



2018-2019

# The 10<sup>th</sup> Robot Design Contest

Rule Book

**VERSION 3 // 21 NOV 2018**

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## Preface

The HKUST Robotics Team participates in various robotics competitions every year, including The MATE Remotely Underwater Operated Vehicle (ROV) Competition, ABU Asia-Pacific Robot Contest (Robocon), and The NXP Cup Intelligent Car Racing (Smart Car).

This Robot Design Contest is held for the newcomers on the Robotics Team. It aims to let participants get familiar with designing and constructing robots and experience the robotics competition environment. The contest is designed with elements from the three above competitions.

The style of this rule book closely follows that used in the Robocon competition, the poster production portion follows that in ROV competition, and the Smart Car control comes from the NXP Cup.

# Overview

## Theme

This game is inspired by "Curling". Curling is a sports activity where one pushes game pieces called "Stones" to a set of circles on the ground called "House". Landing the Stones on the different layers of the circles can earn one different number of points.

The game played this time is with a twist. The game is carried out with a **Thrower Robot** and a **Smart Car**. Soft spongy balls called "Shuttlecocks" act as stones. Two teams are against each other on the same field. The Thrower Robot may play the "Normal Shuttlecocks" on the field, as well as "Special Shuttlecocks". The supply of "Special Shuttlecocks" is unlocked by completing the Smart Car routine. The House is in the center of the field and is shared between the two teams. Shuttlecocks are counted at the end of the game, and a team can knock Shuttlecocks from the other team off the House. The team may trigger an end game with one of their Special Shuttlecocks as well as Normal Shuttlecocks set on the House. They then win after the mentioned Shuttlecocks remain on the House for 3 seconds.

## Safety

Safety is the top priority of the competition. During the construction of the robot, participants are required to keep aware of safety.

## Terms and Definitions

Terms	Definitions
Thrower Robot	The robot that throws the Shuttlecocks to the House.
Smart Car	The small quad-wheel car robot that moves autonomously.
Shuttlecock	Soft spongy balls that the Thrower Robot throws. There are 2 types of Shuttlecocks: <ul style="list-style-type: none"> <li>• Normal Shuttlecocks (75±5g)</li> <li>• Special Shuttlecocks (95±5g)</li> </ul>
House	The circular target area in the center of the field that is shared by both teams. The House has 2 tiers. The House is elevated off the ground at 160±10mm.  The circle is red, and the ring is white.
Track	The white path with black edges the smart car runs on. A magnetic line is placed along the Track through the curvy portions of the fork roads and forms a circuit creating an alternating magnetic field.
Smart Car Starting Zone (SC1)	The area where the Smart Car start.
Smart Car Halt Zone (SC2)	The area where the Smart Car stop.
Checkpoint Line	A black tape line across the Track.
Violation Strip	The area where the Smart Car is not allowed to enter.
Road Block	A white foam wall that is placed behind SC1 that is 2cm tall.
Starting Zone (SZ)	The area to start the Thrower Robot.
Loading Zone 1 (LZ1)	The area to load the Thrower Robot with Normal Shuttlecocks.
Loading Zone 2 (LZ2)	The area to load the Thrower Robot with Special Shuttlecocks.
Throwing Zone (TZ)	The area where the Thrower Robot throws the Shuttlecocks.
No Contact Area	The square area on the game field surrounding the House. No robots are allowed to enter this area during manual control mode.
Rack	Rack for holding any number of Shuttlecocks designed by the team.  Teams can make as many racks as they wish.  All Racks must fit within LZ1.

	<p>No source of power e.g. compressed air, battery. The Rack must not contain any circuitry.</p> <p>The Thrower Robot may only carry at most 1 Rack at a time.</p>
Auto Mode Time	<p>This is the first 1 minute and 30 seconds of the game. The Thrower Robot must act on its own without any control from the team members whether wired or wireless.</p>
Manual Mode Time	<p>This is the time after the first 1 minute and 30 seconds of the game. The Thrower Robot may be controlled manually via a wireless connection in this latter portion of the game.</p>
Controller	<p>The wireless controller that controls the Thrower Robot during Manual Mode. It can be e.g. a laptop, a phone, a game controller, etc.</p>
Track Island	<p>The area between the curvy portion and straight portion of the Track. Can be used to place the Controller.</p>

# 1. Contest Outline

- 1.1. A game between 2 teams takes place within 3 minutes and 30 seconds. Each team has 2 robots:
  - 1.1.1. 1 Thrower Robot and
  - 1.1.2. 1 Smart Car
- 1.2. The game field consists of the following zones: Smart Car Starting Zone (SC1), Smart Car Halt Zone (SC2), Starting Zone (SZ), Loading Zone 1 (LZ1), Loading Zone 2 (LZ2), and Throwing Zone (TZ). Each team has exactly half of the game field divided along the center parallel to the short edge.
- 1.3. The Smart Car Track surrounds the game field where the Thrower Robot can move.
- 1.4. The House is placed in the center of the game field.
- 1.5. Before the game starts, 7 Normal Shuttlecocks and 3 Special Shuttlecocks are placed outside the game field along the Track.
- 1.6. When the game starts, the following 2 flows proceeds in parallel:
  - 1.6.1. **Part 1A:** Thrower Robot throws Normal Shuttlecocks
  - 1.6.2. The Thrower Robot moves to LZ1 to collect Normal Shuttlecock(s), then proceeds to TZ to attempt to throw the Shuttlecock(s) onto the House.
  - 1.6.3. The Thrower Robot **MUST** be automatic during Auto Mode Time and may switch to manual control afterward.
  - 1.6.4. **Part 1B:** Smart Car unlocks Special Shuttlecocks
  - 1.6.5. The Smart Car starts at SC1 then moves along the Track and stops at SC2 to unlock the Special Shuttlecock supply.
- 1.7. Then the game proceeds to the second section, and the following 2 flows proceed in parallel:
  - 1.7.1. **Part 2A:** Thrower Robot throws Normal and Special Shuttlecocks
  - 1.7.2. The Thrower Robot may continue to throw Normal Shuttlecocks, or Special Shuttlecocks to unlock end game requirement.
  - 1.7.3. **Part 2B:** Smart Car re-run the Track to gain points.
- 1.8. When a team has at least a Normal Shuttlecock and a Special Shuttlecock staying within the House, then a 3-second countdown will start. If said Shuttlecocks still remain on the House, then the team gains victory and the game ends.

## 2. Game Procedure

### 2.1. Setup

- 2.1.1. Before the game, there is 1 minute for both teams to set up and prepare for the game. The teams are to place the Thrower Robot and the Smart Car in the SZ and SC1 respectively before the game starts. The team may also place the Racks (if any) and any number of Shuttlecocks in the Loading Zones. The vertical projection of the Racks must completely stay within said zones.
- 2.1.2. The Controller is placed either on the Thrower Robot or in the Track Island on the side of their team. The Controller may be protected to avoid being damaged.
- 2.1.3. Up to 3 team members are allowed to be the game field members and partake in the game field set up.
- 2.1.4. The setup time starts with the signal given by the referee and ends in 1 minute.
- 2.1.5. If the team fails to completely set up within the given time, they may ask for a retry after the game starts to resume setting up.

### 2.2. Start of the game

- 2.2.1. The start of the game is signaled by the referee.
- 2.2.2. If the team completes their setup after the start of the game, they may commence after receiving permission from the referee.

### 2.3. Game field members during the game

- 2.3.1. Game field members are prohibited from entering the game field without permission from the referee.
- 2.3.2. Other team members are strictly prohibited from stepping onto the stage where the game field resides or touching the robots.
- 2.3.3. Game field members are not allowed to touch the robots without permission from the referee.

### 2.4. Loading the Normal Shuttlecocks and Special Shuttlecocks by the Thrower Robot

- 2.4.1. The Thrower Robot moves towards LZ1 or LZ2. To load from LZ2, the team must first unlock LZ2 by completing the Smart Car routine.



- 2.4.2. The Thrower Robot proceeds to grab a Rack with Normal Shuttlecock(s) or only 1 Special Shuttlecock off the ground from the LZ1 and LZ2 respectively. The definition of grabbing here means that the core of the Shuttlecock(s) does not touch the ground, but the fringes and the string can, and the Rack does not touch the ground, and their vertical projections completely leave the loading zones.
- 2.4.3. The Thrower Robot may then proceed to TZ to throw the Shuttlecock(s).
- 2.4.4. The Thrower Robot may only carry 1 Special Shuttlecock at any given time.
- 2.4.5. To convey a Shuttlecock on the Thrower Robot from its grabber mechanism or Rack to the throwing mechanism, i.e. to load, the Thrower Robot may do so automatically on its own or manually by a game field member when the Thrower Robot completely enters the TZ, meaning the vertical projection of the robot must stay within TZ.
- 2.4.6. To do so manually, the robot must then release the Shuttlecock or Rack inside TZ, then a game field member must request for permission from the referee to enter the game field and load the Shuttlecock. The game field member must not touch any part of the robot during this process.
- 2.5. Throwing the Shuttlecock by the Thrower Robot
  - 2.5.1. The Thrower Robot can only throw 1 Shuttlecock at a time.
  - 2.5.2. The Thrower Robot may hold onto any portion of the Shuttlecock. During throwing, the vertical projection of the entire robot must not leave the area of TZ and does not fall onto the border lines of TZ.
  - 2.5.3. Shuttlecocks within the team's field of the Thrower Robot may be reused. Game field members may ask for a retry to retrieve the team's Shuttlecocks and reload them at their assigned LZ(s) and remove the opponent's Shuttlecocks from the game if they are in the team's side of the game field.
- 2.6. Smart Car routine
  - 2.6.1. The Smart Car is placed manually in SC1.
  - 2.6.2. The motors of the Smart Car must remain still when handled by a game field member before starting and may only start spinning a second after the member releases the car. The car must not be pushed to start, or by any other means that involves touching the car during or after the motors start spinning.

- 2.6.3. The entire routine must be done automatically after the member triggers the car to start.
- 2.6.4. The Smart Car may choose one between two track segments for the run: a straight path or a curvy path.
- 2.6.5. The Smart Car is allowed to have only 1 wheel off the white Track base piece during the routine.
- 2.6.6. The Smart Car is required to stop within the cross-road section of the Track (SC2) completely still, meaning all wheels of the car must touch within the area. Stopping near this area or driving into the violation strip counts as a violation.
- 2.6.7. Scores are awarded if the Smart Car passes through the checkpoint line for the first time in that trial routine. However, if the Smart Car first violates then passes through the line, it is counted as not passing through the checkpoint.
- 2.6.8. After the Smart Car completes the routine, game field members can decide whether to attempt the routine again to earn more points. They can either:
  - a. Ask the referee for a retry to move the car back to SC1; or
  - b. Attempt a backward maneuver on the Smart Car to earn bonus points.
- 2.6.9. The backward portion of the routine requires the Smart Car to move backward from SC2 to SC1. The car must use what was the tail of the car during the normal portion of the routine as the head. Game field members may manually change the mode on the car at SC2 to perform this routine without changing the program. If a new program is required at this point, the team will forfeit this round and may only do the backward portion after the next normal portion.

## 2.7. Changing to Manual Mode

- 2.7.1. After Auto Mode Time, the first 1 minute and 30 seconds, the game switches to Manual Mode Time. During this time, the Thrower Robot may be switched to manual control.
- 2.7.2. To switch to manual control, a game field member shall retrieve their Controller by asking for permission by the referee if the controller is in the Track Island and ask for a retry if on the Thrower Robot. They may then initiate manual control immediately.

## 2.8. Score

The score is calculated as follows. Points for the Thrower Robot and the smart car are awarded immediately, with the Shuttlecock points be tallied up after the game ends.

### 2.8.1. Thrower Robot

- 1 successful grabbing of 1 Special Shuttlecock or Rack **1 point**
- 1 successful transport of 1 Special Shuttlecock or Rack **2 points**
- 1 successful landing of 1 Shuttlecock **5 points**
- 1 continuous grabbing and transporting the Shuttlecock(s) to TZ during Auto Mode Time (awarded to team's first demonstration only) **20 points**
- 1 successful landing of 1 Shuttlecock during Auto Mode Time (awarded to team's first demonstration only, not accumulative with points for normal landing) **10 points**

A successful transport is defined as that Shuttlecock or Rack arrives at TZ.

A successful landing is defined as that Shuttlecock prior to being in the area, first lands on the No Contact Area or the House. The points are awarded immediately, so they are not removed even if the Shuttlecock rolls off the said areas.

### 2.8.2. Smart Car Routine

- Passing the checkpoint line **10 points**
- Stopping inside SC2 **5 points**
- Producing the backward maneuver (optional) **15 points**

A max score is imposed on the Smart Car. The Smart Car is only allowed to repeat the routine 3 times.

### 2.8.3. Shuttlecocks

- 1 Shuttlecock within the ring **5 points**
- 1 Shuttlecock within the circle **10 points**

### 2.8.4. End game condition

1. 1 Normal Shuttlecock and 1 Special Shuttlecock from the team remain on the House.
2. The mentioned Shuttlecocks stay on the House for 3 seconds.

## 2.9. End of the game

### 2.9.1. The game ends when:

1. A team satisfies the "end game condition", or

2. When the game time of 3 minutes and 30 seconds is over. There will be beeping sounds in the last 5 seconds as a countdown.

## 2.10. Deciding the winner

2.10.1. A winning team is determined in the following order:

1. The team that accomplishes the “end game condition”.
2. The team with the higher score.
3. The team with the higher score contributed by Special Shuttlecocks.
4. The team that unlocks the Special Shuttlecock supply.
5. The team that has been to SC2 at least once.
6. The team that has committed fewer violations.
7. Decision by judges.

2.10.2. When the game ends, the temporary scores of both teams will be announced.

2.10.3. There will be a 30-second countdown after a game ends. Teams may appeal if there is any doubt towards the game. Teams are not allowed to appeal after the 30-second countdown. The finalized score and the winner of the game will be announced then.

## 3. Retries

- 3.1. A retry is allowed only after the referee gives permission upon request from a team member.
- 3.2. 4 referees will be on the game field overseeing the game, 1 for each robot. A retry on the Thrower Robot must be signaled by raising the flag given to the team, and one on the Smart Car by raising the hand.
- 3.3. The game field member responsible for asking retries for the specific robot must present themselves clearly to that referee before entering into the game field.
- 3.4. The team granted a retry on the Thrower Robot shall immediately carry that robot to SZ.
- 3.5. For a retry on the Smart Car, it shall be carried to SC1 during the normal portion and SC2 during the optional backward maneuver. For a retry during the backward maneuver, the Smart Car must be placed in SC2 having its head during the normal part of the routine facing the Road Block.
- 3.6. A team may ask for as many retries as necessary.

- 3.7. A team may not alter Shuttlecocks positions on the Thrower Robot during a retry. However, team members may remove Shuttlecocks from the Thrower Robot during retry. The removed Shuttlecocks can be reused but must be returned to inside LZ1 (for Normal Shuttlecocks) and LZ2 (for Special Shuttlecocks) during a retry.
- 3.8. Game field members may pick up the team's Shuttlecocks lying on the movable area of their team's Thrower Robot. These Normal Shuttlecocks can be reused but must be returned to inside LZ1 during a retry. These Special Shuttlecocks cannot be reused and must be placed outside the game field after picking up during a retry.
- 3.9. Game field members may also pick up the opponent's Shuttlecocks lying on the team's side of the game field. These shuttlecocks cannot be reused and must be placed outside the game field after picking up during a retry.
- 3.10. The team who wishes to switch to Manual Mode must ask for a retry to remove the Controller from the Thrower Robot for manual control if their Controller is on the Thrower Robot.
- 3.11. A team shall restart after permission from the referee.

## 4. Violations

The team who commits the following shall be deemed to be in violation of the rules and subject to a mandatory retry. However, during Auto Mode Time, if any the following that regards the Thrower Robot is committed, there will be no records of violation to that action, but a retry is still mandatory.

- 4.1. Any part of Thrower Robot comes in contact with the No Contact Area during Manual Mode Time.
- 4.2. The Smart Car has at least 2 wheels not in contact with the Track.
- 4.3. The Smart Car is stationary for more than 5 seconds (except in SC2).
- 4.4. A team member touches the robot(s) without referee's permission.
- 4.5. The Thrower Robot or Smart Car touches the opponent's game field.
- 4.6. The Shuttlecock thrown from the Thrower Robot lands on the Smart Car Track, opponent's game field, or off the game field. The Shuttlecock rolling to said places after landing does not count as a violation.
- 4.7. Any team member tries to manually control the Thrower Robot during Auto Mode Time.

- 4.8. Any team member tries to manually control the Smart Car during the game.
- 4.9. A team makes a false start. The game will be restarted.
- 4.10. Any other acts deemed to be an infringement of the rules.

## 5. Disqualifications

The following actions will lead to disqualification and the opponent team immediately wins the game:

- 5.1. Thrower Robot entirely leaves the game field.
- 5.2. Any robot separates during the game.
- 5.3. Any acts that pose danger to the game field, its surroundings, the robots, and/or people.
- 5.4. Any other acts that go against the spirit of fair play.
- 5.5. Any act of disobedience against a referee's warning.

## 6. Teams

- 6.1. All team members are the 2018/19 candidates of the HKUST Robotics Team and are undergraduates of HKUST.
- 6.2. Team members can be from any school, year or department.
- 6.3. Each team is assigned mentor(s) for handling team affairs.
- 6.4. The HKUST Robotics Team will provide basic materials and tools for each team.
- 6.5. Usages of materials and tools not provided by the contest are required to be approved by the Contest and supplied by team members themselves.

## 7. Robots

- 7.1. Each team is allowed to bring 1 Thrower Robot and 1 Smart Car to participate in the contest.
- 7.2. The robots must not split into separate parts during the game.
- 7.3. The Smart Car must be fully automatic.
- 7.4. The Thrower Robot may be fully automatic or controlled manually via a wireless connection.

## 7.5. Robot sizes

- 7.5.1. The Thrower Robot, excluding the controller, must fit into SZ.
- 7.5.2. The Thrower Robot should not exceed **480mm×480mm×480mm** (width × length × height) at the start of the game.
- 7.5.3. The Thrower Robot should not exceed **800mm×800mm×800mm** (width × length × height) when fully extended.
- 7.5.4. The Smart Car should not exceed **250mm×400mm×400mm** (width × length × height)

### **Smart Car measurement methods:**

**Length Measuring Method:** The length along the front to back direction of the car, including sensors. The bumper piece is not included in the calculation.

**Width Measuring Method:** The entire width of the car including sensors.

**Height Measuring Method:** The highest point of the car including sensors to the ground.

## 7.6. Robot weights

- 7.6.1. The total weight of the two robots including batteries, compressed air, containers, and the controller if there is one, must not exceed 18kg at the beginning of the game.
- 7.6.2. Backup batteries are exempted from the calculation.

## 7.7. Power source of the robots

- 7.7.1. All batteries used in the robots should not exceed 12.6V.
- 7.7.2. The maximum voltage on the circuit(s) should not exceed 42V.
- 7.7.3. Compressed air should be filled into PET bottles and must not exceed 6 bars (600kPa).
- 7.7.4. Dangerous energy sources, (such as high-pressure gases) and explosives are prohibited.
- 7.7.5. An emergency stop button with a 20A fuse must be installed on the Thrower Robot.

- 7.8. If the referee determines that the robots may injure any people or cause damage or harm to the game field, the game may be ended immediately.

- 7.9. The Smart Car may have at most 8 magnetic sensors (Hall effect sensors).
- 7.10. The Smart Car cannot have sensors other than camera(s), magnetic sensor(s) and ultrasonic sensor(s).
- 7.11. Making permanent changes to the Smart Car is strictly prohibited.

## 8. Competition Environment

- 8.1. HKUST Robotics Team does not guarantee a stable environment (e.g. stable wind, lighting, noise, etc.) for the contest venue. The participants should take sufficient measures to prevent their robots from being affected by any varying elements of the contest venue.
- 8.2. The track edges have black edge tapes for track guidance (tapes within the 45cm boundary of the track width). The edges have width  $25\pm 5$ mm.
- 8.3. The embedded magnetic line lies along the median of the track through the curvy portions and forms a closed circuit. It is a magnet wire with diameter 0.1~1.0mm, 20kHz,  $100\pm 20$ mA AC current, frequency range being  $20k\pm 1$ kHz.

## 9. Others

- 9.1. For anything not mentioned in this rule book, the teams are required to obey the decisions of the HKUST Robotics Team.
- 9.2. The dimensions, weights, etc. of the field, facilities, and equipment described in this rule book have a margin of error of  $\pm 5\%$  unless otherwise stated.
- 9.3. All robots must pass requirements of dimension, weight and safety check in order to take part in the contest.
- 9.4. Teams may be required to demonstrate all functions of the robots for vetting before the contest.
- 9.5. The referees may demand additional explanations on safety issues when the safety of a robot is deemed to be in question.
- 9.6. Each team is required to design a poster about their robots and display it to the public before the contest.
- 9.7. All questions should be addressed to the official email of the HKUST Robotics Team: [robotics@ust.hk](mailto:robotics@ust.hk).
- 9.8. Any changes to the rules will be announced through the official website: <http://robotics.ust.hk>. Participants are responsible for checking for the latest information.



## 10. Competition Flow

The competition consists of 2 rounds:

### 10.1. Preliminary Round

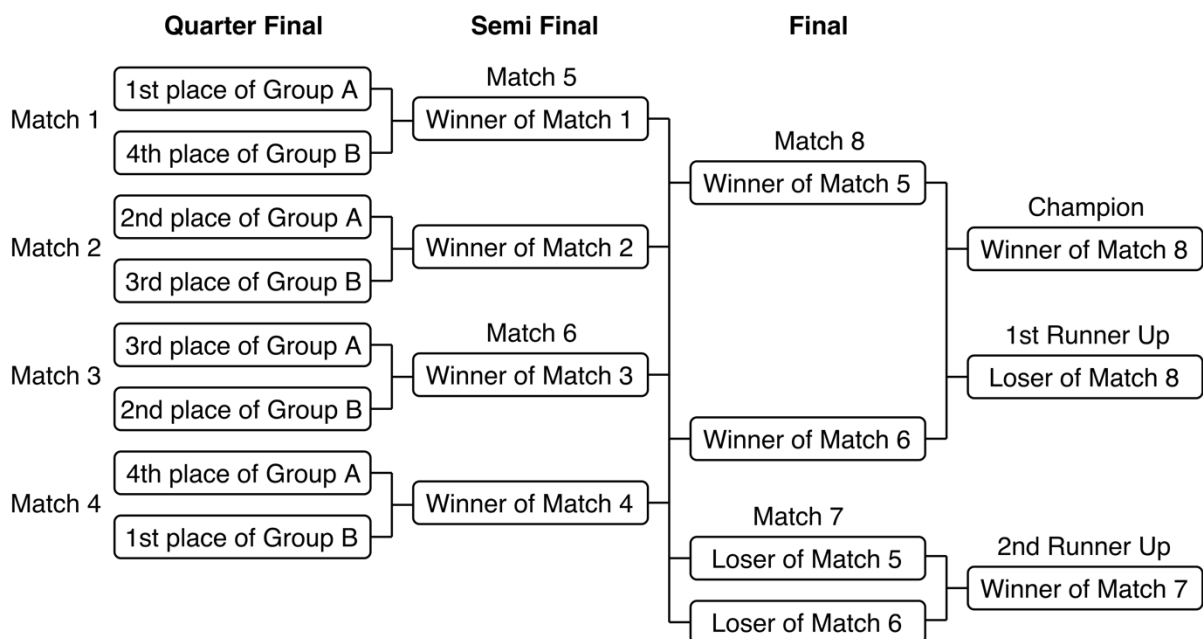
10.1.1. The format of preliminary round is group round-robin. 8 teams will be randomly split into 2 groups.

10.1.2. Each team will play against every other team in the group, and the winning team of a match gains 1 point. Teams are ranked by the points in each group for placement in the finals.

### 10.2. Final Round

10.2.1. The format of the final round is an elimination match, and the opponent of the matches is determined by the ranking of the preliminary round.

10.2.2. The following is a diagram describing the final round.



## 11. Awards

There are 6 awards in the contest:

- 11.1. **Champion**
- 11.2. **1<sup>st</sup> Runner Up**
- 11.3. **2<sup>nd</sup> Runner Up**
- 11.4. **Best Engineering Award:** The award shall go to the team which has the best engineering design of the robot.
- 11.5. **Best Poster Award:** The award shall go to the team which has the best poster design. Refer to Article 12 about the poster requirement.
- 11.6. **Most Cost Effective Award:** The award shall go to the team which uses the least amount of credits throughout the contest.

## 12. Poster

- 12.1. The poster design is one of the important tasks in the ROV competition. The rules of that in this contest will also closely follow that specified by the MATE Center which hosts the ROV competition. The score of the poster only goes towards the Best Poster Award and not the ranking.
- 12.2. Your team is required to create a poster display that will be showcased during the competition. The contest takes place on a stage in Atrium and the posters are placed on boards around it.
- 12.3. Your display should be an informative, clear, and concise presentation about your team and how you designed and built the specialized toolset, e.g. mechanism, algorithms, and electronics to complete the gameplay. During the competition, your poster will be evaluated and scored by judges.
- 12.4. Judges have the technical background to understand technical details, but the general visitors passing by the competition venue may have little to no idea on robotics. In the poster, present and highlight the features of your robots, such as the design rationale behind them. You must reflect on the design choices you have made, then explain and justify them. The poster must also include team evaluation and team information. Summarize your experience in the contest in the team evaluation and list out the complete details of each team member in the team information.
- 12.5. Few things to keep notes on:
  - Make key points and be concise
  - Keep the general public in mind

- Label all figures, graphs, diagrams, and photos and credit the source.
- Make sure the poster is both informative and aesthetically pleasing.
- The poster size is portrait A0. A template frame document will be provided later. The design must be contained within the frame.
- You are required to submit a printable digital image file at the required resolution for printing, e.g. PNG, JPG, TIF, etc.

The following is the scoring rubrics:

Criteria	Scoring
<b>Team name and headers</b>	
<ul style="list-style-type: none"> <li>• The group number and team name placed center top (2)</li> <li>• Required headers: (1)               <ul style="list-style-type: none"> <li>○ Abstract</li> <li>○ Team Information</li> <li>○ Design Rationale</li> <li>○ Team Evaluation</li> <li>○ Acknowledgments</li> </ul> </li> </ul>	3
<b>Overall visual presentation</b>	
<ul style="list-style-type: none"> <li>• Aesthetically pleasing (1)</li> <li>• Logical progression &amp; easy to follow (1)</li> <li>• Same font throughout, clear and easy to read from 1.5m (1)</li> <li>• Consistent header text size (1)</li> <li>• Consistent section text size (1)</li> </ul>	5
<ul style="list-style-type: none"> <li>• Penalty for failure to use SI units (-1)</li> </ul>	
<b>Grammar and spelling</b>	
Quality of grammar, spelling, conventions, and that the writing can be easily understood free of grammatical mistakes.	5
<b>Photo captions and credit</b>	
<ul style="list-style-type: none"> <li>• Captions explaining the graphics and/or labeled features of the robots</li> <li>• Credits are given to the photographer</li> <li>• Source of image cited (program, website, etc.)</li> <li>• Good quality image</li> </ul>	4
<b>Abstract</b>	
<ul style="list-style-type: none"> <li>• No more than 250 words</li> <li>• Introduce your team</li> <li>• Clearly explain the specialized toolset the team has built together for the robots</li> <li>• Describe how these tools help your robots complete the gameplay</li> </ul>	4

<b>Team information</b>	
<ul style="list-style-type: none"> <li>• Photo(s) of all team members</li> <li>• Names of all team members</li> <li>• Role of all team members (SW, HW, M)</li> <li>• Majors and years of all team members</li> </ul>	4
<b>Design rationale</b>	
<ul style="list-style-type: none"> <li>• Explain the benefits of design features</li> <li>• Outline safety features of robots</li> <li>• The benefits of the design features connect to the gameplay in the competition</li> </ul>	5
<ul style="list-style-type: none"> <li>• Vocabulary and phrasing</li> </ul>	3
<ul style="list-style-type: none"> <li>• Photos, diagrams, or sketches</li> </ul>	2
<b>Team evaluation</b>	
<ul style="list-style-type: none"> <li>• How would you characterize the team's overall success?</li> <li>• What do you consider the strengths of your team &amp; the robot you designed?</li> <li>• What areas do you see needing improvement?</li> <li>• What would you do differently next time?</li> </ul>	4
<b>Acknowledgments</b>	
<ul style="list-style-type: none"> <li>• Identify organizations, people and/or individuals who provided technical, logistical, and/or moral support.</li> </ul>	1
<b>Total</b>	<b>40</b>

## 13. Material List

### 13.1. Basic Materials

The following items will be provided to every team. They will be distributed **after the deposit of HKD1500 is paid**. The full amount would be returned if and only if all items are returned in good condition.

Material	Quantity
Smart car kit	1
OV7725 camera	1
Glass fiber rod for mounting camera	1
Servo mount, rod mount, camera mount STL file	1
Motors (Maxon A-MAX 254609)	2
Motor mounts	2
Lock bushes	2
Wheels	2
Solenoid valve	1
2 cells 7.4V Li-Po battery (for the smart car)	1
3 cells 11.1V Li-Po battery (for the Thrower Robot)	2
STM32F1 mainboards	2
Motor driver board sets (designed by the team)	4
Pneumatics controller board	1
Magnetic field sensor kit	1
TFT displays	2
Bluetooth module (HC-05)	1
On/off switches	2
Emergency stop button	1
Fuse socket	1
Battery voltage level monitors	2
Mech tools box (with 2 M3 & M4 hex keys, 2 spanners, 2 crosses)	1

DO NOT steal tools and components from other teams. Most mechanical components found in 3007 are allowed to be used and you should only take what you need. If you are not sure whether the components can be used, ask seniors first.

### 13.2. Additional Materials

Each team initially has 1000 credits. All items have limited stock.

A representative of the team can buy their required items through

<http://robotics-app.ust.hk/internal/marketplace/>.

All team members may also view the comprehensive products catalog through

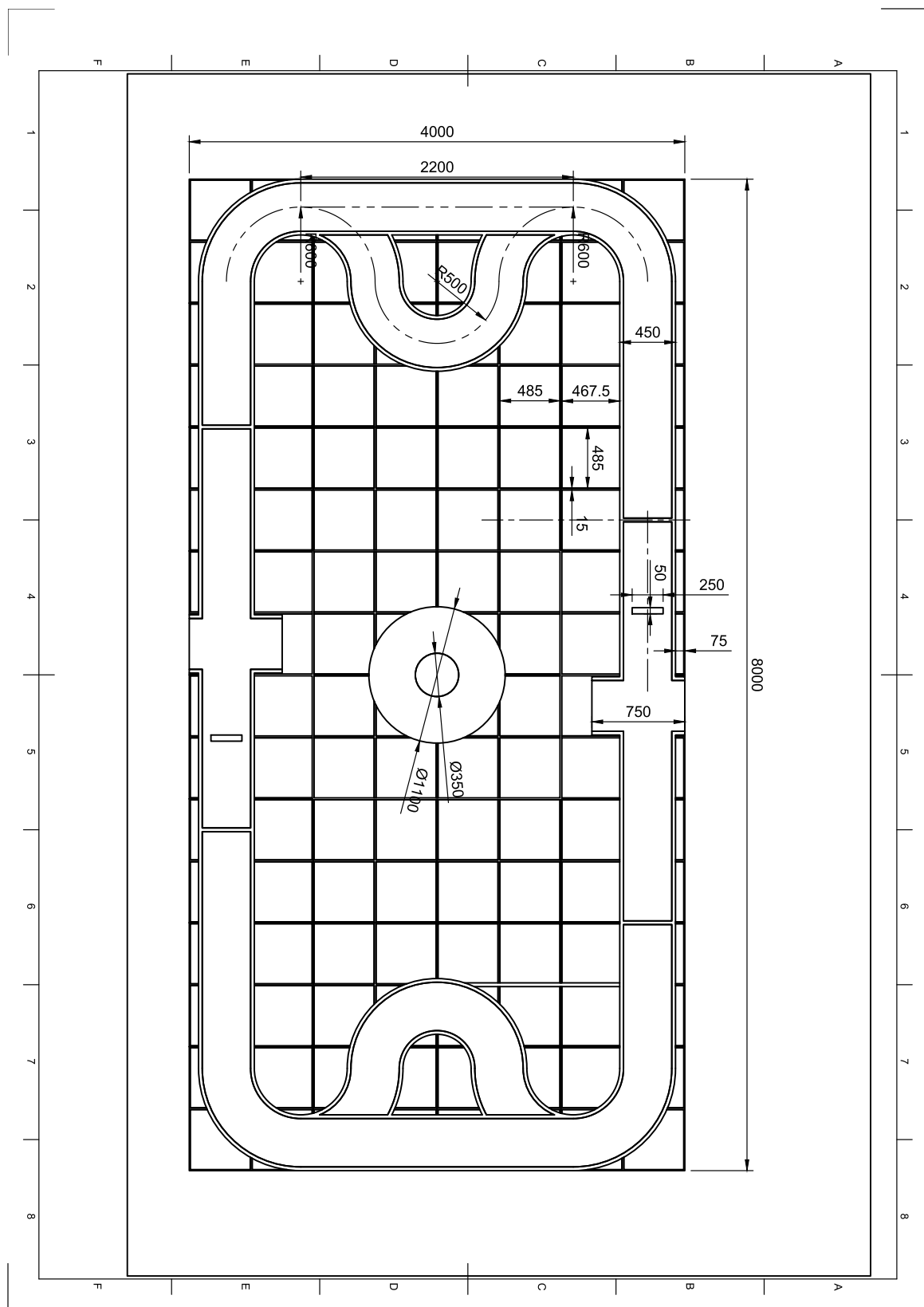
<http://robotics-app.ust.hk/internal/marketplace/catalog>.

Self-pick-up service is provided every working day starting from Oct 15, 2018, from 18:30 to 19:00. Purchases made on working days before 03:00 will be available for pick-up that day except specified, otherwise, the items will be ready on the next working day. Current stock count, history of purchase and team remaining credits can also be found on the website. The following are materials that can be purchased by credits. Stock and availabilities of items may change without notice.

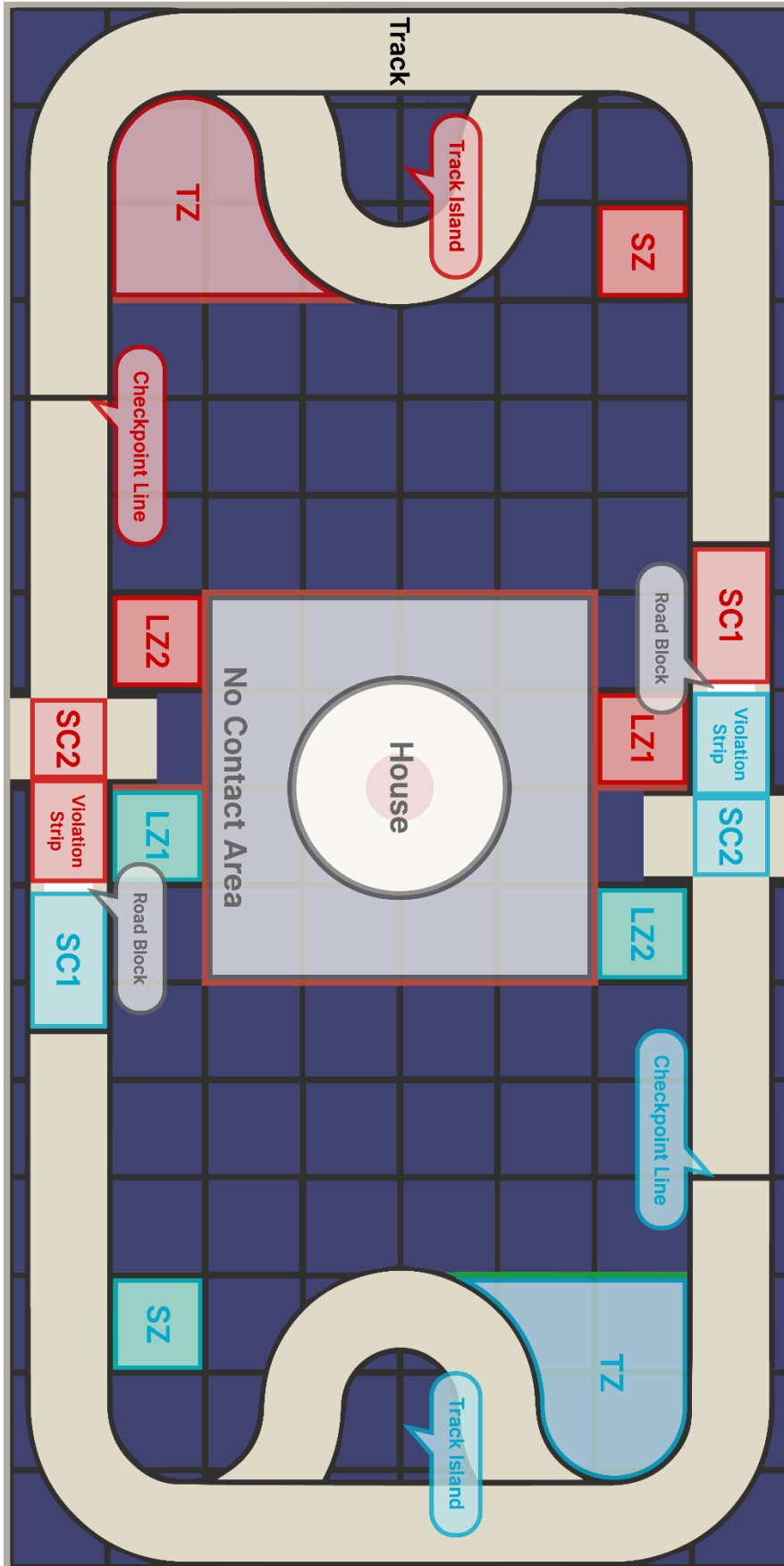
Material	Cost
Mainboard Repair Service	Depends on situation
Line Tracking Sensor	40
Ultrasonic sensor (HC-SR04)	100
IR Proximity Sensor	80
Camera (OV7725)	200
Limit Switch	60
Bluetooth Module (HC-05)	200
Pneumatic Controller Board (with pre-soldered ICs only)	100
Magnetic Sensor Board Kit (with pre-soldered ICs only)	100
Motor Driver Board (with pre-soldered ICs only)	200
H-bridge Motor Driver (HIP4081)	50
Switching Voltage Regulator (MAX662A)	50
DC Gearmotor (36GP-555)	200
Motor Mount	100
Solenoid Valve	70
Bottle Cap	50
LiPo Battery	500

# 14. Figures

## Game field dimensions

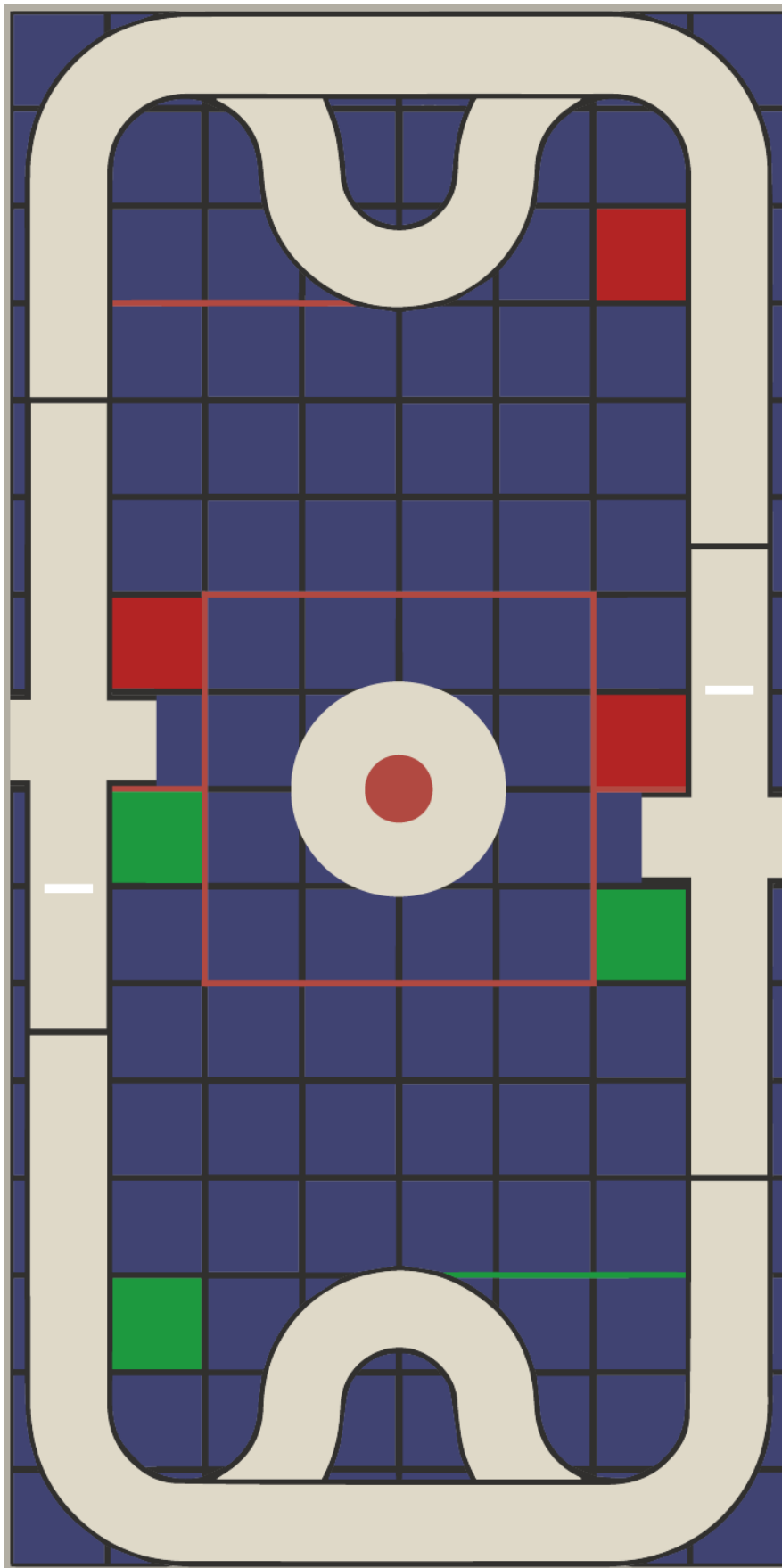


Game field visualization with labeling

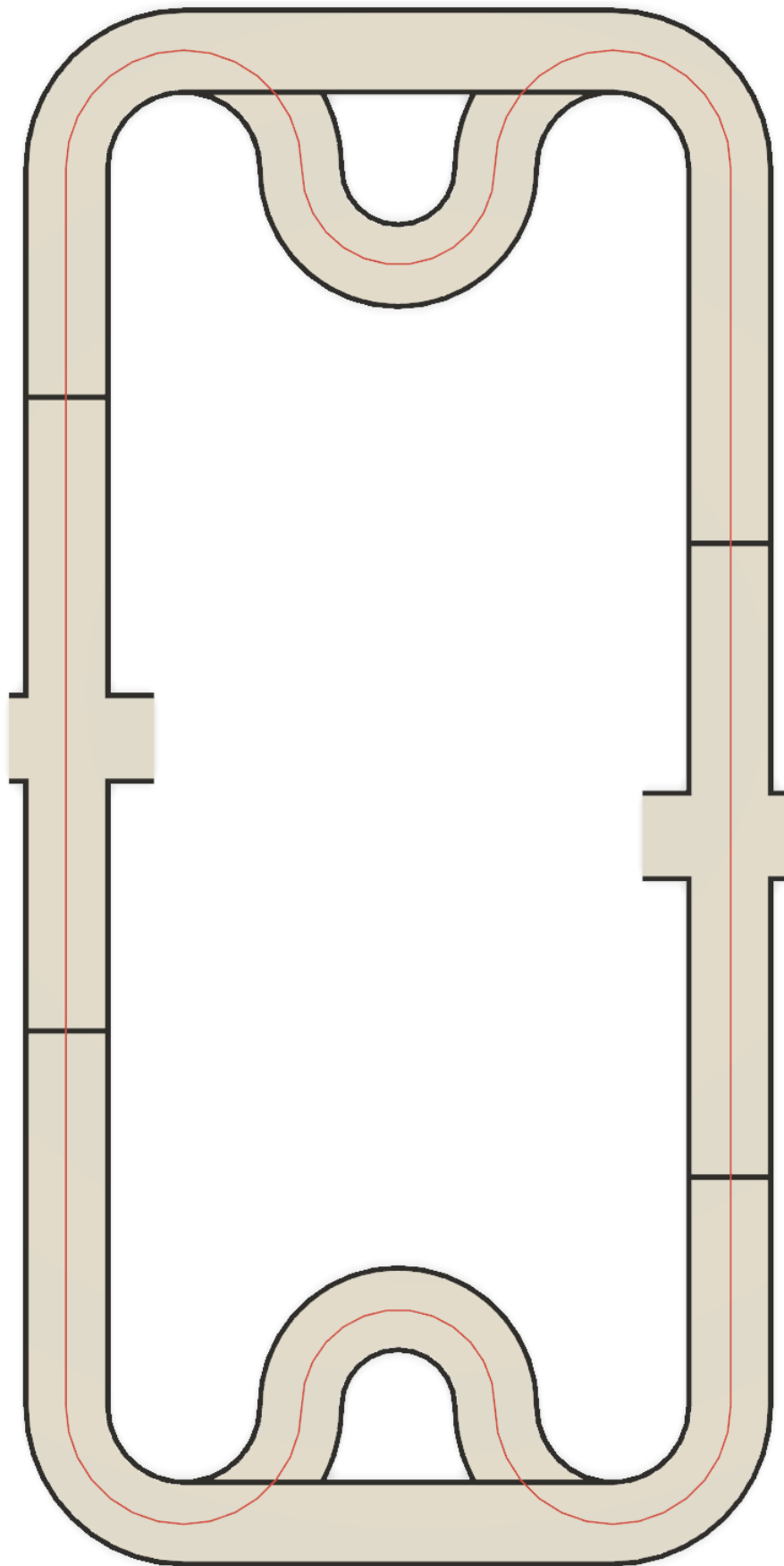




Game field visualization without labeling



Magnetic line placement



## Shuttlecock dimensions



## Update Details

### Date: 23<sup>rd</sup> October 2018

- Page 15, Rule 7.10

“The Smart Car cannot have sensors other than camera(s), magnetic sensor(s) and ultrasonic sensor(s).”

- Page 15, Rule 7.11

“Making permanent changes to the Smart Car is strictly prohibited.”

### Date: 21<sup>st</sup> November 2018

- Page 22

Grid sizes and line width are changed due to material constraints. Line width used to be white 30mm, now black 15mm.

- Page 23, 24

Visualizations are updated. Changed blue tiles and lines to green due to material constraints. Please ignore the visual sizes of the grids and lines and refer to page 22 for the exact dimensions.