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1. Executive Summary

Our project involves utilizing the Sphero Spark 2, a programmable robotic ball, to navigate through a predefined course with specific tasks to be accomplished. The intended audience for this project includes investors and stakeholders who are interested in innovative robotics and automation solutions.

1.1 Project Overview

Our project focuses on developing an algorithm for controlling the Sphero Spark 2 to navigate through a course with various challenges. The course includes tasks such as traveling straight for specific distances, making turns, jumping over a ramp, and knocking down bowling pins with sufficient speed. The Sphero Spark 2 will be controlled using programming blocks that specify the heading degrees, roll degrees, and speed (ranging from 0 to 255) to achieve the desired actions.

1.2 Purpose and Scope of this Specification

The purpose of this specification is to outline the algorithm and actions that the Sphero Spark 2 will perform during the course. It is intended for investors and stakeholders who are interested in understanding the technical details of the project. The scope of this specification includes describing the algorithm for controlling the Sphero Spark 2 to complete the course as outlined in the initial request. This document does not cover any modifications or requirements for future phases of the project.

In scope

This specification addresses the requirements related to the algorithm for controlling the Sphero Spark 2 to navigate through the specific course, including actions such as traveling straight, making turns, jumping over a ramp, and knocking down bowling pins. The algorithm specifies the heading degrees, roll degrees, and speed to achieve these actions.

Out of Scope

The following items are considered out of scope for this specification:

- Any modifications to the Classification Processing or Labor Relations Processing, as this project focuses solely on the algorithm for controlling the Sphero Spark 2.
- Any requirements for future phases of the project beyond the initial course outlined in the request.

2. Product/Service Description

2.1 Product Context

Our product, the Sphero Spark 2 Algorithm, is a software-based solution designed to control the movement and actions of the Sphero Spark 2 robotic ball. The algorithm serves as the brain of the Sphero Spark 2, providing instructions on how it should navigate through a predefined course and complete specific tasks. It is a self-contained product that operates autonomously based on the programmed instructions provided.

2.2 User Characteristics

Our target users for the Sphero Spark 2 Algorithm include students, faculty, staff, and other individuals who are interested in robotics and automation. General customer profiles for each type of user may include:

- Students: These users may have varying levels of technical expertise, ranging from beginners to advanced programmers. They may have experience with coding or robotics, but may not be experts in the field. They may use the Sphero Spark 2 Algorithm for educational purposes to learn programming, problem-solving, and critical thinking skills.
- Faculty/Staff: These users may have higher technical expertise and experience with coding or robotics. They may use the Sphero Spark 2 Algorithm for educational purposes, research, or as a teaching tool in classrooms or workshops.

2.3 Assumptions

Assumptions: The following assumptions may affect the requirements of the Sphero Spark 2

- Algorithm: Availability of equipment: It is assumed that the Sphero Spark 2 robotic balls will be readily available for use without any availability constraints, and will be compatible with the algorithm.
- User expertise: It is assumed that users will have a basic understanding of programming concepts and will be able to utilize the programming language or framework provided to create the algorithm for controlling the Sphero Spark 2.

2.4 Constraints

The design and functionality of the Sphero Spark 2 Algorithm may be constrained by the following factors:

- Design standards: The programming language or framework used for creating the algorithm may be constrained by design or other standards set by the manufacturer or industry best practices.

2.5 Dependencies

The requirements of the Sphero Spark 2 Algorithm may be dependent on other factors, such as:

- Compatibility with Sphero Spark 2 robotic balls: The algorithm will need to be compatible with the hardware and communication protocols of the Sphero Spark 2 robotic balls to ensure proper control and functionality.

- Module completion: If there are multiple modules or components that need to be built or completed before the Sphero Spark 2 Algorithm can be fully functional, the completion of these modules may impact the overall timeline and requirements of the product.

3. Requirements

- The algorithm must be able to navigate the Sphero Spark 2 along the path provided for the “agility” course
- 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 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

Req#	Requirement	Priority	Date Reviewed	SME Reviewed/Approved
AG_SP3_001	The system must be able to initiate the course by speaking "Ready, Set, Go", and continue.	Priority 1	04/17/2023	Arnab
AG_SP3_002	The system must set the heading to 0 degrees.	Priority 2	04/18/2023	Arnab
AG_SP3_003	The system must roll at 0 degrees heading and 33 speed for 3 seconds.	Priority 1	04/19/2023	Jason
AG_SP3_004	The system must set the heading to 90 degrees.	Priority 2	04/17/2023	Arnab
AG_SP3_005	The system must roll at 0 degrees heading and 33 speed for 3 seconds.	Priority 1	04/18/2023	Jason
AG_SP3_006	The system must set the heading to 90 degrees.	Priority 2	04/17/2023	Jason
AG_SP3_007	The system must roll at 0 degrees heading and 33 speed for 7 seconds.	Priority 1	04/19/2023	Arnab

AG_SP3_008	The system must set the heading to 180 degrees.	Priority 2	04/19/2023	Arnab
AG_SP3_009	The system must roll at 0 degrees heading and 160 speed for 7 seconds.	Priority 1	04/18/2023	Arnab
AG_SP3_010	The system must set the heading to 45 degrees.	Priority 2	04/17/2023	Jason
AG_SP3_011	The system must roll at 0 degrees heading and 87 speed for 7 seconds.	Priority 1	04/17/2023	Arnab
AG_SP3_012	The system must say "I am the Winner" and continue.	Priority 2	04/18/2023	Jason
AG_SP3_013	The system must fade from blue to pink for 3 seconds on the main LED.	Priority 1	04/18/2023	Arnab
AG_SP3_014	The system must fade from red to purple for 3 seconds on the main LED.	Priority 2	04/19/2023	Jason
AG_SP3_015	The system must fade from yellow to light blue for 3 seconds on the main LED.	Priority 1	04/18/2023	Arnab
AG_SP3_016	The system must fade from green to orange for 3 seconds on the main LED.	Priority 2	04/19/2023	Arnab
AG_SP3_017	The system must set the main LED to blue.	Priority 2	04/19/2023	Jason

3.2 Security

3.2.1 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.

3.2.2 Authorization and Authentication

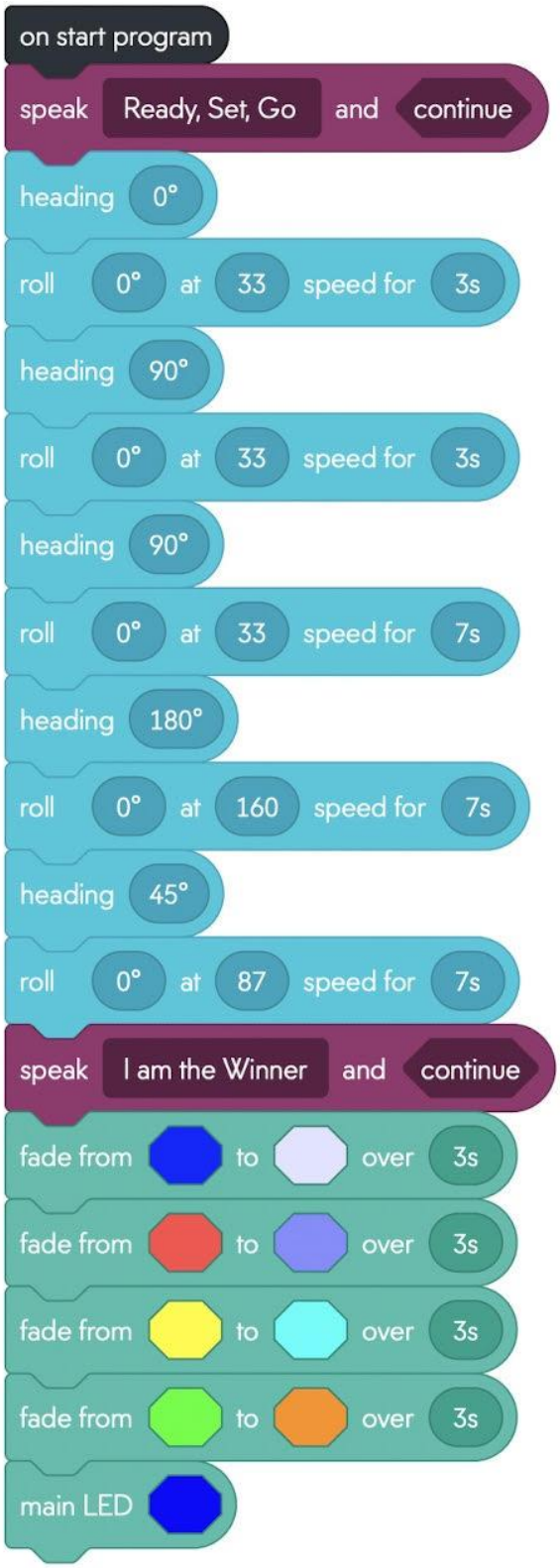
- Use of strong password policies to ensure secure access.
- Implementation of multi-factor authentication for additional security.

3.3 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.

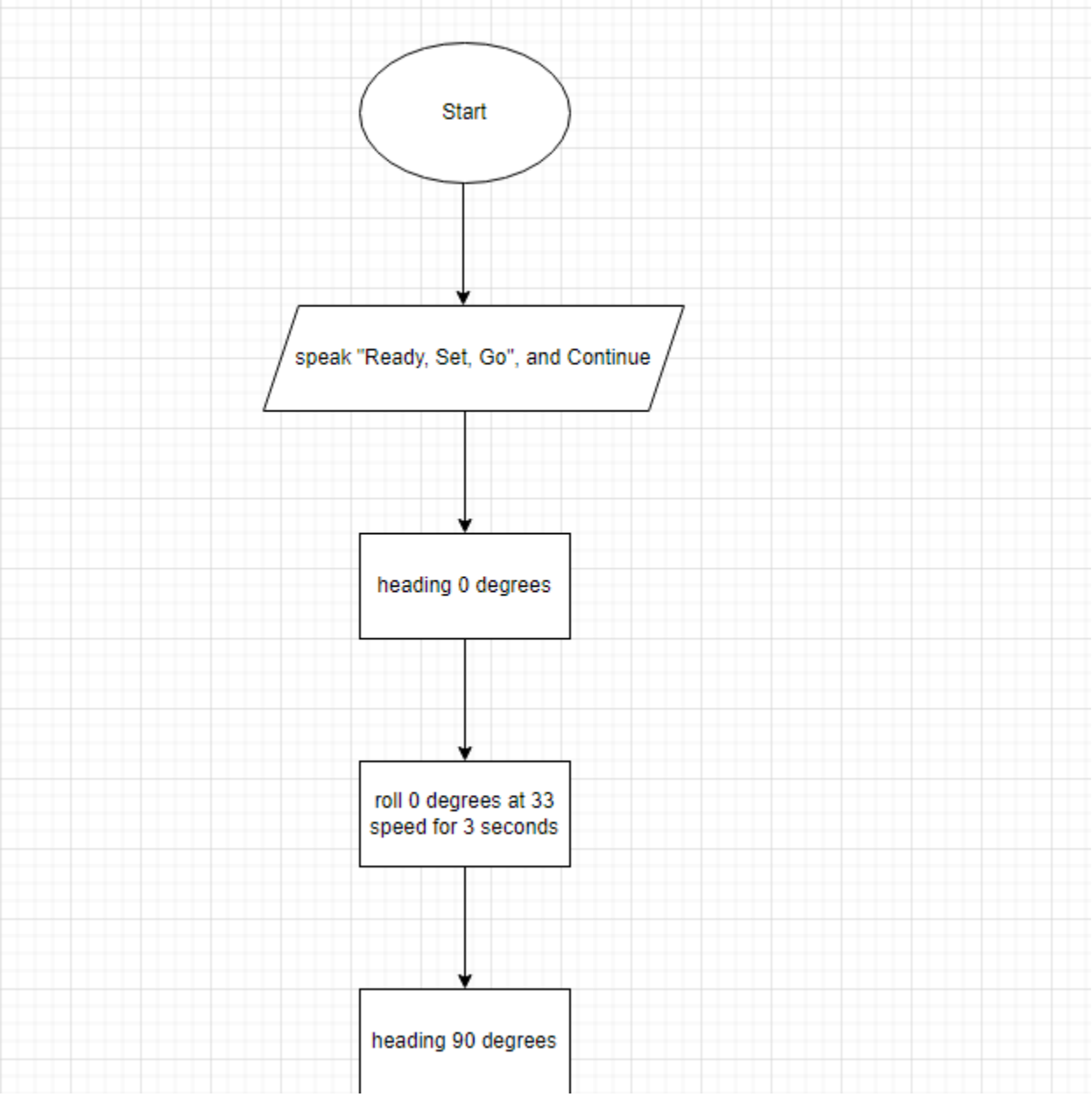
4. System Design

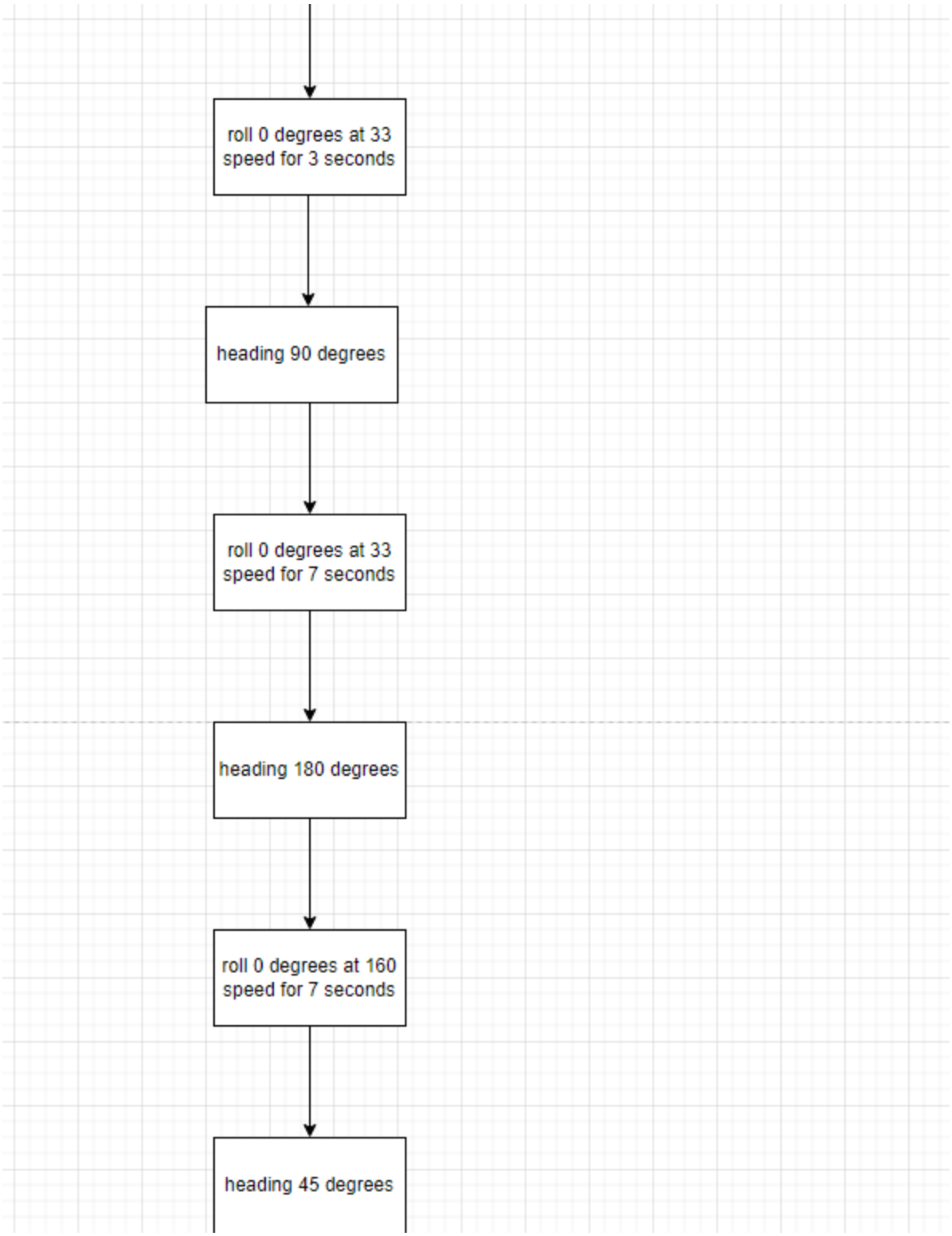
4.1 Algorithm

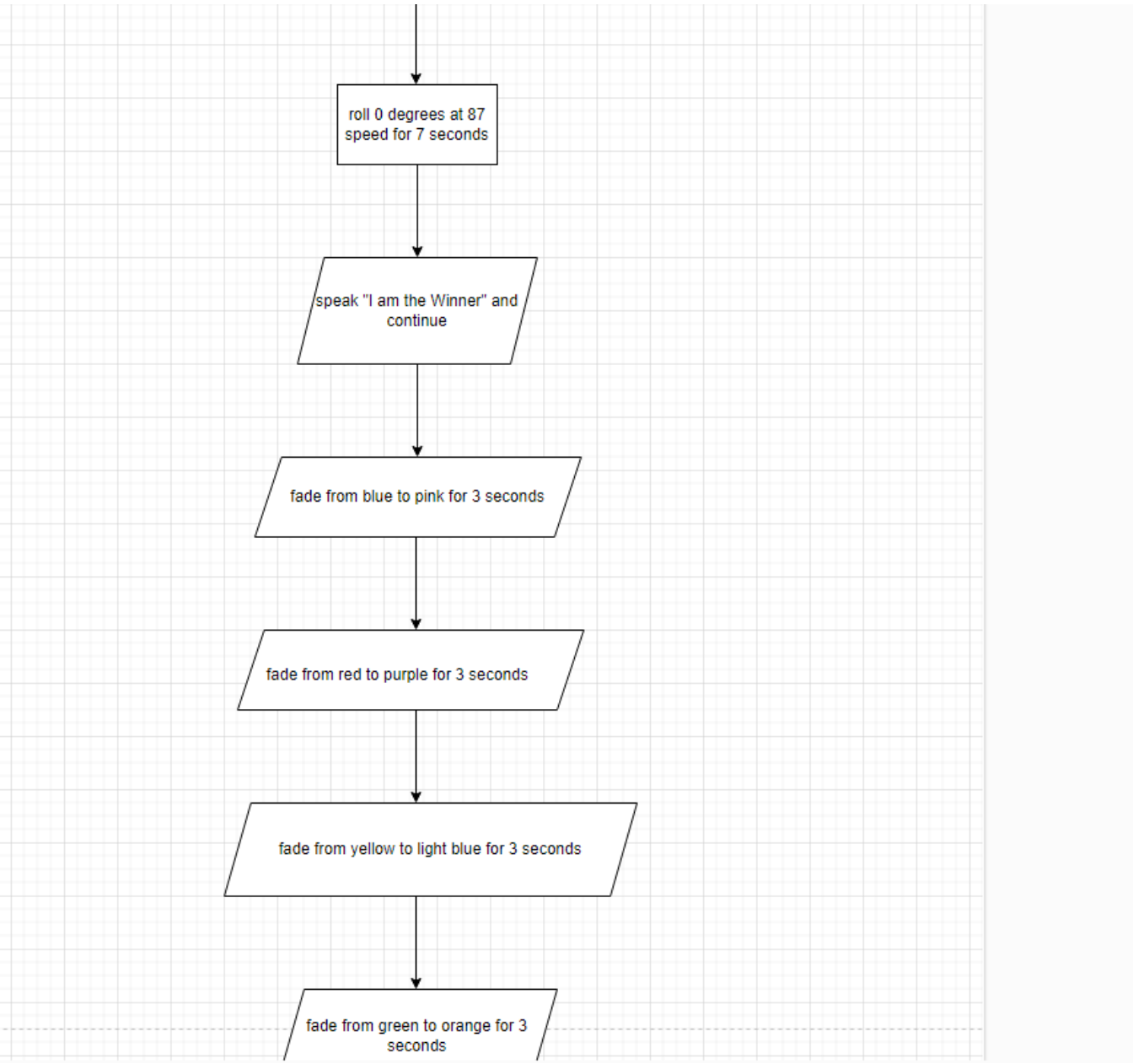


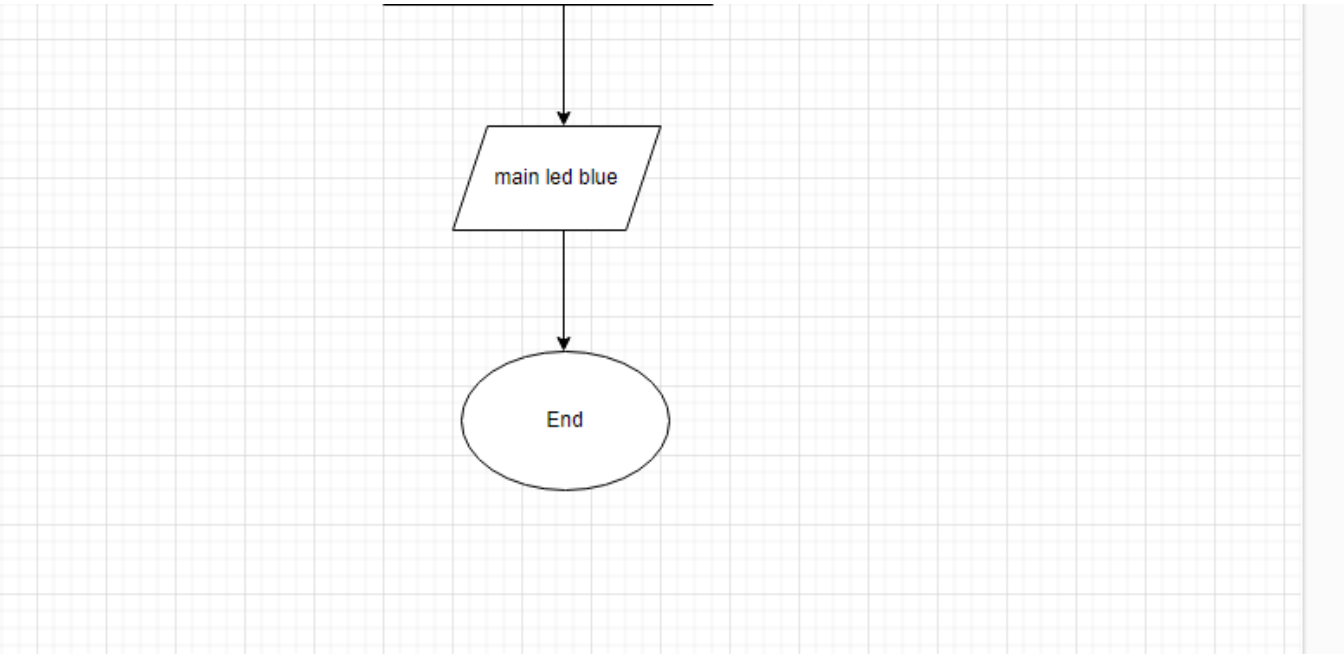
- speak "Ready, Set, Go", and Continue
- heading 0 degrees
- roll 0 degrees at 33 speed for 3 seconds
- heading 90 degrees
- roll 0 degrees at 33 speed for 3 seconds
- heading 90 degrees
- roll 0 degrees at 33 speed for 7 seconds
- heading 180 degrees
- roll 0 degrees at 160 speed for 7 seconds
- heading 45 degrees
- roll 0 degrees at 87 speed for 7 seconds
- speak "I am the Winner" and continue
- fade from blue to pink for 3 seconds
- fade from red to purple for 3 seconds
- fade from yellow to light blue for 3 seconds
- fade from green to orange for 3 seconds
- main led blue

4.1 System Flow




roll 0 degrees at 33 speed for 3 seconds
heading 90 degrees
roll 0 degrees at 33 speed for 7 seconds
heading 180 degrees
roll 0 degrees at 160 speed for 7 seconds
heading 45 degrees


roll 0 degrees at 87 speed for 7 seconds
speak "I am the Winner" and continue
fade from blue to pink for 3 seconds
fade from red to purple for 3 seconds
fade from yellow to light blue for 3 seconds
fade from green to orange for 3 seconds



4.2 Software

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

4.3 Hardware

- Sphero Spark 2
- Computer

4.4 Test Plan

Reason for Test Case	Test Date	Expected Output	Observed Output	Staff Name	Pass/Fail
Initial Test	4/17/2023	"Ready, Set, Go"	"Ready, Set, Go"	Arnab	Pass
Heading 0 degrees	4/17/2023	Heading: 0 degrees	Heading: 0 degrees	Jason	Pass
Roll at 33 speed for 3 seconds	4/17/2023	Roll: 0 degrees, Speed: 33, Time: 3 seconds	Roll: 0 degrees, Speed: 33, Time: 3 seconds	Arnab	Pass

Heading 90 degrees	4/17/2023	Heading: 90 degrees	Heading: 90 degrees	Jason	Pass
Roll at 33 speed for 3 seconds	4/17/2023	Roll: 0 degrees, Speed: 33, Time: 3 seconds	Roll: 0 degrees, Speed: 33, Time: 3 seconds	Arnab	Pass
Heading 90 degrees	4/17/2023	Heading: 90 degrees	Heading: 90 degrees	Jason	Pass
Roll at 33 speed for 7 seconds	4/18/2023	Roll: 0 degrees, Speed: 33, Time: 7 seconds	Roll: 0 degrees, Speed: 33, Time: 7 seconds	Arnab	Pass
Heading 180 degrees	4/18/2023	Heading: 180 degrees	Heading: 180 degrees	Jason	Pass
Roll at 160 speed for 7 seconds	4/18/2023	Roll: 0 degrees, Speed: 160, Time: 7 seconds	Roll: 0 degrees, Speed: 160, Time: 7 seconds	Arnab	Pass
Heading 45 degrees	4/19/2023	Heading: 45 degrees	Heading: 45 degrees	Jason	Pass
Roll at 87 speed for 7 seconds	4/19/2023	Roll: 0 degrees, Speed: 87, Time: 7 seconds	Roll: 0 degrees, Speed: 87, Time: 7 seconds	Arnab	Pass
Speak "I am the Winner"	4/19/2023	"I am the Winner"	"I am the Winner"	Jason	Pass

Fade from blue to pink for 3 seconds	4/19/2023	Fade: Blue to Pink, Time: 3 seconds	Fade: Blue to Pink, Time: 3 seconds	Arnab	Pass
Fade from red to purple for 3 seconds	4/19/2023	Fade: Red to Purple, Time: 3 seconds	Fade: Red to Purple, Time: 3 seconds	Jason	Pass
Fade from yellow to light blue for 3 seconds	4/19/2023	Fade: Yellow to Light Blue, Time: 3 seconds	Fade: Yellow to Light Blue, Time: 3 seconds	Arnab	Pass
Fade from green to orange for 3 seconds	4/19/2023	Fade: Green to Orange, Time: 3 seconds	Fade: Green to Orange, Time: 3 seconds	Jason	Pass
Main LED Blue	4/19/2023	Set Main lED to blue	Main led set to blue	Arnab	Pass

4.5 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	Jason	3:30 pm	1 hour	4:00 pm	30 minutes	100%

and Documentation						

4.6 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
Jason	Lead Developer	Develops algorithm while instructing developing team to follow	Administration
Arnab	Developer	Develops algorithm as instructed by Lead Developer	Lead Developer