Sprint 1 - Endurance Design Document

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# Executive Summary

## Project Overview

This is a project in which the group must program a robot using Sphero Edu to accomplish several actions for it to fulfill an endurance test. The product must pass a course in the shape of a rectangular box with specific measurements while lights change, and words are spoken before and after the course. When the product is on the course, all the conditions must be satisfied in the correct order. To split out the requirements and make it easier for the coders to grasp what must be accomplished with the course, an algorithm was created. Reports and measurements were taken to see if the robot followed the programming provided to it correctly. External devices were utilized to send the code and track the product's behavior. The software is aimed for those who are interested in coding and wish to master the fundamentals of computer science.

## Purpose and Scope of this Specification

The goal of these requirements is to demonstrate how the robot should operate in various contexts and what it can do. The intended audience, those who want to learn how to code, should study these requirements to understand how the project functioned both within and outside of scope. All the following are included in the scope and out of scope:

**In scope**

• The robot must be able to draw a rectangle and return to its original starting place.

• Must be able to adjust colors and communicate.

• The robot must avoid colliding with other items.

**Out of Scope**

* The robot will only function with Sphero Edu’s block coding.
* The robot can only work on a firm level surface.

# Product/Service Description

## General issues that can impact the product's performance and needs might make it difficult for the robot to function effectively. Nothing would operate well or at all if the product had at least one issue prohibiting it from meeting the essential standards. This product is reliant on other hardware, and if a user is lacking a crucial component, the performance may not occur or may occur incorrectly. Before the robot executes the activities that have been assigned to it, the human must always investigate these difficulties.

## Product Context

## The product connects to other goods to obtain the code required to conduct tasks. The product is neither self-contained nor autonomous since it requires additional devices to attach the code to it. Because the same software is utilized with both external devices and the robot, related systems may interact with the product. Inputs, sensory data, timing, and output are all handled by the bigger system's key components. The communication between external devices and the product is what allows the code to be turned into the actions that must be taken. The product's external interfaces are USBs, which allow it to connect to other peripherals.

## User Characteristics

The following is a general customer profile for each sort of user who will use the product:

* College students with minimal experience and technical competence who want to learn and improve their programming abilities. They may put their code to the test to see if the product works as, it should or if it fails. This educates the students that they will have to use trial and error to get the product to work as it should.
* Staff with programming and technical skills who can provide students the opportunity to act out what is being taught in class. Staff must first know what to do, so they educate students how to use the product and pass on their expertise.
* Faculty with programming and technological competence who can store and care for the robots and distribute them as needed for certain sessions. Because the product is delicate and costly, someone who understands how to use and care for it is required.
* Because the robot and code are simple to use, children as young as eight may learn to program even if they have no technical knowledge or programming experience. This can help students prepare for a future in programming and is a good place to start learning.

## Assumptions

The user's assumptions might have an impact on the criteria that are met. Under those two scenarios, the user may be unable to accomplish the action due to a lack of equipment, such as an external device or a robot. The robot cannot move until the user instructs it using an external device, and a robot is required to carry out the commands given by the external device. The LED lights blinking red when they are not meant to potentially hinder performance, and if the battery runs out, the command may halt in the middle of execution. This may be remedied by charging the robot prior to doing any actions. The voice box and LED lights must be changed if the robot has no voice, or the light does not turn on. By the software and hardware not connecting to the robot, out-of-date hardware and software might have an impact on the requirements. This can be modified by updating the robot's software and/or hardware to the most recent version or a version that is compatible with it. The environment can also have an impact on requirements by causing instructions to produce various outcomes. If the robot is in a small space rather than a bigger area, the programming written for the larger room must be scaled down to meet the needs. If the user adapts the circumstance correctly, these assumptions can be corrected.

## Constraints

The following are some of the product's constraints:

* The product must be at a specified distance from the external device for both to interact in real time for audit trails and log files to be correctly captured.
* The product's programming is done in a block code program with the same brand as the product.

The following are some of the product's hardware limitations:

* + The robot can only move up to a speed of 225 km/h.
  + The battery life is only approximately 1-2 hours.
  + The robot's mode of transportation is rolling.
* External devices must have sufficient storage to download the product's data.
* Older operating systems and hardware are no longer supported. iOS 10+
  + Android 5+
  + Fire 7 (2019)
  + Fire HD 8 (2015+)
  + Fire HD 10 (2015+)
  + Windows 10 (1709+)
  + macOS (10.12+)
  + Chrome OS (50+)
* Supported Browsers
  + Chrome
  + Safari
  + Firefox
  + Internet Explorer
* The user must access the code on a regular basis to see if the code has any errors in it and to see if the code made is secure.

## The user must access the code on a regular basis to see if the code has any errors in it and to see if the code made is secure.

## The group had to work largely virtually, but most of the group would work in person on the course

## The group's scheduling had an impact on when each member would work on the project.

## Dependencies

The product contains dependencies that have an impact on the performance requirements:

* Firmware upgrades are required 1-2 times each year to correct faults and enhance performance.
* Before the required requirements are met, code is required to command the product.
* This new product necessitates the use of a separate device to measure and command the operations required.
* Before focusing on conducting a course, the product should go through several basic jobs and test plans.
* Before building any final code for the endurance test, an algorithm should be tried and finalized.

# Requirements

To complete this work, you will require a robot that will be supplied to you, and it must be capable of completing a full cycle around a rectangular track measuring 22' by 11' 9". The proportions may be changed to fit the available space. The user will require a robot that has been programmed using Sphero Edu's block code, which will be utilized to finish this project.

|  |  |
| --- | --- |
| Requirement | Priority |
| 1. Power | 1. This criterion is necessary to ensure that the robot is functioning properly while it is at the beginning and finish of the course, so that it does not halt in the middle of the course or pass through without being able to turn on each corner of the track. |
| 1. Movement | 2. The value of the criterion is required for the robot to travel four times in a straight line to construct the rectangular shape of the course. The functionality provided by the requirement is to verify that the robot can move on its own and that it can complete this task. Because the dimensions may be modified to fit different settings, the requirement can also be altered. |
| 1. Orientation | 3. Because the product must spin 90 degrees each time it reaches a corner in the course, the requirement is critical to the overall structure of the system. This criterion strengthens the structure by requiring the robot to move in a single motion throughout the course rather than adjusting it manually to keep it in a straight path. |
| 1. Communication | 4. This condition is critical for the whole group since it ensures that everyone is on the same page and that everyone has the same aim for the robot before it moves. The project's creators worked in both a physical and virtual environment. |
| 1. Portability | 5. The need is necessary to communicate data between the robot's software and hardware. When a user ports the robot, other hardware, software, and the cloud may access the code and other information about it. The robot's mobility can aid in the transmission of data from external devices to it, and vice versa with the data it already possesses. |
| 1. Sound | 6. This is required for the robot to utter its words both before and after the training is completed. For people to hear it, the sound must be heard. |
| 1. Lighting | 7. This is an important need for the robot since it allows the user to see if the robot has finished the course. |

* How the system should function:
  + The robot begins at the beginning point, which is located at a course corner. The robot's lights should be green and indicate "Ready, set, go" before you begin. Regardless matter whether the route is adjusted or not, the robot would have to go straight for the number of feet it has. The robot would do a 90-degree turn at the first corner. A second straight line, longer than the first, would be required to create the rectangular form, whether on the measurements used to test the product or on a modified version. The robot would do a 90-degree turn on the following bend. The length of the third straight line would be the same as the length of the first line**.** The robot would make a 90-degree turn at a third corner. The measurements of the fourth straight line would be the same as the measurements of the second line. Turn 90 degrees when the robot returns to the starting location to bring the system to a close. The robot's lights should turn red when the system is finished, and it should announce, "I'm done, I need water." The robot should have followed the rectangular-shaped path without any problems because of the results.

## Functional Requirements

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Req# | Requirement | Comments | Priority | Date Reviewed | SME Reviewed / Approved |
| ENDUR\_01 | Power | The robot worked and turned on before it went on the course | 1 | 11/08/21 | Reviewed and approved |
| ENDUR\_02 | Movement | The robot goes on a straight line when given the code to do so | 2 | 11/08/21 | Reviewed and approved |
| ENDUR\_03 | Orientation | The robot turned on every corner in the course | 3 | 11/09/21 | Reviewed and approved |
| ENDUR\_04 | Sound | The robot said its phrases when before and after it started the course | 6 | 11/09/21 | Reviewed and approved |
| ENDUR\_05 | Lighting | The LED lights of the robots turned green before the course and red after the course | 7 | 11/09/21 | Reviewed and approved |

## Security

### Protection

The user and the product must be protected from malicious or unintentional access, alteration, disclosure, destruction, or abuse. The following are some examples:

* Password-protected encryption on external devices, allowing the user to unlock any device used in conjunction with the product.
* When using the product with an external device, make sure you're connected to the internet via a steady connection since data can be captured if you're not utilizing a secure connection.
* Log and record every step the robot does in order to verify if the code supplied was followed as intended and to ensure that nothing touched the code while the user was gone
* Log and record every step the robot does to verify if the code supplied was followed as intended and to ensure that nothing touched the code while the user was gone
* Keep historical data to ensure that the code was executed correctly the previous time the user used it and to see whether it repeats the same activities.
* On the SpheroEdu app, private the code that is being written so that it is not available to other users
* On the SpheroEdu app, make the code that is being written private so that it is not available to other users.
* Check on the external device if the robot being connected is the one the user is now using and see if any other devices are connected to the robot.

### Authorization and Authentication

The following permission and authentication methods were utilized for the project:

* Allowing the product to connect to the external device to proceed
* Allowing the product to connect to the external device to proceed
  + It is strongly advised not to keep usernames and passwords on any external devices in case they are stolen.
* Use usernames and/or passwords on external devices to prevent others from modifying the code on the SpheroEdu account to which they have access.
* Certain document owners in this project granted complete editing access to just other members of the group, and the information was shared secretly.
  + Block Code
  + The project documents
  + Flow Chart

## Users who own code must allow what other users on SpheroEdu can and cannot do with their code, such as reading or altering it.

## Portability

Because portability is a need, the following are examples of system qualities that relate to the ease of porting the system to different devices and operating systems:

* Because the code can be altered at any moment except for starting and ending, the percentage of components having host dependent code was around 90%.
* The host must manually alter the speed per second and angle to match the rectangular course, therefore around 80% of the code is host dependent. Starting and stopping are independent of the host.
* The advantage of using a portable language is that once you start working on the code, you can save it and carry it about with you on your laptop.
* For the code to transfer to a variety of hardware and software, the compiler used to translate the block code is JavaScript.
* The phone software iOS 14 and Android 10 were the operating systems that had the code transferred to each other.
* The need for environment independence demonstrates how the product works with any hardware, software, or network. The code should be able to run on any device that is compatible with the SpheroEdu app and robot.

# Requirements Confirmation/Stakeholder sign-off

|  |  |  |
| --- | --- | --- |
| Meeting Date | Attendees (name and role) | Comments |
| 11/07/21 | Juliana- Project Manager/Coder  Ava- Tester/Coder  Vincenzo- Documentation/Algorithm | confirmed all except ENDUR\_03, ENDUR\_04, ENDUR\_05 |
| 11/08/21 | Juliana- Project Manager/Coder  Ava- Tester/Coder | confirmed all except ENDUR\_04, ENDUR\_05 |
| 11/09/21 | Juliana- Project Manager/Coder  Ava- Tester/Coder | All functional requirements have been confirmed |

# System Design

The project's system architecture is utilized to ensure that the block code generated by coders follows a valid path. When the route was shown so that the robot could be on a fixed path for endurance, the staffing for the project design happened. The block code was utilized and shared by the system design team to examine how the robot responded to each command. The programming went through a lot of trial and error to figure out how to get the robot to follow the path. The developers were given an algorithm to follow and comprehend what actions the robot should do while on the course. On the course given by the class, the testing for the system design was done in person. At initially, the robot was given simple tasks to complete before progressing to more difficult testing.

## Algorithm

* Start
* LED Light Green
* Speak “Ready, Set, Go”
* Go straight at 0 degrees for 22 feet
* Spin 90 degrees
* Go straight at 0 degrees for 11 feet 9 inches
* Spin 90 degrees
* Go straight at 0 degrees for 22 feet
* Spin 90 degrees
* Go straight at 0 degrees for 11 feet 9 inches
* Spin 90 degrees
* LED Light Red
* Speak “I’m done I need water”
* End

**Graphical user interface, text, application, chat or text message

Description automatically generated**

## System Flow

## Diagram Description automatically generated with medium confidence

## Software

Sphero Edu, a JavaScript block program that performs the duties stated in the code, was utilized to install this application for the robot. The application programming interface has components that allow the robot to change direction, move at different speeds, speak phrases, and change the color of its lights. Sphero Edu is available as a mobile app and as a website for PCs. Bluetooth is required for connection between the device and the robot for the device to follow the block code and measure movement. Android 10, iOS 14, Windows 10, and MacOS 10 were used to access the Sphero Edu app and website for this project.

## Hardware

The endurance test was conducted with a transparent Sphero brand robot that can roll in any direction, has a built-in voice box, and LED lights that can change color. iPhone, a Samsung Galaxy phone, MacBook’s, and a Hewlett-Packard PC are among the other devices utilized to connect with the robot. The two iPhones utilized were the iPhone Xs, which included 3GB of RAM, 64GB of storage, an A11 Bionic chip with 64-bit architecture as the CPU, a neutral engine, an embedded M11 motion coprocessor, and a built-in rechargeable lithium-ion battery that lasted 13 hours. The Galaxy S10 phone utilized in this project has 8GB of RAM, 128 GB of storage, an Octa-core processor as the CPU, and a QHD+ resolution. The two MacBook’s utilized were MacBook Pros with a battery life of 10 hours, 16GB of memory, 256GB of storage, and a 1.4GHz four core 8th generation Intel Core i5, Turbo Boost up to 3.9GHz, and 128MB of eDRAM as the CPU. A ProBook 6560b with a 7200 rpm SMART SATA II hard drive, 128 GB of storage, 6 hours of battery life, Intel Core i5-2520M Processor (2.50 GHz, 3MB L3 cache, 2 cores/4 threads, 35 W) up to 3.20 GHz with Intel Turbo Boost Technology, and a Mobile Intel HM65 Express Chipset was utilized in the project.

## Test Plan

Chart, line chart

Description automatically generated ![Chart, line chart

Description automatically generated]()

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Reason for Test Case** | **Test Date** | **Expected Output** | **Observed Output** | **Staff Name** | **Pass/Fail** |
| Robot drifts in different direction | 11/6/2021 | Travel in straight line | Drifts off to side | Ava & Juliana | Fail |
| Increase speed to fix drifting | 11/6/2021 | Move in straight line | Moved in straight line but went past target | Ava & Juliana | Pass |
| Decrease timer | 11/9/2021 | Stop at target | Stopped before reaching target | Ava & Juliana | Fail |
| Increase speed | 11/9/2021 | Reach target and not be affected by incline as much | Drifted and went past target | Ava & Juliana | Fail |
| Fix aim | 11/9/2021 | Move in the correct direction | Didn’t move online completely | Ava & Juliana | Fail |
| Increase speed | 11/10/2021 | Move in straight line | Moved in different direction | Ava & Juliana | Fail |
| Adjust aim | 11/10/2021 | Move in straight line | Drifted to side on second run | Ava & Juliana | Fail |
| Adjust aim | 11/10/2021 | Avoid drifting | Almost followed path | Ava & Juliana | Pass |
| Adjust aim | 11/10/2021 | Avoid drifting | Followed path but went past final target | Ava & Juliana | Pass |
| Decrease speed of final roll | 11/10/2021 | Reach target | Failed to reach target | Ava & Juliana | Fail |
| Reach the target | 11/10/2021 | Move in straight line and reach final target | Moved in straight line and almost reached target | Ava & Juliana | Pass |
| Go around the course | 11/10/20 | Complete the rectangular course | Completed the course | Ava & Juliana | Pass |

## Task List/Gantt Chart

Chart

Description automatically generated

## Staffing Plan

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Role | Responsibility | Reports To |
| Juliana | Project Manager /Coder | Make sure everything is done on time | Ava and Vincenzo |
| Ava | Tester/Coder | Testing the algorithms that the robot runs by | Juliana |
| Vincenzo | Documentation/ Algorithm | Documents and oversees the software | Juliana |