Robotics: Making a Self-Driving Rover

Identify the problem

The surface of Mars is covered with impact craters which vary greatly in diameter. Most of the craters are circular and therefore can be avoided by simply driving a curved path with a diameter slightly larger than the crater's diameter.

For this challenge, you must program a rover to get from point A on a map to point B without driving across any of the craters located between them.

Criteria for success

For this challenge:

- You may choose your own path.
- You must program the rover to travel the path as quickly as possible by using a shorter route rather than higher speeds.
- You must program the rover to move or turn and get your rover through the course.
- The starting point and ending point are marked as well as the location and size of the craters.
- Measurement devices like metric rulers, measuring tapes or meter sticks are permissible and their use is encouraged.
- During specified hardware practice times, users may perform test runs, calculate changes as needed for distance and determine when turns are needed to navigate the official challenge.

Engineering constraints

- Once the challenge begins and the program has begun, users may not touch the rover without penalty.
- The rover must not cross over any of the crater edges.
- No sensors are to be used for navigation.
- The rover may not exceed 50% power on either motor.
- You should program your rover to maintain a safe distance of 3 cm from the edge of any crater.

Points for this challenge will be as follows:

The rover navigates from A to B maintaining a 3-cm safety margin for each crater.	60 points
Complete the course in the shortest time span	10 points
Motor exceeds 50% power position	-2 points for each second the robot moves using more than 50% power

Crossover or touch a crater	-4 points (each instance)
Violate 3 cm safety margin without touching edge of crater	-2 points (each instance)
Touch the rover outside of the start position	-2 points (each instance)

Brainstorm possible solutions

View the layout of the mapped region and think about which pathways to select. Consider each of the criteria and constraints of the challenge. Every team member should draw upon their own background, prior knowledge, experience and strengths to contribute throughout the challenge.

Select a design

Select a pathway from the options you considered. Now, consider the programming needed to navigate the pathway successfully. Measure and draw a map of the transit area including each crater's size and distance from other craters.

Build and program your rover

Once the selected path has been mapped and the programming has been identified, users should input the programming design and download it to their rover. Once the programming for the rover is complete, begin testing. Remember: Leave yourself time to test and revise! It's important to check your solution multiple times throughout and make changes instead of just waiting until the very end!

Test the rover and evaluate

Perform a test run with your rover. If the rover isn't traveling the correct circles, check your programming. If the prototype is making turns in the wrong direction or turning too little or not enough, consider what changes you might make to your programming.

Improve the program design

Record any changes to your designed program in writing, such as in a journal or notebook and be sure to include why you decided to make the changes. Re-program your Mars Exploration Rover and prepare to complete the challenge for an official score.

Share the solution

Present your solutions to the class using photo or video evidence with supporting sketches and justifications for your programming design. You may use audio-visual equipment and technologies to enhance your presentation. Be sure to express how teamwork and the engineering design process played a role in your group's experience with this challenge. Use the reflection questions below to guide your presentation development.

Reflection Questions

About the engineering design process:

- What did you try that didn't work out? How many times did you try it?
- What did you do when things didn't work out like you expected?
- If given access to more parts or sensors, how would it change your design?
- If given more time, what would your next step look like?

About your thinking during the challenge:

- What obstacles did you or your group face in this challenge?
- How did you and/or your group confront these obstacles?
- What was your favorite part of designing, building and testing your robot?
- Did you observe any benefit to blueprinting your design first? Did you need to make any revisions to your blueprint after your first series of tests?