TEACHING CHALLENGE-BASED ROBOTICS

A-MAZE-ING CHALLENGE

Colorado State University Extension with RoboRAVE International

OVERVIEW

In the a-MAZE-ing Challenge, created by RoboRAVE International, youth build robots that can navigate an elevated maze, composed of straightaways and 45, 90 and 135-degree turns, in the fastest time.

Approximate Challenge Time: 3 hours (2 ½ hours build/program, 30 minutes competition)

SUPPLIES

- LEGO Mindstorms EV3 robotics kits (1 per team)
- Tape measures
- Stop watch or timer
- Calculators
- Maze track

Maze Track Supplies

- 1 x 10” board (or shelving) cut to various lengths
  - 1 piece - 18” long
  - 1 piece - 24” long
  - 1 piece - 30” long
  - 2 pieces - 39” long
  - 2 pieces - 48” long
  - 3 pieces - Squares of the 1 x 10, cut to the width of the board (approximately 9.25 x 9.25”)
- Duct tape
- Permanent marker

Creating the Maze Track

1. Cut pieces of the wood or shelving to the lengths listed above (or customize to your chosen lengths).
2. Take the 3 square pieces of 1 x 10 and cut them diagonally down the middle to form 6 right triangles. These pieces will be used for the 45 degree and 135 degree turns.

3. Assemble a maze of your own design for the challenge. The maze should follow this format: straightaway, turn, straightaway, turn, etc. Some of the turns should be to the right, and others to the left. The straightway lengths will vary based on the length of the boards. Turns should vary between 90 degrees, 45 degrees, and 135 degrees. See the example track diagram for help with setting up these angles. Maze length should vary based on age of participants:
    - Elementary School - 5 straightaways and 4 turns
    - Middle School - 6 straightaways and 5 turns
    - High School - 7 straightaways and 6 turns
4. Attach the maze pieces together using strips of duct tape. Place a piece of duct tape at one end of the track, and label it “start”. To simplify scoring, place tape marks at the end of each straightaway, as well. Consult the scoring tape diagram for help with tape set up and labeling.
5. Use permanent marker to write point values on the tape. Each straightaway is worth 50 points and each turn is worth 100, so the board would be marked as follows: 1st straightaway (50), 1st turn (150), 2nd straightaway (200), 2nd turn (300), 3rd straightaway (350), etc. The end of the board should be marked with the appropriate point value for that age group (950 for completing high school, 800 middle school, 650 elementary school), as well as the word “end” or “finish”.

If you don’t have access to boards, it is possible to tape down a maze on flooring instead of using an elevated track, but this will be less challenging and dynamic for teams.

CHALLENGE INSTRUCTIONS

Build

Allow teams approximately 2 ½ hours to build a robot that can navigate the maze track. Teams can use any standard pieces and motors included in their EV3 kit, but no sensors are allowed for this challenge. The goal is to get kids to learn to make precision turns without the use of external sensors.

The majority of time during the “build” will actually be used on programming. Youth should have free access to the maze track to test their program, and should be provided with tape measures and calculators to use for calculations. If teams get through the maze early in the challenge, they should be encouraged to try to find ways to increase the speed with which they can navigate the maze, and should work on improving their accuracy.

If you have a large number of teams, consider having 2 identical mazes for teams to practice and score on. Because mazes might have small differences, assign each team one of the mazes, and have them work and score exclusively on that track. During practice time, ensure that all teams are getting access to the maze track to practice on. During testing, teams should be able to start running their test as soon as the previous robot has reached the 2nd or 3rd turn.

Competition

1. Have one team place their robot at the starting line on top of the maze track. The back of the robot should be lined up with the edge of the board.
2. Have the team start their maze-navigation program. At the same time start a timer. Teams get up to 3 minutes to complete the challenge.
3. If the team drives off the track in their 3-minute time frame, allow them to pick up the robot, reset it at the start line and run their program again. Keep the timer countdown running during this period. The team may reset their robot an unlimited number of times during the 3 minute time frame. They are not allowed to

touch the robot while it is running on the track—only during initial set up and any resets.

4. During the 3-minute run, take note of the furthest distance the robot travels before falling off of the track, and award points accordingly on the scoresheet. For a straight section of track, the robots wheels should touch the point value line for those points to count. For a turn, the robot should completely clear the point value line for it to count. If the robot is able to make it to the end of the track without falling off, stop the timer and note the time remaining. To make it easier to determine when a robot has officially reached the end of the track, place an object like a water bottle at the far edge of the track. When the robot touches this object, stop the timer.
5. For all teams that reach the end of the maze in under 3 minutes, consult the table to determine bonus points. Teams get one extra point per second remaining on the clock when they completed the maze. Note the time and bonus points on the scoresheet.
6. Tally up points earned and bonus points to determine your winners.

If time permits, allow each team to run two or three times, and use each team's highest score for determining the winner.

Did your team enjoy this challenge? Consider entering the a-MAZE-ing Challenge at your local RoboRAVE competition. Visit www.roboquerque.org to find the contest nearest to you and to download their complete challenge rules.