Arab Academy for science, technology and maritime transport
6/6/2021

PROJECT Detailed Report

[Polargraph machine]

[Mohamed Sameh – Nada Samir – Nour Eldin Morsy]
[20103049- 20100752 - 20101066]

1. Summary

This project simulates a software image to paint it on any surface (with any width and Height) using electric motors that generates discrete angular movement to move the wires that are attached with the pen and draw an image we wanted to simulate.

The purpose of the project is being used in schools as if a robot arm to paint a certain design with a total anticipated budget of 1,150 EGP.

2. Introduction

The project mainly is a drawing machine (bot) that simulates images and draws it on any surface. The demonstration shows that the motor produces movement by utilizing a drive in the micro controller that causes the attached string in the top side of the board to begin to move and then produce a movement with the pen that attach in home point of the image to produce the image by using application that is driven by computer processing. It decodes a bitmap and creates a map of the file using a polar coordinates system, recording pixel position, size and brightness. The hardware requests each pixel in turn and renders it on the page using its own shading and movement algorithms. This concludes a higher accuracy by using a software that holds the image.

The purpose of the polar drawing machine is that it could be used in education purposes and art schools in assisting the teachers by demonstrating any image, while the most important purpose of the project is that we can draw any image that we want on any surface with various dimensions.

There are people who used the project for their desires for example: there was a man who named sandy noble he is a programmer and designer, he tried to enhance his designs by the machine, and he downloads his designs on a website called Flickr, also it was used in an exhibition before by Victor Leung in 2013.

3. Needs/Problems

- Needs:
  - 5 weeks to reach the final phase start from 20/4/2021.
  - A lab for the building for the project.
- Problems that may be faced:
  1. The software may not be compatible with the Arduino.
  2. The rubber belt could be cut off due to tension force.
  3. The motors could break down due to high voltage from the power supply.
  4. The board pen length might change from design to design.
  5. The process of the painting might be slow because the problem of the cooling system in the Arduino.
- Solutions of the problems:
  1. Change the rubber string with one that can be a compatible with tension force.
  2. Using a heat sinks and fans for the cooling system.
  3. Apply the voltage in specified range to protect the motors and produce highest efficiency.
  4. Adjust the dimension of the image according to the length of the pen that is applied in the software.

4. Goals/Objectives

- Goals:
  1. Use the project to design other projects before their implementation.
- Benefits:
  1. Save time and effort for teachers who draw on boards.
  2. Reach a perfect state of the machine to draw any image in high accuracy on any surface.

5. Procedures/Scope of Work

First, we will setup the Arduino IDE, upload the polarograph source code in the processing application to be able to sketch and resize the image, install needed libraries for the components, and taking measures of the desired surface/board to be drawn on.

Second, setting up the motor's connection, assemble the customized gondola, belt, and brackets, and then attach them to the board, taking measures for the setup of the machine (width, height, home point).

Third, adjust sizes and dimensions according to the measures of the machine and the area of the board in the software, setting stepper motor, pulleys, and servo motor, and finally converting the selected vector image into a SVG format and adjusting its size.

Forth, testing the machine with different size of images that need to be simulated in various areas.

6. Timetable

	Description of Work	Start and End Dates
Phase One	Components understanding and assembly	20/4/2021 To 3/5/2021
Phase Two	Software installation and training	4/5/2021 To 11/5/2021
Phase Three	Testing the final phase	11/5/2021 To 16/5/2021

Budget

Description of components	price
1 x Arduino MEGA	125 EGP
L293D Motor Drive Shield	60 EGP
2 x L293D Motor Drive IC	70 EGP
2 x 17 Stepper Motor	187 EGP
Servo Motor MG90S	273 EGP
2 x GT2 Pulley 16 Teeth set	60 EGP
5M GT2 Rubber belt	105 EGP
Power Supply (12v)	100 EGP
Board Marker Pen	12 EGP
Any little weight ex: (AA battery)	10 EGP
Jumper Wires	65 EGP
3D Model of Gondola	2.5 EGP per gm
3D Model of Mounting Bracket	2.5 EGP per gm
Adapter 5V/3.5A	50 EGP
Total	**1,150 EGP**

7. Next Steps

- Modify and improve project after reaching the final phase.
- Implement the project in AI College.

8. Appendix

- Websites

https://processing.org/
http://www.polargraph.co.uk/
https://github.com/euphy/polargraphcontroller/releases/tag/
https://tinkerlog.com/2011/09/02/der-kritzler/

Other relevant information or correspondence:
https://www.flickr.com/photos/euphy/

9. Problems Faced Us During The Project.

- We used wrong size of the pulley teeth. Then we fixed this issue by getting the proper size of it.
- We used jumpers to connect the stepper motors to the Arduino, then we bought its original cables to hold all the pins steady in order not to corrupt either Arduino 's pins or the steppers and its pins too.
- We faced also that the pen sized thinner than the gondola's size, we used small screws to hold it steady, also we used layers of double face tape to make the pen go higher to be in the exact middle of the gondola.
- we tried to use the driller to hang the steppers on the both edges of the board but it didn't hold still, so we replaced it with hot glue gun to be sticked with the 3d printed pieces that belongs to the steppers.
- The marker pen gets dry every time we use it due to the gondola's size, so we used pen and paper instead.
- We used tape to hold the paper but it didn't give the full free place for the pen to move, so we used board magnet instead.
- We used batteries to connect for energy but it didn't generate the needed energy, we used an adapter with 5V and 3.5 A.