2. LINE FOLLOWING CHALLENGE

2.1 GOAL

To design, build, and program a line following robot that can follow a black line on a white background to a tower and deliver at first at least one (1) ball and then return to its starting point. Then, in the remaining time of 3 minutes, the robot returns to the tower (as many times as needed) to deliver a set number (not over, not under) of balls as per their division's requirements.

2.2 DIVISION

- Teams in this challenge compete in separate divisions:
    - Elementary School (ES)
    - Middle School (MS)
    - High School (HS)

- Teams of 2 to 4 players

2.3 ROBOT AND BALL CONTAINER

■ Autonomous robot, any platform, costing $1,500 USD or less, that meets the following design constraints, which will be verified during Check-In:

Type	Specifics
Platform	Not limited
Robot	**Autonomous robot**
Volume	**Not exceed 65030 cubic centimeters(ball container included)** **Robot CANNOT be expanded after leaving start position.**
Multiple Controller	Allowed
Sensor Type	Not limited
Sensor Number	Not limited
Motor type	Not limited
Motor / # of Servos	Not limited

■ Volume of robot and ball container must not exceed 65030 cm_3. Teams can design and build a box for fast loading.

2.4 TRACK , TOWER, AND BALLS

■ The white or black background PVC vinyl track dimensions are 76.0 cm x 152.4 cm.

■ The design pattern changes every year and is revealed on the first day of the event. Shown below are past line following tracks for ES, MS, and HS divisions.
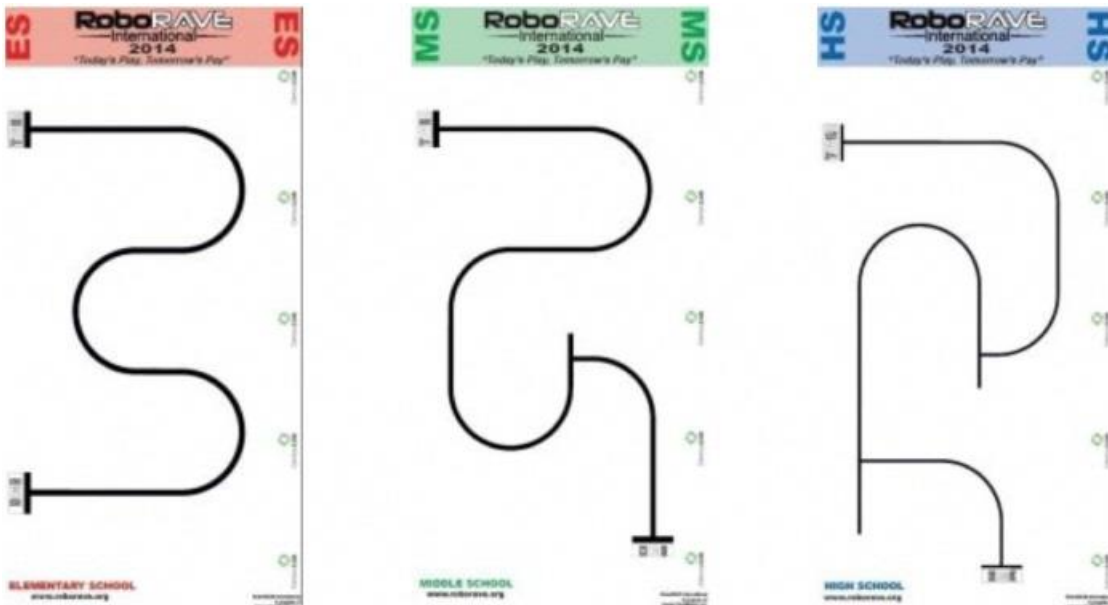
Division	Line Width	Intersection
ES	~1.27 cm	No T intersections
MS	~1.27 cm	One T intersection
HS/BK	~0.75 cm	Two T intersections

■ All divisions use the same 20 cm tall x 10 cm wide x 20 cm long tower with a 10 cm x 10 cm opening at the top and an open back to allow the balls to roll out during delivery. There is a partition behind. The tower is held firmly to the track by a strip of tape.

■ Ping pong balls will be provided at the event.

2.5 RULES AND SCORING

■ In Ball Scoring, you will get 8 official scored runs challenge scoring period.

■ The total of your 5 highest official scores are are used to determine tournament selection. The top 8 teams will move on into the challenge tournament.

■ The robot has 3 minutes to complete the tasks (basic and additional missions).

■ A successful run has two different missions: basic mission HOME-TOWER-HOME (HTH) and Ball Points - Additional mission. The overall score is a combination of points earned from:

● HTH- Basic Mission

・ The robot traversing the track from Home to the Tower, delivering at least 1 ball (number of balls beyond 1 ballis NOT important the points earned are for demonstrating the successful action of delivery) then traversing the track back home. The delivery balls are REMOVED once the robot leaves the tower for home.

● Ball Points – Additional mission

・The robot traverses the track from Home to the Tower and delivers the required number of balls. The robot does not have to traverse the track back home.

Each division will have a set number of balls to deliver：

Elementary School - 130
Middle School – 230
High School/Big Kids – 330

● Time ends OR you call a stop.

Scoring Matrix is shown below for robot: HOME to TOWER + Delivery

	Leaves Home	Turns ANY direction at 1_{st}T	Turns ANY direction at 2_{nd}T	Stops at Tower wheel motors OFF	Delivers at LEAST 1 ball
ES	50	N/A	N/A	100	100
MS	25	25	N/A	100	100
HS/BK	25	25	25	50	100

Continued Scoring Matrix is shown below for robot: LEAVES TOWER to HOME; POINTS for completing the HOME-TRACK-HOME circuit are given ONCE.

	Starts back home	Turns ANY direction at 1_{st}T	Turns ANY direction at 2_{nd}T	Returns Home	Total
ES	50	N/A	N/A	100	400
MS	25	25	N/A	100	400
HS/BK	25	25	25	100	400

o   If the number of balls is under the required number of balls, then that number is your ball score. (For example: Required 130, you deliver 123…7 under required…then 123 is your score)

■ A line following program must control your robot's horizontal motion at all times. If the vertical projection of robot leaves the line for any large distance, the robot must be picked up and eturned to home. Current score will be kept.

■ Touching the robot at any time requires it to be picked up and returned to home. Current score will be kept.

- ■ Robot cannot be touched when it's delivering balls to the tower.
- ■ The tower cannot be touched during delivery.
- ■ No ONE can reach inside the tower during delivery. If done, the judge will stop the delivery in action and end the run for the team.
- ■ Teams cannot scoop balls out of the tower DURING the delivery.

2.6 TOUNAMENT SCORING

- ■ The top 8 teams from each division will compete in the final tournament.
- ■ Teams got same score in the top 8, decision match will be.
- ■ Teams get same scorement, the faster one will be advanced.
- ■ Advancing teams will be seeded into the tournament bracket according to their aggregate score (see bracket below).

"RoboRAVE Kaga Japan 2019" 8 Team Tournament Bracket

Tournament Placing

・The losing teams from Round 1 will place 5th through 8th in accordance with their aggregate score coming into the tournament.

・The losing teams from Round 2 will face each other in Round 3 to determine the 3rd and 4th place winners respectively.

・The winning teams from Round 2 will face each other in the Championship Round (which may be run at the same time as Round 3) to determine the 2nd place winner, and the Tournament Champion.

Round 1 | Round 2 | Championship Round

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1 ┐
  ├ 1) ┐
8 ┘    ├ 5) ┐
4 ┐    │    │
  ├ 2) ┘    │
5 ┘         ├ 8) ── Champion
3 ┐         │
  ├ 3) ┐    │
6 ┘    ├ 6) ┘
2 ┐    │
  ├ 4) ┘
7 ┘   L5 ┐
        ├ 7) ── 3rd Place
  Round 3
      L6 ┘
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