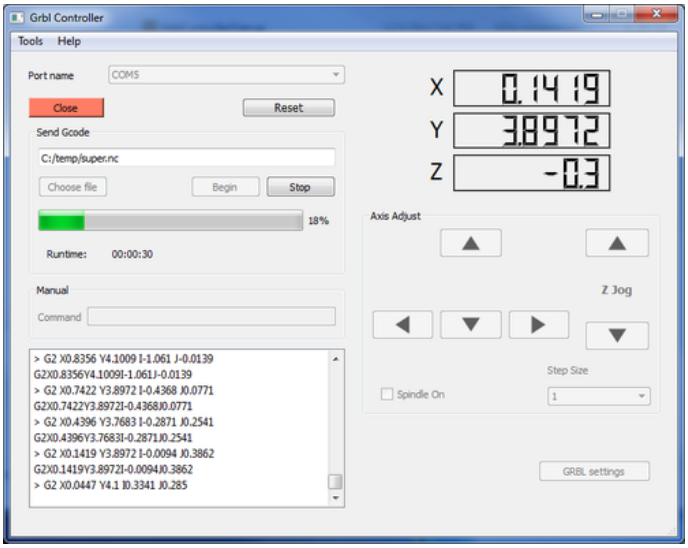


Fig 18: GRBL

6

PROGRAMMING AND CALIBRATION

6.1 Program uploading procedure

After all the procedure has been done, the main factor in the making of the project successful is to calibrate and upload the programming into the Arduino board through USB cable. The following are the procedures for uploading the code in the board:-

1. Extract the MI GRBL Zip File

2. It will create the MI GRBL folder name

3. Copy the folder and go to the Arduino area and find the folder of the library and place it there.

4. Turn on the Arduino ID goes to the files.

5. Example: - MI GRBL download code -> connect Arduino code to PCTool “ARDUINO UNO” Select compt (where Arduino code connects) known bugs and upload code.

6. Now download another Inkscape zip file extension (MI Extension).

7. After you copy the folder and open the Inkscape cape open area of the shared space extension then the previous folder copied inside the expansion folder this open the file to copy all the files and paste the outside of the folder then additional additions can be made.

8. Open the Inkscape folder to measure and create a simple G-Code first.

9. Inkscape does not have a built-in format for storing files in G-code. So, we need to install a plugin for our files to be converted and saved in G-code format.

10. After installation change its size from pixels to mm. It also reduced the height and width to 90mm. This will enable our workspace where all our text and drawings will be written.

11. Now draw the image you want and select "object to understand" and save the file to "MakerBot Unicon G-code."

12. Finally, the G code is ready and transmitted to the board and the machine is ready to operate.

6.2 Coding

Following are some of the screenshots of the coding that we have done for the movement of CNC plotter and engraving machine:

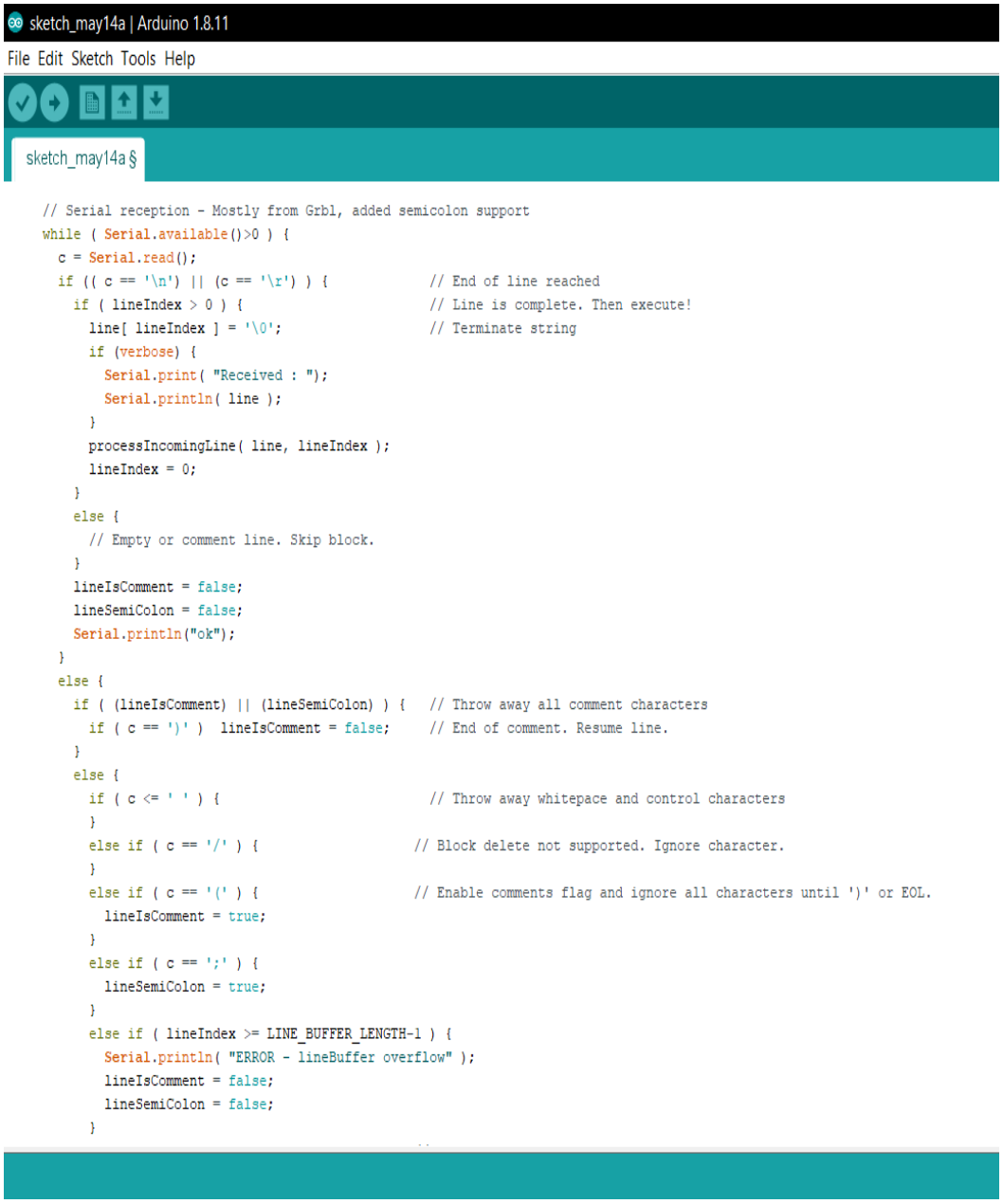


Fig 19(a): Coding for process incoming line

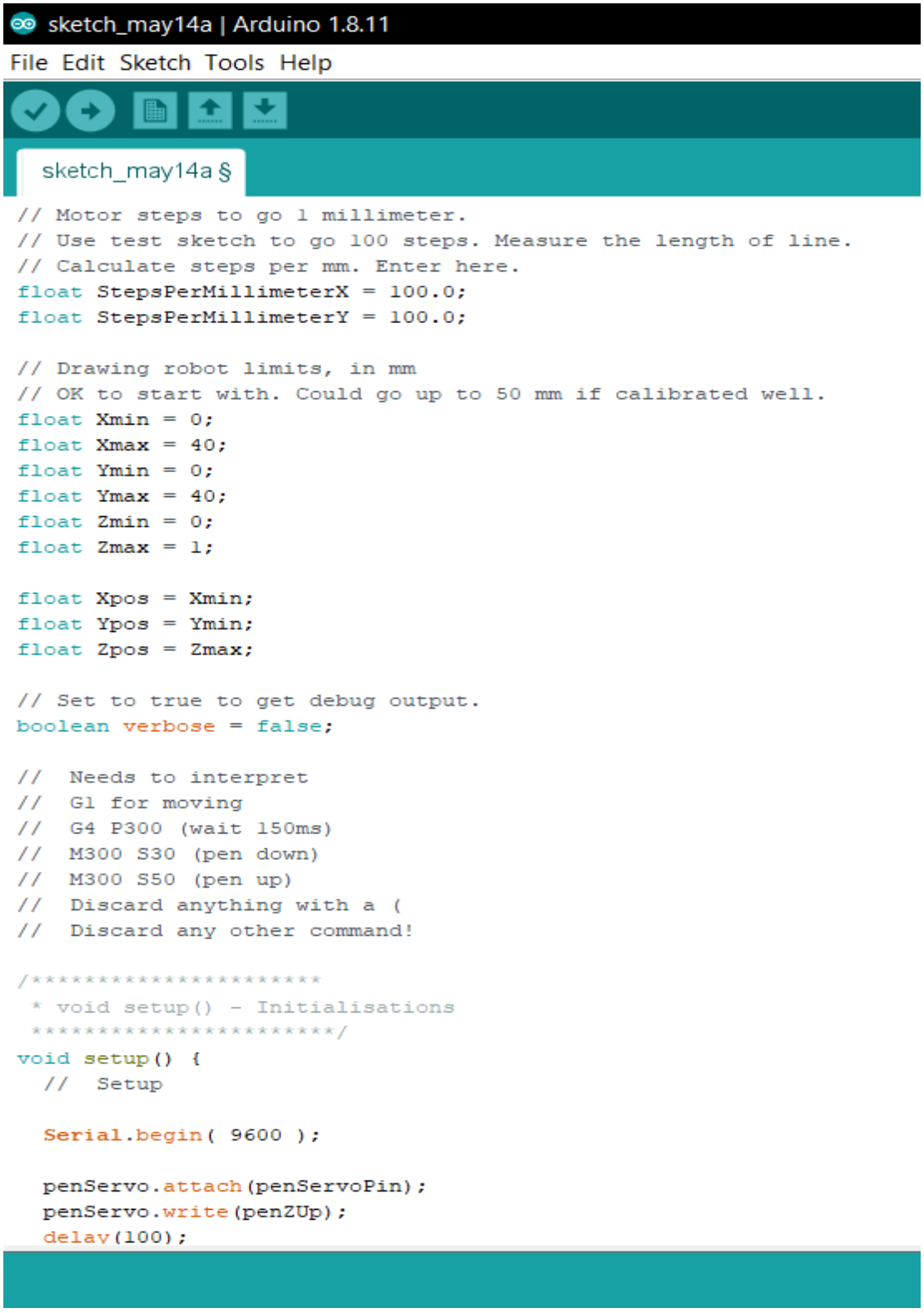


Fig 19(b): Coding for positioning of axis and pen/laser

Fig 19(c): Coding for different positioning of the axis

The full coding has been uploaded in the below link:

https://drive.google.com/drive/u/0/folders/1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

7

ANALYSIS

7.1 Analysis

Following were the analysis done on the parts of our CNC plotter and engraving machine:

7.1.1 Upper Rod

We did a static structural analysis of the upper rod (diameter= 8mm) by applying a torque of 4.28281kgf.cm. We took value because the holding torque of our stepper motor was 4.28281kgf.cm. Below is the link for the analysis report file:

https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

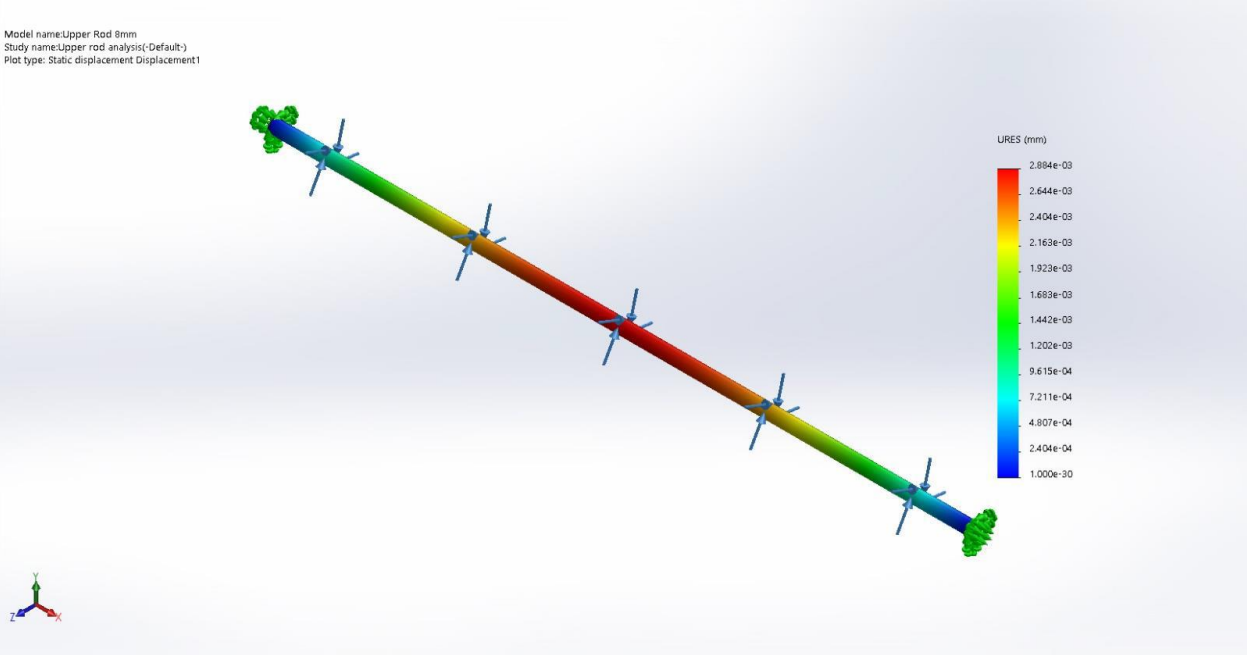


Fig 20: Total displacement of the upper rod

According to the obtained results, the chances of deformation of the upper rods are very less as the value obtained is much less than the applied value.

7.1.2 Side Rod

We did a static structural analysis of the side rod (diameter= 8mm) by applying a torque of 4.28281kgf.cm. We took value because the holding torque of our stepper motor was 4.28281kgf.cm. Below is the link for the analysis report file:

https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

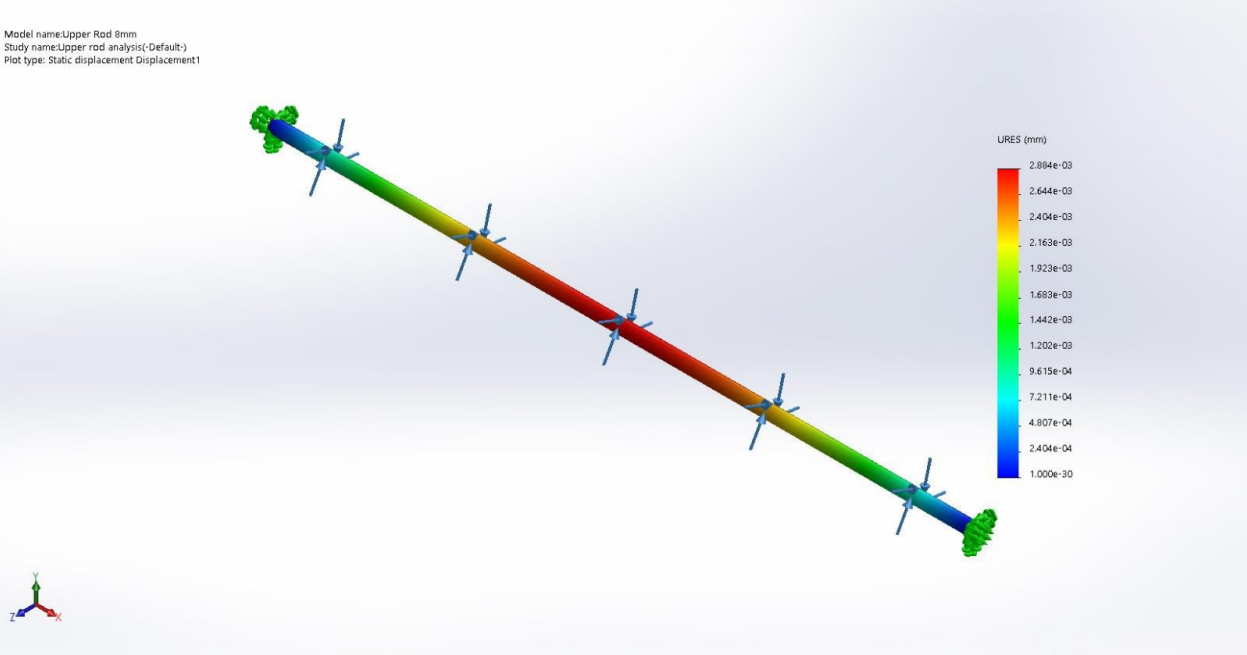


Fig 21: Total displacement of the upper rod

According to the obtained results, the chances of deformation of the upper rods are very less as the value obtained is much less than the applied value.

7.1.3 Pen

We did a static structural analysis of the pen, which will be used in the plotting of the PCB circuits, by applying a pressure of 2.847e-006 MPa. We took this value because the holding torque of our servo motor is 2.847e-006 MPa. Below is the link for the report file:

https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

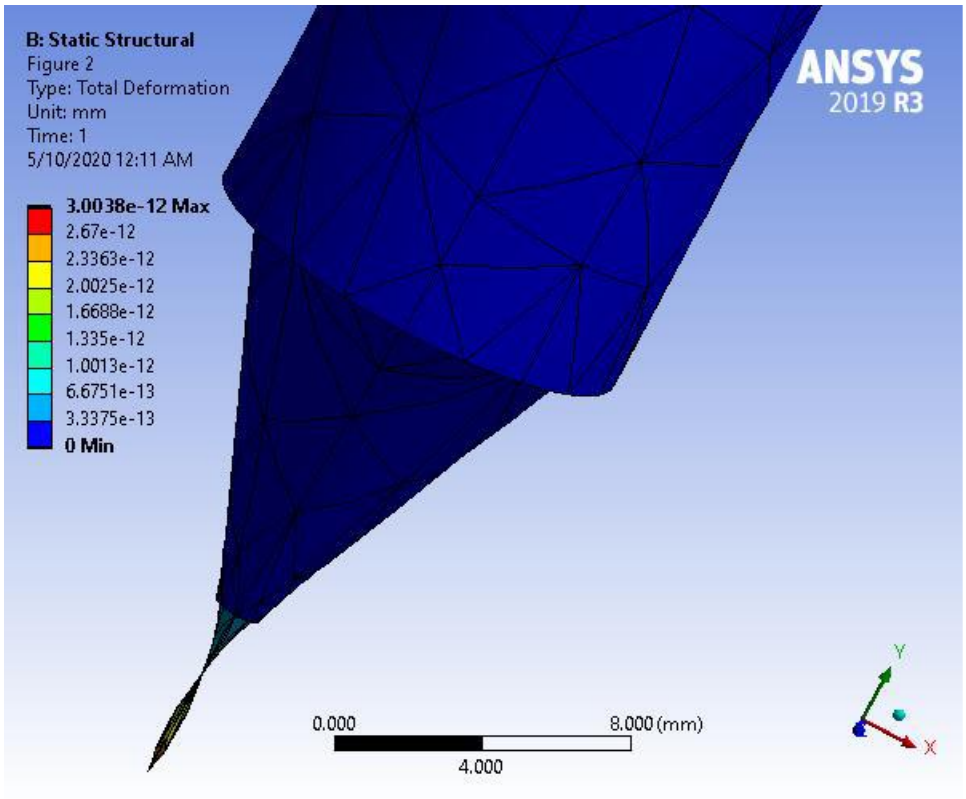


Fig 22: Total deformation of the pen tip after applying the required pressure

According to the obtained results, the deformation of the pen will be very less as the value obtained is less than the actual applied value.

7.1.4 Heatsink

We did a thermal analysis of the heatsink that will be attached to the CNC shield. The heat sink is a type of heat exchanger that transfers the heat generated by any mechanical or electronic devices into the air. This is generally made of aluminium or copper because they are good conductors of heat. In this project, our heat sink is made from aluminium. We have compared the heat exchanger with a laptop's condition so that we can analyze because the Arduino board generates less heat as compared to a laptop. Below is the link for the thermal analysis report of the heatsink:

https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

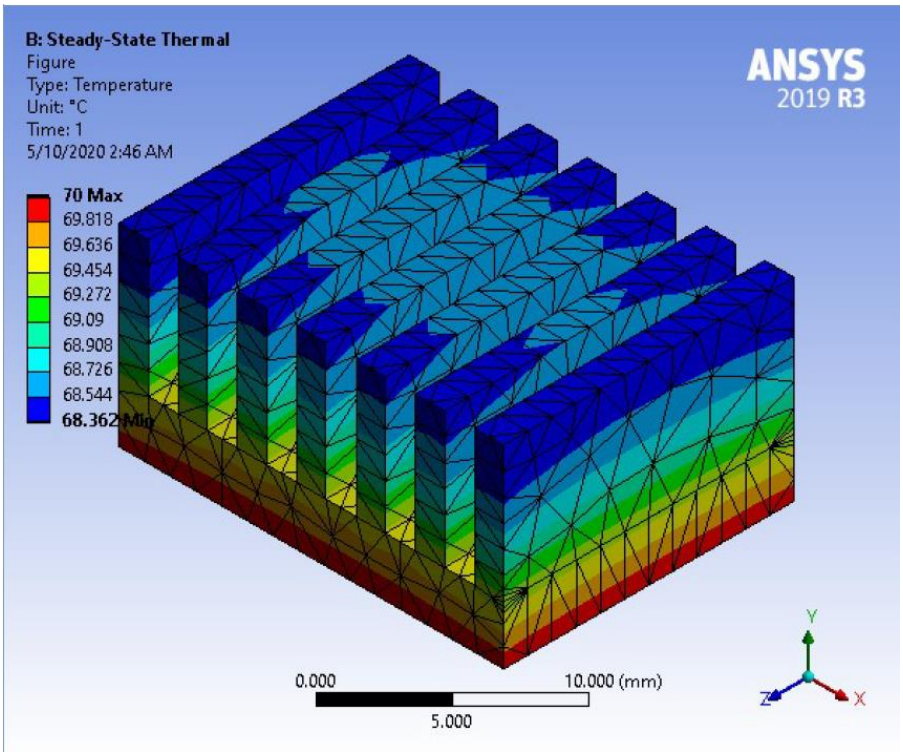


Fig 23: Maximum temperature

According to the obtained results, the maximum temperature generated by the machine will be absorbed and exchanged with the surroundings as Arduino boards generated less heat.

7.1.5 Base of CNC plotter and engraving machine

We did a static structural analysis on the base of our machine. We applied pressure of 2.e-006 MPa because the pressure generated by the pen will be equal to the pressure applied on the base. Below is the link of the report file:

https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

According to the obtained results, there will be no deformation as the obtained value is less than the applied value. Hence, our base will not be damaged under the required applied force.

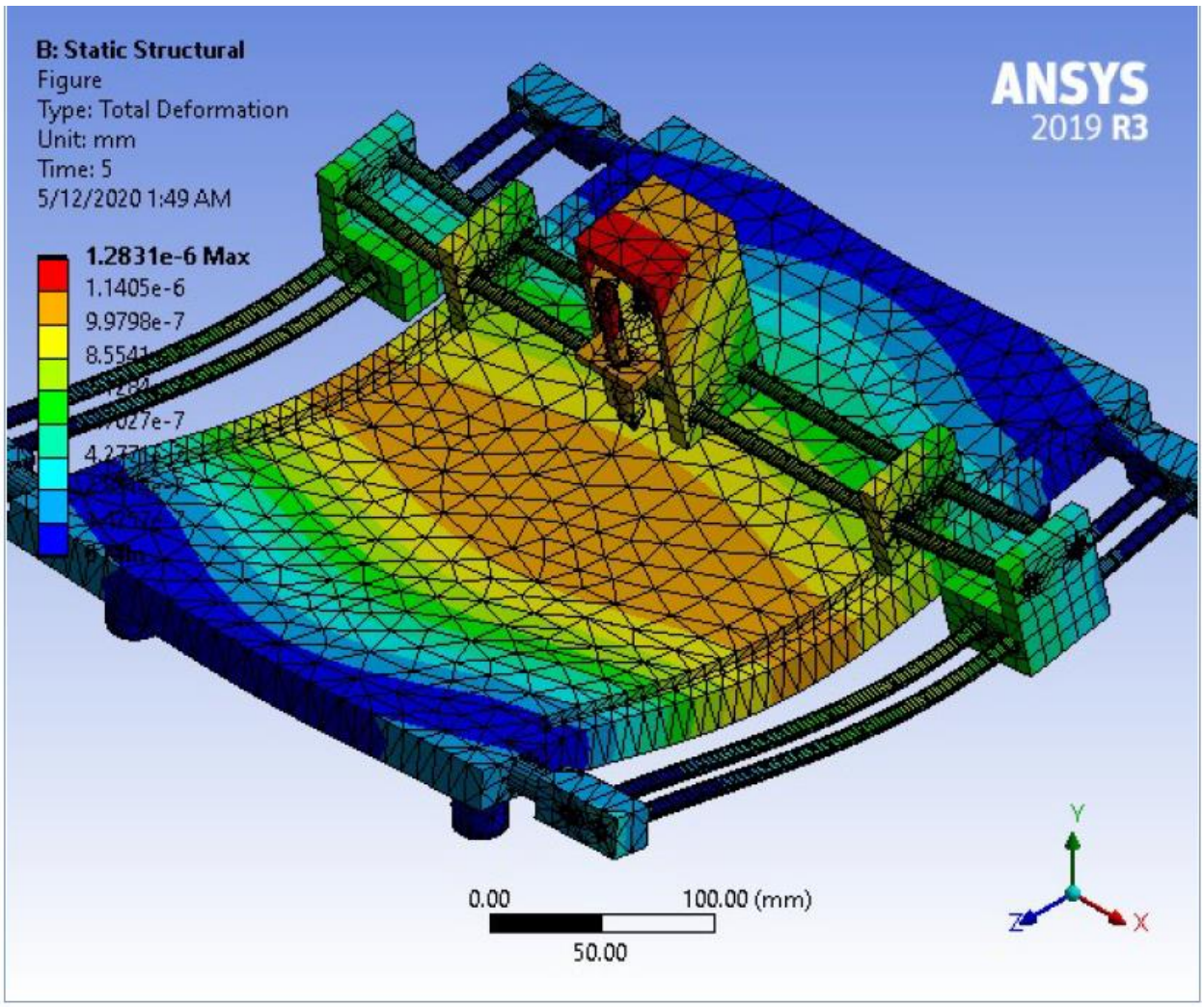


Fig 24: Total deformation of the base of the machine

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RESULT AND DISCUSSION

In today's CNC machine, all components are highly functional with CAD and CAM systems. Programs generate a translated file to issue a command for the operation of a specific machine through a background installation. After being decrypted, the code is then loaded into CNC production machines. Given the increase in population we are increasing the number of areas with relatively small numbers of different industries. So, these types of small machines will help those types of industries because they can provide both flexibility and efficiency in manufacturing. This will also reduce investment but will ensure maximum profit for small businesses.

We have transformed our machine in such a way that it will be able to draw and write in all related fields such as wood, paper, cacao and plastic. It will also help to attach to surfaces such as aluminum, marble, stone, tile, glass, etc. The unique feature of our machine is that parts will be easily accessible and readily available in the market. The cost of repairs to our machine will be low compared to other machines available in the market. We tried to keep our design small and simple so that the average worker with basic knowledge could use it easily.

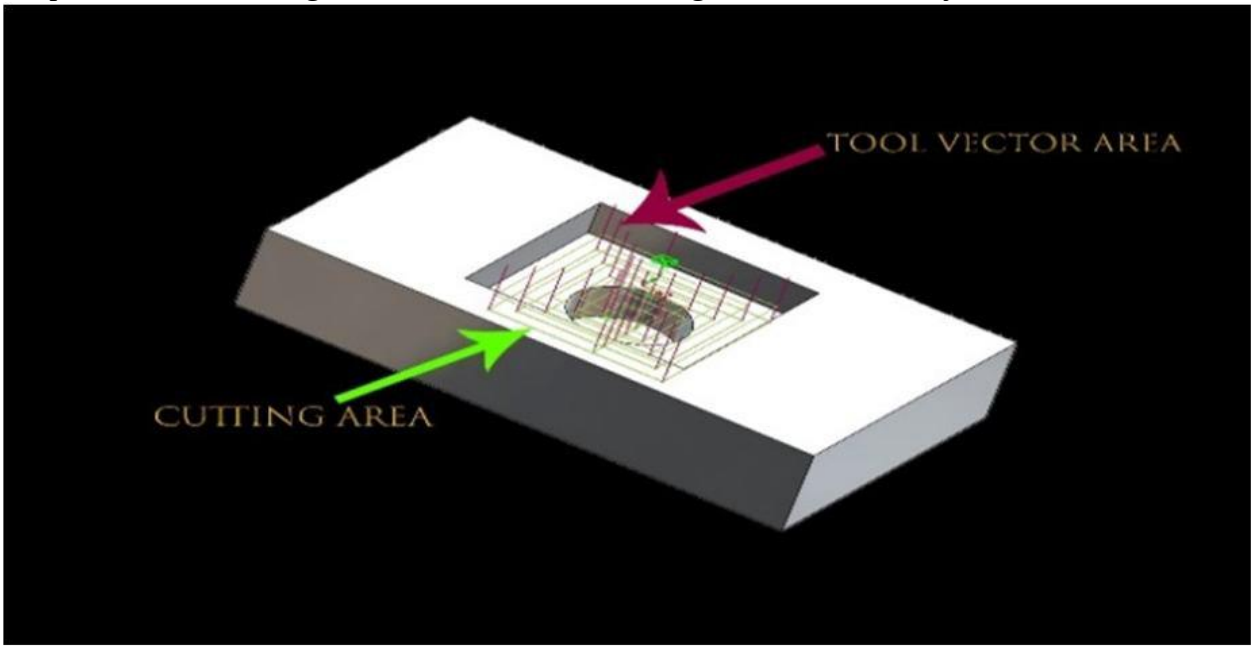

Fig 25: Tool path obtained by simulation on an aluminium block

The green arrow shows the area that will be cut with the assistance of the tool or laser engraver. The red arrow shows the tool vector area that will be covered by the tool.

9

ADVANTAGES AND LIMITATIONS

9.1 Advantages

There are various advantages. Some of them are as follows:-

1. The software used for coding and calibrating are open source programs.
2. It supports various kinds of hardware and configuration and it’s very easy to use.
3. The stepper motor never misses any step. Hence the whole operation is reliable.
4. Through InkScape software we can very easily generate G-code.
5. The whole project is cheap and can be easily constructed through used parts of hardware form computers.

9.2 Limitations

Apart from the great advantages, there are major limitations too for CNC PLOTTER. Some of them are as follows:-

1. As per the size and limit of the project, it can't work in bigger burden applications and cutting powers too. It can't withstand higher cutting powers while cutting and the high weight of cutting devices.
2. Since the circuit utilized the shapes that can be draft are constrained. Arduino Uno limit is restricted up-to constrained shapes considering of grbl programming utilized also.

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FUTURE SCOPE

The servo can be replaced with a stepper motor and the pen with a 3-D pen to make it a 3-D printer which can print objects with dimensions. By extrapolation of the axes, the working area of the machine can be extended keeping the algorithm unaltered.

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CONCLUSION

After performing and analyzing the above contents, we can say that, CNC machine tools must be better designed and constructed, and must be more accurate than conventional machine tools. It is necessary to minimize all non-cutting machine time, by fast tool changing methods, and minimize idle motions by increasing the rapid traverse velocities to make the use of the machine tool more efficient. Digital control techniques and computers have undoubtedly contributed to better accuracy and higher productivity. However, it should be noted that it is the combined characteristics of the electric control as well as the mechanical design of the machine tool itself that determine the final accuracy and productivity of the CNC machine tool system. High productivity and accuracy might be contradictory. Because high productivity requires higher feed, speed and depth of cut, which increases the heat and cutting forces in the system. This will lead to higher deflections, thermal deformations and vibration of the machine, which results in accuracy deterioration. Therefore, to achieve high operating bandwidth while maintaining relatively high accuracy, the structure of CNC machine tool must be more rigid and stiff than its conventional counterpart. To achieve better stiffness and rigidity of structure, several factors were considered during the modeling of the design. The first concern was the material. Conventional machine tools are made of cast iron. However, the structures of CNC machines are usually all-steel-welded, constructed to achieve greater strength and rigidity for a given weight. In addition, better accuracy is obtained in CNC machines by using low-friction moving parts, avoiding lost motions and isolating thermal sources. Regular sliding guides have higher static friction than the sliding friction. The force used to overcome the static friction grows too large when the guide starts to move. Due to inertia of the slide the position goes beyond the controlled position, adding overshoot and phase lag to the system response, and affects the accuracy and surface finish of the part. This can be avoided by using slides and ball screws in which the static friction is lower than the sliding friction for example, rolling type parts such as ball-bearing ball screw and recirculating linear slides can be used.

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REFERENCES

I. "A knowledge-centric Machine Tool Design & Development Process Management Framework", International Journal of Production Research, 2014, vol. 52, no20, 6033-6051, by Linyan liu, Barrets s.calwell, Huifen wang, Ying li

II. "Design and Implementation of Three dimensional CNC machine", International Journal of Computer Science and Engineering, Nov.2010, vol 02, 2567- 2570, by Venkata krishna pabalu, Prof.k.n.h.shrinivas

III. "Fabrication of Low cost 3 axis CNC Router", International Journal of Engineering Science Invention, ISSN (online):2319-6734, ISSN (print) 2319-6726, vol 3 issue6, june2014, by Dr.J.B. Jayachandraiah, o vamsikrishna, P.abdullah khan,R.ananda Reddy

IV. "Improvement on CNC Gantry Machine Structure Design for Higher Machining Speed Capability", International Journal of Mechanical, Aerospace, Industrial and Mechatronics Engineering, vol 9, Nov: 2015,by Ahmed a.d.sarhan, S.r.besharaty, Javed akbaria, m.hamdi

V. "Prototype Development of Milling Machine Using CAD/CAM", International Journal of Science And Research, ISSN 2319:7064, vol.4 issue 8 2015, by Nikita r saharkar ,Girish m dhote

VI. "Design Optimization of CNC Vertical Milling Machine Bed", Indian Streams Research Journal, vol.2, issue 7, 2012 by B.Malleswara swami, K. Sunil ratna kumar, C.H Ramakrishna

VII. "An Investigation Effect of Machining Parameters on CNC Router", IJEDR, ISSN: 2321-9939, vol. 2, issue 2 ,2014, by Mr.Dhruv H. Patel, Prof. V. N. Patni

VIII. "Selection of Kinematic Structure for Portable Machine Tool", Advances In Manufacturing Science and Technology, vol.36, no.1, 2012 by Monika Nowak, Daniel Jastrzębski

IX. A DYNAMIC ANALYSIS OF AN INDUSTRIAL CNC PLOTTER D. Cekus, D. Skrobek, T. Zając

X. Design and Manufacturing of Mini CNC Plotter Machine Mr. Pritesh Runwal, Mr. Anil Shelke, Mr. Pankaj Udavant, Mr. Sujit Rokade, Prof. D.A. Baitule, Department of Mechanical Engineering Trinity Academy of Engineering, Pune

XI. Accurate and Cost-Effective Mini CNC Plotter Sara Raad Qasim, Haider Mohammad & Mustafa Falah

XII. Arduino Based Cost Effective CNC Plotter Machine Puja Girhe, Shubham Yenkar & Arpita Chirde

XIII. CNC Machine Pcb Plotter A S Patil, S R KAKADE, B LAD, D D SASTE, & D N HOMKAR

XIV. Wireless Base CNC Mini Plotter Three Axis Control Machine Ghulam Dastgeer, Prof. Muhammad Asad & Saad. S.S. Ali Department of BSc Electrical Engineering & Technology Faisalabad (Affiliated with University of Engineering and Technology Lahore), Pakistan

XV. Programming upload procedure-https://circuitdigest.com/microcontroller-projects/arduino-cnc-machine-project-code

XVI. Heatsink Conditions- https://www.youtube.com/watch?v=i2IsAucK85Y&t=452s

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PUBLICATIONS

Below are the details of our published paper:-

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1

INTRODUCTION

1.1 HISTORY

and assembly line for helicopter blades. John T. Parsons then motorized

strategy.

Fig 1: First CNC machine

In 1952, Richard Keg, in a joint effort with Massachusetts Institute of Technology, built up

innovation.

1.2 OBJECTIVES

The fundamental target of this task is to gracefully plotting/drafting activity as a substitute for conventional manual activities done by a worked by hand instrument. The venture is utilized as a rule that despises the plotting activity which may get supplanted by the other cutting apparatuses like Drilling machine, Milling cutters, even Laser cutters, and so forth. Compact disc ROM CNC plotter might be a less expensive CNC plotter and might be effectively made by rejected/utilized equipment parts. The plotter can likewise be utilized for drafting purposes.

Fig 2: Flow chart to implementation CNC plotter machine

2

LITERATURE REVIEW

2.1 INTRODUCTION

Over the most recent couple of years, part measures have diminished significantly the same number of assembling firms have embraced the in the nick of time producing reasoning. Therefore, the providers of machined parts both hostage machining offices and agreement machine shops to those organizations have required machine apparatuses which will be discovered quicker for the following occupation. They have required machine tools that enable them to respond faster to customer orders and at the same time more readily accommodate part design changes. The machine tool

manufacturers have had to fulfill these customer requirements to stay competitive. What follows may be a check out a number of the main improvements that are made to CNC multi-spindle screw machines as a result.

The arrangement of high-creation, multi-axle screw machines has consistently been a tedious procedure. In any case, controls for CNC multi-axle screw machines have improved colossally inside the most recent decade. A significant advantage of these upgrades is a stamped decrease in arrangement times. The present CNCs are as incredible as the most current and best PC. The PC has become an integral part of the machine.

2.2 REVIEWS

I. Linyan Liu et al. (2014) presents an information-driven procedure the board structure for the CNC plotter plan and advancement (D&D) with the coordination of procedure and information. Prerequisites for the structure are created dependent on the idea of the machine apparatus configuration practice. The proposed system comprises of procedure incorporation model, process reenactment, process execution, and information objects the board modules. Every one of these modules is expounded to help the information-driven machine apparatus improvement process the board. The model improvement is additionally introduced by the creator. Aftereffects of this investigation encourage the information joining in CNC machine apparatus D&D, and subsequently increment machine device improvement capacity, decrease advancement process duration and cost, and eventually accelerate the adequacy and guarantee the amazing machine instrument improvement. At last, the investigation includes laid out a system inside which creators are urged to take part in the machine device advancement effectively and advantageously, to help every person and the organization. Contrasted and the current references, the proposed system of information-driven CNC machine apparatus D&D process the board incorporates the accompanying outcomes: - • Based essentially on the idea of the machine apparatus configuration practice, prerequisites for the information driven casing work with the joining of procedure and information are dissected in light of the structure questions, the D&D procedure, the information driven interest, and its executing and checking request. At that point, the system of information driven CNC machine instrument D&D process the executives utilized in the CNC machine device industry is proposed, which incorporates displaying, reenactment, and execution and thinks about the information. The plan procedure of the KVC1050N Vertical machining focus is additionally concentrated for instance to exhibit the plausibility and accessibility of the proposed system. The aftereffects of this investigation fundamentally add to endeavors to accomplish information and procedure joining in the CNC machine device D&D. In a word, continuous endeavors are being taken to make the system progressively down to earth in the modern application. Therefore, this arrangement can serve machine device organizations in this significant industry segment by expanding machine apparatus advancement abilities, improving work productivity, and at last decreasing improvement process duration and expenses. II. Venkata Krishna Pabolu et al examine the plan and usage of ease three-dimensional mechanized numerical control framework (CNC) for mechanical application. In this paper prototyping, an Embedded CNC machine was made. Detail depiction of various modules, for example, programming advancement, Electronic/Electrical turn of events, alongside specialized subtleties of their usage has been given. III. D.J. Jayachandraiah et al give the plan to build up the minimal effort Router framework which is equipped for 3 axis simultaneous interpolated. The minimal effort is prototyping is accomplished by joining the highlights of the standard PC interface with a microcontroller-based CNC framework in an Arduino based implanted framework. With a restricted financial plan, the creator infers that little machine instruments to create little parts can give adaptability and proficiency in the assembling approach and diminish the capital cost, which is valuable for entrepreneurs. IV. Ahmed A.D. Sarhan et al. in this paper, an underlying CNC gantry processing machine structure with the possibility to create high surface completion has been planned and investigated. The objective of the creator is to accomplish the most reduced normal recurrence of 202Hz relating to 12000 rpm at all movement amplitudes with a full scope of reasonable recurrence reactions. Modular investigation of the underlying gantry structure configuration was performed and its normal recurrence was 102.36HZ. To improve the dynamic conduct of the gantry structure so it can suffer at frequencies above 200HZ, an alteration procedure was done to expand solidness. The above upgrade, proper conduct was accomplished. Misshapen of less than 10 microns followed at the tip of the shaft when the base characteristic recurrence of the gantry structure transcended 200Hz. An expansion in the structure's weight was a critical factor for the distinguished twisting. In any case, the variety didn't hurt the accuracy of the machine. Subsequently, the weight expanded after adjustments to the gantry structure were made, while the measure of distortion and generally speaking powerful conduct improved. Additionally, the adequacy of the Z-pivot part's situation on the dynamic conduct of the gantry structure was contemplated. By relocation of the shaft position, the dynamic conduct of gantry structures will change. Assessments on the gantry structure's conduct showed that the least common recurrence happened while the Z-pivot part was situated beneath the center of the pillar. This implies the structure was in a basic circumstance. The outcomes are appeared by the creator, that as indicated by the basic condition, the base recurrence of the structure is worthy. The examination results show that the structured CNC

gantry machine is equipped for working at a speed of 12,000rpm. V. Nikita R. Saharkar et al. plan the CAD Model in Solidworks and done the FEA examination in hyper work device giving the proper imperatives, burdens, and second qualities. As per the creator, he got the pressure an incentive around 14 MPa which is not exactly the permissible pressure estimation of M.S. closing the plan is sheltered. The creator likewise produces the G and M codes by reproducing the CAD document in Power plant programming which is only the CAM programming. Sundar Pandian et al. (2014) grow ease 3 hub CNC machines utilizing off-the-rack parts, stepper engines with drivers, Arduino open source, microcontroller, and open-source engine control programming. The writer utilized prepared to collect unit from Zen Tool works, USA. The unit gave stepper engine, lead screw, manage pole, hostile to kickback spine, and spring. He made the Body with high-thickness PVC. The machine has fixed gantry and a versatile bed so there is a limitation in the working territory. The creator builds up a Low-cost CNC machine just for instructive purposes. VI. B. Malleswara Swami et al. in this paper creator portray the strategy for static and dynamic investigation. The creator utilized a standard bed for investigation. The examination is conveyed to decrease the weight without changing the basic unbending nature and precision by including the ribs in a reasonable area. The static investigation is accomplished for 1g for example gravitational power is considered with an outer burden on the structure and 5g, for example, gravitational power multiple times 'g' esteem is applied on structure alongside the outside burden. In the modular investigation, the normal recurrence of the body is assessed to discover dynamic and vibration qualities. At that point, the upgraded plan is created utilizing the pick struct instrument. The outcomes which get after advancement lessens the weight by 1.55% with unique worth and normal recurrence moved by appx. 8.8 % with the first common recurrence. VII. Dhruv Patel et al. studied influences of various parameters like tool speed, tool feed and depth of cut on CNC router and concluded from ANOVA that percentage contribution of feed rate is maximum and it means Feed rate is the most dominating factor for modeling surface finish. VIII. Monika Nowak et al. detailed strategies for the determination of geometric and physical structures of the portable machine by indicating the plan necessities and the advancement of the end conditions dependent on these prerequisites. The determination technique depended on an investigation of the useful portrayal of the necessary forming developments, cautiously creating proper conditions for the disposal of options utilizing the data concerning the requirements of future versatile machine administrators. IX. D. Cekus published a paper in which the drive parameters for an arranged machining process have been resolved. For this reason, a powerful investigation of a CNC plotter has been completed in the Motion module of the SolidWorks program. The outcomes have been utilized in the planning phase of a mechanical plotter for a Polish organization delivering CNC machines. X. Mr. Anil Shelke describes a minimal effort sequential correspondence based scaled-down CNC Plotter Machine dependent on open-source programming and equipment. Smaller than expected CNC Plotter Machine is an installed framework that deals with the Principle of 'PC Numeric Control (CNC)'. The framework works with three stepper engines (two for X-pivot and one for Y-hub) and a miniaturized scale servo controller (for Z-hub). Wherein Arduino Circuit plots the information given from the PC through 'INSCAPE Software' on the sheet which is put on the planning phase utilizing a small scale controller. The plotter has four-hub control (2 X-hub and 1 Y& Z hub resp.) and a smaller scale servo controller for the development of the pen. This framework diminishes human exertion and furthermore lessens the odds of mistake. The proficient and right mounting of the considerable number of parts and legitimate utilization of programming and the right arrangement of the circuit makes the framework progressively effective. XI. Sara Raad Qasim portrays in her paper, a minimal effort, medium-size, and precise small scale CNC plotter are planned to utilize straightforward and ease parts: a microcontroller (Arduino), stepper, and servo engines and their control programming. The product has been utilized to deliver a G code for the activity of the framework. XII. Puja Girhe in her paper manages the plan of a programmed smaller than expected CNC machine for PCB drawing and penetrating. The thought behind our venture is to plan and drill PCB dependent on a minimal effort CNC framework the lower cost is accomplished by consolidating highlights of PC with ATMEGA 328 controller in an Arduino. We have utilized a G code for entire framework activity G code is only a language in which individuals tell modernized machine instruments 'How to make something'. The How is characterized by directions on where to move and how quick to move. XIII. A S PATIL, the paper is about the CNC Machine PCB Plotter which is utilized to draw circuit format on PCB. For that first, you have to change over the content record or picture document into G code utilizing InkScape programming. At that point, this G code is applied to handling programming. ATmega 328 microcontrollers utilizing Arduino Uno is utilized to control the gadget. The controller changes the given G code and afterward makes an interpretation of them into a machine language guidance. These directions are for the engine drivers to be sent to the engine drivers. XIV. Prof. Muhammad Asad in his paper ensures an affinity to style a less expensive cost remote CNC smaller than usual plotter three-hub control machine that joined with a microcontroller. CNC machines territory unit prepared numerically and conjointly use for draw animation pitchers and 3D pitchers with ninety-seven.5% precision. The precisely part as indicated by a structured program took care of into their controller unit. The controller unit can be both a PC and a microcontroller. The remote CNC machine has stepper and servo engines to draw any pitchers or signature according to the fed program. This framework basically works with an HC-05 Bluetooth component (for remote correspondence) 2 Stepper engines for the

pivot of turn and one servo engine (for z-hub). This procedure diminishes the human exertion and usage of essentialness and time. Because we have the affinity to utilize an HC-05 component for remote correspondence between CNC machine and PC or information gadgets, we have a penchant to deal with a CNC machine with remote correspondence. First matched gadgets and afterward give the G-Codes to Arduino. The conservative and [proper] mounting of the considerable number of segments and appropriate utilization of the product framework and arrangement of the circuit construct the framework a ton of affordable. We have conjointly assessed our monetary machine and have discovered its presentation venerate the current forefront high-ticket machines.

3

PROBLEM DESCRIPTION

3.1 PROBLEM DEFINITION After analyzing the research papers, we got to know the following points: • The cost of a CNC plotter was high. • The plotter lacked accuracy therefore the plotting done on the PCB boards was inappropriate. • The frame wasn't strong enough to handle the vibrations of the motors which resulted in loosening and breakage of the frame. • Many faults occurred while performing the tasks. • The workers were required to be skilled within a particular operation as this machine runs on specific codes.

3.2 PROBLEM SOLUTION After reviewing the research papers, we found out the problems that needed to be overcome. Hence, to overcome the problems that we had discussed in 3.1 we are presenting here an idea of a mini CNC plotter and engraving machine. The idea behind this project is to make a small CNC plotter which will have the following specifications: - • It will have high accuracy and precision as it will be fully computer-based and all the easy and high-end software will be used. • It will be easy to operate. • We have planned our project in such a way so that the tool could be replaced with different cutters like a blade, laser, milling cutter, etc. • The important feature of our project will be that it will be cost-efficient and the parts used to make the machine would be easily replaceable. • This will also be user-friendly and easy to operate.

Fig 3: CNC plotter and engraving machine

4

TECHNICAL SPECIFICATION

4.1 Arduino UNO One of the major components of our project is Arduino. In our project, we have chosen Arduino Uno R3 which just sudden spikes in demand for G-codes. The Uno is a microcontroller board which is completely dependent

on

begin.

We are using Arduino R3 Atmega328P. It operates at 5 V. It has 2

translates to

connected to the host computer and a DC power jack for connecting an external power source.

Fig 4: Arduino Uno R3 Atmega 328P

Following are the specifications of "Arduino Uno R3":-

PARAMETERS SPECIFICATION Microcontroller ATmega328P Operating Voltage 5V Input voltage (recommended) 7V-12V Input voltage (limits) 8V-20V Digital I/O

of which 0.5kb is

Table 1: Arduino Uno specification and parameters

4.2 CNC Shield CNC shield functions the controlling axis of our cutter. Considering X-Y axis as linear axis for movement whereas Z- axis functions the cutting motion, though the last axis, for example, A-axis is for the choices for giving the rotational movement to the cutting instrument, for example, a rotational movement for boring activity, and so on.

Each axis will have three jumper that can set to configure the stepping for the axis.

Fig 5: CNC shield

Fig 6: Different connections in CNC shield

PARAMETERS

Table 2: Parameters and specifications of CNC shield

4.3 Stepper Motor The motor stepper is used to achieve the exact position with computer control. The engine operates in direct synchronization with the heart rate from the controller to the main touch. Stepper engines, with their capacity to provide high torque at low speed while minimizing vibration, are ideal for applications that require a faster environment with shorter distances. The stage car provides direct power to stand without power. They are used in various types of hardware directly on the turning edge and speed control using hit signals. Stepper engines produce high torque that is lightweight and is ideal for quick response and speed. Stepper engines additionally hold their position in the stall, due to their structure.

Fig 7: Construction of stepper motor

4.4 HC-06 Bluetooth Module Bluetooth module is a PCBA board that incorporates Bluetooth capabilities. It is often used for remote transcription of short distances, which can be distinguished from the Bluetooth module and the Bluetooth voice module as indicated by its use. The module is a basic set of circuitry that incorporates Bluetooth power and can be used for remote program transmission. In general, the Bluetooth module can be divided into the following types: data

transfer module, remote control module, and so on. Usually, modules are the last-used, customizable dependencies on chips to make the next program easier.

The HC-06 is a Bluetooth module that is intended to set up long-distance short-distance communication between two microcontrollers or a frame. The module works with Bluetooth 2.0 encryption and can act as a slave gadget. This is an inexpensive way to move data remotely compared to different strategies and can transfer records at speeds up to 2.1Mb / s. The HC-06 using a distance-based re-distribution system (FHSS) to maintain optimal distance from being locked by various gadgets and is fully distributed. Gadget gadgets from multiplication range from 2.402 GHz to 2.480GHz. Fig 8: HC-06 Bluetooth module

Fig 9: HC-06 Bluetooth module pinout

HC-06 module has six pins as shown in the pinout. The function of the pins are as follows:- 1. Key- The pin state determines whether the module works in AT command mode or normal mode [High=AT commands receiving mode (Commands response mode), Low or NC= Bluetooth module normally working].

2. VCC- +5V Positive supply needs to be given to this pin for powering the module.

3. GND- Connect to ground

4. TXD- Serial data is transmitted by module through this pin (at 9600bps by default), 3.3V logic.

5. RXD- Serial data is received by module through this pin (at 9600bps by default), 3.3V logic.

6. State- The pin is connected to the LED on the board to represent the state of the module.

4.5 Laser High power laser for Engraving and Cutting accompanies LASER Light intensity of 1 Watt and having the frequency of 445nm accompanies a driver. We can etch plastic, wood, acrylic, PVC, PCB, for the benefit of the wood and different materials. This module doesn't contain pictures on the section and power supply. This likewise has a compatible driver connected to it.

Fig 10: Green Laser

PARAMETERS SPECIFICATIONS Laser wavelength 445nm(blue) Spot type Dotted Light power 1W (1000mW) Cooling method Air-cooled Input voltage 5V Table 3: Features and specification of the laser

5

DESIGN, WORKING & SOFTWARE

5.1 Design The design of our project will be as shown in figure 9. It consists of several parts such as a wooden base, SS rods, writing pen/laser, stepper motor, Bluetooth module, etc. This design has been created in Solidworks which is a 3d modeling software. There are various types of commands and features in Solidworks like rectangle, extrude boss, extrude cut, mirror, etc., which helped us in creating the 3d model of our design.

Fig 11: CNC plotter and engraving machine design

The dimensions of the design are as follows:- PART DIMENSION Base 420mm X 297mm SS Rod 390mm (side rod) 437mm (upper rod) Pen 9.89mm Case 419mm X 169.55mm Laser 12mm dia.

Table 4: Dimensions of main parts

The model is designed in such a way that it will move in 4 directions i.e., X-axis, Z-axis, Y-axis, and (-Y)-axis. The detailed dimension of the model is given in figure 10.

Fig 12: Dimensions of 3d model

5.2 Working The performance of our machine will be as follows: 1. 1. The CNC layout machine needs three axes

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to operate the X, Y, and Z-axis. The x and y-axis always work to make a two-dimensional image on paper. These x and y -axis are set to 90 degrees with the final error that any point in an empty space is expressed by the given value of x and y. The z-axis is used to lift and lower the pen,

laser, and axle on transparent paper.

Fig 13: Block diagram of the working of CNC plotter and engraving machine

2. Compatible with

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the image to be drawn, the software will generate acceptable links and send it to the microcontroller on the USB port. The microcontroller describes these links and then controls the position of the vehicle to create the image. Here we used

the Arduino Uno ATmega 328P because it is the Microcontroller used to create the Mini CNC Machines.

3. To make the x and y-axis, two SS rods are used. All of these parts consist of a stepper motor and a part of the drive system that are commonly

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used to move the cartridge back and forth. On the z-axis, the engine smaller than the standard servo is put into the y-axis input. This servo engine is used to move the pen here and there. A

decent tool is being developed that will provide free energy for all development. 4.

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Due to the large size of this machine, the device is capable of drawing on A3 paper. So we will cut an A3-size platform (297mmx420mm) from acrylic glass and

attach it to the x-axis using glue.

5. Insert the shield of the L293D motor driver into the Arduino UNO board. Then connect the two step motors. The ground connection should be left unplugged. Connect the 5V - 7V power supply to the driver's shield port of power.

6.

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Since we are using the motor shield of the L293D, we need motor library. Then paste it into your Arduino IDE library folder. Rename it as AFMotor. If the Arduino IDE was open then open it again and click on

the

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file -< examples -< Adafruit Motor Shield Library -< stepper. Select the correct port and board

for the

the ladder of steps. Stepper gearbox is changed from 2 to 1.

5.3 Software Used The various software that is used in the modeling and simulation of our machine are as follow:- 1. SolidWorks- This is a software that is used for computer-aided design and computer-aided engineering (CAD and CAE). This product helped us in structuring a 3 dimensional model of our venture. It also helped us in analyzing rods.

Fig 14: SolidWorks

2. Ansys- This software is used mainly for analysis of the 3-dimensional models. By using this software we calculated Equivalent Stress and Equivalent Strain for different parts that were involved in our machine.

Fig 15: Ansys

3. Arduino IDE- Arduino Integrated Development Environment is a cross-stage application that is written in abilities from C and C++. It is utilized to write down and transfer projects to Arduino appropriate sheets.

Fig 16: Arduino IDE

4. Inkscape- Inkscape is a free and open-source vector pictures supervisor. Inkscape's main vector pics group is Scalable Vector Graphics; be that as it may, numerous different configurations can be imported and sent out. Inkscape can render crude vector shapes and content.

Fig 17: Inkscape

5. Grbl-

Arduino.

Fig 18: GRBL 6 PROGRAMMING AND CALIBRATION

6.1 Program uploading procedure After all the procedure has been done, the main factor in the making of the project successful is to calibrate and upload the programming into the Arduino board through USB cable. The following are the procedures for uploading the code in the board:- 1. Extract the MI GRBL Zip File 2. It will create the MI GRBL folder name 3. Copy the folder and go to the Arduino area and find the folder of the library and place it there. 4. Turn on the Arduino ID goes to the files. 5. Example: - MI GRBL download code -< connect Arduino code to PCTool “ARDUINO UNO” Select compt (where Arduino code connects) known bugs and upload code. 6. Now download another Inkscape zip file extension (MI Extension). 7. After you copy the folder and open the Inkscape cape open area of the shared space extension then the previous folder copied inside the expansion folder this open the file to copy all the files and paste the outside of the folder then additional additions can be made. 8. Open the Inkscape folder to measure and create a simple G-Code first. 9. Inkscape does not have a built-in format for storing files in G-code. So, we need to install a plugin for our files to be converted and saved in G-code format. 10. After installation change its size from pixels to mm. It also reduced the height and width to 90mm. This will enable our workspace where all our text and drawings will be written. 11. Now draw the image you want and select "object to understand" and save the file to "MakerBot Unicon G-code." 12. Finally, the G code is ready and transmitted to the board and the machine is ready to operate.

6.2 Coding Following are some of the screenshots of the coding that we have done for the movement of CNC plotter and engraving machine:

Fig 19(a): Coding for process incoming line

Fig 19(b): Coding for positioning of axis and pen/laser

Fig 19(c): Coding for different positioning of the axis

The full coding has been uploaded in the below link:
https://drive.google.com/drive/u/0/folders/1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

7 ANALYSIS

7.1 Analysis Following were the analysis done on the parts of our CNC plotter and engraving machine: 7.1.1 Upper Rod We did a static structural analysis of the upper rod (diameter= 8mm) by applying a torque of 4.28281kgf.cm. We took value because the holding torque of our stepper motor was 4.28281kgf.cm. Below is the link for the analysis report file: https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

Fig 20: Total displacement of the upper rod

According to the obtained results, the chances of deformation of the upper rods are very less as the value obtained is much less than the applied value.

7.1.2 Side Rod We did a static structural analysis of the side rod (diameter= 8mm) by applying a torque of 4.28281kgf.cm. We took value because the holding torque of our stepper motor was 4.28281kgf.cm. Below is the link for the analysis report file: https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

Fig 21: Total displacement of the upper rod

According to the obtained results, the chances of deformation of the upper rods are very less as the value obtained is much less than the applied value.

7.1.3 Pen We did a static structural analysis of the pen, which will be used in the plotting of the PCB circuits, by applying a pressure of 2.847e-006 MPa. We took this value because the holding torque of our servo motor is 2.847e-006 MPa. Below is the link for the report file: https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

Fig 22: Total deformation of the pen tip after applying the required pressure According to the obtained results, the deformation of the pen will be very less as the value obtained is less than the actual applied value.

7.1.4 Heatsink We did a thermal analysis of the heatsink that will be attached to the CNC shield. The heat sink is a type of heat exchanger that transfers the heat generated by any mechanical or electronic devices into the air. This is generally made of aluminium or copper because they are good conductors of heat. In this project, our heat sink is made from aluminium. We have compared the heat exchanger with a laptop's condition so that we can analyze because the Arduino board generates less heat as compared to a laptop. Below is the link for the thermal analysis report of the heatsink: https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

Fig 23: Maximum temperature According to the obtained results, the maximum temperature generated by the machine will be absorbed and exchanged with the surroundings as Arduino boards generated less heat.

7.1.5 Base of CNC plotter and engraving machine We did a static structural analysis on the base of our machine. We applied pressure of 2.e-006 MPa because the pressure generated by the pen will be equal to the pressure applied on the base. Below is the link of the report file: https://drive.google.com/open?id=1Iw_Y4nmVmEEsBI7SehFKNSFov9Op8E0e

According to the obtained results, there will be no deformation as the obtained value is less than the applied value. Hence, our base will not be damaged under the required applied force.

Fig 24: Total deformation of the base of the machine

8 RESULT AND DISCUSSION

In today's CNC machine, all components are highly functional with CAD and CAM systems. Programs generate a translated file to issue a command for the operation of a specific machine through a background installation. After being decrypted, the code is then loaded into CNC production machines. Given the increase in population we are increasing the number of areas with relatively small numbers of different industries. So, these types of small machines will help those types of industries because they can provide both flexibility and efficiency in manufacturing. This will also reduce investment but will ensure maximum profit for small businesses.

We have transformed our machine in such a way that it will be able to draw and write in all related fields such as wood, paper, cacao and plastic. It will also help to attach to surfaces such as aluminum, marble, stone, tile, glass, etc. The unique

feature of our machine is that parts will be easily accessible and readily available in the market. The cost of repairs to our machine will be low compared to other machines available in the market. We tried to keep our design small and simple so that the average worker with basic knowledge could use it easily.

Fig 25: Tool path obtained by simulation on an aluminium block

The green arrow shows the area that will be cut with the assistance of the tool or laser engraver. The red arrow shows the tool vector area that will be covered by the tool.

9

ADVANTAGES AND LIMITATIONS

9.1 Advantages There are various advantages. Some of them are as follows:- 1. The software used for coding and calibrating are open source programs. 2. It supports various kinds of hardware and configuration and it's very easy to use. 3. The stepper motor never misses any step. Hence the whole operation is reliable. 4. Through InkScape software we can very easily generate G-code. 5. The whole project is cheap and can be easily constructed through used parts of hardware form computers.

9.2 Limitations Apart from the great advantages, there are major limitations too for CNC PLOTTER. Some of them are as follows:- 1. As per the size and limit of the project, it can't work in bigger burden applications and cutting powers too. It can't withstand higher cutting powers while cutting and the high weight of cutting devices. 2. Since the circuit utilized the shapes that can be draft are constrained. Arduino Uno limit is restricted up-to constrained shapes considering of grbl programming utilized also.

10

FUTURE SCOPE

After performing and analyzing the above contents, we can say that, CNC machine tools must be better designed and constructed, and must be more accurate than conventional machine tools. It is necessary to minimize all non-cutting machine time, by fast tool changing methods, and minimize idle motions by increasing the rapid traverse velocities to make the use of the machine tool more efficient. Digital control techniques and computers have undoubtedly contributed to better accuracy and higher productivity. However, it should be noted that it is the combined characteristics of the electric control as well as the mechanical design of the machine tool itself that determine the final accuracy and productivity of the CNC machine tool system. High productivity and accuracy might be contradictory. Because high productivity requires higher feed, speed and depth of cut, which increases the heat and cutting forces in the system. This will lead to higher deflections, thermal deformations and vibration of the machine, which results in accuracy deterioration. Therefore, to achieve high operating bandwidth while maintaining relatively high accuracy, the structure of CNC machine tool must be more rigid and stiff than its conventional counterpart. To achieve better stiffness and rigidity of structure, several factors were considered during the modeling of the design. The first concern was the material. Conventional machine tools are made of cast iron. However, the structures of CNC machines are usually all-steel-welded, constructed to achieve greater strength and rigidity for a given weight. In addition, better accuracy is obtained in CNC machines by using low-friction moving parts, avoiding lost motions and isolating thermal sources. Regular sliding guides have higher static friction than the sliding friction. The force used to overcome the static friction grows too large when the guide starts to move. Due to inertia of the slide the position goes beyond the controlled position, adding overshoot and phase lag to the system response, and affects the accuracy and surface finish of the part. This can be avoided by using slides and ball screws in which the static friction is lower than the sliding friction for example, rolling type parts such as ball-bearing ball screw and recirculating linear slides can be used.

16

Hit and source - focused comparison, Side by Side

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1/18	SUBMITTED TEXT	90 WORDS	44%	MATCHING TEXT	90 WORDS

CNC machining uses a machining technique that was developed within the 18th Century. The first turning the machine was invented in 1751. It had a metal frame. The essentials of an all-inclusive arrangement of machines advancing to make more exact activities precisely than is conceivable by carefully assembled procedures. This denoted the start of industrialization. However, it had been not until the conflict that the event of automation was addressed. At that point, the corporate Parsons Works was commissioned by the U.S. Navy to extend the productivity of its production

CNC machining uses a machining technique that was developed in the 18th Century. In fact, the first 'turning the machine   with a metal frame' was invented in 1751, the first of   a long series of machines aiming to create more precise operations mechanically than are possible by   handcrafted techniques. This marked the beginning of industrialization. However, it   was not until the Cold War that the development of automation was addressed. At that time, the company Parsons Works was commissioned by the U.S. Navy to increase the productivity of its production

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the axes of the machines for making these blades. Working with IBM, he studied the chances of controlling these machines by computer. This was the beginning line of the CNC machining

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3/18	SUBMITTED TEXT	35 WORDS	71%	MATCHING TEXT	35 WORDS

the first CNC processing machine: the Cincinnati Milacron Hydrotel. After five years, in 1958, he recorded a patent for an "Engine Controlled Apparatus for Positioning Machine Tool". This was the business birth of this

the first CNC milling machine: the Cincinnati Milacron Hydrotel.   Five years later, in 1958, he filed a patent for a "Motor Controlled Apparatus for Positioning Machine Tool". This was the commercial birth of this

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4/18	SUBMITTED TEXT	66 WORDS	84%	MATCHING TEXT	66 WORDS

the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple data sources, a 16 MHz, a USB association, a force jack, an ICSP header, and a reset button. It contains everything expected to help the microcontroller; basically interface it to a PC with a USB link or force it with an AC-to-DC connector or battery to

the ATmega328P. It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple information sources, a 16 MHz quartz gem, a USB association, a power jack, an ICSP header and a reset catch. It contains everything expected to bolster the microcontroller; basically associate it to a PC with a USB link or power it with an AC-to-DC connector or battery to

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5/18	SUBMITTED TEXT	31 WORDS	46%	MATCHING TEXT	31 WORDS

Kb of RAM, 32 Kb of ash memory for storing programs. It also has 1 Kb of EEPROM used for storing parameters. The clock speed is 16 MHz, which

Kb of RAM, 32 Kb of fiery debris memory for   putting away projects and 1 Kb of EEPROM for putting away parameters. The clock speed is 16 MHz, which

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6/18	SUBMITTED TEXT	28 WORDS	68%	MATCHING TEXT	28 WORDS

about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB

about executing around 300,000 lines of C source code every second. The board has 14 advanced I/O pins and 6 simple info pins. There is a USB

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7/18	SUBMITTED TEXT	107 WORDS	100%	MATCHING TEXT	107 WORDS

pins 14 DC current per I/O pin 40mA Flash memory 32kb (

pins) 6) DC Current per I/O Pin : 40 mA 7) Flash Memory : 32 KB (2

W https://de.slideshare.net/saddagovardhan/design-and-development-of-automated-microcontroller-base ...

8/18	SUBMITTED TEXT	144 WORDS	100%	MATCHING TEXT	144 WORDS

used by boot-loader) SRAM 2kb EEPROM 1kb Clock Speed 16MHz

used by boot loader) 8) SRAM : 2 KB 9) EEPROM : 1KB 10)Clock Speed 1 : 6 MHz • 56. 48 3.4.6

W https://de.slideshare.net/saddagovardhan/design-and-development-of-automated-microcontroller-base ...

9/18	SUBMITTED TEXT	216 WORDS	84%	MATCHING TEXT	216 WORDS

SPECIFICATIONS Motor voltage 8V-35V Logic circuit voltage 3V-5.5V Current 2A (max) Five-step resolution Full, 1/2, 1/4, 1/8 and 1/16 Protection Under-voltage, Over-current, and Over-temperature

Specifications • Motor Voltage: 8 V to 35 V • Logic Circuits Voltage: 3 V to 5.5 V • Current: 2 A (MAX) • Five step resolutions: full, 1/2, 1/4, 1/8 and 1/16 • Protection: under-voltage, over-current and over-temperature

W https://www.openimpulse.com/blog/products-page/product-category/a4988-cnc-shield-v3-arduino/

10/18	SUBMITTED TEXT	62 WORDS	50%	MATCHING TEXT	62 WORDS

to operate the X, Y, and Z-axis. The x and y-axis always work to make a two-dimensional image on paper. These x and y -axis are set to 90 degrees with the final error that any point in an empty space is expressed by the given value of x and y. The z-axis is used to lift and lower the pen,

to operate, 3 axes are required (x-axis, y-axis and z-axis. The x-axis and y-axis work in unison to create a 2   D image on a plain paper. These x and y axis are   placed 90 degrees to each other such that any point on the plain surface is defined by a given value of x and y. The z-axis is used   lift and lower the pen

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11/18	SUBMITTED TEXT	42 WORDS	64%	MATCHING TEXT	42 WORDS

the image to be drawn, the software will generate acceptable links and send it to the microcontroller on the USB port. The microcontroller describes these links and then controls the position of the vehicle to create the image. Here we used

the image to be drawn, the computer will generate the appropriate coordinates and send them to the microcontroller through the USB port. The microcontroller interprets these coordinates and then controls the positions of the motors to create the image. Here we have used

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12/18	SUBMITTED TEXT	38 WORDS	29%	MATCHING TEXT	38 WORDS

used to move the cartridge back and forth. On the z-axis, the engine smaller than the standard servo is put into the y-axis input. This servo engine is used to move the pen here and there. A

used to move the catridge to and fro. ASSEMBLY OF THE X, Y AND Z AXES For the z-axis, a mini servo motor is attached on the y-axis using glue. This servo motor is used to move the pen up and down. A

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13/18	SUBMITTED TEXT	30 WORDS	66%	MATCHING TEXT	30 WORDS

Due to the large size of this machine, the device is capable of drawing on A3 paper. So we will cut an A3-size platform (297mmx420mm) from acrylic glass and

Due to the immense size of this machine, the device is capable of drawing on an A5 sized paper. Therefore we will cut out an A5 (148mmx210mm) sized platform from the Perspex glass and

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14/18	SUBMITTED TEXT	41 WORDS	56%	MATCHING TEXT	41 WORDS

Since we are using the motor shield of the L293D, we need motor library. Then paste it into your Arduino IDE library folder. Rename it as AFMotor. If the Arduino IDE was open then open it again and click on

Since we are using the L293D motor driver shield, we need to download the AFmotor Library from here. Then add it into your Arduino IDE library folder. Ensure you rename it to AFMotor. If the Arduino IDE was open close it and open it again and click on

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15/18	SUBMITTED TEXT	17 WORDS	80%	MATCHING TEXT	17 WORDS

file -< examples -< Adafruit Motor Shield Library -< stepper. Select the correct port and board

file -< examples -< Adafruit Motor Shield Library -< stepper. Ensure you choose the correct port and board

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16/18	SUBMITTED TEXT	16 WORDS	66%	MATCHING TEXT	16 WORDS

tools and upload the code to the Arduino board. Other movements should be viewed on

tools and then upload the code into the Arduino board. Some movements should be observed on

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17/18	SUBMITTED TEXT	29 WORDS	77%	MATCHING TEXT	29 WORDS

Grbl is a free, open-source, elite programming for controlling the movement of machines that move, that make things, or that make things move, and will run straight on

Grbl is a free, open source, high performance software for controlling the motion of machines that move, that make things, or that make things move, and will run   o n

W https://abc.pimsheep.com/a6n7x/grbl-pen-plotter.html