Abstract:

In this lesson, we will explore how a robot can use vector math to determine which side of a line it is on, and how far away the line is. We will also see how the robot can use this information as part of a Proportional Feedback Controller to constantly update the motor commands to account for any errors that may occur and successfully follow a provided trajectory.

Objective:

By the end of this lesson, students will be able to:

- Compile data using vector math to determine which side of a line the robot is on and how far away the line is (side and distance)
- Synthesize the concept of abstraction with respect to a Proportional Feedback Controller

Standards:

Computer Science Teachers Association (CSTA):

- 3A-CS-01 Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects.
- 3A-AP-16 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions.
- 3A-AP-17 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

Resources / Materials:

Playlist Overview: The Robot Doctor Series
Lesson Video: Lesson 108 - Robot Controls
Student Handout: 108 Student Handout
Student Handout: 108 Student Handout - Modified
Student Handout: 108 Student Handout - Enrichment
Teacher Handout: 108 Teacher Handout - Enrichment
Teacher Handout: 108 Teacher Handout
Student Survey: https://forms.gle/vNKUqjGNyuC2X8zNA
(Have students complete this at the end of the lesson)

Procedures:

1. Opening Questions: **How do robots follow a line? How do they know how to correct for errors or disturbances as they try to follow a path?**
2. Review Opening Question: Ask students to guess if they say that they don't know. Make sure to support/compliment student ideas about the opening question.
3. Explain that the video was created by **WQED** (Television Company) and **RobotWits** (Artificial Intelligence Company) who partnered to create the Robot Doctor educational video series.
4. Read the Abstract to the students or explain in your own words what the video will be about.
5. Prepare the room for the video by asking students to eliminate distractions (close laptops, lower blinds, put away folders, set down pencils, ect.).
6. **Show the video** to the students.

***To make improvements (add suggestions) to this lesson plan, please **CLICK HERE** ***

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7. After the video, ask the students to share **what they liked** and **what they learned** from the video with someone beside them. Facilitate discussion, then ask for volunteers to share with the rest of the class.
8. Pass out the **Student Handout** to each student.
9. Discuss the first page of the student handout with the class.
10. Have the students work on the Challenge questions. They may work individually or in small groups.
11. Provide light guidance to each student on their progress with the challenge questions, if needed.
12. After the majority of the students have finished the student handout (or a majority are stuck), prepare to review the challenge questions one at a time.
13. Use the **Teacher Handout** to help students walk through each part of the Student Handout.
14. Review with the students the concepts on the first page of the Student Handout.
15. Have the students go to this link: https://forms.gle/vNKUqjGNyuC2X8zNA and fill out the survey.

Modification:

Students will have their lesson modified according to their IEPs and individual capabilities. The **Modified Student Handout** does not have an accompanying Teacher Handout because the problems follow the video. Use the video as a reference when working through the problem with students. The activity explanation is at **6:10** in the video.

Enrichment:

Students who are advanced will finish early and have extra time. They can work on the **Enrichment Student Handout** independently or with a partner. This handout could also be assigned for homework. If time allows, review this content with the entire class, even if they didn't have a chance to solve the enrichment activities.

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