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ENGINEERING COLLEGE

APPROVED BY AICTE AND AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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PROJECT WORK

DEPARTMENT OF APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING

Contents

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DEPARTMENT OF APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING
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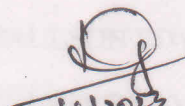NBA: B.Tech CE,CSE, EEE & ME

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This is to certify that the Project Phase-II report entitled **"EYE DIRECTIVE WHEELCHAIR"** *is a bonafide record of the AED416 Project Phase-II done by* **ADWAITH PRADEEP, DEVA PRAKASH, PAULSON EDWIN, PRABIN BABY** *under our guidance towards the partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Applied Electronics and Instrumentation Engineering of the APJ Abdul Kalam Technological University through Vimal Jyothi Engineering College, Chemperi.*

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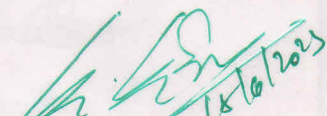
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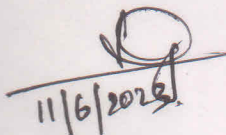OF ACCREDITATION
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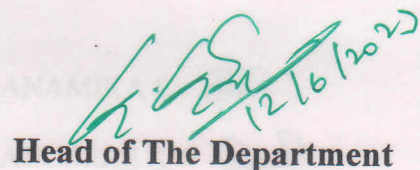Place: Chemperi

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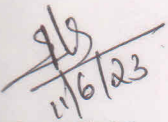Dr. G. GLAN DEVADHAS
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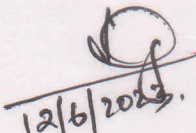Place: Chemperi

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2023

AED334 MINIPROJECT REPORT

CNC PLOTTER

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

CNC PLOTTER

AED334 Miniproject Report

Submitted in partial fulfillment of the requirement for the award of B. Tech. Degree in APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING

Of the APJ Abdul Kalam Technological University

Done by

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE

CHEMPERI, KANNUR, 2023

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

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CHEMPERI, KANNUR -2019

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This is to certify that the report entitled *"CNC PLOTTER"* is a bonafide record of the AED334 Miniproject done by *ASWIN VINOD C,TOM JESSAN,AYANA P V,AJAY K P*, under our guidance towards the partial fulfillment of the requirements for the award of the Degree of Bachelor of technology in Electronics and Instrumentation Engineering of the APJ Abdul Kalam Technological University through Vimal Jyothi Engineering College, Chemperi.

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ACKNOWLEDGEMENT

To begin with we are submitting this Miniproject in the divine feet of God Almighty "the satisfaction and euphoria that accompany the successful completion of any task will be incomplete without the mention of people who made it possible". We take this humble opportunity to thank all those who have inspired and motivated us to make the project a success.

We are grateful to our principal **Dr. Benny Joseph** the leading light of our institution. We express our sincere thanks to the Head of the Department **Dr. G Glan Devadhas** for his consent and appropriate guidance throughout the project.

We take this opportunity to express our profound thanks and deep sense of gratitude to our project guide **Mr. Shinu MM,** Assistan**t** Professor in the Department of Electronics and Instrumentation Engineering for his kind advice and knowledgeable suggestions, which helped us to take our project to great height of success.

Now we take our time to thank all the teachers of the college and our entire batch mates for their support and encouragement. I truly admire our parents the success of our ventures.

Project Team

ASWIN VINOD C

TOM JESSAN

AYANA P V

AJAY K P

ABSTRACT

Sketching a picture is now also belongs to technology. Computer Numerical Control or CNC Plotter sketches picture controlled by a computer. CNC plotter is a 3D controlled machine which sketches a 2D picture of an object. It is used in different industry, workshop, factory where need to sketch any complex design or need to cut different metal in precise shape. The complete system of a CNC machine is large, costly and difficult to move from one place to another. In this project a low-cost CNC plotter is designed to mitigate the difficulties. To design this system three axis controlling unit is needed to control X, Y and Z axis position. All the three axis are controlled by 3 stepper motor. To control this machine, a computer has been used to create and load G-code which sets the coordinates of X, Y and Z axis. Arduino IDE is used as the programming software and JSCut website is used to generate G-code. UGS software is used send gcode to Arduino. This machine's movement on the X axis is 150 mm and Y axis is 150 mm.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Background

The technology in the world has been speed up in this century. Works that involve movement or action keep repeating all the time has been substitute by machine from human as human concentration become lower when time goes on. For the machine, the performance in accuracy and precision can maintain when the time moves on. Computer Numerical Control, CNC machine is a machine that been widely used in the industry nowadays.

There are many types of CNC machine being used in the industry such as CNC milling machine, CNC routers, circuit drawing and the others. CNC milling machine is a machine that automatically cut the provided material by follow the instructions given by the computer. For the CNC routers, it is used to make cuts, as well as computer programmable 3D printing and also turret punch purpose. The CNC machine can be used in different cutter including laser, water and plasma as well. G-code is the code use to program the CNC machine. The instruction or drawing input by the user will convert into G-code and transfer to the machine to carry out the given task. G-code is a low level language which can only be understands by the machine. CNC machine plays an important role to fabricate the part of product quickly and accurately. With the CNC machine, the industries can speed up their production quality and also quantity.

1.2 Project Statement

Generally, CNC machine had been widely used in the industries. With the invention of CNC machine, many work can be replace by the machine instead of using men power. CNC machine boosts the productivity of the industries as well as the accuracy. However, the cost of a CNC machine used in industry is very high which is not affordable for small businesses and family use. Besides, CNC machine used in the industries nowadays only have a single function. In this project, a simple low cost Arduino based CNC machine had been built to perform simple drawing in X-axis and Y-axis according to the given image scale. This low cost CNC machine is built for the family use and small businesses as the price is cheaper compared to the industries CNC

machine. This project is constructed to study the working principle of the machine and to learn on the hardware and software used for the machine

1.2 Project Objective

i.   To build a low cost Arduino based CNC machine for small businesses and family use.

ii. To build CNC machine hardware which able to communicate with software.

iii. To run the CNC machine in both X-axis and Y-axis for simple drawing.

iv. To transfer G-Code file from software to hardware to perform simple drawing.

v.   To perform simple drawing according to the given scale.

CHAPTER 2

LITERATURE SURVEY

2.1 Design and Implementation of a Microcontroller Based Low Cost Computer Numerical Control (CNC) Plotter using Motor Driver Controller.

Md. Mahedi Hasan, Md. Rokonuzzaman Khan, Abu Tayab Noman, Design and Implementation of a Microcontroller Based Low Cost Computer Numerical Control (CNC) Plotter using Motor Driver Controller. 2019 International Conference on Electrical, Computer and Communication Engineering (ECCE), 7-9 February, 2019

Now-a-days, the CNC plotter machine are mostly used in workshop for plot a design. In this system, A CNC plotter machine has developed that can sketch a picture or design. This is very simple application. The required area and cost of this machine are very low and the most delighting feature of the device is it is portable. The system implementation is done under close supervision with great care of circuit designing and assembling. The hardest part was synchronizing two stepper motors but with great motivation and Effort, final successful implementation of the system has become possible. Though the efficiency of the device not hundred percent, it is used to sketch complex design precisely. However, this CNC plotter machine has some future work: Using Bluetooth module with this system can sketch a design from Bluetooth module range distance. Using long length rod with stepper motors in this system can develop a machine for sketches large picture. Implement Rapid prototyping technology which designed 3D print. It also need to used 4 to 6 axes CNC plotter.

2.2 Implementation and Manufacturing of a 3-Axes Plotter Machine by Arduino and CNC Shield.

Yousif Mohsin Hasan, 2 Layth Fadhil Shakir, 3Hassan Hamed Naji ,Implementation and Manufacturing of a 3-Axes Plotter Machine by Arduino and CNC Shield . 2018 International Conference on Engineering Technologies and their Applications (ICETA), Islamic University – ALNajaf – IRAQ

In this paper, they used the concept of a low-cost plotter machine, which is easily controlled by the computer and suddenly stopped and paused by clicking on the computer. This small machine can be easily transported and assembled everywhere as required. The board size of this device is 40X40 cm. Stepper Motor will run on this standard for board size. If we have an increase in the size or length of the lead coil, it will be free to make the large size of the design on paper.

2.3 Modern Design and Implementation of XY Plotter.

In the proposed system they have presented the concept of a low cost three-axis machine. The total coverage area for the object to create is larger and are extendable. Since the outer supporting pieces are made up of wood they are easily can be enlarged. Servo motor which controls the speed accordingly to the gears will give accurate movement. Exact stopping and start of the pixels are easily controlled in this process by stepper motors that are efficiently controlled by G-code generated by inkscape software.The existing CNC machines are higher cost, difficult to maintain and requires highly skilled operators. This XY Plotter overcomes these problems. It is of low cost and easy to control and there is no need of highly skilled operators and it is automatic once it obtain the g-code. The multi colour markers can be used along with the current process. The size of the total area can be easily increased. The vertical axis enabling option will add another feature with it. Instead of marker, a drill machine or a laser for cutting metal or wood will be the industrial application of this process in future. It can be used for long hours at a stretch which is not possible in existing ones. It is hoped to extend this work for future development. The robotic arm have a possibility to be implemented in future. This project along with the future work will have the efficient commercial application.

2.4 CNC Plotter Machine

In this project, they used the concept of a low-cost plotter machine, which is easily controlled by the computer. It is easy to operate and the work also can be done accurate without any errors. This small machine can be easily transported and assembled everywhere as required. The board size of this device is 40X40 cm. Stepper Motor will run on this standard for board size. If we have an increase in the size or length of the lead coil, it will be free to make the large size of the design on paper. Due to small size it is restricted to a certain area width and length.

2.5 Accurate and Cost-Effective Mini CNC Plotter

In this project, small drawing machine or mini CNC was built. It is a digital electromechanical machine with digital control through a piece of wood and low cost components. Two main axes (x & y) and a vertical axis (z) were used to draw image or figure with a specific dimension and speed. This project design was success prototype design since it can draw any figure or image easily and in a short time as compared to human drawing time.

CHAPTER 3

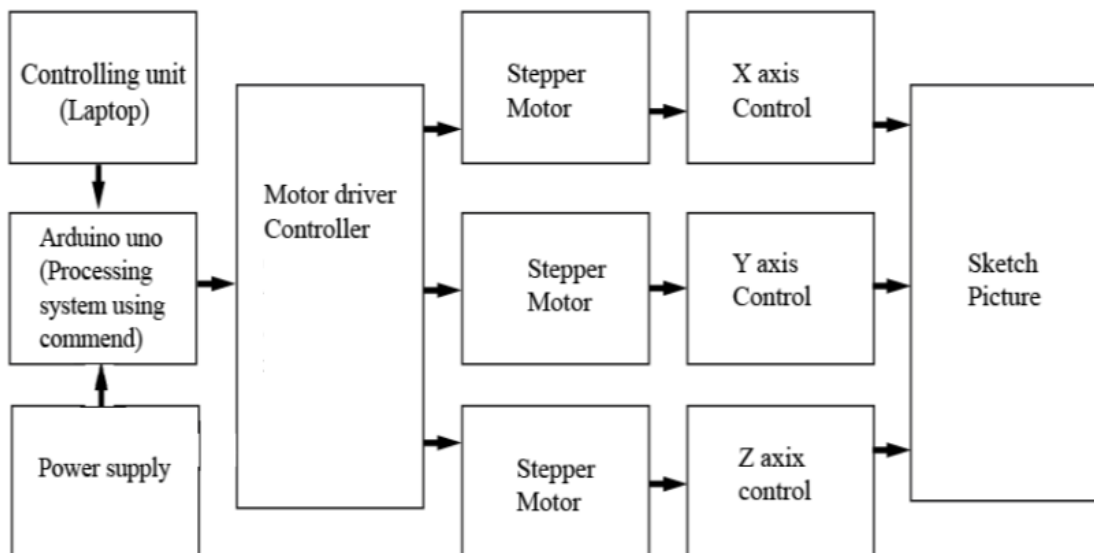# DESIGN METHODOLOGY

3.1 Block Diagram

Fig 2.1 Block Diagram

3.2 Methodology

The aim of this system is to design and implement a Low-Cost CNC plotter. In this plotter, three motors have been used for sketching a picture. Three motor drivers are used for controlling motors. Arduino ATmega328P is used as a processor. Three motor driver circuits using ULN2003A have been used for controlling three stepper motor as X-axis , Y-axis and Z-axis.. In this system, Arduino IDE V1.6.0 used as the programming software and JSCut website is used as the G-code generator. Power is supplied to Arduino Uno. A computer used as the control unit is connected to Arduino Uno to control the whole operation. The motor driver controller is used to drive the motors which is connected with X, Y and Z axis. By controlling different positions of these three motors via computer, a photo has been sketched.

3.3 Flow Chart

In this system, the ULN2003A motor driver controller has been used which is designed to drive high current and high-voltage loads including DC and unipolar stepping motor[]. To sketch a picture the system needs to create G-code of a picture

which is loaded Arduino Uno later. G-code of a picture can be created by using JSCut website. It is a set of information which indicates the position of X, Y and Z axis. The G-code is loaded into the Arduino using UGS software. Once a G-code is loaded to Arduino Uno from the computer, Processor sets to operate the motors. The motor drivers are enabled in pairs. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high impedance state. G-code instructs X axis to travel along forward and backward direction and instructs also Y axis to travel long left and right direction. A pen or a pencil or a drawing tool is attached with stepper motor which acts as Z axis.
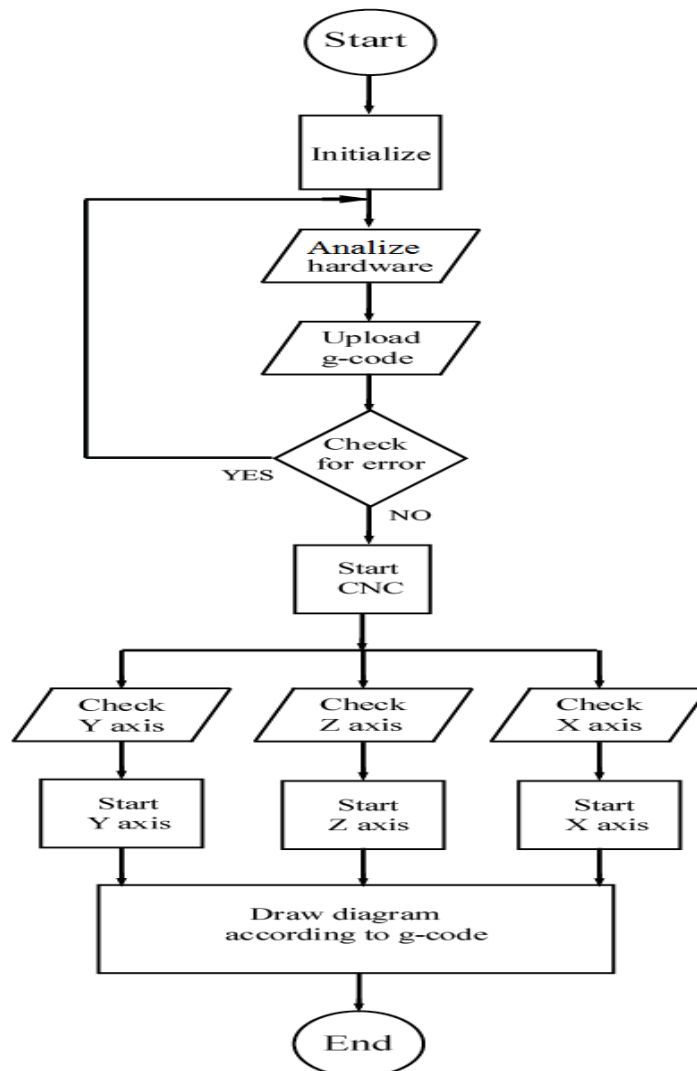

Fig 2.3 flow chart

Figure illustrates the flow chart of the system. The system starts with analyzing hardware. It checks for any hardware initializations error and in the very next step, G-code is being sent to the microcontroller through PC. The system will check for any error in X-axis, Y-Axis, and Z-Axis. If any error is found it jumps back to the initial position to repeat the operation again. If no error is found, the CNC machine sets to operate the motors from their initial position. If the position of the corresponding motor is right, each motor starts to operate according to the instruction sent from the processor. Once the instruction is completed the device ends its operation.
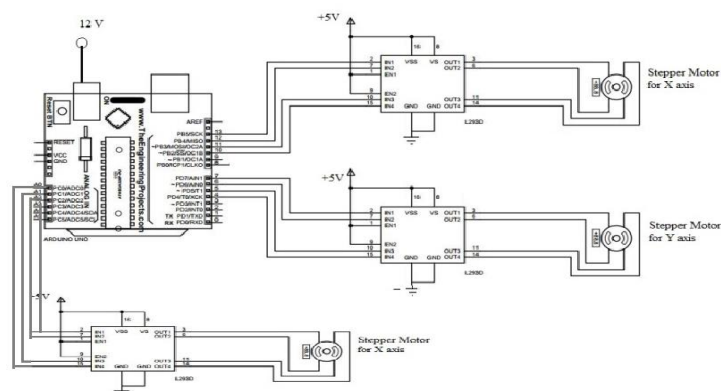
3.4 Circuit Diagram

Fig 2.4 circuit diagram

The system processor is based on ATmega328P. For the development purpose, Arduino Uno has been utilized which is connected with three motor drivers ULN2003A. Pins A0,A1,A2,A3 of the Arduino Uno is connected with ULN2003A motor driver which is set to drive a stepper motor for Y-axis. Pin 2,3,4,5 of the Arduino Uno is connected with another ULN2003A motor driver to drive another stepper motor for X-axis. Motor drivers 8,9,12,13 no pin is connected by stepper motors controlling z axis. The G-code is generated by using the website JSCut. The Arduino board is connected to the UGS software through a laptop.

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CHAPTER 4

HARDWARE DESIGN

4.1 Arduino Uno R3

Arduino Uno is microcontroller based on ATmega328P Atmel AVR family microcontroller (MCU). It is an open source software and hardware.
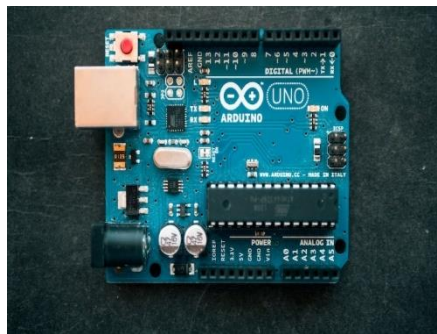

fig 4.1 Arduino Uno R3

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm

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Width	58.4 mm
Weight	25 g

4.2 Stepper Motor

     The digital pulse stepper can be converted into the movement of the pen with respect to the X, Y, Z axes directions. The stepper motor is a brushless motor that distributes full rotation in several equal steps.
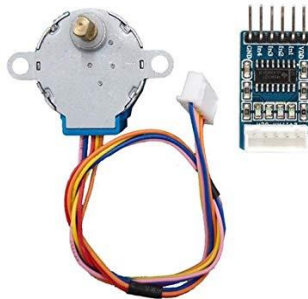

Fig 4.2 28byj-48 stepper motor

Model	28BYJ-48
Rated Voltage(V)	5
Rated Current (mA)	500 mA
Step Angle	5.625°/64

4.3 Motor Driver

The ULN driver board is one of the most common motor driver ICs, consisting of an array of 7 Darlington transistor pairs, each pair is capable of driving loads of up to 500mA and 50V.
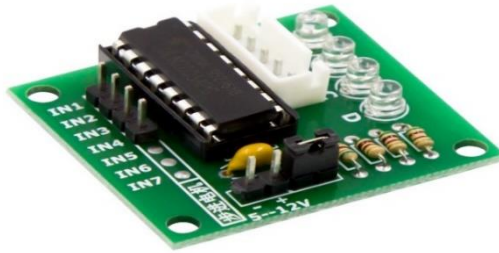

Fig 4.3 ULN2003A motor driver

motor driver chip	ULN2003A
power supply	5-12V
signal indicator	4-way
Step angle	5.625 x 1 / 64
Reduction ratio	1 / 64
Phase	4

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CHAPTER 5

SOFTWARE DESIGN

5.1 Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board .

Fig 5.1 Arduino Ide Logo

5.2 Inkscape version 0.48.5

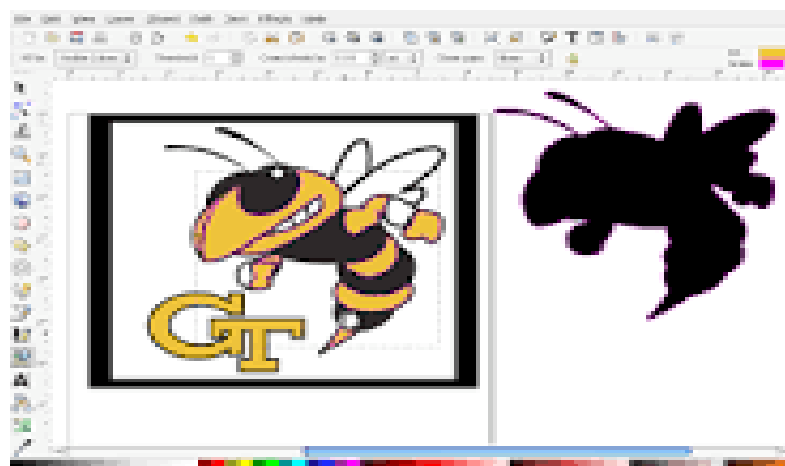This software is used to design the input image or text to generate the G-code file.

Fig 5.2 Inkscape

5.3 UGS

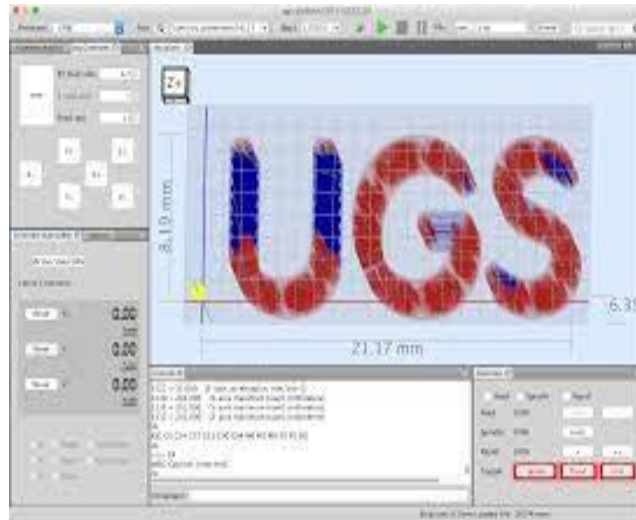This software is used to upload G-code for the process into the arduino.

Fig 5.3 UGS software

5.4 JSCut

This website is used to generate gcode from the image generated in inskscape.
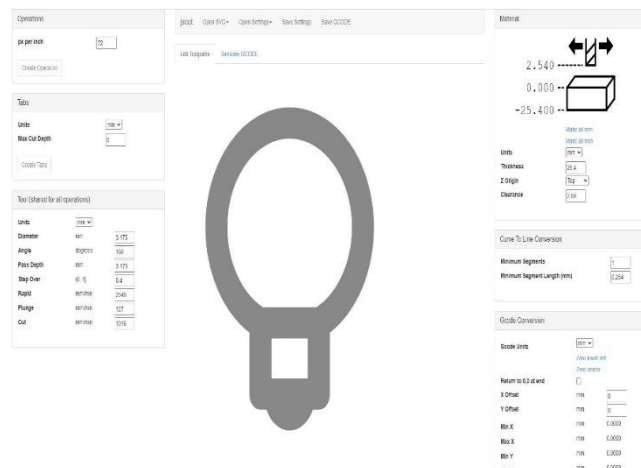

Fig 5.4 JSCut website
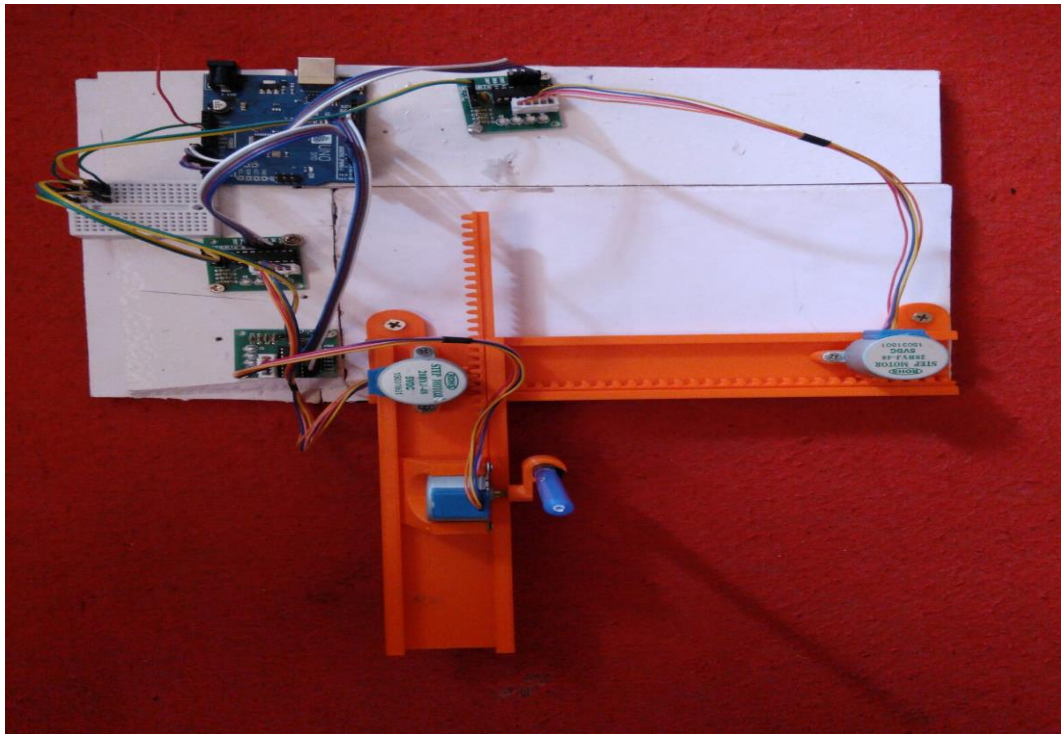
CHAPTER 6

RESULT

Fig 6.1 Completely Assembled CNC Plotter

A figure's G-Code is been generated and is uploaded to the UGS software. The figure has been plotted with 99% accuracy. A small error in observed which is due to backlash nonlinearity in the gear and the mechanical parts.
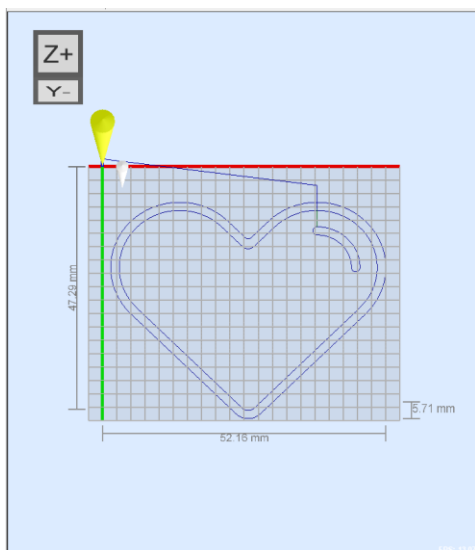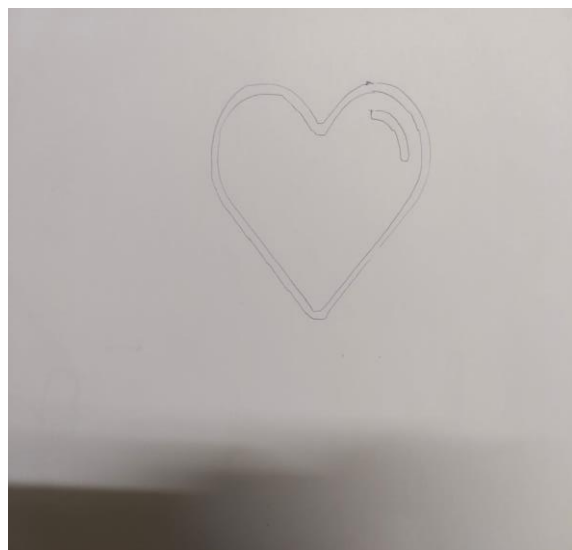

Fig 6.2 Input Image To UGS   **Fig 6.3 Plotted Image**

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CHAPTER 7

CONCLUSION

The CNC plotter machine are mostly used in workshop for plot a design. In this system, A CNC plotter machine has developed that can sketch a picture or design. This is very simple application. The required area and cost of this machine is very low and the most delighting feature of the device is it is portable. CNC plotter is a 3D controlled machine which sketches a 2D picture of an object. This can be transported and assembled easily. This machine is cost effective. The system design is done under close supervision with great care of circuit designing and assembling. The hardest part in the making of CNC plotter was to synchronize three stepper motors.

FUTURE SCOPE

By introducing a bluetooth module to our CNC machine, we can sketch the image in a bluetooth range distance. Also by using long length rods with this system, we can develop a machine for large images.

Art and Design: CNC plotters have already made significant inroads in the art and design fields. They can create precise and intricate drawings, paintings, and sculptures. In the future, we can expect further advancements in the capabilities of CNC plotters, allowing artists and designers to explore new creative possibilities and push the boundaries of their work.

Education and Research: CNC plotters have great potential in educational institutions and research settings. They can be used to teach students about computer-aided design (CAD), engineering, and manufacturing principles. Additionally, researchers can utilize CNC plotters for fabricating prototypes, conducting experiments, and exploring new applications in various fields, including materials science, robotics, and biomedical engineering.

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[4] International Journal of Computer Applications (0975 – 8887) Volume 178 – No. 48, September 2019 10 Accurate and Cost-Effective Mini CNC Plotter Sara Raad Qasim, Alfarabi, Haider Mohammad ,Mustafa Falah

[5] International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072 © 2020, IRJET | Impact Factor value: 7.529 | ISO 9001:2008 Certified Journal | Page 5300 CNC PLOTTER MACHINE Syed Fazle Hyder1, Mohammed Ibrahim2, Mohd Zeeshan Adan3, Fazal Mohammed4

APPENDIX

G-Code for the figure
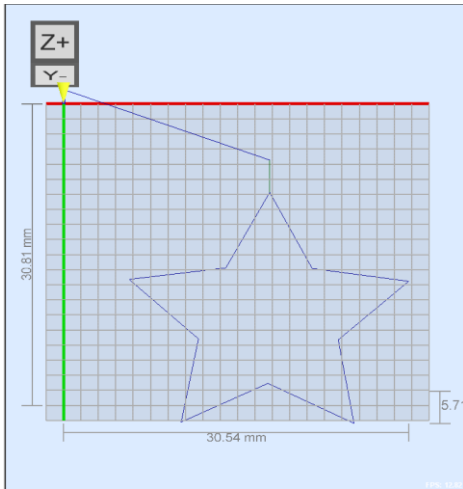
G21   ; Set units to mm

G90   ; Absolute positioning

G1 Z2.54 F2540   ; Move to clearance level

;

; Operation: 0

; Name:

; Type: Engrave

; Paths: 1

; Direction: Conventional

; Cut Depth: 3.175

; Pass Depth: 3.175

; Plunge rate: 127

; Cut rate: 1016

;

; Path 0

; Rapid to initial position

G1 X18.2479 Y-7.2161 F2540

G1 Z0.0000

; plunge

G1 Z-3.1750 F127

; cut

G1 X14.3632 Y-14.9301 F1016

G1 X5.8064 Y-16.1031

G1 X11.9421 Y-22.1813

G1 X10.4135 Y-30.6817

G1 X18.0904 Y-26.7244

G1 X25.7023 Y-30.8051

G1 X24.3111 Y-22.2811

G1 X30.5443 Y-16.3027

G1 X22.0076 Y-14.9918

G1 X18.2479 Y-7.2161

G1 X18.2479 Y-7.2161

; Retract

G1 Z2.5400 F2540

M2

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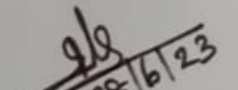**Project Guide**

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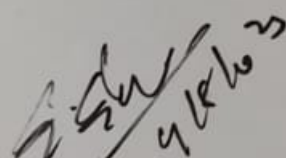Assistant Professor

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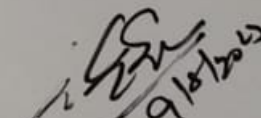
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