The 16th Intelligent Robot Contest

SENDAI, JAPAN 2004

January 31, 2004

Please check the website for changes and/or updates of this contest rule.

1.Application Provision

The entry can either be indiviual or organizations. The group who can make/produce a robot/s which can matched the rule in this rulebook can join this contest.

2.Date & Contest Site

Date: 2004/06/26 (Sat.) Preliminary Round
2004/06/27 (Sun.) Preliminary Round, Final Round

Contest Site: Sendai Science Museum, Sendai, JAPAN
(URL: `http://www.kagakukan.sendai-c.ed.jp`)
Dainohara, Shinrin Koen
Aoba-ku, Sendai, JAPAN 981-0903
`Tel: 022-276-2201, Fax: 022-276-2204`

3. Deadline

! !! !! !! Deadline for application: ! 2004/05/10(Mon.)

4.Contest's Objective

Today, skills in computers and mechatronics are indispensable in all of the technological fields. One of the best way to learn about these areas is by using them to build something. However, even engineering students and researchers have not had the opportunity to assemble circuits or use equipments such as a lathe to produce a real moving machine. The purpose of this contest is to give students and engineers a chance to obtain a background into the latest technology on computer control and mechatronics while extending their practical skills. It will also be an opportunity for us to extend our knowledge and stock of information.

Intelligent Robot Contest Japan is the most authoritative and historic autonomous robot contest in the world. We hope this contest produces satisfactory results, both in terms of the student's and engineer's education and robotics research.

5.Internet & Homepage Information

The Intelligent Robot Contest 2004 website is also available. Information on the contest rules, robot kits and other important information will be posted on the said site.

Kindly check the site for new updates:

`URL: http://www.inrof.org/index.html.en`

6.Application Inquiries

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Rule of the Competition

In the following description, the number in !N !Oindicates the item in page 9-10 (Details).

1 Outline

An entry to this contest has to perform a predefined task in a fixed time. Except for at the starting point the robots must function autonomously.

The contest is divided into two categories, Challenge and Technical Courses. Below is the information of each category.

!N**Challenge Course**!OIn this course, Fifteen (15) balls [1] in 3 different colors [Green, Yellow, Pink] (5 balls of each color) are scatterred on top of the field (table). A free ball [2] will be given, and it will be at the sole discretion of the player, where the ball should be placed, e.g. on the table or in the robot itself. The objective is to transport the balls to the goal containers. All robots are evaluated according to Competition score and Performance, Challenge, Arts and Speed.

!N**Technical Course**!OIn this course, the robot has to deliver three different objects to its goals. A free ball [2] is also given for each player and the same rule applies to the free ball in the challenge course. Balls [3], Empty cans [4] and Soap boxes [5] will be scattered in the field. In one area of the field, a soap box, an empty cans and a ball are placed on top of each other (See Figure 4(d)). Participating entries for the Technical course can avail of additional points by introducing/performing a "Technical Theme" [6]. The points will be based on the difficulty of their theme.

2 Flow of the Competition

"!Contest Field

Competition should be perform on the specified field (Fig.1: The competition field, Fig.2: Top view of the field, Fig.3: Goal Box)

"!Size and Weight of the Robot

If a robot [9] is not a self-contained type [7], the size and weight checking must be done where cable [8] is disconnected to the robot.

(1) At the starting position, the robot [9] must be in the size of 450 mm(W) x 900 mm(H) x 450 mm(L).

(2) The robot's weight must not exceed 20 Kg.

"!How the robot should be controlled?

(1) Basically by computer, and if it's not controlled artificially, other means are also accepted [10].

(2) Control systems (include power sources and others) can be installed on the robot itself, or can be connected with cables in a specific area in the field. If it's connected with cables, it must not touch the objects. Competitor should either hold the cable or attach the cables in a stick.

"!Arrangement of Objects

[Challenge Course] The arrangement of the balls is shown in Fig. 4(a). There are eight (8) regions separated by dashed line. The balls in each of the region will be placed randomly.

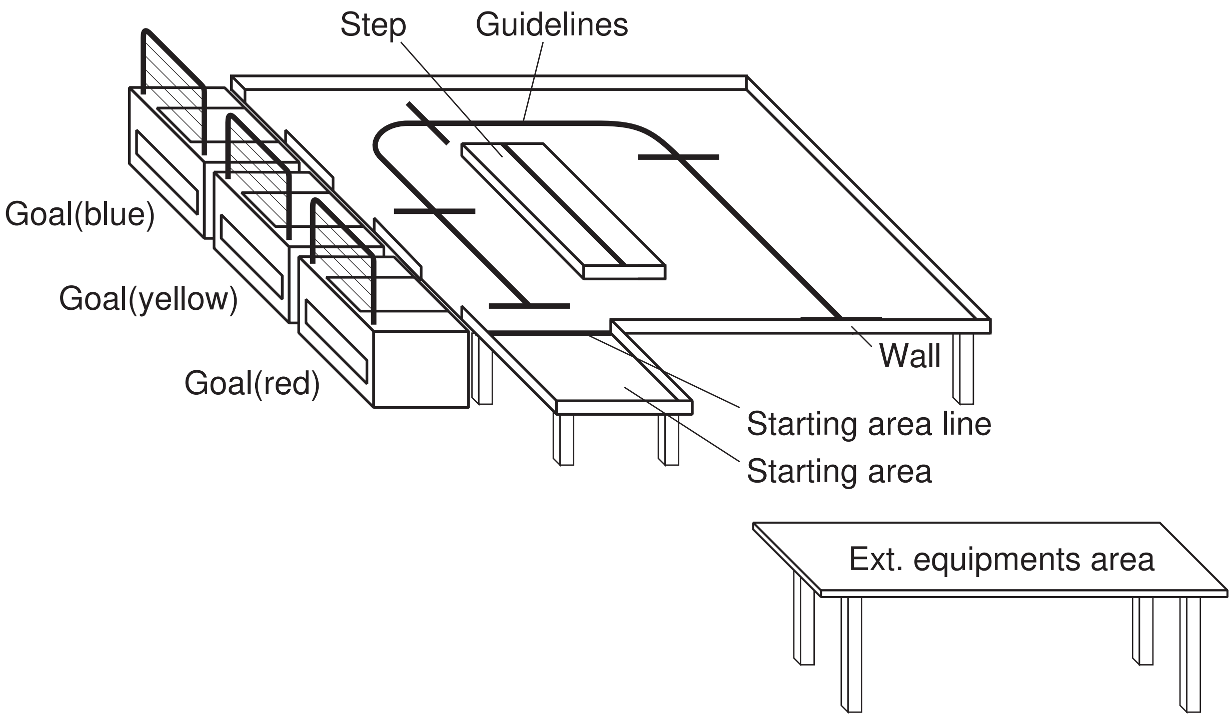
[Technical Course] There are fifteen (15) different objects in the course. Seven (7) tennis balls, four (4) empty cans, and four (4) soap boxes. The arrangement of the objects are divided into pattern area and random area. These areas are depicted in Fig. 4(c).

Pattern Area

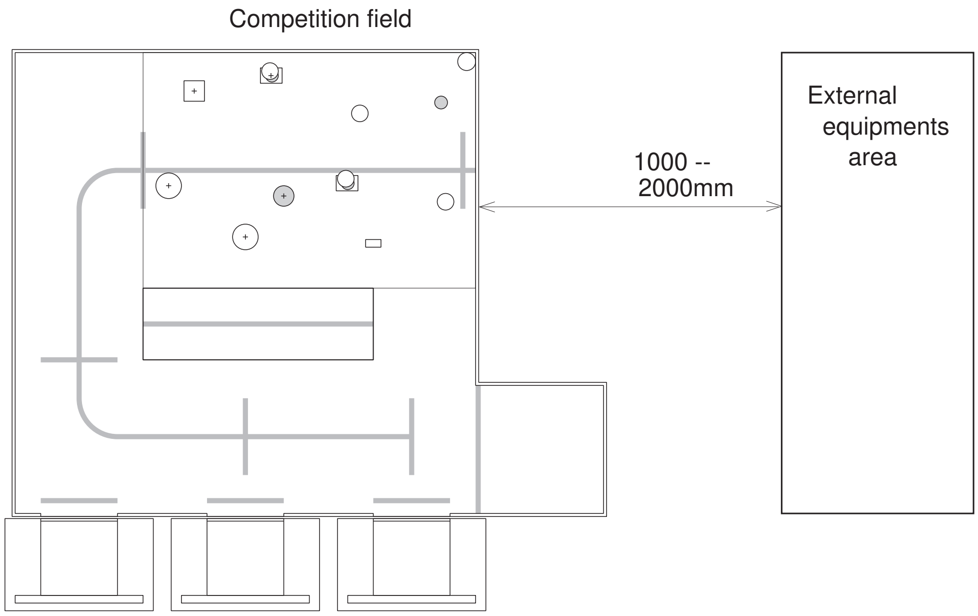
There are a total of seven (7) objects in this area [Three (3) tennis balls, two (2) empty cans, and two (2) soap boxes]. The pattern plate [ABCD] (as shown in Fig. 4(c))is used for arranging the 7 objects in it. These objects will be arranged in one of the 4 Possible patterns in the rectangular Plate ABCD. This pattern will be decided through a lottery. When the objects are arranged on the plate (Fig.4(b)), one of the corner points (A,B,C,D) is being fixed at point Q (see Fig. 4(c)). In the case of B or D, the pattern plate is turned face down. Objects (balls, box, and cans) will be placed in the orifice of the plate. The soap box will be placed where its smallest surface is attached to the table and the largest surface is parallel to the y-axis in Fig. 4(c).

At one of the orifice, a soap box, an empty can and a tennis ball are placed on top of each other. This is referred to as the "TOWER".

Random Area There are a total of 8 objects in the random area (Four (4) tennis balls, two (2) empty cans, and two (2) soap boxes). Also in this area, a tower is placed, where an soap box, an empty can and a tennis ball is placed

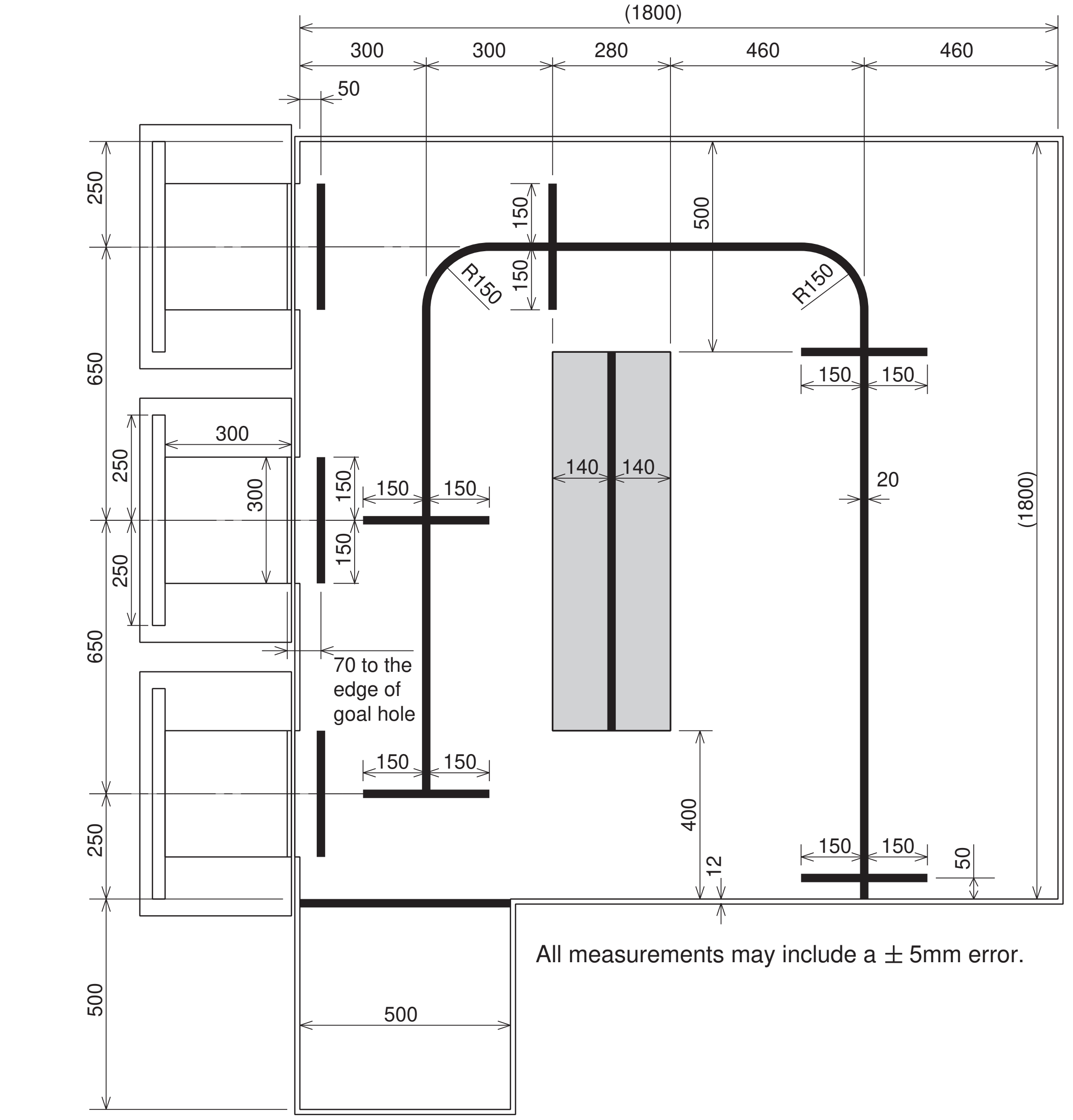


(a) Competition Field



(b) Top view of the competition field

Fig 1: Sketch of the Competition Field (Tables)



Field	!' the floor: Made by lauan [19], Thickness: 15mm
	!' the wall: Made by lauan [19], Thickness: 12mm
	!' Color: horizontal surface=white vertical surface=yellow (painted)
Step	!' Made by lauan [19], Height: 40mm
	!' Color: horizontal surface=white vertical surface=yellow (painted)
Guiding Line	!' vinyl tape, Width: 19mm, Max. Error of width: -2mm, Color: black
Box of Goal	!' Thickness: 9mm, Made by lauan [19] , Color: blue, yellow and red (painted)
Bucket	!' plastics
Net	!' Green Net for baseball with 40mm×40mm stitch
Frame of the Net	!' pipes (dimeter is 28mm)
Starting Area Line	!' Same with the Guiding Line

Fig 2: Top view of the Competition Field

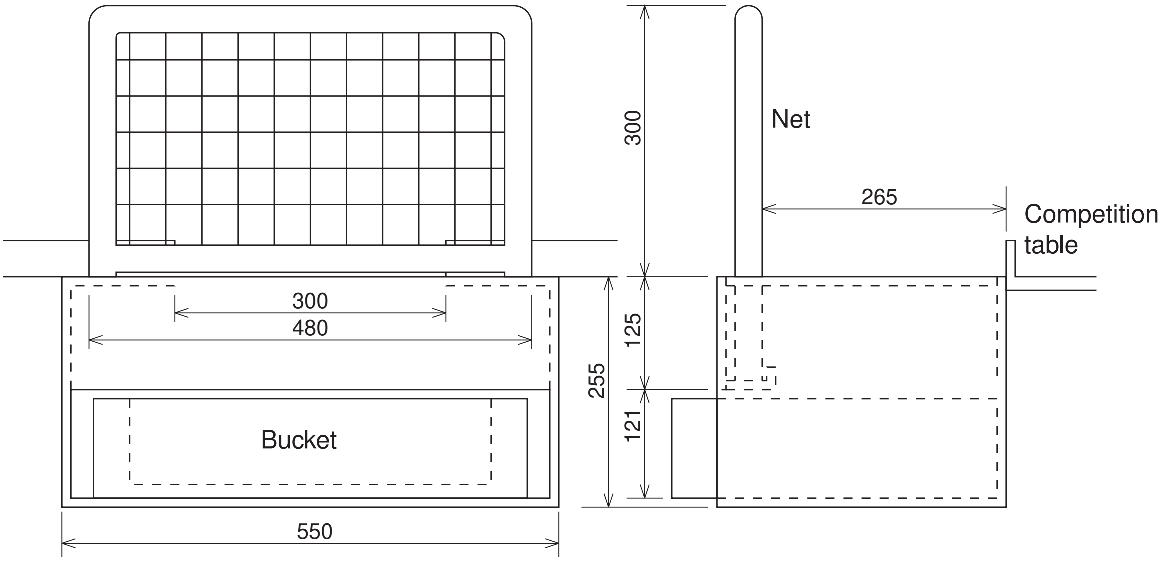


Fig 3: Goal Box

on top of each other, which is being referred to as “TOWER” (see Fig. 4(d)).

The different objects will be placed within the five (5) specified area (rectangle frame) as shown in Fig. 4(c). And the placement area of each object will be decided through a lottery.

" ! Preparations

The competitor can only enter the competition field after the instruction of the referee. Control system and other attachments/peripherals must be in a specific area (see Fig. 1(a))which will be notified in advance. The voltage source is 100V 50Hz. The computers can be turned on before entering, but the wireless communication device must be turned off.

" ! Number of people allowed to enter the presentation field

Only two people are allowed during the competition [11].

" ! Area of performance

! | **Robot**
Topview of the competition tables (Fig. 1(a)), stares, goals, including the enclosure at the sides of the tables (40 cm in height, Fig. 5).

! | **Participants**
Within the area of the competition tables and the table of the peripherals.

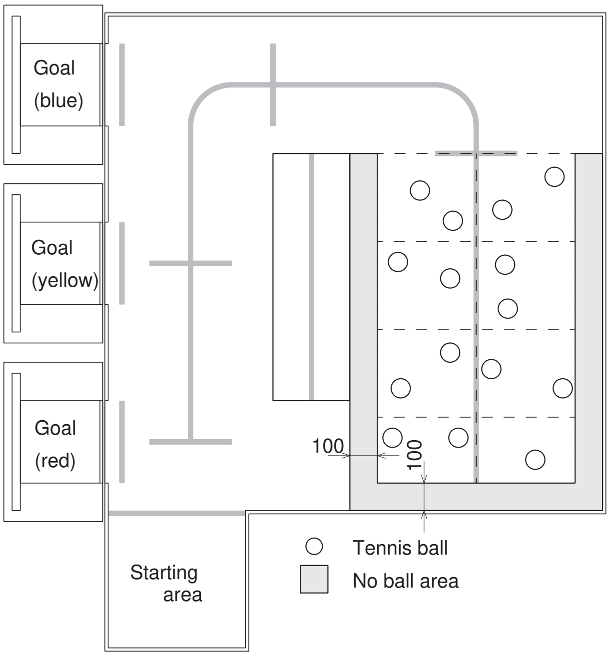
" ! Contest Rule

! | **Commencement**

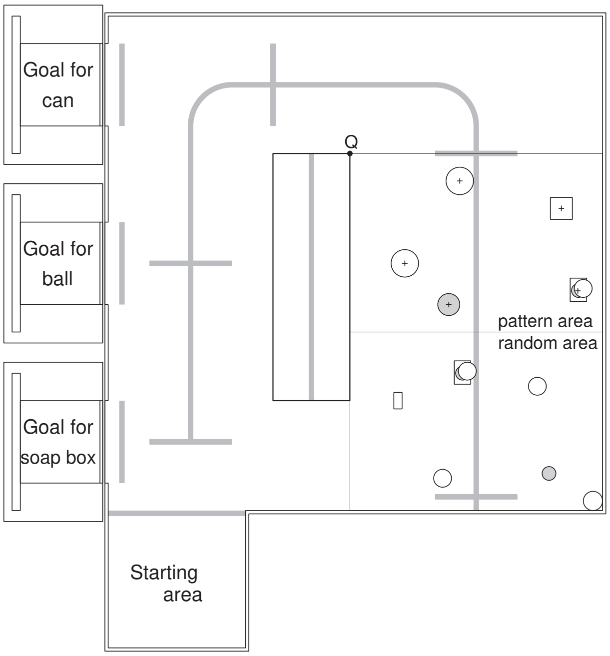
(1) The total time for each entry is 12 minutes, divided into 2 minutes for preparation, and 10 minutes for the competition. In the preliminary round, each entry will only have 7 minutes, where 5 minutes is for the competition. Team should wait outside the competition area until the referee authorize him to prepare for the competition.

The referee will give one “free ball” and the contestant can placed the ball anywhere in the competition field or can even place it in the robot. After the preparation, the competitor should inform the referee in order to receive a permission to begin the robot’s motion. If the preparation could not be finished within the specified time (2 min.), then the time for the competition will be started, which basically reduces the competition time. For example, during the preliminary round, where the total time is 7 minutes (5 minutes for competition and 2 minutes for preparation), if one participant has exceeded the limit of preparation by 1 minute (3 minutes for the preparation), then his competition time will only be 4 minutes.

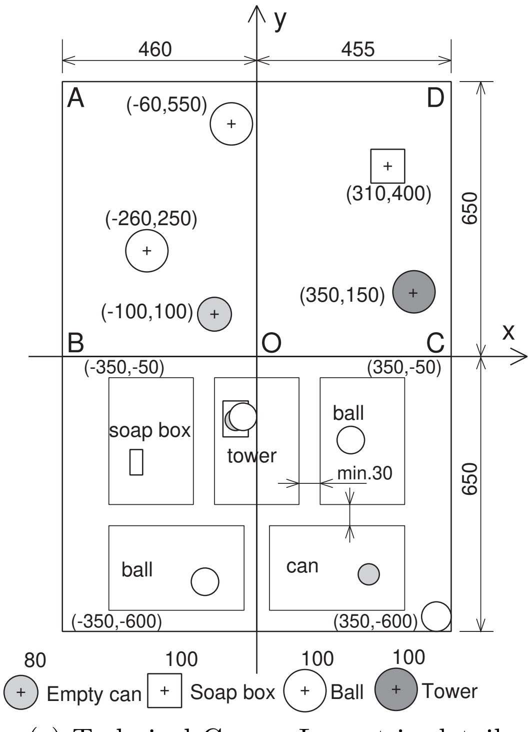
(2) The robot must be placed inside the starting area. The robot’s initial condition can be choosen as the competitor pleases. It can be set to any direction, refer to Fig. 6. Cables [8] or other peripherals



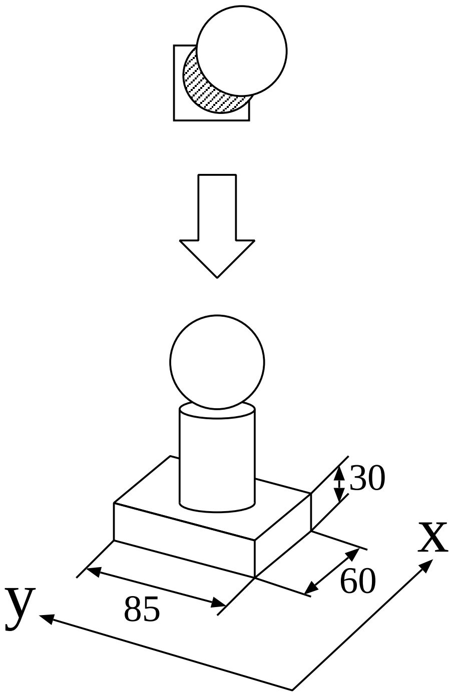
(a) Object arrangement of Challenge Course



(b) Object Arrangement of Technical Course



(c) Technical Course Layout in detail



(d)

Piled objects (TOWER)[soap box, empty can, and tennis ball]

Fig 4: Object's arrangement

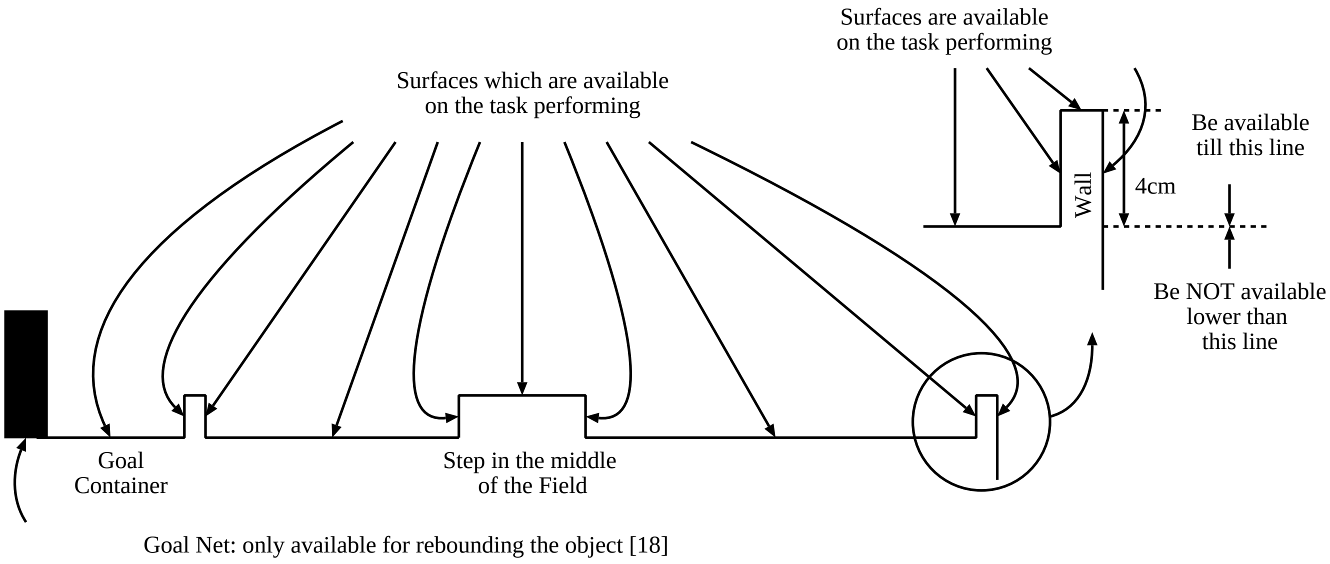


Fig 5: Performance Area

are not allowed to be placed on the table except on the starting area.

(3) If multiple robots are used, starting each of them should be done once. This mean, that, the competitor cannot start one robot, and wait for some time and start again the other robot.

! | While the robots are in operation

(1) In case if the robot fails/stuck, the competitor can either restart again (RETRY), or give up the competition.

(2) If the objects (tennis balls or empty cans or soap boxes) fall down from the table, it is not allowed to return them back to their original places except when the competitor declares a “RETRY”.

(3) The cables (which are connected to the robot) should not touch the objects intentionally.

(4) Touching the robot while in motion is a violation which will disqualify the competitor. The game will be halted temporarily when the competitor declares a “RETRY”.

(5) The chief referee can disqualify any competitor if it is found violating the prescribed rule in this competition.

! | Retry

(1) In declaring a RETRY, the competitor should raise his hands and announce a “RETRY” audibly (Since during the competition the place is quite noisy).

(2) Retry is considered when the competitor declares it to the chief referee and is recognized by the latter. In this case, the competition time would be paused for a short time in order to rearrange the objects. But if the objects wasn’t move from its original position then the time will not be paused. In the challenge course, when any objects were moved by the robot, the staff will re-arrange all the objects. But in Technical course, only the objects that were moved will be rearranged.

(3) Once Retry is acknowledge by the referee, all the objects which is already in the goals will be return to its original position and that points incurred will become void. And if the robot would have taken an object at that time, the competitor must take it off. Arrangement of the objects will be done by the staff of this contest [13].

(4) When the competitor are ready to restart their robot, he should declare it to the chief referee. Once acknowledged, the competitor can start his robot.

(5) Competitor can only declare a “Retry” three (3) times.

! | Completion

The competition only finishes in three cases:

(1) The competition time is already over (5 minutes for preliminary round, and 10 minutes for the Final round).

(2) The competitor declares it finished.

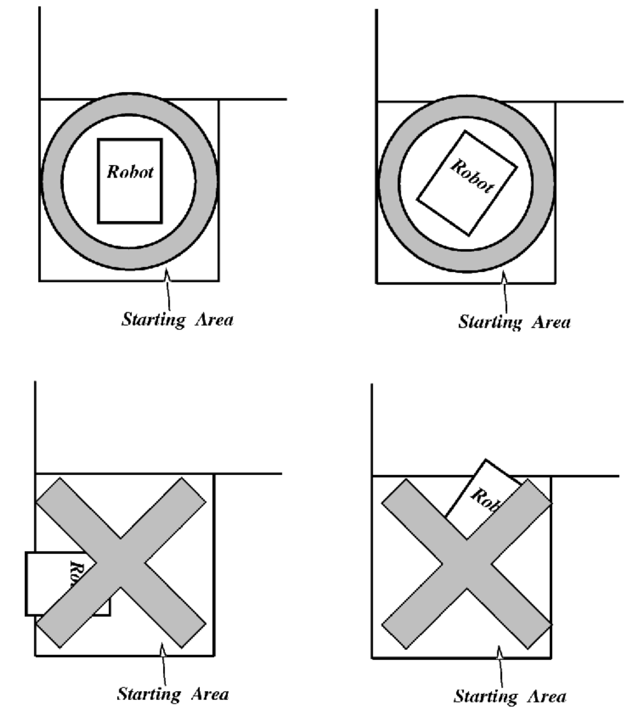


Fig 6: Starting position of the Robot

(3) If the robot cannot cross the start line in 3 minutes from the start of the competition.

After the competition, the competitor should take the robot and other equipments out of the field as soon as possible.

"!Point system of the competition

(1) When the competition finishes, the objects [16] which are in the buckets [15] of goal boxes will be recorded as the competition score. “No Record” [17]is used instead of “0 point” when there is no object in the buckets.

!N**Challenge Course**!OThe correct goal for the green, yellow and pink balls is blue, yellow and red respectively. For each ball that is delivered to its correct goal, there would be three (3) points for each. Only one (1) point will be recorded if an object delivered into a wrong goal. Therefore, a total of 45 points when all of them are delivered correctly. The free ball has 5 points and it could be delivered to any of the goals, Therefore a total of 50 points will be obtained , when all the balls are delivered correctly.

!N**Technical Course**!OFour (4) points for each ball, six (6) points for each can or soap box. Therefore, a total of 80 points when all the objects are delivered in their respective bucket. Only one (1) point will be recorded if an object delivered into a wrong goal.

(2) In the second preliminary round and the final round, the robots will be judged according to performance, challenge, art, and speed points in the Challenge course. And performance and Technical Theme points in the Technical Course.

!N**Challenge Course**!OThe judges will score the following, Performance - 20 points, Challenge - 10 points, Art (Robot Design) - 10 points, Speed - 10 points. A total of 50 points.

- **Performance Points**
  This is evaluated according to how the robot performs on the collections of objects, the method used and etc.
- **Challenge Points**
  This is evaluated according to the advance method or technology that a competitor used during the competition. This is also given to participants who are very young or elderly people.
- **Art Points**
  This is based on the decoration or the built of the robot.
- **Speed Points**
  This is based on the movement of the robot.

!N**Technical Course**!OThe judges will score the following, Art - 10 points, and Performance - 10 points. A “Technical theme” point is another 20 points. This theme points will only be given in the case where the robot conforms and implements the “Technical Theme” that introduced by the participants. A total of 120 points for the best entry in this course.

- **Art Points**
  This will be based on how the robot is build and its motion.
- **Performance Points**
  This is based on the robots movement, and anything that could impress the audience (Entertainment).
- **Technical Theme Points**
  This is based on the difficulty of the team theme.

"!Penalty

When the referee found the competitor performed something against the rules and makes a warning about it, it will be a penalty of 10 points. Each warning called is a 10-point deduction.

"!Prohibited actions

Six (6) things as follows,

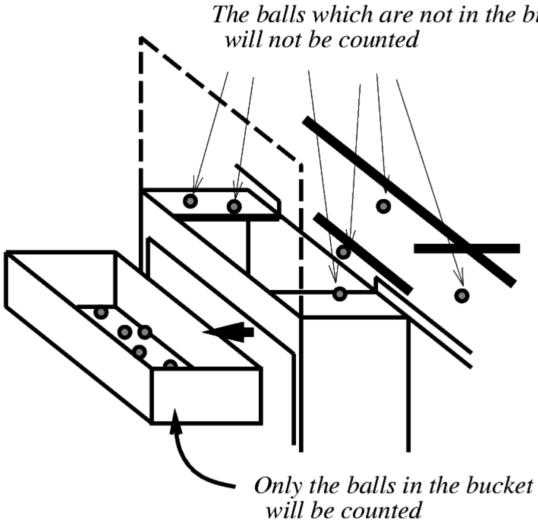


Fig 7: Goal and Competition Score

(1) To control the robots remotely via wire/wireless communication or voices.

(2) To interrupt when the other competitor is performing.

(3) To destroy or tarnish the table of the competition.

(4) To destroy the objects used in the competition.

(5) Behaviours that destroy the dignity of this competition.

(6) To object against the commitee's interpretation of the rules.

3 Preliminaries

(1) In case when two or more teams got the same score, the referees will decide the ranking. If no agreement can be reached, a play-off will be held.

(2) Basically, the competition will be held as First Preliminary, Second Preliminary, and Final Round. The number of teams that passed the preliminary games will vary and will depend on the number of competitors. A revival [12] round might be held.

(3) The referees can decide to advance a particular team to the second preliminary even if the said team did not get any points on the first preliminary.

(4) In situation where there are too many registered participants, an advanced preliminary round will be held. If this will be the case, every team will be notified in advanced.

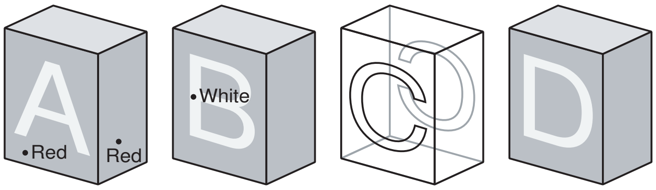


Fig 8: The characters written on the soap boxes.

4 Prizes

Below will receive prizes,

- First Place, Second Place, for each course and one Grand Prize, Special Awards: e.g, Robotics Society President Award, and other prizes sponsored by companies.

5 Others

(1) Robots that were considered as identical by the committee can only participate as one entry.

(2) A numbered label will be given to each team. This label should be attached to the robot before the competition begins. It is recommended that the team's name or the robot's name be written on the label.

(3) Competitors cannot make objections against the referee's decision. In case, if there are any doubts about the enforcement of the rules, a representative of the team can make formal objection to the executive committee within the competition dates.

(4) In case of any inconveniency due to crosstalk of the wireless communication devices, there wouldn't be any mediation from the referees. The problem should be solved between the concerned competitors. Just in case of a big effect on the performance of others , the referee might stop the concerned team from using wireless communication.

[Details]

[1] **Type of Ball (Challenge Course)**
A foam ball of approximately 65 to 70 [mm] in diameter and weigh about 10 [g] to 15 [g]. The colors are green, yellow and pink. There are five balls for

each color on the field. One that sold at http://www.promostressball.com/surface-standard.html looks very similar, but the committee does not confirm if the hardness is the same or not.

[2] **Free Ball**
A standard yellow tennis ball of approximately 65 [mm] in diameter and weigh 60 [g]. One that made by DUNLOP Co. is compatible. This can be placed on the competition table, e.g., in front of the goal, in the robot, etc., before the start of the competition.

[3] **Type of Ball (Techinical Course)**
A standard yellow tennis ball of approximately 65 mm in diameter and weigh 60 g. One that made by DUNLOP Co. is compatible.

[4] **Type of Empty Can !!**
Navy blue empty steel can of approximately 53 mm in diameter, 110 mm in height, and weigh 34 g. [BOSS SUPERBLEND coffee] by Suntory Co. is now compatible.

[5] **Type of Soap Box**
A box made by paper including soap. It looks almost red. It is 85 mm x 60 mm x 30 mm in dimension and weigh 100g. On largest two faces(85x60mm), the character 'A', 'B', 'C', 'D' are written respectively(i.e. there are box of 'A' .. and box of 'D') as shown in Fig. 8. There is one character per each face. The background color is red, and characters are written in white. The font and size of character is not definite, but it will be san-serif font such as Arial or Helvetica, and not too small. [MYUSE medical soap (with soap inside)] by P&G Maxfactor Co. is compatible to the dimension and weight of box itselt.

[6] **Technical Theme Presentation (Not obligatory)**
The highly motivated participants can propose " Tehchnical Theme" that needs high level technique at their application. Please note that they can introduce the theme only at their application. In the second preliminary round and the final round, the robots will be judged according to the "Technical theme". And they will get extra 20 points at the best. They need to pay attention to show the technology explicitly. For example, if vision system is implemented, it is good to use the sound or display (LCD) so the audience or judges can see the robot's ability to recognize the character.

[7] **Self Contained Robot**
It's not connected with cables from the things outside of the table for the competition. Wireless control by a computer is also permitted.

[8] **Cable**
The one which is connected from the robot to the things outside of the table.

[9] **Robot**
All the things inside of the starting area when the performance will be started. Controllers, power-supplies, vision processing unit, etc. can be put at "external equipments area", but sensors including camera are regarded as a part of robots.

[10] **Other Control Method that can be used**
The sequence control type robots (microswitch or others are used as a sensor) is permitted.

[11] **Position of the Team member during the Competition**
Team members should take necessary measures not to conceal/cover the playing field for the judges and audience during the game.

[12] **Condition for a Return Match**
To have the chance of entering a second match, the team must have a competition score, comprising of at least one or more balls. The team who fails to score cannot join the return match.

[13] **Objects Arrangement during Retry**
The pattern will be the same as they started. However, in the random area, the position might not be the same.

[14] **Other Things that a Competitor can do during Retry**
While the retry is applied, you will be allowed to make repair of your robots, mechanical checks, battery exchange or anything that which pertains to your robot will be allowed.

[15] **Inside the Goal Bucket**
Inside the bucket, a shock absorber will be placed in order to protect the objects.

[16] **Is there a score if the robot falls with the objects**
When the robot/s or part of it fall into the bucket with the objects, a point can still be awarded to it. But in the case where the bucket cannot be removed due to the robot, then no points will be awarded to the said object taken.

[17] **No Record**
No record means that either there is no valid points incurred or which the referee declared a void to any incurred points of the competitor. This also means that competitor gets 0 points.

[18] **Net behind the Goal**
Net is used to protect the objects from getting off behind the goal. And it is spread loose enough to accomplish this.

[19] **What is a Lauan?**
It is a kind of wood, readily available as lumber, veneer, and plywood.

[20] **Degradation of objects**
Of course, the objects will be degradation as contest is proceeded. It will be change to new one when it was too damaged, but this replacement is not guaranteed. Therefore the robot must be adapted to such degradation.

Technical notes

1. **Optical sensor device**

   The game field is set indoor, and TV staff and audience are allowed to use spotlights and flashlights. So, you need to hide optical sensor devices from such optical noise. You also have to pay attention to make sonic sensors and color sensors robust to the changes of the environment.

2. **Wireless communication**

   - If you use wireless communication devices, you have risk of crosstalk because two games start at a time. In addition, we permit audience to use their cellular phones. We advice you to prepared a variable frequency ranges or changing it to communication by wire.
   - If you manipulate robots by wireless communication, you will be disqualified in the game. (See Prohibited Action # 1)