

ABU Asia-Pacific Robot Contest 2023 Phnom Penh, Cambodia

Rule Book

Theme and Rules Casting Flowers over Angkor Wat

ABU Asia-Pacific Robot Contest 2023, Phnom Penh, Cambodia Host Organizing
Committee, TVK-National Television of Cambodia

21 August 2022

<Rulebook revision>

- 1st Revision on 18 Nov 2022: in yellow highlight
- 2nd Revision on 17 April 2023: in Green highlight

<Background of the Contest Theme>

Angkor Wat in Cambodia is well known as a breath-takingly beautiful temple complex which is the UNESCO world heritage site. In Cambodian fables, among many animal characters, rabbit is often featured as the symbol of wisdom while elephant is strong and has a gentle nature.

The theme of this year's competition is to cast flowers over Angkor Wat by the corporation of a rabbit robot and an elephant robot. The actual competition is "Ring Toss Game" using blue and red rings made of rubber hoses instead of flowers.

<Outline of the Contest Rules>

Two robots, a rabbit robot (RR) and an elephant robot (ER) cooperate with each other to toss their team's-color rings into 11 poles located at the Angkor Wat Area. At the end of the game, the team who has the top ring can get points for the pole.

There are a total of 40 red and blue rings in the contest field. The two robots pick them up and toss them into the poles. ER can move and enter only Red Zone or Blue Zone. On the other hand, RR can move and enter Red Zone or Blue Zone, Bridge, Angkor Red Area or Angkor Blue Area and Angkor Center Area but it is not allowed to enter Moat Area.

Whether ER tosses the rings directly to the poles or RR tosses the rings to the poles while moving in all directions in the Angkor Wat Area, the strategy depends on the team, and the cooperation of the two robots is the key to victory.

The moment the team successfully put all top rings of their color into all 8 poles (own team's Type 1 poles and Type 2 and Type 3 poles in the Angkor Centre Area), they achieve Chey-Yo and be declared as a winner.

< Importance of Safety >

Safety is one of the essential elements to promote the sustainable development of the ABU Robocon. The safety of the designed robots is the primal issue of the safety principle of the contest.

1. The participating teams, as the robot designers, are responsible for the safety of the robots.
2. The teams must consider the safety as the top priority and must consider the safety of all people involved in the contest, including officials, participants, and spectators in all circumstances.
3. The teams must work and cooperate closely with the organizers to ensure the utmost safety of the contest.
4. The teams must pay sufficient attention to the safety in the performance of the robots which must be visible both to the naked eye and to the cameras.
5. The teams must show if the designed robots meet the safety requirements in the robot check video and test runs.
6. The team must attach the emergency button on the robots in visible places.
7. The team members must take care of their own safety by wearing appropriate protective gears during the practice and games in the contest.

<Conditions in the venue>

Please design your robots considering the following venue characteristics in Cambodia regarding the effects of wind and outside light.

1. Since the venue is not designed to block wind, the airflow conditions are not always consistent.
2. The venue is not designed to completely block outside light. Refer to the video link: <https://youtu.be/Gqy1OAS9KFc>
3. Light and air volume data has been released on the official website.

<Robot size and Packing>

The robots must fit inside a single crate with the external dimension of (L1600mm x W1000mm x H1000mm) for transport.

Only one box can be used. The weight of the crate, including the robots, must not exceed 270 kilograms. For ABU Robocon 2023, the crates containing the robots, etc., will be picked up in late July 2023. Participants should consider this when preparing for the contest.

<Contest Outline>

Title:	ABU Asia-Pacific Robot Contest 2023 Phnom Penh, Cambodia (Alias: ABU Robocon 2023 Phnom Penh)
Organizer:	ABU (Asia-Pacific Broadcasting Union)
Host:	ABU Asia-Pacific Robot Contest 2023, Phnom Penh, Cambodia Host Organizing Committee, TVK-National Television of Cambodia
Local Sponsors:	TBA
Special Sponsors:	TBA
Co-operation:	TBA
Contest Date:	Sunday, 27 August 2023
Contest Venue:	Morodok Techo National Stadium (Indoor Stadium)
Schedule:	TBA
Theme and Rules:	Casting Flowers over Angkor Wat
Competition Method:	TBA
Participants:	TBA
Awards:	ABU Robocon award, Grand Prix, 1st runner-up, 2nd Runner-ups, Best Idea Award, Best Engineering Award, Best Design Award, Special Awards

Game Rules

1. Terms and Definitions

Terms and definitions used in the rules of ABU Robocon 2023 are as follows:

No.	Term	Definition
1	Team	There are two teams, Red Team and Blue Team.
2	Robot	Each team can build maximum of two robots, one Rabbit Robot and one Elephant Robot. They can be manual or automatic.
3	Rabbit Robot (RR)	RR can enter all of their teams' areas and zones in the field. RR picks up a ring(s) and tosses it into the pole of Angkor Wat Area. RR is prohibited to enter the opponent team's area including the space above nor can they touch the Moat Area.
4	Elephant Robot (ER)	ER cannot enter Angkor Wat Area. ER picks up rings and tosses them into the pole of Angkor Wat Area. ER is prohibited to enter the opponent team's area and Angkor Wat Area including the space above nor can they touch the Moat area.
5	Field	Field is where the robots complete their tasks. It is a square of 12,000 mm X 12,000 mm.
6	Start Zones	Start Zones are where the robots are placed in the field at the beginning of the game. Each teams has one Start Zone for their two robots. It is a rectangle of 1,500 mm × 1,000 mm.
7	Fence	Fences are structures installed as area boundaries around the field and the Moat Area. The perimeter of the field is surrounded by a fence with a height of 100mm and thickness of 50mm. The outer circumference of the Moat Area is surrounded by a fence with a height of 50 mm and a thickness of 25 mm. The robot may touch the top and inside of the fence but cannot touch outside of the fence.
8	Red Area and Blue Area	The field consists of a Red Area and Blue Area which surround the Moat area. Each team's robots can move in their area freely.
9	Moat Area	Moat Area is the dark blue area surrounding Angkor Wat Area. Both robots cannot touch the Moat Area.
10	Bridge	There is a Bridge to each Red Team and Blue Team. Bridges are the passages connecting the Red/Blue Area with the Angkor Wat Area. ER is prohibited to touch the Bridge.
13	Angkor Wat Area	Angkor Wat Area means the area inside of the Moat Area. It consists of Angkor Red Area, Angkor Blue Area and Wat Centre Area. Moat Area is not included in the Angkor Wat Area.
11	Angkor Red Area and Angkor Blue Area	The area 200 mm higher than the lowest surface of the field. The Angkor Wat Area has Angkor Red Area and Angkor Blue Area. Each team's RR can move here freely.
12	Angkor Centre Area	The area 400 mm higher than the lower surface of the field. Each team's RR can move here freely.
14	Retry Zone	There are two Retry Zones, each for Red Team and Blue Team. Retry Zones are the zones to adjust and restart the RR when it's in the Angkor Wat Area retries.

15	Poles	Poles are the ring toss targets. They are located at 11 places in Angkor Wat Area. There are three types of poles: type 1, type 2 and type 3. See drawing.
16	Ring	Rings are the objects represent flowers which will be tossed to the poles. A ring has an inner diameter of 200 mm made of a rubber hose. There are total of 40 rings for each team. There are total of 40 rings, 10 rings placed at 2 different locations and 20 rings at 1 location for each team in the field. The team who has the top ring can get points for the pole at the end of the game. A ring that is tossed in the pole but is sitting above the top of the pole does not score a point.
17	Ring Zone	The zone where the rings are placed before the start of the game. There are three ring zones for each team. The team can place 10 rings in each Ring Zone in the Blue area or Red area. The team can place 20 rings in the Ring Zones in the Angkor Red area and Angkor Blue Area. Teams can place their rings freely in their Ring Zone during setting up time. Teams are allowed to use a jig to place their Rings. However, at the end of the setting time, only Rings should remain in the Ring Zones.
18	Chey-Yo	The moment the team successfully put all top rings of their color into all 8 poles (own team's Type 1 poles / Type 2 poles / Type 3 pole), they achieve Chey-Yo and be declared as a winner.

2. Contest Rules and Game Proceedings

The game time is 3 minutes.

2.1 Game Proceedings

◆ Before the game starts

- 2.1.1 Both teams place their robots in their Start Zone in the field before the setting time.
- 2.1.2 Referee will give one-minute setting time before each game starts. Three team members and a maximum of three pit crews can participate in the setting time.
- 2.1.3 Once the setting time has started, they can start setting their robots.
- 2.1.4 If they fail to complete the setting within the given time, they can resume setting after the start of the game. Once they finished setting, they can start their robots with the referee's permission.
- 2.1.5 Before the game starts, two robots must be in their respective Start Zone, including its space above.

◆ During the game

- 2.1.6. When the setting time has passed, the game will start.
- 2.1.7 Team members must not touch their robots except when they turn on the start button **or** retry, or when they push the emergency stop button.
- 2.1.8 Team members must not touch rings except for a retry.
- 2.1.9 When the game starts, the two robots will each leave the Start Zone and pick up their team's ring.

- 2.1.10 Rabbit Robot (RR) can toss rings at poles from all areas where intrusion is permitted. RR cannot touch, grab, suck or stick any poles. RR can **pass by and lightly touch** any poles only during travelling. The ring is valid only when RR is not in contact with the pole.
- 2.1.11 Elephant robot (ER) can toss a ring into the pole only from the team's area in the Red Area or Blue Area.
- 2.1.12 The ER can carry and lift the RR.
- 2.1.13 The two robots can pick up the ring(s) which has fallen in the area where they can move and toss it into the pole.
- 2.1.14 Once the rings are tossed in the pole, they cannot be removed.
- 2.1.15 The RR cannot touch the RR of the opponent team. It is a foul of the robot that actively touched the other robot.
- 2.1.16 The game will end when any of the following conditions are met:
 - ① When either team achieves "Chey-Yo".
 - ② When 3 minutes have passed since the start of the game.
 - ③ When either team is disqualified.

2.2 Points

The team who has the top ring can get points per Pole at the end of the game. The points earned by each of the three types of Poles are as follows.

Type 1: 10 points per Pole

Type 2: 30 points per Pole

Type 3: 70 points per Pole

Opponents Type 1 : 25 points per Pole

2.3 Deciding the Winner

- a) The team who achieves Chey-Yo" wins the game.
 - b) The team with the higher total points wins.
- If there is a tie, the winner will be decided in the following order:
- c) The team has the ring at the top of the Type 3 pole.
 - d) The team has the ring on top of more Type 2 poles.
 - e) The team has the ring on top of more Type 1 poles.
 - f) The team has the ring on top of more Opponents Type 1 poles.
 - g) The team who placed the first ring on any pole.
 - h) If there is a tie, the judges will decide the winner.

2.4 Retry

2.4.1 If needed the team can apply for a retry with the permission of the referee.

2.4.2 If the robot is in the Red Area, Blue area, or Bridge, return the robot to the Start Zone for adjustments.

2.4.3 If all the ground planes of the RR are in the Angkor Wat Area, return the robot to the Retry Zone for adjustments. However, if the other robot is nearby and the referee determines that it is dangerous, the robot cannot be moved.

2.4.4 During the retry, team members cannot adjust the ring(s) held by the robot. The ring(s) held by robot must be returned to any Ring Zones.

2.4.5 There is no limit to the number of retries.

3. Violations

If the following violation occurred, the robot will be forced to retry and restart from the location corresponding to "2.4 Retry".

3.1 Entering areas or space above where each robot should not enter.

3.2 RR stands to prevent opponent from entering the Angkor Center Area.

3.3 Team members touch the robot in situations not permitted by this rulebook.

3.4 Robots touching the area or objects which is prohibited to touch.

3.5 Robots touching the opponent team's robots.

4. Disqualification

A team will be disqualified with any of the following actions during the game:

4.1 The design and build of the robot are not following the rulebook.

4.2 The team intentionally damages or tries to damage the field, facilities, and game objects.

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.

5. Robots

5.1 The robots are not allowed to suction or to stick on the game field.

5.2 The robots in the contest must be built by team members from the same university or college, or polytechnics.

5.3 Teams are not allowed to bring or set up any equipment around the field, except robots and spare parts used in the game and some tools/devices used in setting time.

5.4. Robot Size

5.4.1 At the start of the game, the RR must fit in a cube with a horizontal surface of 500 mm x 500 mm and a height of 500 mm. During the game, the RR should be sized to fit in a cube with horizontal surface of 700 mm x 700 mm and a height of 800 mm. When the robot is tilted from the horizontal surface due to step movement or jumping and etc, RR must not extend beyond the cube which RR must fit. The rings which the robot has will not be included in the size.

5.4.2 At the start of the game, the ER must fit in a cube with a horizontal surface of 1000 mm x 1000 mm and a height of 1000 mm. During the match, the bottom of RR should be 1400 mm x 1400 mm and the size should fit in a cube with a height of 1300 mm. When the robot is tilted from the horizontal surface due to step movement or jumping and etc, ER must not extend beyond the cube which ER must fit. The rings which the robot has will not be included in the size.

5.4.3 RR must be controlled wirelessly. When controlling ER with a wired controller, the cable length is unlimited. However, be careful not to wind the cable on the facilities and game objects in the field.

5.4.4 Team members must not enter the game field except for retry.

5.4.5 Flying objects cannot be used as robots.

5.5 Weight of the Robots

The total weight of two robots, controllers, the primary set of batteries used in the game must not exceed 50 kg. Any other equipment that the team brings for setup purposes, tools, air containers, and backup batteries (of the same type as that initially installed in the robot) are exempt.

5.6 Power Sources of the Robots

5.6.1 Each team shall prepare its own power source.

5.6.2 Teams can use only batteries, compressed air, and/or elastic force as power source.

5.6.3 The nominal voltage of any battery used in the robot, controller, and any other devices during the game shall not exceed 24V. When connecting batteries in series, the total voltage must be 24V or less.

5.6.4 Measured voltage should be set to 42V or less by actual measurement. If the power supply system includes multiple isolated circuits, voltage in each system must be 42V or

less.

- 5.6.5 Teams using compressed air must use either a container made for the purpose or a plastic bottle in pristine condition prepared appropriately. Air pressure must not exceed 600 kPa.
- 5.6.6 Any power source deemed dangerous may be banned from use.

5.7 Communication

- 5.7.1 Two robots in a team can cooperate and communicate with each other to complete the task.
- 5.7.2 For radio frequency communication, teams can use only Wi-Fi (IEEE 802.11), Zigbee (IEEE 802.15), and Bluetooth for the communications between controller and robot and between two robots. The organizer will not control the environment of Wi-Fi, Zigbee or Bluetooth.

5.8 Robot Inspection

- 5.8.1 During the test run before the contest, referees, will inspect the robots. Robots that do not meet the above requirements cannot participate in the game.

6. Safety

The design and build of robots should not pose any kind of danger to any person at the competition scene.

- 6.1 All robots must be designed and built to cause no damage to any robots of the opposing team or the field.
- 6.2 An emergency switch must be attached to each of the robot to shut down the robot in case of loss of control at any time.
- 6.3 Team members must wear running shoes, helmets, and safety goggles during the games and test runs.
- 6.4 The use of explosives, fire, or dangerous chemicals is prohibited.
- 6.5 Accumulators, lead-acid batteries are not allowed.
- 6.6 In designing and using the laser or infrared beams, full care must be taken to protect all persons at the venue from harm during all procedures. In particular, the beams must be so oriented that they cannot shine into the spectators' eyes.
- 6.7 When using a laser, it must be class 2 or lower. Class 1M and Class 2M are not accepted.
* Compliant with IEC60825.
- 6.8 Team should design fail safe systems
- 6.9 When teams have multiple power supply systems, teams must design the circuits and mechanisms not to go out of control or move dangerously no matter which power supply is lost or regardless of the order of turning on the power.
- 6.10 To avoid starting a fire or smoking by the overload of a motor stall and so on, proper current limiting devices such as a circuit breaker must be installed to power supply circuits.
- 6.11 Use wires, connectors, terminals, etc., with a rated current equal to or higher than the assumed maximum current.

7. Teams

- 7.1 One team represents one country/region. 2 teams can represent the host country.
- 7.2 Each team consists of three (3) students (called team members), and one (1) instructor. They all belong to the same college, university, or polytechnic. The three students of the team can participate in the game.
- 7.3 In addition to three (3) team members, an additional three (3) student members can register as the pit crews and to assist in the pit area, to carry the robots to the field, and participate in the setting of the robots. They must be students from the same college, university, or polytechnic as the team.

7.4 Postgraduates cannot participate.

8. Others

- 8.1 The legitimacy of any actions not mentioned in this Rulebook is subject to the discretion of the referee and judges.
- 8.2 The dimensions, weights, etc., of the field, facilities, and equipment described in this Rulebook have an error margin of $\pm 5\%$ unless otherwise stated. However, the dimensions and weights of the robots shown in the Rulebook are the maximum and cannot be tolerated.
- 8.3 All questions should be addressed to the official website of the ABU Asia-Pacific Robot Contest 2023, <http://www.aburobocon2023.com>. Notification of any additions and/or corrections to this Rulebook are made on the official website.