Sprint 1 - Endurance Design Document

November 8, 2021

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1. Executive Summary

1.1 Project Overview

This product is one leg of a larger product testing the abilities of the Sphero SPRK+ robot using different courses / sprints. Each course is located on the floor of room HH-208. This part of the project is called the Endurance sprint. The robot will navigate the room with the goal being for it to stay on the blue lines laid out on the floor in the shape of a rectangle. A video will be taken of the robot completing the sprint. It will then be turned in to the professor alongside the block code and other requested information.

1.2 Purpose and Scope of this Specification

In scope

This part of the project involves testing for Endurance only, as explained in section 2.1.

Out of Scope

This part of the project does not involve testing for Agility and Accuracy.

2. Product/Service Description

2.1 Product Context

This product is part of a larger project containing three different sprints- Endurance, Accuracy, and Agility. This is the first of the three products- the Endurance sprint. All three of these products will be presented through video.

2.2 User Characteristics

Our group of three students will be using the product during testing and while taking the final video of the sprint. We have minimal experience using the robot so far, but some of us have experience with software development in general and at least one of us has used JavaScript-based block code before.

The professor will also be testing our code.

2.3 Assumptions

We are to use an SPRK+ robot and the Sphero Edu application for development. We must use a predetermined course located inside room HH-208. The application can be used on mobile or a laptop, but we are using laptops to create the block code. We are using phones to film the robot (the program can also be run on the phone while filming).

2.4 Constraints

The room containing the course for the Endurance sprint is not always available, therefore limiting the times at which the group can meet up and test the robot on the course. On top of this, it is difficult for our group to meet up and work in person in general due to some members having major time constraints.

Also, as the course is constrained to one room and is only available at certain times, multiple groups of people were testing their robots in the room at similar times, making it so that there was less time available for us to test ours so as not to keep others waiting for too long. (This was only an issue during the second round of testing, especially with only one group member available so the testing was slower.)

2.5 Dependencies

Any dependencies are explained inside the requirements chart in section 3.1.

3. Requirements

3.1 Functional Requirements

Req#	Requirement	Comments	Priority	Date Rvwd	SME Reviewed / Approved
ENDUR_01	Robot will start from yellow square with blue tape		1	10/28	10/28
ENDUR_02	Robot will start with green light		1	10/28	10/28
ENDUR_03	Robot will speak 'ready set go'		1	10/28	10/28
ENDUR_04	Robot will travel to each corner of rectangular course	4 corners Should be done in an order so that robot navigates periphery of room according to ENDUR_06	1	10/28	10/28
ENDUR_05	Robot will turn right at the center of each corner	Turns 90 degrees (in block code, turning 90 degrees is indicated by adding 90 degrees to previous rotation)	1	10/28	10/28
ENDUR_06	Robot will travel around periphery of HH208, staying on blue line	Accomplished through previous two requirements Robot must be properly oriented in the beginning in order to accomplish this	1	10/28	10/28
ENDUR_07	Robot will not collide with objects as it moves	Any tables and chairs in the way are moved before running program	1	10/28	10/28
ENDUR_08	Robot will return to its starting location	Starting location is yellow square with blue tape	1	10/28	10/28
ENDUR_09	Robot will stop with red light		1	10/28	10/28
ENDUR_10	Robot will speak 'I'm done and I need water'		1	10/28	10/28

3.2 Security

3.2.1 Protection

As a group, we did not feel that it was worth putting more extreme protective measures on our program. We did use a password protected account on the Sphero Edu application, however, that would protect our code. The robot itself is also secured in a case when not being used.

3.2.2 Authorization and Authentication

N/A

3.3 Portability

This system is overall not portable. The track is located in HH-208, and therefore the robot must be run in this room. The robot itself and laptop being used to run the robot can be moved around, but as the laptop uses Bluetooth to run the robot, the robot must be near the laptop in order to run.

4. Requirements Confirmation/Stakeholder sign-off

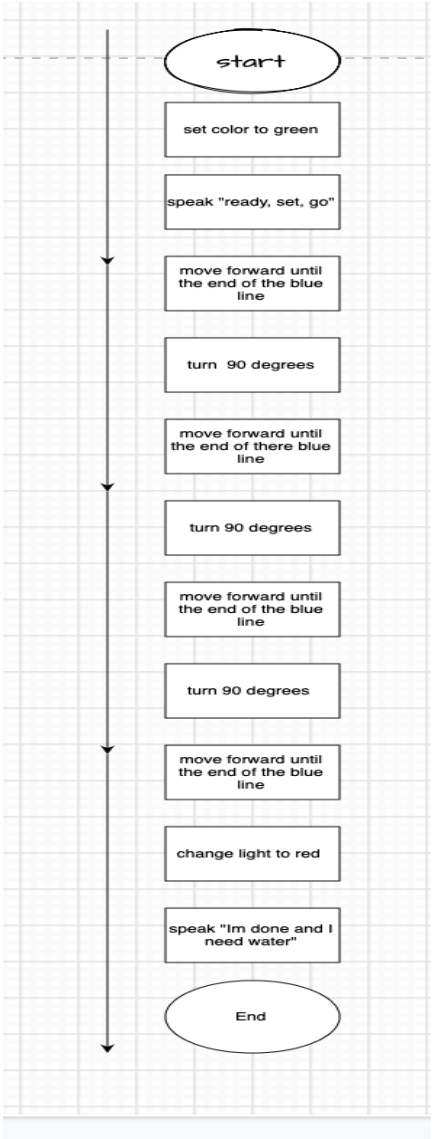
Meeting Date	Attendees	Comments
10/28/21	Jarek, Anjali, James	All requirements approved

5. System Design

5.1 Algorithm

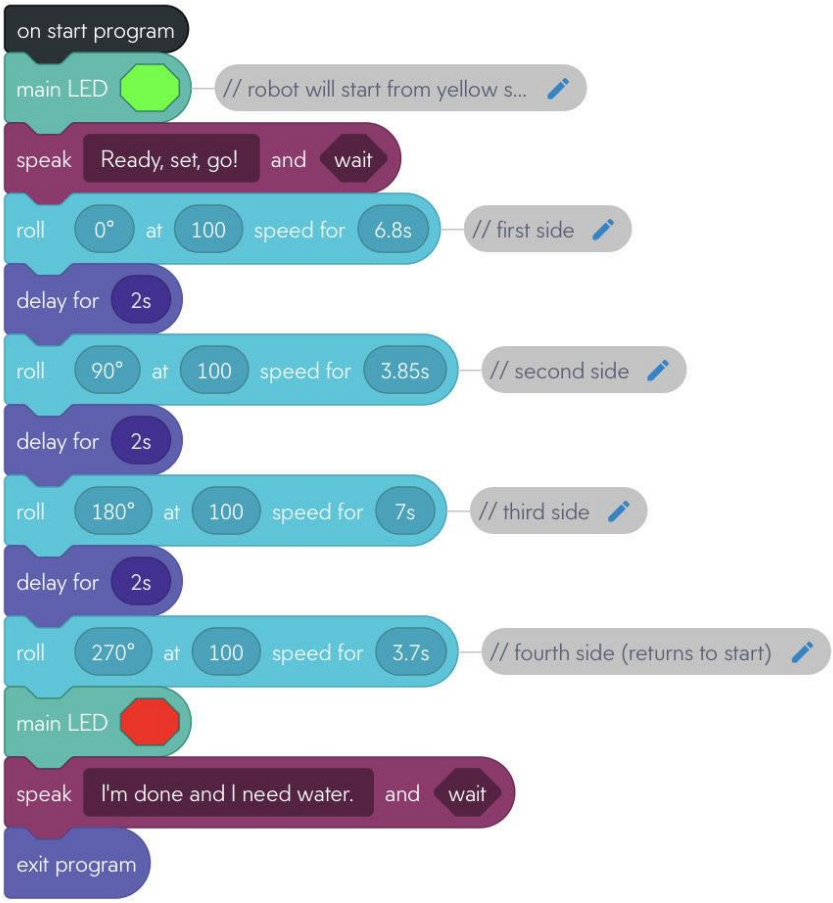
- Start on yellow corner with blue tape
- Change light to green
- Speak “ready set go”
- Travel forward to end of blue line
- Turn 90 degrees at center of corner
- Travel forward to end of blue line
- Turn 90 degrees at center of corner
- Travel forward to end of blue line
- Turn 90 degrees at center of corner
- Travel forward to end of blue line
- Change light to red
- Speak “I’m done and I need water”

5.2 System Flow

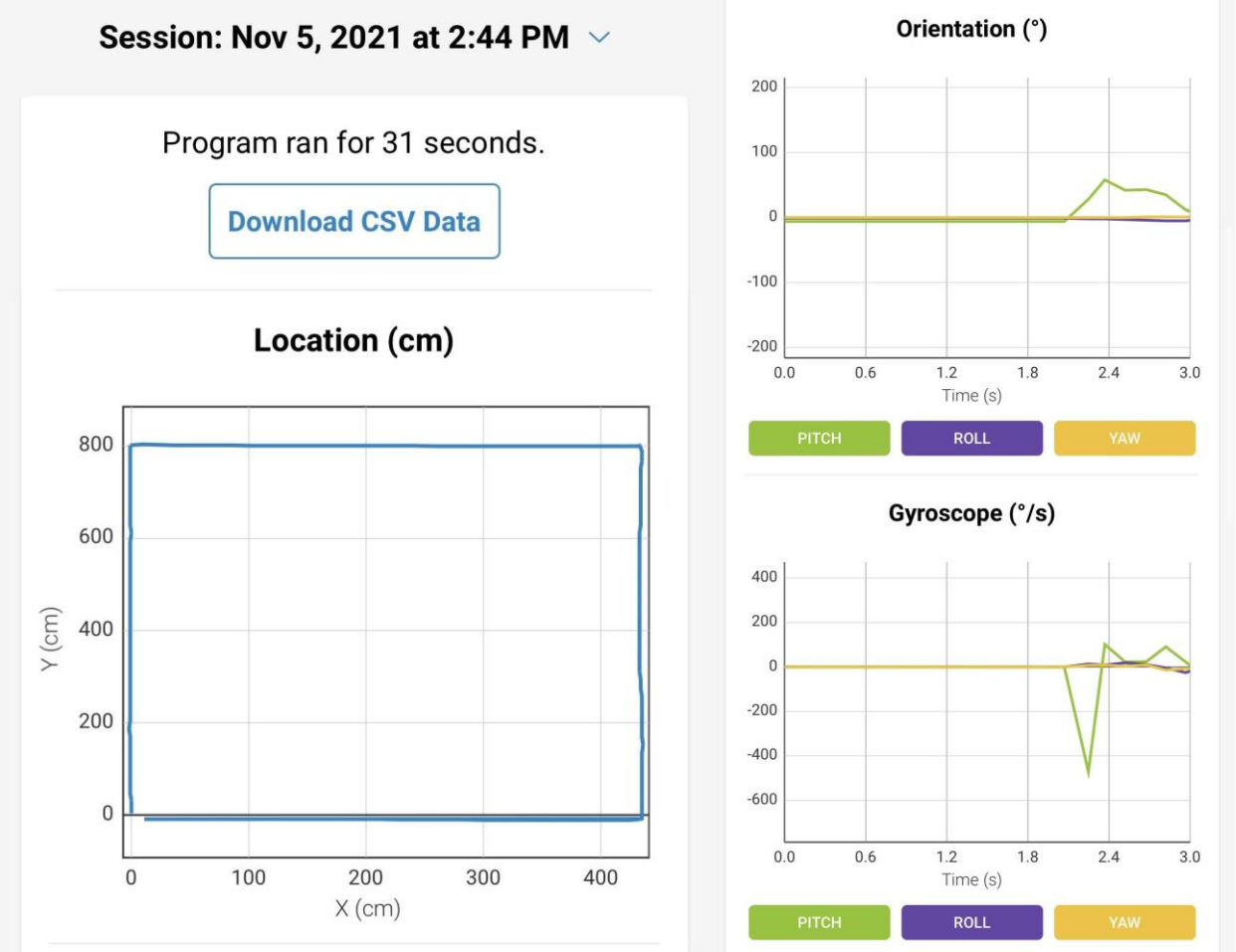


5.3 Software

This product is programmed using the Sphero Edu application for Windows. It was run during testing and filmed using the Sphero Edu app for iPhone. This application uses block code.



Block code for Endurance sprint – Sphero Edu app


Session: Nov 5, 2021 at 2:44 PM
Program ran for 31 seconds.
Download CSV Data
Location (cm)
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600
400
200
0
Y (cm)
0
100
200
300
400
X (cm)
Orientation (°)
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100
0
-100
-200
0.0
0.6
1.2
1.8
2.4
3.0
Time (s)
PITCH
ROLL
YAW
Gyroscope (°/s)
400
200
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0.6
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Time (s)
PITCH
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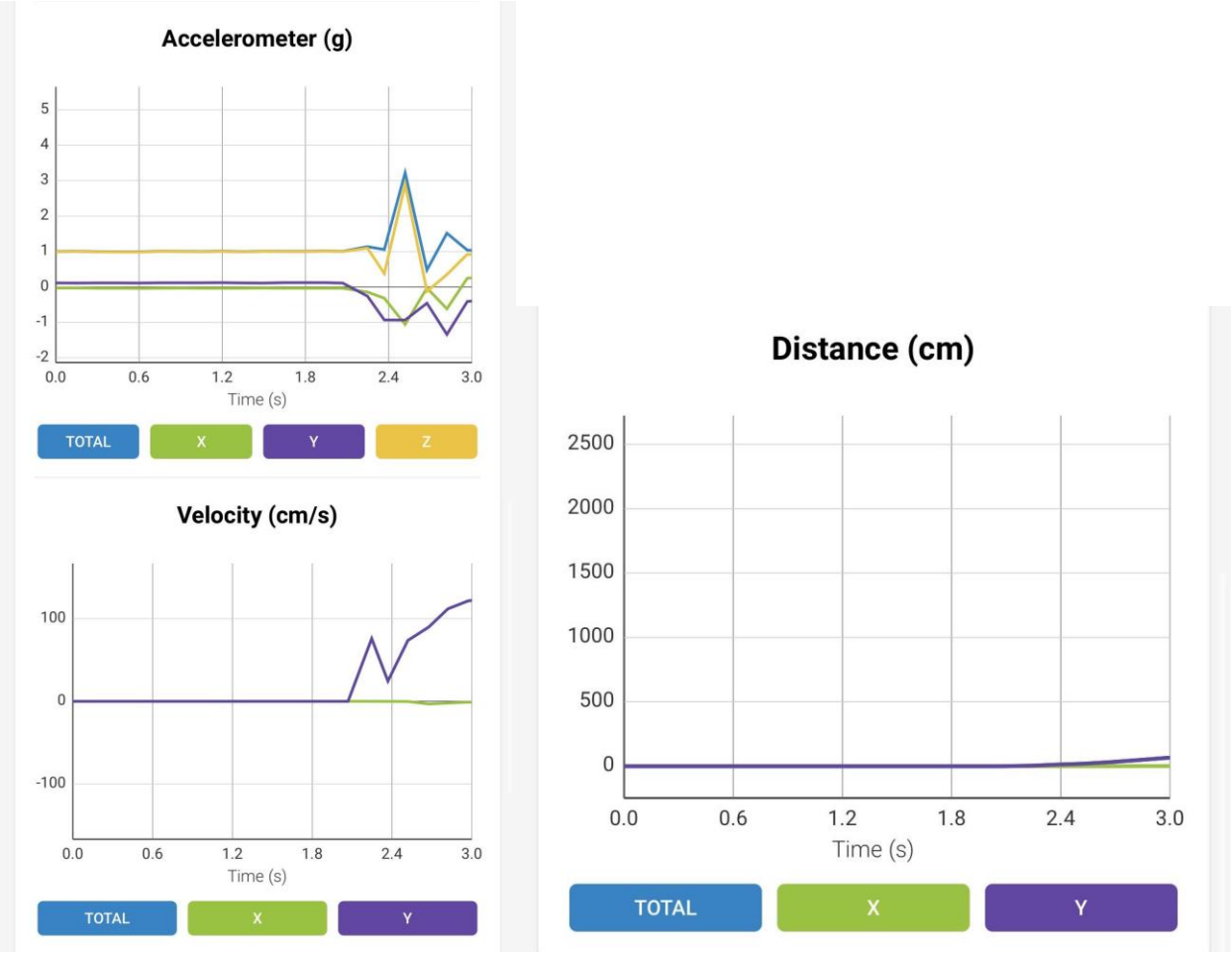
YAW



Sensor data diagrams – Sphero Edu app

5.4 Hardware

The robot being used is the Sphero SPRK+. The block code was programmed using an HP laptop. The robot was run and filmed using an iPhone.

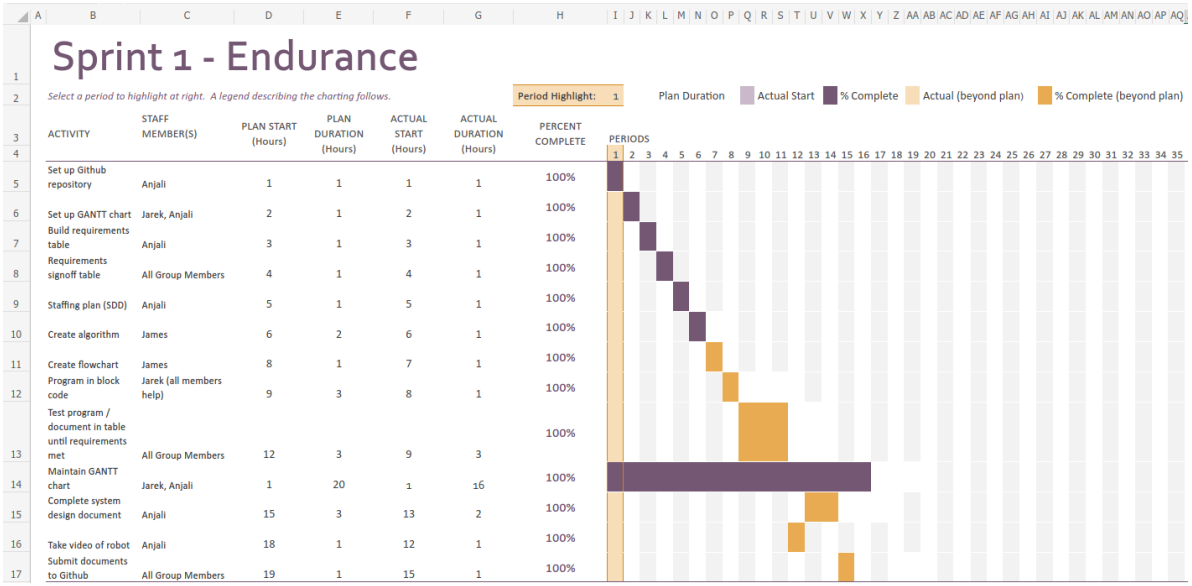
5.5 Test Plan

Reason for Test Case	Test Date	Expected Output	Observed Output	Staff Name	Pass/Fail
Seconds travelled for robot to navigate first side of track	10/28	As this was a guess, it was expected that robot would stop short of or go further than end of first side	Guess appeared correct alongside our selected robot speed- robot stopped at end of side, staying on line entire time	All	Pass
Robot travels on first side staying directly on blue line	10/28	Repeating previous test case to ensure it worked- same observed output expected	We were unable to keep robot from moving diagonally away from line- difficulty orienting it before running program	All	Fail

Reason for Test Case	Test Date	Expected Output	Observed Output	Staff Name	Pass/Fail
Seconds travelled for robot to navigate second side of track	10/28	This was done before fully fixing orientation issue, so expected output was just close estimate of how many seconds robot should travel after turning at first corner	Robot stopped close to second corner	All	Pass
Robot stays on first blue line and reaches the end	10/5	Expected that there would need to be a few tests for this in order to properly orient robot	Robot strayed slightly to the right of the blue line	Anjali	Fail
Robot stays on first blue line and reaches the end	10/5	Robot reaches end of the blue line staying on it	Robot stayed on blue line and reached the end of it	Anjali	Pass
Robot stays on first and second blue line	10/5	Robot stays on first blue line and on second blue line and reaches end of second line	Robot stopped short on second blue line	Anjali	Fail
Robot stays on first and second blue line and reaches end of second line	10/5	Seconds was increased for the second line, so robot should reach end of it	Robot traversed first two sides successfully	Anjali	Pass
Robot stays on all blue lines and reaches back to the starting position	10/5	May have to adjust the amount of time for third line	Robot stopped short on third line. Ended test here	Anjali	Fail
Robot stays on all blue lines and reaches back to the starting position	10/5	Success in reaching starting position and staying on lines	Robot ultimately stayed on first three lines but stopped too far after third line and was a bit off on the fourth. Likely overestimated the slight difference in times needed for opposite sides.	Anjali	Fail (accepted due to constraints)

Note: Some tests were not documented if they were done multiple times in a row due to small errors such as robot not being oriented properly / very small time adjustments. These tests were often stopped short in order to reorient the robot.

5.6 Task List/Gantt Chart



Sprint 1 - Endurance

Select a period to highlight at right. A legend describing the charting follows.

Period Highlight: 1

Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

ACTIVITY	STAFF MEMBER(S)	PLAN START (Hours)	PLAN DURATION (Hours)	ACTUAL START (Hours)	ACTUAL DURATION (Hours)	PERCENT COMPLETE
Set up Github repository	Anjali	1	1	1	1	100%
Set up GANTT chart	Jarek, Anjali	2	1	2	1	100%
Build requirements table	Anjali	3	1	3	1	100%
Requirements signoff table	All Group Members	4	1	4	1	100%
Staffing plan (SDD)	Anjali	5	1	5	1	100%
Create algorithm	James	6	2	6	1	100%
Create flowchart	James	8	1	7	1	100%
Program in block code	Jarek (all members help)	9	3	8	1	100%
Test program / document in table until requirements met	All Group Members	12	3	9	3	100%
Maintain GANTT chart	Jarek, Anjali	1	20	1	16	100%
Complete system design document	Anjali	15	3	13	2	100%
Take video of robot	Anjali	18	1	12	1	100%
Submit documents to Github	All Group Members	19	1	15	1	100%

PERIODS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

Link to excel: https://live365monmouth-my.sharepoint.com/:x:/g/personal/s1328134_monmouth_edu/EdDvV-h0wiREukZ0GCLUdoUBx4zvVEF03gNoSXaqAqMoVQ?e=n369iH

5.7 Staffing Plan

Name	Role	Responsibility	Reports To
Anjali	Manager	System Design Document, maintain GitHub, robot testing	N/A
James	Data / Planning	algorithm, flowchart, robot testing	Anjali (for SDD)
Jarek	Programmer	Gantt chart, block code, robot testing	Anjali (for SDD)