Sprint 2 - Accuracy

System Design Document

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CS-104-01

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1. Executive Summary

1.1 Project Overview

Utilizing a Sphero SPRK robot, the goal of this project is to develop a block code algorithm that will allow the robot to successfully and accurately complete two figure eights around the CS-104-01 classroom without any errors.

1.2 Purpose and Scope of this Specification

The purpose of this project is to test and evaluate the accuracy of the Sphero SPRK robot as well as the effectiveness of our block code algorithm. The project's intended audience is the CS-104-01 class and professor.

The following requirements listed are in the scope of this project:

- A GitHub repository must be created and maintained for this project
- A Gantt chart made in Excel must be created and consistently updated to reflect progress made on the project
- A flow chart made in draw.io must be created to effectively display the robot's algorithm in a step-by-step format
- A video of the robot successfully completing the two figure eights must be recorded and uploaded to the collaborative GitHub repository

The following items listed are outside the scope of this project:

- The robot does not need to be as fast as possible because accuracy (i.e. staying on the blue tape) and successfully completing two figure eight shapes in a row is of higher importance

2. Product/Service Description

2.1 Product Context

The Sphero SPRK robot is dependent on a computer or laptop to be controlled by the Sphero EDU application's block code.

2.2 User Characteristics

The users of the Sphero SPRK robot and the audience for this project are students and professors of CS-104-01. This audience has a higher technical expertise, as the vast majority of students in the class are computer science or software engineering majors at Monmouth University.

2.3 Assumptions

For this project, it is assumed that the user will be utilizing the Windows operating system on their computer to run the block code. It is also assumed that the user will have all the necessary parts in order to operate the Sphero SPRK robot.

2.4 Constraints

The design of the algorithm for this project may be constrained by some aspects of the Sphero SPRK robot and its application. For example, the robot itself is slightly unstable and has difficulty with moving straight in one direction. It also has difficulty moving smoothly due to its spherical design. In terms of the Sphero EDU application, the block code format may constrain how the algorithm is developed.

2.5 Dependencies

This project's algorithm is dependent on a laptop running the Windows 11 operating system. It is also dependent on a charger and charging adapter that will power the robot.

3. Requirements

Top Priority Requirements:

- An algorithm must be designed to make the Sphero SPRK robot complete two figure eights marked by blue tape on the floor of the CS-104-01 classroom
- The robot must be able to fully complete the figure eights all in one go, meaning it cannot bump into any objects or encounter any errors in the block code
- The robot's sensor data as shown in the Sphero EDU application must accurately reflect the figure eight shape of the blue tape marked on the floor of the classroom

Low Priority Requirements:

- The robot does not need to complete the figure eights as fast as possible, but speed and timing will be of slight importance

3.1 Functional Requirements

Req#	Requirement	Comments	Priority	Date Rvwd	SME Reviewed / Approved
1	Complete the figure eights marked with blue tape on the floor of the classroom	Must complete without bumping into anything	Top Priority	11/10/24	Approved
2	Sensor data must show a figure eight	Must be as exact as possible	Top Priority	11/10/24	Approved

3.2 Security

3.2.1 Protection

There are no major security restrictions or requirements for this project, except for making sure to store the robot in a safe location when it is not in use.

3.2.2 Authorization and Authentication

There are no major authorization or authentication requirements for this project, except for making sure the robot is connected to the correct computer when working on the Sphero EDU application during class time.

3.3 Portability

The block code can be transferred to other computers as a Java code file.

4. Requirements Confirmation/Stakeholder sign-off

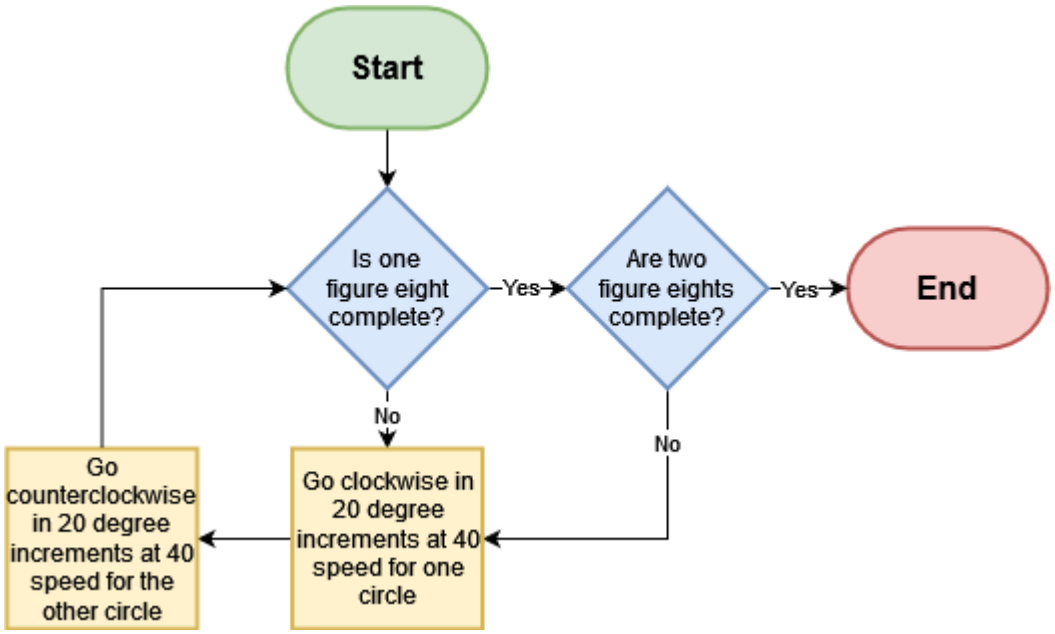
Meeting Date	Attendees (name and role)	Comments
11/12/24	Anna Pitera (Team Leader) Isuhi Acosta (Team Member) Joseph Ventimiglia (Team Member)	Confirmed all requirements

5. System Design

5.1 Algorithm

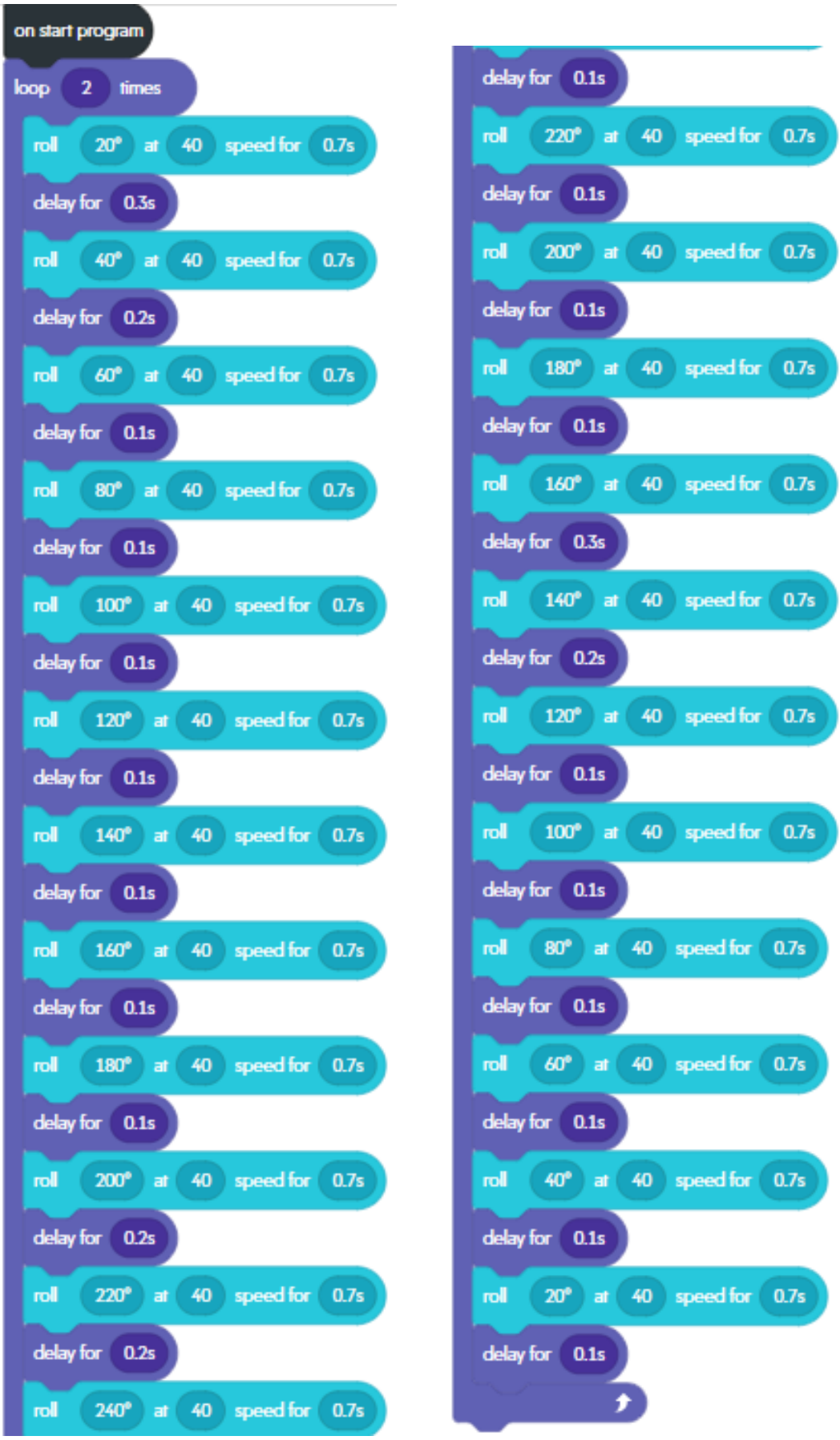
- When the program starts, the robot will move clockwise from the middle intersection point of the two circles around the first circle
- Once it reaches the middle intersection point of the two circles again, it will move counterclockwise from that point around the second circle, forming a figure eight shape
- Once it reaches the middle intersection point of the two circles again, it will repeat the process, forming two figure eight shapes
- After completing two figure eight shapes back-to-back, the robot will end at the middle intersection point of the two circles and complete the program

5.2 System Flow



5.3 Software

The Sphero EDU application was used to develop the block code for this project.


on start program
loop 2 times
roll 20° at 40 speed for 0.7s
delay for 0.3s
roll 40° at 40 speed for 0.7s
delay for 0.2s
roll 60° at 40 speed for 0.7s
delay for 0.1s
roll 80° at 40 speed for 0.7s
delay for 0.1s
roll 100° at 40 speed for 0.7s
delay for 0.1s
roll 120° at 40 speed for 0.7s
delay for 0.1s
roll 140° at 40 speed for 0.7s
delay for 0.1s
roll 160° at 40 speed for 0.7s
delay for 0.1s
roll 180° at 40 speed for 0.7s
delay for 0.1s
roll 200° at 40 speed for 0.7s
delay for 0.2s
roll 220° at 40 speed for 0.7s
delay for 0.2s
roll 240° at 40 speed for 0.7s
delay for 0.1s
roll 220° at 40 speed for 0.7s
delay for 0.1s
roll 200° at 40 speed for 0.7s
delay for 0.1s
roll 180° at 40 speed for 0.7s
delay for 0.1s
roll 160° at 40 speed for 0.7s
delay for 0.3s
roll 140° at 40 speed for 0.7s
delay for 0.2s
roll 120° at 40 speed for 0.7s
delay for 0.1s
roll 100° at 40 speed for 0.7s
delay for 0.1s
roll 80° at 40 speed for 0.7s
delay for 0.1s
roll 60° at 40 speed for 0.7s
delay for 0.1s
roll 40° at 40 speed for 0.7s
delay for 0.1s
roll 20° at 40 speed for 0.7s
delay for 0.1s

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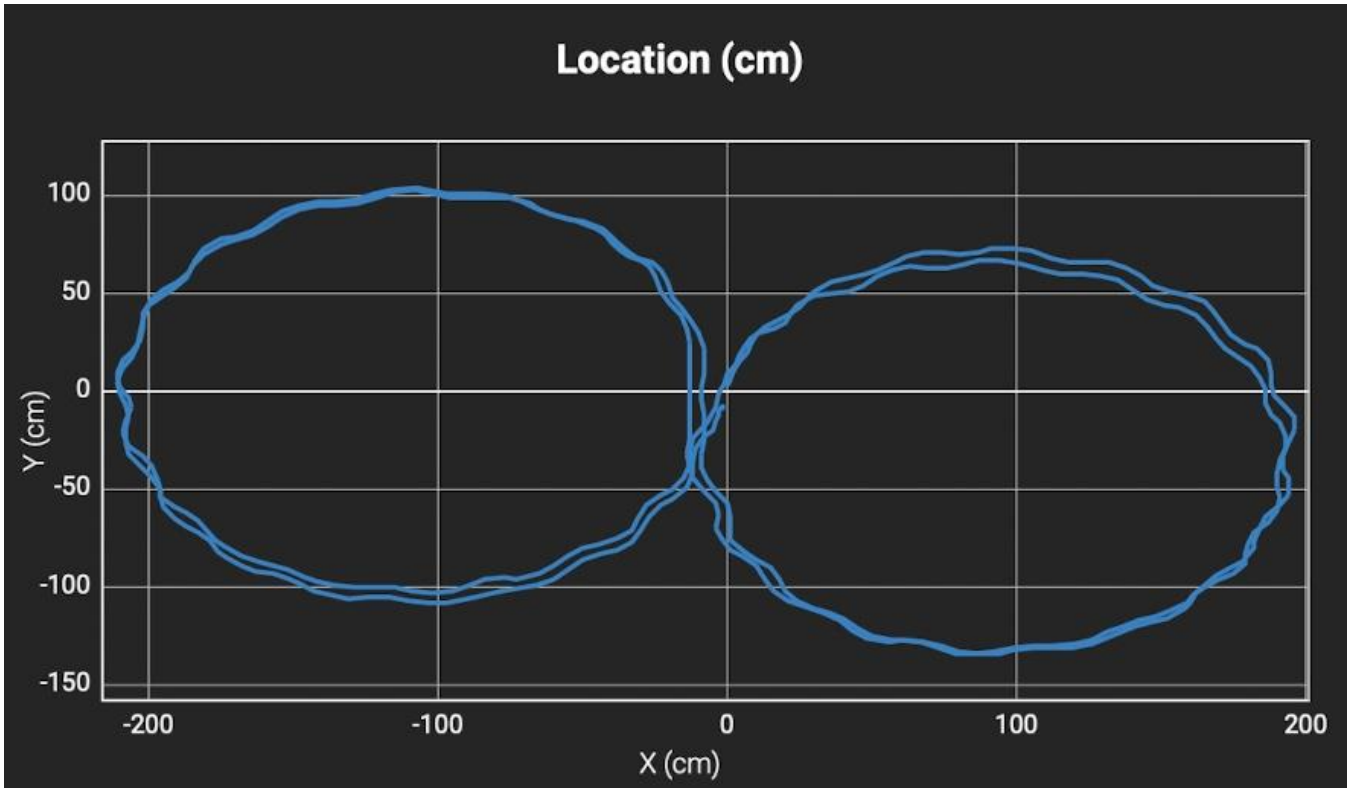

5.4 Hardware

A laptop running the Windows 11 operating system was used to run the Sphero EDU application in order to control the Sphero SPRK robot. A charging wire, an adapter, and a Sphero charging pad were also used to power the robot.

5.5 Test Plan

Reason for Test Case	Test Date	Expected Output	Observed Output	Staff Name	Pass/Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot performed half a circle, then bumped into a table	All team members	Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot performed half a circle, then lost aim before the second half of the circle	All team members	Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot completed first circle, but was inaccurate and way off the blue tape lines	All team members	Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot completed first circle, then lost aim before second circle	All team members	Fail

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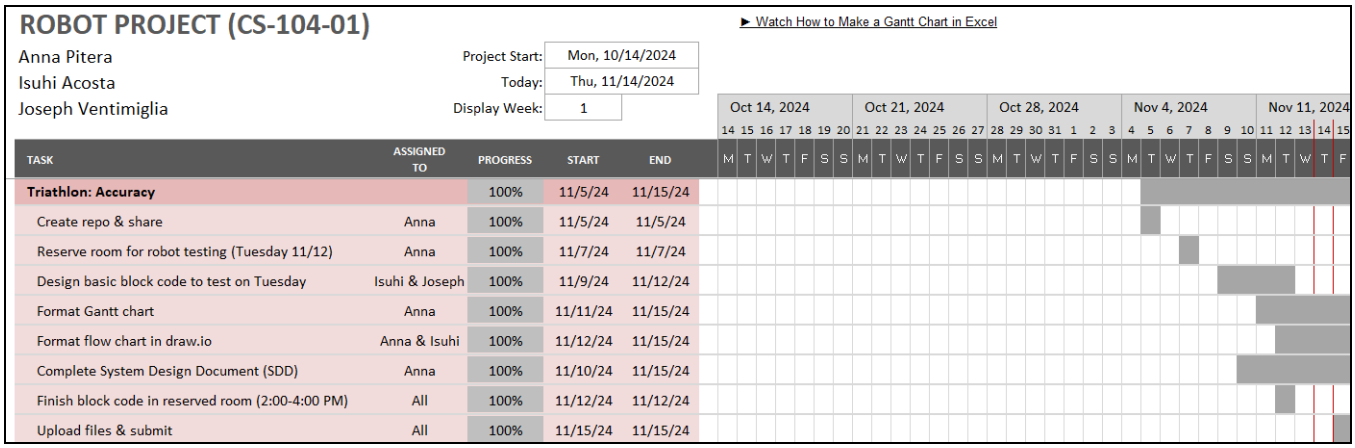
Reason for Test Case	Test Date	Expected Output	Observed Output	Staff Name	Pass/Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot completed first and second circle (one full figure eight), then lost aim before starting second figure eight	All team members	Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot completed first and second circle (one full figure eight), but lost aim while turning to start the second circle of the second figure eight	All team members	Fail
Testing block code	11/12/24	Robot will successfully complete two figure eights	Robot successfully completed two figure eights	All team members	Pass

5.6 Task List/Gantt Chart



5.7 Staffing Plan

Name	Role	Responsibility	Reports To
Anna Pitera	Team Leader	- Maintaining Gantt chart - Room reservations - Block code - Robot storage/charging - Writing SDD	Prof Qu
Isuhi Acosta	Team Member	- Flow charts - Block code - Updating GitHub repository - Record videos	Prof Qu
Joseph Ventimiglia	Team Member	- Block code	Prof Qu

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Name	Role	Responsibility	Reports To
		- Updating GitHub repository - Calibrating robot aim during testing	