**System Requirements**

**Specifications for Volt & Pepper System (VPS)**

Sponsor

**The Department of Electrical, Computer, Software & Systems Engineering at Embry-Riddle Aeronautical University**

Released September 18, 2014

**Volt & Pepper Development Team**

**Abstract**: The System Requirements Specifications (SyRS) for the Volt & Pepper System are detailed within this document. These requirements serve as a contract between the customer of the Volt & Pepper System and the Volt & Pepper Development Team. All stakeholders are recognized and the extent of each party’s respective involvement is thoroughly detailed. This document is compliant with the Institute of Electrical and Electronics Engineers (IEEE) Std. 1233-1998 **Error! Reference source not found.** and the *IEEE Recommended Practice for Software* *Requirements Specifications* **Error! Reference source not found.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Revision History

|  |  |  |
| --- | --- | --- |
| **Date** | **Reason for Change** | **Version** |
| Sep. 5, 2014 | Initial draft of document | 0.0.1 |
| Sep. 7, 2014 | Added requirements and user stories | 0.0.2 |
| Sep. 8, 2014 | Revised requirements, definitions added | 0.0.3 |
| Sep. 9, 2014 | Updated Definitions | 0.0.4 |
| Sep. 11, 2014 | Defined document sections | 0.0.5 |
| Sep. 12, 2014 | Compiled components of SyRS together | 0.0.6 |
| Sep. 14, 2014 | Refined document sections and styles | 0.0.7 |
| Sep. 15, 2014 | Abstract, references added | 0.0.8 |
| Sep. 16, 2014 | Use cases added | 0.0.9 |

**Table of Contents**

Revision History ii

List of Figures iv

List of Tables v

1. Introduction 1

1.1 Purpose 1

1.2 Mission Statement 1

1.3 Scope 1

1.4 Team Roles 1

1.5 Overview 2

2. General Description 2

2.1 Stakeholders 2

2.1.1 Volt & Pepper System Development Team 2

2.1.2 Dr. Barott, Dr. Seker, Jorge Torres 2

2.1.3 Embry-Riddle Aeronautical University 2

2.1.4 Nova Southeastern University & Broward College 2

2.1.5. Institute of Electrical and Electronics Engineers, Inc. Error! Bookmark not defined.

2.1.6 Accredation Board of Engineering and Technology, Inc. 3

2.2 Product Perspective 3

2.3 Product Functions 3

2.4 User Characteristics 3

2.5 General Constraints 3

2.6 Assumptions and Dependencies 3

2.7 Use Cases 3

2.8 Sequence Diagrams 9

3. Requirements 15

3.1 Functional Requirements 15

3.2 Nonfunctional Requirements 15

A. Appendicies 17

A.1. Appendix A 17

Glossary 19

Acronyms & Abbreviations 20

References 21

# List of Figures

# List of Tables

# Introduction

## Purpose

The purpose of this document is to provide a detailed account of the scope, high-level description, and system requirements of the Volt & Pepper System, henceforth known as VPS. The requirements include functional and nonfunctional requirements and system constraints. This document is aimed toward the customer of the VPS. This document is meant to capture the high-level requirements of the VPS.

## Mission Statement

To create a fully autonomous robot that can traverse over a path marked by a white line, and complete four tasks. These tasks include playing Simon for 15 seconds, drawing IEEE on an Etch-A-Sketch, rotating one row of a Rubik’s cube 180 degrees, and picking up and carrying a playing card to the end of the course.

## Scope

The VPS is intended to compete in the IEEE SoutheastCon 2015 Hardware Competition **Error! Reference source not found.**. SoutheastCon is the annual IEEE Region 3 Technical, Professional, and Student Conference. It brings together Computer Scientists, Electrical, and Computer Engineering professionals, faculty and students to share the latest information through technical sessions, tutorials, and exhibits **Error! Reference source not found.**.

## Team Roles

The following table presents all members of the Volt & Pepper System Development Team (VPSDT) and respective role assignments. Each member is accountable for the overesight and advancement of the positions held.

Table 1—Team roles

|  |  |
| --- | --- |
| **Name** | **Role** |
| Nezar Bahksh | Team Leader  Scrum Master  Development Team |
| Greg Carkin | Software Configuration Manager  Development Team |
| Gary Roach | Development Leader  Development Team |
| Brittany Rompa | Testing Leader  Prodct Owner  Development Team |

## Overview

This document is compliant with the standards established in IEEE Std. 1233, 1998 Edition **Error! Reference source not found.**. The document has been divided into three sections. Section 1 serves as a introduction to the VPS, which describes the scope of the project and the team involved. Section 2 contains the general VPS description which includes the product stakeholders, functions of the VPS, and proposed use cases, and Section 3 contains the VPS functional and nonfunctional requirements.

The glossary contains all ambiguous words and phrases, as well as industry terms used in the document. Appendix A serves as the index for all diagrams, tables, and pictures used in the document.

# 2. General Description

## Stakeholders

The following is a comprehensive list of individual parties that have a stake in the development, production, and operation of the VPS.

### Volt & Pepper System Development Team

The development team for the VPS will be graded on the adequate completion of the system by customers (see 2.1.2). Grading of the product includes the product itself, along with all artifacts created throughout the 2014-2015 Senior Design process.

### Dr. Barott, Dr. Seker, Jorge Torres

As custumers of the VPS, Dr. Barott, Dr. Seker, and Jorge Torres are interested in the completion of the product and all artifacts created throughout the 2014-2015 Senior Design process. Additionally, Dr. Barott and Dr. Seker are interested in the development team ensuring the product meets the standards set forth in the Capstone Senior Design project for the Department of Electrical, Computer, Software & Systems Engineering (ECSSE) at Embry-Riddle Aeronautical University (ERAU).

### Embry-Riddle Aeronautical University

The VPS will be one of three contending teams from ERAU that is competing to be sent to the IEEE SoutheastCon 2015 Hardware Competition **Error! Reference source not found.**. If chosen, the final product produced by the VPSDT will uphold the prestige of ERAU. In doing so, the VPS must conform to the standards of the University as defined in the 2014-2015 Student Handbook **Error! Reference source not found.**.

### Department of Electrical, Computer, Software & Systems Engineering

ERAU’s Department of Electrical, Computer, Software & Systems Engineering (ECSSE) is interested in the product being delivered on time and within budget, as specified by the budget document for this product; which is TBD as of 9/18/14.

### Nova Southeastern University & Broward College

The hosting University is interested in the product complying with all regulations for the competition. It is essential to maintain a safe environment by assurring no product will cause harm to the University / College, or any persons which may come into contact with the product.

### Accredation Board of Engineering and Technology, Inc.

The product must abide by the standards of ABET in order to receive credit for completion of this two-semester course.

## Product Perspective

The VPS is intended to be a self-propelled, autonomous robot that can complete a series of challenges for the 2015 IEEE SoutheastCon Hardware Competition **Error! Reference source not found.**.

## Product Functions

The functionality of the VPS is divided into seven major functions: (1) The robot startup function, referred to as the setup throughout this document, (2) The robot navigation function, referred to as navigation throughout this document, (3) The robot Simon challenge function, referred to as Simon throughout this document, (4) The robot Etch A Sketch challenge function, referred to as Etch A Sketch throughout this document, (5) The robot Rubik’s Cube function, referred to as Rubik’s Cube throughout this document, (6) The robot playing card challenge function, referred to as playing card throughout this document, (7) The robot shut down function, referred to as shut down throughout this document, These functions do not impose a design constraint on the VPS, but are instead used to facilitate the requirements engineering process.

## User Characteristics

<Nezar>

## General Constraints

<Nezar>

## Assumptions and Dependencies

<Nezar>

## Use Cases

The following use cases demonstrate the proper functionality of the autonomous robot. These use cases represent the required operation in order to receive maximum points for the competition. Deviation from the normal operation of the robot may result in a loss of points or disqualification

<insert diagram. IEEE standard does not require it, but it may be useful in our situation>

1. Use Case 1: Startup

Scope: Robot

Level: User goal

Primary Actors: Volt and Pepper team member

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions

1. The robot is not on (power to the robot is disabled)

2. The robot is not within the 1’x1’ starting square

1. Postconditions

The robot is on (power to the robot is enabled)

The robot is within the 1’x1’ starting square

1. Main Success Scenario
   * + 1. The team member places the robot within the 1’x1’ starting square, ensuring that the robot is facing towards the desired path of travel
       2. The team member turns on the robot (enables power to the robot)
2. Frequency of Occurrence

This use case will occur at the start of each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course.

1. Use Case 2: Monitor Red LED

Scope: Robot

Level: User goal

Primary Actors: Red LED

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions
2. The robot is on (power to the robot is enabled) as described in Use Case 1: Startup
3. The robot is within the 1’x1’ starting square as described in Use Case 1: Startup
4. The Red LED light is on (the light is illuminated)
5. Postconditions
6. The robot will begin the task of navigation, as described in Use Case 3: Navigation
7. The robot is within the 1’x1’ starting square, as described in Use Case 1: Startup
8. The red LED light is off (the light is not illuminated)
9. Main Success Scenario
10. The robot will wait for the red LED light to turn off
11. The red LED light will turn off
12. The robot will begin the task of navigation, as described in Use Case 3: Navigation

2.7.2.5 Frequency of Occurrence

This use case will occur once during each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course

1. Use Case 3: Navigation

Scope: Robot

Level: User goal

Primary Actors: White line

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions
2. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
3. The robot is within the 1’x1’ starting square or in front of one of the 4 challenges, as described in Use Case 1: Startup, Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card
4. The Red LED light is off (the light is not illuminated) or the challenge the robot is currently in front of has been successfully completed, as described in Use Case 2: Monitor Red LED, Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card
5. Postconditions
6. The robot will be halted at the finish line or in front of one of the 4 challenges, as described in Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card
7. The robot will be touching the white line of the finish line or the painted white line which makes up the box that the challenge resides in
8. Main Success Scenario
9. The robot will follow the white line, as it heads to the finish line or the next challenge
10. The robot will cover the white line at all times on route to its destination
11. The robot will visit and complete each challenge, as described in Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card
12. The robot will, after completion of each challenge(as described in Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card), will navigate to and halt at the finish line
13. The robot will remain halted at the finish line
14. Frequency of Occurrence

This use case will occur five times during each round of the competition. The use case will be used each time the robot must navigate to the next challenge (four challenges in total, described in Use Case 4: Simon Carabiner, Use Case 5: Etch A Sketch, Use Case 6: Rubik’s Cube, and Use Case 7: Playing Card), then once more to navigate to the finish line. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course

1. Use Case 4: Simon Carabiner

Scope: Robot

Level: User goal

Primary Actors: Simon Carabiner

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. **Preconditions**
2. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
3. The robot is directly in front of the Simon Carabiner game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
4. Postconditions
5. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
6. The robot is directly in front of the Simon Carabiner game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
7. **Main Success Scenario**
8. The robot will depress (push) the center button on the game to start Simon Carabiner
9. The robot will wait for the visual and audible pattern emitted from the game
10. The robot will then duplicate this pattern by depressing (pushing) the corresponding buttons on the Simon Carabiner game
11. The robot will then wait for the next visual and audible pattern to be emitted from the game
12. The robot will once again duplicate this pattern by depressing (pushing) the corresponding buttons on the Simon Carabiner game
13. The robot, after 15 seconds had passed since depressing (pushing) the center button to start the game, will then depress (push) the center button on the game to stop Simon Carabiner
14. The robot will then begin navigation, as described in Use Case 3: Navigation
15. **Frequency of Occurrence**

This use case will occur once during each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course.

1. Use Case 5: Etch A Sketch

Scope: Robot

Level: User goal

Primary Actors: Etch A Sketch

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions
2. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
3. The robot is directly in front of the Etch A Sketch game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
4. The Etch A Sketch will be blank (nothing has been drawn on the Etch A Sketch display)
5. Postconditions
6. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
7. The robot is directly in front of the Etch A Sketch game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
8. The Etch A Sketch will display “IEEE” (the letters “IEEE” have been drawn on the Etch A Sketch display)
9. Main Success Scenario
10. The robot will begin to turn the knobs of the Etch A Sketch
11. The robot will continue to turn the knobs in a manner in which the Etch A Sketch will display the letters “IEEE”
12. The robot will then begin navigation, as described in Use Case 3: Navigation
13. Frequency of Occurrence

This use case will occur once during each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course

1. Use Case 6: Rubik’s Cube

Scope: Robot

Level: User goal

Primary Actors: Rubik’s Cube

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions
2. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
3. The robot is directly in front of the Rubik’s Cube game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
4. The Rubik’s Cube will be solved (no rows are turned from its initial, in package, condition)
5. Postconditions
6. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
7. The robot is directly in front of the Rubik’s Cube game, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
8. The Rubik’s Cube will have one row turned 180 degrees (from its initial, in package, condition)
9. Main Success Scenario
10. The robot will begin to turn a row on the Rubik’s Cube
11. The robot will continue to turn the row on the Rubik’s Cube until it has turned 180 degrees
12. The robot will then begin navigation, as described in Use Case 3: Navigation
13. Frequency of Occurrence

This use case will occur once during each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course

1. Use Case 7: Playing Card

Scope: Robot

Level: User goal

Primary Actors: Deck of Playing Cards

1. Stakeholders and Interests

(insert stakeholders that apply to this use case)

1. Preconditions
2. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
3. The robot is directly in front of the deck of playing cards, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
4. The deck of cards will contain 52 cards
   * + 1. Postconditions
5. The robot is on (power to the robot is enabled), as described in Use Case 1: Startup
6. The robot is directly in front of the deck of playing cards, touching the painted white square in which the game resides, as described in Use Case 3: Navigation
7. The robot will have possession of one playing card
8. The deck of cards will contain 51 cards
   * + 1. Main Success Scenario
9. The robot will pick up the playing card
10. The robot will maintain possession of the playing card
11. The robot will then begin navigation, as described in Use Case 3: Navigation
    * + 1. Frequency of Occurrence

This use case will occur once during each round of the competition. Amount of rounds will vary based on amount of participants, successful completion of the course, as well as the time it takes to achieve successful completion of the course

## 2.8 Sequence Diagrams

The following diagrams provide a sequence of actions in order to complete a task. The tasks are broken into 6 components based on the potential states of the robot. Initially, there is the startup state which occurs when the robot receives the start signal, which has yet to be determined by the competition. The following state is an ongoing state having to do with navigation around the course. Thus it is named the navigation state. The last four states have to do with each of the games; a Simon state, Etch A Sketch state, Rubik’s cube state, and a playing card state. All of the states require preconditions and post conditions in order to enter and exit the state. The specific conditions have yet to be determined, but in general the main task of each state must be completed before the robot transitions to the following state (i.e. before the robot can exit the Simon state, it must have completed the task first).

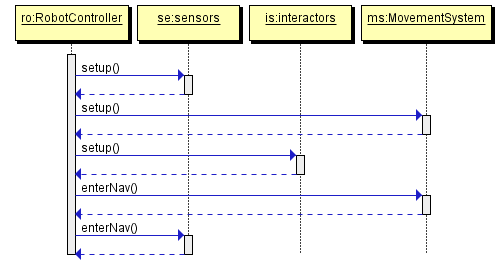


Figure 1—Setup

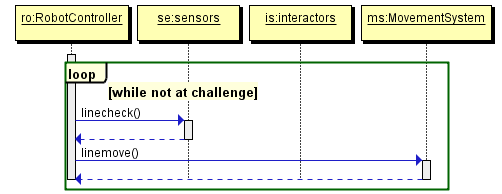


Figure 2—Navigation

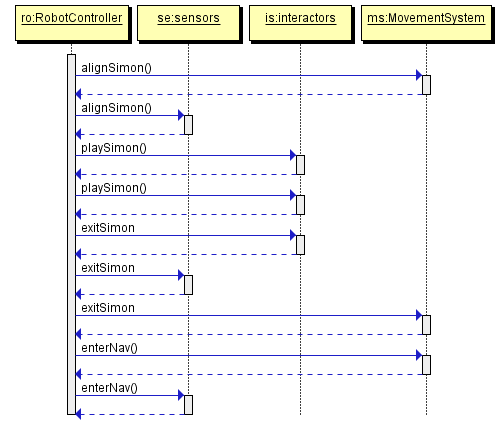


Figure 3—Simon

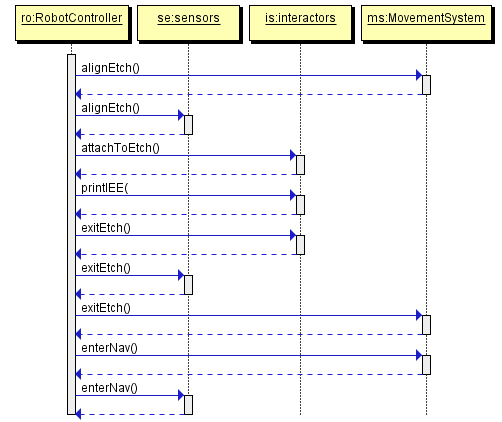


Figure 4—Etch A Sketch

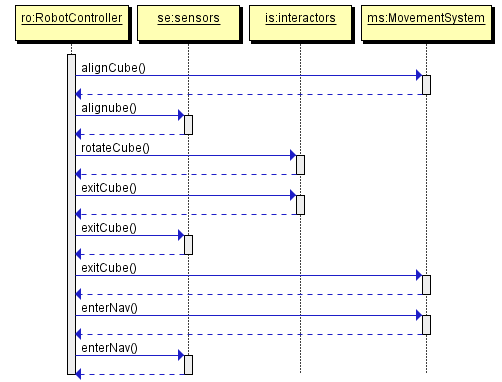


Figure 5-Rubik's Cube

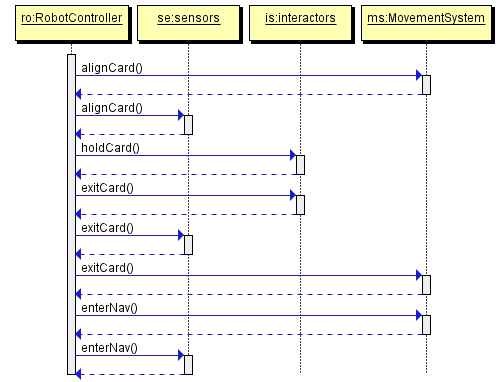


Figure 6—Playing card

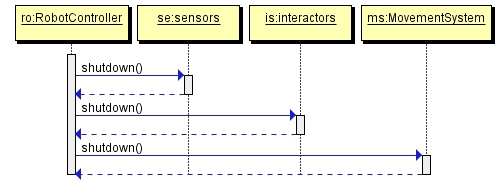


Figure 7-Shutdown

# 3. Requirements

## 3.1 Functional Requirements

* + 1. The robot shall traverse the course.
       1. The robot shall remain on the white line, which marks the path of the course, at all times.
       2. The robot shall move to the next challenge once the current challenge is complete.
       3. The robot shall move to the finish line once all challenges are complete.
       4. The robot shall cross the finish line.
    2. The robot shall complete all four challenges, defined as: Simon, Etch A Sketch, Rubik’s Cube and playing card.
       1. The robot shall complete each challenge once.
       2. The robot shall keep track of progress on a challenge.
       3. The robot shall complete the challenges in a sequential matter.
       4. The robot shall execute the challenges one at a time.
    3. The robot shall complete the Simon challenge.
       1. The robot shall activate the Simon game.
       2. The robot shall obtain a pattern from Simon.
       3. The robot shall press the buttons on Simon in a pattern corresponding to the obtained pattern.
    4. The robot shall complete the Etch A Sketch challenge.
       1. The robot shall print “IEEE” on an Etch A Sketch.
    5. The robot shall complete the Rubik’s Cube challenge.
       1. The robot shall rotate one row of a Rubik’s Cube 180 degrees.
    6. The robot shall complete the playing card challenge.
       1. The robot shall obtain one playing card from a deck of cards.
       2. The robot shall complete the course with the playing card.

## 3.2 Nonfunctional Requirements

1. The robot shall fit within 1 ft3.
2. The robot shall be autonomous.
3. The robot shall remain on the course for 5 minutes.
4. The robot shall interact with Simon for exactly 15 seconds.
5. The robot shall complete the challenges in sequence.
6. The robot shall execute all requirements within 5 minutes.
7. The robot shall press the buttons on Simon before Simon outputs an error tone.
8. The robot shall fulfill the competition safety regulations.
   * + 1. The robot shall contain nonflammable substances.
       2. The robot shall not damage the course.
       3. The robot shall do no harm.
       4. The robot shall shut off in case of emergency.
     1. The robot shall operate with an on-board power supply.

# A. Appendicies

## A.1. Appendix A

The following figures are a supplemental visual aid of the IEEE SoutheastCon 2015 Hardware Competition course and challenge components.

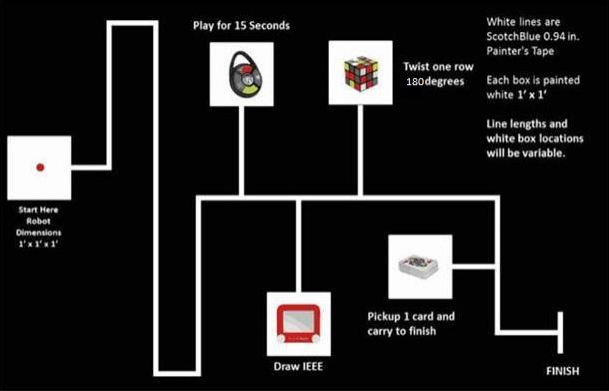
[](#_Table_of_Figures)

Figure 1—Course for IEEE SoutheastCon 2015 Hardware Competition []



Figure 2—Etch A Sketch Error! Reference source not found.



Figure 3—Standard 52-deck of playing cards Error! Reference source not found.



Figure 4—Rubik's 3x3 Cube Error! Reference source not found.



Figure 5—Simon Carabiner [1]

# Glossary

|  |  |  |
| --- | --- | --- |
| **Entry** | **Definition** | **Alias** |
| autonomous |  |  |
| challenge | One of the four tasks- Simon, Etch A Sketch, Rubik’s Cube, or playing card | Task |
| course | 5/8 in. x 4 ft. x 8 ft. Sanded Pine Plywood |  |
| deck of cards | Standard 52-card deck (see Appendix A.1, Figure 3) | Deck |
| emergency |  |  |
| Etch A Sketch | Pocket Etch A Sketch by: Ohio Art (see Appendix A.1, Figure 2) |  |
| finish line | Refer to “FINISH” (see Appendix A.1, Figure 1) | Finish |
| line | Scotch Blue 0.94 in. x 60 yd. Painter’s Tape |  |
| obtain | To have possesion of |  |
| playing card | A card from the standard 52-card deck (see Appendix A.1, Figure 3) | Card |
| print | To draw or produce |  |
| robot | The platform being built for the IEEE SoutheastCon 2015 Hardware Competition. |  |
| Rubik’s Cube | Rubik’s 3x3 Cube (see Appendix A, Figure 4) |  |
| sequence | Simon, Etch A Sketch, Rubik’s Cube, playing card, finish line |  |
| Simon | Simon Carabiner (see Appendix A, Figure 5) |  |
| traverse | To move across |  |
|  |  |  |

# Acronyms & Abbreviations

|  |  |
| --- | --- |
| **Entry** | **Expanded Phrase** |
| ABET | Accredation Board for Engineering and Technology, Inc. |
| ERAU | Embry-Riddle Aeronautical University |
| ECSSE | Electrical, Computer, Software & Systems Engineering |
| IEEE | Institution of Electrical and Electronics Engineers, Inc. |
| SyRS | System Requirements Specifications |
| VPS | Volt & Pepper System |
| VPSDT | Volt & Pepper System Development Team |

# References

1. Booyabazooka. *Rubik's Cube.* March 5, 2008. http://commons.wikimedia.org/wiki/File:Rubik%27s\_cube.svg (accessed September 13, 2014).
2. ERAU. "Student Handbook - Embry-Riddle Aeronautical University." *ERAU - Daytona Beach, FL.* 2014. http://daytonabeach.erau.edu/Assets/daytonabeach/forms/daytonabeach-student-handbook.pdf (accessed September 13, 2014).
3. IEEE. *IEEE Citation Reference.* September 9, 2014. http://www.ieee.org/documents/ieeecitationref.pdf (accessed 2014).
4. IEEE. IEEE Guide for Developing System Requirements Specifications. 1998. New York, NY: IEEE, Decembeer 22, 1998.
5. IEEE. *IEEE Recommended Practice for Software Requirements Specifications.* New York, NY: Institute of Electrical and Electronics Engineers, Inc., 1998.
6. —. *IEEE Region 3.* 2014. http://www.ewh.ieee.org/reg/3/southeastcon/ (accessed 2014).
7. —. "SoutheastCon 2015 Hardware Competition Rules (DRAFT)." *IEEE.* March 19, 2014. http://sites.ieee.org/sb-unfc/files/2014/07/hardwareComp2015.pdf (accessed September 13, 2014).
8. IEEE Standards Association. *2014 IEEE-SA Standards Style Manual.* New York, NY: IEEE, 2014.
9. Ohio Art. *Pocket Etch A Sketch - Red.* Ohio Art. 2014. http://www.toysrus.com/buy/etch-a-sketch-doodle-pro/pocket-etch-a-sketch-red-5163-2395954 (accessed September 13, 2014).
10. Plank Fitness. *Deck of Cards "Anywhere" Workout.* January 3, 2014. http://plankavl.com/wp-content/uploads/2014/01/deck-cards.png (accessed September 13, 2014).
11. The Bridge Direct, Inc. *Simon: Carabiner Edition.* 2012. http://www.thebridgedirect.com/sim\_prd\_carabiner.php (accessed September 13, 2014).