ABU

Asia-Pacific Robot Contest 2019

Ulaanbaatar, Mongolia

THEME & RULES

“GREAT URTUU”

August 2019

ABU Asia-Pacific Robot Contest 2019 Ulaanbaatar, Mongolia

Organizing Committee

http://aburobocon2019.mnb.mn

Contest Theme

"GREAT URTUU"

Slogan: "Sharing the knowledge"

The concept of the contest:

The mission of the ABU Robocon 2019 Ulaanbaatar is to deliver information fast by using a relay messenger system - the Urtuu, which was first innovated in the world by the nomadic Mongolians. For exchanging information in a long distance, Mongolians had been using the Urtuu system as a messenger for rest (feeding, replacing a horse, etc.,), and in some cases, relay to another messenger. By using the Urtuu system, a messenger was able to travel in distance of 400 kilometres per day. At present days, we are going through massive and abrupt development of exchanging and sharing knowledge and information. This Urtuu system was an important invention that opened a new door for us to exchange and share the knowledge in regardless of space. Based on this concept, ABU Robocon 2019 Ulaanbaatar is designed to promote the idea of "Sharing the knowledge".

A match is between Red and Blue teams. It lasts three minutes at most. Each team has one manual robot known as Messenger-Robot 1, and one automatic robot known as Messenger-Robot 2. The automatic robot has four legs as of horses while wheels are not allowed. The manual robot carries the Gerege as a testimony from the Khangai urtuu, which is the the starting point. It goes along Forest, Bridge, and crosses the Line 1 next to Gobi urtuu, which is the starting point of the automatic robot. After Messenger-Robot 1 reaches Gobi urtuu, Messenger-Robot 1 passes Gerege to Messenger-Robot 2 at Gobi urtuu. Once Messenger-Robot 2 successfully receives Gerege, it can go along the Gobi area. Messenger-Robot 2 must go by four legs, like a horse, and cannot use wheels to move. Messenger-Robot 2 passes through Sand dune and Tussock, and directs to Mountain urtuu. After Messenger-Robot 2 reaches Mountain urtuu, Messenger-Robot 1 can enter Throwing zone to throw Shagai, and must earn 50 or more points. In case that Messenger-Robot 1 earns 50 or more points, Messenger-Robot 2 is allowed to climb the Mountain. Afterwards, if it reaches Uukhai zone and raises the Gerege first, the team is the winner, which is called "UUKHAI".

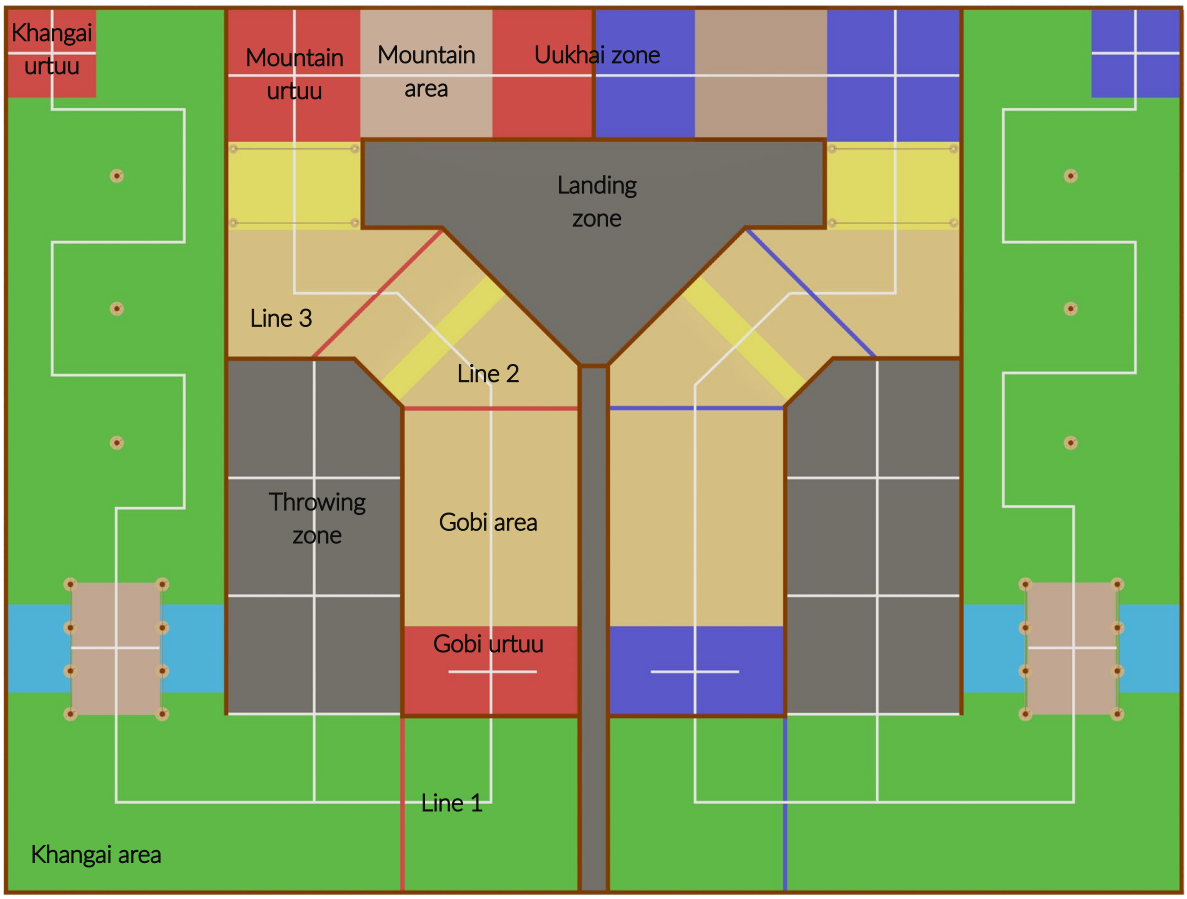

Figure 1. Game field- Areas and Zones

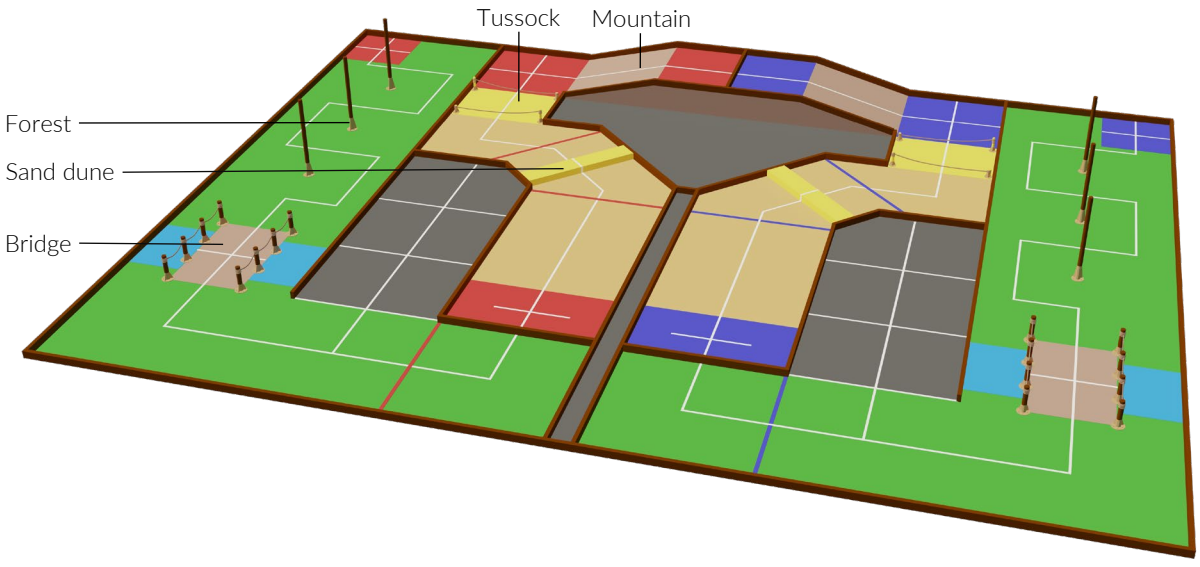

Figure 2. Game field- Objects

Importance of Safety

Safety is one of important elements in the sustainable development of the ABU Robocon.

The safety of the designed robots is the first and foremost issue for the safety principle of the contest. The participating teams, as the robot's designers, are responsible for the safety of their robots.

The teams must work and cooperate closely with the organizers to ensure the utmost safety of the contest.

Safety must always be the top priority and must be considered by all people involved in the contest including officials, participants and spectators in all circumstances.

Teams are required to pay sufficient attention to the safety of their robots before applying to take part in the contest.

It must be observable whether the designed robots meet the safety during the video check and test runs.

Team members must wear running shoes, helmets, and safety goggles during the matches and test runs.

Domestic Contest in Each Country and/or Region

Since all domestic contests in each country and/or region are organized in order to find the representatives to participate in ABU Robocon 2019 Ulaanbaatar, they should conform to the rules. It is known that materials may not be available in some places. Domestic organizers are advised to use the best possible materials and adhere as closely as possible to the specifications laid down for the final contest.

Transporting the Robots

1. The robots must fit inside a single box with the dimension of 1000 mm Width x 1800 mm Length x 800 mm Height for transport. Only one box is used. The weight of the box, including the robots, must not exceed 240 kilogrammes.
2. As for ABU Robocon 2019, the robot delivery time to Ulaanbaatar is expected to take longer than past years. Therefore, the robot pick-up time could be as early as early July. Please ask participants to prepare for the contest by taking it into consideration.

The contest outlines

Title:	Asia-Pacific Robot Contest 2019 Ulaanbaatar, Mongolia (Alias: ABU Robocon 2019 Ulaanbaatar)	
Organizer:	ABU (Asia-Pacific Broadcasting Union)	
Host:	Mongolian National Broadcaster, The Organizing Committee of Robocon 2019 Ulaanbaatar, Mongolia	
Contest Date:	Sunday, 25 August 2019	
Contest Venue:	Buyant Ukhaa Sport Palace	
Schedule:	Friday, 23 August	Participants' Arrival
	Saturday, 24 August	Orientation, Test-run, Rehearsal
	Sunday, 25 August	Contest Day
	Monday, 26 August	Friendship Exchange Programme,
ABU Meetings:	Tuesday, 27 August	Participants' Departure
Theme and rules	'Great Urtuu'	
Competition Method:	Preliminary League and Final Tournament	
Participants:	To be confirmed in July 2019	
Awards:	ABU Robocon award, Grand Prix, 1st runner-up, 2nd Runner-ups, Best Idea Award, Best Engineering Award, Best Design Award, Special Awards.	

Rules

Terms and Definitions

Terms and definitions which are used in the rules of ABU Robocon 2019 Ulaanbaatar, are given in the following table.

#	Term	Definition
1	Messenger-Robot 1 (MR1)	Either a manual or semi-automatic or fully automatic robot. It passes the Gerege to Messenger-Robot 2 and throws the Shagai to earn a point.
2	Messenger-Robot 2 (MR2)	An automatic robot. It has to move only on four legs, like a horse. Also, it brings the Gerege to Uukai zone.
3	Gerege	An official document (a testimony) of the messenger. MR1 passes Gerege to MR2 and MR2 raises it on top of the mountain.
4	Shagai	The traditional game of the Mongolians - ankle bones of animals, especially sheep. In this game MR1 throws Shagai to score more than 50 points. 50 points, 40 points and 20 points are allocated to each face of the Shagai.
5	Urtuu	Relay station or starting zone.
6	Khangai area	The green area, Forest, Khangai urtuu and Bridge of the Game Field .
7	Forest	The obstacle that MR1 has to go through.
8	Bridge and River	The obstacle that MR1 has to cross over. MR1 crosses the river over the bridge.
9	Gobi area	The dark yellow area, Gobi urtuu, Sand dune and Tussock of the Game Field.
10	Sand dune	A timber that MR2 has to cross over.
11	Tussock	The obstacle made of ropes that MR2 has to cross over.
12	Mountain area	Mountain urtuu, Uukhai zone and the slope that MR2 has to climb.
13	Khangai urtuu	MR1 starting zone
14	Gobi urtuu	MR2 starting zone
15	Mountain urtuu	The zone that MR2 stays while MR1 earns 50 or more points by throwing Shagais.
16	Uukhai zone	The zone that MR2 raises the Gerege to be a winner.
17	Line 1, 2, 3	The task is completed when the lines are crossed. Crossing the Line 1: The robot comes from Khagai urtuu, crosses the entire line. Crossing the Line 2, 3: The robot travels from Gobi urtuu to Mountain urtuu on four legs.
18	Throwing zone	Zone where MR1 throws Shagai.
19	Landing zone	Zone where the thrown Shagai lands .
20	UUKHAI	Shout for joy or in praise or encouragement.
21	Moving on four legs	Each of the four legs must touch and leave the field. Shuffling is not allowed. Mechanism whose contact area with the field rotates 360 degrees is prohibited. MR2 must not have wheels in the contact area with the field.

1. Game Procedure and Competition Tasks

Each team has to complete tasks in the following orders:

1.1. Setting of robots

1.1.1. Team must set up their robots in a one minute 'setting-time' before the game starts.

1.1.2. Three (3) team members and up to three (3) pit crew members is allowed to participate in the set-up process.

1.1.3. If the team that fails to complete setting up within one minute, they can resume setting up after the game has started. Once setting up is finished, the team can start their robot with permission from referee.

1.2. Deployment of the robots at the start of the game and team members during the game

1.2.1. MR1 must start from Khangai urtuu. The robot must fit into the Khangai urtuu including its space above.

1.2.2. MR2 must start from Gobi urtuu. The robot must fit into the Gobi urtuu including its space above.

1.2.3. All team members have to be outside the game field. Only MR1's operator is allowed to be inside the game field. However, the operator must not run while controlling MR1.

1.2.4. If an operator needs to be inside the game field, the operator can be in the Khangai area and Throwing zone only.

1.2.5. If MR1 is designed as a fully automatic robot, all team members must be outside the game field except during start of operation or a retry.

1.2.6. MR1 is allowed to enter outside of the space above the Khangai Area and Throwing zone. MR2 is allowed to enter outside of the space above the the Gobi Area and Mountain Area. However, both robots must not enter the space above opponent team's field.

1.3. The Gerege and Shagai

1.3.1. Each team uses one Gerege and three Shagais that are prepared by a host organizer.

1.3.2. MR1 must hold the Gerege when the game starts.

1.3.3. Each team uses three Shagais, and they must be placed in the Khangai area when the game starts. Teams decide where to place them by themselves.

1.3.4. Team members are not allowed to touch the Gerege and Shagais except during setting time or a retry.

1.3.5. Carrying the Gerege:

1.3.5.1. MR1 must carry the Gerege vertically. (Holed-side is an upside)

1.3.5.2. MR1 is allowed to tilt the Gerege in the range up to 45°.

1.3.5.3. When MR 1 holds Gerege, at least 70% of one side of the Gerege must be visible.

1.3.5.4. Messenger-Robot 1 must carry the Gerege higher than its upper body, while Messenger-Robot 2 must carry it lower than its upper body.

1.4. Task in the Khangai area

1.4.1. MR1 starts from Khangai urtuu with the start sound. It runs along Forest, River and crosses the Line 1. 'Crosses the line' is considered successful when all of the contact surfaces of the robot make contact with the field in front of the Line.

1.4.2. MR1 has to travel through the forest according to the route indicated by white guidelines.

1.4.3. When travel through Forest, MR1 can touch trees/woods but must not use it for changing direction or moving.

1.4.4. MR1 has to cross the River over the Bridge.

1.5. Passing the Gerege

1.5.1. After crossing Line 1, MR1 passes Gerege on to MR2.

1.5.2. MR1 cannot physically touch MR2 while passing the Gerege. However, MR1 can start MR2 by giving sign or pushing start button of MR2 through Gerege.

1.5.3. Throwing the Gerege is prohibited. The robots can only hand over the Gerege. When passing on the Gerege there must be a moment that both robots are in contact with Gerege at the same time.

1.5.4. It is considered "successfully passed" only when MR1 is separated from the Gerege, and MR2 holding the Gerege.

1.5.5. When carrying Gerge, MR2 doesn't have to hold it vertically and the Gerge doesn't have to be visible.

1.6. Task in the Gobi area

1.6.1. When MR2 received Gerge and move on to crosses the Line 2, the team gets points. 'Cross the line' means, all contact surface of each of four legs of MR2 must be in contact with the field beyond the Line. It is unnecessary for all of the four legs are in contact with the field at the same time.

1.6.2. When MR2 travel through Sand Dune and crosses the Line 3, the team gets point.

1.6.3. When MR2 travel through Tussock and reaches Mountain urtuu, the team gets points. 'Reach' means that all of the contact surfaces of each of four legs of MR2 make contact with the Mountain urtuu. It is unnecessary for all of the four legs are in contact with the urtuu at the same time.

1.6.4. After MR2 reaches the Mountain urtuu, MR2 has to wait there.

1.7. Throwing a Shagai

1.7.1. Once MR1 successfully passed Gerege on to MR2, MR1 can pick up Shagai.

1.7.2. Once MR2 successfully reached Mountain urtuu, MR1 can enter the Throwing zone and throw a Shagai.

1.7.3. MR1 can hold and throw only one Shagai at a time. MR1 can throw 3 Shagais until the team scores more than 50 points by throwng Shagai.

1.7.4. MR1 cannot damage shagai with actions such as, sticking or grasping too hard.

1.7.5. When MR1 earns 50 or more points by throwing Shagai, referee raises flag for confirmation.

1.7.6. If Shagai landed on the team's own field or landed out of the field, team can apply for 'Shagai Retry'. With permission from referee, team member can pick up the thrown Shagai and return it to Khangai area. During this time the team member must stop MR1. Once shagais is arranged, team member can activate MR1 with a permission from referee. Then MR1 can re-throw Shagai.

1.7.7. If a Shagai thrown by MR1 lands in the opponent's game field, the team is disqualified, and the opponent is the winner by knockout.

1.8. Climbing the Mountain

1.8.1. After MR2 reaches the Mountain urtuu, with referee's permission, team members can enter the Mountain urtuu and touch MR2 to stop MR2 and change programme and/or re-arrange direction of MR2.

1.8.2. As MR1 earns at least 50 points by throwing a Shagai, MR2 is allowed to climb the Mountain.

1.8.3. Signal to start climing the Mountain can be given by a team member without any physical contact.

1.8.4. Once MR2 reaches Uukhai zone, MR2 can raise Gerege vertically above its upper body. 'Reach Uukhai zone' means that all of the contact surfaces of each of four legs of MR2 make contact with the Uukhai zone. It is unnecessary for all of the four legs are in contact with the zone at the same time. The team that raises The Gerege first is the winner of the game by knockout that is called "UUKHAI". 'Raising vertically' means, while MR2 raise Gerege, MR2 can tilt the Gerege in the range up to 45° with at least 70% of one side of the Gerege must be visible.

1.9. Team members cannot touch robots except during retry, start, and when MR2 reached the Mountain urtuu.

1.10. In case of an emergency, with permission from referee, one team member can enter the contest field to push emergency stop button.

2. Retries of the Robots

2.1. A retry can be made only with/after referee's permission.

2.2. Team members must place the robots at an assigned restart position while preparing for a retry.

2.3. There is no limits for retry. A retry is considered by the rule with approval from the referee.

2.4. A retry is compulsory when the robots hold Gerege in the way that deviated from the prescribed range or drop the Gerege or violate the rules.

2.5. Restart position after a retry of the robot is the last leaving Urtuu or before the Line that is the last crossing. If restart from urtuu, the robot must restart from the position which all of the its contact surface with the field must be inside of the urtuu. If restart from one of the Lines, the robot must restart from the position of 'stride over' the Line.

2.6. Strategies premised on the use of retries are allowed.

3. Deciding of Winner

3.1. The first team that MR2 successfully climbs the Mountain and raises the Gerege is the winner of the game by knockout. The winning is called "UUKHAI".

3.2. If neither team achieves "UUKHAI" at the end of the 3 minutes match, the winner is decided based on the earning scores. The team that earns higher score is the winner. The score for each task is described as follows:

Tasks	Points
MR1 crosses Line 1 successfully	20 points
MR1 passes the Gerege successfully	20 points
MR2 crosses Line 2 successfully	30 points
MR2 crosses Line 3 successfully	30 points
MR2 reaches Mountain urtuu successfully	30 points
MR2 reaches Uukhai zone successfully	30 points
A Shagai lands in the Landing Zone. (Except horse or camel. See Appendix 11)	20 points
A Shagai lands in the Landing zone as a camel. (Grey. See Appendix 11)	40 points
A Shagai lands in the Landing zone as a horse. (Yellow. See Appendix 11)	50 points

*Points are given only once for completion each task.

3.3. Game results

3.3.1. The game result is announced at the end of 3-minutes match as a referee checks and confirms completion of each task.

3.3.2. End of match:

3.3.2.1. End of 3 minutes.

3.3.2.2. One of teams is disqualified.

3.3.2.3. One of teams achieves "UUKHAI".

3.3.3. In case neither team achieved Uukhai, the winner is decided based on the following order.

3.3.3.1. The team that scored higher points.

3.3.3.2. The team that first completes the final task.

3.3.3.3. The team that lands a "horse" side of a Shagai.

3.3.3.4. The team that lands a "camel" side of a Shagai.

3.3.3.5. The team that is announced as winner by Judges.

4. Robots' Design and Development

Regulations for both MR1 and MR2.

4.1. Each team builds 2 robots: MR1 and MR2.

4.2. Each robot cannot be split into sub-units or connected by flexible cords.

4.3. Communication between robots is not allowed. However, communication through Gerege is allowed.

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

4.5. The robots are allowed to only touch inner side of fences where holding is not allowed.

4.6. The robots in the contest must be built by team members from the same university/college/polytechnics.

4.7. The weight of robots

Total weight of two robots, controller, cable, the primary set of batteries used in the game must not exceed 50 kg. Any other equipment that team brings for setup purposes and backup batteries (of the same type as that originally installed in the robot) are exempt.

4.8. The power source of the robots

4.8.1. Each team shall prepare its own power source.

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

4.8.3. All batteries used in the robot, controller, and any other device used during the game shall not exceed nominal voltage of 24V. However, when connecting batteries in series or in parallel, that total must be 24V or less.

4.8.4. The voltage in the circuit should be set to 42 V or less by actual measurement: However, if the power supply system includes multiple isolated circuits, each system must be 42V or less.

4.8.5. Teams using compressed air must use either a container made for the purpose, or a plastic bottle in pristine condition that is prepared appropriately. Air pressure must not exceed 600kPa.

4.8.6. Any power source deemed dangerous may be banned from use.

4.9. Fail Safe Design

4.9.1. When you have multiple power supply systems, you 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.

4.9.2. When using radio for signal transmission, you must design so that circuits and mechanisms do not go out of control or move dangerously even if the connection is broken.

4.10. Use wires, connectors, terminals, etc. with a rated current that is equal to, or higher than the assumed maximum current.

4.11. Messenger-Robot 1 (MR1)

MR1 can be either a manual, semi-automatic or fully automatic robot.

4.11.1. MR1 must fit into the Khangai urtuu (Width1000mm X length1000mm). MR1 must have dimension of no larger than 1500 mm in width, length and height during the game.

4.11.2. The robot is allowed to expand, stretch or extend as long as the dimension is still within limit of dimension.

4.11.3. MR1 can be operated by the operator through a connected cable or wireless.

4.11.4. If MR1 is operated through a connection cable, the length of cable from robot to controller must be in between 1000 mm and 3000 mm.

4.11.5. Wi-fi and Bluetooth controllers are allowed to operate MR1. The organizer will not control Wi-Fi and Bluetooth.

4.11.6. An infrared, visible ray, sonar, sound, or radio frequency remote control is prohibited.

4.11.7. The operator is not allowed to ride on the robot.

4.12. Messenger-Robot 2 (MR2)

4.12.1. MR2 must have dimension of no less than 400 mm in width, length, and height. It may not exceed 800 mm width, 1000 mm length and 800 mm height during the game.

4.13. Examination of the robots

4.13.1. Participating robots are examined prior to the test run on the day before the contest, and again on the day of the contest before it begins. The team that fails the examination is not permitted to participate in the test run or contest.

5. Violations

A retry is complusary after each violation. The violations are categorized as follows:

5.1. Any part of any robots or the Gerege lands out of the game field.

5.2. Any part of any robot enters an area that is not allowed during the current task.

5.3. Any part of MR1 touches MR2.

5.4. Any team member touches any part of robot except controller or cable of MR1 and the situations this rulebook allows.

5.5. The team makes a false start. The game (both teams) is restarted.

5.6. Other actions that infringe on the rules without mentioning in the disqualification are considered a violation.

6. Disqualification

A team is disqualified if it takes any of the following actions during the match:

6.1. The team intentionally damages or tries to damage the field, facilities, equipment or opponent's robots.

6.2. The robots enter the opponent's game field (including space area).

6.3. The robots drop a Shagai in the opponent's game field.

6.4. The team performs any acts that are not in the spirit of fair play.

6.5. The team fails to obey instructions or warning issued by referees.

6.6. The team has made the false start three times in the same match.

7. Safety

7.1. All robots must be designed and manufactured as to pose no danger of any kinds to any persons in the venue.

7.2. All robots must be designed and manufactured as to cause no damage to any robots of the opposing team or the field.

7.3. Emergency stop buttons must be built on all robots. If MR1 is a fully automatic robot, emergency stop buttons must be built on its controller.

7.4. The use of explosives, fire or dangerous chemicals is prohibited.

7.5. Accumulator, lead-acid batteries are prohibited.

7.6. In designing and preparing the laser or infrared, 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 eyes of the spectators.

7.7. If the laser is used, it must be of class 2 or less.

8. Teams

8.1. Each participating country or region in the contest can be represented by one team only. Mongolia, as the host country, may be represented by two teams.

8.2. A team consists of three students, called team members, and one instructor who all belong to the same college, university, or polytechnic. The three students on the team are entitled to participate in the match.

8.3. In addition, three members of pit crews are allowed to assist in the pit area, to carry the robots to the field, and participate in the setting of the robots. The members of the pit crew must be students of the same college, university or polytechnic as the team.

8.4. Participation of graduate or post-graduate students is not permitted.

9. Others

9.1. The legitimacy of any actions not provided in this rulebook is subject to the discretion of the referee.

9.2. The dimensions, weights, etc., of the field, facilities and equipment described in this rulebook have a margin of error of plus or minus 5% unless otherwise stated. However, the dimensions and weights of the robots as shown in the rulebook are the maximum and cannot be tolerated.

9.3. All questions should be addressed to the official website of the ABU Asia-Pacific Robot Contest 2019 Ulaanbaatar, Mongolia, http://aburobocon2019.mnb.mn FAQ section is provided on the site. Notification of any additions and/or corrections to this rulebook is made on the official website.

9.4. A set of one Shagai and Gerege will be provided by the organizer of the ABU Roboocn 2019 to all participating broadcasters. If requested by teams or domestic contest organisers, these items are available for purchase. Please send inquiries to the official website.

10. Materials and colours of the contest tools

Items	Colours	R-G-B	Materials
Khangai urtuu	Red	200-50-50	Plywood Water Paint
	Blue	50-50-200	
Khangai area	Green	50-200-50	Plywood Water Paint
Gobi area	Dark yellow	255-200-100	Plywood Water Paint
Mountain Slope	Brown	180-100-20	Plywood Water Paint
Forest Pole	Dark Brown	120-80-40	Metal/Steel Oil Paint
Bridge	Light Brown	220-160-100	Plywood Water Paint
Bridge pole	Dark Brown	120-80-40	Metal/Steel Oil Paint
Bridge rope	Light brown	220-160-100	Nylon Rope
Line 1, 2, 3	Red	200-50-50	Non-Shiny Vinyl Tape
	Blue	50-50-200	
Guideline	White	255-255-255	Non-Shiny Vinyl Tape
Gobi urtuu	Red	200-50-50	Plywood Water Paint
	Blue	50-50-200	
Mountain urtuu	Red	200-50-50	Plywood Water Paint
	Blue	50-50-200	
Uukhai zone	Red	200-50-50	Plywood Water Paint
	Blue	50-50-200	
Landing Zone	Grey	150-150-150	Plywood Water Paint
Sand dune	Yellow	255-230-130	Plywood Water Paint
Throwing Zone	Grey	150-150-150	Plywood Water Paint
Tussock	Yellow	255-230-130	Plywood Water Paint
Tussock Pole	Dark yellow	255-200-100	Metal Oil Paint
Tussock Rope	Dark yellow	255-200-100	Nylon Rope
Fence	Dark brown	120-80-40	Wood Oil Paint
River	Light Blue	120-220-255	Plywood Water Paint
Gerege (160 grams ±10%)	Shiny Yellow	255-245-100	Latten (An alloy of copper and zinc resembling brass)
Shagai (700 grams ±10%)	Yellow	255-230-130	Emulsion Paint
	White	255-255-255	Emulsion Paint
	Light Red	255-50-50	High-density Polystyrene Emulsion Paint
	Light Blue	50-50-255	High-density Polystyrene Emulsion Paint

UPDATE DETAILS

- 26 September 2018
  - Page 13, Rule 3.2, Table rows 7, 8, 9
    See Appendix 10.8s are changed to See Appendix 11.
  - Page 13, Rule 4.8.2
    and/or elastic force is added.
  - Page 18, Rule 10
    RGB values of Khangai area *95 185 71* are added as
- 19 November 2018
  - Page 18, Rule 10
    All RGB values are updated.
  - Page 18, Rule 10
    Weights of Gerege and Shagai are updated.
  - Information about Shagai's weight
    The Shagais are made in Mongolia. Each Shagai weighs 700g with the tolerance of +/-10% (within 630-770g) at the time of shipping. However, foamed styrol are easily affected by humidity and climate. Depending on the destination, the weight of Shagai may vary which could be as great as +/-100g of 700g (600-800g) upon arrival. The Shagais which will be used at the ABU Robocon 2019 Ulaanbaatar shall weigh 700g with the tolerance of +/-10% (within 630-770g) as per Rulebook.