An-Najah National University

Faculty of Engineering & Information Technology

Computer engineering department

Hardware graduation project

FlingArt

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presented in partial fulfillment of the requirements for Bachelor degree in Computer Engineering

Acknowledgment

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Thanks to our families and friends too who have been a constant source of inspiration and support. Your encouragement kept us going.
Lastly, we extend our gratitude to all those who have contributed in any way to the completion of this project. Your contributions have impacted our personal and academic growth, and we'll take the lessons learned here into our future adventures.

Disclaimer

This project was accomplished by Farah Touqan and Arzaq Doudar from the Computer Engineering Department at An-Najah National University for educational purposes only, and the Department computer engineering at An-Najah National University does not share the writers' opinions, which are their own. The content, features, and functionality presented in this application are based on our skills and knowledge at the time of completion.

Contents

First chapter

1. Introduction

1.1 Statement of the problem

Picture feeling a bit annoyed when you're trying to make art that's spontaneous and fun, but the usual ways make it hard to control and predict what will happen. That's what FlingArt wants to fix. Usually, when people try to make random art, it doesn't always turn out the way they want. FlingArt is like a helpful friend stepping in to solve this problem. It brings in a robot arm that you can control with a phone app. The idea is to keep the excitement of random drawing but also make the robot arm precise, like a creative assistant. The challenge is to make sure the robot arm works well, lets you control the colors just right, and is easy for everyone to use. FlingArt wants to be more than just a tool – it wants to be a fun friend that gives you surprises while also letting you create art with control.

1.2 Objectives

First, we aim to make a mobile app that's easy for everyone to use. This app will let users control FlingArt effortlessly, picking colors, amounts, angle and how they want to draw. Then, we're focused on building a strong robotic arm for FlingArt. This arm has a long scoop and six color containers, each with special valves to help users control the paint perfectly. We're also adding two drawing modes – one for surprises and one for users who want more control. Making sure users can easily control the paint, we pay special attention to designing the color containers with adjustable valves. We do tests to make sure the paint flows smoothly and that the materials work well together. Understanding how quickly people learn to use FlingArt and what they like helps us make the app and the whole experience better. In simple terms, these goals guide FlingArt's development to be a tool that's easy, versatile, and fun for everyone who loves art.

1.3 Significance or importance of the work

This project is not just about making art; it's also a way to learn about robots and how they can be pals with artists. FlingArt lets you play with both random and planned painting, giving you lots of options for your artistic style. It's like a cool mix of art and technology that keeps up with today's trends.

FlingArt isn't just for serious stuff. It's fun to use and can even help you relax and enjoy yourself. Whether you're into art for fun or looking for something therapeutic, FlingArt is here to make art more exciting and inspire future creative ideas.

1.4 Report organization

In Chapter 2 Constraints, Standards, and Earlier Coursework, we will talk about the limitations faced while working on this project as well as how past coursework aided in its completion.

In Chapter 3 Literature Review, we will discuss similar research and other works related to the project.

In Chapter 4 Methodology, we will discuss how the project has been built and the tools used to build the project.

In Chapter 5 Conclusion and Discussion, we will give a summary of the project and what we have learned from the process of creating it and highlight some improvements that are future work.

Scond chapter

2. Constraints, Standards, and Earlier Coursework

2.1 Constraints and Limitations:

- *Budget Constraints:* The cost of materials, and tools was a limiting factor.
- *Paint can cause problems by getting into the machine parts:* It might harm electrical stuff, and make the system not work right. To fix this, we need to use materials that can handle the paint and make sure everything is sealed up well. Adding Teflon plumber's tape helps seal things even better and reduces the chance of leaks, also we used Selecon.
- *Power Consumption:* The project involves the continuous operation of the robotic arm and electronic components, which may lead to higher power consumption.
- *Weather and Environmental Conditions:* FlingArt is intended for outdoor use, so if the weather conditions change, like raining, we can work indoor.

2.2 Standards:

- *Robotic Arm:* The core component of FlingArt, designed for precision and controlled movement to create unique and dynamic drawings.
- *Mobile App:* With this mobile application, you can tell the arm what to do, pick your favorite colors, and even set the rules for how your drawings should turn out. It's the secret sauce that makes FlingArt so much fun and easy for everyone to use. So, whenever you want to create, just tap into the app.

2.3 Earlier Coursework:

We used what we learned in our courses to make our project. In particular, the courses about PIC microcontrollers, the C programming language, and digital and electronic topics were super helpful. The microcontroller course taught us how these tiny computers work, how to write code for them, and how to connect them to other parts of our project. We got really good at writing code, making different things work, and controlling the hardware parts.

Third chapter

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3. Literature review:

In this review, we explore how artists are teaming up with robots to create amazing art. You know, like when artists use robots to help them draw or make sculptures. Some researchers, like Carlos Aguilar, Hod Lipson in *“A robotic system for interpreting images into painted artwork”* article, show how robots can be like art buddies, helping humans express their creativity. It's exciting because we get to see how technology and art can come together in new and cool ways.
Aslo in *“Interactive Multi-Robot Painting Through Colored Motion Trails”* paper, this paper connects closely with our FlingArt project. They both use robots to make art, but in different ways. FlingArt is about drawing in a controlled or random way, while the robotic painting system is about having a team of robots work together to paint on a canvas. These projects join forces in the exciting world where technology and creativity come together to open up new possibilities in art.

Fourth chapter

4. Methodology

3.1 How It Works

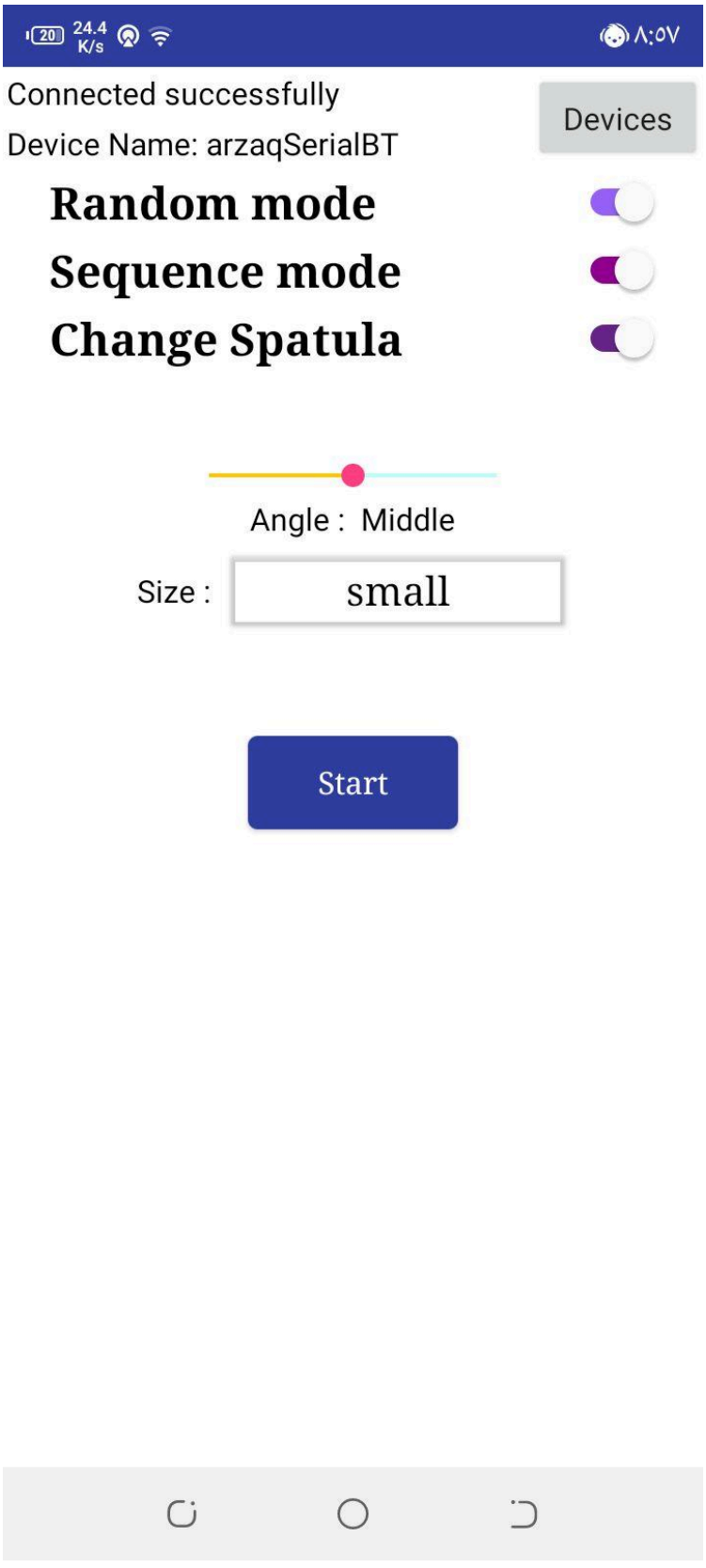
1. *Establishing the Artistic Parameters:* Determine the mode of the operation, either a random motion sequence or make the arm to follow your lead.
2. *Color Selection:* If you want the robot to follow your lead ,so select the colors you want from the six options, you can choose more than one color in the same time.
3. *Quantity Specification:* If you choose the controlled mode, select the quantity you want for the selected colors. (Large or Small)
4. *Angle Adjustment:* Adjust how the robotic arm moves by picking the angle you want it to throw. (-1 means left, 0 means the middle, and 1 means right(.
5. *Initiating the Drawing Process:* Tap the draw button to initiate the arm's movement.
   The arm spins until it finds the sensor for each color. It stops under the valve for that color, lets the paint flow onto the spatula, and then turns towards the other colors if the user picked more than one. After that, it comes back to the middle and flings the paint onto the palette at the angle the user picked, also we can change the shape of the spatula using “change spatula” button, we have also the ultrasonic sensor, it gives the user that the color container has run out of stock.
   here we can see our mobile application, its so easy!
   - here we change the angle to left

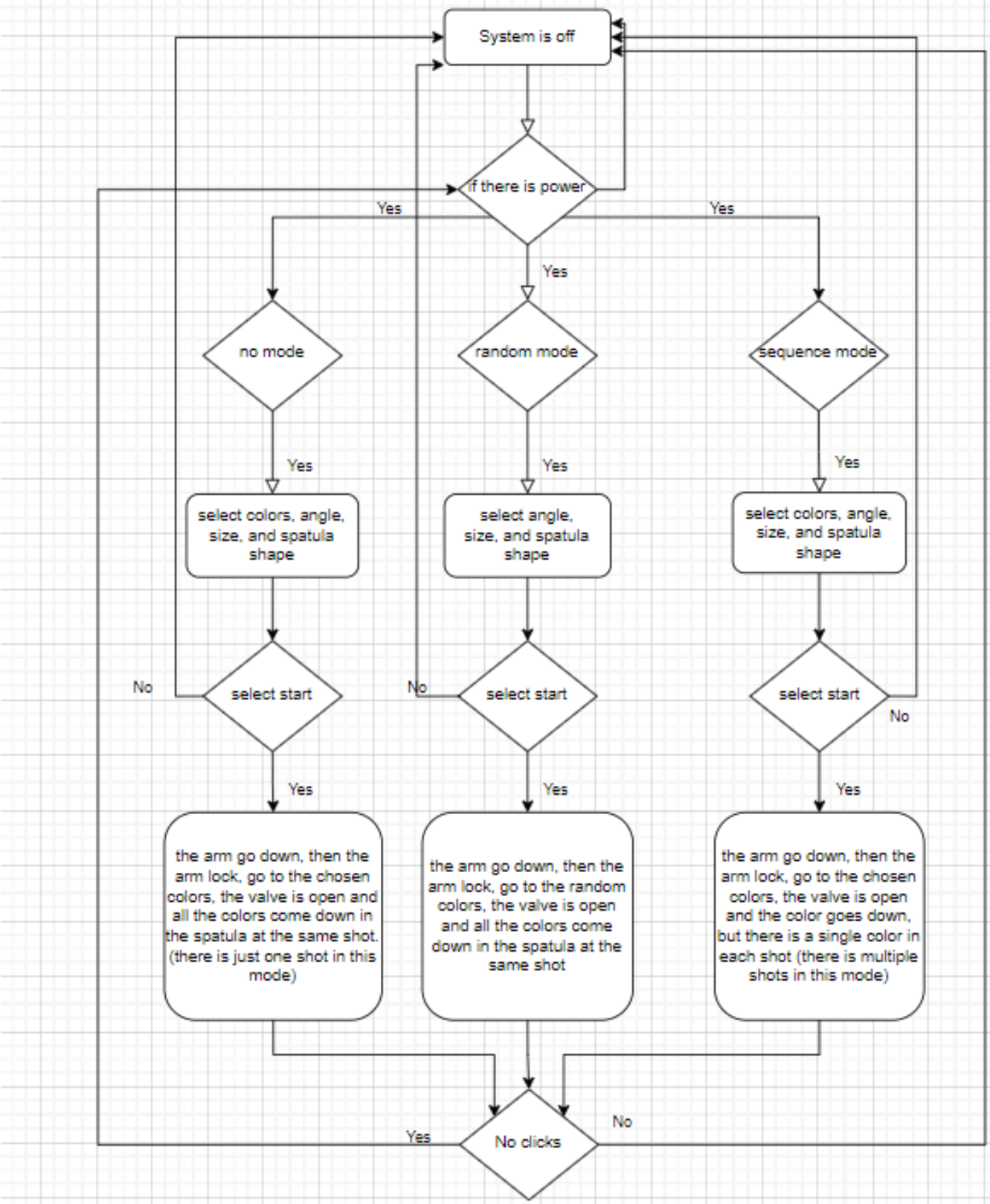
- here we change the angle to right


Connected successfully
Device Name: arzaqSerialBT
Devices
Random mode
Sequence mode
Change Spatula
Select mode
Red
Yellow
Green
Orange
Blue
Pink
Angle : Right
Size :
small
Start

- here we choose sequence mode, and change spatula. We choose all the colors, also we change the angle to the middle, the size of the colors is large.

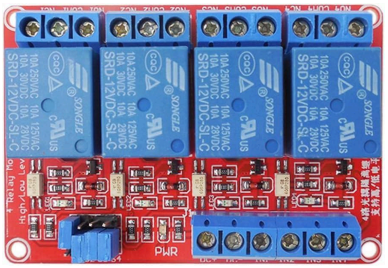
- here we choose the random mode, the angle to the middle, change spatula, and size of the colors is small.

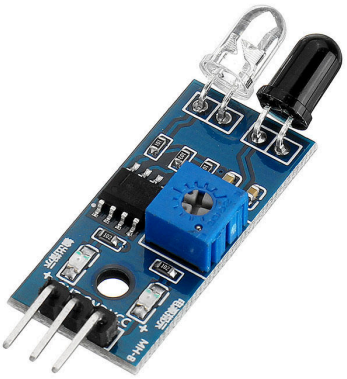
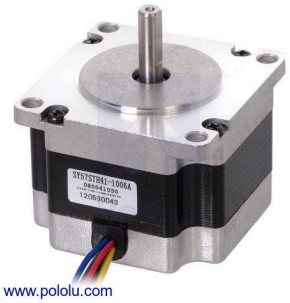


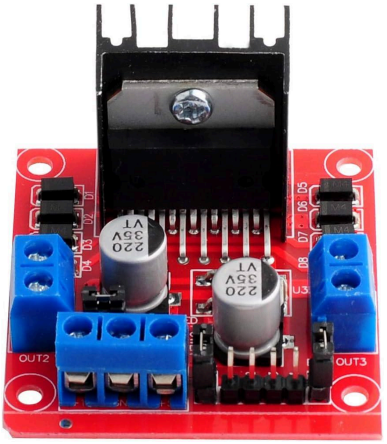

System is off
if there is power
Yes
Yes
Yes
no mode
random mode
sequence mode
Yes
Yes
Yes
select colors, angle, size, and spatula shape
select angle, size, and spatula shape
select colors, angle, size, and spatula shape
No
select start
No
select start
select start
No
Yes
Yes
Yes
the arm go down, then the arm lock, go to the chosen colors, the valve is open and all the colors come down in the spatula at the same shot. (there is just one shot in this mode)
the arm go down, then the arm lock, go to the random colors, the valve is open and all the colors come down in the spatula at the same shot
the arm go down, then the arm lock, go to the chosen colors, the valve is open and the color goes down, but there is a single color in each shot (there is multiple shots in this mode)
Yes
No clicks
No

3.2 What We Need?

Hardware components

Hardware Component	***Image***	***Number***	***Purpose***
Arduino Mega		1	Main controller board for overall system functionality.
Solenoid valve (½ inch)		6	Controls the flow of liquids in the system.
pumps 12v		6	pumps the colors.
5V 4-Channel Relay Module High/Low		1	Controls the activation of the 8 solenoid valves for various system operations.

5V 1-Channel Relay Module Active High/Low		8	Controls the operation of the water pump, providing on/off control signals.
IR-sensor		7	make arm stop.
Ultrasonic-sensor		2	Check the quantity of colors.
stepper motor		1	to make the arm rotate
stepper motor - nema23		1	to make the arm go down

servo motor MG995		2	the first servo is to change the shape of spatula. and the second is used to lock the arm
L298N Motor Drive Controller Board Module Dual H-Bridge for DC Motor.		1	It is used to control the speed and the direction of the motors.
TB6600 Stepper Motor Driver		1	It is used to control the speed and the direction of the motors.
12V 12.5A Power Supply		1	Supplies the required power to the system, ensuring proper functioning of the components.

5V power supply		2	Supplies the required power to the system, ensuring proper functioning of the components.
ESP32-WROOM-32		1	we used it to connect the project to the Blynk application that we have created, and send data to arduino serially.

Secondary Components

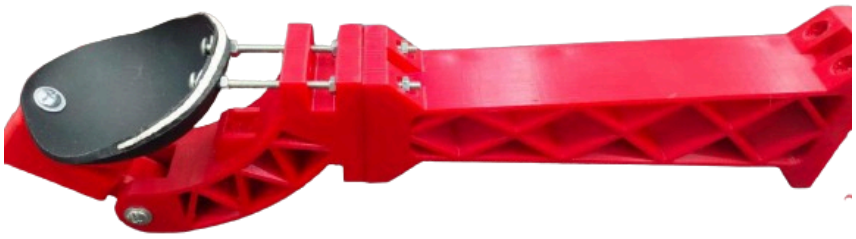
Building the system involves using important parts like wires, tubes, pipes, connectors, transfer pipes, fittings, and more. These parts are like the system's building blocks, and they are crucial for putting everything together and making sure it works well. Including these extra parts is really important for making sure all the hardware pieces fit and work together smoothly.

3.3 Design

- **arm**

  We carefully created the arm using 3D printing, making sure every detail was just right. We specifically designed spots where the thread could weave with the spatula, allowing us to change its shape as needed. Additionally, we set aside a dedicated spot for the spatula, giving it a special place in the whole setup. It's all

about making sure every part works together seamlessly!



◆ **Solenoid valves**

We made a connection between the pump and the valve. So, when you want a color, the pump gets it from the container. Then, the color travels down to the valve, It flows through the relays, making everything work smoothly.

Fifth chapter

5. Results and Analysis

Our goal was to make a robot that's easy and brings a lot of joy. In the experiments, most people liked telling the robot what to do, but some also enjoyed when it surprised them. We made sure the paint came out just right when people directed the robot. The mobile app and controls were designed to be easy for everyone. Overall, FlingArt successfully mixes technology with art, giving people a fun and easy way to get creative.

Sixth chapter

6. Conclusion and Future Work

In conclusion, FlingArt represents a successful fusion of technology and artistic expression, providing users with a dynamic and enjoyable platform for creative exploration. The project achieved its objectives by offering dual drawing modes to cater to user preferences, and ensuring precision in paint flow control. The user-friendly design of the mobile app contributed to a short learning curve, making FlingArt accessible to a diverse audience. The robustness of the system's components demonstrated durability under regular use, with maintenance proving to be straightforward. FlingArt not only fulfilled its mission of combining fun and learning but also provided users with an engaging and accessible tool for artistic endeavors.

Future Work:

- It is possible to add a new feature, such as a tap, and use it to color large objects
- We can make the drawing board rotate in more than one direction

Seventh chapter

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