SCHOOLS' ROBOTIC COMPETITION – ROBO CAN - COLLECTOR

1. OBJECTIVE

To design and build an autonomous robot that is able to follow a black path with built-in obstacles. At the end of the path, it is to collect a "can" weighing **200g** and to return to the starting box before unloading. It must be capable of receiving and transmitting wirelessly the can's position information.

2. JUDGING CRITERIA

The robot which has the **highest points** (collected "cans" – total penalty points) within the stipulated time of **FOUR minutes** is the winner.

3. ENTRY REQUIREMENTS

3.1 The **Robo Can–Collector** is opened for all full-time students from formal MOE primary or secondary schools. Student participants should not exceed the age limit of 18 year-old as of 31-Jan 10.

3.2 Each school could submit up to **three entries**. Each entry shall not be more than four students and must have its own can-collection robot. No robot shall be shared by any entries and no cloning (identical design) is allowed.

3.3 Entry closes two weeks before the competition. The robot must pass inspection at the beginning of the competition. Further details are available from the official web site.

3.4 All robots and the transmitting controller shall be caged at the beginning of the competition and will be returned only at end of the entire competition.

4. RULES AND REQUIREMENTS

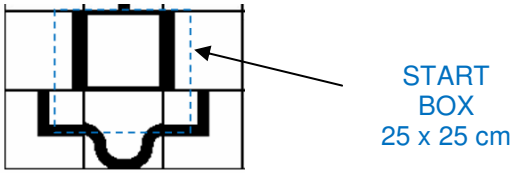
4.1 The robot is to be controlled by an on-board programmable microcontroller and powered by 6 AA batteries or its equivalent of 9V (6 x 1.5V). The robot should not exceed 25 cm in length and width.

4.2 Playing field design:

a) As shown in Figure 1, the playing field with an approximate size of 176 by 192 cm is constructed using the proprietary brick tiles from Plegofield (www.plegofield.com) into 12 columns x 11 rows.

b) The playing field which has black path (against the white background) layout for path tracing purposes is made up of **modules one and two**.

c) **Module one** playing field has a **start box** measuring 25 cm by 25 cm and an unkown black path design. The black path will be a single track with no cross junctions leading to the entrance of module 2. The start box will be constructed from 6 brick tiles as follows. It is where the robot will start and finish and it can be located any where within the module facing any direction.



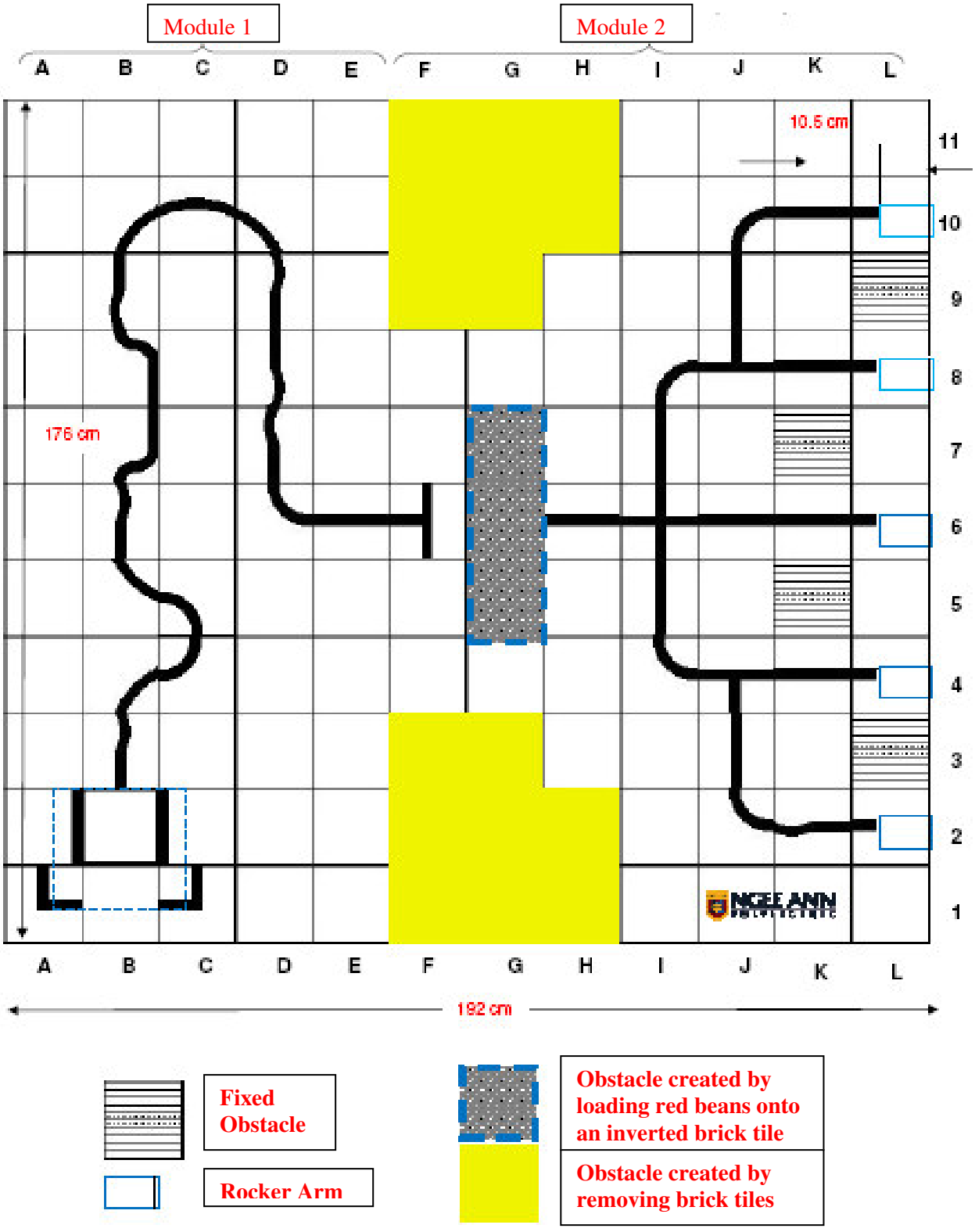
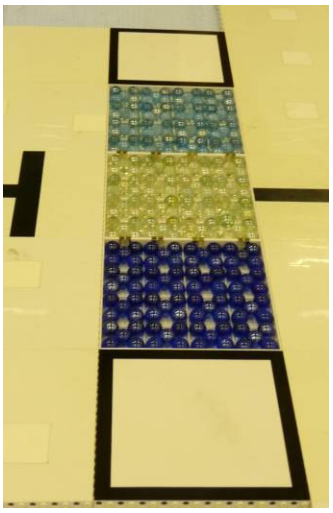
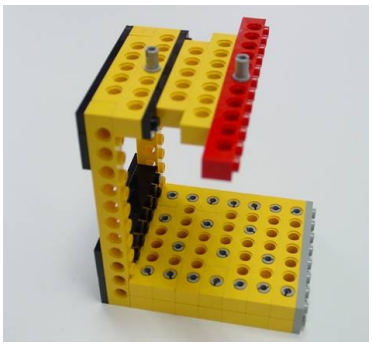


Figure 1

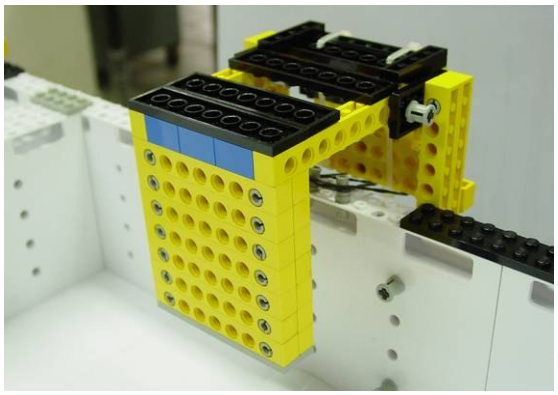
d) As shown in Figure 1, the **module two** of the playing field has a known layout. Robot is expected to run over an obstacle simulating a **rocky terrain** as shown in Figure 2. The obstacle that has width equivalent to three brick tiles is contructed by loading marbles onto the inverted brick tiles. Beyond the obstacle, the black path continues and subsequently branches into five separate paths, at the end of which a "can" could be pre-loaded on one of these five rocker arms (Figure 3).

Rocky Terrain as
constructed from marbles
Figure 2 (right)

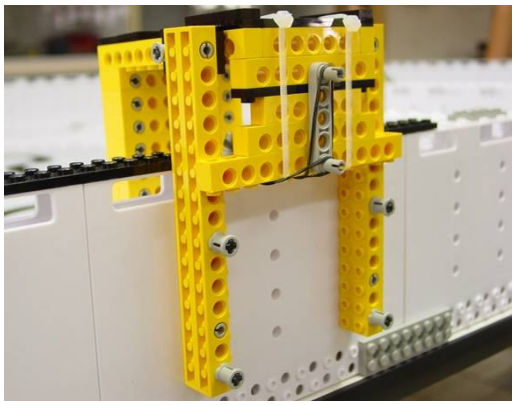




Construction of the Rocker Arm



Rocker Arm Front View



Rocker Arm Back View

Figure 3: The Rocker Arm

e) An **example** of the playing field is given in Figure 4. Other than the rocky-terrain obstacles, other types of obstacles include:

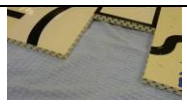
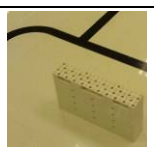
• Obstacles created by removing the brick tiles,	
• Cylindrical obstacles to be placed randomly by the judges just before competition commences to prevent robot from taking "short cut" to reach the "can",	 
• Other fixed obstacles are placed near the end of each path.	

Figure 4(a): An Example of Playing Field Layout

4.3 Each team will provide a robot and a transmitting controller. The robot will be started manually at the start box of module 1 playing field. **One 200g "can" will then be placed on one of rocker when the robot reaches end of module one of the path. At the same time, the transmitting controller will transmit wirelessly the required can's position to the robot.** The robot is to acknowledge the can's position information by **echoing the information****. After the acknowledgement, the transmitting controller is to stop the transmission. The handler is **not allowed to handle** the transmitting controller **after it is turned on and the program running**. A **penalty of 0.5 points (2 penalties is equivalent to one can collected)** will be given if the controller does not stop transmission after the acknowledgement and when the robot collected the can and return to the starting position.

Both the robot and the transmitting controller will be caged at the beginning of the event. A printout of the transmitting program must be submitted at the time of caging. For different teams from the same school, the same transmitting controller can be used. However this must be made known at the time of caging with the team names stated in the printout.

4.4 Upon reaching the end-of-path, the robot has to collect the **"can"**. Robot should make contact with the rocker arm to dis-lodge the "can" onto its receptacle. Robot must then carry the "can" (off the ground), and bring it back to the starting box. The "can" is said to be **successfully delivered** when any part of the robot body touches the starting box outline. Upon reaching the finishing position, the handler will unload the "can" and at the time reposition the robot within the starting box to commence the following run to collect the next "can". The transmitting controller could be reset if needed. Only one "can" is to be collected for each run. Only one handler is allowed to assist the robot at the starting and finishing position and another handler to operate the transmitting controller.

4.5 It is considered an "aborted run" should the robot drop its "can" on the field in the course of its run. The robot is to start from the starting position and a **"can" will be placed on any rocker arms by the judge. The transmitting controller is to be re-sent the can position.**

4.6 The robot is given **four minutes** to collect as many "cans" as possible.

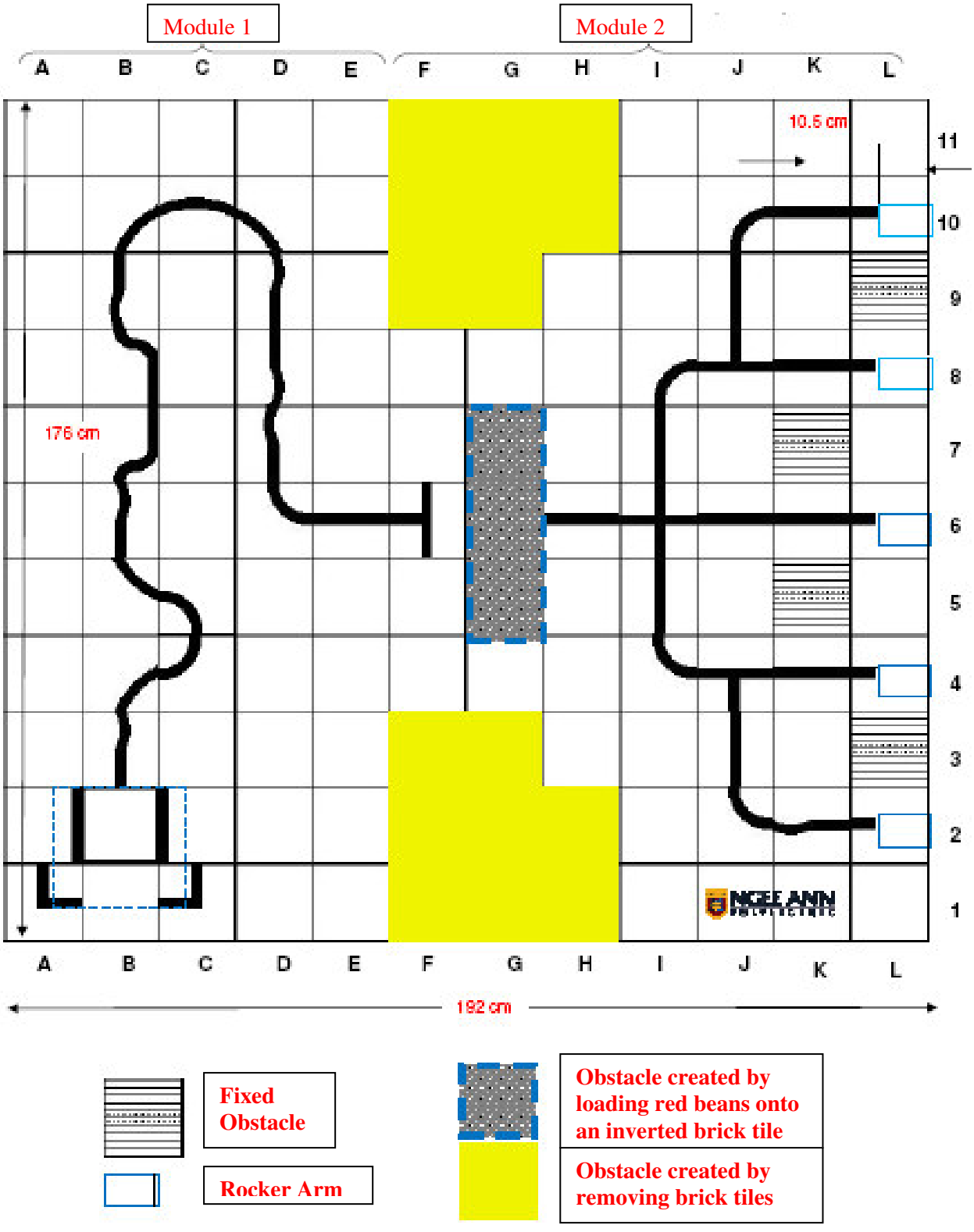


Figure 4(b): An Example of Playing Field Layout

4.7 No adjustment is allowed in the open field during the run. The robot must be brought back to the starting box and restart when being inactive, disabled, stucked or out of control in the open field. This will be considered as one aborted run, and the decision to abort the run is at the discretion of the handler.

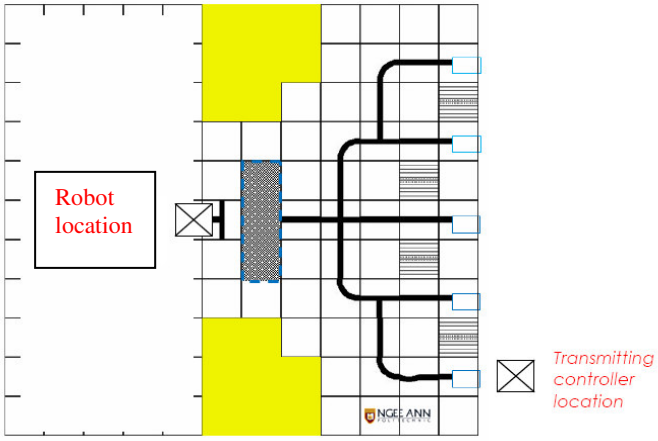
Permission may be granted for 1 recess (10 minutes) and it carries a penalty of 2 minutes on the competition time.

4.8 In the event of a tie, **the robot that collects a "can" in its very first run and with the shortest time will be ranked highest**. If there is still a tie, the robot with the least number of aborted runs during the game will be ranked next. On further tie, the rank will be determined by either the shortest time for a successful collection of a "can" or the furthest distance covered for a non-delivery, of ONE final run.

FAQ (Frequently Asked Questions)

1. Must we use only Lego parts. Can we use parts from other sources?
   There is no restriction on parts used.
2. How many motors are allowed?
   No limits on number of motors used. However, you are limited in the use of maximum 9 V (6 x 1.5V) battery source.
3. How many sensors are allowed?
   No restriction on number of sensors used.
4. Are we allowed to use other microprocessors beside the RCX and other type of sensors supplied with Lego Mindstorm?
   There are no restrictions microprocessor and sensors used.
5. Can my robot collect more than one can at a time?
   No, robot can only collect one can at one time.
6. What brand is the can drink?
   We use Jia Jia Herbal Tea cans.
7. What is filled inside the can to make its weight 200g?
   Beans or rice.
8. Will there be a practice run?
   Due to constrain in the venue, we could only set up the track on the actual day. We might consider allowing practice time one to two hours before event commences.
9. Are we allowed to measure the light sensor values so that we can program it on our robot before caging?
   Please do so during practice runs, usually few hours before the event.
10. What does caging mean?
    Only particpating robots need to be caged in a common area before the start of competition.Caged robot will only be released back to the students until the end of the whole competition.
11. Can I take back my robot if I know I have no chance of winning any medal?
    Usually you are not allowed to take back your robot till the end of the competition. However, we understand that some school need to leave early as the bus is waiting etc. In that case, we allow early return of robots provided all the teams from the same school have completed their runs and are out of contention for any medals.
12. Must the entire robot start behind the starting line or can some parts of the robot be in front of the line such as the light sensor?
    The entire robot including sensors, arm etc need to be behind the starting red line.
13. Must the robot follow the line strictly. Can we just program the robot to go straight without following the line.
    Robot must follow the line to reach the "can" as there are obstacles placed randomly everywhere and robot will not be able to take any short-cut .
14. Is flash photography allowed during the runs?.
    Flash is not allowed as flash might affect the light sensors.
15. Are we allowed to wipe the playing field with a dry cloth before starting the run?
    Yes, but please inform the judges first to get his/her permission.
16. What kind of message is sent by the broadcasting controller?
    Participants decide their own message.

17. Which is "can" number 1 and which is "can" number 5?
    "Can" number 1 is at grid I2, while "can" number 5 is at grid I10.
18. Where is the transmitting controller positioned?
    The transmitting controller is to be held by a handler standing directly opposite the handler managing the robot.
19. Who will be responsible to operate the broadcasting controller? How could you ensure that message is sent at the right time?
    A team member will operate the transmitting controller. The judge or the event organizer will inform the team member the "can position" after the robot start moving away from the "start" position where the handler is not allowed to touch the robot anymore.
    The picture shows the transmitting controller location and the robot location when the can position is made known.



20. What is meant by "echoing the information received 3 times." in para 4.3 line 5?
    Upon receiving the can position message by transmitting controller, your robot's controller must echo some message to acknowledge receipt of the message back to the transmitting controller. Upon the receipt of the acknowledgement the transmitting controller is to stop running the program, otherwise a penalty of 0.5 point will be given. (2 penalties equivalent to one can collected.)