

## Glass painting Machines and it's applications

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### ABSTRACT: -

Glass painting machine is a specialized equipment used for applying decorative or functional coatings onto glass surfaces. It offers precise and automated painting capabilities, enabling efficient customization and enhancement of glass products for various applications. Glass Painting Machines automate this process and provide high precision and efficiency. Due to placement of glass processing and glass must be consistent when drawing. Painted a good picture by special software available from the CAD drawing to the processing procedure. CNC cutting line, which is controlled by means of AutoCAD files. CNC Automation uses the latest technology in the production of Glass Painting Machines and offers its customers high-quality, efficient, and reliable machines. CNC Automation's Glass Painting Machine is known for its high precision and fast production capabilities. In this paper, the application of glass painting machine is emphasized.

**Keywords:** Glass painting machine, CNC, CAD, AutoCAD.

### I. INTRODUCTION

Glass is a solid-like and transparent material that made from silica sand, limestone, soda ash and sodium carbonate. The properties of glass are transparency, scattering, absorption and thermal response allows multiple applications. Glass is a product with utility in small, medium and hi-tech applications ranging from household mirrors, solar panels, optical fibre to radiation shielding glasses in nuclear facilities. It is mostly used in glass windows and bottles. It is increasingly used in construction

applications. Tempered glass is employed in roofing applications as well as in manufacturing of glass windows. The tempered glass is used to replace the standard glass in roofing applications on account of its high strength properties [1].

Glass in history has completed the evolution from daily necessities of our life to culture. Glass intervenes in the memory of every period of history, which records the traces of every moment in the past.

Glass Painting is the process for applying a color or pattern to the surface of glass. This process is used to enhance the aesthetic appearance of the glass and to alter its properties [2].

The term "glass-painter" appeared for the first time between the end of the 15th century and beginning of the 16th century. The division of tasks between the glazier and the glass-painter became more acute: to the glazier was reserved the work of assembling the painted glass fragments and leading the window, while the glass painter was in charge of the artistic side of the stained glass making [3].

Glass painting machine is a specialized equipment used for applying decorative or functional coatings onto glass surfaces. It offers precise and automated painting capabilities, enabling efficient customization and enhancement of glass products for various applications. Glass Painting Machines automate this process and provide high precision and efficiency. CNC Automation uses the latest technology in the production of Glass Painting Machines and offers its customers high-quality, efficient, and reliable machines. CNC Automation's Glass Painting Machine is known for its high precision and fast production capabilities. CNC technology machines are programmed to achieve high-quality results and minimize the margin of error. These machines provide operators with time and labor savings.

### II. OPTICAL GLASS PAINTING MACHINE

Optical glass painting is a technology that is especially used in the production of optical glass products such as eyeglass lenses, camera lenses, and other optical glass products. An optical glass painting machine provides high precision and efficiency. CNC Automation's optical glass painting machine has the latest technology to achieve high-quality results. These machines automatically perform the glass painting process

and provide high precision and efficiency. In CNC technology, these machines can be programmed to achieve high-quality results and minimize the margin of error.

The optical glass painting machine is of great importance in the production of optical glass products. These machines are used to apply the desired color and patterns to the surface of the glass.

### **III. THE VALUE OF GLASS AS A CREATIVE MEDIUM**

The glass materials can make artists to create open art works. It is the ambiguous binary relationship between glass materials and light that gives the artistic and mysterious aesthetic beauty- glass can be passed through by the light and it also can reflect the light. After processing of the thickness, the color and molding method of glass, it can shape into various forms of manifestations. The invention of a new glass technology is to trigger new manifestations of glass art [4].

### **IV. CASES ABOUT ARTISTS' INNOVATION STRATEGY: CREATIVE IDENTITY**

After the Industrial Revolution in the middle of the 18th century, the glass manufacturing industry began to develop into two paths. First, stepping from artificial production to mechanized production, which mainly focused on the flat glass, bottle glass and jar glass. Second, extending the handicraft production methods to produce glass products, which was mainly led by the opposition of some artists and designers to stylized industrial products. Under that condition, they began to explore glass products for the purpose of concept and practicality. The products made and designed by artists for emphasizing the design characteristics of handicrafts. The common feature of these glass artists lies in that they put their thoughts and personal expression in the first place, in order to produce intellectual property rights with mental works, thus realizing the commercial application of glass through the way of developing intellectual property rights and patents. At this point, the glass art is an enterprise with new ideas in various fields such as art, scientific invention, new mode of economic growth, social policy and so on. At the same time, these artists are also cultural entrepreneurs with new ideas, with unique management style and entrepreneurial spirits.

### **V. THE GLASS ARTIST AND DIGITAL TECHNOLOGY**

Glass as an artistic medium is fairly young and its existence to technology. Computer aided design programs (CAD) and computer numerical controlled (CNC) machines are applicable to a glassblowing artist's practice, given the hand-made nature of blown glass. Engaging with these contemporary making tools can provide opportunities that is impossible or very difficult using traditional handcrafting methods alone. Inserting the hand into the digital fabrication can create opportunities that CAD-based making alone cannot provide. "Digital technology" refers to media and machines that assist directly with the making or forming of an artist's artifact: specifically, applications and software that can generate files that are read by CNC machines, and refers to the machines themselves. Digital or CAD technology here includes 2D and 3D modeling applications like Adobe Illustrator, AutoCAD, Rhinoceros and Sketchup which can generate files that can be read by CNC routers, lathes, plotters, laser cutters, water jet machines and 3D printers. There are other instances of digital technology used in glassmaking: the controllers and computers that run the glassblowers melting furnaces, reheating furnaces, casting kilns and annealing ovens [7].

### **VI. HOW TO USE A CNC MACHINE FOR GLASS PAINTING**

Four Step process to using CNC Machine

#### **Step 1: Understanding G-Code**

The G-Code, NC-Code, or proprietary code all mean the same thing. Put, running a glass shop is impossible without a basic understanding of this.

In non-programming terms, a G-Code is simply a set of instructions that tells your CNC device how to cut the glass. Without this G programming language, your CNC device might as well be an expensive paperweight.

Glass manufacturers may implement their unique codes. However, there are a group of core codes worth knowing about:

G00: Known as G0 in older machines, the command tells the tool to return to its base location on the feed knob. This code is typically for trading out instruments.

G01: Informs the machine to cut in a straight line. This code is otherwise known as linear interpolation.

G02/03: Informs the machine to cut in a circular pattern. This code is otherwise called circular interpolation.

G04: Pauses the cutter for a bit for a rest period or a quick check. It is also known as a dwell code.

#### **Step 2: Knowing the type of Glass Machine Handles**

When determining the type of glass machine can be handled by the following:

- The minimum or maximum glass size
- The minimum or maximum glass thickness
- The type of glass can cut

### **Step 3: Work With Software**

This feature allows to handle the programming of large-scale tasks. There is a market for glass optimization software that works to simplify custom projects.

### **Step 4: Seek Pre-Made CAD Drawings and Test Machine**

Once have a good idea of where everything is to start by testing machine. With automatic glass cutting, start by seeking out CAD drawings that can place into CAM programs.

CAD Drawings are available from CNC software shops but typically have free versions available. To test the effectiveness of machine, start with free programs.

CAM Programs include the actual process of taking the drawing and telling machine what tools it needs to use [6].

## **VII. DESIGNING PHASE OF GLASS PAINTING**

### **1. HARDWARE DESIGNING**

It is more desirable to first virtually design the hardware on a CAD/CAM Software, such as SolidWorks. Mostly, the thinking and fabricating part does not go hand to hand simultaneously as it's necessary that what we think can be implemented and fabricated practically, this leads to loss of time and capital. So, in order to check our design ideas and its practical fabrication feasibility, we do the designing work first.

In the designing phase, we first started with our conveyor. First the conveyor frame structure of dimensions 70in x 20in x 3in was made. To understand it, it is basically like a table structure. Now, in order to run make the conveyor bed, we attached 2 rollers at each end of the conveyor frame. By attaching two rollers, it was observed that the conveyor belt be stable while moving as when the part comes in the middle of the conveyor belt while travelling, the belt will sag downwards due to no roller in the middle and this will cause irregular movement of the conveyor belt. Thus, we added a third roller in the middle of the conveyor frame.

Now, added a white rubber belt of 2mm thickness over the rollers to form a conveyor bed. Three double slotted pulleys of were mounted on each on the three rollers in order to interconnect the rollers with each other so that movement of the rollers are in sync. These pulleys are interconnected 2 rubber V-Belt and the third belt of size relates to a pulley and with a D.C Geared Motor of 30Nm torque (24V-3A) in order to drive the conveyor. The part to be painted will be placed on the conveyor which will help in transporting the part to and from the painting work area. The conveyor design is given below in Figure 1.

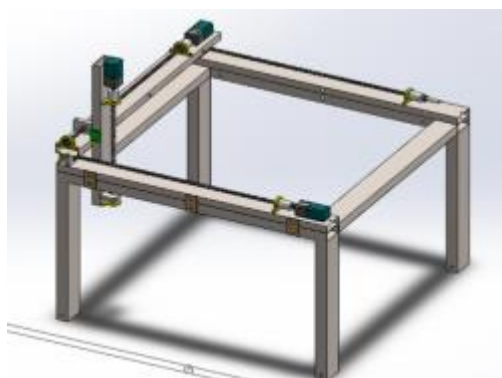


**Figure 1. Conveyor Design**

After the completion of the Conveyor Design or the Part Transporting Mechanism, we started to design the CNC Mechanism which is the Painting Mechanism of our Machine. The overall size of the CNC mechanism is 24in x 20in x 24in. Each of the 3 axes of the CNC machine is made of square shaped 2.5"x1" mild steel pipe. The main axis mechanism is formed of a ball screw of length 500mm and 8mm size of double threads. Each of the two ends of the ball screw is connected in the 8mm bearing which is mounted inside bearing housing.

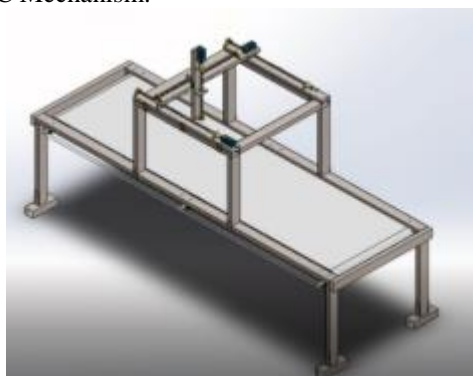
Now, screw an 8mm double threaded nut over which an aluminum cube is fixed which acts as a traveler. All these things are fixed to form a single axis structure. We replicate this structure four time to form X, Y and Z axis individually. We mount individual Stepper Motor on each axis in order to rotate the ball screw

so that the aluminum cube mounted over a nut move linearly back and forth. Each axis motion is limited/restricted by attaching a limit switch at its both ends. This helps in restricting the axis motion in forward or backward direction, so all the 3-axis does not collide with each other. The painting spray gun is mounted on the Z-axis of the CNC Mechanism. The Design of CNC Mechanism is given below in Figure 2.



**Figure 2. CNC mechanism Design**

This CNC Mechanism is mounted on the conveyor in the middle, thus the area under the CNC mechanism is the painting working area. Ball screws are used to move the 3-axis of the CNC mechanism. These ball screws are rotated with the help stepper motor and stepper drives are also used. The painting spray gun is mounted on the Z-axis of the CNC Mechanism.

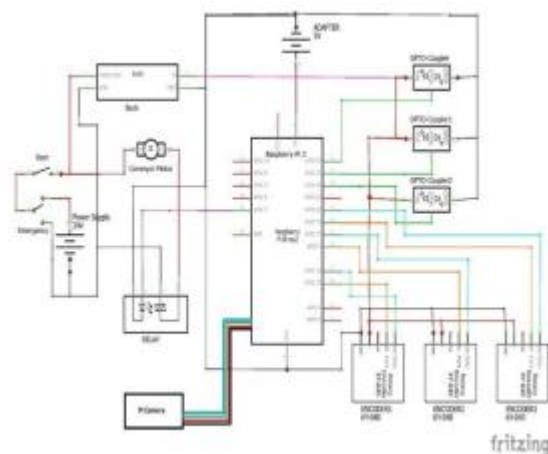


**Figure 3. Smart Painting Machine Complete Hardware Design**

## **2. ELECTRONIC CIRCUITRY DESIGNING**

Apart from the hardware of the machine, the Brain which help in driving the functionality of this machine is the Electronic Circuitry. Basically, the electronic Circuit of this machine needs to be designed exclusively for itself. The readily available circuits can't be integrated with one another to drive this painting machine, instead its circuit needs to be designed. The main task required by the circuitry is to:

1. Drive and Control the motion of the Conveyor.
2. Drive and Control the motion of the Painting Mechanism.
3. Assist the Image Processing Program in execution so that the part Geometry can be identified, and it's coordinated can be extracted in order to move the painting mechanism to perform the painting task.



**Figure 4. Design of circuit for Smart Painting Machine**

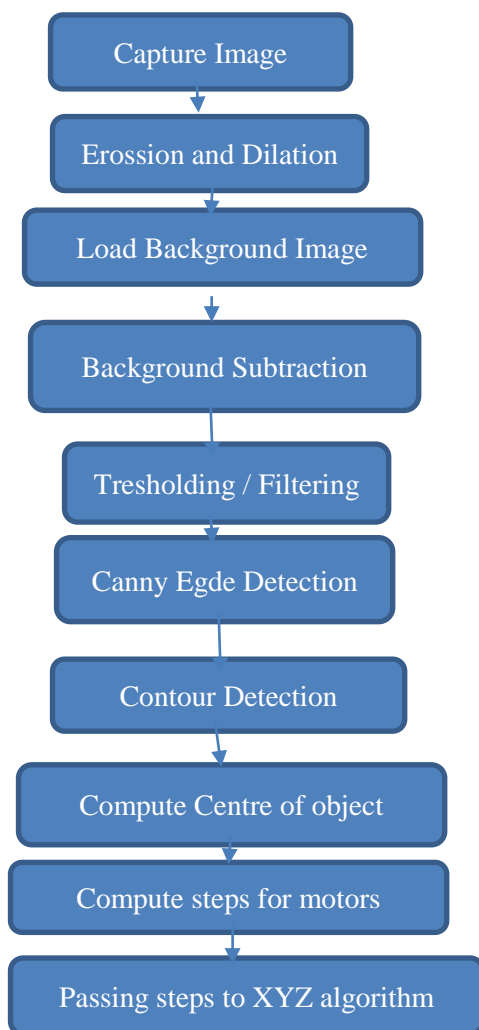
### **3. SOFTWARE DESIGNING**

The software is basically termed as heart because the sole purpose which makes this machine smart is the image processing program. Applying image processing in this machine as to get rid of uploading new programming from every new part and forbid the idea of keeping/placing the part to be painted in a fixed place or to be fixed in its respective jigs. Image processing is used to help in determining the part orientation on the conveyor bed and will calculate the part coordinates and command the motor to move the axis respectively in order to paint it. To implement this idea, first check that whether his idea is working or is practically feasible to implement on a machine to calculate the part coordinates on real-time basis. Thus, for developing, testing and final implementation of this program, to do this task using Python.

The camera which will be taking the part image will be mounted over the workspace. Once the part enters the workspace, IR sensor will indicate the microcontroller to stop the conveyor and then the part image will be taken and processed and then the part will get painted and then the conveyor will move, and the part will depart the workstation. So, to implement the software idea, we made program which works as follows:-

First the part image is read by the program. After reading the image, filters of Erosion and Dilation are implemented. Then the object in the image is subtracted from its background and then thresholding is applied on the image. After this Canny Edge Algorithm is applied and then the Counter detection is applied [5].

This enable the program to calculate the center of the object and its dimension. After this the coordinated of the image is found. Then the motor steps are calculated, and this is passed on to the XYZ Algorithm which then controls the motor movement of the CNC axis. The below Figure 6 shows the Software design flowchart.



**Figure 5. Software Design Flowchart**

## **VIII. CONCLUSION**

The biological system and human-computer system combines glass with artificial intelligence. Glass integrates with various new materials to promote communication, collaboration and links in the future. Promoting scientific progress with the development of technology, thus serving the real life. Glass painting machines are changing the style of people's daily life.

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