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DESIGN AND FABRICATION OF SEMI-AUTOMATED SCREEN-PRINTING MACHINE FOR MEDICAL GRADE PVC SHEETS

A Project Report

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ABSTRACT

Many bulk printing procedures rely heavily on-screen printing. Over the decades, a great deal of innovation has occurred, and screen printing now plays an essential role in the manufacturing, newspaper, textile, and medical industries. Because industrial operations have become more automated, the screen-printing process has developed from batch to continuous manufacturing. Screen printing has the advantage of being able to print on practically any type of surface, including fabric, paper, glass, wood, card, plastic, and leather. Flat screen printing is commonly done by pushing the squeegee back and forth manually. We're working on a semi-automatic machine that will provide uniform pressure rather than unequal pressure. Saving energy and reducing work intensity are two advantages of using an automatic screen-printing equipment. The method is especially popular since it enables the machine to effortlessly repeat a design several times. Because a single stencil can be used to duplicate a pattern several times, it's ideal for making multiple copies of the same garment or accessory. Our project's main goals are to reduce the operator's workload, produce high-quality prints, and reduce the amount of time it takes to print. When compared to a PLC-controlled machine, the cost of making the machine semiautomatic is lower. Our machine can print on any material; however, our primary goal is to print on Medical Grade PVC sheets.

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Chapter 1: Introduction

Screen printing is a printing process in which the required ink is applied on a rig/dye through a mesh, except for the areas that is made impermeable to the ink by the blocking of stencil. A blade or squeegee is dragged over the screens to fill the open mesh pores with ink, and a reversed stroke causes the screen to briefly touch the substrate along a contact line. As the screen bounces back after the blades has passed, the ink wets the substrate and pulls the ink out of the mesh holes. Because only one colour is produced at a time, several coloured image or pattern may be created by combining numerous screens. The most popular screen-printed surfaces are fabric and paper, but it's also possible to print on other materials using specialist inks. [1]

A=Ink, **B**=Squeegee, **C**=Image, **D**=Photo emulsion, **E**=Screen, **F**=Printed Image

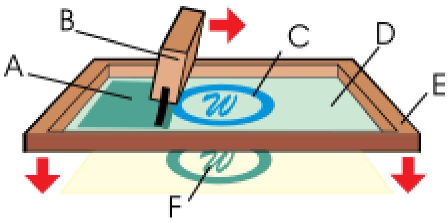


Figure 1 Basic Diagram

The method is also known as silk screening' or silk screen printing.' Depending on the materials used, the stencil can be made in a variety of ways. Screen-printed designs might employ a single colour of ink or a combination of colours. Colours must be applied in discrete layers to multicoloured artefacts, with separate stencils for each ink.

For the hybrid electronic industry, paper printing industry, medical industry, and textile industry, screen printing technology is a means to optimise and acquire the most cost-effective facility of applying and patterning distinct layers. Screen printing is a popular process for producing vibrant canvases, posters, and artwork, but it may also be used to print fabrics and textiles. [2]

Figure 2 Automatic Screen-Printing Machine

1.1 Manual and Automatic screen printing

Screen printing machines generally come in two classes: manual and programmed. The basic principle of thumb is to pick the one that best satisfies the necessities and requests.

- Manual Printing is generally finished the hard way. This permits planners to make any important changes as the item is printed, modifies tone immediately and print conceal two times. A manual print machine needs more exertion with regards to lifting, pivoting, and decreasing print heads. Getting it adjusted suitably need some ability and practice while doing physically.
- On the off chance that we have a great deal of printing undertakings, and you want to finish them in the most limited conceivable time, it's smart to contribute on programmed screen-printing machine.

1.2 Screen printing on Polymers

Polymer substrates can be produced using different kinds of plastic materials. Polypropylene, polyethylene, poly (vinyl chloride), polyester, polystyrene, and much more polymers are accessible in the present business practice in a wide scope of shapes.

Different kind of holders, tubes, and other bundle things, toys, athletic gear, signs, credit and personality cards, RFID labels, sunlight-based cells, and boards for machines, sensors, and other printed electronic parts are totally produced using polymer materials and they all are printed for the most part by screen printing. [3]

Figure 3 Polymers

The wide assortment of polymer substrates additionally requires various sorts of inks. Printing inks should be chosen likewise to the sort and surface attributes (surface harshness and surface strain) of printing substrates. To satisfy the expected capacity of printed products with high printing quality and wanted ink layer thickness, the cross-section texture and the stencil material, its profile, and surface harshness must be adjusted to the pre-owned ink, and in this way to the printed substrate, as well. Moreover, a sharp edge of printed picture requires inks with higher consistency in screen printing than in other printing strategies. [4]

1.3 Motivation

1.3.1 Reason of Preference

Our Group preferred to fabricate an automatic screen-printing machine over a manual screen-printing machine.

This is because in case of manual screen printing:

- Screen printing is more physically demanding, and the final design is mainly reliant on the screen press operator's physical ability.
- Accuracy training and experience are required.
- Alignment and understanding how much pressure to apply to the blade to manage the amount of ink applied are two factors that demand ongoing practise and ability.

There were some additional aspects to consider as well, such as:

- The number of colours required.
- The level of difficulty in design.
- Do we need to print a certain number of items?
- How much time we have?
- After considering all these aspects, we concluded that an automatic screen-printing machine is the best option in all of these situations. The key to a successful fabrication of an autonomous screen-printing machine would be good planning and preparation. [5]

1.3.2 Reasons of Choosing this project

Reasons for choosing the project are:

- It Reduces the time utilization for printing.
- It's Cheaper.
- Decreases labour supply.
- Its solid and reliable for printing purpose.
- It will apply force equally throughout the surface.

Chapter 2: Literature Review

2.1 Background

Screen printing is a centuries-old technique. Around AD 950, an early form of the process was developed in China as a method of printing designs onto fabric. Several decades later, Japanese artisans began employing a stiff brush to force ink through a mesh screen woven from human hair to transfer images onto paper and fabric.

Screen printing arrived in Europe in the 18th century, but because to the exorbitant expense of silk mesh at the time, it took a long time to catch on as a fabric printing method. Screen printing became a popular and profitable way to print fabric after the Silk Road made imported silk cheaper. Printers had created photo-sensitized emulsions by the early twentieth century. facilitating the creation of complicated stencil designs by craftspeople.

Artists began experimenting with screen printing as an artistic medium in the 1930s, coining the term "serigraphy" to distinguish it from industrial printing. Screen printing was used by artists such as Eduardo Paolozzi and Andy Warhol in the 1960s to make fine art. The artist, dubbed 'pop-art,' employed screen-printing to generate many copies of a single image, thereby challenging the definition of fine art. Perhaps the most well-known example of screen printing as an artistic medium is Andy Warhol's Marilyn diptych. [6]

Screen printing is being employed as an artistic medium as well as a commercial printing method. It's a wonderful approach for generating huge orders of personalized apparel because one stencil can be used to replicate the same design hundreds or even thousands of times.

2.2 Why we use printing?

Printing is basically done to reduce the time consumption along with good and efficient result. It is much cheaper as compared to handwritten materials and in much good condition. There are many different types of printing techniques used for different materials.

Surface printing, flexographic printing, screen printing, rotary screen printing, gravure printing, and digital printing are all options.

2.3 Purpose of Project

Screen printing, also known as silk screening or silkscreen printing, is the process of employing a mesh screen, ink, and a squeegee to imprint a stenciled image onto a surface (a rubber blade). Screen printing begins with the creation of a stencil on a mesh screen, followed by the application of ink to form and imprint the design on the below surface. [7]

2.4 Types of Printing

There are several types of Screen-Printing Techniques:

Spot Color Screen Printing, Halftone Screen Printing, Grayscale Screen Printing, Duotone Screen Printing, CMYK Printing, Simulated Printing Process, Laser Screen Printing.

2.4.1 Spot Colour Screen Printing

The most frequent sort of screen printing for t-shirts is spot color screen printing. It makes advantage of the ink's stock color by printing it via the screen mesh's stencil. It is beneficial to printing 1 to 4 colors; when there are multiple spot colors, other printing techniques for example, simulated process may be useful. For example, company logos are perfect to print using spot color as it does not generally require gradients or excessive colors. [8]

2.4.2 Halftone Screen Printing

Here mostly, single, or multiple colors in gradients are printed. These tones might range from a full color spot to a lovely halftone. When you want the look of multi-color printing without having to do it, this screen-printing method is ideal. For instance, if you want a pink radiant hue on your white t-shirt, you can print red on a white shirt with a 50% gradient. With only one screen and one hue, the 50% gradient will blend with the white give it a pink appearance. When printed directly into the garment, it improves the graphics quality and gives the print a softer feel.

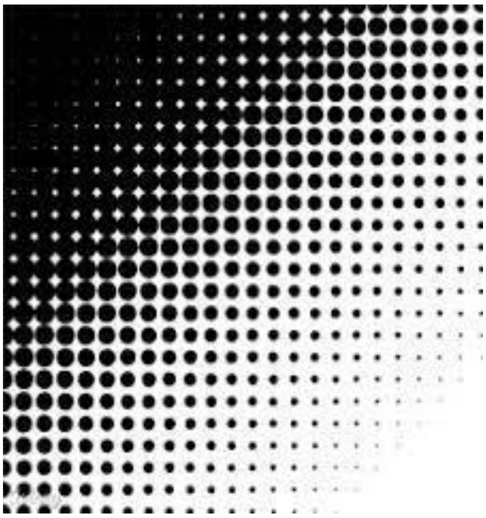


Figure 4 half tone screen printing

2.4.3 Grayscale Printing:

Figure 5 grayscale printing

That's a terrific approach to make one-color grayscales or halftones out of full-color photos. One-color halftones can be printed on full-color pictures. A one-color halftone can also be used to create full-color drawings with a wide variety of distinct colors. It's usually done in black ink on a light-colored fabric, but it may potentially be done in any color ink. The resolution is determined by the number of lines per inch in the dot pattern.

2.4.4 Duotone Screen Printing

It's the result of combining two halftones for a single image printed in two colors. It gives prints on light clothes a retro and cooling impact, as well as the illusion of a full-color print at a far lower cost. When printed on a garment, it gives a softer feel. It's also good for screen printing clothing, especially light textiles. [9]

2.4.5 CMYK Printing

The most complicated of all screen-printing procedures, CMYK printing should be done on an automatic press. It can be done manually, but for best results, an automatic t-shirt press is required. We're going to break down a full-color snapshot into its four constituent colors: cyan, magenta, yellow, and black. The printing process mixes these four colors to recreate the full tone and color range of the source image. Also, it is a costly technique, mostly done on darker garments.

2.4.6 Laser Screen Printing

Laser Screen Printing is the type in which instead of ink, fused powder is used for printing on Sheets. The powder is first fused into molten material by radiation or heating then by injecting system it is used to print on the required material.

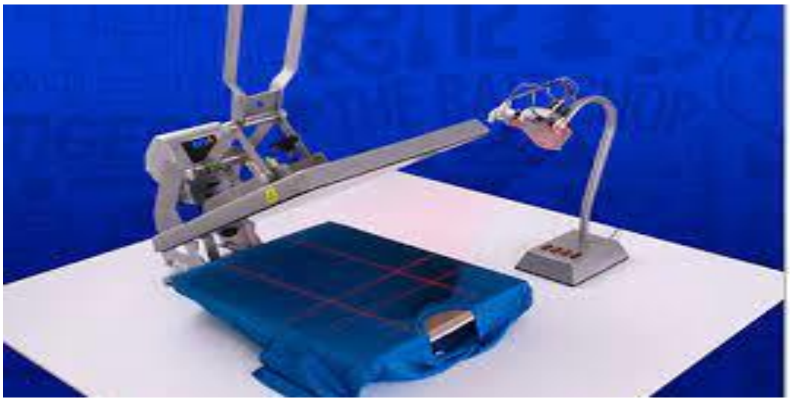


Figure 6 laser screen printing

Based on working Method, Screen printing is of two Types:

- Flatbed
- Rotary

2.4.7 Flatbed Screen Printing

Flatbed printing is an automated variant of hand-operated silkscreen printing. Each color and design need its own screen. Instead of printing a continuous pattern, flat screens print a finite region. This technique has the advantage of allowing multiple squeegee strokes on each screen to apply huge amounts of print paste.

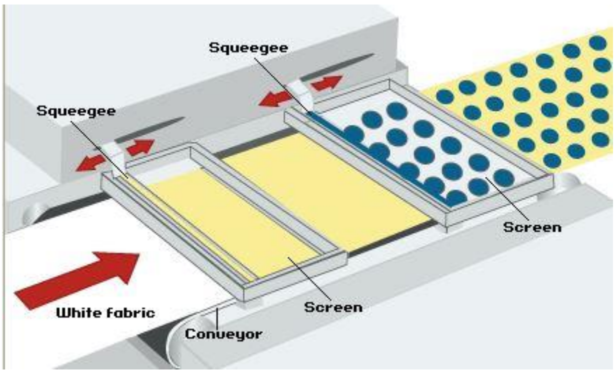


Figure 7 Flatbed screen printing

2.4.8 Rotary Screen Printing

Rotary printing machines make use of screens that are fashioned into a roll, allowing for continuous pattern printing in the length direction. The basic technique is similar to flatbed screen printing on a flatbed. Both screen printing methods contain a metering system for controlling dye paste feeding into the printing process, as well as a rotating blanket to which the fabric is "tacked" to prevent length and width distortion, a print head, a drier, and fixation equipment.

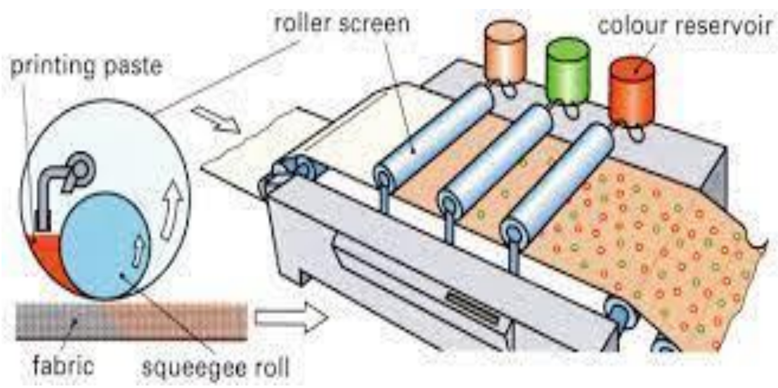


Figure 8 rotary screen printing

Chapter 3: Methodology

The Methodology we have followed to complete the final year project is by first designing the prototype (creo model) of the project after having some market research. After designing of the prototype, the components were purchased, and the manufacturing of the project was carried out. It was done in many steps.

The following flow diagram depicts the way we have carried out our project till the completion.

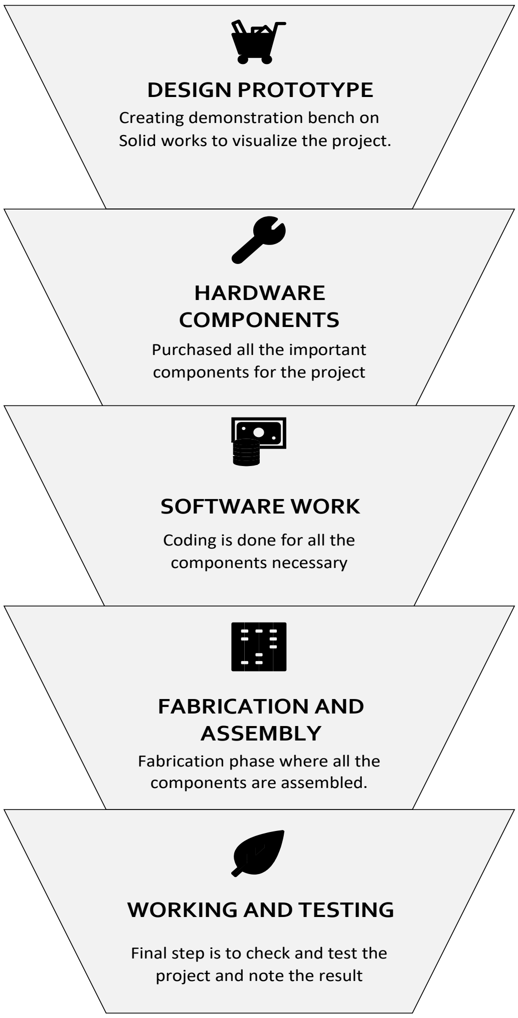


Figure 9 Methodology flow diagram

3.1 Mechanical Software

3.1.1 Rig Manufacturing

First, we manufactured the design of the rig. The outer frame was drawn and the sheet on which the data which is to be engraved is printed. Then the sheet was fixed in the outer wooden frame and the rig was designed.

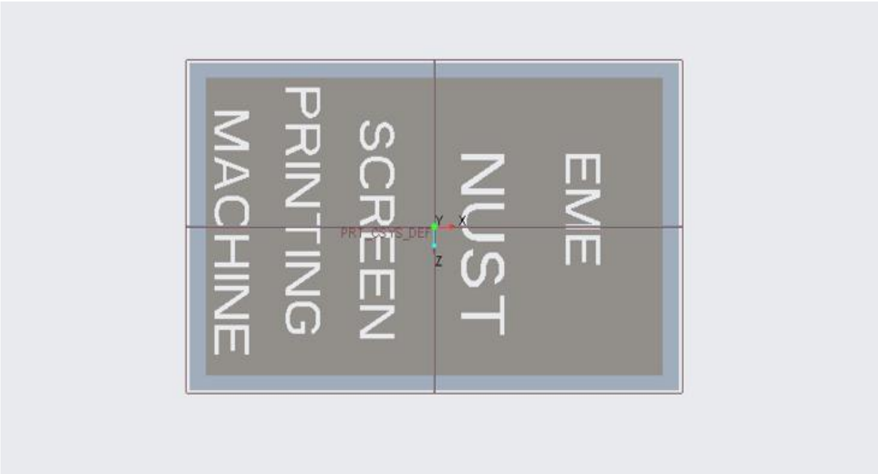


Figure 10 Rig prototype top view

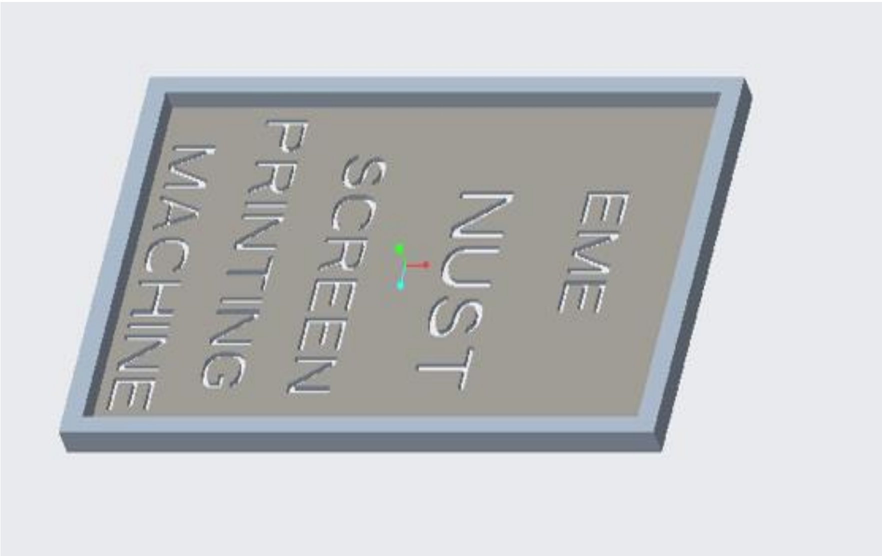


Figure 11 Rig prototype tilted view

Initially the first figure shows only the sheet from the top view and the other figure shows that the sheet is attached with the outer wooden frame which is collectively known as Rig or Dye in screen printing process. [10]

3.1.2 Base Manufacturing

After the rig prototype, the base of the machine was designed. It is of rectangular shape with holes on sides for the accommodation of conveyor system. The figure shows isometric view:

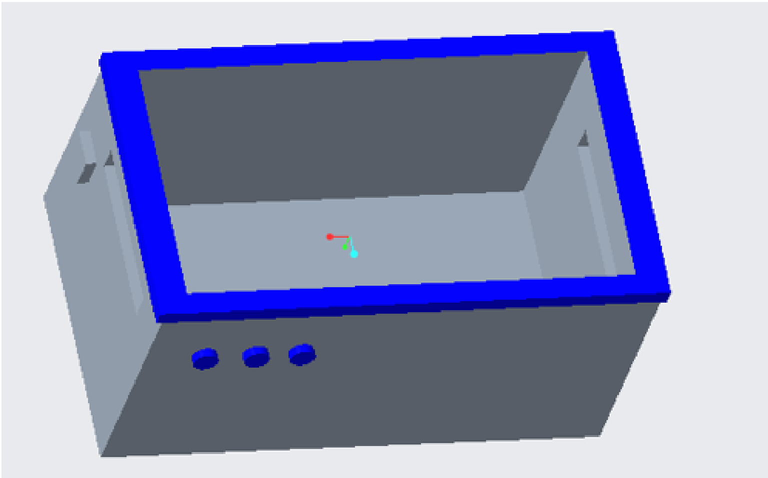


Figure 12 base prototype

3.1.3 Basic Structure

The basic structure prototype includes the base and rig. The rig was attached with the base of the machine and the basic prototype was designed. The figures show different views:

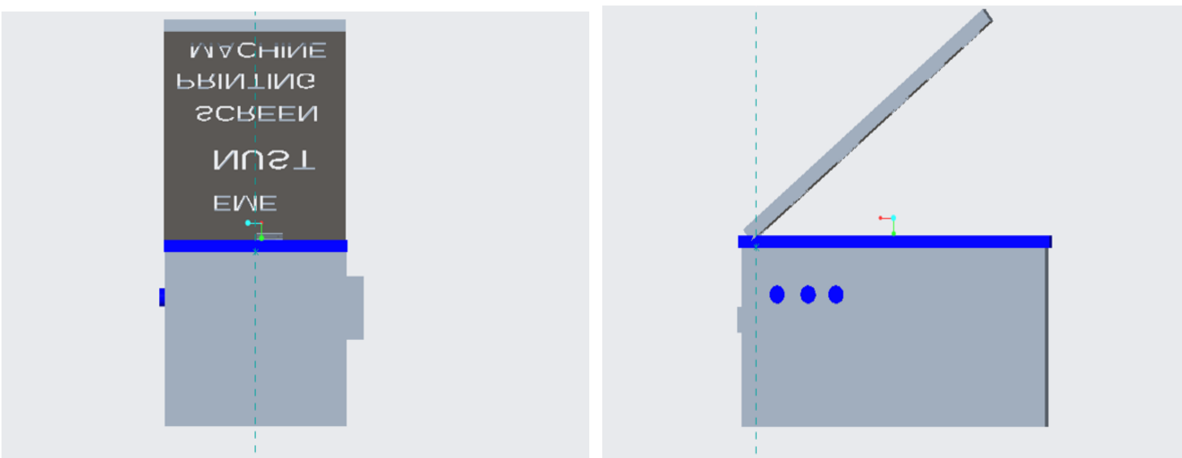


Figure 13 basic structure prototype

It shows the front and the left view of the figure.

The figure shows the isomeric view of the part.

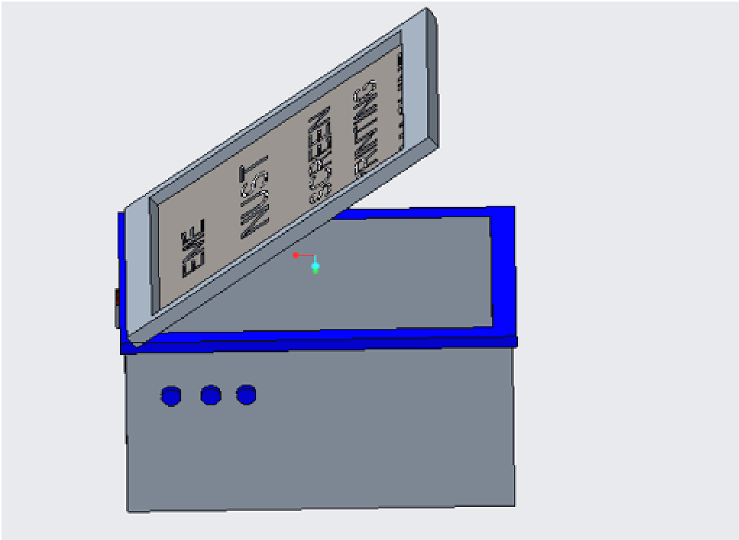


Figure 14 isomeric view of basic design

3.1.4 Squeegee assembly

The squeegee is first designed along with the guide rods and lead screw. At the end sides of the rig, there is structure which is first designed through which the rods and squeegee are applied and fixed which helps in moving squeegee and applying pressure without moving.

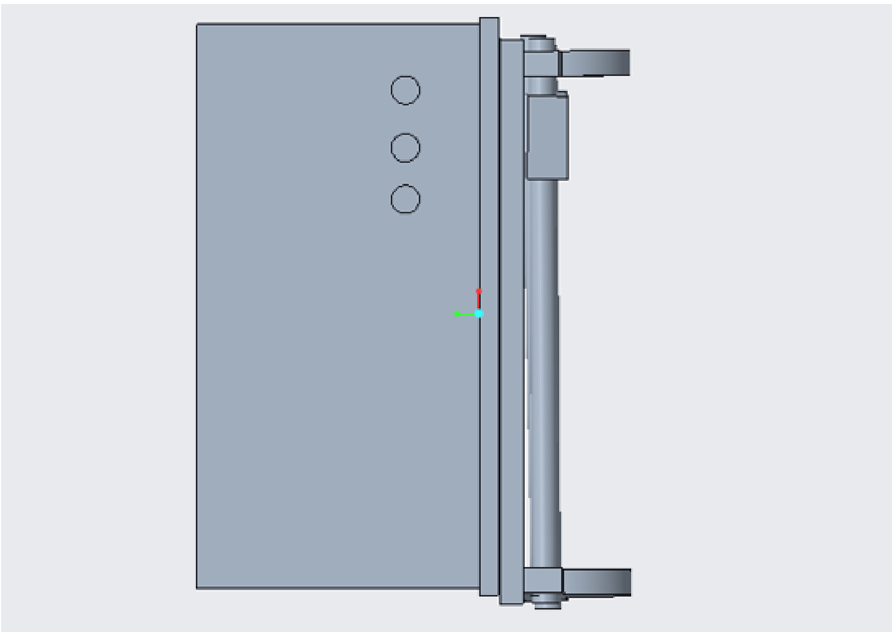


Figure 15 squeegee prototype

It shows the side view of the product.

This is the isometric view of the machine. Side flappers along with guide rods and box shaped squeegee are fixed with the rig above the base which can move here and there on rods. It is shown in the figure.

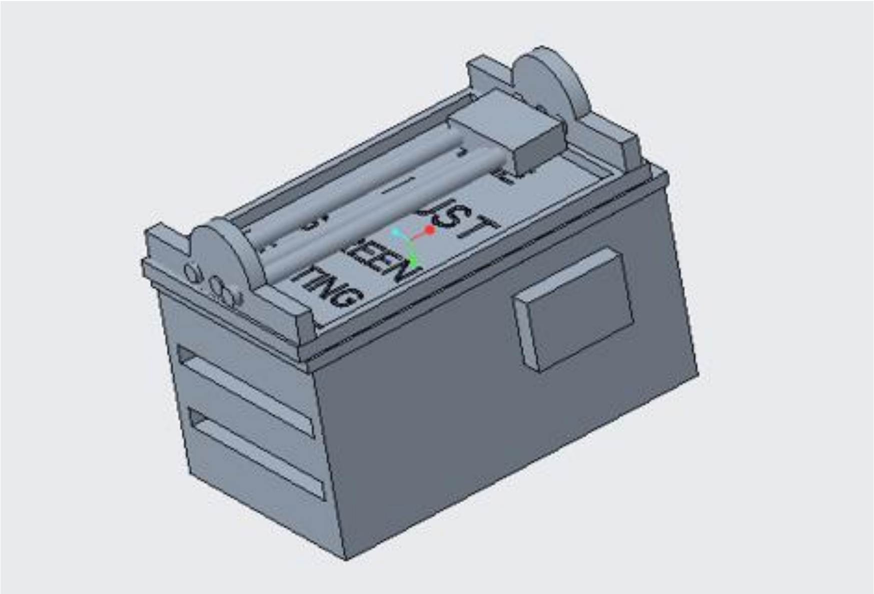


Figure 16 isomeric view of the machine

3.1.5 Conveyor system

The belt and conveyor system were designed first by making rollers. Then the belt was applied by using sweep technique on the rollers.

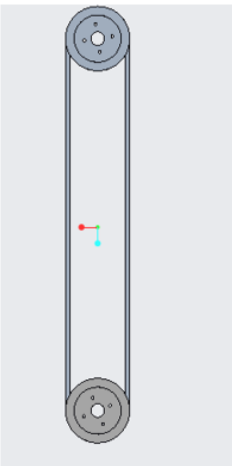


Figure 17 belt and conveyer system prototype

The front view of the belt and the conveyor system is shown in the figure which will be used to move the product which is to be printed. It will be attached to the base.

The figure is shown.

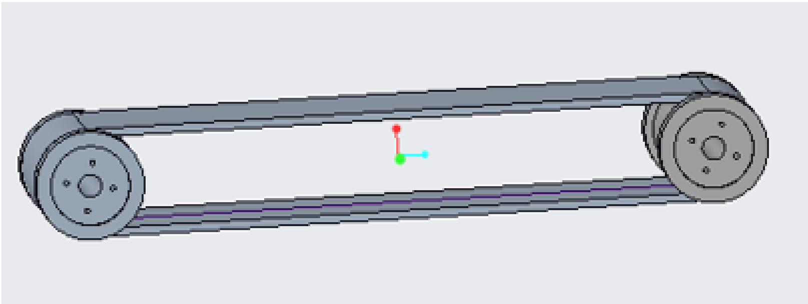


Figure 18 front view of belt and conveyer system prototype

3.1.6 Complete Prototype

The prototype will be completed as the roller was then attached with base of the machine in which squeegee and rig was already attached.

The figure shows different views of the final prototype.

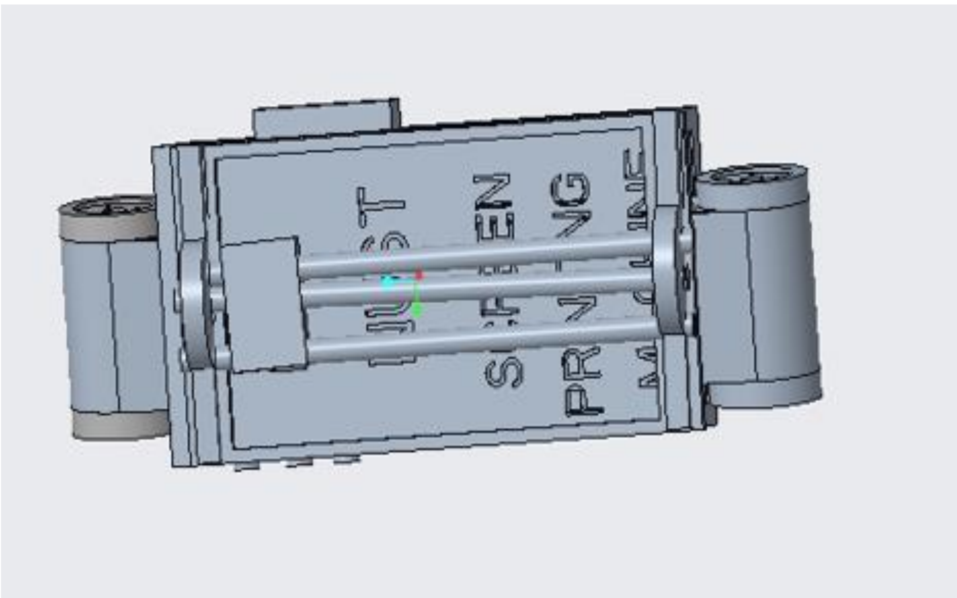
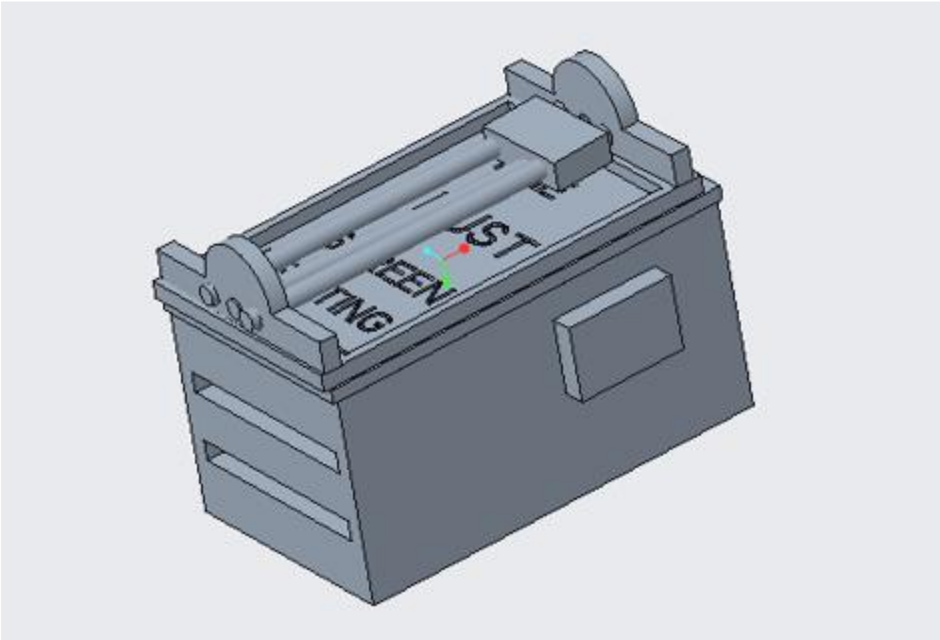


Figure 19 final prototype

This is the top view of the complete prototype of the machine.

The isometric view of the prototype of the semi-automated screen-printing machine without and with the roller is shown in Fig 20.



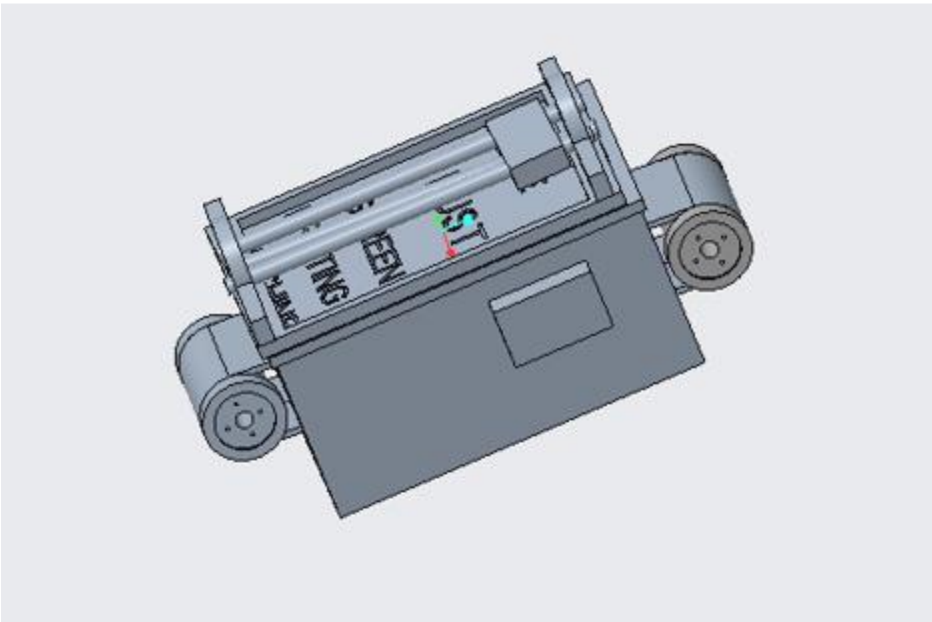


Figure 20 Isomeric view of the final prototype

3.2 Electrical hardware

3.2.1 Nema-17

The Nema-17 motor is extremely helpful in a variety of applications, particularly those requiring low speeds and excellent precision. Nema-17 high torque stepper motors offer excellent affordability without sacrificing quality. NEMA 17 is a 1.8° step angle hybrid stepping motor with 200 steps per revolution. At 4 volts, every phase extracts 1.2 A, producing torque of 3.2 kg-cm. Printers, CNC equipment, and Laser Cutters all require NEMA 17 stepper motors.

Technical Specifications:

- 12V DC Rated Voltage
- Step Angle: 1.8 degree.
- Current: 1.2A at 4V
- 4 phase motor
- 1.54-inch motor length
- 4-wired, 8-inch lead
- 1.8 degrees, 200 steps per revolution
- Operating temperature range: -10 to 40 degrees Celsius

Figure 21 Nema motor

3.2.2 Arduino uno

It is a microcontroller board based on the ATmega328P microcontroller. There are 14 digital I/O pins (six of them can be utilized as PWM outputs), 06 analogue inputs, a 16 mega-Hz quartz crystal, a USB connection, a power jack, ICSP header and a button to reset.

Powering up the Arduino Uno:

Any external power source or a USB connection can be utilized to power Arduino Uno board. The power source is automatically selected. An AC-to-DC adapter or a battery can provide external (non-USB) power. A 2.1mm center-positive plug can be plugged into the board's power jack to connect the adapter. Battery leads can be placed into the POWER connector's GND and Vin pin headers. The board can be powered from a 6 to 20-volt external sup

Technical Specifications:

• ATmega328P microcontroller

• 5V Operating Voltage

• 5V Operating Voltage

• Output Voltage (maximum): 6-20V

• 14 Digital input-output Pins

• DC Current every I/O Pin: 20 mA

• DC Current every I/O Pin: 20 mA

• DC Current 3.3V Pin: 50 mA

• 6 PWM Digital I/O Pins

• 6 Analog Input Pins

• led built-in: 13

• Length: 68.6 mm

• Width: 58.4 mm

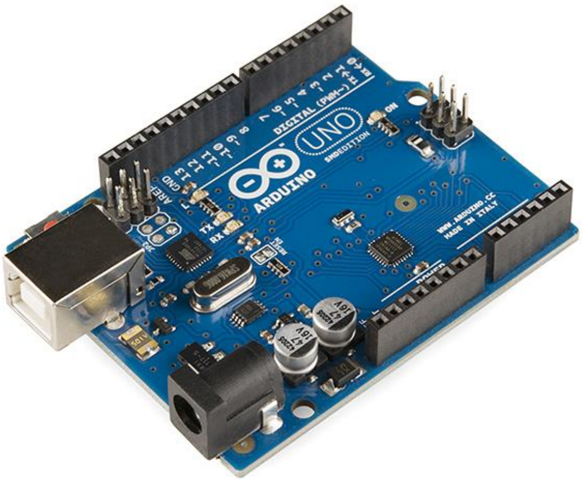


Figure 22 Arduino UNO

3.2.3 H bridge driver

An H-bridge is an electrical circuit that allows the polarity of a voltage applied to a charge to be transmitted. To move DC motors forward or backward, these circuits are frequently employed in robotics and other applications. The term comes from the fact that the four switching parts are connected as a partition and the hub is configured as a branch by the letter "H." H bridges are used in most DC to AC converters (power converters), AC / AC converters, push-pull DC converters, insulated DC converters, motor controllers, and many other forms of power electronics. Almost always, a motor controller with two H-bridges is used to drive a bipolar stepper motor.

The direction of rotation is changed by changing the polarity of the DC motor supply. The H-bridge can enable other operating modes, such as "brake" and "idling till friction stops," in addition to changing the direction of rotation. The H-jumper setting is often used to reverse the polarity / direction of the motor but can also be used to "brake" the motor when the motor suddenly stops when the motor terminals shorten. In the short case, the kinetic energy of a rotating motor is applied in the form of an electric current in short circuits. Another case where the motor stops "idling" because the motor is effectively disconnected from the circuit. The following table summarizes the operation, with S1 - S4 corresponding to the diagram above. In the. In the table below, "1" is used to indicate the "on" status of the switch, "0" to indicate the "off" status.

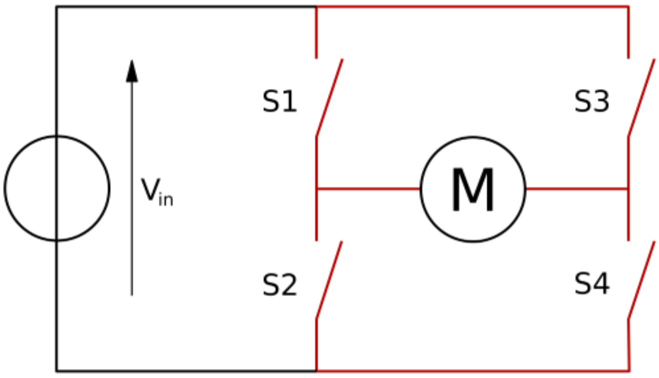


Figure 23 H Bridge Circuit

Table 1 H bridge data

S1	S2	S3	S4	Results
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor coasts
1	0	0	0	
0	1	0	0	
0	0	1	0	
0	0	0	1	
0	1	0	1	Motor brakes
1	0	1	0	
x	x	1	1	Short circuit
1	1	x	x	

The H-bridge is used to power two terminals. You can change the power polarity of the device by setting the switches correctly. Below are two examples, a DC motor controller and a transformer switching regulator. Please note that not all transmission status cases are secure. "Short" cases (see section "DC motor controller") are dangerous for the power supply and the switches.

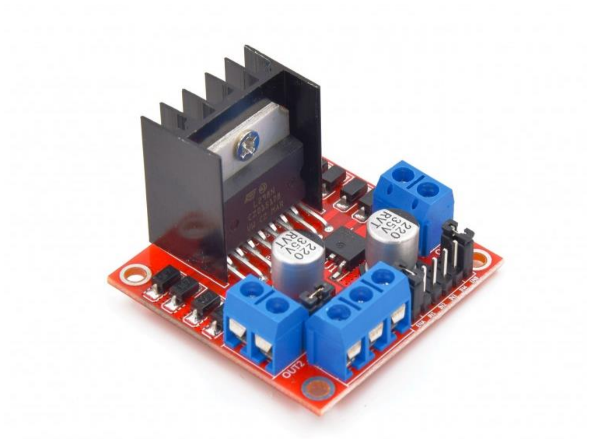


Figure 24 H Bridge

3.2.4 Relay Driver

In a low circuit, the power or power of the microprocessor is very low. Enough for the LED to light up, but you need a relay (Solenoid Switch) to supply high charge, and you need a relay driver to supply the correct voltage or current to the relay. Many times, a resistor is enough to create a Relay Driver. In this type of circuit, the transistor is used as a current amplifier and the relay to do two things (a) isolate the current (electron current), this is important because high charge devices run at different voltages (potential difference), so relay your sensitive electronic parts protected. (b) The relay is an electromagnetic switch. It is a kind of mechanical switch that is pulled by an electromagnet, so its resistance is very small, and it is possible to control large power devices. Currently, a combination of relay and transistor is commonly available on the Relay Driver Module market. In many modules, an LED is also located to indicate the status of the relay switch. The Market Relay module can be purchased by specifying how much Channel Relay is needed and the operating system voltage. We can control various devices and other equipment with great flexibility. It can be controlled directly by a microcontroller.

Figure 25 Relay driver

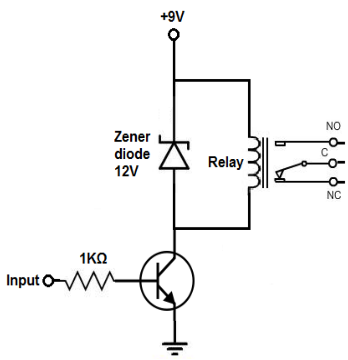


Figure 26 Relay Driver Circuit

3.2.5 DC Jack

The DC jack is a component used in many electronic devices that can be connected to a constant power source, mainly because of its ability to reach long distances without losing power. Thus, most electronics require an AC adapter connected to a DC outlet to supply power in a usable manner. Unlike AC plugs, which are uniform and regulated by country, DC jacks and plugs, technically called coaxial power connectors, are often non-standard. Many electronics manufacturers have their own proprietary AC adapters, also known as power adapters, that use a unique size of DC connectors. Currently, Germany and Japan are the only countries that have tried to issue standards for DC connector sizes. Different AC adapters and DC connectors can vary in many ways, from voltage to physical diameter. DC Jack of 12 A will be converted into 3.3 A by Arduino. Due to the weak nature of electronic circuits, it is not necessary to mix and match the power supplies of different devices.

The DC jack is designed to accept only one connector size. Although different sizes look the same, it can be dangerous to try to pair the wrong power supply with one device. While the most common DC jack connectors are 0.21 inch (5.5 mm) in diameter and 0.37 inch (9.5 mm) in length, it is not uncommon to encounter some that are taller and wider. Although not an absolute rule, larger connectors usually indicate higher voltages.

Figure 27 DC Jack

3.2.6 Buck 2 Amp LED Driver

When the input voltage is higher or lower than the LED voltage, analogue buck-boost LED driver devices allow LED bias. This is appropriate in situations where the input voltage of a lithium-ion battery (Li-Ion) driving an LED can range from 4.2 volts fully charged to 2.7 volts fully depleted, while the forward voltage of the LEDs can range from 2 V to 4 V depending on light and temperature. Our LED drivers are the most efficient, quietest, and have the smallest footprint. Despite high input voltage variations, our synchronous 4-switch Buck-Boost LED driver architecture easily shifts between Buck, pass-through, and boost operating modes and provides well-regulated output. Integrated Schottky diodes, perfect LED current matching, and numerous output options are among the other features available. The ALT80802 is a high frequency switching regulator with a constant output current for driving high-power LEDs. To reduce or reverse the currency conversion, a power MOSFET is integrated. The ALT80802 is appropriate for a wide range of lighting applications, including those in the car entrance area, thanks to its wide input range of 3.8 to 50 V. The device review also enables a simple 3 to 4 WLED driving solution for buck-boost setup, which is a popular application need in car lighting.

The ALT80802 is a frequency dithering, smooth idling, and economical node switching device that aids in EMC / EMI design. The ALT80802's configurable oscillator enables it to switch outside of EMI-sensitive frequency bands like the AM band. The ALT80802 may provide a quick transient response thanks to current mode control and convenient external charging. The ALT80802 control loop is optimized for PWM dimming to produce fast dimming and minimal switching times. The ALT80802 lowers the surge current produced by the zero power of the right half of the aircraft during transient PWM dimming in buck-boost mode.

Figure 28 LED Amplifier

3.2.7 DC JACK LM-2596

The LM2596 is a step-down voltage regulator, often known as a buck converter, that is primarily used to reduce voltage or drive loads of less than 3A. It has excellent load and line control and is available in 3.3V, 5V, and 12V fixed output voltages. It also includes a version with customizable output.

A fixed-frequency oscillator and an internal frequency adjustment technique are included in this regulator. To avoid oscillation and vibration in the circuit, frequency compensation is provided by modifying both the phase and gain characteristics of the open-loop output. Resistance-capacitance networks are used to accomplish this. This regulator, which operates at a fixed frequency of 150 kHz, requires only a few external components. Surface mount package TO-263 and standard 5-pin package TO-220 are also available.

Features:

• Fixed output versions, such as 3.3-V, 5-V, and 12-V, as well as adjustable output versions.

• Customizable output version with a voltage range of 1.2 to 37 volts, with a maximum of 4% overload and line conditions.

• There are four external components required.

• Awe-inspiring load and line regulations.

• Internal oscillator with 150 kHz fixed frequency.

• Has a low-power standby mode (typically 80 A).

• Extremely efficient and accessible.

• Anti-thermal shutdown and current protection

Figure 29 DC Jack

3.2.8 Motor driver L-298N

The L298 Dual H-Bridge Motor Driver Integrated Circuit allows you to drive two motors in both directions with ease and independence. It is highly suited for robotic applications and can be connected to a microcontroller with only a few control lines per motor. Simple manual switches, TTL logic gates, relays, and other electronic devices can all be attached to it. Power LEDs, a +5V regulator, and protection diodes are all included on this board.

L298N Module Pinout Configuration:

Table 2 Motor Driver Pin Configuration

Pin Name	**Description**
IN1 & IN2	Motor A input pins. Motor A's spinning direction is controlled by these pins.
IN3 & IN4	Motor B input pins. Motor B's spinning direction is controlled by these pins.
ENA	Enables PWM signal for Motor A
ENB	Enables PWM signal for Motor B
OUT1 & OUT2	Output pins of Motor A
OUT3 & OUT4	Output pins of Motor B
12V	12V input from DC power Source
5V	Provides Power to the L298N IC's switching logic circuits.
GND	Ground pin

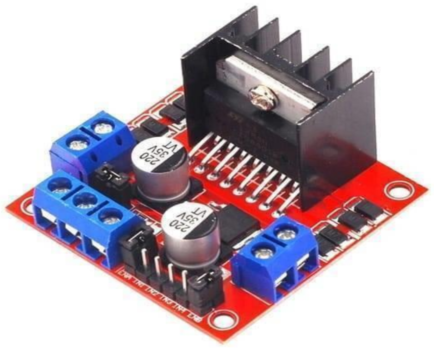


Figure 30 Motor driver

Features:

• Each motor has a current sense.

• Improved performance with a heatsink.

• On-Board LED Indicator

3.2.9 Gear motor GM-3246

The shaft rotation direction of a miniature worm gear DC motor (12V 40RPM) can be changed while the positive and negative wiring are altered.

Characteristics:

- The micro speed reduction gear motor is small, light in weight, high efficiency and easy to carry.
- The DC metal gear motor has a big output torque due to its high torque and strong torsion.
- With self-locking, the output shaft can't rotate when switch off. This automatically saves energy and protects the internal circuits and maintains the motor torsion of the motor.
- The output shaft of the gearbox and the motor shaft have become a rectangle; it's extensively employed in a variety of situations that necessitate a unique installation size.

Applications:

Worm geared motors are widely used in

- Window openers.
- Head Lamp.
- Home decoration.
- Motor shaft.
- Machine tool.

Figure 31 Roller Gear Motor

3.2.10 FSR-1000 Pressure Sensor

FSRs are sensors that permit you to identify actual tension, pressing and weight. They are easy to utilize and minimal expense. The FSR is made of 2 layers isolated by a spacer. The more one presses, a greater amount of those Active Element spots contact the semiconductor and that makes the obstruction go down.

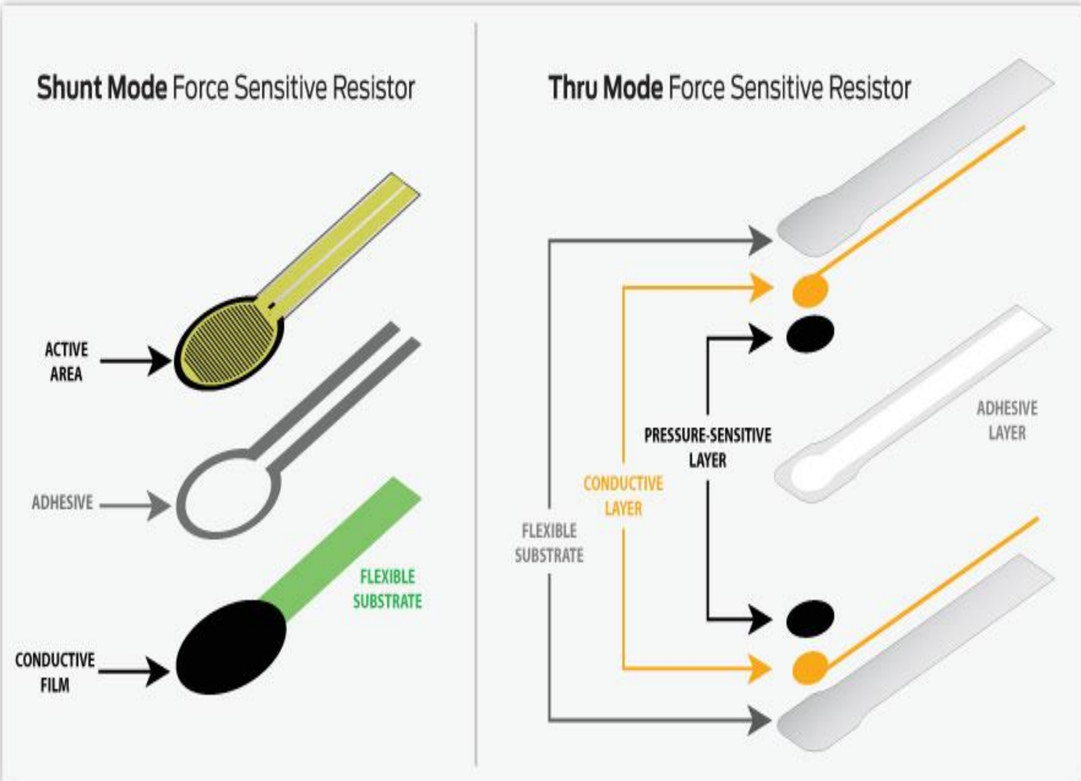


Figure 32 Pressure Sensor

FSRs are generally a resistor that changes its resistive worth dependent upon the sum it is crushed. These sensors are low in cost, and easy to use anyway they're only occasionally exact. They moreover shift some starting with one sensor then onto the next perhaps 10%. So basically, when you use FSRs you should simply expect to get extents of response. While FSRs can recognize weight and determine force acting on it , they're a horrendous choice for distinguishing exactly the quantity of pounds of weight that are on them.

3.2.11 Temperature Sensor

A temperature sensor is a device that measures an object's temperature. The temperature of the air, the temperature of a liquid, or the temperature of a solid can all be considered. Temperature sensors exist in a range of shapes and sizes, and they all use different technologies and concepts to detect temperature.

In this project, we have used a D18B20 temperature sensor.

Specifications:

- Operating voltage: 3V to 5V
- Temperature Range: -73°C to +273°C
- Accuracy: 0.5°C
- Output Resolution: 9-bit to 12-bit (programmable)
- Unique 64-bit address enables multiplexing
- Conversion time: 750ms at 12-bit
- Programmable alarm options

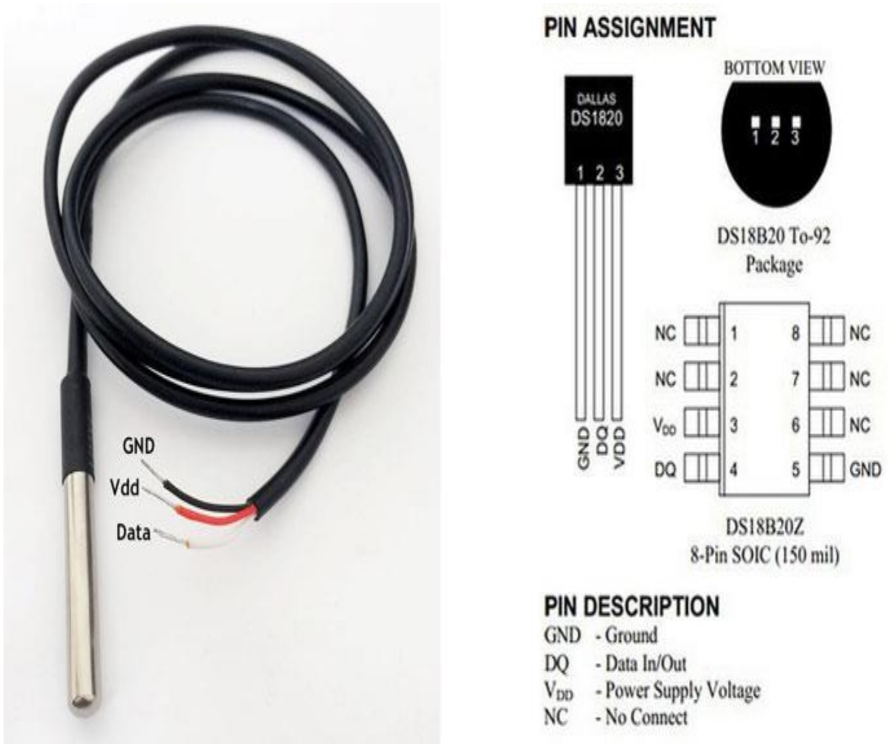


Figure 33 Temperature sensor

Pin Configuration:

Table 3 Temperature Sensor Pin Configuration

No:	Pin Name	Description
1	Ground	Connect to the ground of the circuit
2	V_{cc}	Powers the Sensor, can be 3.3V or 5V
3	Data	This pin gives output the temperature value which can be read using 1-wire method

3.3 Mechanical Hardware

3.3.1 Acrylic Sheets

Acrylic is a strong, tough, and clearly transparent plastic with excellent strength and hardness. Acrylic film is easy to produce, adheres well to adhesives and solvents and is easily thermoformed. In terms of heating, it surpasses many other transparent polymers.

The acrylic sheet has glass-like properties such as clarity, clarity and transparency, but it is half the weight of glass and has many times higher impact resistance. Acrylic plastic offers exceptional versatility, durability and aesthetic qualities in everything from robust markings and skylights to distinctive equipment, displays and shelves for retailers.

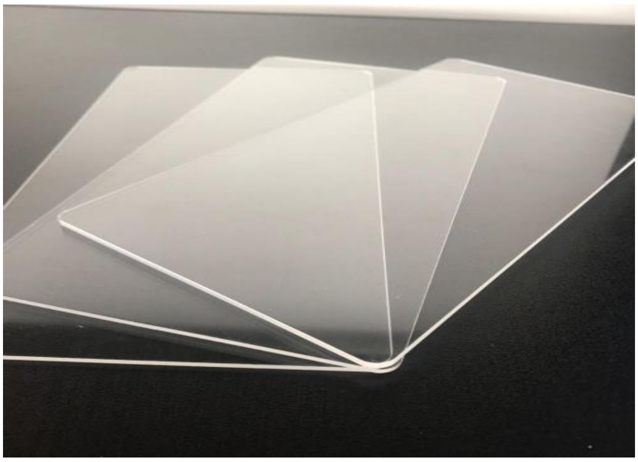


Figure 34 Acrylic sheet

3.3.2 Lead Screw

The term "lead" refers to the distance a nut will travel during a full rotation of the screw. Regarding material, Stainless steel is an option. Corrosion resistance is practically universal (can be used in a wet or corrosive environment). We have used metal lead screw usually used in 3D printer, lathe machines etc.

Table 4 Lead screw data

Length	210mm
Diameter	8mm
No. of Turns	204mm

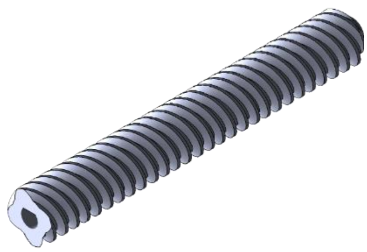


Figure 35 lead screw

3.2.3 Coupler and Screw

Beam Coupler:

A beam coupling is made consisting of one or more spiral incisions placed between solid metal and a cylindrical piece of metal, commonly aluminum or steel. Couplers are mechanical components that join two parallel shafts so that one can drive the other at the same speed. These components are suited for low-torque and light-load applications. We have used between nema-17 motor and lead screw.

Figure 36 Beam coupler

Screws:

They are mounted on lead screws. They are used to move any substance along the lead screw. Here in our case, we have moved squeegee along the lead screw. Material used is stainless steel.

Figure 37 Screws

3.2.4 Flapper

Flapper in this project is used to carry the vipers to spread the ink properly on the rig and print it on the medical grade PVC sheet. Its CAD-model was made on Creo parametric. It is made up of acrylic sheets. It was laser cut. Different holes were made for two guide rods and one lead screw. Different parts of the flapper were joined together by small screws.

Below flapper a squeegee(viper) is attached to put force on the ink to be printed on the sheet.

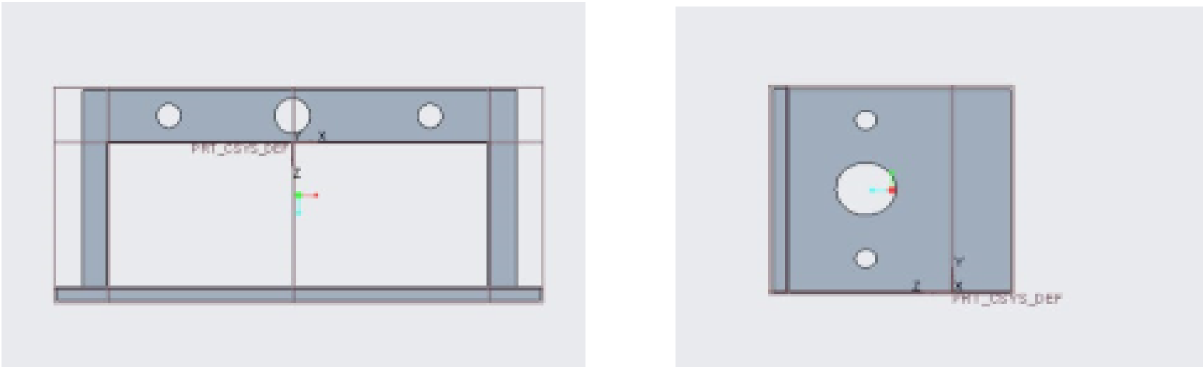


Figure 38 Flapper Creo Model

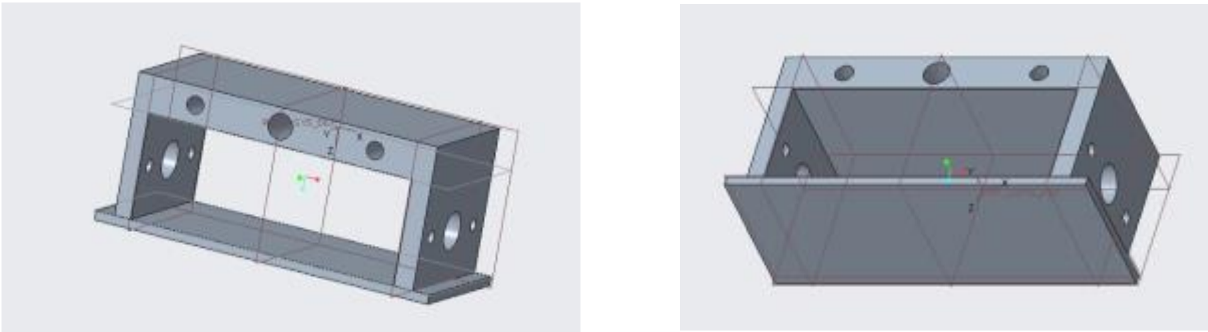


Figure 39 Tilted views of flapper

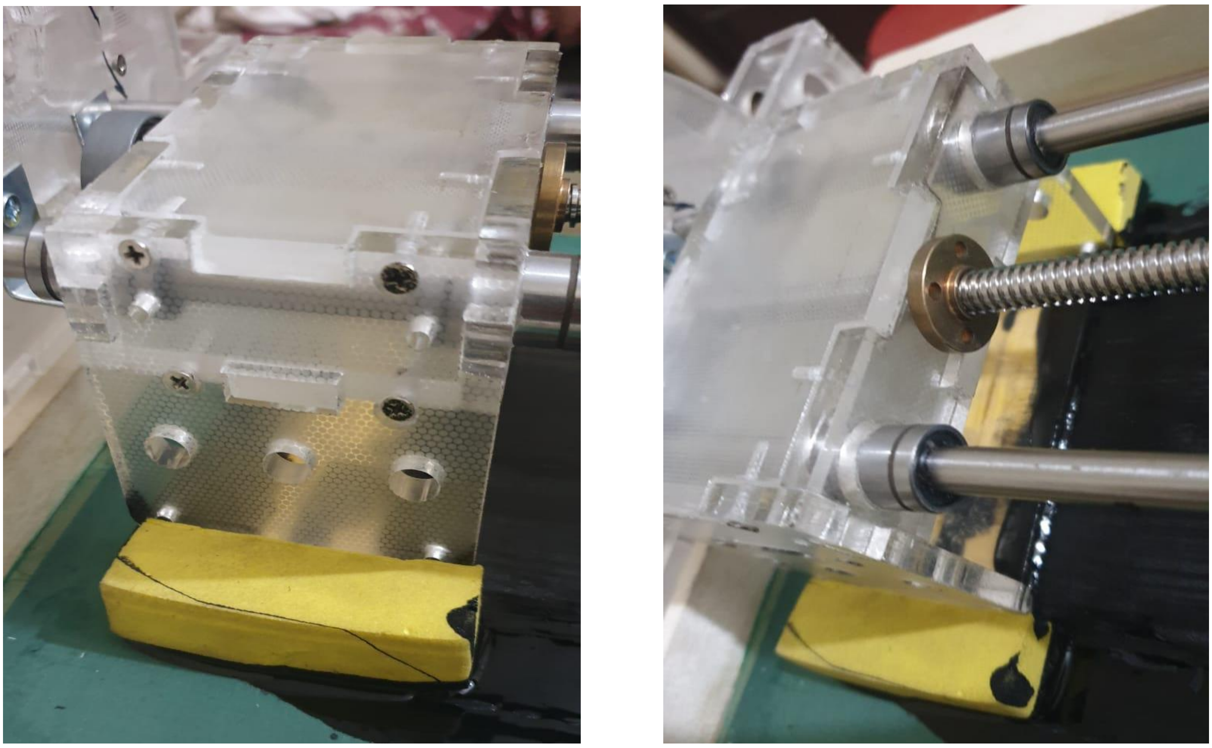


Figure 40 Flapper used in a project

3.3.5 Sides

Sides are used to hold the rods in position as they are attached to the rig. Also, they limit the movement of the Flapper. There CAD-model was made on Creo parametric. They are made up of acrylic sheets. They were laser cut. Two basic holes were made for guide rods to keep flapper in a straight line.

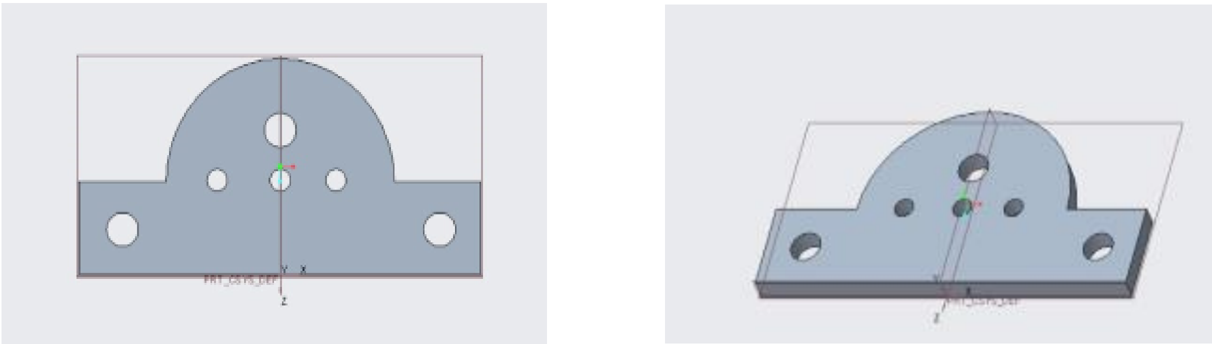


Figure 41 Project sides Creo model view

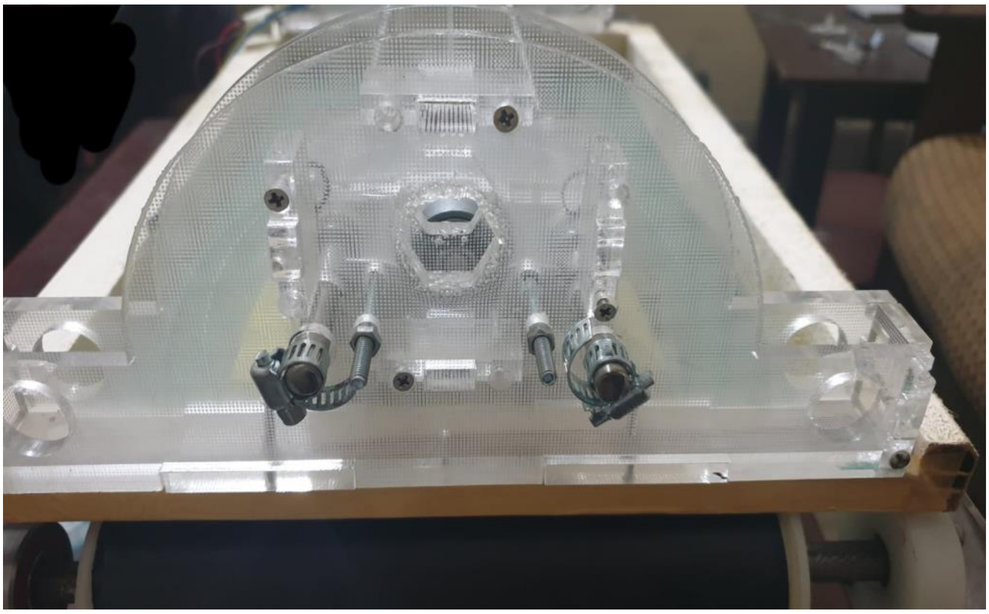


Figure 42 Project sides from back

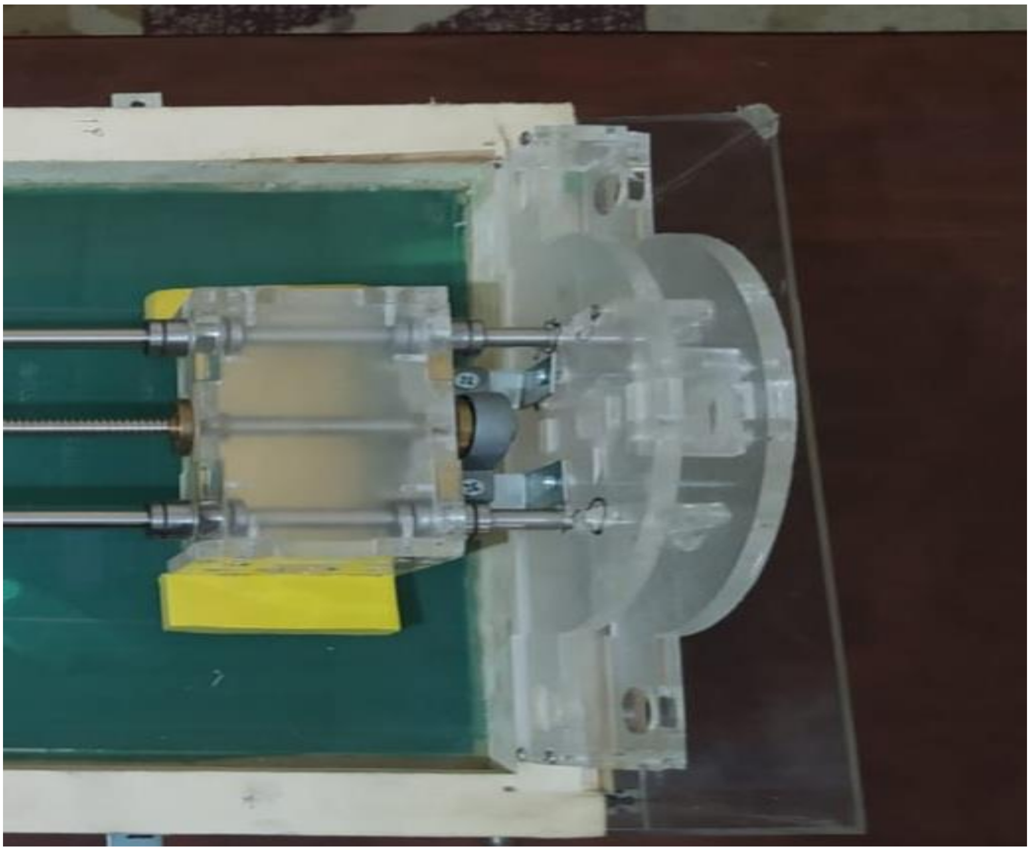


Figure 43 Project sides from top

3.3.6 Belt and Conveyer

Belt and conveyer are basically used to transfer PVC sheet from one location to another. A belt is moving on two rollers fixed on opposite end on the base and they are fixed with the help of stationers and screws. Blood bag is initially put on the belt on one end below the engraving on the rig and after printing it is moved to the other end for collection. Rollers are made up of acrylic material and metal road is placed between them.

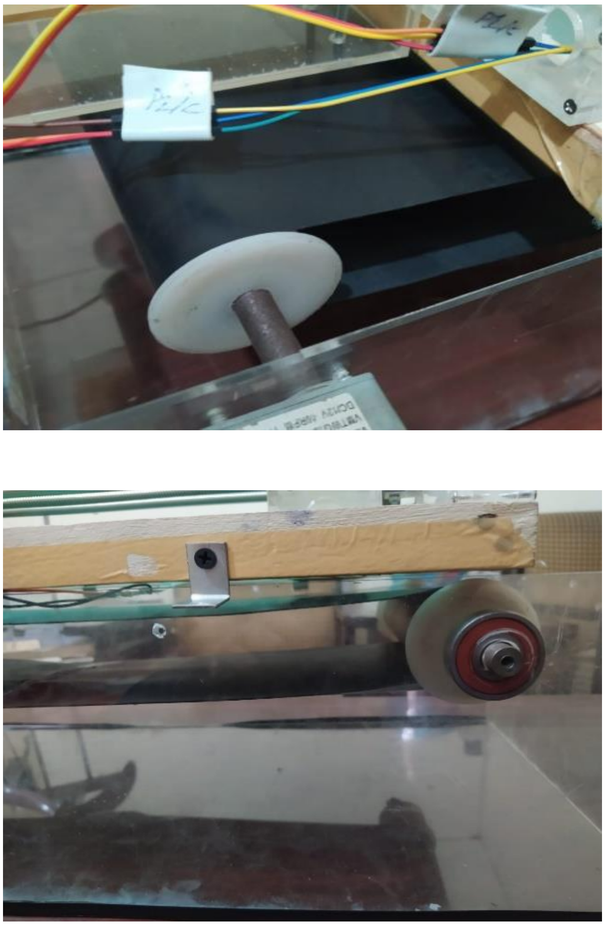


Figure 44 Belt and conveyer system

3.3.7 Base

To accommodate all the mechanical hardware and electronic circuits and machinery, an acrylic sheet base is made. The acrylic sheets used for base making are transparent. Acrylic sheets were laser cut on specific dimensions. Length of 25inch, width of 12inch and height of 6inch. They were joined together through glue gun and tape. Within the base belt and conveyer system is placed and upon it rig is placed.

Figure 45 Base

Figure 46 Basic Structure

3.3.8 Rig/Die

Rig is a rectangular structure which gives pattern for any print. It is designed on illustrator using different tools. It was given design to have specification of a blood bag on it like bar code, exp date, blood group etc. it was a rectangular wooden frame and a green sheet which does not allow any ink to pass. Upon that green portion there is a portion of blood bag specifications in silver lining which allows the passing of ink, and it is printed on the PVC sheet.

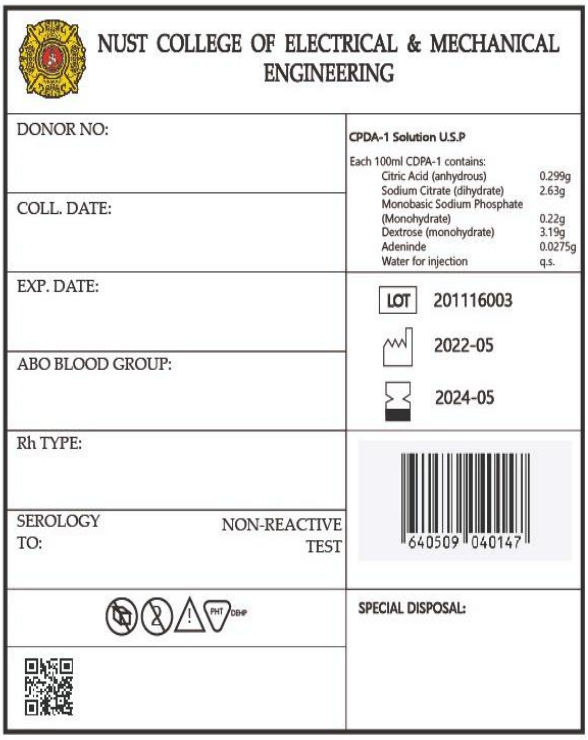


Figure 47 illustrator model of die

Figure 48 die

3.4 Electrical software

3.4.1 Coding of components

In electrical software portion of our project, we have done the coding of following components:

- Roller motor.
- NEMA stepper motor.
- Temperature sensor.
- Pressure sensor.

Roller motor:

The Roller motor GM-3246 is coded in way to control the movement of a belt and conveyer system via a time delay. The belt and conveyer system will move and and will stop on a position where we are supposed to print and then will move forward

NEMA stepper motor:

Nema-17 stepper motor is coded in way to control the movement of flapper on die/rig. The motor will move the flapper on the die slowly so that the squeegee exert more pressure on die for better printout quality.

Temperature sensor:

The temperature sensor is coded in a way to have an idea about the room temperature. The temperature value will be displaced on the TFT display screen and once we know the room temperature, we can operate the machine accordingly so that it may not get overheated.

Figure 49 Temperature sensor reading

Pressure sensor:

The pressure sensor is placed below the die so that we get to know about the pressure being exerted by squeegee and flapper on the die. The value of pressure sensor will also be shown on the TFT display screen. We are moving the flapper slowly on the die so that we can have a maximum possible pressure on die for the better print quality and equal distribution of ink.

Figure 50 Pressure sensor readings

3.4.2 Software's used

The coding of roller motor and NEMA stepper motor was done on JAVA while the coding for temperature and pressure sensor was done on Arduino IDE. The detailed code has been attached in appendices.

JAVA

Java is an object-oriented programming language with a high level of abstraction and as few implementation dependencies as possible. It's a general-purpose programming language designed to enable programmers write once and execute anywhere, which means that compiled Java code can run on any platform that supports Java without requiring recompilation. Java has a syntax that is like C and C++, although it has less low-level features than any of these languages.

Benefits:

- **Object Oriented**:

Everything in Java is an Object. Because it is built on the Object model, Java can be easily extended.

- **Platform Independent:**

Unlike many other programming languages, such as C and C++, Java is compiled into platform-independent byte code rather than platform-specific machine code. This byte code is distributed over the internet and is interpreted by the Virtual Machine (JVM) on the platform on which it is run.

- **Simple:**

Java is intended to be simple to learn.

- **Secure**:

Java's secure feature enables the creation of virus-free and tamper-proof systems. Public-key encryption is used in authentication systems.

- **Architecture-neutral**:

With the inclusion of the Java runtime system, the Java compiler generates an architecture-neutral object file format, which makes the compiled code executable on a wide range of processors.

- **Portable:**

Java is portable because it is architecture-neutral and has no implementation-dependent features of the standard.

- **Robust**:

Java focuses on compile-time error checking and runtime error checking in order to eliminate error-prone situations.

Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

Benefits:

- **Easy to implement:**

Arduino IDE can be implemented within Windows (11, 10, 8.1, 8, 7), Mac and Linux operating systems.

- **Easy editing:**

Most of its components are written in JavaScript for easy editing and compiling.

- **Easily accessible:**

It has been equipped with a means to easily share any details with other project stakeholders. Users can modify internal layouts and schematics when required.

- **Availability of help guides and tutorials:**

There are in-depth help guides which will prove useful during the initial installation process.

Tutorials are likewise available for those who might not have a substantial amount of experience with the Arduino framework.

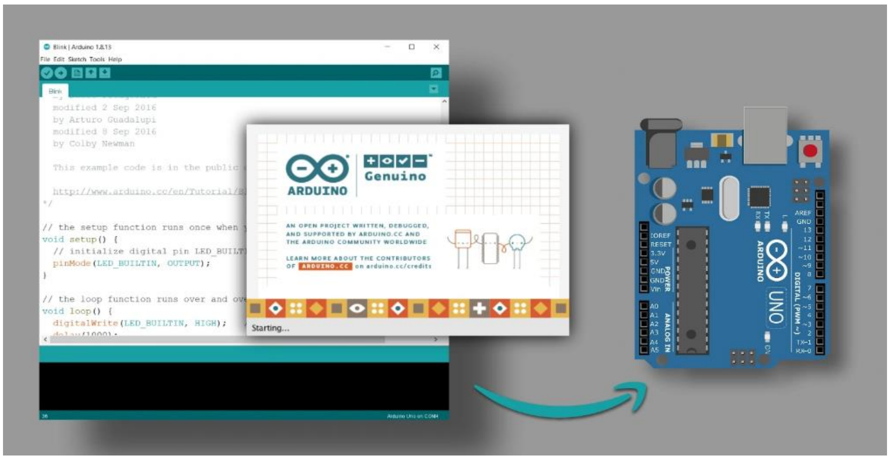


Figure 51 Arduino IDE

Chapter 4: Working and Results

4.1 Working Procedure

Initially, the sheet on which we desire to print is placed under the Rig and the rig will be fixed on its place. After that the CMYK ink is distributed on the rig using a brush which is already prepared in the bowl by using kerosine oil and emulsion. After the ink is distributed on the rig, we will turn on the Machine which is connected by the electrical system and as the coding is coding is done the squeegee will start moving forward by using the lead screw and guide rods attached with them giving the support so that it should not move here and there. The squeegee will to the other end and then come back.

On the rig we have manufactured two models so that we can print two sheets at a time or one sheet twice. One sheet twice can be printed by the aide of conveyor system which will move the sheet from 1^{st} printing model to the 2^{nd} printing model. When squeegee will print on first model, it will then move towards the other model on the same rig. The conveyor coding is done in such a way that the sheet will be moved from the 1^{st} model to 2^{nd} model quickly and the moving squeegee will then print on the sheet again.

If the roller is not used, then we have to place a thick acrylic sheet under the rig on the PVC sheet. The rig is fixed, and ink will be distributed on the rig. In this case two sheets can be printed at a time as sheet can't be displaced from one place to other. If we want to print twice on the sheet, then the squeegee will be allowed to make 2 complete rounds on the sheet and as the round will be completed the motor will be stopped and rig will be opened to take the sheets out.

We have done printing on PVC Sheets, the plastic sheet and also on a piece of fabric. It shows that the machine prototype is suitable for any type of material on which the printing is required but need some size adjustments so that it can be easily handle and easy to use.

4.2 Sample Result

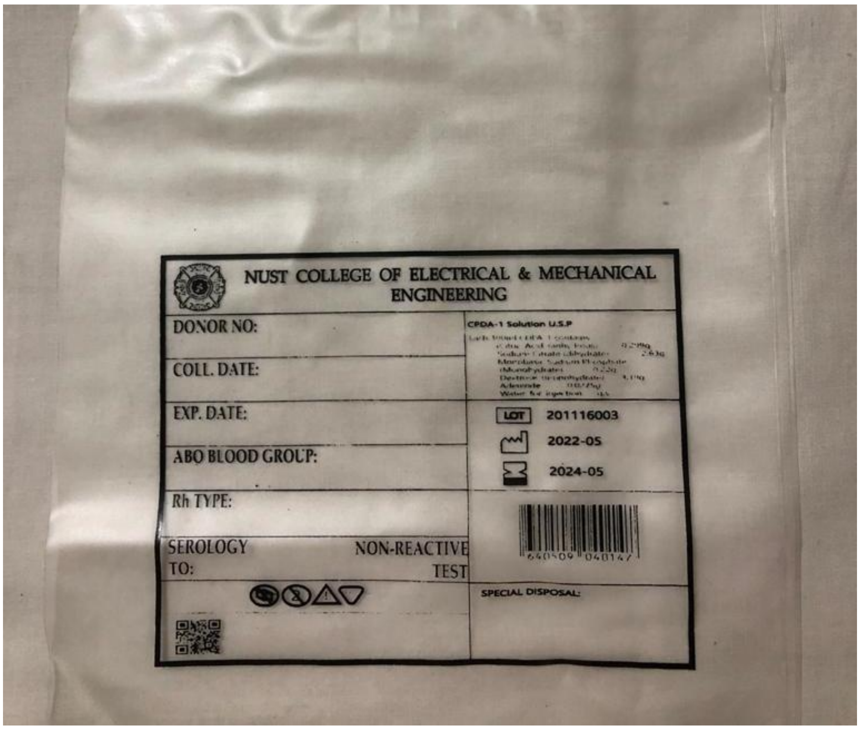


Figure 52 Sample result

4.3 Limitations

We have developed a semi-automated screen-printing machine. Screen printing is mostly done manually. And there is a hug market of manual screen printing. We have semi-automated the machine, but it still has certain limitations which must be taken under-consideration.

- Costly for small demand orders.
- Limited amount of color ranges is available.
- Ink is material specific.
- Rig is pattern specific.
- It is not suitable for very long operations, i.e., must change or wash the rig after usage.
- Not very suitable for fine detailing.
- Necessity of electricity.
- Delicate handling is required.

Chapter 5: Recommendations for Future Work

Screen printing technology is expanding rapidly as a marketing tool for small businesses and a way to make new progress in many other fields.

In modern screen printing we need some necessary tools as used in past. These are:

- Squeegee
- Ink
- Stencil
- Material

Different inks are used for printing on different material e.g.: there is a specific ink used for the printing on medical grade PVC Sheets.

5.1 Conventional vs Modern screen printing

It is best used for design with limited colors. However, screen-printed clothes are durable and of high quality. This process can be performed using a flatbed machine, a hand squeegee or a rotary roller press for more efficient printing. An alternative technology, printing directly on clothes, is sometimes compared to a conventional inkjet printer, which you can make at home, because it works by spraying ink directly on the fabric. This method allows you to print digitally on demand, but the quality may be lower than traditional screen printing. A screenshot is the best choice when it comes to running your own products for your small business.

5.2 Advancements

The new technology comes with advanced screen-printing techniques, such as an electronic display that is printed directly on everyday fabric for medical use. This technology allows patients to control it with a soft cloth that is wearable and impermeable. Screen printing will be a major player in the next generation of printing electronics. The screen-printing computer or CTS is relatively new in the screen-printing industry. This new screen capture process eliminates the need to manage movies, reduce costs and working hours. Screen printing from a computer also allows you to customize the design using a computer and the placement of the screens is always correct. The latest version of this system, CTS digital light image, also eliminates the need for toner with a digital mirror device to expose the image to UV light. These new advances in screen printing technology will enable faster printing of products with remarkable innovation.

5.3 Applications of advancements:

These are application of advance screen-printing machines

- Biomedical sensors
- Solar cells
- Televisions
- Circuit boards
- Smart fabrics
- Printed textiles
- Screen printing is used for T-shirts, posters, hats and medical grade PVC sheets

Screen printing technology may evolve into a new industry, but it will remain the best tool for industry to grow your business with your own products. The future of screen printing will always support your marketing efforts.

Chapter 6: Conclusions

We have developed a semi-automated screen-printing machine. Screen printing is mostly done manually, and there is a hug market of manual screen printing. There are two types mostly either manual or fully automatic. Manual takes a lot of time and chance of error is more which will result in the rejection of the product. The fully automatic is quite expensive, as in Pakistan, there are lot of tax implementation while importing machinery and not all the industrialists can afford that machinery. This prototype will help all the industrialists who work on small scale and can work without requirement of more labor with reduced error.

REFERENCES

[1] D. N. V. benni, "Printed Electrochemical Instruments for Biosensors," *ECS Journal of Solid State Science and Technology,* 2015.

[2] V. Benni, "Printed Electrochemical Instruments for Biosensors," *IOP Sceince ,* 2015.

[3] M. Sharafeldin, "3D-Printed Immunosensor Arrays for Cancer Diagnostics," *MDPI ,* vol. 20, no. 16, 2020.

[4] M. kostic, "Design and Development of OECT Logic Circuits for Electrical Stimulation Applications," *Applied Science ,* 2022.

[5] E. noviana, "Microfluidic Paper-Based Analytical Devices: From Design to Applications," *ACS Publications,* vol. 121, no. 19, pp. 1183-1185, 2021.

[6] HoumanKholafazad-Kordasht, "Smartphone based immunosensors as next generation of healthcare tools: Technical and analytical overview towards improvement of personalized medicine," *Science direct,* vol. 145, 2021.

[7] C. R. Mace, "Manufacturing prototypes for paper-based diagnostic devices," *Springer Link,* pp. 801-809, 2013.

[8] S. B. Puneeth, "Microfluidic viscometers for biochemical and biomedical applications: A review," *Engineers research express,* vol. 3, 2021.

[9] A. fakharudin, "A perspective on the production of dye-sensitized solar modules," *Royal society of chemistry ,* no. 12, 2014.

[10] Y. Alsharif, "Conductive Stretchable and 3D Printable Nanocomposite for e-Skin Application," *university library,* vol. 12, no. 3, pp. 123-154, 2018.

[11] M. Sharafeldin, "3D-Printed Immunosensor Arrays for Cancer Diagnostics," *sensors,* 2020.

[12] C. R. Mace, "Manufacturing prototypes for paper-based diagnostic devices," *Springer Link,* 2014.

APPENDICES

Arduino Code:

```
#include "math.h"

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include <OneWire.h>

#include <DallasTemperature.h>


LiquidCrystal_I2C lcd(0x27, 16, 4);


#define ONE_WIRE_BUS 6

OneWire oneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);


int fsrPin = 0;     // the FSR and 10K pulldown are connected to a0

int fsrReading;     // the analog reading from the FSR resistor divider

int fsrPin1 = 1;     // the FSR and 10K pulldown are connected to a0

int fsrReading1;     // the analog reading from the FSR resistor divider

int on = 500;

#define A 2

#define B 3

#define C 4

#define D 5


#define NUMBER_OF_STEPS_PER_REV_for 512*14.3 //256 512

#define NUMBER_OF_STEPS_PER_REV_rev 512*14.4
```

```
int prev = 0,i = 0;
void setup() {
  pinMode(A, OUTPUT);
  pinMode(B, OUTPUT);
  pinMode(C, OUTPUT);
  pinMode(D, OUTPUT);
  pinMode(7, OUTPUT); //relay
  digitalWrite(7,HIGH);
  Serial.begin(9600);
  sensors.begin();
  lcd.begin();
  lcd.backlight();
}


void write(int a, int b, int c, int d) {
  digitalWrite(A, a);
  digitalWrite(B, b);
  digitalWrite(C, c);
  digitalWrite(D, d);
}
void forwardstep() {
  write(1, 0, 0, 0);
  delay(1);
  write(1, 1, 0, 0);
  delay(1);
  write(0, 1, 0, 0);
  delay(1);
```

```
  write(0, 1, 1, 0);
  delay(1);
  write(0, 0, 1, 0);
  delay(1);
  write(0, 0, 1, 1);
  delay(1);
  write(0, 0, 0, 1);
  delay(1);
  write(1, 0, 0, 1);
  delay(1);
  write(0, 0, 0, 0);
  delay(1);
}
void reversestep()
{
  write(1, 0, 0, 1);
  delay(1);
  write(0, 0, 0, 1);
  delay(1);
  write(0, 0, 1, 1);
  delay(1);
  write(0, 0, 1, 0);
  delay(1);
  write(0, 1, 1, 0);
  delay(1);
  write(0, 1, 0, 0);
  delay(1);
```

```
  write(1, 1, 0, 0);
  delay(1);
  write(1, 0, 0, 0);
  delay(1);
  write(0, 0, 0, 0);
  delay(1);
}
void loop() {
sensors.requestTemperatures();
float  temperature = sensors.getTempCByIndex(0);
Serial.println(temperature);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Temp: ");
lcd.print(temperature);
lcd.print("'C");
delay(200);

fsrReading = analogRead(fsrPin);

  Serial.println("Analog reading = ");
  Serial.println(fsrReading);     // the raw analog reading

 fsrReading1 = analogRead(fsrPin1);

  Serial.println("Analog reading = ");
  Serial.println(fsrReading1);     // the raw analog reading
```

```
 lcd.setCursor(0,1);
  if (fsrReading == 0) {
    Serial.println(" - No pressure");
    lcd.print("P1-No pressure");
  } else if (fsrReading < 10) {
    Serial.println(" - Light pressure");
    lcd.print("P1-Light pressure");
  } else if (fsrReading < 50) {
    Serial.println(" - Light pressure");
    lcd.print("P1-Light pressure");
  } else if (fsrReading < 150) {
    Serial.println(" - Medium pressure");
    lcd.print("P1-Medium pressure");
  } else {
    Serial.println(" - Big pressure");
    lcd.print("P1-Big pressure");
  }
  delay(1000);
lcd.setCursor(-4,2);
  if (fsrReading1 == 0) {
    Serial.println(" - No pressure");
        lcd.print("P2-No pressure");
  } else if (fsrReading1 < 10) {
    Serial.println(" - Light pressure");
        lcd.print("P2-Light pressure");
  } else if (fsrReading1 < 50) {
```

```
    Serial.println(" - Light pressure");
        lcd.print("P2-Light pressure");
  } else if (fsrReading1 < 150) {
    Serial.println(" - Medium pressure");
        lcd.print("P2-Medium pressure");
  } else {
    Serial.println(" - Big pressure");
        lcd.print("P2-Big pressure");
  }
  delay(1000);

digitalWrite(7,LOW);
delay(on);
digitalWrite(7,HIGH);
delay(on);

while(i < NUMBER_OF_STEPS_PER_REV_for)
{
  forwardstep();
  //reversestep();
  i++;
}

i=0;
while(i < NUMBER_OF_STEPS_PER_REV_rev)
{
  //forwardstep();
```

```
  reversestep();
  i++;
}
i=0;
while(i < NUMBER_OF_STEPS_PER_REV_for)
{
  forwardstep();
  //reversestep();
  i++;
}

//  for (int i = 0; i < NUMBER_OF_STEPS_PER_REV; i++)
//  {
//    forwardstep();
//  }

//  for (int i = 0; i < NUMBER_OF_STEPS_PER_REV; i++)
//  {
//    reversestep();
//  }

}
```

Nema-17 motor and Rotor motor Code:

```
public class MainActivity extends AppCompatActivity {
```

```
private WebView camv = null;
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main);

    Switch rfid = findViewById(R.id.rfidswitch);
    Switch fingerprint = findViewById(R.id.fingerswitch);
    camv = findViewById(R.id.cameraview);

    FirebaseDatabase rootnode = FirebaseDatabase.getInstance();
    DatabaseReference reference0 = rootnode.getReference("RFID");
    DatabaseReference reference1 = rootnode.getReference("FingerPrint");
    DatabaseReference reference2 = rootnode.getReference("IP");

    rfid.setOnCheckedChangeListener(new CompoundButton.OnCheckedChangeListener() {
        @Override
        public void onCheckedChanged(CompoundButton compoundButton, boolean b) {
            if (b) {
                reference0.setValue(true);
                Toast.makeText(getApplicationContext(), "rfid true",Toast.LENGTH_SHORT).show();
            } else {
                reference0.setValue(false);
                Toast.makeText(getApplicationContext(), "rfid false",Toast.LENGTH_SHORT).show();
            }
        }
    });
```

```
fingerprint.setOnCheckedChangeListener(new CompoundButton.OnCheckedChangeListener() {
    @Override
    public void onCheckedChanged(CompoundButton compoundButton, boolean b) {
        if (b) {
            reference1.setValue(true);
            Toast.makeText(getApplicationContext(), "finger true",Toast.LENGTH_SHORT).show();
        } else {
            reference1.setValue(false);
            Toast.makeText(getApplicationContext(), "finger false",Toast.LENGTH_SHORT).show();
        }
    }
});

camv.setWebViewClient(new WebViewClient());
String userAgent = "Mozilla/5.0 (Linux; Android 10) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/101.0.4951.61 Mobile Safari/537.36";
camv.getSettings().setUserAgentString(userAgent);

reference2.addListenerForSingleValueEvent(new ValueEventListener() {
    @Override
    public void onDataChange(@NonNull DataSnapshot snapshot) {
        if(snapshot.exists())
        {
            String ipadd = snapshot.getValue().toString();
            camv.loadUrl(ipadd);//192.168.242.205
        }
```

```java
        }

        @Override
        public void onCancelled(@NonNull DatabaseError error) {

        }
      });

      camv.setWebChromeClient(new WebChromeClient());
      WebSettings webSettings = camv.getSettings();
      webSettings.setJavaScriptEnabled(true);
      webSettings.setPluginState(WebSettings.PluginState.ON);
    }

}
```

Temperature sensor Code:

```cpp
#include <SPI.h>
#include <DMD2.h>
#include <fonts/Arial14.h>

/* For "Hello World" as your message, leave the width at 4 even if you only have one display connected */
#define DISPLAYS_WIDE 3
#define DISPLAYS_HIGH 1

SoftDMD dmd(DISPLAYS_WIDE,DISPLAYS_HIGH);
DMD_TextBox box(dmd, 0, 0, 32, 16);
```

```
// the setup routine runs once when you press reset:
void setup() {
  dmd.setBrightness(255);
  dmd.selectFont(Arial14);
  dmd.begin();
  /* TIP: If you want a longer string here than fits on your display, just define the display DISPLAYS_WIDE value to be wider than the
    number of displays you actually have.
   */
//  dmd.drawString(0, 0, String(temperature));
}

int phase = 0; // 0-3, 'phase' value determines direction

// the loop routine runs over and over again forever:
void loop() {
  dmd.clearScreen();
  int sensorValue = analogRead(A0);
  int temperature = map(sensorValue, 0, 1023, 800, 2400);
  Serial.println(temperature);

  dmd.drawString(0, 0, "Temperature: ");
  dmd.drawString(0, 0, String(temperature));
  dmd.drawString(0, 0, "'C");
  int steps = random(48); // Each time we scroll a random distance
  for(int i = 0; i < steps; i++) {
```

```
    // Do a different type of scroll, depending on which phase we are in
    switch(phase) {
      case 0:
       dmd.marqueeScrollX(1); break;
      case 1:
       dmd.marqueeScrollX(-1); break;
      case 2:
       dmd.marqueeScrollY(1); break;
      case 3:
       dmd.marqueeScrollY(-1); break;
    }
    delay(10);
  }

  // Move to the next phase
  phase = (phase + 1) % 4;
}
```

VENDORS LIST

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- Management Plaza, Quaid e Azam Road Rahwali Gujranwala
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