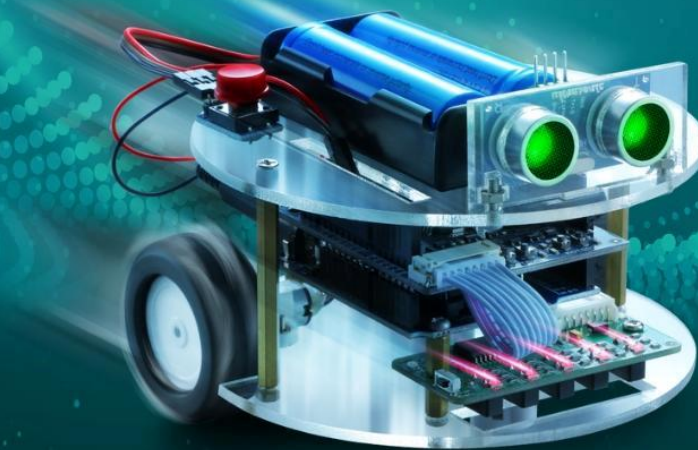


PETROSAINS RBTX CHALLENGE 2023



RULES AND REGULATIONS



ROBO TRACER Open 7 years old & above

It is recommended that you review the general terms and conditions prior to reading the rules for a specific category, as the general terms and conditions apply to all categories throughout the entire competition.

Version: 15 April 2023

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1. Introduction

Robo Tracer, also known as line following, is a technique used in robotics where a robot follows a line, usually a contrasting colour, that is marked on a surface. This is accomplished using sensors, such as infrared or optical sensors, that detect the contrast between the line and the surrounding surface. By continuously detecting the position of the line, the robot can adjust its movement to stay on the line. Robo Tracer is commonly used in industrial and manufacturing settings, where robots can be programmed to follow a specific path to move materials or perform tasks. It is also a popular application in educational robotics, as it is a simple and engaging way to introduce students to robotics and programming concepts.

The Robo Tracer Open category challenged young innovators aged 7 years old and above to program a robot that can move on a given line (black on white) and pass through all obstacles. The robot which completes the task in the fastest time will be declared the winner.

2. General Rules

2.1. Competition Phases

- I. **Registration:** Each team is required to register through the RBTX website. Each participant can register for one team **ONLY**. Teams are then required to submit a video of the complete challenge upon registration.
- II. **Online Learning:** Participants are required to complete the learning modules and passed the assessment in the RBTX Portal to proceed for the next level. Passing marks is 80%.
- III. **Zone Qualifying:** The zone qualifying stage will be online.
- IV. **Grand Finals:** Top teams from the Zone Qualifying Stage will be selected to move on to the onsite Grand Finals. All finalists will be informed of the competition schedule right after the completion of the qualifying stage. All costs incurred shall be borne solely by the participating teams.

2.2. Participant

- 2.2.1. All team members except for the guardian must be between 7 years old and above only. (Maximum of two team members)
- 2.2.2. The guardian can be a teacher, parent, mentor, or technical advisor.
- 2.2.3. The guardian is not allowed to touch or repair the robot during all phases of the competition. (Refer to **2.1. Competition Phases**)
- 2.2.4. The guardian must not be involved in the programming of the robot during all phases of the competition. (Refer to **2.1. Competition Phases**)
- 2.2.5. In the case of any interference by the guardian with the robot or referee decisions during any phase of the competition, the team will risk disqualification.

2.3. Competition Rounds

- 2.3.1. Every team will compete in ONE (1) round.
- 2.3.2. The round should not last more than three minutes (labelled as **Runtime**).
- 2.3.3. If the robot has yet to reach the finish line once the Runtime is over, the round will be automatically stopped.
- 2.3.4. Race clock
 - Once the robot moves from the Start line, a timer will start to count the **Race Time**.
- 2.3.5. The timer will stop when the robot reaches the finish line, and the final recorded race time value will be saved.
- 2.3.6. Robot Control
 - Once a robot has crossed the start line, it must remain fully autonomous, or the team will be disqualified.

2.4. Competition Area

A robot that moves out of the Competition Field will be disqualified. A robot shall be deemed to have left the arena when any wheel, leg, or track has moved completely off the competition surface area.

2.5. Losing the Line

Any robot that loses the line course must reacquire the line at the point where it was lost or at any earlier (already traversed) point.

2.6. Competition Field

- 2.6.1. All participating teams must print their own competition field for the **Video Submission Phases**. The **competition field template** will be issued by the organizer in PDF format.
- 2.6.2. There will be only **ONE (1)** track design for the video submission phase.
- 2.6.3. Each team is responsible to ensure the quality of the competition field, which includes the printing material, colour tone and accurate measurement. The field must also be smooth and free of smudges.

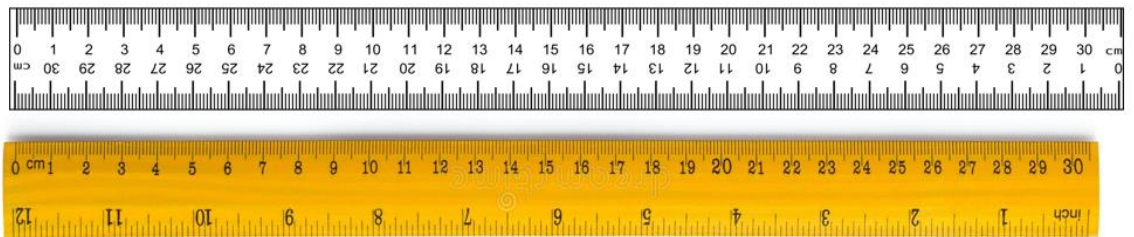
2.7. Field specifications

- 2.7.1. The lines to be followed are 16 mm to 20 mm in width and are black in colour.
- 2.7.2. Expect all measurements and dimensions to have a 10% tolerance.
- 2.7.3. The dimensions of the competition field, including the border, is **3 meter in length** and **2 meter in width**.
- 2.7.4. Characteristics of the line course are as follows:
Crossover, switchbacks, and hairpins are possible. For switchbacks and hairpins, the adjacent sections of the line shall be no closer together than 15cm when measured from the center of each line.

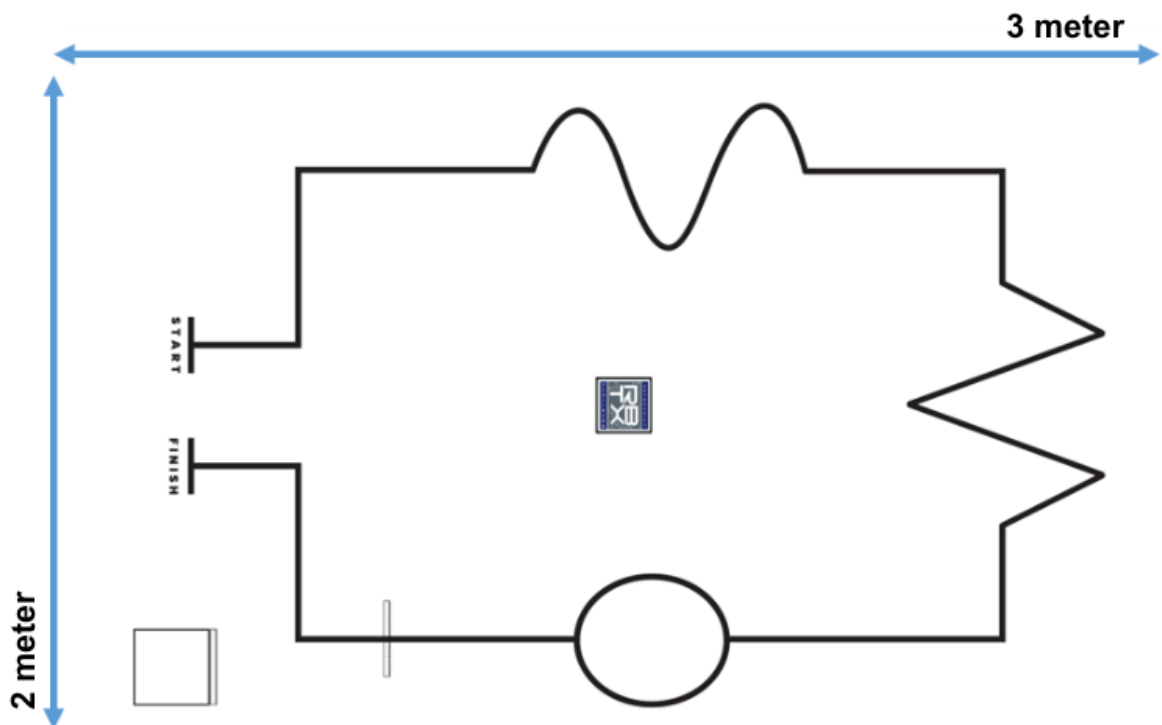
- 2.7.5. The closest approach of the line course to the edges of the arena shall be no less than 15cm, measured from the center of the line.
- 2.7.6. Sharp angles may occur.
- 2.7.7. A printable rule scaler and robot size checker will be made available to ensure accurate measurements of the competition field and robot specifications are met.
- 2.7.8. There will be a new challenge called 'speed hump'. Participants need to prepare a wooden ruler. The dimension of the ruler should be:

Height : 0.3 cm
 Width : 2.5 cm
 Length : 30 cm

- 2.7.9. Expect all measurements and dimensions to have a 10% tolerance.



**The installation of the speed hump will be shared in the track preparation video on the website.



Remark: The track design for the Video Submission is as per display.

3. The Robot

3.1. Dimensions

Each team must comply with the following robot specifications:

Width – 200mm max

Length – 200mm max

Height – no limit

3.2. Control and Programming

3.2.1. The robot must be controlled autonomously with no human aid.

3.2.2. The controller unit should be embedded in the robot and cannot be placed on the robot's exterior.

3.3. Sensors

No limit on the number of sensors used.

3.4. Power Source

3.4.1. The robot must be powered by a power source such as a battery fixed onto the robot.

3.4.2. The robot cannot be powered by a stationary power source connected to the robot by a cord.

3.5. Start Button

The robot must be equipped with a push-button to initiate the starting sequence.

3.6. Construction

Any robot kit or building material may be used, as long as the robot complies with the above specifications.

4. Game Play

4.1. Game Zone

An area around the competition field will be designated as the **Game Zone**. No one is allowed inside the game zone except for the robot handlers.

4.2. Start and Restarts

- 4.2.1. One (1) team member is elected as the robot handler. Only that team member is permitted to handle the robot during the game.
- 4.2.2. The robot handlers may request a restart whenever it is deemed necessary within the THREE (3) minutes time limit. During the restart process, the handlers are allowed to make minor adjustments to the robots but not in terms of programming or replacing parts.
- 4.2.3. At every game, the robot must be positioned back at the start line.
- 4.2.4. Adjusting the sensor position on the robot is allowed during the allocated runtime.

4.3. Following the Line

- 4.3.1. To determine if the robot has moved outside the line or strayed off the field, the competition will use the CONVEX HULL of the robot. This measure is done by stretching an imaginary rubber band around the extremities of the robot and using the enclosed space as a silhouette.
- 4.3.2. The robot must remain on the field until the game has been completed.

4.4. Scoring

- 4.4.1. Race time is the time recorded for the robot to complete tracing the route from start to finish.
- 4.4.2. The team with the fastest race time will be the winner. If there are two teams or more with the same race time, these teams will compete in an extra round to determine the final winner.

5. Code of Conduct

5.1. Fair Play

- 5.1.1. It is expected that all teams aim to play a fair and clean game.
- 5.1.2. The rules are enforced at the discretion of the referees, officials, and local law enforcement authorities.
- 5.1.3. Participating teams and robots that do not meet the stated specifications will not be allowed to compete.
- 5.1.4. Participating teams that violate the code of conduct may risk being disqualified from the competition.

6. Judges

- 6.1. All decisions on scoring, game play and timing are made by the judges. Teams should completely respect their vote and decisions.
- 6.2. Judges may announce new rules or decisions about any issues that might not be mentioned in the existing rules and regulations, which must be abided by all participants.
- 6.3. All decisions are final.

7. Video Submission Brief

7.1. The Challenge

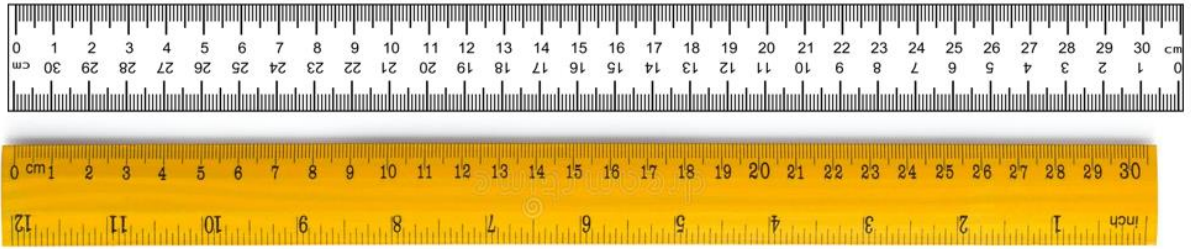
- 7.1.1. The challenge of the competition is to program a robot that can move on a given line (black on white) and pass through all obstacles. The robot which completes the task in the fastest time will be declared the winner.
- 7.1.2. Participating teams are required to record a Video of their robot completing the challenge in the fastest time and passing through all obstacles given.
- 7.1.3. The following are the requirements for the video file:
 - i. Teams must provide a link to the video (which can be uploaded to any platform such as Google Drive, YouTube etc). The link must be listed and accessible for the organizer to view.
 - ii. The duration of the video must not exceed 3 minutes.
 - iii. All final audio/video presentations must be in MP4 Format (H.264 video and AAC audio codec).
 - iv. Video size set at HD (1280 x 720 or other '720p' setting)
 - v. The audio/video dimensions must have a minimum height of 480 pixels with an aspect ratio of 16:9.
 - vi. The naming convention for the video must include the team's name for the judges' reference.

All the requirements stated are to be adhered to.

7.2. Verification

Before the start of the game, participating teams must first verify their competition field measurements, robot size and robot features. This will include testing the visual stopwatch timer and the robot's onboard display timer capabilities.

- i. Start the video with a full view of the entire competition field.
- ii. Track Scale Check – Zoom the video to the scale checker to verify the track measurements. Place a standard 30cm stationary ruler on the track beside the scale checker.



7.2.1. Robot Size Check

Place the robot inside the robot size checker on the track. Teams must show that the robot can fit within the outline of the robot size checker.



7.2.2. Robot Features Check – Teams must include shots of their robot's features as per the competition requirements.

7.3. Competition Video Display Setup

- 7.3.1. The entire competition field (as stated in **2.7 Field specifications**) must be in full view throughout the video.
- 7.3.2. Place any form of a stopwatch timer that is visible at the bottom right-hand corner of the video.
- 7.3.3. Any editing or manipulation of the video timing will cause **immediate disqualification**.

7.4. Competition Start

- 7.4.1. The video must consistently capture the robot's movement and the entirety of the competition field throughout the recorded run.
- 7.4.2. Participants may first implement any calibration procedures.
- 7.4.3. The handler must place the robot at the designated start line. A certain part of the robot must also be perpendicular to the designated start line.
- 7.4.4. After pressing the start button, the robot should then begin to trace the line and complete the run in the fastest time.
- 7.4.5. Simultaneously with (7.4.4), a team member shall start the stopwatch timer that is visible in the video.

7.5. Following the Line

- 7.5.1. To determine if the robot has moved outside the line or strayed off the field, the competition will use the CONVEX HULL of the robot. This measure is done by stretching an imaginary rubber band around the extremities of the robot and using the enclosed space as a silhouette.
- 7.5.2. The robot must remain on the field until the game has been completed.

7.6. Competition Finish

- 7.6.1. The competition is complete as and when any part of the robot touches the finish line.
- 7.6.2. A team member shall also stop the timer on the stopwatch at the same time as 7.6.1.
- 7.6.3. Show the final reading of the stopwatch timer clearly in the video.

7.7. Code of Conduct

As stated in General Brief (Refer to **5. Code of Conduct**).

7.8. Judges

As stated in General Brief (Refer to **6. Judges**).

8. Zone Qualifying Phase

The challenge of the competition is to make a robot that can move on a given line (black on white). The robot which completes the task in the fastest time will be declared the winner.

Based on their video submissions, the top-ranked teams will be selected to move on to the Virtual Qualifying Phase and subsequently the Grand Finals. The qualified teams shall be notified in advance of their game schedule. All qualified teams are required to compete via **live video streaming** on a **virtual competition platform**. Teams will be at their own location with their own printed tracks and robot.

All the requirements as stated in this Game Play brief are to be adhered to.

This Game Play brief shall be read together with the Robo Tracer open level competition brief.

8.1. Game Play

8.1.1. Virtual Competition Overview

- i. The participating team will be given access to the virtual competition platform at a designated time. This will be informed to the team at least 24 hours before the competition run.
 - ii. The competition run will be conducted online with referees remotely evaluating the race and run time and adherence to all competition rules and regulations.
 - iii. The competition includes a minimum of one (1) referee, two (2) race coordinators and the participating team.
 - iv. Participating teams may be required to record the live video streaming for backup purposes.
 - v. A compulsory briefing session will be conducted before the competition run for all participating teams on the morning of the competition day.
 - vi. Each participating team shall have ONE (1) competition run.
 - vii. The competition run should not last more than THREE (3) minutes (labelled as Runtime).
 - viii. If the robot has yet to complete the run despite exceeding the THREE (3) minutes runtime, the online referee in attendance will ask the team to stop.
 - ix. The live video streaming session of the Virtual Competition will be conducted as per the following:
 - Verification Phase
 - Competition Run Phase
- 8.1.2. The competition field (as stated in **2.7 Field specifications**) must be in full view throughout the live video streaming session.
- 8.1.3. Teams must place any form of a stopwatch timer that is visible at the bottom right-hand corner of their screen.
- 8.1.4. Any editing or manipulation of the timing will cause immediate disqualification.

- 8.1.5. Participating teams shall ensure and are responsible for a stable internet connection throughout their competition run.
- 8.1.6. If a participating team has a technical problem during their competition run, the referee, at their sole discretion, will decide if the run must be cancelled or restarted.

8.2. Race clock

- 8.2.1. When the robot passes the start line, a visible stopwatch timer will be started by a team member to count the Race time.
- 8.2.2. The stopwatch timer will be stopped as the robot reaches the finish line, and the final recorded race time value will be saved.

8.3. Verification Phase

As stated in Video Submission Brief (Refer to **7.2. Verification**)

8.4. Competition Run

- 8.4.1. Teams must consistently capture their robot's movement and the entirety of the competition field throughout the virtual competition run.
- 8.4.2. Participants may first implement any calibration procedures.
- 8.4.3. The handler must place the robot at the designated start line. A certain part of the robot must also be perpendicular to the designated start line.
- 8.4.4. After pressing the start button, the robot should then begin to trace the line and complete the run in the fastest time.
- 8.4.5. Simultaneously with 8.4.4, a team member shall start the stopwatch timer that is visible on the screen.
- 8.4.6. Teams may restart their run if deemed necessary, within the three minutes runtime.
- 8.4.7. The restart can be requested only if the robot does not follow the line, has stopped halfway, or has lost direction.
- 8.4.8. At any restart, the robot must be positioned back at the start line.
- 8.4.9. Adjusting the sensor position on the robot is allowed during the allocated runtime.
- 8.4.10. The race time will be reset to zero at every restart. However, the runtime will keep running during all restarts.
- 8.4.11. There is no limit to the number of restarts within the runtime of three minutes.

- 8.4.12. A robot **must restart** if:
 - i. The robot handler asks for a restart.
 - ii. The robot is touched by a participant.
 - iii. The robot moves off the field.

8.5. Following the Line

- 8.5.1. To determine if the robot has moved outside the line or strayed off the field, the competition will use the CONVEX HULL of the robot. This measure is done by stretching an imaginary rubber band around the extremities of the robot and using the enclosed space as a silhouette.
- 8.5.2. The robot must remain on the field until the game has been completed.

8.6. Competition Finish

- 8.6.1. The competition is complete as and when any part of the robot touches the finish line.
- 8.6.2. A team member shall also stop the timer on the stopwatch at the same time as **8.6.1**.
- 8.6.3. Show the final reading of the stopwatch timer clearly on the screen.

8.7. Code of Conduct

As stated in General Brief (Refer to **5. Code of Conduct**)

8.8. Judges

As stated in General Brief (Refer to **6. Judges**)

9. Grand Final Phase

9.1. The Challenge

The challenge of the competition is to program a robot that can move on a given line (black on white) and pass through all obstacles. The robot which completes the task in the fastest time will be declared the winner.

9.2. General Rules

9.2.1. Format and Rounds

Every team will compete in Double Elimination format.



*Remarks: Double elimination format example. The number of teams that qualify for the grand final is subject to change.

- i. Participants will be facing off against each other.
- ii. One round consists of maximum **THREE (3)** games. One (1) minute will be allocated for each game. Participants need to win at least 2 to advance further.
- iii. One round should not last more than 5 minutes (labelled as RUNTIME).
- iv. If a robot has yet to reach the finish line once the RUNTIME is over, a BUZZER will go off and the team will be asked to remove the robot from the COMPETITION FIELD.

9.3. Race clock

9.3.1. Once the robot moves from the START line, a timer will start to count the RACE TIME.

9.3.2. As the robot reaches the finish line, the timer will stop and the final recorded RACE TIME value will be saved.

9.4. Robot Control

Once a robot has crossed the START line, it must remain fully autonomous, or it will be disqualified.

9.5. Competition Area

A robot that moves out of the COMPETITION FIELD (Refer to **9.7.1 Field specifications**) will be disqualified. A robot shall be deemed to have left the arena when any wheel, leg, or track has moved completely off the competition surface.

9.6. Losing the Line

Any robot that loses the line course must reacquire the line at the point where it was lost, or at any earlier (e.g., already traversed) point.

9.7. Competition Field

9.7.1. Field specifications

- i. The grand final track will be revealed within TWO (2) weeks before the grand final day.
- ii. The lines to be followed are 16mm to 20mm in width and are black in colour.
- iii. Expect all measurements and dimensions to have a 10% tolerance.
- iv. Competitors must be prepared to deal with any extra bumps or slight deviations in height and width of up to 3mm.
- v. There will be one START line and one FINISH LINE.
- vi. The dimensions of the COMPETITION FIELD are 3 meter in length and 2 meter in width.
- vii. Characteristics of the line course are as follows:
 - a. There shall be no crossovers (e.g., places where the line crosses itself)
 - b. Switchbacks and hairpins are possible, but the adjacent sections of the line shall be no closer together than 15cm when measured from the centre of each line.
 - c. The closest approach of the line course to the edges of the arena shall be no less than 15 cm, measured from the centre of the line.
 - d. The minimal curve radius is 7.5 cm.
 - e. Sharp angles may occur.

9.8. The Robots

As stated in general rules. (Refer **3.The Robot**)

9.9. Game Play

9.9.1. Game Zone

An area around the field will be designated as the GAME ZONE. No one is allowed inside the game zone except for the robot handlers and the referees.

9.9.2. Start and Restarts

- i. One team member is elected as the robot handler. Only that team member is permitted to handle the robot during the game.
- ii. The robot will be placed at the START line and checked by one of the referees.
- iii. There will only be THREE (3) games within the RUNTIME of FIVE (5) minutes.
- iv. There will be no restart. The first robot to reach the finish line will be the winner.
- v. At every game, the robot must be positioned back at the START line.
- vi. Both teams must start at the same time.
- vii. The RACETIME will be reset to zero during every game. The RUNTIME will keep running during all THREE (3) games.
- viii. A best-of-three (Bo3) format is one where you must win 2 games to claim victory. After every game, teams will change the field.

9.9.3. Following the Line

- i. To determine if the ROBOT has left the line or left the tile, the referee will use the CONVEX HULL of the robot. This measure is done by stretching an imaginary rubber band around the extremities of the robot and using the enclosed space as a silhouette.
- ii. A team's robot must remain on the field until it has completed its game.

9.9.4. Scoring

- i. RACETIME is the time considered for tracing the route from START to FINISH. The time it does that will be recorded.
- ii. RACETIME is started automatically by the on-field optical sensors that detect the robot's movement and/or by the referee.
- iii. The winner will be decided based on the following criteria:
 - Best of Three games
 - As per the judges' decision.

If both teams are unable to complete the track, the winner will be determined based on their distance towards the finish line.

9.10. Code of Conduct

As stated in General Brief (Refer to **5. Code of Conduct**)

9.11. Behaviour

9.11.1. Contestants who misbehave may be asked to leave the competition area and risk being disqualified from the contest.

9.11.2. The rules will be enforced at the discretion of the referees, officials, and local law enforcement authorities.

9.12. Judges

9.12.1. All decisions about scoring, game play and timing are made by the juries. Teams should completely respect their vote and decisions.

9.12.2. Judges may discuss and announce new rules or decisions about any issues that are not mentioned in the rules and regulations. Objections will not be entertained.