



2024~2025

The 16th Robot Design Contest

Rule Book

Version 4 (Oct 15)

Table of Contents

Preface	2
Overview	3
Terms and Definitions	4-6
1. Contest Outline	7
2. Game Procedure and Competition Task	8-13
3. Violation	14
4. Disqualifications	15
5. Competition	16-17
6. Teams	18
7. Robots	19
8. Others	20
9. Awards	21
10. Material List	22-24
11. Figures and dimensions	25-30

Preface

The HKUST Robotics Team competes in various robotics competitions every year, including the ABU Asia Pacific Robot Contest (Robocon), the MATE Remotely Operated Vehicle Underwater Competition (ROV), RoboGames (Intelligent Racing) and FPV Drone Racing (UAV).

This Robot Design Contest is part of the new member recruitment process for the HKUST Robotics Team. During this process, participants will be able to have the first taste of a robot's entire development process and build one on their own, and eventually participate in an exciting competition at HKUST.

Members of the Robotics Team organize training for members throughout the preparation and development of their robots, providing tutorials on electronics, mechanics, and software programming. The members are also involved in organizing the competition.

The style of this rule book closely follows that of the ABU Asia Pacific Robot Contest (Robocon) competition, and the RoboGames (Intelligent Racing).

Overview

Theme

The theme of this year merges some features from the ABU Robocon competition and the RoboGames competition. Our adviser Professor Tim Woo is caught by a giant squid next to UST seafront. To negotiate with the squid, we need to build a signal tower underwater so we can contact the squid. This year's game features 2 robots: Task Robot (TR) and Auto Robot (AR). The duty of TR consists of 3 main tasks: Loading Building Blocks from the TR Loading Zone, collecting the Signal Unit and Conducting Unit from the Delivery Zone, and building the Signal Tower in the Building Zone. Meanwhile, AR needs to identify the Signal Unit and Conducting Unit in the AR Loading Zone and deliver the Signal Unit and Conducting Unit to the Delivery Zone. In the game, two teams play against each other on different sides of the same field. The team that completes the Signal Tower and rescues Professor Tim Woo first will win the competition.

Safety

Safety is the top priority of the competition. During building, debugging, and operating the robots, participants are required to be aware of safety. Always keep the safety instructions in mind!

Tidiness

Tidiness is essential for a coworking space like a lab. Participants should keep their own materials tidy to avoid missing components and keep the shared tool in place for the sake of other users.

Terms and Definitions

• Game Process Related

Terms	Definitions
Building Blocks	Objects for building the Signal Tower. Rectangular game props with dimensions 200mm×200mm×100mm with a circular hole in the smaller surface. The Building Blocks would be invalid and cannot be used to build the Signal Tower if they touch the ground that is not BZ, TLZ, or DZ.
Signal Unit	The top and core part of the Signal Tower. The Signal Unit consists of a PVC pipe and a 3D-printed base. The PVC pipe has a diameter of 75mm and the 3D-printed base has a diameter of 100mm. The whole Signal Unit has a height of 70mm.
Conducting Unit	An object for building the Signal Tower. A cubic game prop of unknown color with side lengths of 139.7mm.
Signal Tower	A Signal Tower consists of multiple valid Building Blocks and/or the Conducting Unit stacked on top of each other with the Signal Unit stacked on the top. The Signal Tower must stand for 3 seconds on its own without any robots/people touching it in order to be a valid Signal Tower. The Signal Tower must be fully inside the Building Zone in order to be valid.
Great Victory	The team that finishes building the Signal Tower with the bottom of the Signal Unit 600mm above the ground will achieve Great Victory, the team wins and the game ends immediately.
Fences	Barriers that are used to restrict the movement of the robots. Robots cannot touch the top surface and outer (or opposite) side of the Fence. However, they can touch the inner side of the Fence.

● Auto Robot Related

Terms	Definitions
Auto Robot (AR)	A fully automatic robot that collects the Signal Unit or the Conducting Unit in the ALZ and delivers them to the DZ. An AR consists of a stationary part (details in Auto Robot Stationary Part) and a moving robot. The moving robot can travel along the Automatic Track to complete its task.
Auto Robot Stationary Part	The stationary part of AR must be settled on the outermost fence of the Automatic Track or outside the game field during the preparation time. Each team has to build their stand for the camera. Only 1 laptop, 1 camera, 1 stand, and USB cables are allowed to be the stationary part of the Auto Robot.
Automatic Track (AT)	A straight track for the AR to run on, consisting of ASZ, ALZ, and DZ. TR is not allowed to enter the Automatic Track.
Auto Robot Starting Zone (ASZ)	A rectangular area where the moving robot of AR should stay inside completely before the start of the game or during a retry. The dimension of the area is 400mm×800mm. TR is not allowed to enter ASZ.
Auto Robot Loading Zone (ALZ)	A rectangular area with 4 small squares at the end of the Automatic Track. The opponent team will randomly place the Signal Unit and the Conducting Unit fully inside the small square, without placing on any of the black areas, during preparation time. Each small square can only hold 1 Unit. AR can only load and carry 1 Unit at a time. The dimension of a small square is 150×150mm and the whole area is 180mm×720mm. TR is not allowed to enter ALZ.
Delivery Zone (DZ)	An area where AR passes the Signal Unit and the Conducting Unit to TR. The dimension of the area is 800mm×800mm.

● Task Robot Related

Terms	Definitions
Task Robot (TR)	A manual or semi-automatic robot that performs loading and building tasks
TR Starting Zone (TSZ)	The area that the TR should stay inside completely before the start of the game or a retry. The dimension of the area is 650mm×650mm.
TR Loading Zone (TLZ)	An area where the Building Blocks are stored. There will be 8 Building Blocks in the TLZ.
TR Auto Path (TAP)	A TR shortcut between the TSZ and TLZ. TR will be allowed to carry at most 3 Building Blocks only when the TR reaches the TLZ by the TR Auto Path automatically (TR runs without the player's control) Controllers can switch back to manual control once any part of the TR enters the TR loading zone (including its orthogonal projection).
Building Zone (BZ)	An area where the Signal Tower is built. The dimension of the area is 1000mm×800mm.

1. Contest Outline

A game between two teams takes place within 3 minutes. Each team has two robots:

1.1.1. Task Robot (TR): Loading and building the Signal Tower in the Building Zone.

1.1.2. Auto Robot (AR): Run autonomously on the track, recognize the Signal Unit, and deliver the Signal Unit to TR

The game field consists of the following zones or paths: the Task Robot Starting Zone (TSZ), the TR Auto Path (TAP), the Task Robot Loading Zone (TLZ), the Auto Robot Starting Zone (ASZ), the Automatic Track (AT), the Auto Robot Loading Zone (ALZ), the Delivery Zone (DZ), and the Building Zone (BZ).

The fence encloses the half-field for each team and the whole game field. Under no circumstances are robots allowed to enter the opponent's side of the field.

The Automatic Track (AT) is located in the outermost part of the game field. AT is completely separated from the other areas except the Delivery Zone (DZ)

8 Building Blocks, 1 Signal Unit, and 1 Conducting Unit will be given to each team at the start of the game. Team members need to set up the Building Blocks in TLZ and the 2 Units in the opponent team's ALZ during the 1 minute preparation time. During the game, AR will identify the location of the 2 Units in ALZ and deliver them to the DZ, while TR will load Building Blocks from the TLZ and load the 2 Units from DZ, and use them to build a Signal Tower in the BZ. The team that finishes building the Signal Tower in the Building Zone first would win the competition.

2. Game Procedure and Competition Task

2.1. Game field facility and scoring object:

2.1.1. In this game, there are multiple scoring methods:

- Build the Signal Tower into the Building Zone;
- Delivers Units into the Delivery Zone;
- Correctly identifying the Units in ALZ;

2.1.2. The winning objects in this game are the Signal Unit, Building Blocks, and the Conducting Unit. Therefore, the game field facilities are the Task Robot Starting Zone (TSZ), the TR Auto Path (TAP), the Task Robot Loading Zone (TLZ), the Auto Robot Starting Zone (ASZ), the Automatic Track (AT), the Auto Robot Loading Zone (ALZ), the Delivery Zone (DZ), and the Building Zone (BZ). Their dimensions are specified in Section 7 of this rule book.

2.1.3. Team members are not allowed to touch any of the game field facilities during the game.

2.2. Before the game starts:

2.2.1. Before the game begins, robots should be put out of the Game Field.

2.2.2. Before the one-minute preparation time of the game, 8 Building Blocks, 1 Signal Unit, and 1 Conducting Unit will be given to each team outside the game field.

2.2.3. Before a game begins, one-minute preparation time is given to each team through the signal from the main referee. During the one-minute preparation time, team members should:

- Put their robots in the corresponding Start Zones on the Game Field,
- Put their Building Blocks into their TLZ, and
- Place the Signal Unit and Conducting Unit into the small squares of the opponent's ALZ.

2.2.4. The orthogonal projection of the Building Blocks must be totally inside the TLZ after the one-minute preparation time and before the game starts.

2.2.5. The square surface of the Conducting Unit and the circular surface of the Signal Unit must be touching the ground and totally inside the small squares of ALZ after the one-minute preparation time.

2.2.6. Each team is allowed to have 3 game field members and 3 pit crew members. All of the 6 members can enter the game field before the game starts. After the game starts, only game field members are allowed to enter the game field during retry. No members are allowed to enter the game field without a retry. No more than 6 members can stay in the preparation area before the game begins. The rest of the team members must stay in the audience area.

2.2.7. If a team fails to set up their robot or the game props within the one-minute preparation time, they may continue to set up after the

game starts. Once the set-up is finished, the team can start their robots with the permission of the referee, but no extra time will be given.

2.2.8. Before the start of the game, all team members should leave the Game Field once they finish setting up the robots. The controller should be put on the ground without any team members touching it. When the game starts, no team members are allowed to enter the game field, except during retry.

2.2.9. The referees will indicate the start of a game by raising of flags.

2.3. At the start of the game and during the game:

2.3.1. Both TR and AR moving robot must completely fit into their corresponding Starting Zone, including the space above the Starting Zones. Stationary part of AR must be put on the outermost fence of the Automatic Track or outside of the game field. No parts of Auto Robot Stationary Zone can be placed on or above the space within the game field(excluding the outermost fence). When the game starts, TR and AR must start from the Starting Zones.

2.3.2. The motors of the AR must remain still when handled by a game field member before starting and may only start spinning after the game field member has released the robot. Game Field members must leave the Game Field once AR is released.

2.3.3. All team members must stay outside of the Game Field except during preparation time and when retrying.

2.3.4. Only 3 Game Field members are allowed to stay close to the zone and participate during the game. The 3 pit crew members must return to the audience area once the game starts.

2.3.5. Both TR and AR must stay in the Game Field during the game.

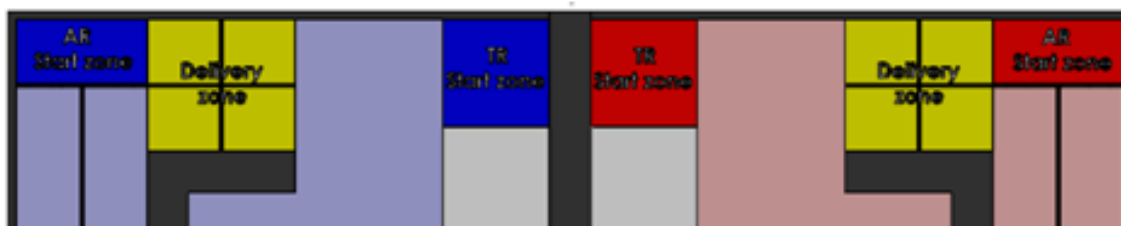
2.4. Task of Robots:

2.4.1. Tasks of TR:

There are two types of tasks that TR can perform during the game:

- Loading task - loading different Game Props from TLZ or DZ
- Building task - stacking up different Game Prop in the BZ

1) Before the game starts, TR should be placed in the Task Robot Starting Zone. The starting positions denoted (TR Start zone) of both TR can be shown in the following picture:



- 2) After the game starts, TR can move out from the TR Starting Zone.
- 3) TR can only carry 1 Building Block from TLZ if TR moves to TLZ manually.
- 4) Every time after TR successfully moves to TLZ along the TR Auto Path automatically, TR can carry at most 3 Building Blocks from TLZ.
- 5) When the team wants their TR to move along the TR Auto Path automatically, team member must signal the referee and put TR controller on the ground without touching it.
- 6) Building Blocks must not touch the ground that is not TR Loading Zone, Building Zone or Delivery Zone, or else they are considered as invalid.
- 7) Bringing invalid Building Blocks to the Building Zone is a violation, and the invalid block will be removed by gamefield members.
- 8) TR can load the Signal Unit and Conducting Unit at any time but the Unit must have passed the Delivery Zone before.
- 9) TR can stack different game props on top of each other to build the Signal Tower in the Building Zone.
- 10) Teams cannot have their game props back if the game props are dropped into the opponent's area or outside the Game Field.
- 11) During the game, TR is not allowed to enter or extend into the opponent team's side of the field and the Automatic Track, including the space above. Moreover, TR must not perform any of the following. Otherwise, there will be a violation:
 - TR uses game props to damage the opponent robot from a design perspective
 - TR touch any Signal Unit or Conducting Unit that has not yet touched the spaces above the Delivery Zone before.

2.4.2. Tasks of AR:

The AR consists of one **moving robot** and one **stationary part**.

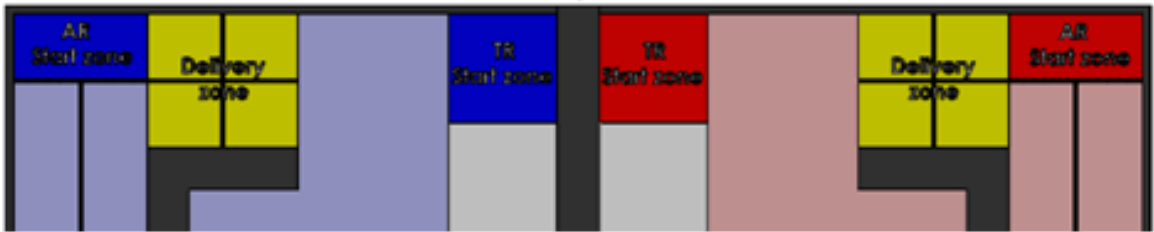
Moving robot:

- Move along the automatic track
- Load the Signal Unit or the Conducting Unit from ALZ
- Delivers the Signal Unit or the Conducting Unit to the Delivery Zone or TR

Stationary part:

- Consists of a laptop computer, a USB Camera, a camera stand, and some USB cables
 - Identify the location of the Signal Unit and Conducting Unit using the USB Camera
 - Show the result of your Image Processing part on the screen of the laptop computer to score
 - Send the result to the Moving Robot wirelessly.
- 1) Before the game starts, the moving robot of AR should be placed in the Automatic Robot Starting Zone. Each team should also set up the stationary part near the Auto Robot Loading Zone. The starting positions denoted (AR

Start zone) of both AR can be shown in the following picture:



- 2) During the game, the moving robot of the AR needs to move along the Automatic Track automatically to the Auto Robot Loading Zone to load either the Signal Unit or the Conducting Unit. The AR can only carry 1 unit at a time. The AR needs to deliver the Signal Unit or the Conducting Unit to the Delivery Zone for TR to use. The AR track consists of assistant lines for the moving robot. It is optional to follow the line.
- 3) The stationary part should identify the location of the Signal Unit and the Conducting Unit, "Identify the location" means to identify which of the 4 squares(see figure below) the Signal Unit and the Conducting Unit is located in respectively. Then the stationary part should send commands to the moving robot of AR wirelessly so that it can correctly locate the unit to load it.



- 4) The identification result must be displayed on the computer screen for at least 10 seconds using the given GUI code in HKUST Robotics Team Software Tutorial 2024 Notes Github Pages to score the points. (<https://github.com/UST-Robotics-Team/Software-Tutorial-2024-notes/blob/main/advanced-tutorial-1-image-processing/rdc-image-processing-skeleton.md>)
- 5) The AR moving robot needs to deliver the Units to the Delivery Zone. The AR moving robot can choose to put down the Units into the Delivery Zone or directly transfer the Units into TR. The Units must have entered the spaces above the Delivery Zone before AR can transfer the Units into TR.
- 6) All parts of AR must be fully autonomous. All members cannot touch or operate the stationary part of AR by any means after the game starts. All members cannot touch or operate the AR moving robot except for retries.
- 7) Any of the following will lead to the identification not being counted:
 - The computer does not recognize and print all of the units correctly.
 - The correct result is displayed for less than 10 seconds continuously
- 8) When the AR moving robot exits the game field, the corresponding team may perform a retry on the AR.

- When AR performs a retry, team members can take back the Units on the Automatic Track or AR and put them back into their original positions in the ALZ. If the Units are inside the Delivery Zone, team members can only take the Units back into ALZ when TR is not in the Delivery Zone. If the Units are on TR, team members can only take them back if they also call a retry for TR.
- When AR performs a retry, team members can clear the Automatic Track area.
- There are no limits on the number of retries. Retries must be done according to the rules with approval from the referee.

2.5. Scoring of Robots:

2.5.1. TR:

- For each valid Building Block in the Building Zone: 10 points
- Successfully deliver the Signal Unit to the Building Zone: 30 points
- If the Conduct Unit is NOT in the Building Zone,
For each 100mm (rounded down) between the ground and the top of the tallest valid signal tower in the Building Zone: 10 points
- If the Conduct Unit is in the Building Zone,
For each 100mm (rounded down) between the ground and the top of the tallest valid signal tower in the Building Zone: 20 points

2.5.2. AR:

- Correctly identified the Signal Unit and Conducting Unit: 50 points
- Successfully deliver the Conducting Unit to the Delivery Zone: 20 points
- Successfully deliver the Signal Unit to the Delivery Zone: 30 points

2.6. End of the game:

The game shall end when:

- A team achieves “Great Victory”.
- The 3 minutes of game time is over.
- One of the teams got disqualified.

2.7. Deciding the winner:

2.7.1. The winner will be determined in the following order:

- 1) The team that achieves the “Great Victory”;
- 2) The team with a higher total score;
- 3) In case two teams have the same score, the winner will be decided

according to the following order:

- i. The team with their Signal Tower that has a Signal Unit;
- ii. The team with their Signal Tower's Signal Unit taller than the opponent;=
- iii. The team with a taller Signal Tower;
- iii. The team whose AR delivers the Conducting Unit to the DZ first;
- iv. The team that has committed fewer violations;
- v. The team with less total weight of robots;
- vi. Decisions made by referees.

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

2.7.3. There will be a 30-second countdown after a game ends. Teams may appeal if there are any doubts about the game. Teams are not allowed to appeal after the 30-second countdown. The score and the winner of the game will be finalized and announced after 30 seconds if no team appeals.

3. Violation

The team who commits the following shall be deemed to be in violation of the rules and subject to a mandatory retry. The referee will shout 'violation' if a violation is committed.

- 3.1.** Any part of any robot exits the Game Field.
- 3.2.** Any game props are put outside the Game Field by any robot.
- 3.3.** Any part of any robot entering the opponent's side of the game field or the space above it.
- 3.4.** Any part of TR enters the Automatic Track.
- 3.5.** The Signal Unit or the Conducting Unit is delivered to TR without passing through the Delivery Zone.
- 3.6.** Any robot carrying invalid Building Blocks into the Building Zone
- 3.7.** The team makes a false start.
- 3.8.** Other actions that infringe on the rules but are not mentioned in the disqualifications are considered a violation.
- 3.9.** In case of a violation committed by one of the robots, tasks achieved by another robot will still be counted during the retry of the robot that committed a violation.

Both AR and TR can retry separately when only one of them causes a violation.

4. Disqualifications

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

- 4.1.** The design and build of the robot are not in accordance with the regulations in Section 7.
- 4.2.** The team intentionally damages or tries to damage the field, facilities, game objects, or opponent's robots.
- 4.3.** The team performs any acts that are not in the spirit of fair play.
- 4.4.** The team fails to obey instructions or warnings issued by referees 3 times
- 4.5.** Any robot entirely leaves the game field. However, this is not applicable when a retry is requested before the robot entirely leaves the game field.

5. Competition

5.1. The whole contest will be conducted face-to-face for all members.

5.2. The game flow of the competition:

5.2.1. The competition will be conducted in a double-elimination tournament, which means each team will have to lose twice to be eliminated.

5.2.2. Winner Bracket

- Every team will start with the Winner Bracket stage in the competition.
- The winning team in the Winner Bracket match will be arranged for the next Winner Bracket match
- The loser team in the Winner Bracket match will be arranged for the next Loser Bracket match
- The placement in the finals will be given to the last team in the Winner Bracket stage.

5.2.3. Loser Bracket

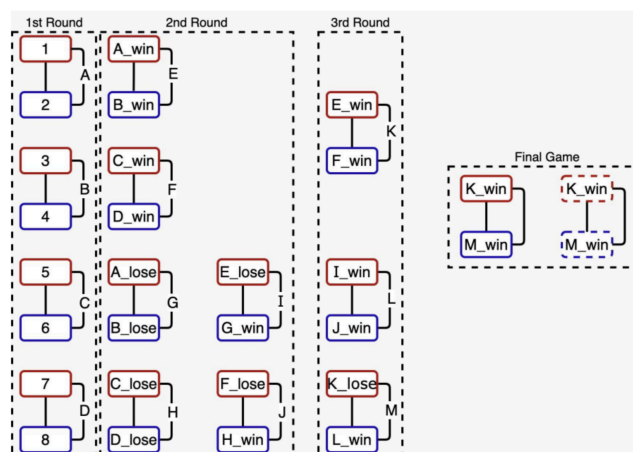
- The winning team in the Loser Bracket match will be arranged for the next Loser Bracket match
- The Loser team in the Loser Bracket match will be eliminated from the competition
- The placement in the finals will be given to the last team in the Loser Bracket stage.

5.2.4. The Final Round

The winner will be decided in the following situations:

- The team from the Winner Bracket stage wins in the first round
- The winning team in the second round, which will be delivered if the team from the Loser Bracket wins in the first round.

The complete game flow is described in the following flow chart.



5.3. Final Presentation

5.3.1. The presentation will be held on 16/11/2024 morning, with each team presenting for 10 minutes.

5.3.2. A total of 9 scoring categories, with each category holding a score of 0-4 points.

5.3.3. A scoring sheet will be given to participants well before the presentation for their preparation.

5.3.4. Scoring Sheet

- Preparation

All team members contributed to and were well-prepared for the presentation.

- Delivery

The presentation was dynamic, clear, and informative.

- Content

The presentation demonstrated a well understanding of the contest and described the group's game plan.

The presentation clearly explains an overview of their values (Designs, Innovation, etc.) and how it's built

Discussed the extent to which the TR and AR were tested prior to the contest

- Teamwork

The Demonstration project was a collaborative effort with each member contributing.

Members are supportive of each other and self-teaching/ mentoring is demonstrated.

- Lessons Learned

Describing the most significant technical lesson learned, can be related to a challenge encountered.

Described most significant interpersonal or management lessons learned, can be related to challenges encountered.

5.4. Poster Design

5.4.1. Each team has to design a team introductory poster on or before 13/11/2024 23:59.

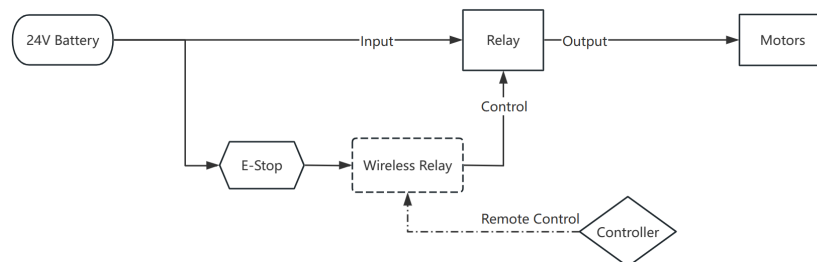
5.4.2. Scoring criteria would be similar to the final presentation, be reminded that your poster would be shown to the audience on the competition day.

6. Teams

- 6.1. All team members are 2024/2025 candidates of the HKUST Robotics Team
- 6.2. Team members can be from any school, year, or department.
- 6.3. Each team is assigned mentor(s) to provide advice to the team affairs, team members should contact their mentor proactively.
- 6.4. Each team consists of a similar number of members from different departments, randomly grouped.
- 6.5. Each team consists of 3 members, called Game Field members to participate in the game.
- 6.6. In addition, 3 members are allowed to be registered as the pit crews to carry the robots to the field and participate in the setting of the Robots and the game props during the 1 minute preparation time.

7. Robots

- 7.1. Each team is allowed to design one Task Robot and one Auto Robot.
- 7.2. All parts of the robots must not split into separate parts during the game.
- 7.3. The AR must be fully automatic.
- 7.4. Robot sizes
 - 7.4.1. The Task Robot should not exceed 650mm x 650mm x 650mm (width x length x height) at the start of the game. Throughout the game, the maximum dimensions should not exceed 900mm x 900mm x 900mm.
 - 7.4.2. The moving robot of Automatic Robot should not exceed 400mm x 400mm x 400mm (width x length x height) in the whole game. The stationary part of Automatic Robot must not enter the space on or above the game field besides the space on or above the outermost fence.
- 7.5. Robot weights
 - 7.5.1. The total weight of the Task Robots including the battery must not exceed 18kg.
 - 7.5.2. The total weight of the Automatic Robots including the battery must not exceed 10kg. Note that the stationary part of the AR is excluded.
- 7.6. The power source of the robots
 - 7.6.1. All batteries used in robots should not exceed 24V.
 - 7.6.2. The maximum voltage on the circuit(s) should not exceed 24V.
 - 7.6.3. Compressed air should be filled into PET bottles and must not exceed 6 bars (600kPa).
 - 7.6.4. Dangerous energy sources (such as high-pressure gasses) and explosives are prohibited.
 - 7.6.5. A switch for the total power supply must be installed.
 - 7.6.6. 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.
 - 7.6.7. During competition, a wireless and a physical E-stop must be implemented on the TR.



8. Others

- 8.1. For anything not mentioned in this rule book, the teams are required to accept the decisions of the HKUST Robotics Team.
- 8.2. The dimensions, weights, etc of the field, facilities, and equipment described in this rule book have a margin of error of 5% unless otherwise stated.
- 8.3. All robots must pass the requirements of dimension, weight, and safety checks in order to take part in the contest.
- 8.4. Teams might be required to demonstrate all functions of the robots in the final presentation.
- 8.5. The referees may demand additional explanations on safety issues when the safety of a robot is deemed to be in question.
- 8.6. All questions should be addressed to the Q&A link:

<https://forms.gle/m1ixrcv2FVKh17D27>
- 8.7. Any changes to the rules will be announced through Google Drive. Participants are responsible for checking the latest information.
- 8.8. The HKUST Robotics Team will provide basic materials and tools for each team.
- 8.9. Usage of materials and tools not provided by the contest is required to be approved by the Contest (Ask in FAQ section) and supplied by team members themselves.

9. Awards

There are 6 awards in the contest:

- 9.1. Champion
- 9.2. First-Runner Up
- 9.3. Second-Runner Up
- 9.4. Best Engineering Award: The award shall go to the team that has the highest total score from the Mech, Hardware, and Software divisions.
- 9.5. Best Presentation Award: The award shall go to the team that has the best presentation. The presentation refers to the Final Presentation in Section 5.3 of this Rule Book.
- 9.6. Best Creativity Award: The award shall go to the team that has the most creative robot design idea and game strategy.

10. Material List

10.1. Basic Materials

The following items are the basic materials every team can have in designing their Robot:

Mechanical group materials:

Type	Name	Group QTY	Unit price (¥)	Sub Total
tools	Spanner	3	0.6	1.8
	Cross spanner	2	0.99	1.98
	hex key M3	4	0.094	0.376
	hex key M3 (ball)	1	1.32	1.32
	hex key M4	2	0.14	0.28
	Andy scissor	1	11.7	11.7
	Ruler 15mm	1	3.9	3.9
	Ruler 30mm	1	8.5	8.5
	Cutter	1	3.9	3.9
	Best thing ever 1515 or 2020	1	/	/
	Marker	2	/	/
	Puncher	1	2.585	2.585
	Caliper	1	17.9	17.9
	drill bit M3	3	/	/
	drill bit M4	1	/	/
	screw box	1	/	/
	misc. box	1	/	/

Mechanical shared materials

- 20mm x 20mm aluminum tubes
- 15mm x 15mm aluminum tubes
- pneumatic cylinders
- Nuts & screw (on request to mentors)
- Pneumatic connectors (on request to mentors)
- Wire

DO NOT steal tools and components from other teams. You may request anything u can think of, mentor will solve the problem with you. Please do not take any other materials in the lab unless it is on the above lists or with the approval of a mentor. Keep the broken tools or materials until returning.

Type	Name	Group QTY	Unit price (¥)	Sub Total	Remarks
Materials	big plastic box	1	/	/	
	Template45TShape(15mm)	20			
	Template45LShape(15mm)	20			
	Template60TShape(15mm)	20			
	Template60LShape(15mm)	20			/
	Template90TShape(15mm)	40			
	Template90LShape(15mm)	40			
	Template120LShape(15mm)	20			
	M3*25 cup (1.6g)	300			480g
	M3*30 cup (1.9g)	300			570g
	M3*40 cup	50			125g
	M3*50 cup	50			155g
	M3*8 cup (0.8g)	50			40g
	M4*10 cup (1.8g)	50			90g
	M3 Nuts (0.384g)	700			269g
	M4 Nuts (0.81g)	100			180g
	M3 nylon washer	50			
	M4 nylon washer	10			
	Solenoid valve	3	45	135	
	switch (6 tube)	2	2.67	5.34	
	Throttle valve (4)	3	1.5	4.5	
	Throttle valve (6)	1	2.3	2.3	
	Connectors (4 to 6)	1	0.234	0.234	
	Connectors (4Y)	4	0.39	1.56	
	Connectors (6Y)	1	0.4	0.4	
	Connectors (4T)	4	0.38	1.52	
	Connectors (6T)	1	0.4	0.4	
	Outlet 4 tube (straight)(M5)	8	0.32	2.56	
	Outlet 4 tube (L, straight) (M5)	8	0.36	2.88	
	Outlet 6 tube (straight)(M5)	5	0.4	2	
	Outlet 6 tube (L, straight) (M5)	5	0.65	3.25	
	Tread seal PTFE	1	/	/	
	Bottle cap	3	7.5	22.5	
	Omni wheels	3	/	/	
	Omni lockbush	4	26	104	
	Straight wheels	2	7	14	
	coweye	1	/	/	
	RM m3508 P19 + c620	4	599	2396	
	RM m2006 + c610	2	251	502	
	RM m2006 mount	2	/	/	
	RM m3508 mount	4	/	/	
	3dp filament (stored in printers)	1kg	31.5	31.5	
	Wire lock	2	0.38	0.76	
	duct tape	1	4	4	
	e tape	1	10.5	10.5	

Group \$ 3301.445

Hardware materials:

Signal Related	Bluetooth Module (HC-05)	3
	STM32F405	2
	Mainboard PCB	5
	TFT display	2
	TTL	2
	ST-Link (if lost, have to pay \$30 for each)	2
	Power Management Board	3
Power Related	24V LIPO battery + 12V LIPO battery with LIPO Guard	1
	Switch	2
	Emergency stop button (e-stop) + wireless estop set [TR]	1
	Relay	1
	Fuse socket	2
Others	Battery voltage level monitor (beeper)	2

10.2. Additional Materials

Other than the basic materials that are provided, we also provide a list of additional materials. You can buy them with credits. Each team initially has 120 credits. All items have limited stock. A representative of the team can buy the required items through

Google form: <https://forms.gle/Rgx392mMtUq9veir8>

10.2.1. Sensors Refund Policy

To encourage team members to try using different sensors(Item number 1~4) on their robots, when the team purchases a new type of sensor, the team can return their sensor within 24 hours with their credits fully refunded.

- For each team, each type of sensor(Item number 1~4) can be refunded once only. We will not refund the second sensor of the same item number.
- The 24-hour refund period is counted separately for different types of sensors(Item number 1~4).
- The sensor can only be refunded if and only if the sensor is not damaged and within 24 hours of the purchase.

The following are materials that can be purchased by credits.

Number	Materials	Credits
1.	Line Tracking Sensor	4
2.	Ultrasonic Sensor	3
3.	Limit Switch	10
4.	TOF sensor (VL53L1)	12
5.	Mentor help solder MCU on mainboard	5
6.	Mainboard (Soldered)	20
7.	Change wheelset	20
9.	Solenoid valve (total stock: 23)	15
10.	3D-printing (*max 500g in total for each team)	0.5 /g
11.	Tailor-made Glass/carbon fiber plates	0.0005 /mm ²
12.	Slider (total stock: 10)	20
13.	MG996R Servo Motor	30

You may propose some extra types of material and ask for approval in the FAQ. If it is approved, all teams would be allowed to use that, but it should be self-provided.

DO NOT steal tools and components from other teams.

Any lost item(i.e. Not being returned in its original shape and well-organized after the game ends, such as not disassembling the robots) will use deposit to buy with market price.

11. Figures

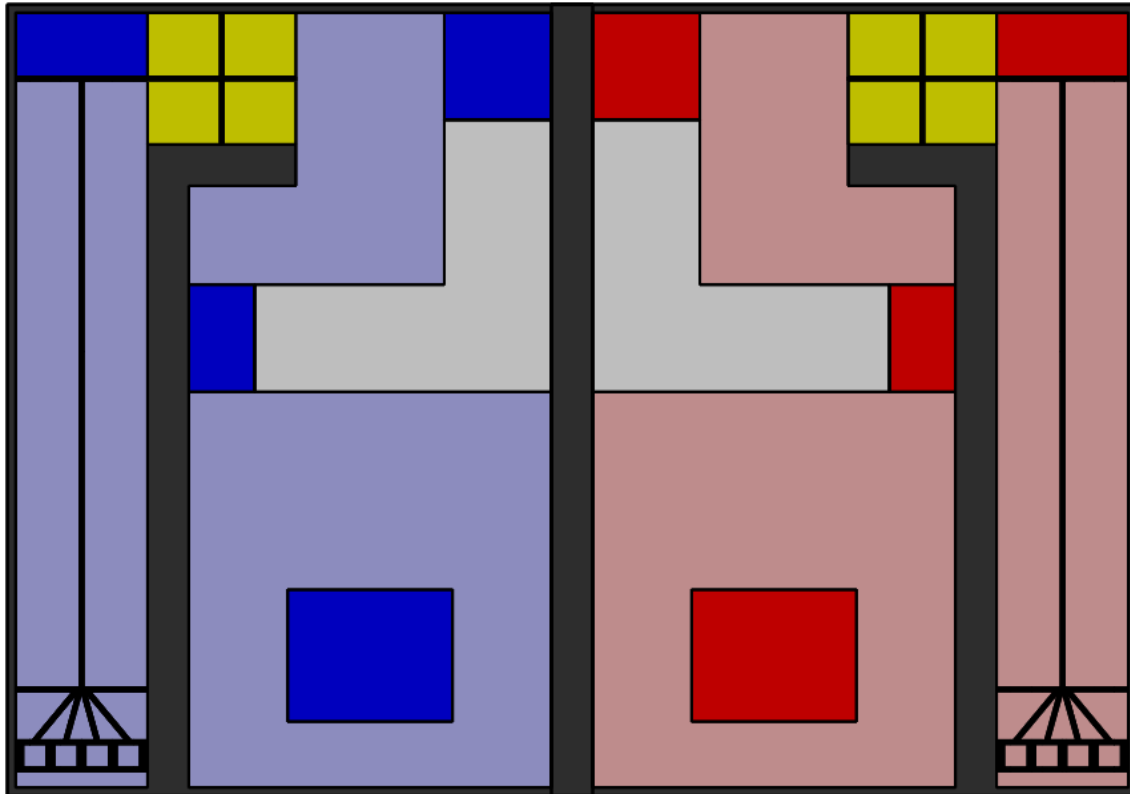


Fig. 1.1: Game Field (Bird-eye view)

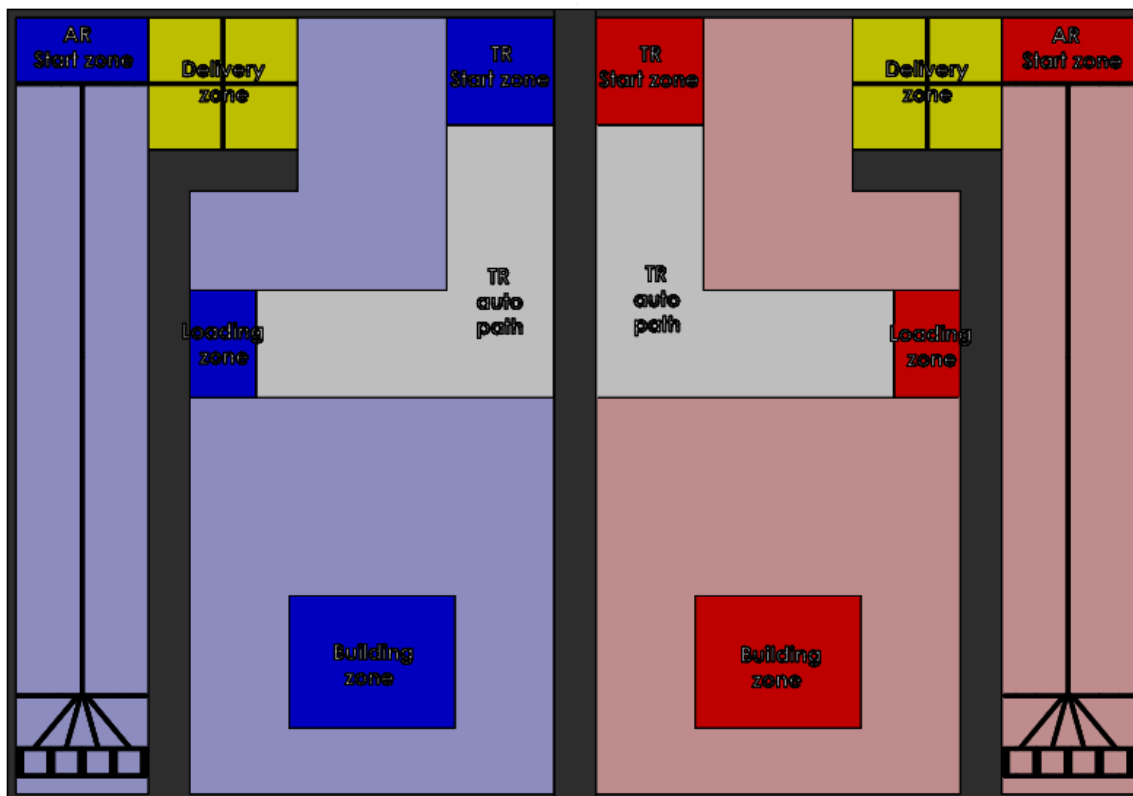


Fig. 1.2: Game Field and its function areas

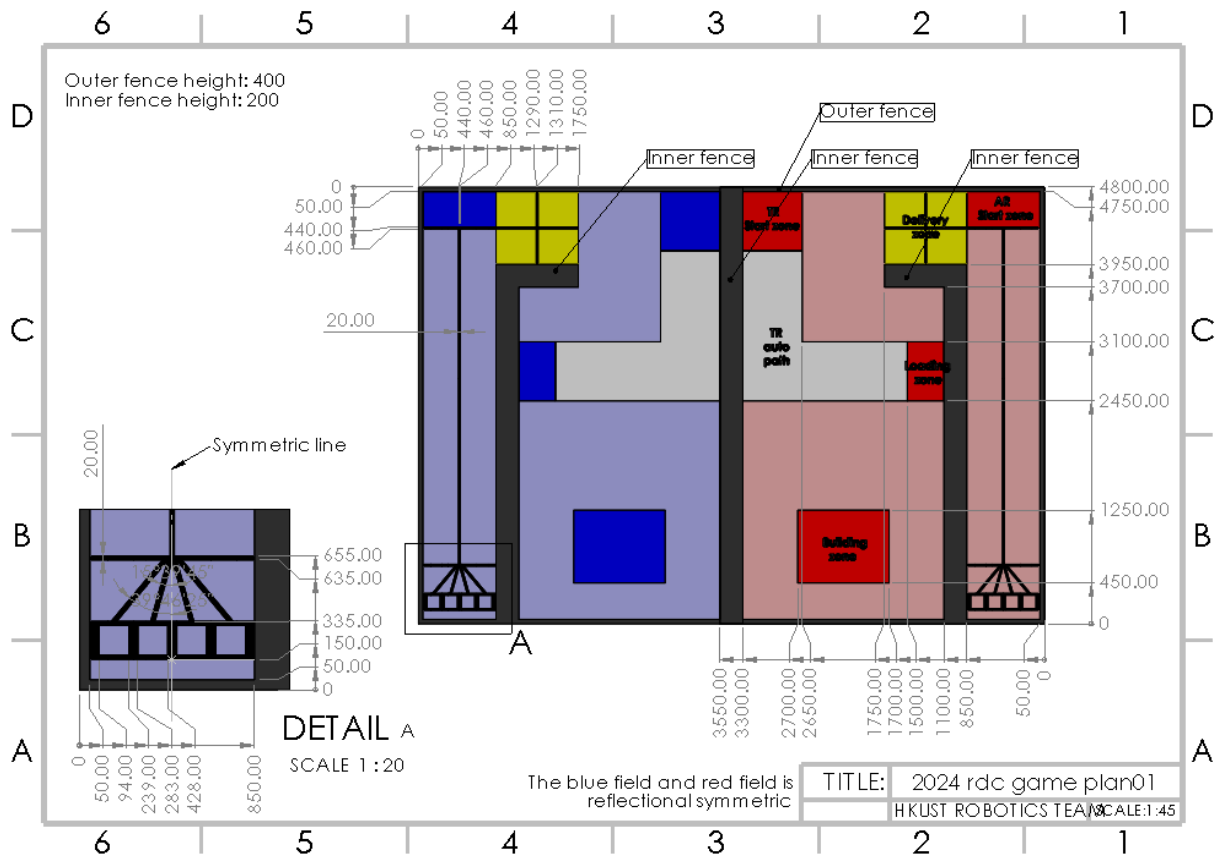


Fig. 1.3: Game Field Dimension

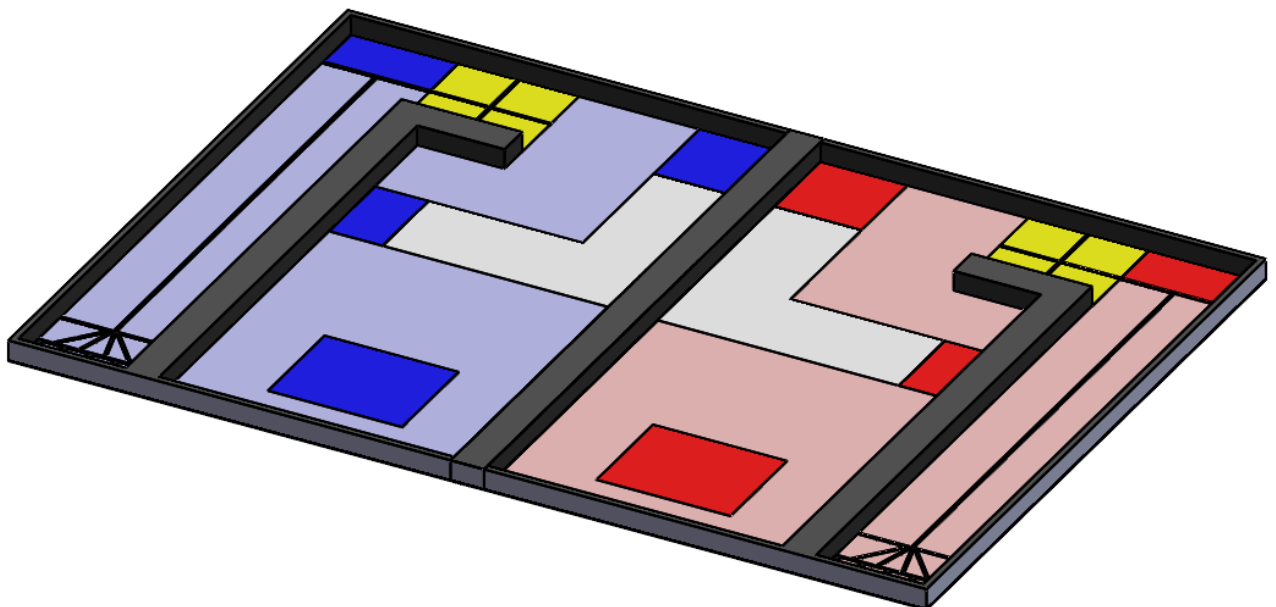


Fig. 1.4: Game Field (Perspective View)

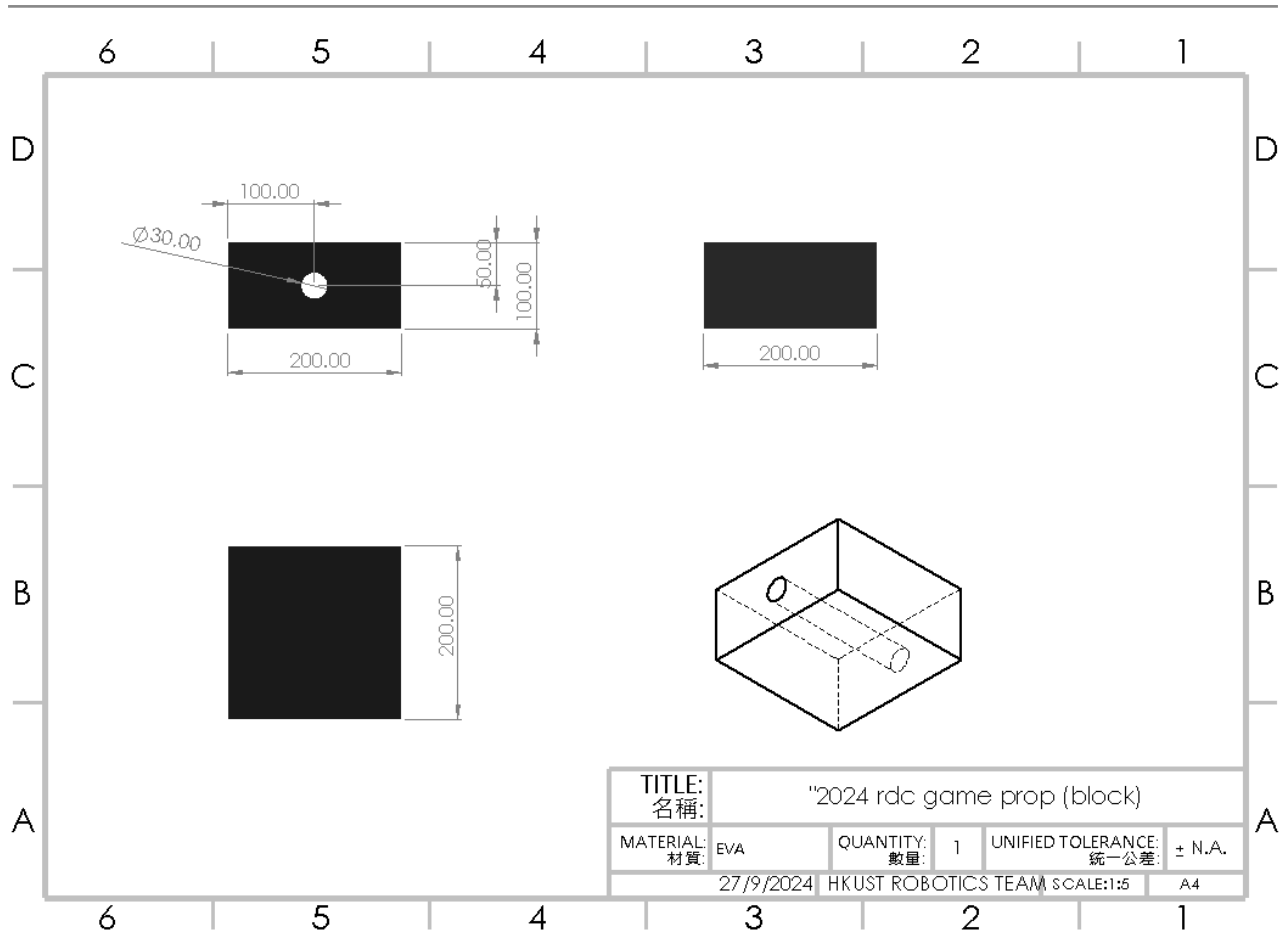


Fig. 2.1: Building block

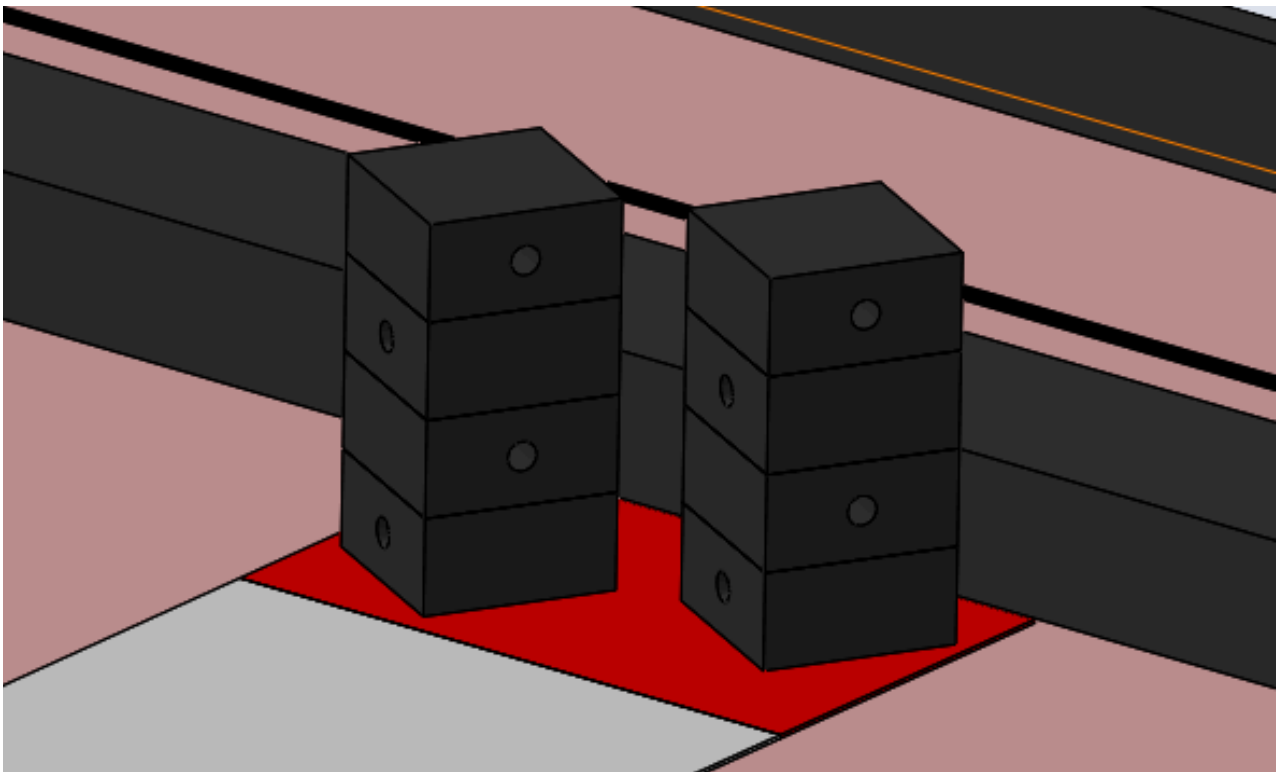


Fig. 2.1.1: Stacked building blocks in loading zone

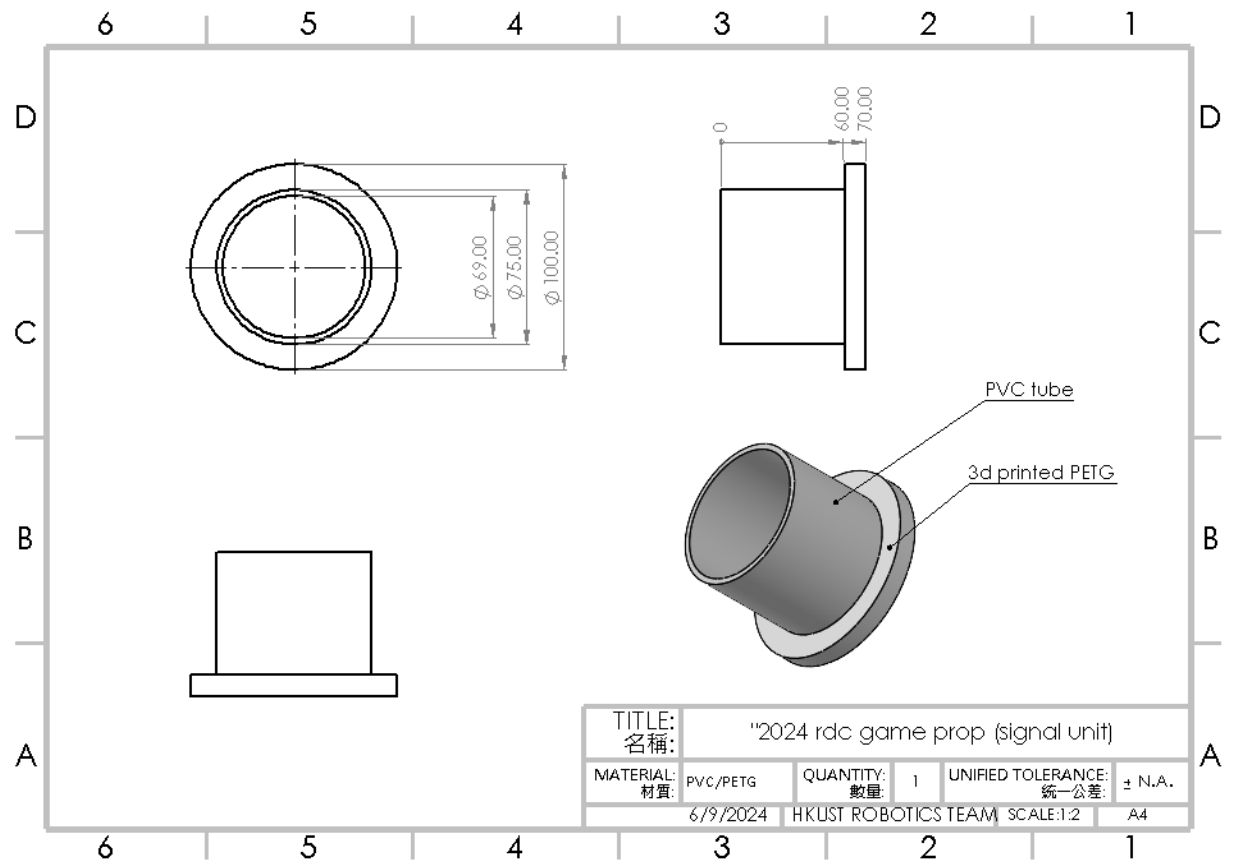


Fig. 2.2: Signal unit

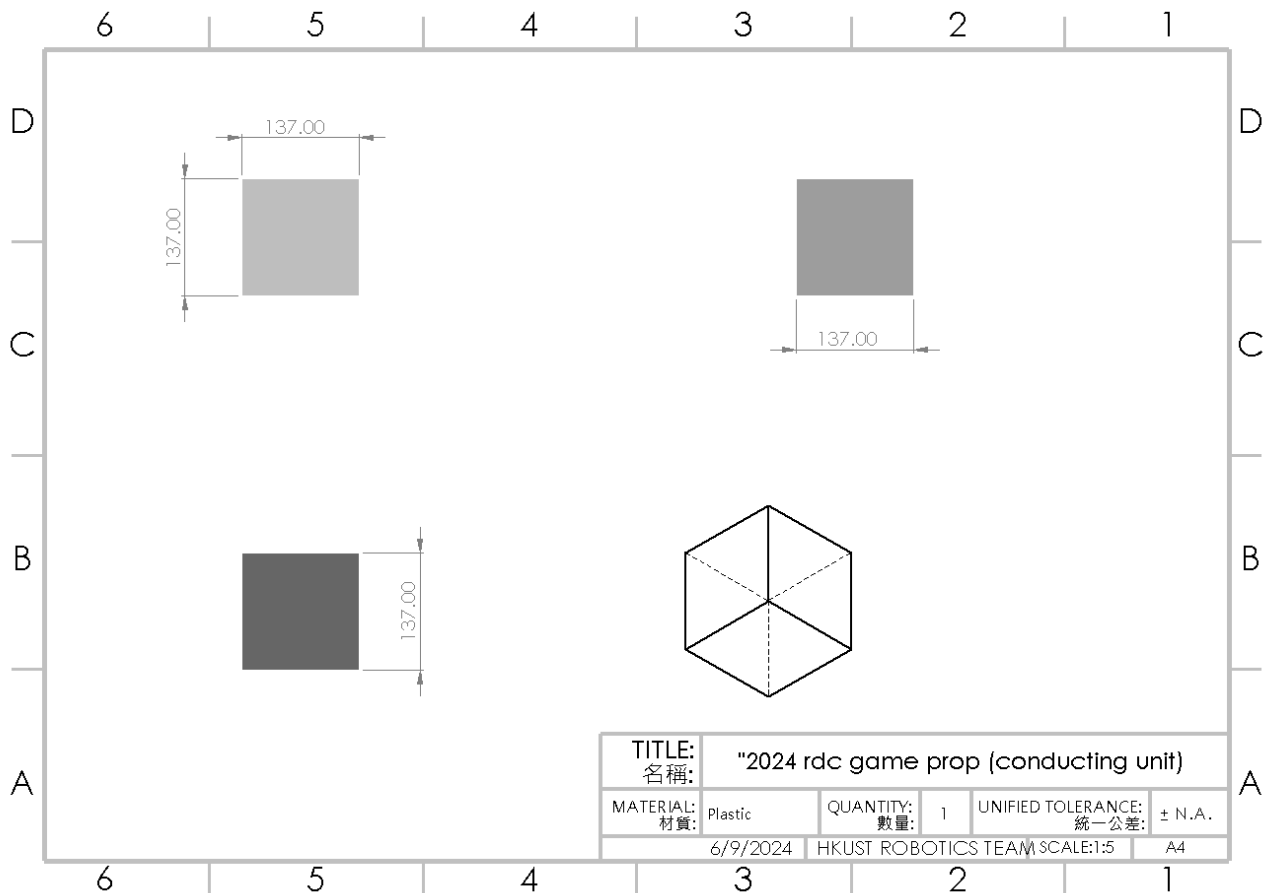


Fig. 2.3: Conducting unit



Fig. 3.1: Slider

MG996R High Torque Metal Gear Dual Ball Bearing Servo

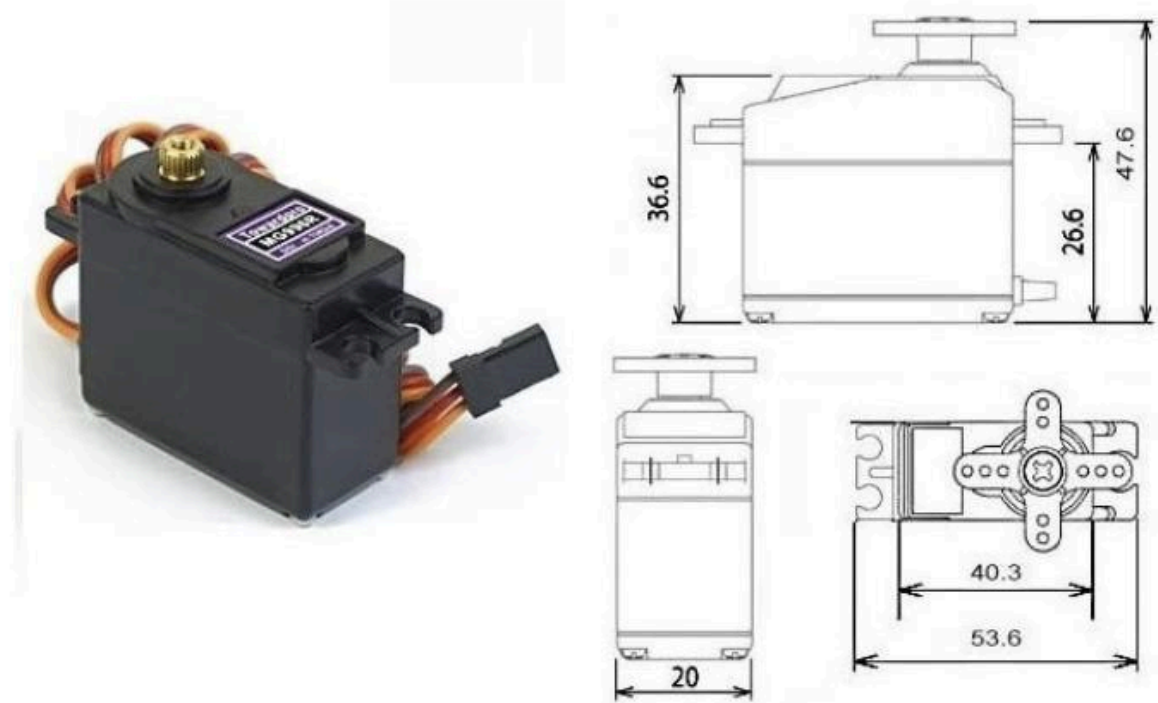


Fig. 3.2: MG996R Servo Motor

[MG996R Tower-Pro \(electronicoscaldas.com\)](http://www.electronicoscaldas.com)

