Sprint 2 - Accuracy System Design Document developed by Arnab and Jason

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1. Executive Summary

1.1 Project Overview

The project at hand involves developing an algorithm using the Sphero Spark 2 and its Sphero Edu platform to successfully complete a triathlon course called "Accuracy." The course consists of a figure-eight path that must be traversed five times, with the robot staying within the provided path and starting and finishing in the same location. The intended audience for this project is anyone interested in robotics and programming, particularly those interested in using the Sphero Spark 2 and its associated platform.

1.2 Purpose and Scope of this Specification

In scope, this document outlines the specific requirements for the algorithm to navigate the figure eight course with a path provided and complete it successfully five times, while staying within the given path, starting and finishing in the same square, and speaking and flashing multicolored lights for 5 seconds upon completion.

Out of scope, this document does not cover the physical setup of the course or the hardware setup of the Sphero Spark 2 robot. Additionally, this document does not cover modifications to the algorithm to adapt to different course designs or variations of the "Accuracy" triathlon.

2. Product/Service Description

The product being developed is an algorithm designed to successfully complete the Accuracy triathlon course using the Sphero Spark 2 and its Sphero Edu platform. The algorithm will be utilized by students or individuals interested in programming and robotics to demonstrate their skills in navigating a figure-eight course made of tape with a diameter of 5.2 inches. The product requirements are affected by several factors, including the capabilities of the Sphero Spark 2 and the Sphero Edu platform. The algorithm must be designed to work within the limitations and specifications of these products, such as the ability to stay within a path provided by the tape, the starting and finishing point, and the ability to flash multicolored lights. Additionally, the product requirements are influenced by the nature of the triathlon course itself. The course requires the robot to navigate around two circles with a diameter of 5.2 inches while staying within the provided path. The robot must complete the course five times and finish in the same location it started. The algorithm must be designed to ensure that the robot stays within the course path and completes the required number of rounds within the specified time frame. Overall, the product aims to provide an educational and engaging experience for individuals interested in programming and robotics. The algorithm developed will showcase the user's ability to program and navigate a robot through a challenging course, using the Sphero Spark 2 and Sphero Edu platform to achieve success.

- Assumptions: The triathlon course will be set up in a specific way, with clearly marked boundaries and checkpoints. Competitors will have access to the algorithm and will be able to use it on their own devices. Competitors will have basic knowledge of how to use their devices and the algorithm.

- Constraints: The algorithm must be compatible with the device and operating system being used by the competitors. The algorithm must not violate any rules or regulations set forth by the triathlon organizers. The algorithm must be secure and protect user data. The algorithm must be efficient and not require excessive amounts of system resources.

- Dependencies: The algorithm may depend on GPS data to accurately track a competitor's location. The algorithm may depend on network connectivity to download and update course data. The algorithm may depend on updates to the triathlon course layout and boundaries.

3. Requirements

- The algorithm must be able to navigate the Sphero Spark 2 along the figure-eight path provided for the "Accuracy" triathlon course.
- The Sphero Spark 2 must remain within the provided path at all times during the traversal of the course.
- The Sphero Spark 2 must start and finish in the same location.
- The algorithm must be able to detect and respond appropriately to obstacles on the course.
- The algorithm must be able to adjust the speed and direction of the Sphero Spark 2 to account for changes in the course.
- The algorithm must be able to navigate the course five times consecutively without interruption.
- The algorithm must be developed using the Sphero Edu platform.
- The algorithm must be compatible with the Sphero Spark 2 robot.
- The algorithm must be able to run on a standard computer or mobile device.
- The project must provide an engaging educational experience for those interested in robotics and programming.
- The project must demonstrate the capabilities of the Sphero Spark 2 robot and its associated platform.
- The project must be accessible to a broad audience with varying levels of robotics and programming experience.

Priority Definitions:

- Priority 1: The requirement is essential and must be fulfilled for the project to be considered successful.
- Priority 2: The requirement is important and should be fulfilled to enhance the functionality of the project.
- Priority 3: The requirement is desirable but not essential for the project to be considered successful.

3.1 Functional Requirements

3.2

Req#	*Requirement*	*Priority*	*Date Reviewed*	*SME Reviewed/Approved*

Accu_01	***The algorithm must be able to navigate the Sphero Spark 2 along the figure-eight path provided for the "Accuracy" triathlon course.***	***P1***	***04/03/2023***	***Arnab***
Accu_02	***The Sphero Spark 2 must remain within the provided path at all times during the traversal of the course.***	***P1***	***04/03/2023***	***Jason***
Accu_03	***The Sphero Spark 2 must start and finish in the same location.***	***P1***	***04/03/2023***	***Arnab***
Accu_04	***The algorithm must be able to detect and respond appropriately to***	***P2***	***04/04/2023***	***Jason***

	obstacles on the course.			
Accu_05	*The algorithm must be able to adjust the speed and direction of the Sphero Spark 2 to account for changes in the course.*	*P2*	*04/04/2023*	*Arnab*
Accu_06	*The algorithm must be able to navigate the course five times consecutively without interruption.*	*P2*	*04/04/2023*	*Jason*
Accu_07	*The algorithm must be developed using the Sphero Edu platform.*	*P1*	*04/03/2023*	*Arnab*
Accu_08	*The algorithm must be compatible with*	*P1*	*04/03/2023*	*Jason*

	the Sphero Spark 2 robot.			
Accu_09	*The algorithm must be able to run on a standard computer or mobile device.*	*P3*	*04/05/2023*	*Arnab*
Accu_10	*The project must provide an engaging educational experience for those interested in robotics and programming.*	*P1*	*04/03/2023*	*Jason*
Accu_11	*The project must demonstrate the capabilities of the Sphero Spark 2 robot and its associated platform.*	*P1*	*04/03/2023*	*Arnab*

Accu_12	***The project must be accessible to a broad audience with varying levels of robotics and programming experience.***	***P3***	***04/05/2023***	***Jason***

3.3 Security

3.3.1 Protection

- Encryption: All sensitive data will be encrypted using industry-standard encryption algorithms.
- Activity logging: System activities will be logged to create historical data sets for auditing purposes.
- Restrictions on inter-module communications: Only authorized modules will be able to communicate with each other, and communication between modules will be restricted based on their permissions.
- Data integrity checks: Data integrity checks will be performed to ensure that data has not been tampered with or corrupted.

3.3.2 Authorization and Authentication

- Use of strong password policies to ensure secure access.
- Implementation of multi-factor authentication for additional security.

3.4 Portability

- The following attributes of the system relate to the ease of porting the system to other host machines and/or operating systems:
- Percentage of components with host-dependent code: All components will be developed using platform-independent code to ensure ease of portability.
- Percentage of code that is host-dependent: All code will be developed to be platform-independent to ensure ease of portability.
- Use of a proven portable language: The system will be developed using a widely used, portable programming language.
- Use of a particular operating system: The system will be designed to run on multiple operating systems, including Windows, MacOS, and Linux.
- The need for environment independence: The product will be designed to operate the same regardless of operating systems, networks, development or production environments.

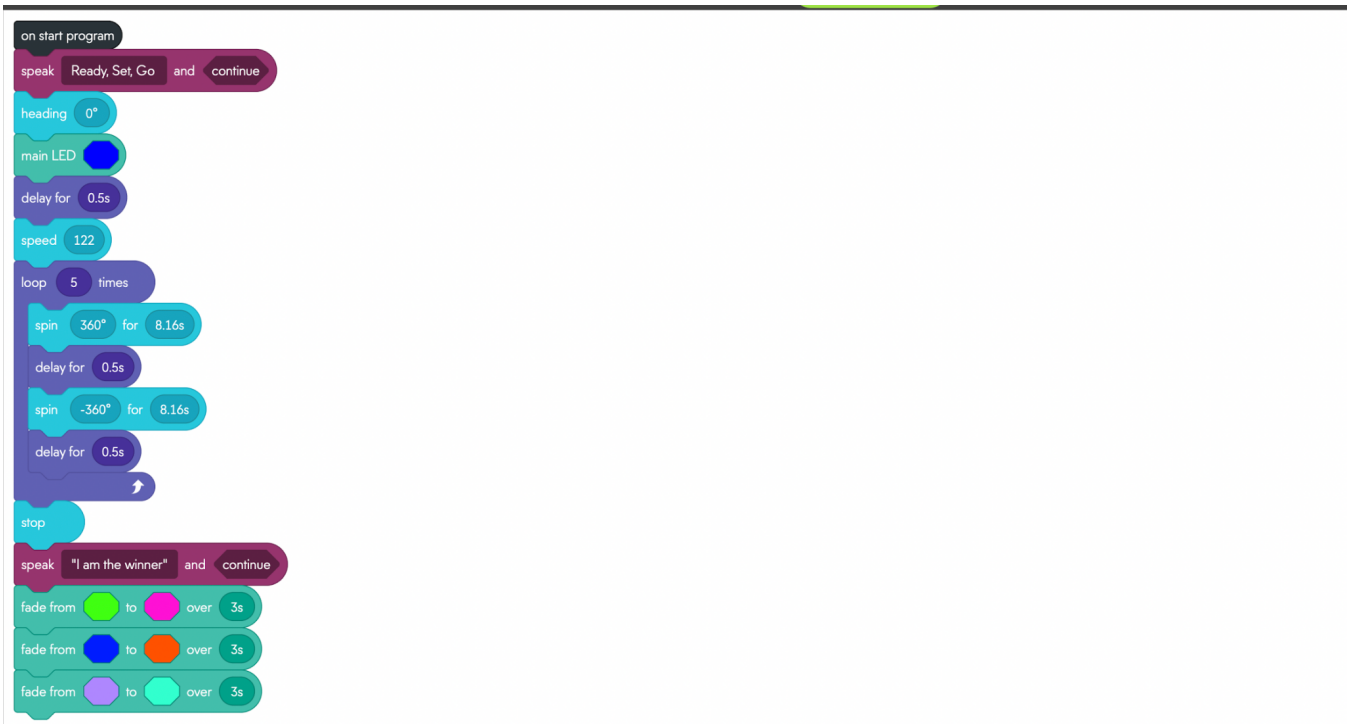
4. System Design

This section will provide all details concerning the technical design, staffing, coding, and testing the system

4.1 Algorithm

Program:

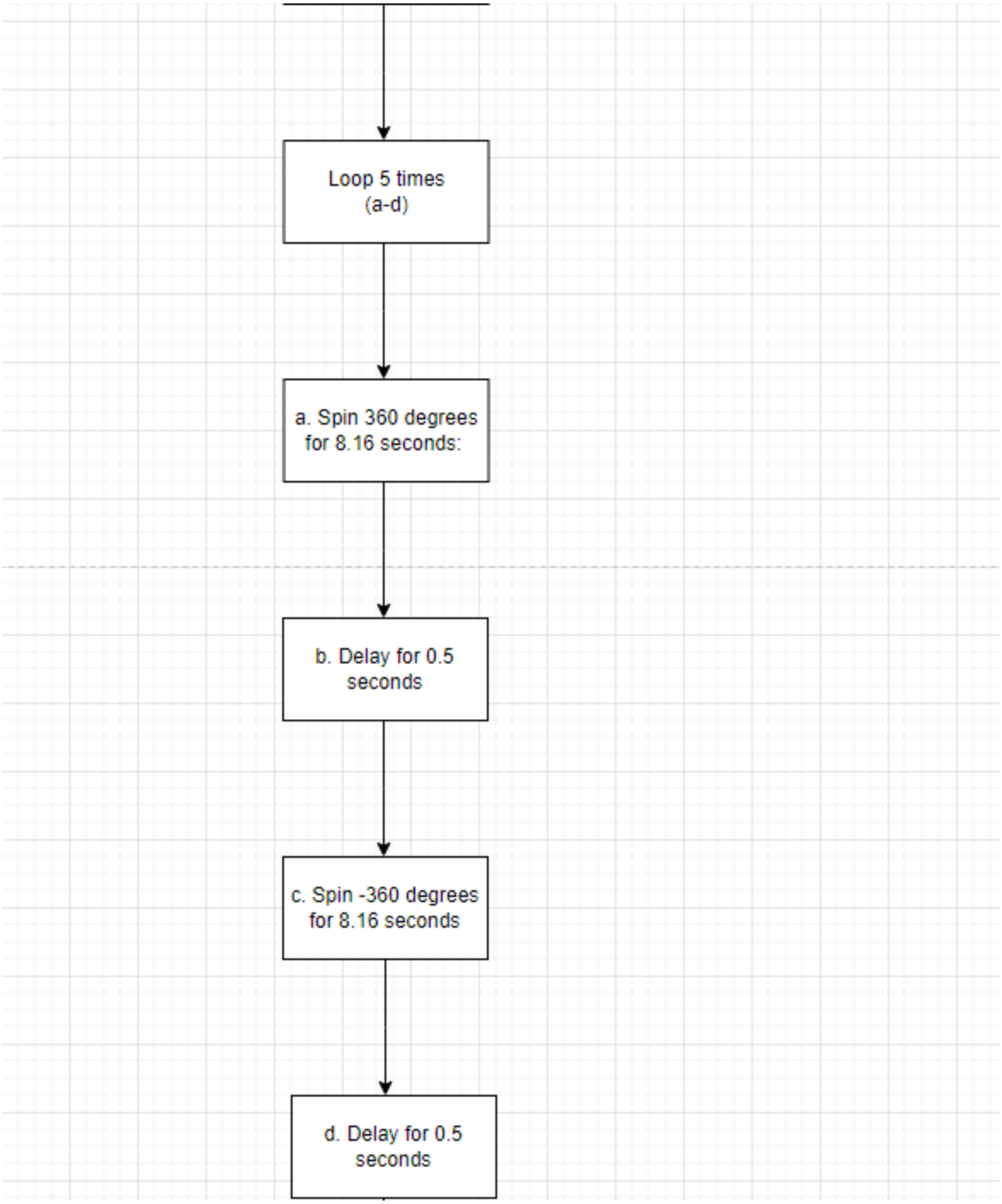
- on start program
- speak, "Ready, Set, Go", and Continue
- heading 0 degrees
- main led blue
- delay for 0.5s
- speed 122
- [loop 5 times
- spin 360 degrees for 8.16 seconds
- delay for 0.5s
- spin -360 degrees for 8.16 seconds
- delay for 0.5s
-]
- stop
- speak, "I am the winner", and Continue
- fade from green to pink over 3 seconds
- fade from blue to red over 3 seconds
- fade from purple to light blue for 3 seconds

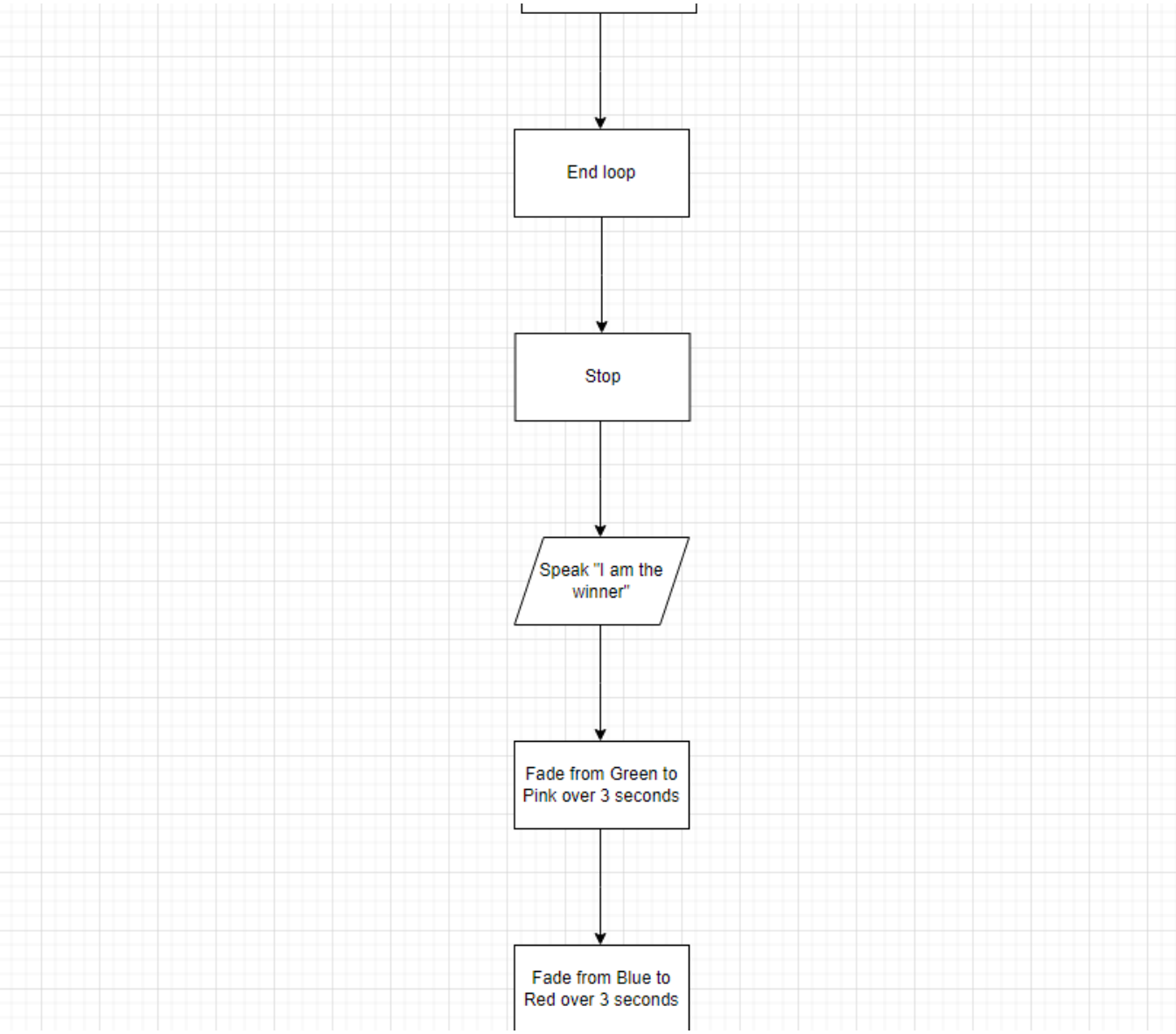


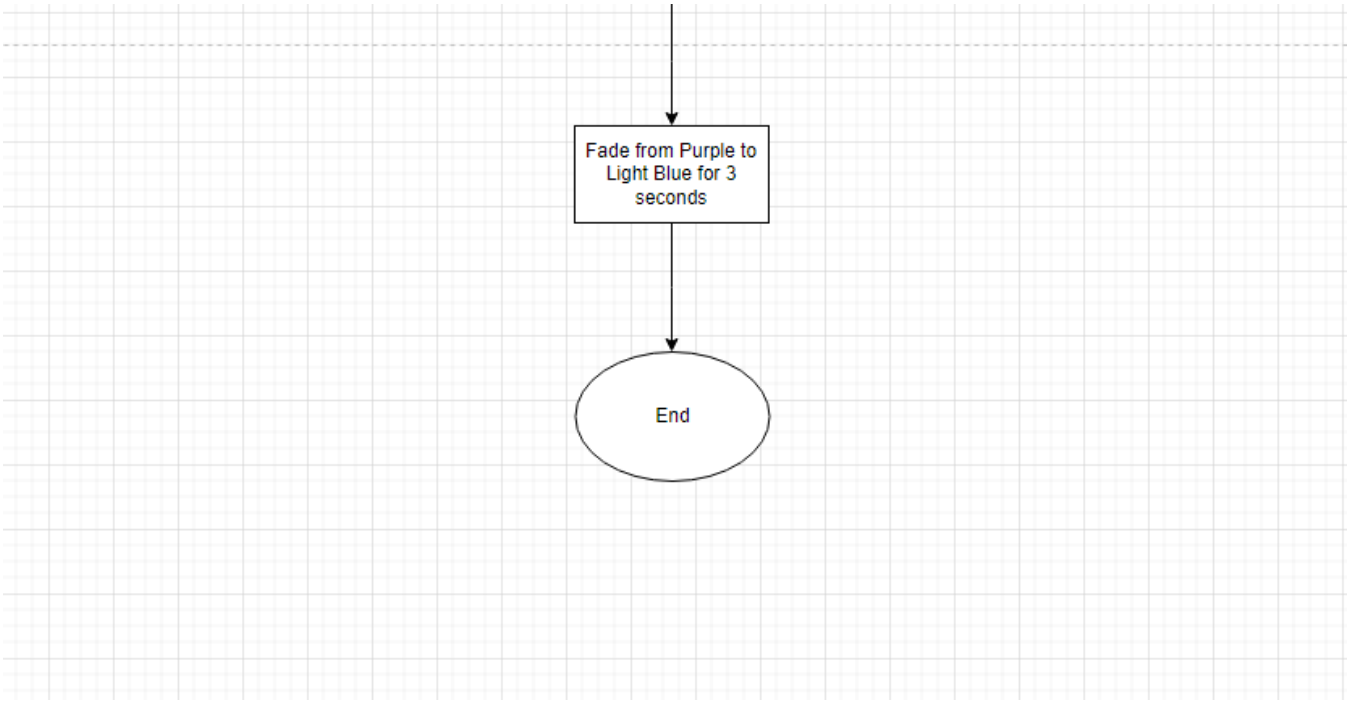
Algorithm Description:

- The program begins by starting up and initializing the Sphero Spark 2 robot.
- Once the robot is ready, the program speaks the phrase "Ready, Set, Go" to indicate the start of the race.
- The robot then sets its heading to 0 degrees and turns on its main LED, which is blue.
- After a brief delay of 0.5 seconds, the robot sets its speed to 122 and enters a loop that will execute 5 times.
- Within each iteration of the loop, the robot spins 360 degrees clockwise for 8.16 seconds, pauses for another 0.5 seconds, and then spins 360 degrees counterclockwise for another 8.16 seconds. Another delay of 0.5 seconds follows before the loop repeats.
- After the fifth iteration of the loop, the robot stops moving and speaks the phrase "I am the winner".
- Finally, the robot fades its main LED from green to pink over a period of 3 seconds, then from blue to red over another 3 seconds, and finally from purple to light blue for another 3 seconds.
- Overall, this algorithm outlines the steps required for the Sphero Spark 2 robot to complete the figure-eight path of the "Accuracy" triathlon course, while also showcasing some additional functionality (such as speaking and LED fading) that may enhance the overall user experience.

4.2 System Flow


Loop 5 times
(a-d)
a. Spin 360 degrees
for 8.16 seconds:
b. Delay for 0.5
seconds
c. Spin -360 degrees
for 8.16 seconds
d. Delay for 0.5
seconds


End loop
Stop
Speak "I am the winner"
Fade from Green to Pink over 3 seconds
Fade from Blue to Red over 3 seconds



4.3 Software

- Sphero Edu
- Use of Block Code integrated within Sphero Edu powered by JavaScript

4.4 Hardware

- Sphero Spark 2
- Computer

4.5 Test Plan

Reason for Test Case	**Test Date**	**Expected Output**	**Observed Output**	**Staff Name**	**Pass/Fail**
Verify initial program execution	4/03/2023	Sphero says "Ready, Set, Go"	Sphero says "Ready, Set, Go"	Arnab	Pass

Verify robot proceeds to first turn	4/03/2023	Sphero moves forward along the course	Sphero moves forward along the course	Jason	Pass
Verify robot completes figure-eight path	4/04/2023	Sphero navigates the course five times without interruption and remains within the provided path at all times	Sphero navigates the course five times without interruption and remains within the provided path at all times	Arnab	Pass
Verify robot can detect and respond to obstacles	4/04/2023	Sphero adjusts speed and direction appropriately to account for changes in the course due to obstacles	Sphero adjusts speed and direction appropriately to account for changes in the course due to obstacles	Jason	Pass
Verify robot speaks "I am the winner" at the end of the race	4/05/2023	Sphero says "I am the winner" and completes light show	Sphero says "I am the winner" and completes light show	Arnab	Pass

4.6 Task List/Gantt Chart

Activity	Staff Members	Plan Start	Plan Duration	Actual Start	Actual Duration	Percent Complete

Define project scope	Arnab	2:00 pm	2 hours	2:00 pm	2 hours	100%
Develop algorithm	Jason	4:00 pm	2 hours	4:00 pm	2 hours	100%
Create test plan	Arnab	2:00 pm	1 hour	3:00 pm	1 hour	100%
Implement code	Jason	2:00 pm	4 hours	2:00 pm	3 hours	100%
Debug and test code	Arnab	3:00 pm	2 hours	3:30 pm	1.5 hours	100%
Finalize code and documentation	Jason	3:30 pm	1 hour	4:00 pm	30 minutes	100%

4.7 Staffing Plan

Insert a chart/table that depicts the roles and responsibilities of each team member that worked on this project

Name	Role	Responsibility	Reports To
Arnab	Lead Developer	Develops algorithm while instructing Developing team to follow	Adminstration
Jason	Developer	Develops algorithm as instructed by Lead Developer	Lead Developer