Project Based Learning Report

on

“Automatic Handwriting Machine”

Submitted by

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(2023-2024)

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This is to certify that, **Akash.D.Boraste, Dnyaneshwar.S.Ban, Jayesh.R.Bhamare, Durgesh.M.Ahire,Darshan.N.Dehadray, Nikhil.V.Borse** of F.E. (Electronics & Telecommunication Engineering) 2022-23, under the supervision & guidance has submitted a Project Based Learning titled "**Automatic Handwriting Machine**" in partial fulfillments for the award of the degree of first year of Engineering in Electronics & telecommunication at MET's Institute of Engineering, BKC, affiliated to Savitribai Phule Pune University, Pune (M.S.)

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TABLE OF CONTENTS

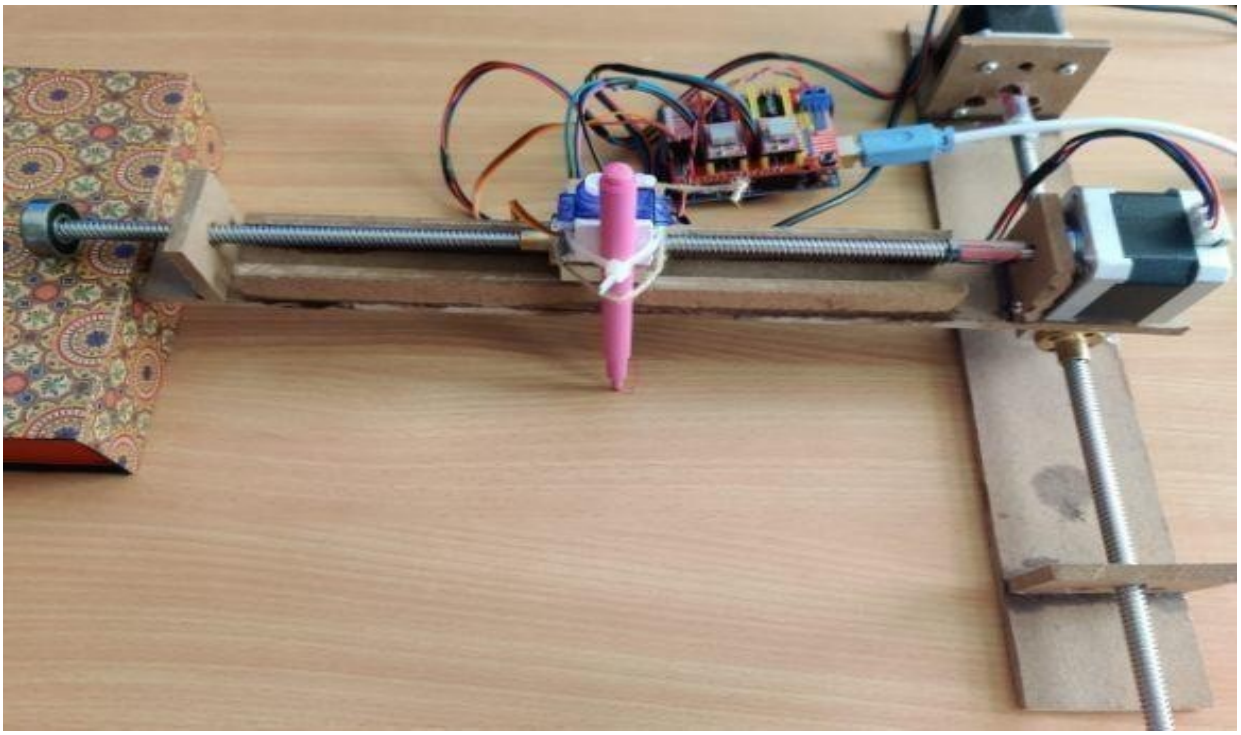
CHAPTER 1:

INTRODUCTION

As the world is entering the dawn of a new era, manufacturing is undergoing an evolution which has been termed as Industry 4.0 or Smart Manufacturing. The speed with which industries are moving towards digital technologies like industrial robotics, 3D printing, machine learning, optical character recognition, cloud computing, augmented reality and sensors can make the Industry 4.0 revolution more realistic . The human race is turning to robots to do the work and reduce human effort. In this society which is undergoing a rapid change, time and manpower are the major critical constraints in the completion of any tasks on large scales and with efficiency. Therefore automation is playing a significant role in saving a lot of human efforts in most of the regularly carried out works like welding, painting, assembly, container filling, writing, etc. As far as writing is concerned, the time and effort taken in typing the keys on a keyboard which is time consuming and requires a lot of skills and human efforts can be avoided with the help of automation

.Some existing technologies such as automated voice to text converters are used to write only the inbuilt fonts like the Roman, Calibri, Arial, Impact, Georgia, etc.

This system is an embedded system whose working principle is based on the Computer Numerical Control machine. It uses an Arduino development board which is connected with other peripherals like motors to provide the necessary pen movement on the paper. The servo motor helps in the vertical movement of the nib of the pen so that the pen nib will touch the paper only when something needs to be written and is raised above when not needed. This motion of the pen in the z axis coupled with the x and y axis movement achieved through the stepper motors results in a two dimensional sketching on the paper.



CHAPTER 2:

LITERATURE SURVEY

In this chapter , we will discuss how the automated writing concept developed through history. Table shows a list of all major automated or mechanical writing systems.

- List of all major automated or mechanical writing systems

Machine	Year
1804	Polygraph
1874	Typewriter
1888	Telautograph
1937	Autopen
2004	Longpen
2014	AxiDraw
2017 - 19	Papers published

1. POLYGRAPH :

A Polygraph is a duplicating device that produces a copy of a piece of writing simultaneously with the creation of the original, using pens and ink. It was first developed by an Englishman named John Isaac Hawkins. Hawkins received a United States patent for his device in 1803. This early device was known at the time as a polygraph and bears little resemblance to today's autopens in design .

POLYGRAPH

2. TYPEWRITER :

A typewriter is an electromechanical machine for writing characters similar to those produced by a printer's movable type. Typically, a typewriter has an array of keys, and each one causes a different single character to be produced on the paper, by means of a ribbon with dried ink struck against the paper by a type element similar to the sorts used in movable type letterpress printing. The first commercial typewriters were introduced in 1874, but did not become common in offices until after the mid-1880s. The typewriter quickly became an indispensable tool for practically all writing other than personal handwritten correspondence. It was widely used by professional writers, in offices etc.

TYPEWRITER

3. TELAUTOGRAPH :

The telautograph, an analog precursor to the modern fax machine, transmits electrical impulses recorded by potentiometers at the sending station to servomechanisms attached to a pen at the receiving station, thus reproducing at the receiving station a drawing or signature made by the sender. The telautograph's invention is attributed to Elisha Gray, who patented it on July 31, 1888. Gray's patent stated that the telautograph would allow "one to transmit his own handwriting tto a distant point over a two-wire circuit".

4. AUTOPEN :

AUTOPEN MODEL

An autopen or signing machine is a device used for the automatic signing of a signature or autograph. The autopen called the Robot Pen was developed in the 1930s, and became commercially available in 1937. It was used as a storage unit device (similar in principle to how vinyl records store information) to record a signer's signature. A small segment of the record could be removed and stored elsewhere to prevent misuse. The machine would then be able to mass-produce a template signature when needed. The first commercially successful autopen was developed by Robert M. De Shazo, in 1942. The modern autopen, the Autopen Model 50 was one of the International Autopen Company's earliest automatic signature machines [20].At top speed, the machine signed about twice as fast as a human

5. LONGPEN :

The LongPen is a remote signing device conceived of by writer Margaret Atwood in 2004 and debuted in 2006. It allows a person to remotely write in ink anywhere in the world via tablet PC and the Internet and a robotic hand. It also allows for an audio and video conversation between the endpoints, such as a fan and author, while a book is being signed.

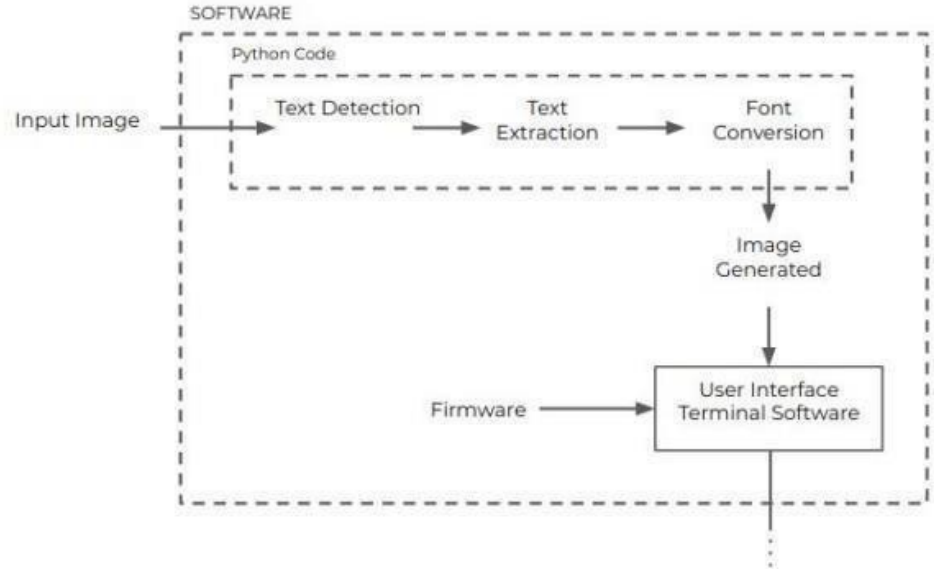
6. AXIDRAW :

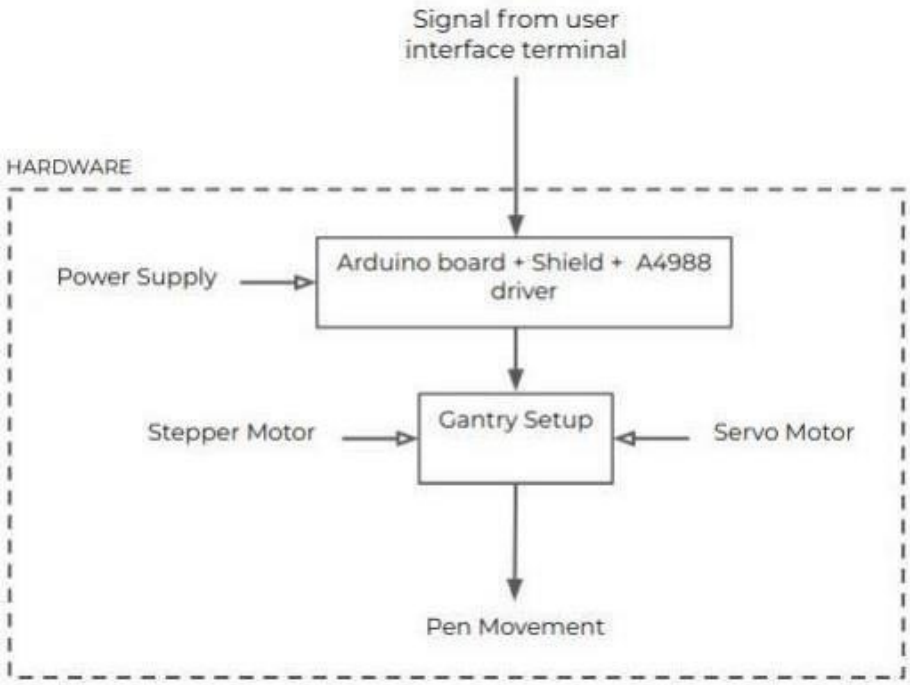
The AxiDraw project has been active since 2014, when it was first created by Dr. Lindsay Robert Wilson. In the UK. The AxiDraw is a simple, modern, precise, and versatile pen plotter. AxiDraw machines work witha variety of writing instruments, including permanent markers and fountain pens. The unique writing head extends beyond the base of the machine, making it possible to write or draw on almost any flat surface . The AxiDraw is a pen plotter, which is a type of simple robot.

Its sole function is to guide a pen along the set of vector lines, curves, and paths that you ask it to follow. It is capable of drawing essentially anything that can be composed from a set of lines. But there are not many advances made in the machine where the output is in the user's handwriting. Additionally, these machines are really expensive for a common man to buy.

CHAPTER 3:

SYSTEM BLOCK DIAGRAM





CHAPTER 4:

SYSTEM IMPLEMENTATION DETAILS

HARDWARE :

The hardware components, and the rationale behind the selection of different components is discussed in detail in this chapter. The overview of the components used is shown in Fig and these components are discussed in detail in this chapter.

Driver expansion board for Arduino

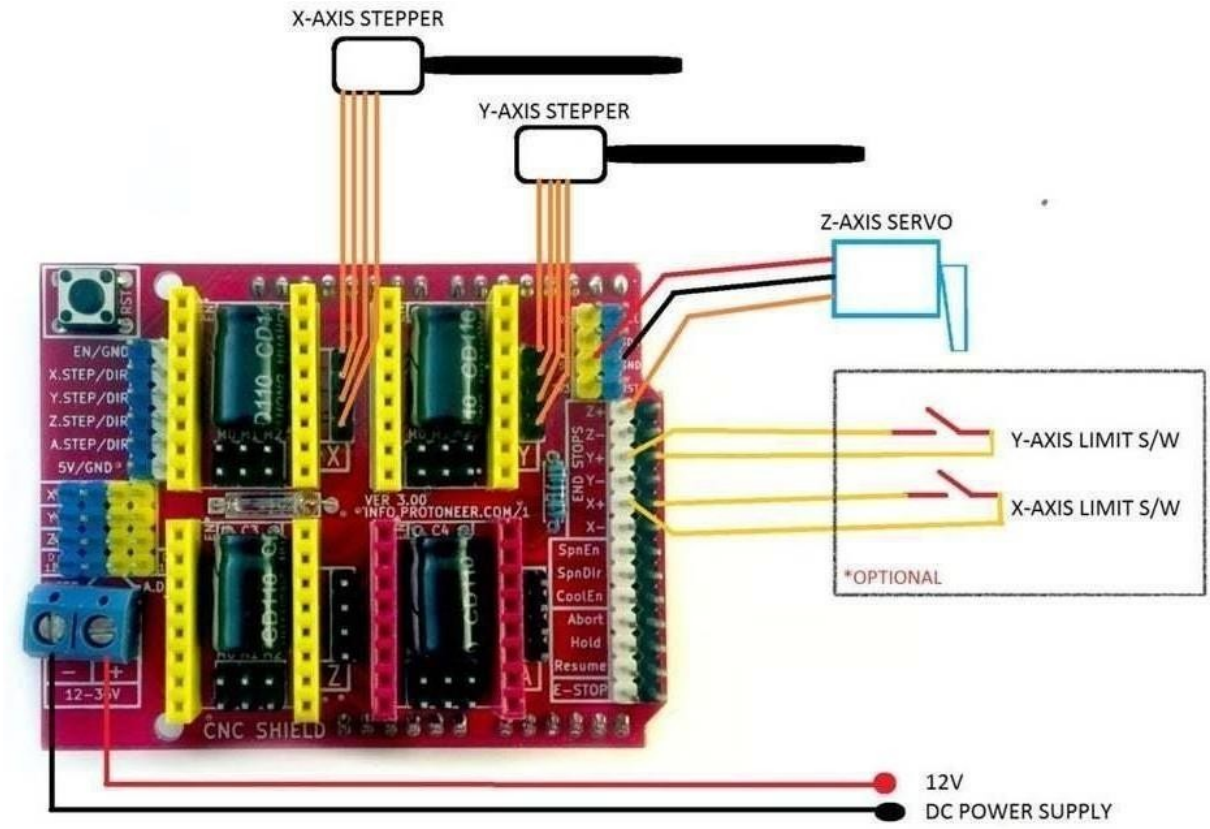
Arduino UNO

Nema 17 stepper motor

A4988 motor driver

Servo motor

CIRCUIT DIAGRAM



CONNECTIONS:

1. **Motor driver shild connected to the arduino.**
2. **Stepper motor connected to the “x” and “y” axis provided in motor driver shild.**
3. **Servo motor connected to shild.**
4. **Power supply given to the shild.**

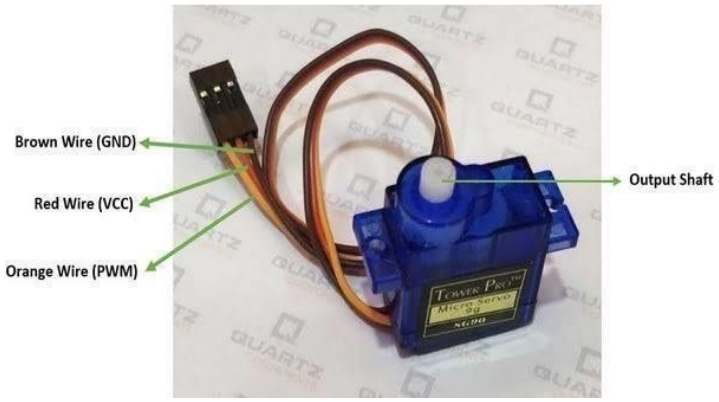
1. STEPPER MOTOR

Stepper motors basically are electromagnetic devices which convert digital pulses into mechanical shaft rotation. Many advantages are achieved using these motors such as: high simplicity, low cost, high reliability, high torque and high accuracy.

This project involves usage of two Nema 17 stepper motors . One motor to control the X-axis motion and another motor to control the Y-axis motion.

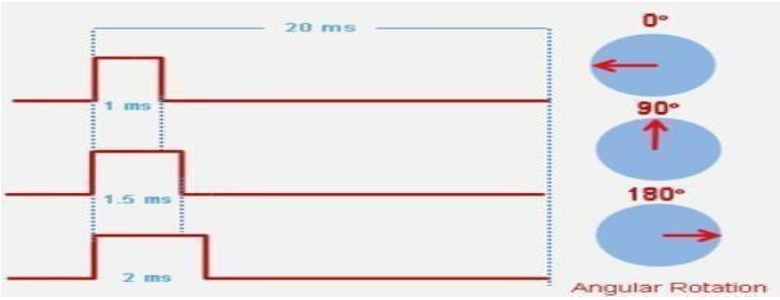
Additionally, a driver is used to drive the motors. Stepper motors are categorized by frame size, such as "size 11" or "size 23". The National Electrical Manufacturers Association (NEMA) sets standards for many electrical products, including step motors. Generally speaking, "size 11" means the mounting face of the motor is 1.1 inches

2. SERVO MOTOR:



A servo motor is an electrical device which can push or rotate an object with great precision. It consists of three parts: Controlled device, Output sensor, Feedback system. It is a closed loop system where it uses a positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

In this project, a servo motor is used for the movement of the pen in the Z-axis. More specifically MG90S-Metal Gear Micro Servo Motor is used. This small and lightweight servo comes with high output power, thus ideal for Robotic Arduino .



CONTROL OF SERVO MOTOR USING PWM

3. MOTOR DRIVER

A stepper motor driver is an electronic device that is used to drive the stepper motor. By itself it usually does nothing and must be used together with a controller. Stepper motors require voltages and/or currents that the controller simply can't produce. Therefore we need to use a stepper motor driver. This electronic device will transform our movement instructions from a controller into a sequence where the winding in the stepper motor will be turned on or off while still providing enough power to it. Basically a motor driver acts as an interface between the motor and the control circuits. Motors require a high amount of current whereas the controller circuit works on low current signals. So, the function of motor drivers is to take a low current control signal and then turn it into a higher current signal that can drive a motor. Having only one Arduino control all of the stepper motors can take up a lot of the processing and not leave a lot of

room to do anything else; unless a self-contained dedicated stepper motor driver is used.

Therefore, the stepper motor driver used in this project is A4988. Fig 5.7 shows A4988 motor driver with heat sink, heat sink is used as a passive heat exchanger that transfers the heat generated by an electronic device to air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature at optimal levels. Motor drivers can control both speed and spinning direction of a bipolar stepper motor like NEMA 17 with just two pins. The A4988 stepper motor driver has output drive capacity of up to 35 V and ±2A and lets you control one bipolar stepper motor at up to 2A output current per coil like NEMA 17.

4. EXPANSION BOARD

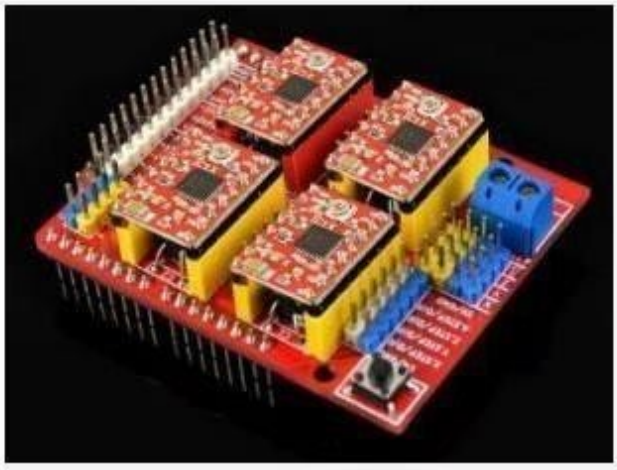
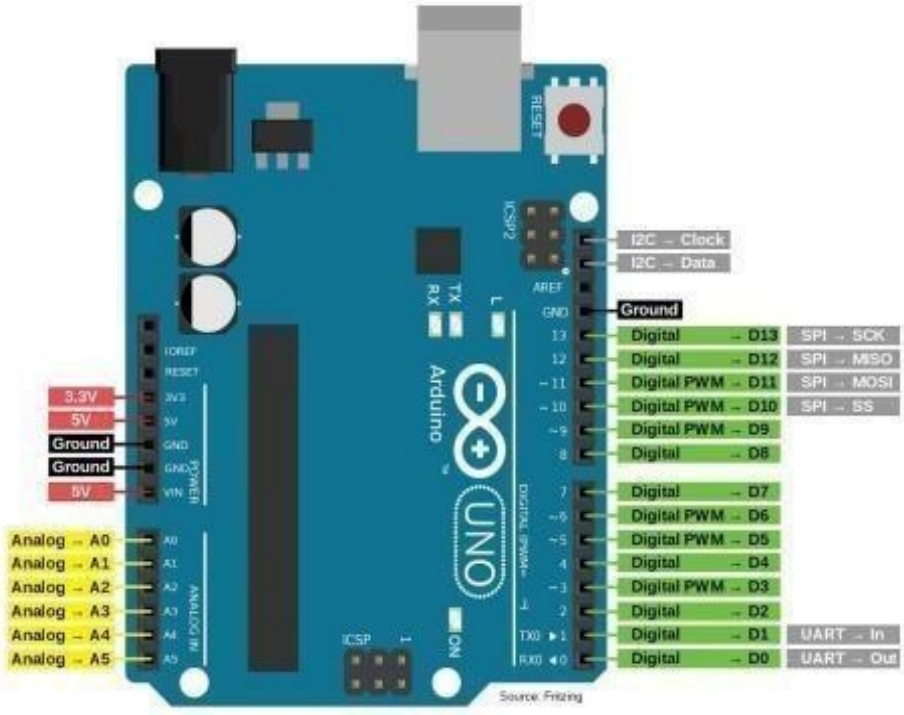


Fig 5.9 A4988 driver expansion board for Arduino

A microcontroller has a limited number of pins, and hence a limited number of interfaces with the outside world. An expansion board takes a few of those pins and fans them out to even more pins. Expansion boards are also called shields. Ashield is basically a board that can be plugged on top of theArduino PCB extending its capabilities. Shields are pieces of hardware thatsit on top of your Arduino, often to give it a specific purpose. For example,you can use a shield to make it easier to connect and control motors. Fig shows A4988 driver expansion board for Arduino. In our case, the expansion board is used so that two stepper motors and a servo motor can be controlled easily. Fig shows the expansion board with A4988 motor driver and Arduino board connected to it.

5. ARDUINO



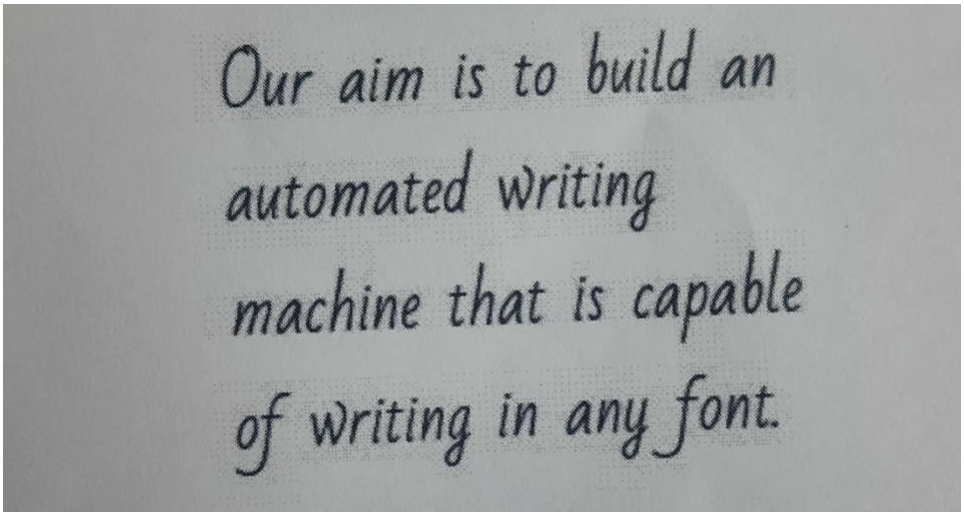
Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino board is a printed circuit board (PCB) designed to use a microcontroller chip as well as other input and outputs. A microcontroller is a small computer contained in a single, integrated circuit or computer chip. Microcontrollers are an excellent way to program and control electronics. Microcontroller boards have a microcontroller chip and other useful connectors and components that allow a user to attach inputs and outputs. You write code in the Arduino software to tell the microcontroller what to to-do. For example, by writing a line of code, you can tell a light-emitting diode (LED) to blink on and off. If you connect a push button and add another line of code, you can tell the LED to turn on only when the button is pressed. Next, you may want to tell the LED to blink only when the pushbutton is held down. In this way, you can quickly build a behavior for a system that would be difficult to achieve without a microcontroller. Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator , a USB connection, a power jack, an ICSP header and a reset button.

6. WOODEN FRAME

Selection of frame is an essential part for system designing. The main material used to make up the X and Y gantry is Medium Density Fiberboard (MDF). Medium-density fiberboard is the most versatile building material because it's inexpensive and fairly durable. MDF is a good choice for practical projects. This MDF is fitted with 3D printing rods which are in turn connected to the Nema 17 stepper motors. These rods help in achieving the two dimensional movement because these rods are thread.

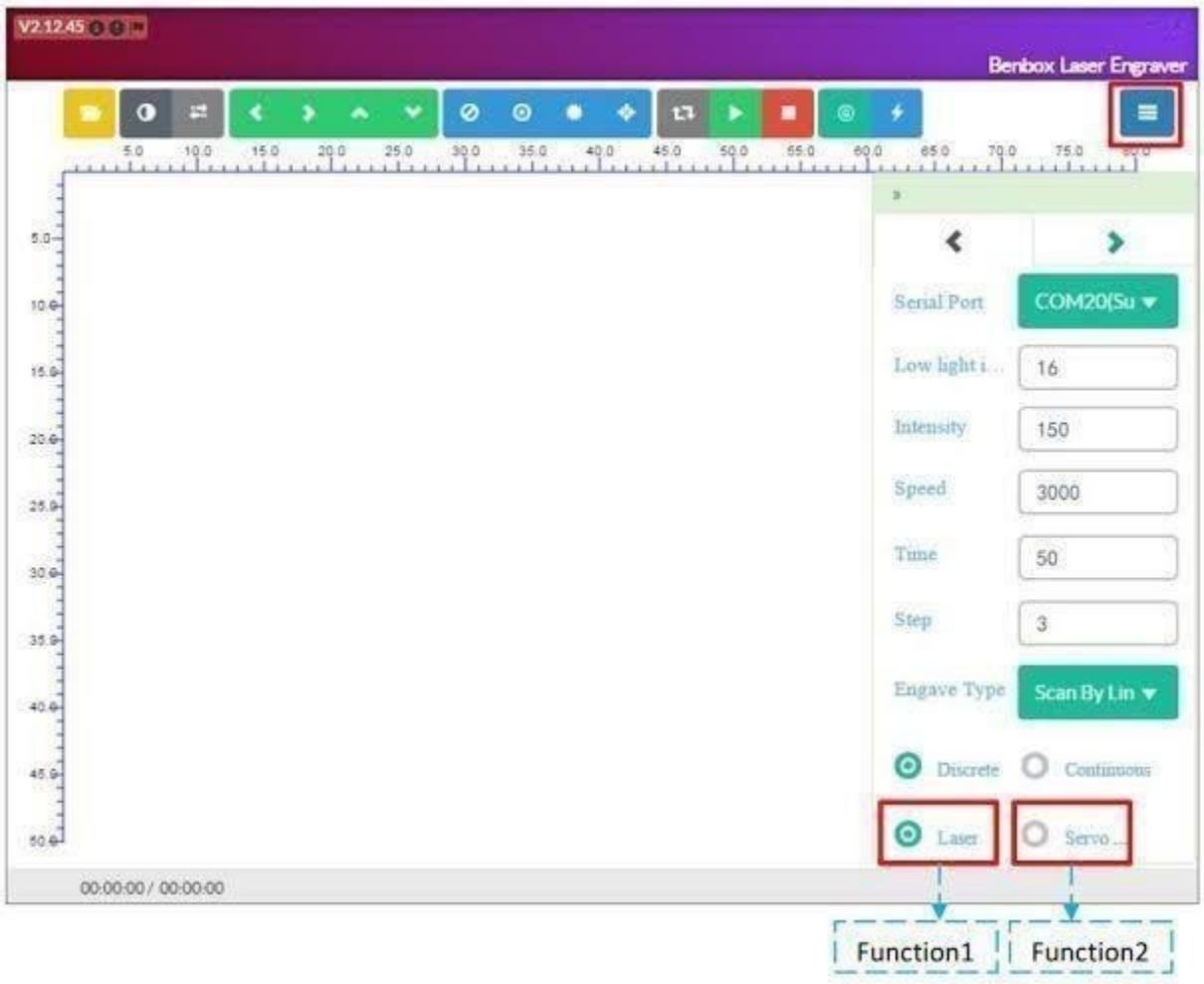
METHODOLOGY OF IMPLEMENTATION

The methodology of implementation was structured and carried out after a detailed analysis. To achieve the automated writing, a detailed study and analysis was made before executing the full mission. An analysis was made to select a programming platform for easy and faster processing which is also compatible with most systems with minimum configuration required. This resulted in converging to use the python programming platform. In this chapter, firstly the flowchart of the entire process is shown and then the overall process of implementation is discussed in detail.



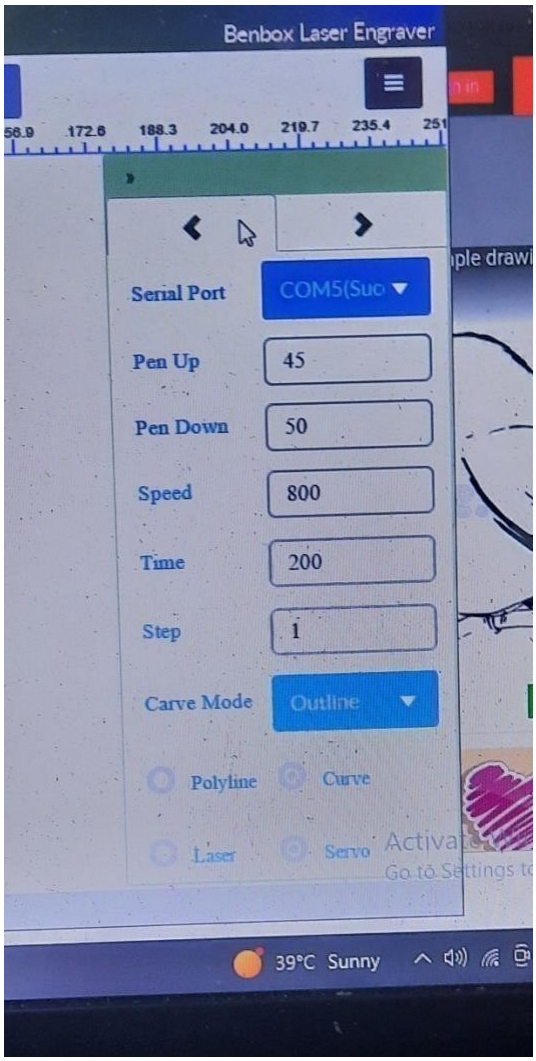
STEP 1: Input the image of the text document which can be in predefined text or in a human's handwriting. We will consider predefined text for the sample implementation as shown in Fig.

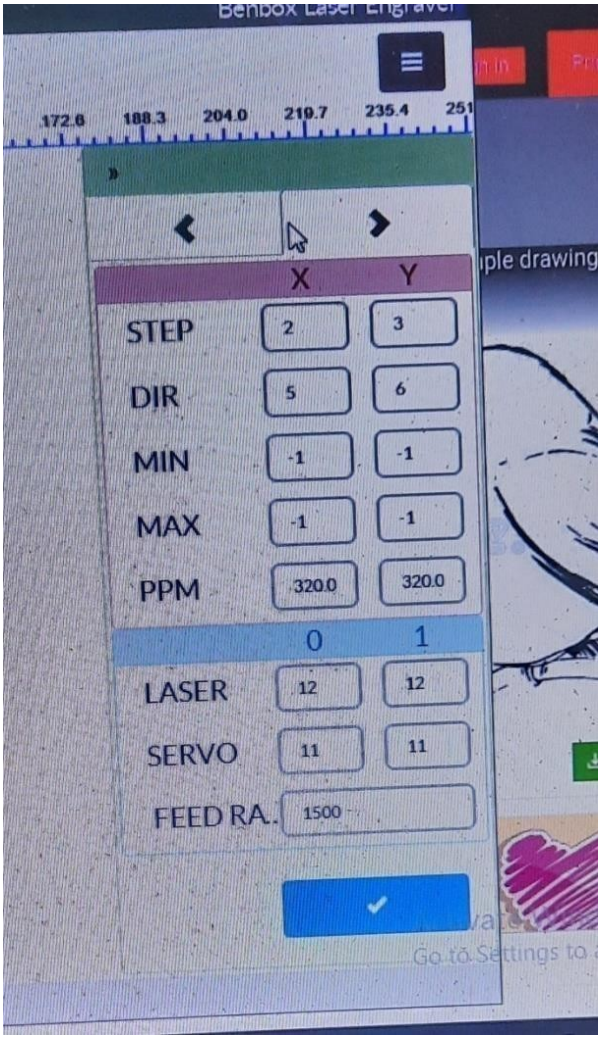
STEP 2: Finally the image obtained in the previous step is uploaded into the user interface terminal software, which is Benbox in this case. With the help of the firmware code, the image that is uploaded is written onto the paper with the help of hardware motion that is achieved through motors and power supply. Fig shows how the image can be uploaded into benbox. Fig shows the parameter configuration in Benbox.



Benbox Software

Parameter Configuration for Benbox



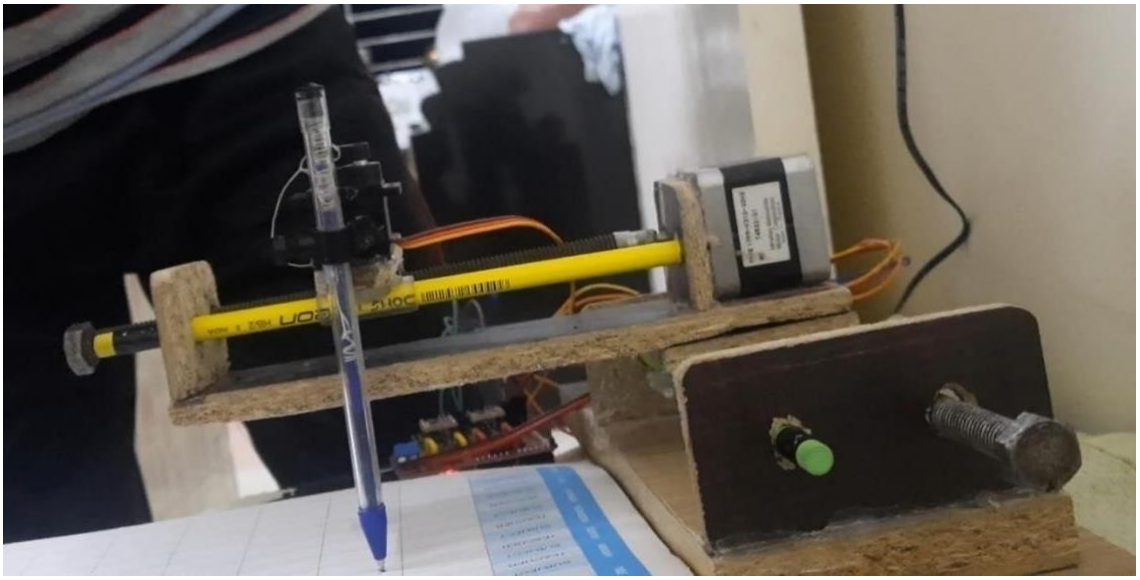


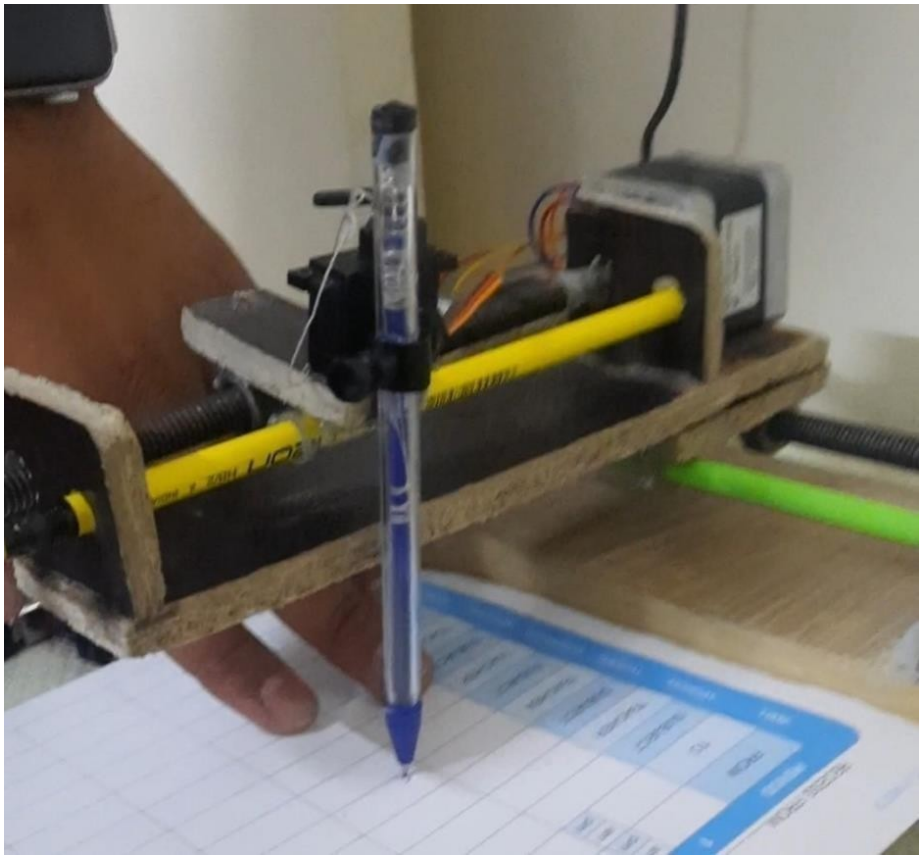
CHAPTER 5:

DISCUSSION AND ANALYSIS OF RESULTS

This proposed system is a new kind of automated writing machine which incorporates optical character recognition. The source code will first extract the text from the input image and this extracted text is converted into any of the predefined fonts stored in the computer or to the user's handwriting. Fig shows the input image which is a snippet of scanned document in predefined font - “Arial” and Fig shows the extracted text converted to user’s font. The font conversion is done with the help of a web application. Here the user’s alphabetical data is uploaded and using this the font is built.

RUNNING MODEL





CHAPTER 6 :

CONCLUSION

In these developing times, humans are turning towards robots to do their work to save time and manpower and to have an efficient output. The basic problem with the already existing technologies like automated speech writing machines, speech to text converter, printers, scanners, is that they only write in predefined fonts present in the computer. The proposed system works as an automated writing machine that is capable of writing in any predefined font or in the user's handwriting style. Afterintegrating the software with hardware, the resultant mechanical system makes up an user friendly and cost effective automated writing machine with minimum human interruption, reducing the requirement of manual effort and time. To summarize, the automated writing machine will be able to contribute to our daily life challenges and hence improve the quality of lifeThis project proved good for us as it provided practical kno.Knowledge of not only programming in python and working with embedded systems, but also about all the handling procedures related with

"Automated Writing Machine". This will provide better opportunities and guidance in future in developing projects independently. To summarize, the automated writing machine will be able to contribute to our daily life challenges and hence improve the quality of life.

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