DEVELOPMENT OF POLARGRAPH DEVICE

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Abstract: The development of polargraph device is for scheming two-dimensional data on a rectangular coordinate system. This device prints by moving a pen or marker across the surface of a piece of paper. By using this device, one can draw the complex line art including text. The result is very accurate. This project mainly uses two software: Arduino, Processing. Based on Processing command the desire outputs can be loaded rapidly. The main components are stepper motor, GT2 pulley, servo motor, L293D motor. This project controls the mechanical movements with the electronic pulse. Polargraph have essentially become obsolete, and have been replaced by large-format inkjet printers and LED toner-based printers. Such devices may still understand vector languages originally designed for plotting use, because in many uses, they offer a more efficient alternative to raster data. Polargraph offers the fastest way to efficiently produce very large drawings or colored high-resolution vector-based artwork.

*Key words- **Polargraph, Arduino, Stepper motor.***

I. INTRODUCTION

A Polargraph is a two-dimensional printing or writing machine with continuous lines along x and y axis. A Polargraph is a two-dimensional printing or writing machine with continuous lines in x and y axes [1]. Polargraph can be designed to record and plot two-dimensional data on a rectangular coordinate system [2].

Polargraph, although being a slow and raster based device, is highly versatile drawing machine capable of extending its use in wide variety of fields. An artistic recreation, rather than an exact duplication, of digital images on canvas using elementary hardware components and complex algorithms act paradoxical to the way normal printers work. Yet their immense scalability and cost-effectiveness provide advantage over printers in certain areas. This paper introduces a programmatic method to reduce the average plotting time of a vertical plotter by optimizing the input image. The optimizations are carried out over three phases by analyzing the input image, using three different algorithms, to render out the important pixels and create an intermediate input file in software vector graphics format. [3]

The material selection of the mechanism was made considering the cost and wide range of applications such as servo motor. Servo motor can be differentiated through the cost, peak torque capability, speed range to compromise the standard and application of the system. The design uses the software's capability to convert an image into geometrical codes which can be used by the processor to plot. The Arduino microcontroller is an easy to use as it is equivalent to powerful single board computer and the design steps for 2D printing is based on the choice of plotter used. It is used for productivity, safety, and in saving time and money. In the stream of mechanical, a polargraph is used in which a plotter that offers the works based on the principle of CNC which render a wide variety of uses like cutting, engraving, fabrication of electronic parts and drawing. To obtain 2D printing a complex design circuit is used and it leads to cost overhead. It includes the machining technology that covers a wide range of aspects. [4]

II. LITERATURE SURVEY

The goal of this project is to design and build a high-quality plotter. The mechanical subsystem of a CNC provides the means needed to plot on a material for a given job. The choice of materials has a direct impact on performance, precision, repeatability, longevity, and mechanical noise transfer into the parts. The mechanical subsystem is comprised of the guide system, the drive system, and the frame housing structure. Each of these systems has a direct impact on the qualities of a polargraph.

In order for the polargraph to process any design implanted into it, the machine must have a connection system between itself and the software being used by the computer. Many connections used today are very common to people from using cable linking to add pictures to their computer hard drive or using a modem connection to log on to the internet.

Low cost, home and small business plotters require at least one software package to operate. This is the basic package which allows the user to open a graphics file and command the system to plot the part. There are several basic interface software but in this polargraph we have used processing software which is available for free and has a good user interface. This software is linked to arduino UNO microcontroller directly using usb ports [5].

III. COMPONENTS USED IN POLARGRAPH

Stepper motor - A stepper motor, also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.

Arduino UNO R3 - Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 16 MHz quartz crystal, USB connection, power jack, ICSP header and reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. It can be powered by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

L293D Motor Driver Shield - The L293D is quadruple high-current half-H drivers. It is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. When the input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the input is

low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

Servo Motor (SG90) - A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft.

GT2 Pulley - A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

Gondola - It is the Assembly which supports the pen as well as the servo motor.

Frame Housing Structure - It helps in holding the components on it and also helps in holding the drawing sheet.

IV. METHODOLOGY

A processing software along with Arduino IDE is used for programming part. The scanning of image and location of points (G-code) on paper is done by processing software. The G-Codes are fed to the Arduino which further controls the stepper motor. Two stepper motors are connected perpendicular to the wooden board using mounting bracket separated at certain distance, both the motors carry a GT2 pulley for the motion of gondola. The servo motor is attached to gondola which also holds the pen. The device uses the 12v power supply. The system uses two L293D motor, one servo motor. The stepper motor is used for the x and y motion of gondola, servo motor for engaging and disengaging of pen on paper (z-axis motion). The Fig.1 shows the working of polargraph device.
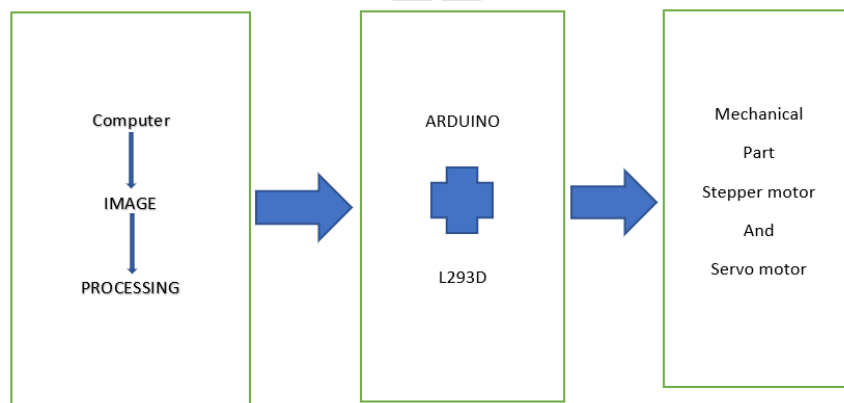

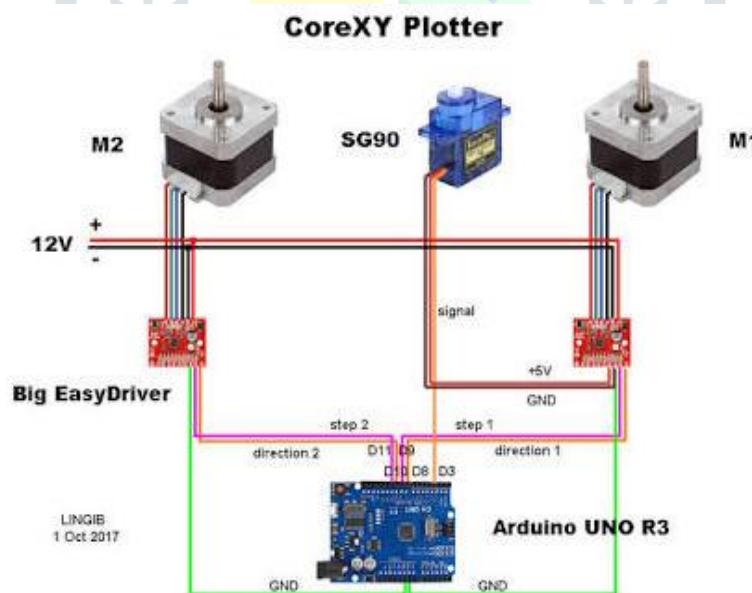Fig.1 Block Diagram showing the working of polargraph

Fig.2 Circuit diagram of polargraph

The image is uploaded on to the processing software. The processing automatically detects the outline of the image to be drawn, this image is then converted into codes that are understandable by the microcontroller. The microcontroller controls the stepper motor and servo motors to draw or plot the given image on to the paper. The microcontroller uses a motor shield which is capable to control four DC motors or two stepper motors. The Fig.2 shows circuit design of the polargraph device.

V. RESULT AND DISCUSSION

The assembly of polargraph is complete and is in perfect working condition. The input is given using processing software .The following are the tests and result of this machine.This project is polargraph that is a portable mini CNC machine. A Plotter that operates in two axes of motion ("X" and "Y") in order to draw continuous vector graphics, it uses pencil to plot the paper that is lying on the flat surface area of the plotter. It is achieved because the polargraph is connected to a computer, which is equipped with specialized plotting design or drawing computer software programs. Those computer software programs are responsible for sending the necessary plotting dimensions or designs in order to command the pencil to produce the correct project plotting needs. The input image to the system and output image of the polargraph device are shown in Fig.3 and Fig.4 respectively.
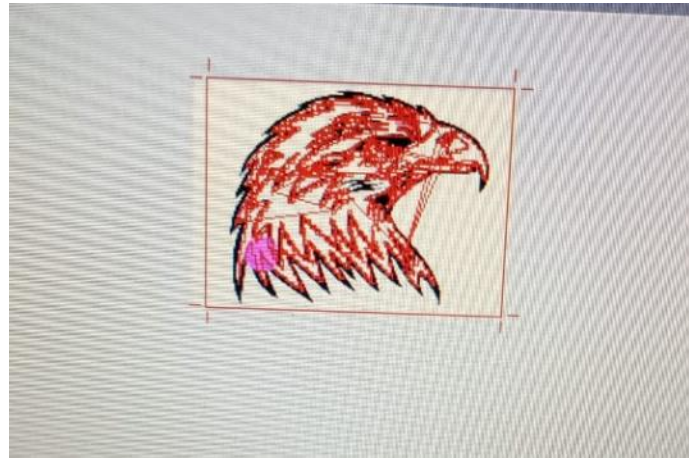

Fig.3 Input Image given

Fig.4 Output image of the polargraph device

VI. CONCLUSION

In this study, an attempt is made to develop X-Y Polargraph that accurately synchronize with the Arduino software system for better response on the movement along X and Y axis. The processing and arduino software have been used effectively to scan the image and produce G codes. This machine can be used as a pyrography machine to carve the designs on the wood.

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