TEACHING CHALLENGE-BASED ROBOTICS

JOUST CHALLENGE

Colorado State University Extension with RoboRAVE International

OVERVIEW

In the Joust Challenge, created by RoboRAVE International, robots follow a line and face off to see who can knock their opponent's water bottle "knight" off first. This challenge requires at least 2 teams.

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

SUPPLIES

- LEGO Mindstorms EV3 robotics kits (1 per team)
- Wide canning lids (1 per team)
- Painter's tape
- 2 jousting knights (see directions below to create)
- Jousting mat (download & professionally print, or see directions below to create)

Jousting Mat Supplies

- 6' x 3' white butcher paper
- Dark-colored masking or painter's tape
- Tape measure
- Straight edge
- Marker

Creating the Jousting Mat

1. Consult the jousting mat diagram for help setting up this mat. To start, draw a 4-foot dashed line down the center of the paper, lengthwise. This is your center line.
2. Parallel to the center line, measure out 5 inches in each direction and tape down a 4-foot straight tape line. These are the two joust lines the knights will follow with their programs.
3. On the far end of one of the joust lines, tape a 6-inch line coming off the line at an approximately 45 degree angle. Work to make a gradual curve where the tape meets the main joust line.
4. Repeat step 3 on the opposite end of the opposing joust line. Write "START" in marker at the end of both of these lines.

5. Draw in the scoring lines, as marked on the mat diagram, and label those areas.

Knight Supplies (x2)

- 20 oz aluminum water bottle
- Clear packing tape
- Scissors
- 3 ¾" button magnets
- 20" zip ties
- ½" wide clear plastic tubing
- Chopstick
- Size 6 cork
- Exacto knife
- Hot glue gun

Creating the Knight

1. Cut a 3" long piece of the clear plastic tubing.
2. Run a zip tie through this tubing, then secure it around the aluminum water bottle. Cut off the excess zip tie.
3. Using the exacto knife, hollow out a hole in the small end of the cork to fit the end of the chopstick in. These pieces will be used to form your knight's lance.
4. Use the hot glue to secure the chopstick into the hollowed out part of the cork. Your lance is now complete.
5. Slot the lance into the tubing on the water bottle, cork end pointing out. The lance should slot in so that when placed on the platform, it is on the side of the center line on the mat.
6. Cut a 2 inch piece of clear packing tape. Line up the 3 button magnets in a row on the edge of the tape. Then, wrap the rest of the tape around the magnets to secure them in place.
7. Place the taped magnet strip inside the water bottle, then re-secure the lid.
8. Repeat this process to create a second knight.

CHALLENGE INSTRUCTIONS

Build

Allow teams approximately 2 ½ hours to build a robot that can follow the joust line, and support their water bottle knight. Teams can use any standard pieces and motors included in their EV3 kit, along with the color sensor. In addition, the teams will each need one wide canning lid. They will need to build a platform for this lid using kit parts. This platform needs to support their lid and water bottle knight. Kids can attach the canning lid to the platform using painter's tape or with LEGO parts. However, the platform and lid cannot have a lip around the top. The knight must be able to fall freely off the platform. In addition, the platforms should be no more than 4 inches in front of the robot and no more than 4 inches off the floor. They also may not extend over the center line of the mat when the line-following program is running.

The goal of this challenge is to ease kids into learning how to write a simple line following program that can handle straightaways, as well as a curve. Teams will spend a lot of time during the build writing and perfecting

this program. During this time, teams can run practice bouts against other teams to help them improve their scoring, as well as their lance placement.

Youth can adjust the height of the lance on their robot by sliding the zip tie assembly up and down the water bottle. They can also choose the angle their lance is pointed before the start of each match.

Competition

1. Have two teams set up their robots on opposing starting positions on the mat. During this time they should adjust their robot and bring up their jousting program so that it can be run with the push of a button. Advise teams to size up their opponent's robot, then set their lance height and angle accordingly.
2. Countdown "3-2-1-Joust!". On "joust" teams should start their programs.
3. Allow the robots to run to the end of the line and then have kids catch them to stop the robot and cancel the program. If during the run, a robot manages to knock off their opponent's knight, note where the knight falls on the mat, and award points accordingly on the scoresheet. If a knight lies between two scoring zones, award the points from the higher-valued zone.
4. Depending on how you are scoring, you would then have teams reset their robots on the opposite end, and run another pass.

   Scoring Methods:

   Single Elimination - Teams face off against each other in bouts up to 5 times, switching sides after each bout, until one team knocks the other team's knight off. As soon as a knight is knocked off, points are awarded to the team who knocked off the knight and the match immediately ends. If no teams manage to knock their opponent off in 5 passes, both teams receive points for a draw.

   Cumulative Points - Teams face off against each other in 5 bouts, switching sides after each bout. Teams get scored on each pass, and their points from all 5 bouts are totaled to get their match score.
5. You can choose to score using the values on the mat, or you can use RoboRAVE scoring, where each subsequent pass is worth 10 less points. This encourages teams to knock their opponent off early.
6. Allow teams to play as many matches as you have time for. If possible, allow each team to face off against all opposing teams.
7. Total all the points on the scoresheets to determine your winners.

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