Backyard Splashpad Specifications Document

Braydan J. Allen

James S. Humble

November 9, 2018

Signature Page

_____   _____   _____

Signature   *Signature*   *Signature*

_____   _____   _____

Date and email   *Date and email*   *Date and email*

Revision History

Revision	Description	Author	Date	Approval
1	Initial Revision	James and Braydan	Oct. 24, 2018	
2	Incorporate Feedback	James and Braydan	Nov. 1, 2018	
3				
4				
5				
6				
7				
8				
9				
10				

Contents

Specifications

1   SCOPE

(a) <u>General:</u> **This document describes the design and verification requirements of the Backyard Splash Pad. The Backyard Splash Pad is used to provide backyard entertainment for adults and children alike. This specification for the backyard splash pad does not include any information on installing the Backyard Splash Pad or creating a playable surface around the Backyard Splash Pad.**

(b) **<u>Acronyms:</u>**

BSP: Backyard Splash Pad

2 APPLICABLE DOCUMENTS

Government Documents

- **MIL-STD-108** *Basic Requirements for enclosures of electrical componenents.*

  Download: http://everyspec.com/MIL-STD/MIL-STD-0100-0299/download.php?spec=MIL_STD_108E.1711.pdf

- **MIL-STD-810** *Testing methods for environmental hazards.*

  Download: http://everyspec.com/MIL-STD/MIL-STD-0800-0899/download.php?spec=MIL-STD-810G.00002212.PDF

- **MIL-STD-1310H** *Electrical Shock Hazard Protection Requirements.*

  Download: http://everyspec.com/MIL-STD/MIL-STD-1300-1399/download.php?spec=MIL-STD-1310H.00002652.pdf

3 STAKEHOLDER REQUIREMENTS

The stakeholders for the Backyard Splash Pad are:

1. Dr. Don Cripps

2. Jolynne Berrett

3. The Families of Braydan Allen and James Humble

4. The USU ECE Department

3.1 Stakeholders Requirements

The primary stakeholders needs are described below.

- **Dr. Don Cripps The device:**

  1. Must be complicated enough to challenge the designers.

- **Jolynne Berrett. The device:**

  1. Must have a useful, readable user manual.

- **The Families of Braydan Allen and James Humble will be the primary users of the device. The device:**

  1. Must not present safety/shock hazards to any user.
  2. Must have an easy user interface.
  3. Must be able to run in a typical backyard.
  4. Must have multi-colored lights.

- **The USU ECE Department is funding the project. The device:**

  1. Must be low in initial cost (design and prototype).

  2. Must meet the pedagogical requirements of the course (ECE 4820/4830/4840/4850) for which it is designed.

4 ENGINEERING REQUIREMENTS

4.1 System Overview

The Backyard Splash Pad is comprised of four main components: a device controller, a user interface, a mechanical system, and an object-tracking system. The device controller receives input from the user interface and uses it to control the mechanical system. The user interface presents information about the system to the user and accepts input from the user. The mechanical system controls the flow of water. The object-tracking system detects objects near the Splash Pad and reports information to the controller. See Figure 1.
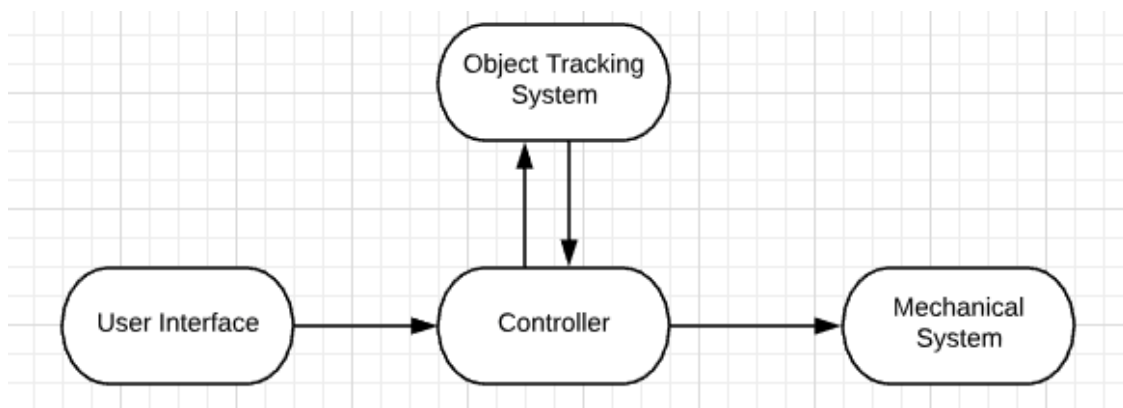
4.1.1 Functional Diagram

Figure 1: Functional Diagram.

4.2 Functional Requirements

4.2.1 Controller

4.2.1.1 Stream Control
The controller shall be able to turn on and off each water stream individually.

4.2.1.2 Light Control
The controller shall be able to turn on and off each light individually.

4.2.1.3 Color Control
The controller shall be able to change the color of each light individually.

4.2.1.4 Responsive to Object Tracking System
The controller shall be able to turn on a specified nozzle as directed by the Object Tracking System.

4.2.1.5 Programmed Display
The controller shall have at least one pre-programmed fountain routine containing light changes and water streams turning on and off.

4.2.2 User Interface

4.2.2.1 User Nozzle Control
The user interface shall allow the user to select what nozzle(s) are turned on.

4.2.2.2 User Color Control
The user interface shall allow the user to select what color the LEDs are.

4.2.2.3 User Object Tracking Control
The user interface shall allow the user to enable or disable the object tracking system.

4.2.3 Mechanical System

4.2.3.1 Water Flow
The mechanical system shall be able to create seven water streams that rise at least 6.0 ft vertically above the nozzle.

4.2.3.2 Water Protection
The mechanical system shall be sprayproof.

4.2.3.3 Dust Protection
The mechanical system shall be dust-tight.

4.2.3.4 Play Surface
The mechanical system shall provide a play surface capable of supporting at least 500.0 pounds.

4.2.3.5 Operation Time
The mechanical system shall be able to operate for 10,000 hours.

4.2.3.6 Safety
Electrical components in the mechanical system shall conform to section B.4 in MIL-STD-1310H.

4.2.4 Object Tracking System

4.2.4.1 Minimum Object Size
The Object Tracking System shall be able to detect any object larger than a sphere with a 9.4 in. diameter that is within 2.0 ft of any nozzle.

4.2.4.2 Lighting Levels
The Object Tracking System shall be able to function when the brightness level around the splash pad is at least 2000 lux.

4.2.4.3 Automatic Calibration
The Object Tracking System may be able to automatically adjust to differences in its position relative to the splash pad if its position changes.

4.3 Support Requirements

4.3.1 Device Controller
The Device Controller shall have labeled buttons.

4.3.2 Mechanical System

4.3.2.1 Power Consumption
The system shall operate on 1000.0 Watts or less.

4.3.2.2 Power Supply
The system shall be powered by a standard 120 V electrical outlet.

4.3.2.3 Size
The system shall fit within a cube that is 10 ft on an edge.

4.3.2.4 Water Conservation
The system shall reuse at least 50% of the water.

4.3.2.5 Nozzles
The Nozzles shall create laminar flowing streams of water.

5   VERIFICATION OF REQUIREMENTS

5.1   System Overview

The Backyard Splash Pad is comprised of four main components: a device controller, a user interface, a mechanical system, and an object-tracking system. The device controller receives input from the user interface and uses it to control the mechanical system. The user interface presents information about the system to the user and accepts input from the user. The mechanical system controls the flow of water. The object-tracking system detects objects near the Splash Pad and reports information to the controller. See Figure 2.

5.1.1   Functional Diagram

Test by confirming that each element of the functional diagram is present in the final design.
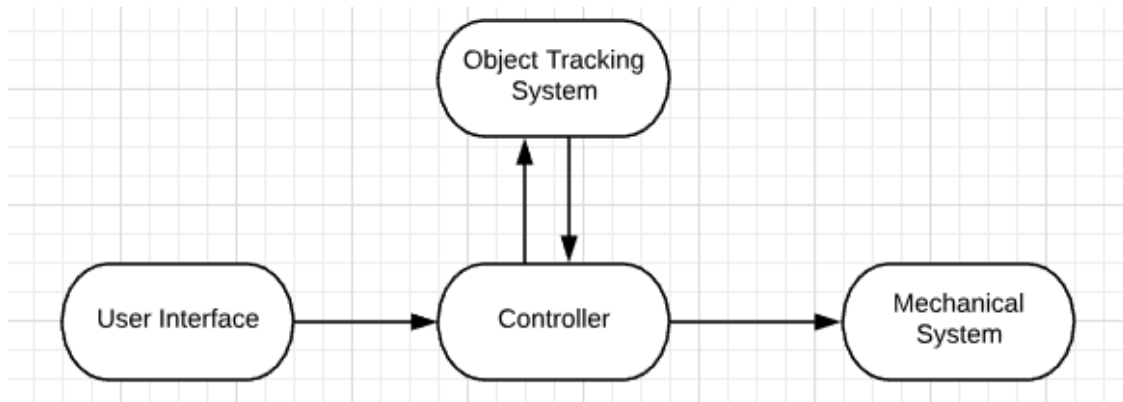

Figure 2: Functional Diagram.

5.2   Functional Requirements

5.2.1   Controller

5.2.1.1   Stream Control
Test by observing that each stream turns on and turns off.

5.2.1.2   Light Control
Test by observing that each light turns on and turns off.

5.2.1.3   Color Control
Test by observing that each light changes color.

5.2.1.4 Responsive to Object Tracking System

Enable the object tracking system. Observe that a water stream turns on due to input from the Object Tracking System.

5.2.1.5 Programmed Display

Use the user interface to run the fountain routine. Observe that lights change and water streams turn on and off.

5.2.2 User Interface

5.2.2.1 User Nozzle Control

Use the user interface to turn on a water stream. Observe that the water stream turns on.

5.2.2.2 User Color Control

Use the user interface to change the color of a light. Observe that the color of the light changes.

5.2.2.3 User Object Tracking Control

Use the user interface to disable the Object Tracking System. Place a basketball-sized object (or larger) near a nozzle. Observe the the splash pad does not react to the presence of the object.

5.2.3 Mechanical System

5.2.3.1 Water Flow

Turn on seven water streams. Observe that there are seven. Measure height of each water stream with a tape measure. Ensure that each stream rises at least 6.0 ft high.

5.2.3.2 Water Protection

Test according to the procedure described in section 4.9 of MIL-STD-108.

5.2.3.3 Dust Protection

Test according to procedure described in section 510.5 of MIL-STD-810.

5.2.3.4 Play Surface

Place weights totaling 500 pounds on the play surface. Inspect system for damage. Verify that no non-cosmetic damage exists.

5.2.3.5 Operation Time

Run the system continuously for 1 week. Ensure that system is fully functional after 1 week of operation.

5.2.3.6 Safety

Verify that components used meet the standards found in section B.4 of MIL-STD-1310H.

5.2.4 Object Tracking System

5.2.4.1 Minimum Object Size

Enable the Object Tracking System. Roll a ball that is 9.4 inches in diameter towards a nozzle. If one of the fountains changes due to the presence of the basketball, then the system passes this test.

5.2.4.2 Lighting Levels

Perform test 5.2.4.1 when a lux-meter mobile application placed on the splash pad reads 2000 lux.

5.2.4.3 Automatic Calibration

Move the Object tracking system so that it is in a new location relative to the splash pad. Perform any steps required by the design to account for location adjustment. Perform test 5.2.4.1.

5.3 Support Requirements

5.3.1 Device Controller

Verify that each button has a label.

5.3.2 Mechanical System

5.3.2.1 Power Consumption

Total the maximum power used by all of the components as stated in product specifications. Ensure that it is less than or equal to 1000.0 Watts.

5.3.2.2 Power Supply

Ensure that the power source for the system is a 120 V electrical outlet.

5.3.2.3 Size

Measure the dimensions of the system with a tape measure. Make sure the system is no longer than 10 feet on a side.

5.3.2.4 Water Conservation

Fill the system with water. Measure the water level of the water stored in the system. Operate the system for 10 minutes. Measure the water level again. Ensure that the difference in water is less than 50% of the original measurement.

5.3.2.5 Nozzles

Turn on the water streams. Inspect the water streams for visual breaks. Ensure that there are no visual breaks.

Paragraph Number	Test Type	Tester's Name	Pass/Fail	Date