2024 Taiwan Micromouse and Intelligent Mobile Robot Contest

Introduction to Competition Events for Foreign Participants

1. Competition Date and Venue

(1). Competition Date: August 18, 2024

(2). Time: The competition schedule will be notified separately before the event.

(3). Competition Venue: Lunghwa University of Science and Technology, Republic of China (Taiwan), Taoyuan.

2. Competition Events

(1). Micromouse contest (Please refer to p.1 – p.10)

(2). Robotrace contest (Please refer p.11 – p.18)

I. Micromouse Contest

1. Players and time rules

(1). Only one player is allowed to operate during the game.

(2). Maximum 6 minutes and maximum 5 tries.

(3). Each game can be tested up to 5 times, and the shortest time will be taken as the game result. The number of times will be determined by starting from the starting point and triggering the timer. The seconds will be calculated to the third decimal place. If the seconds are the same, the one with the lighter weight will win.

2. Maze Rules

(1). The micromouse maze consists of 16 X16 maze squares, each unit square is 18cm X 18cm.

(2). The height of the maze wall is 5cm and the thickness is 1.2cm, so the corridor of the micromouse in the maze will be 16.8cm wide. The entire periphery of the maze is connected by maze walls.

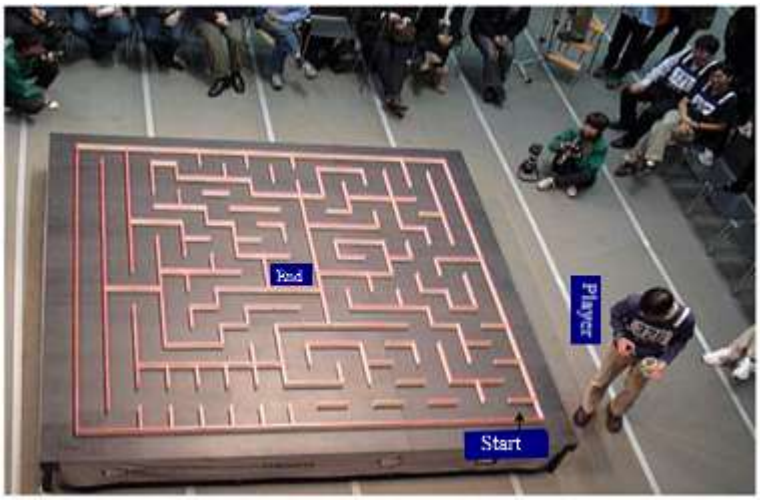
(3). The color of the maze wall is white and the top is red. The floor

on which the micromouse travels in the maze is made of wood with a matte black paint finish. The paint on the walls and top of the maze walls must reflect infrared projections, while the paint on the walking floor must absorb infrared projections.

(4). The "starting point" of the maze is located in one of the four maze corner squares. The "starting point" of the maze should have three maze walls. If the starting direction is north, then the outer walls of the maze should be in the west and south. The "end" of the maze consists of four squares in the center of the maze. There will be no maze walls between these four maze squares.

(5). The small square pillars of 1.2 cm X 1.2 cm X 5 cm on the four corners of each maze square are called "grid points". Except for the four squares at the end of the maze, the grid points of each maze square must touch at least one maze wall.

(6). The accuracy of the maze size should be within 5% or 2cm. The height difference between the maze floor joints cannot exceed 0.5mm, and the slope of the maze floor joints cannot exceed 4 degrees. The gap between walls between adjacent maze blocks cannot exceed 1mm.



3. Micromouse Rules

(1). The micromouse must be able to control itself independently and cannot obtain energy through combustion.

(2). The dimensions of the micromouse should not exceed 25cm x 25cm in length and width, with no height restriction. If the micromouse alters its geometric structure while moving, it must still comply with the aforementioned dimensions.

(3). The micromouse must not leave anything behind in the maze while navigating.

(4). The micromouse must not leap over, climb, damage, or destroy maze walls.

4. Contest rules

(1). The basic function of the micromouse is to travel from the starting point to the end of the maze. This is called a "trip" and the time used is called "movement time". However, the time it takes for the micromouse to return from the end of the maze to the starting point cannot be counted as "Moving time" for "one trip".

(2). The time from when the micromouse is started to when a certain trip starts is called "maze time". If the micromouse requires human assistance from the operator while traveling, it is called a "touch". However, if the micromouse returns to the starting point on its own, the operator's action of cleaning the micromouse's tires before the next start will not be considered a touch.

(3). The score of the micromouse is evaluated based on three parameters: "movement time", "maze time" and "touch occurrence" in terms of speed, maze-solving efficiency and autonomy.

(4). The micromouse can only have a maximum of 6 minutes in the maze competition. Under this time limit, the micromouse can try to find the end point of the maze and the shortest movement path from the starting point of the maze up to 5 times (when there are too many competition teams, the organizer reserves the right to adjust the time and number of attempts).

(5). After the micromouse reaches the end of the maze, the player can manually move the micromouse to the starting point, or let it return to the starting point on its own. If the micromouse is artificially moved to the starting point, it means "touch" occurs, and subsequent score calculations will not be able to enjoy the time feedback of the 3 seconds without "touch".

(6). The calculation of each "moving time" is to measure the time interval from when the micromouse leaves the starting block until it enters the end point. After the operator is ready, he must signal to the referee to start timing. The calculation of "maze time" is to measure the time interval from the first start of the micromouse to the start of a certain movement.

(7). The formula for calculating micromouse scores and the recording method for the best scores are as follows:

Single result =

"moving time" + ("maze time" divided by 30) –

3 seconds (if no "touch" occurred)

Best result = the shortest time among all Single results.

Example 1: Suppose an operator wants to start the game. After the preparation is completed, he signals to the referee to start timing. After the micromouse starts, it finds the end of the maze after 80 seconds. The micromouse then leaves the end of the

maze and continues to search the wall arrangement of the maze. situation, it took another 55 seconds to return to the starting point. Then the first moving time T1 is 80 seconds. Since there is no "maze time" in the first startup, and the micromouse returns to the end point on its own without "touching", the first result is

$$80 – 3 = 77 \text{ seconds.}$$

At this time, the operator picked it up to clean the dust on the tires and put it back to the starting point of the maze field. It took 22 seconds to remove the dust and start again. Then he sprinted to the finish line using the shortest path found in 10.23 seconds. Then the micromouse took 12.02 seconds to return to the starting point again. At this time, the second moving time T2 is 10.23 seconds, and the previously used search time is 80 seconds plus 55 seconds plus 22 seconds. The total time of 157 seconds is the maze time M2 for calculating the second result. Since there was no "touch", the second result was

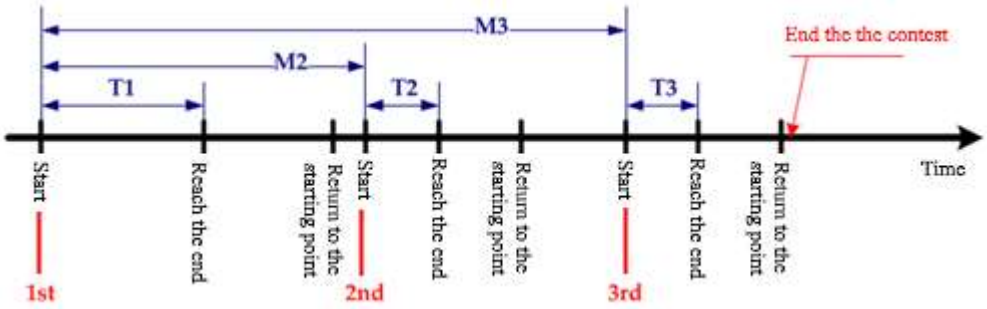
$$10.23 + 157/30 – 3 = 12.46 \text{ seconds.}$$

When the micromouse returns to the starting point again, the operator picks it up and cleans the dust on the wheels, then puts it back to the starting point of the maze field for the third time attempting from the starting point to the end of the maze. It takes a total of 20.75 seconds to clear the dust and start again. This time he sprinted to the finish line in 10.05 seconds. At this time, the third moving time T3 is 10.05 seconds, and the total search and sprint time used before is 80 seconds plus 55 seconds plus 22 seconds plus 10.23 seconds, 12.02 seconds and 20.75 seconds, a total of 200 seconds The time is the maze time M3 when calculating the third result. Then the micromouse took 11.55 seconds to return to the starting point again. Since there was no

"touch", the result for the third time was

$$10.05 + 200/30 - 3 = 13.72 \text{ seconds.}$$

Finally, the operator signals to the referee that he will not try again and ends the competition. The best result of this micromouse was 12.46 seconds, the best of the three results. The figure below is an illustration of the above process.



Example 2: Assume that another micromouse finds the end of the maze after 70 seconds after starting up. Then the first movement time T1 is 70 seconds. The micromouse then left the end of the maze and continued to search for the arrangement of the walls of the maze. Unfortunately, it made a mistake due to it hit the wall before it returned to the starting point. Unfortunately, it made a mistake due to it hit the wall before it returned to the starting point. Therefore, after the operator signaled to the referee, the micromouse was taken out from the venue. So there is no 3-second time feedback for "touch occurs". Since there is no "maze time" in the first startup, the first result is

$$70 \text{ seconds.}$$

After a little tidying up, the operator restarted the second search. At this time, it was 150.35 seconds since the first micromouse started. After it took 42.68 seconds to find the end of the maze, it

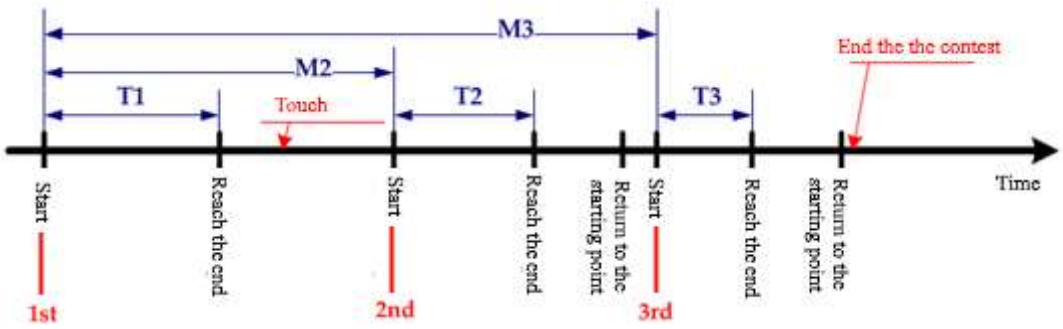
took another 22.50 seconds to return to the starting point, stopped for 3 seconds, and automatically turned 180 degrees away from the starting point of the maze. Then, using the shortest path found and the fastest speed, it took 16.23 seconds to sprint to the finish line. At this time, the operator signals to the referee that he will not try again and ends the competition.

At this time, the second moving time T2 is 42.68 seconds, and the third moving time T3 is 16.23 seconds. The maze time M2 related to the second moving time is 150.35 seconds, and the maze time M3 related to the third moving time is 150.35+42.68+22.50+3=218.53 seconds. Due to "touch", there is no time feedback of 3 seconds. The results for the second and third times are respectively

$$42.68 + 150.35/30 = 47.69 \text{ seconds.}$$

$$16.23 + 218.53/30 = 23.51 \text{ seconds.}$$

The best result of this micromouse was 23.51 seconds, that is the best of the three results. The figure below is an illustration of the above process.



(8). The calculation of "moving time" and "maze time" is measured manually by the referee or automatically by an infrared sensor between the starting block of the micromouse maze and the end

block of the maze. When using infrared sensors, the sensor at the beginning of the maze will be installed on the boundary between the starting block and the next maze block, and the sensor at the end of the maze will be installed at the entrance of the end block of the maze. The infrared sensor will maintain a horizontal transmitting and receiving angle and is located approximately 1cm above the maze floor.

(9). The startup program of the micromouse should not include providing the operator with different action strategies to choose based on the characteristics of the maze.

(10). When the structure of the maze is revealed to all contestants, the operator can no longer input any information into the micromouse.

(11). The brightness, temperature and humidity of the location of the maze are the same as those of the general indoor environment. If contestants request to adjust the brightness of the venue, they must obtain the approval of the conference.

(12). When the micromouse becomes abnormal, the operator can ask the referee for permission to give up the attempt of the micromouse to travel to the end of the maze, and move the micromouse back to the starting block of the maze. However, if it is just a wrong turn or other factors other than a malfunction of the micromouse, then consent is not allowed.

(13). During the game, if the micromouse replaces any part (such as battery or removable read-only memory) or performs significant adjustments (such as speed control and action strategy selection, etc.), it shouldn’t be restarted before the structure of the maze in its memory has been erased. However, when the referee of the competition determines that the adjustment is a simple

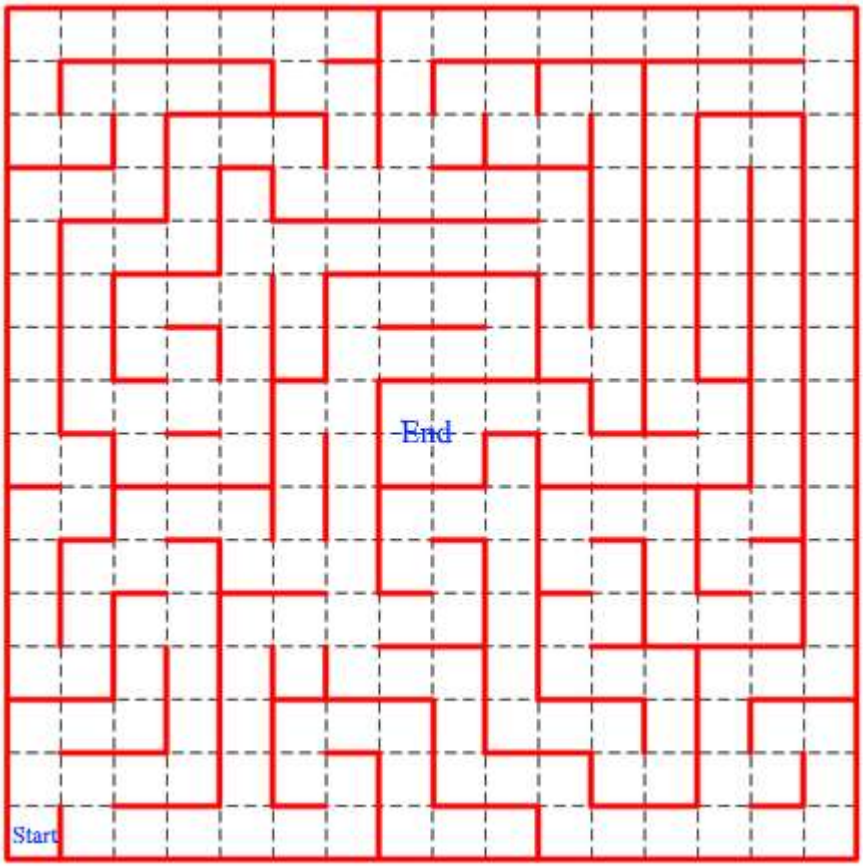
adjustment (such as the adjustment of the light sensor) based on on-the-spot judgment, the micromouse does not need to erase the maze structure in the internal memory.

(14). Except for the battery, which may be permitted by the competition referee, any other parts of the micromouse may not be transferred to other micromouse of different participating teams during the competition. For example, if the same micromouse base is replaced with a second different controller, it shall be regarded as a micromouse of the same participating team and must complete the competition within the 7-minute time limit. When changing to a different controller, the micromouse's internal memory of the structure of the maze must be erased before the game can continue.

(15). When the referee of the conference determines that the maze venue used for the competition may be damaged while the micromouse of the participating team continues to play, the conference has the right to require the micromouse of the participating team to stop continuing the competition, or to rule that the right to compete is lost.

(16). After the micromouse of the participating team completes a movement from the starting point to the end of the maze, it must stay in the starting square of the maze for at least 3 seconds before leaving the starting point of the maze next time. If the maze uses an infrared sensor for timing, the micromouse must not interfere with the operation of the infrared sensor when it stays on the starting square of the maze.

5. Maze venue example



II. Robotrace Contest Rules

1. Players and time rules

(1). Only one player is allowed to operate on the field during the contest.

(2). Each attempt is limited to a maximum of 3 minutes and 3 tries. The shortest time recorded among the attempts is taken as the timed score for that round. The counting of attempts starts from the moment the timer is triggered upon departure from the starting point. The time is calculated to the third decimal place. In case of a tie in seconds, the lighter robotracer is declared the winner.

2. Contest rules

The robotrace contest refers to a racing event where autonomous robot competes on a designated track equipped with visual cues. A autonomous robot participating in the Speed Autonomous robot Contest is referred to as "Robotracer".

(1). Robotracer must operate independently, and participants are not

allowed to control them via wired or wireless radio signals.

(2). During the contest, no adjustments or replacements (including programs, batteries, and circuit boards) may be made to the robotracer’s components, and no requests for suspension of the contest are allowed. However, with the referee's permission, simple repairs may be carried out.

(3). The length and width of a robotracer must not exceed 25 centimeters, and the height must not exceed 20 centimeters.

(4). The time taken and recorded as the robotracer moves from the starting point to the endpoint along the designated racing track is the benchmark for the timed race.

(5). Once the contest venue is open, no information about the venue may be input into the robotracer in any way. Furthermore, no adjustments or replacements may be made to any components of the robotracer during the contest (including programs, batteries, and circuit boards).

(6). The calculation of the time spent by the robotracer moving from the starting point to the finishing point along the racing track is determined by the sensors at the starting point detecting the robotracer's start and the sensors at the finishing point detecting the robotracer's arrival. However, this result is only considered valid if the robotracer passes the finish line completely.

(7). Each participating robotracer can use up to 3 minutes of time, during which up to 3 timing results may be recorded (the organizers reserve the right to adjust the time and number of attempts when there are too many competing teams).

(8). Each participating robotracer must depart from the designated "starting and finishing area" in the specified direction but may proceed continuously during consecutive lap timing without

interruption.

(9). After completing one lap timing, each participating robotracer must stop automatically in the designated "starting and finishing area" for at least 2 seconds.

(10). If the robotracer’s body leaves the racing track or remains stationary for more than 2 seconds, it is considered a failure and must be withdrawn.

(11). Participants are not allowed to touch their robotracer during the contest unless requested or authorized by the head referee to abandon the contest. Only when the robotracer cannot continue the contest can the head referee agree to the request for the robotracer to be abandoned.

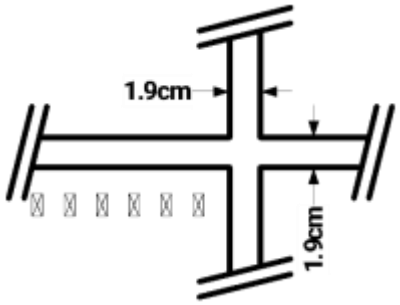
(12). If the body of a participating robotracer fails to cover the white track, it is considered to have left the racing track.

(13). The lighting and environmental temperature and humidity at the venue on the day of the contest are the same as those in general indoor environments. Participating teams are not allowed to request adjustments to the brightness of the lighting.

(14). When the head referee deems it necessary, participating teams may be asked to provide relevant explanations for their robotracer. The head referee may also take necessary measures to require participants to abandon the contest or to disqualify participants based on the contest rules or other reasonable considerations.

3. Contest Venue Description

(1). The surface of the contest venue is black, and the racing track is marked with white stripes that are 1.9 centimeters wide.



(2). The racing track consists of arcs and straight lines, with the minimum radius of the arcs being 10 centimeters.

(3). The same arc must be more than 10 cm long to change the curvature.

(4). The total length of the racing track will not exceed 60 meters. The racing track may intersect (the angle of intersection is 90 ± 5 degrees, please refer to the diagram on the right), but the robotracer must proceed straight at the intersection of the racing track.

(5). The starting point and finishing point of the racing track are on the same straight line, with the finishing point located 100 centimeters behind the starting point. On the right side of the direction along the racing track, there will be "markers" at the starting point and finishing point. At the marking points of the starting line and finishing line, there will also be a gate with a width of 40 centimeters and a height of 25 centimeters labeled "START" and "GOAL" respectively. The area between the starting point and finishing point is referred to as the "starting and finishing area" (please refer to figures 1a-b for details).

Figure 1(a): Gate labeled "START" and "GOAL" with an inner diameter of 40 centimeters, height of 25 centimeters.

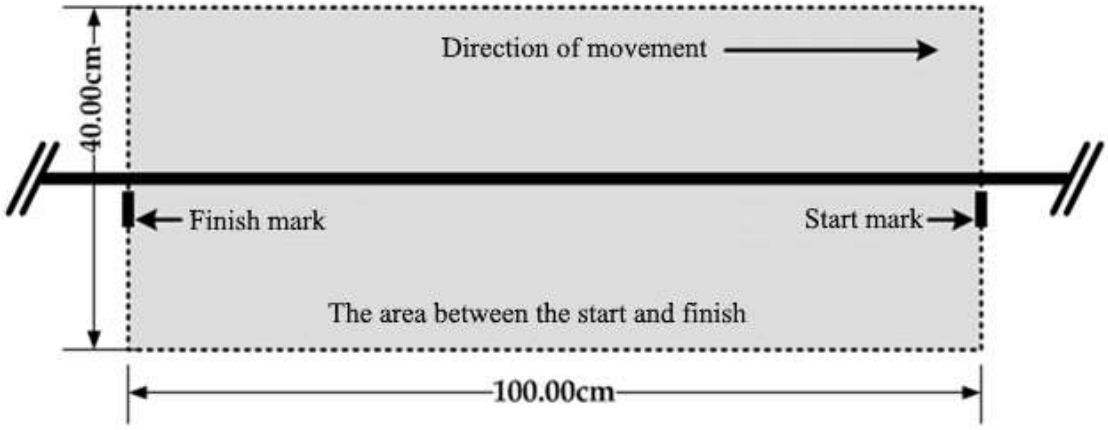
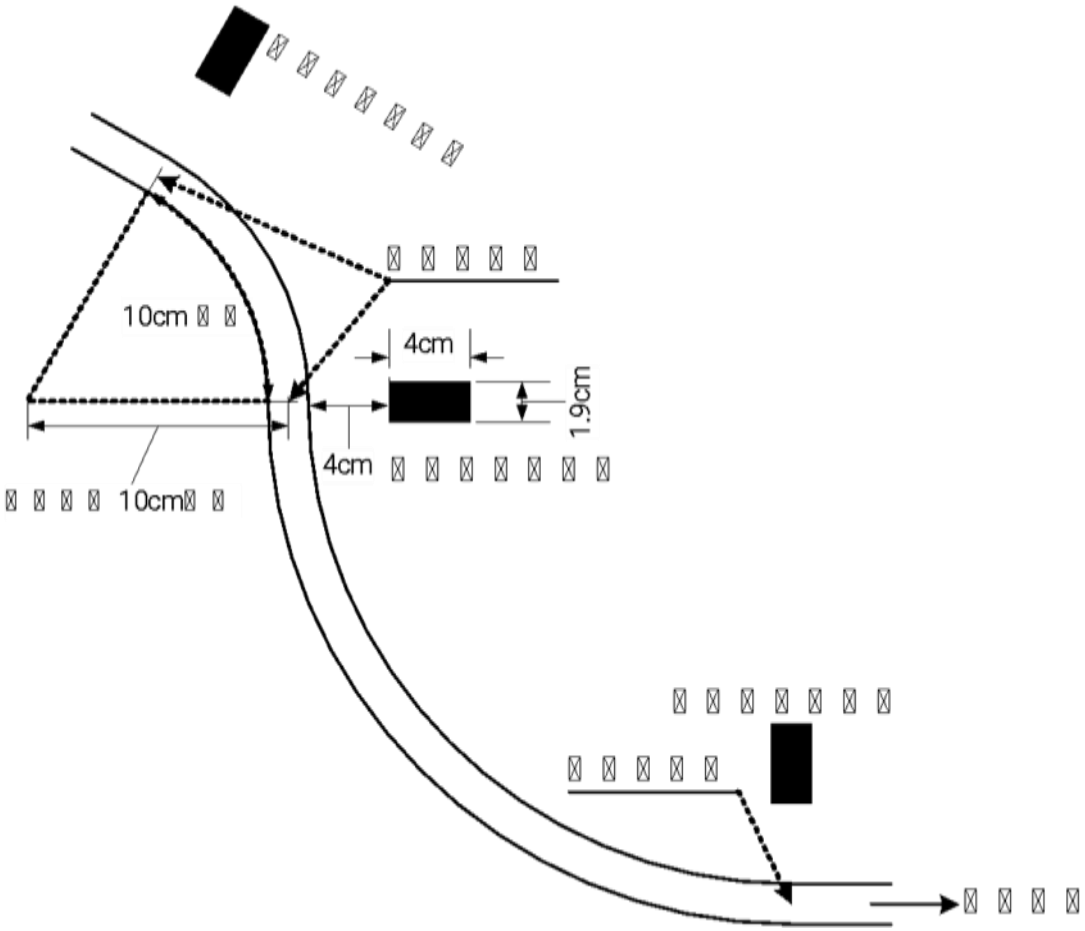


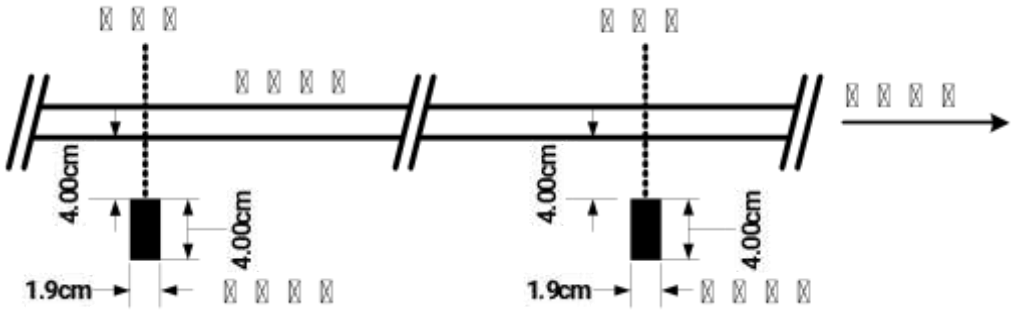
Figure 1(b): The area between the starting point and finishing point is referred to as the "starting and finishing area".

(6). Within 25 centimeters from the starting point and finishing point on the racing track, or within 25 centimeters from the intersection point of the track, the track is straight.

(7). The starting and ending positions of the curved sections of the racing track will be marked on the left side in the direction along the racing track.



(8). The contest venue is mostly horizontal, but certain sections may have inclines of up to 5 degrees.



4. Notice

(1). During the contest, downloading programs to the robotracer or replacing ROM is not allowed. It is also prohibited to connect the robotracer to any hardware or software device that can adjust the program for the robotracer.

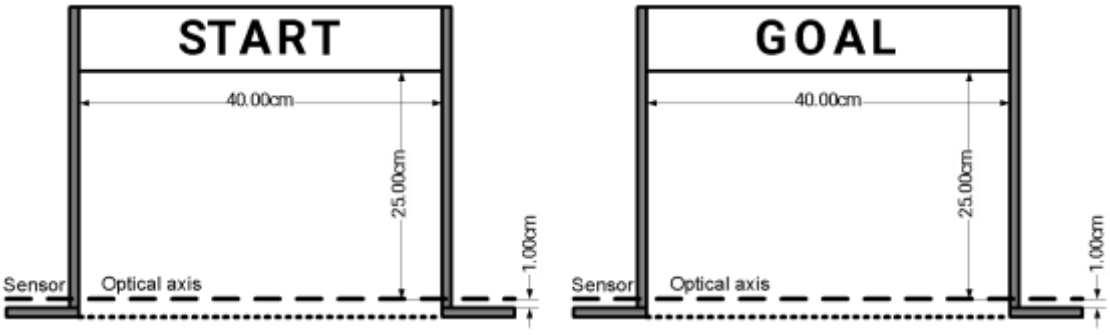
(2). If an robotracer stops or leaves the racing track before reaching the starting line after starting the race, it will be considered as completing one timing.

(3). Even if an robotracer completes one lap timing and passes the finish line, if it fails to automatically stop in the designated "starting and finishing area," the result will be considered invalid.

(4). Different curvature arcs may be connected to each other in the racing track.

(5). There may be a height difference of about 1mm at certain junctions of the racing track.

(6). The starting and finishing lines of the racing track are equipped with through-beam sensors mounted horizontally, approximately 1 centimeter above the racing surface.



(7). When there are fewer robotracer teams completing the event than there are contest awards, it may be necessary to have absences.

(8). Complaints or demands regarding the grip of robotracers on the

contest venue are not allowed.