Determining the Speed of Your Robot & Programming for Coordinate Motion, Module 3

Overview:

In this lab students will determine the actual speed of their robot and then use this data to program for coordinate motion. First, the students will program their robot to go forward with a constant speed for a set amount of time. Next, rulers will be used to measure the total distance traveled by the robot. Using a simple physics formula, students will calculate the actual speed of their robot. Using the same constant speed as before students will need to write a program that spins their robot, either right or left, for a set amount of time and then stops. The time spinning will need to be varied until the robot spins exactly 45 degrees. Students will finally be asked to program their robot to reach a 2D-coordinate using the calculated speed and turn time knowledge. This lab will require approximately 50 minutes to complete. If the NewCDbot robots have not previously been assembled then the lab would require an additional 50 minutes to complete.

Lab Setup and Preparation:

It will be assumed that the students have been properly introduced to the NewCDbot robot and that they have already completed assembly of their robot. If not then please refer to Lab Module 1. At least one desktop computer or laptop must have the necessary software installed: the NewCDbot Programmer Software (NCPS) and OOPic Multi-Language Compiler. If more than one computer is available then it would be beneficial to install the required software on each available computer as this will help to reduce bottlenecks in the computer time when the students are programming their robots. A small area in the classroom should be cleared so that the students will have a place to run their robots during the experimentation phase. Check to be sure that each of the robots has the proper number of batteries installed and that they are in good working condition. It is always recommended that the robots use rechargeable batteries, as this will reduce the cost associated with operating and maintaining the robots. If rechargeable batteries are used then they can always be charged before a lab to ensure that the robots will have good batteries, which in turn will help to reduce any unwanted delays in the lab. The following supplies should be made available to the students for this lab: measuring tapes or rulers, protractors, and tape.

The Day of the Lab:

Students should be partitioned into groups of four or five for this lab. However, this number strongly depends upon the number of available NewCDbot Kits. It has been found that groups of four or five appear to work well and allow each the students to obtain a close interaction with the NewCDbot. However, groups smaller than four or five tend to work even better, but we know that this is not always possible. At this time several questions can be presented to the students for them to answer in a group-wise manner. Several sample questions are listed below.

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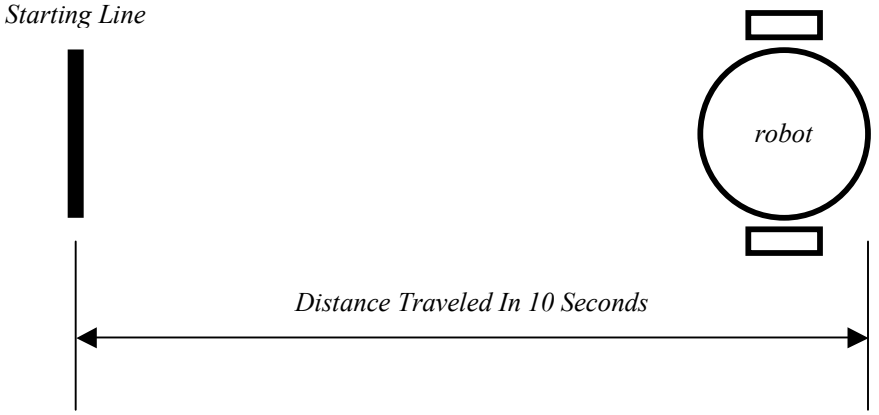
(1) What is the difference between Velocity and Speed?
(2) How fast do you think your robot will go?
(3) How could you make your robot faster?

At this time the student groups should be given five or ten minutes to answer these questions. At the end of the lab another five to ten minutes should be provided so that the students can discuss their answers to the above questions.

Once the students have completed answering the above questions a brief description of the lab experiment can be given to the students. It would be beneficial to demonstrate programming a NewCDbot to drive forward for ten seconds and then stop so that the students will have an example of what they need to do in the lab. You may want to add a one second delay as shown in the code below. This will prevent the robot from moving as soon as the power is switched on.

```
Sub RunRobot( )
        OOPic.Delay=100
        Speed= 10
        FWD
        OOPic.Delay=1000
        STOP
End Sub
```

It should be explained to the students that any speed can be used, but they must remember to use the same speed setting in each of their programs. Students will use the exact same program that is listed above. Once the program has been compiled and downloaded, they will need to create a staring line using the tape. This will allow them to measure the distance traveled by the robot once it stops.



Once the students have measured the distance traveled in ten seconds they can calculate the actual speed of their robot using the following physics formula:

Speed = distance / time

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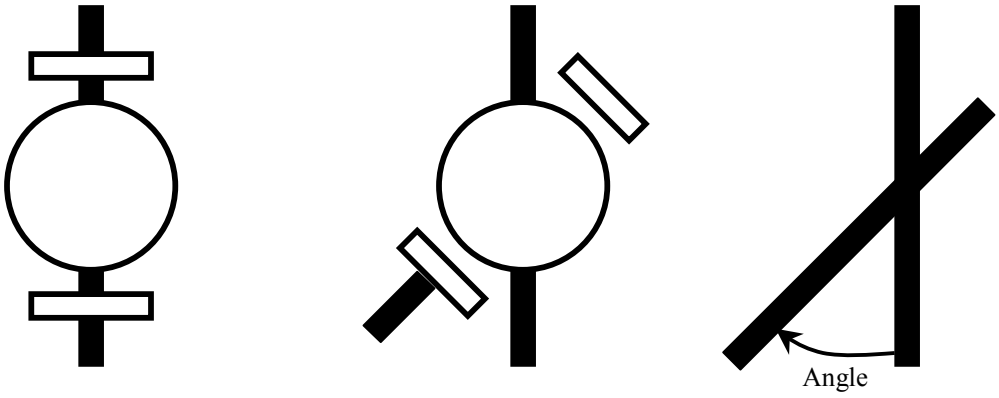
Distance in the above formula refers to the distance measured and the time refers to the 10 seconds that the robot was traveling forward. For example, if the robot traveled 10cm in the 10 seconds, then the robot would have an actual speed of 1cm/second.

Speed = 10cm/10seconds = 1cm/sec

The next program must spin the robot for a set amount of time at the same speed that was previously used to determine the actual speed. An example program is listed below.

```
Sub RunRobot( )
        OOPic.Delay=100
        Speed= 10
        SpinRight
        OOPic.Delay=50
        STOP
End Sub
```

The students will need to change the OOPic.Delay after the SpinRight command in the above program until the robot spins exactly 45 degrees. Again, a starting line should be made so that the angular distance can be measured using a protractor. A straight line can be drawn on a blank sheet of paper, then the robot can be placed on the paper so that the wheels align with the straight line. After the robot is turned on and finishes spinning, students can draw a line on the paper where the robot's wheel stops. Finally, the angle can be measured using a protractor. An illustration is provided below.



Step1. Step2. Step3.

Now that the students know how to make the robot spin 45 degrees and also know the robot's actual speed they can be asked to program their robot to travel to a specified 2D-coordinate, but in the least amount of turns. This step will work best if a 2D-grid has been drawn on a large piece of paper or poster board and a starting position is marked as (0,0).

Please email any questions to abe@abotics.com

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