# IEEE SoutheastCon 2023 Hardware Competition

## Hurricane Alley

## *"CAT5 Robots Rebuild the Magic at Duck Gardens"*

Stephen Hopkins, Hardware Competition Chair

Stephen.Hopkins@ieee.org

Regina Hannemann, R3 SAC Hardware Competition Consultant

Thomas Dillen, Lead, Valencia Design Build Team

# Preface – August Release

Welcome to the August 2022 release of the IEEE SoutheastCon 2023 Hardware Competition Rules. This release is the last release prior to the . The phase of the competition rules development includes analysis and testing of the concept to determine the feasibility of the concept, fine-tune details, and determine which are the best design methods that will best help the robot accomplish this challenge. Tommy Dillen led the Valencia IEEE Student Chapter design team to build the board, analyze the concept, and fine-tune the details. Valencia and UCF IEEE design teams are working together to make this build happen and provide you with the lessons learned from the experience. Readers should consider the descriptions, visual components, and dimensions as refined concepts. Since the requirements are being tested, you should not consider these rules to be final. You should not build competition boards or robots based on this release of the rules. You may use this release to start discussions on a very rough budget, conceptual build strategies, and of course input on the rules. Our next release is scheduled for August. The august release will provide refined rules with the goal of a final release by November 2022. I am looking forward to your input on this release.

I encourage you to provide your questions and comments directly to me.

Thank you, Tommy, for your magnificent work on this initial arena build, building a two-Chapter collaboration, and sharing the team's experience.

Welcome to Duck Gardens, the IEEE Orlando Theme Park!


Thank you,

Stephen Hopkins
IEEE SoutheastCon 2023 Hardware and Software Competition Chair
stephen.hopkins@ieee.org

# I. Introduction

Orlando has been hit by a hurricane. The hurricane has left some damage and stranded animals at the IEEE theme park Duck Gardens. IEEE Region 3 is working to fix the damage, save the animals, and re-open the magic of Orlando. There is a lot of work that is time-consuming, and guests are waiting to drive and fly to Orlando. We need autonomous robots that can help animals, clean up debris, and rebuild Orlando. Luckily, IEEE is rolling into town for an annual conference. IEEE Student Teams are bringing their CAT5 Recovery Robots to recover Duck Gardens Orlando. Their robots will have several tasks to pick from to help rebuild the magic. The robots may do them all or as few as they would like to.

# II. Playing Field

## Design Considerations

## Layout

The main course is constructed of a 4' x 8' sheet of plywood with a boundary of 1' x 4' wooden beams on three sides and 2 – 2" x 4" x 4' wooden beams on one end. The entire course is painted black. Figure 1 includes the design of the board. Figure 2 includes a photo of the concept. The board should be sanded before being painted. There will be curved lines forming a path from the start area to each attraction. The path lines shall be 1" in width. The path lines shall be painted white. All practice and competition boards shall have the same line pattern. The inside dimensions are 3 foot 11 and ¼ inches wide and 7 foot 7 and ¼ inches in length with a 3/4" outline on 3 sides and a 4" outline on 1 end.  The diagonal lines are at a 45-degree angle to the side of the board. Create the lines by covering the area with painter's tape side-by-side. After all painter's tape is applied this creates a pattern (stencil). Paint the lines using this stencil. Remove the remaining painter's tape after the paint dries. The arena build team developed templates which can be used to paint the three circles and two crosses. The board design, in DWG, and templates, in PDF, are available online.
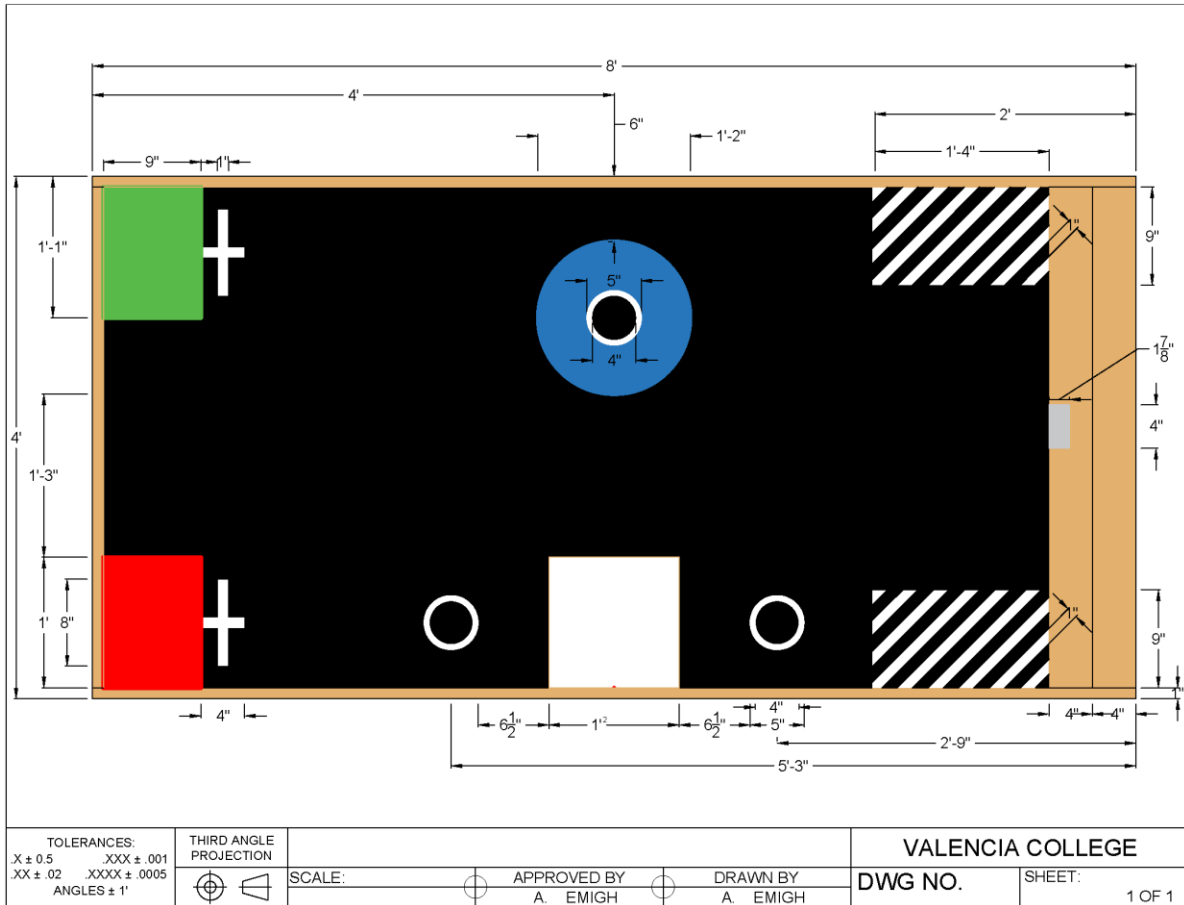
*Figure 1 Board Design*

*Table 1 Board Design Legend*

| Board Component | Description |
|---|---|
| **Duck Gardens Theme Park** | 4' x 8' arena |
| **Green Rectangle** | Manatees Aquarium Attraction |
| **Red Rectangle** | Alligator Aquarium Attraction |
| **Blue Circle** | Duck Pond Attraction |
| **Black and White Circle** | Duck Statue Attraction |
| **Rectangle with Diagonal White Lines** | Recycling Attraction |
| **Light Grey Rectangle** | Switch Box for Fireworks |
| **Dark Grey Rectangle** | Fireworks Display Computer |

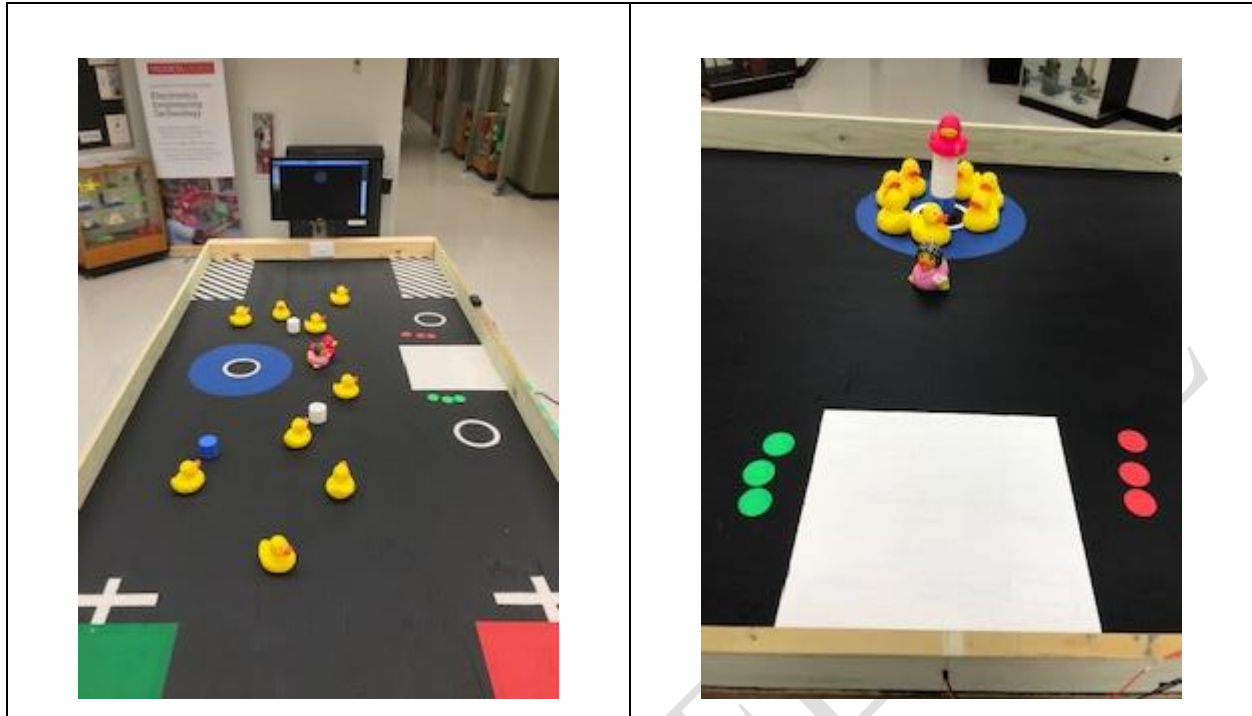*Figure 2 Duck Gardens Concept Photo*

*Figure 3 Duck Gardens First Arena Build*

Arena Tolerance

Note: Please design your robot to consider variations on the measurements of the competition track. We will do our best to ensure that all measurements are within 15% of the published coordinates. Design to adapt!

## III. Objective

Teams will build a robot that operates inside Duck Gardens. Unfortunately, the roads are damaged. Most of the lines on the road are washed away. Luckily, the paths from the entrance to the start area still remain. The hurricane forced the ducks out of the duck pond and knocked over the three duck statues. The ducks and statue pieces are scattered throughout the park. The park includes manatees and alligators. The manatees are safely in their pen but are hungry. The alligators are in their pen next to the manatee pen. The alligators are hungry as well. The robot will navigate the park feeding the manatees, feeding the alligators, moving the ducks back to the pond, rebuilding the statues, and placing the remaining pieces in the recycling bins. In customary theme park tradition, the robot may end their cleanup by starting the daily fireworks! The robot

may do any number of tasks in any order, with exception of the fireworks. The activation of the fireworks defines the end of the round.

## Hurricane Damage, Ducks, and Statues

The ducks, Figure 4, have been blown all over the theme park. None of the ducks are located inside any attraction. There is no rhyme or reason as to how they are laying on the ground. No ducks are within 2" of an outside wall. There are no ducks within 14" of the theme park entrance. This means the robot can move left towards one end or right towards the other end without running into a duck. There are 10 ducks in the theme park. One of the 10 ducks is a pink duck. To accomplish the placement of the ducks, the pit crew will randomly toss the ducks into the arena.



*Figure 4 Duck Gardens Duck*

Ducks measure 3-1/2"L x 3"W x 3"H, are weighted and balanced to float upright, and sealed to block out moisture. The IEEE SoutheastCon 2023 Hardware Competition Committee will provide ducks at the competition for practice and competition.

The statue pedestals, Figure 5, are cylinders. There are seven statue pedestals. Three are white, two are green, and one is red. The three white statue bases are the bottom pedestals for each statue. The two green pedestals are the second level for two of the statues. Those two statues are the ones to the left and right of the robot's starting position. The red statue pedestal is the third level of the statue in the duck pond. There is no rhyme or reason as to how they are laying on the ground. No pedestals are within 2" of an outside wall. There are no pedestals within 14" of the theme park entrance. This means the robot can move left towards one end or right towards the other end without running into a duck.

*Figure 5 Duck Garden Statue Pedestal*
*source: https://www.thingiverse.com/thing:4869571*

The statue pedestals are made with TPU 1.75 mm diameter filament. The 3D Print file is located at https://www.thingiverse.com/thing:4869571 (edited). The only change made was to change to use 10% infill. TPU is not the standard print material. So, some of you may not have that in your maker spaces. It is also a finicky material to print, so make sure to read it up a little bit before you try it for the first time. The IEEE SoutheastCon 2023 Hardware Competition Committee will provide ducks at the competition for practice and competition.

## Duck Garden Attractions

Duck Gardens is a 4' x 8' theme park. The entrance to Duck Gardens is on one 8' side of the park. The entrance is located halfway along the side. The gates are closed during hurricane recovery. The robot will start just inside the entrance on a 12" x 12" square white square painted on the black painted board. The robot must fit in this 12" x 12" square and be no taller than 12". The left end of the park includes the manatee and alligator aquarium attractions. The right end of the park includes the recycling and fireworks attractions. Directly in front of the robot's starting position is the duck pond attraction. There are three duck statue attractions, which are pedestals with a duck on top. One duck statue is located in the center of the pond. The other two duck statues are on the left and right sides of the robot's starting area.

## Duck Statues

There are three duck statue locations at Duck Gardens. Two statue locations are on either side of the robot starting location. The third duck statue location is in the center of the duck pond. Each

duck statue location is a circular area with two rings. The inner ring has a radius of 2" from the center and is painted black. The outer ring has a radius of 2.5" from the center and is painted white. The robot can choose to rebuild the statues. The duck pond has three pedestals. The other two statues have two pedestals. The three duck statues have a duck on top, leaving seven ducks for the duck pond. Each completed statue has a duck on the top of the highest pedestal. The duck pond statue is supposed to have a pink duck on top. Robots placing the pink duck on top of the duck pond statue are awarded more points than placing a non-pink duck. Any duck placed on top of a statue is awarded points. Statues do not have more than one duck on top. The duck pond statue is centered in the duck pond 12" from the wall opposite of the park entrance and 28" from either outside end of the park. The statue placed to the right of the robot's starting area is centered 6" from the park entrance side of Duck Gardens and 33" from the far-right side of Duck Gardens. The statue placed to the left of the robot's starting area is centered 6" from the park entrance side of Duck Gardens and 33" from the far-left side of Duck Gardens. The robot may only stack one statue at a three-pedestal height.

Robots building statues inside the inner ring without the statue touching anything outside the inner ring will receive the most points. Lesser points will apply for statues built entirely within the outer ring. Lesser points will apply for statues built anywhere else.

## Manatee and Alligator Aquariums

The manatee aquarium is a 9" x 12" rectangular area in one corner on the left side of the park. The manatee area is painted green. The alligator aquarium is a 9" x 12" rectangular area in one corner on the left side of the park. The alligator area is painted red. The 12" side of the aquariums runs along the left side of the park. One aquarium is nearest one corner, and the other aquarium is nearest the other corner. Some boards swap the location of the alligators and manatees. The robots must detect where each aquarium is located to correctly feed the manatees and alligators. Your robot will be randomly assigned a particular board configuration for each match. On the interior 12" side of each aquarium is a white cross painted on the arena floor. The white cross is composed of an 8 line and a 4" line. The 8" long line runs parallel along the 12" side of the aquarium and is centered 2" from the edge of the 12" side towards the center of the board. The 4" line is perpendicular to the 8" line and centered a 6" along the 12" side of the aquarium. There will be three green food chips and three red food chips on the board next to the

robots' starting space. The three green food chips are for the manatees. The three red chips are for the alligators. The teams will be allowed to pre-load the food chips in the robot before the match start. The robots will put the food chips in the aquarium(s). Robots will be awarded more points for putting the correct food chips in an aquarium. Any food chip in any aquarium will be awarded points. The robot does not have to feed either aquarium. The robot may feed one aquarium and not the other. The feeding chips are 1.5" in diameter and 1.24" in thickness.

## Duck Pond

We need to clear the park so everyone can get back to the magic at Duck Gardens. Robots will relocate the ducks back to the duck pond. Robots will pick up ducks and place them in the pond. Robots may place 0 to 10 ducks in the pond. If the robot is placing ducks on tops of statues, then a maximum of 7 ducks will be available for the duck pond.

## Recycling Attraction

There are two recycling areas in Duck Gardens. Each recycling area is an 18" x 12" rectangular area in each corner on the right side of the park. The recycling area is painted with diagonal white lines. Points will be given for moving the unused or never used items into either recycle bin. The robot may place any or all food chips, pedestals, and ducks in the recycling area.

## Fireworks Attraction

The right end of the park is where the fireworks is located. A light switch is mounted horizontally on the 2 – 2" x 4" x 4' wooden beams in a metal electrical box. The electrical box is a 1-gang gray metal new work/old work standard electrical box. The box is a 4" x 2" x 1.875" deep and the capacity is 13.0 cubic inches. The electrical box shall be mounted horizontally with off on the right and on the left from the view of the robot. The switch is connected to a small projects board which is designed to activate a video of fireworks on a computer. When finished with all chosen tasks, the robot may, but is not required to, flip the switch, and activate the fireworks attraction. Fireworks will display on the attached computer screen. The fireworks video will run for 5 seconds. The fireworks system is a Raspberry Pi controller programmed in Python and running a MPEG video. Duck Gardens includes a complimentary fireworks video which any robot can use.

Teams are encouraged to make your own fireworks video to play during your matches. Teams must submit their fireworks code and video prior to the competition. No team fireworks will be

accepted after the deadline indicated below. MPEG videos without code will not be accepted. Fireworks code may be in Python or Java and muse run on a Raspberry Pi. The hardware competition team will not debug code. All submitted fireworks videos will be judged and the top three selected for awards. This is a separate award than the hardware judging. Teams are encouraged to demonstrate your school spirit in your videos. Teams are required to submit your fireworks video at least 30 days prior to the competition. Judges will review and approve your video for use in the competition. You will be able to redesign and resubmit videos until the deadline for videos passes. Teams do not need to submit fireworks code and MPEG video. The hardware competition team has a complimentary fireworks code and MPEG video for teams to use.

The fireworks video will be judged on four components. Components are measured on a scale of 1 – 4; 4 being the highest score. Listed below are the criteria for a score of 4 for each component.

- 35% - Content Clarity: Does the video clearly describe the team's vision?
    - The content of the video clearly describes a celebratory nature for a theme park.
- 35% - Creativity: Is the video original and describe a new way of looking at fireworks for Duck Gardens?
    - The content of the video is original and is presented in an original way.
- 20% - Team Spirit: Identifies and presents the team identity.
    - The video clearly identifies the team's university, make-up, or other features which distinguish the video as relating to the team's robot.
- 10% - Production: What is the overall quality of the production (including visual and sound elements.)
    - The video is well planned, with smooth transitions and edits. Sound is excellently balanced and easy to hear. All elements support the message.

## IV. Vehicle

The robot must be completely autonomous and must fit completely within the 12"x12"x12" starting area at the start of each match. The robot body (or bodies) must at all times be wholly contained within the playing surface but may reach a maximum of 1" beyond the outside edge of

any arena walls, and a maximum of 1/2" down the backside of the arena walls. There is no weight restriction on the robot. Aerial or flying robots are not allowed.

## Multiple Robots

The robot may expand beyond the initial size to any size. It may split into multiple independent robots during the competition. It does not need to be tethered. If multiple independent robots are used, they must all start within the same starting space and split after the competition begins. All robots must be secured in an encasing that opens once the start signal has been given. Regardless of number of robots, only one handler is allowed in the competition area during the round. Robots may not communicate with each other after the start of the round.

## Emergency Cut-Off Switch

The robot must have an easily reachable emergency cutoff switch to allow the robot team to disable the robot if necessary (this is to avoid damage to both the robot and the arena in case a sudden stop is required). It is advisable that if the robot splits into multiple independent robots, the single emergency cutoff switch should stop the motion of all the robots, but this is not a requirement. It is recommended that robots automatically stop at the three-minute mark to avoid teams having to manually reach over to stop the robots and accidentally interfering with the stack.

## Start Switch

While multiple switches can exist on the robot for powering up and controlling the various subsystems on the robot, there must be a single, clearly visible, labeled start switch. The start switch must be a physical switch located on the robot. The start switch can be either a pushbutton or a toggle switch. The start switch shall not be on a laptop or other device external to the robot. The start switch will activate the robot and prepare it for a competition run. The robot may position or center itself in the start box at this time. The robot will start the run upon reading a red LED light located on the side wall next to the start area. The LED light is recessed inside the sideboard. A judge will activate the LED light, which the robot will sense and begin the competition. Teams shall specify whether they want to auto-start upon placement of the robot in the pre-staging area. Points will be given to robots that auto-start. The LED is 2 &1/2" from the top of the plywood as seen in Figure 6.
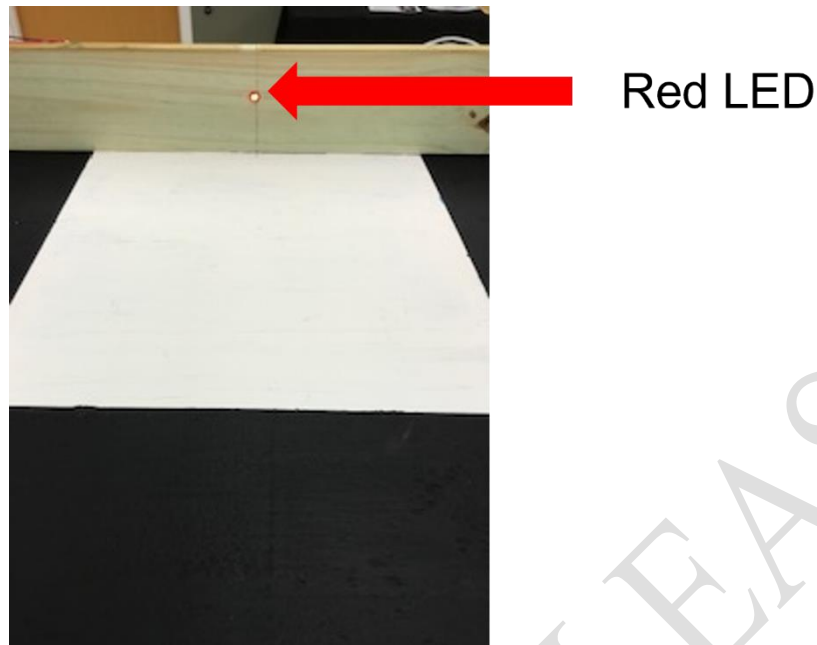
*Figure 6 Auto Start LED Position*

## Sonar and LIDAR

Sonar and LIDAR sensors are allowed on the robot. Teams should be aware that other teams may be using similar sensors, so teams are required to handle any accidental interference from other robots or other noise sources with either shielding or software filtering of false data. However, while it is the team's responsibility to handle accidental interference, any intentional interference by another robot or team will not be tolerated and can result in sanctions.

## Dangerous Chemicals and Gasses

The robot cannot contain any explosive, pyrotechnic, toxic, or corrosive materials. Flammable liquids or gases are also prohibited.

Compressed gas is allowed on the robot as long as the pressure is limited to no more than 30 pounds per square inch at any time. Gases other than air are permitted as long as they do not pose a safety threat if accidentally released.

## General Safety

The robot shall not present any danger to the judges, spectators, playing arena, or area surrounding the arena. If at any time the judges deem the robot is causing or is likely to cause harm, the judge may terminate the match immediately. The judge will have the discretion of

whether any points are awarded for that match and if the robot is allowed to complete in any remaining matches.

### Spirit Flag

It is encouraged that the robot displays a flag on the robot representing the school flag or logo, state, territory, or national flag, but the flag must fit within the initial size constraints of the robot. The flag can be static or can be raised automatically at any time once the match begins. The flag size can be no bigger than 2" x 4" and must fit within the 12" x 12" x 12" size of the robot.

## V. Rules of Play

### Sequestered Area

At the start of each round of matches, the judges will require that all robots be sequestered in a special staging area. Once in the staging area, the robots must remain turned off and cannot be touched by students until they are called for their match to begin. The robots cannot be charging during the sequestration period. All teams are required to place their robot and competition material used with the robot during competition in the sequestered area. The robot and competition material shall remain in the sequestered area from pre-staging until the team is called to the arena to setup for the match. If teams have any equipment of their own, it needs to be presented at the time sequestering begins. This includes all items extraneous to the robot which will be used in the competition area.

### Match Pre-staging

For each match, the judges will call the names of the teams to run in that match. Once called, teams will have two minutes to retrieve their robot from the sequestration area and move it to a pre-match staging area near the arenas. In this area, teams can perform final checks to the robot, make any last-minute adjustments, swap in a new set of batteries, and power it on. Batteries must be installed in the robot at the entry to pre-staging. This time will overlap with the time another set of teams is competing. Once the current set of teams has completed their matches and cleanup, the judge will call the teams from the pre-match staging area to the arena to begin their setup.

## Setting up for a Match

Once teams have been called from the pre-match staging area to the match, they will have an additional two minutes to get their robots and their arenas ready for the match. There is no limit on the number of students allowed in the arena area during setup as long as they can do so without disturbing other nearby arenas. The teams shall not start the robot during the setup.

## Conducting the Match

Once the team is ready, all team members but the one designated to initiate the robot start must step away from the arena. That team member then indicates the readiness of the robot to the judge, backs away from the arena, and the judge begins the match countdown. Once the countdown is complete, the judge will activate the LED light underneath the robot. The robot will start its run based on the activation of the LED light. If the team is not using the LED light activation, the start switch will be actuated by the robot team once the judge indicates the start of the match.

Laptops and all other electronic devices other than the robot are not allowed in the competition area. Any interaction with the robot (remote control, additional buttons, touching or adjusting of the robot, etc.) during this time will lead to disqualification.

## Order of Challenge Completion

The robot may complete the challenges in any order. The robot may complete any of the challenges and may skip any of the challenges. The one exception is the fireworks challenge. Once the robot activates the fireworks switch, the round ends.

# VI. Competition Format

Each match will last for a maximum of three minutes. The robot team can stop their robot at any time before the three-minute period and signal to the judge that they are finished with their match. The judge may stop the match at any time if the robot is acting in a manner that may cause injury to anyone nearby or damage to the arena or itself. If the judge does force a stop in a match, it is the judge's discretion whether the points in that match are counted and if the robot is allowed to run in the next match. Each team will be allowed three matches. After the preliminary rounds, the top eight teams will advance to a single-elimination bracket. The teams will be

seeded based on their placing in the preliminary rounds. The top two teams will advance to the final round. The final round will be held at the awards banquet.

## VII. Scoring

Points will be awarded for performing certain tasks during the competition.

| Points | Task |
|--------|------|
| 36 | Three pedestals stacked on the duck pond statue location inside the inner circle and in the correct order (base level – white, second level – green, third level – red) with a pink duck on top |
| 33 | Three pedestals stacked on the duck pond statue location inside the inner circle and in the correct order (base level – white, second level – green, third level – red) with a yellow duck on top |
| 30 | Three pedestals stacked on the duck pond statue location inside the inner circle and in any order with a pink duck on top |
| 27 | Three pedestals stacked on the duck pond statue location inside the inner circle and in any order with a yellow duck on top |
| 27 | Three pedestals stacked on the duck pond statue location inside the inner circle and in the correct order (base level – white, second level – green, third level – red) |
| 24 | Three pedestals stacked on the duck pond statue location inside the inner circle and in any order |
| 24 | Three pedestals stacked on the duck pond statue location inside the outer circle and in the correct order (base level – white, second level – green, third level – red) with a pink duck on top |
| 21 | Three pedestals stacked on the duck pond statue location inside the outer circle and in the correct order (base level – white, second level – green, third level – red) with a yellow duck on top |
| 18 | Three pedestals stacked on the duck pond statue location inside the outer circle and in any order |

| 18 | Three pedestals stacked on the duck pond statue location anywhere in the park and in the correct order (base level – white, second level – green, third level – red) with a pink duck on top |
|---|---|
| 15 | Three pedestals stacked on the duck pond statue location anywhere in the park and in the correct order (base level – white, second level – green, third level – red) with a yellow duck on top |
| 12 | Three pedestals stacked on the duck pond statue location anywhere in the park and in any order |
| 30 | Two pedestals stacked on a non-pond statue location inside the inner circle and in the correct order (base level – white, second level – green) with a pink duck on top |
| 27 | Two pedestals stacked on a non-pond statue location inside the inner circle and in the correct order (base level – white, second level – green) with a yellow duck on top |
| 24 | Two pedestals stacked on a non-pond statue location inside the inner circle and in any order with a pink duck on top |
| 21 | Two pedestals stacked on a non-pond statue location inside the inner circle and in any order with a yellow duck on top |
| 21 | Two pedestals stacked on a non-pond statue location inside the inner circle and in the correct order (base level – white, second level – green) |
| 18 | Two pedestals stacked on a non-pond statue location inside the inner circle and in any order |
| 18 | Two pedestals stacked on a non-pond statue location inside the outer circle and in the correct order (base level – white, second level – green) with a pink duck on top |
| 15 | Two pedestals stacked on a non-pond statue location inside the outer circle and in the correct order (base level – white, second level – green,) with a yellow duck on top |
| 12 | Two pedestals stacked on a non-pond statue location inside the outer circle and in any order |
| 12 | Two pedestals stacked on a non-pond statue location anywhere in the park and in the correct order (base level – white, second level – green) with a pink duck on top |
| 9 | Two pedestals stacked on a non-pond statue location anywhere in the park and in the correct order (base level – white, second level – green) with a yellow duck on top |

| 6 | Two pedestals stacked on a non-pond statue location anywhere in the park and in any order |
|---|---|
| 2 | Placing a duck, food chip, or pedestal in the recycling attraction |
| 7 | Each correct food chip fed to the manatees |
| 7 | Each correct food chip fed to the alligators |
| 3 | Each incorrect food chip fed to the manatees |
| 3 | Each incorrect food chip fed to the alligators |
| 5 | Each duck in the pond |
| 3 | Each duck, chip, or pedestal in a recycling area |
| 10 | Start the fireworks |
| 10 | Auto-start feature used and successful |

## VIII. Tiebreakers

In the event of a tie, the team with the lowest total time will advance. The match is limited to three minutes. If the robot completes the tasks or is stopped prior to three minutes, at the time of stop will be recorded. If multiple teams have the same number of points the total time for all matches in a round will be calculated. The team with the lowest (fastest) time shall be declared the winner and will advance to the next round.

## IX. Team Participants

There is no limit on team size for the participating team, but each team member should be a member of the same institution's student branch, and they must all be IEEE Region 3 student members. Only one team per institution's student branch is allowed in the main competition, referred to as Main category. This team is referred to as the Main Team. Each section may have only one Main Team. Teams that do not fit this qualification (additional teams in the student branch beyond the one allowed in main competition, teams including students from other regions, hobby groups, or non-students, or the robots are not associated with the institution student branch) may compete in the Open category, but all team members must be IEEE members. Each section may have zero or more Open Teams.

## XI. Design, Analysis, and Testing of the Competition Rules

The IEEE SoutheastCon 2023 Hardware Competition Chair is the lead for the design, development, testing, and analysis of the arena, robot requirements, and the competition rules. The Valencia College hardware team is the local branch for the Orlando hardware competition The local branch is part of the team for building, testing, the arena prior to the competition. The local branch will support operations of the competition during the competition.

## XI. Clarification and Design Questions

Competition teams may contact the IEEE SoutheastCon 2023 Hardware Competition Chair through direct email and the competition Discord site. The IEEE SoutheastCon 2023 Hardware Competition Chair will post responses to questions and comments in the IEEE SoutheastCon 2023 Google Docs site. Answers will be in the form of two categories, clarification, and contest design. Clarifications relating to contest design will be posted to the Google Docs site. Questions relating to contest design will be submitted to the design review, testing, and analysis. Contest design changes will be communicated via official rules updates.

## XII. Communications

Hardware competition communications will be through the IEEE SoutheastCon 2023 website, the IEEE SoutheastCon 2023 Discord site, and the IEEE SoutheastCon 2023 Google Docs site. The website includes official releases and notifications and links to the Discord and Google Docs sites. The Discord site provides an open channel for questions, comments, and discussion. The Google Docs site provides a repository of rules, design, and development information. Information on the website and Google Docs is authoritative. The website is authoritative if the information between the website and Google Docs differs.

## XIII. Schedule

The dates below are the best estimates of the milestones leading up to the competition. The plan is to meet or exceed those dates, but if any delay occurs, it will be reported through the communication channels discussed above.

| Date | Milestone |
|------|-----------|
| **March 30, 2022** | Presentation / Draft to R3 SAC |
| **April 3, 2022** | Presentation / Draft to SEC Community, Discord opens for teams to join |
| **April 17, 2022** | Google Docs opens for teams to access |
| **June 15, 2022** | Competition team initial rules input deadline |
| **July 1, 2022** | An updated release of rules and software |
| **August 15, 2022** | The first official release of arena and arena electronics |
| **October 1, 2022** | Frozen rules released for review Post lessons learned to the Google Docs site |
| **October 15, 2022** | Competition team deadline for frozen rules review inputs |
| **November 1, 2022** | Rules frozen FAQ started |
| **March 11, 2023** | Deadline to submit fireworks videos for review and approval |
| **April 8, 2023** | Deadline for teams to register for hardware competition (Please register for the conference earlier!) |

## Revisions

| Revision | Date | Notes |
|----------|------|-------|
| 1.1 | 3/31/22 | Refinement based on simulated board design |
| 1.2 | 4/2/22 | Refinement based on SEC 22 Hardware Competition Lessons Learned |
| 1.3 | 4/2/22 | Refinement based on SEC 23 Conference Team review |
| 1.4 | 4/3/22 | Typographical and grammatical updates from concept brief |
| 1.5 | 6/30/22 | Updated preface of the document to describe July release. Incorporated Change Log |
| 1.6 | 8/28/22 | Added clarifications to requirements Added appendices with information to other competition related documents. |

## FAQ

1. What TPU is IEEE Student Programs using to print the pedestals?
    a. The SoutheastCon 2023 Hardware Competition is printing the pedestals.
    b. We are using SainMart TPU (https://www.sainsmart.com/). Some links to purchase on Amazon are included below for reference.
    c. White: Amazon.com: SainSmart - TPU-WHT-0.25KG1.75 SAINSMART 1.75mm 250g Flexible TPU 3D Printing Filament, Dimensional Accuracy +/- 0.05 mm (White) : Industrial & Scientific
    d. Green: Amazon.com: SainSmart - TPU-GRN-0.25KG1.75 SAINSMART 1.75mm 250g Flexible TPU 3D Printing Filament, Dimensional Accuracy +/- 0.05 mm (Green) : Industrial & Scientific
    e. Red: Amazon.com: SainSmart - TPU-RED-0.25KG1.75 SAINSMART 1.75mm 250g Flexible TPU 3D Printing Filament, Dimensional Accuracy +/- 0.05 mm (Red) : Industrial & Scientific

## Change Log

### Changes for the August Release v1.6.

The ID column corresponds to the ID number assigned in the IEEE SoutheastCon 2023 Hardware Competition Inputs document. Not all IDs submitted for review were implemented in this rules document. Please see the Inputs document for a complete list of all inputs.

| ID | Discussion | Change |
|---|---|---|
| 1001 | Arena and arena electronics shipping estimate longer than expected. The design is complete. The team is ready to implement. | Slipped the first official release of arena and arena electronics to end of August to allow for the use of production parts. |
| 1002 | Arena build complete. Need to add findings and updates. | Updated arena specifications and pictures (II. Playing Field | Design Considerations | Layout) |
| 1003 | Region 3 requested "Please design your robot to consider variations on the measurements of the competition track. We will do our best to ensure that all measurements are within 15% of the published coordinates. Design to adapt!" | Added Expected Tolerances section (II. Playing Field | Design Considerations | Arena Tolerance) |

| ID | Discussion | Change |
|---|---|---|
| 1004 | Printing details are not germane to requirements as the competition committee will provide the pedestals. | Moved pedestal printing success notes from (III. Objective \| Duck Garden Attractions \| Duck Statues) to (Appendices \|\| Successful Pedestal Printing Notes) |
| 1005 | Arena fireworks design complete. Need to add findings and updates. | Clarified Fireworks Raspberry Pi/MPEG design (III. Objective \| Duck Garden Attractions \| Fireworks Attractions} |
| 1006 | Confusing how multiple robots start and compete. | Clarified Multiple Robots requirements (IV. Vehicle \| Multiple Robots) |
| 1007 | Arena design build lessons learned indicate LED better on side than bottom. | Moved the LED start light to the sideboard next to the start area (IV. Vehicle \| Start Switch} |
| 1008 | There should be no changes of robot from sequester to competition. | Removed the option to have fully charged batteries available for swapping at final checks. (V. Rules of Play \| Match Pre-staging) |
| 1009 | Robots are autonomous. There should be no remote control. | Removed remote control requirements. The robots should be autonomous. (V. Rules of Play \| Setting up for a Mach) |
| 1010 | Since there are two ways to start depending on the use of auto-start LED, clarification could be added. | Clarified robots may start by judge-initiated LED or student activating the manual switch. (V. Rules of Play \| Conducting the Match) |
| 1011 | Only the robot should be in the competition area. | Clarified that laptops and other electronic devices are not allowed in the competition area during a round (V. Rules of Play \| Conducting the Match) |
| 1012 | Switches heading is used for order of challenges. | Changed heading from (V. Rules of Play \| Switches) to (V. Rules of Play \| Order of Challenge Completion) |
| 1013 | Fireworks may be started at any time, but that event ends the round. | Clarified the activation of the fireworks is and end of round action. (V. Rules of Play \| Order of Challenge Completion) |
| 1014 | Auto-start feature seems overweighted in scoring. | Reduced points for Auto-start feature from 25 to 10 (VII. Scoring) |
| 1015 | Now that the design build is complete, it may be confusing to have the first build in the rules document. | Removed First Design Build Report to a separate document and included a reference to that document in the |

| ID | Discussion | Change |
|---|---|---|
| | | appendices (Appendices \| First Design Build Report) |
| 1016 | The design build team developed painting templates, build presentation, and design CAD drawings. | Added available documents list to appendices. |

## Changes for the July Release v1.5.

The ID column corresponds to the ID number assigned in the IEEE SoutheastCon 2023 Hardware Competition Inputs document. Not all IDs submitted for review were implemented in this rules document. Please see the Inputs document for a complete list of all inputs.

| ID | Discussion | Change |
|---|---|---|
| 0003 | Painting a line from the start area to each attraction will provide a line to follow. The theme of the event is recovering from a hurricane. Although missing lines would be consistent, the existing challenges are sufficient and reasonable for the competition. A curve line or straight line provides the same function. A curve line is more representative of an animal park. | Added specifications to Playing Field section<br><br>Added clarification to Objective section |
| 0005 | The design team is updated the specification of the 4' x 8' board as part of the build. Those updates will be added as each iteration of the board builds is complete. | Added dimensions to Playing Field section |
| 0006 | Considering this is an IEEE competition, woodworking may not be a common skill of team members. Adding a section on "Recommended Sanding Practices" is reasonable. | Added dimensions to Playing Field section Added Recommended Sanding Practices to Appendices |
| 0007 | We expect representative batteries installed in the robot when it reaches pre-staging. It is understandable a team may want to charge batteries until the last opportunity. This section should clarify batteries must be installed in the robot at the entry to pre-staging. Identical batteries may be swapped out at final checks to allow for fully charged batteries. | Added clarification to Match Pre-Staging section |
| 0018 | Clarifying that each institution may have one main team and zero or more open teams | Added clarification to Team Participants section |
| 0019 | Use change log | Added to Change Log section |
| 0020 | Add change log | Added to Change Log section |

| ID | Discussion | Change |
|---|---|---|
| 0022 | Rules added to allow teams to specify whether they want to auto-start upon placement of the robot in the pre-staging area. Points will be given to robots that auto-start. | Added to Start Switch section |
| 0024 | Plan for IEEE SoutheastCon 2023 Hardware Competition to purchase and provide the practice and competition ducks, chips, and pedestals. Remove purchase links from rules. Insert sizes in rules | Updated Hurricane Damage, Ducks, and Statues section<br><br>Updated Manatee and Alligator Aquariums section |
| 0026 | Section III. Fireworks Attraction<br>: "Duck Gardens will provide the project board(s) at the competition."<br>To: "Duck Gardens will provide the practice and competition project board(s) at the competition. " | Updated Fireworks section |
| 0027 | Section III. Fireworks Attraction<br>Develop and include a rubric for the fireworks judging | Updated Fireworks section |
| 0029 | Section IV<br>Remove "The robot will not start a competition run."<br>Redundant. | Removed from the Start Switch Section |
| 0030 | Clarification of the start of the sequestration is included in the rules. Emphasis is added. | Updated Sequestered Area section |
| 0031 | Clarification of the use of remote-control programs included in the rules. | Updated Setting up for a Match section |
| 0032 | Emphasize the tiebreaker rule. | Updated Tiebreakers section |
| 0033 | If teams have any equipment of their own, it needs to be presented at the time sequestering begins. This includes items such as ducks, chips, etc. This includes all items extraneous to the robot which will be used in the competition area. | Updated Sequestered Area section |
| 0036 | Plan for IEEE SoutheastCon 2023 Hardware Competition to purchase and provide the practice and competition ducks, chips, and pedestals. Remove purchase links from rules. Insert sizes in rules. | Updated Hurricane Damage, Ducks, and Statues section |
| 0037 | Plan for IEEE SoutheastCon 2023 Hardware Competition to purchase and provide the practice and competition ducks, chips, and pedestals. Remove purchase links from rules. Insert sizes in rules. | Updated Hurricane Damage, Ducks, and Statues section |
| 0038 | Recommend the brand of TPU | Updated FAQ section |
| 0039 | Add "The electrical box shall be mounted horizontally with off on the right and on the left from the view of the robot." | Updated Fireworks section |
| 0040 | Add "The diagonal lines are at a 45-degree angle to the side of the board. Create the lines by covering the area with painter's | Updated the Playing Field section |

| ID | Discussion | Change |
|---|---|---|
| | tape side-by-side. After all painter's tape is applied this creates a pattern (stencil). Paint the lines using this stencil. Remove the remaining painter's tape after the paint dries." | |
| 0042 | Change to 14" in diameter | Updated Playing Field section |
| 0045 | We have design report for the first arena build. We will include that on the website and refer to it in the FAQ. | Updated FAQ |

# Appendices

## Recommended Sanding Practices

Step 1

Wipe away any dirt or dust from the plywood before you begin sanding.

Step 2

Use 180-grit sandpaper to sand the plywood. Stroke the sandpaper over the plywood in the direction of the grain 3 to 4 times. Further sanding can create too many grooves in the surface and cause the layers to peel up from the ends of the plywood. This grit addresses any imperfections in the wood.

Step 3

Sand the plywood with 200-grit sandpaper. Follow the grain for 3 to 4 strokes along the surface. This finer grit smooths away the lines the 180-grit paper creates when grinding away the imperfections.

Step 4

Rub the plywood with 220-grit sandpaper making two passes over the surface. This grit gives the plywood an extra smooth finish as the final sanding before applying stain or finish.

Step 5

Wipe the plywood clean of sandpaper dust with a clean cloth.

## Successful Pedestal Printing Notes

The following details the settings from a successful print with a Prusa MK3+ using the setting Saintsmart TPU material. ALL speeds set to 20mm/s. Retraction is set to 0. Load the filament with Flex setting of the Prusa. Finally, the gears pulling in the filament must be on the loosest setting you can have without the screw falling out. The main issue is to prevent the extruded from clogging. If your print has a bubbly texture on the top, add more top layers and cover the printer with a cardboard box during printing. Printing one pedestal takes a little over 4 hours. The statue pedestal is 45 mm high and 49 mm in diameter.

## Other Reference Documents

The Hardware Competition Committee and Valencia College Student Section developed several documents which provide informative material supporting the Arena Design Build. This section enumerates those documents. The documents are available online at the IEEE Southeast Con 2023 website or IEEE Southeast Con 2023 Hardware Competition Google Docs site.

### IEEE SoutheastCon 2023 Hardware Competition Arena Build

A PowerPoint presentation which details the build of the arena. This PPTX formatted document includes details on the paint color scheme, painting the arena, arena build issues tips & tricks, materials list, fireworks display design, switch design, and LED start light design.

### Arena AutoCAD Drawing

A drawing of the arena in AutoCAD format details the specifications of the arena board.

### Painting Templates

Printable painting templates can be used to aid in painting the arena board. Teams can print the PDF formatted 1:1 sized template, cut out, and use the templates for painting.

### First Design Build Report

The Valencia College Student Section led by Thomas Dillen completed a first design build of the arena. This was a great learning experience which improved the competition and laid the foundation for information which will help competition teams.