ACTIVITY #5: RC CAR ACCELERATION STUDY

This activity demonstrates how use DatalogAcceleration.bs2 from the previous activity to analyze the acceleration forces on a radio controlled (RC) car during a variety of maneuvers.

Parts, Equipment and Circuit Diagrams

In addition to the parts for Activity #4, you will need an RC car and controller. The circuit diagrams that should be built on your board are at the beginning of Activity #4 in this chapter.

Hardware and Setup

Figure 6-4a shows an inexpensive RC car that can be obtained at many hobby shops and retail electronics outlets. Figure 6-4b shows how the board was mounted. Rubber feet were affixed to the underside of the board in a way that prevented any of its electrical connections from coming in contact with any of the RC car's electrical metal parts. Another option would be to use double-stick tape to affix the board to the roof of the plastic shell.

Figure 6-4: RC Car with Acceleration Datalogger

a.   b.
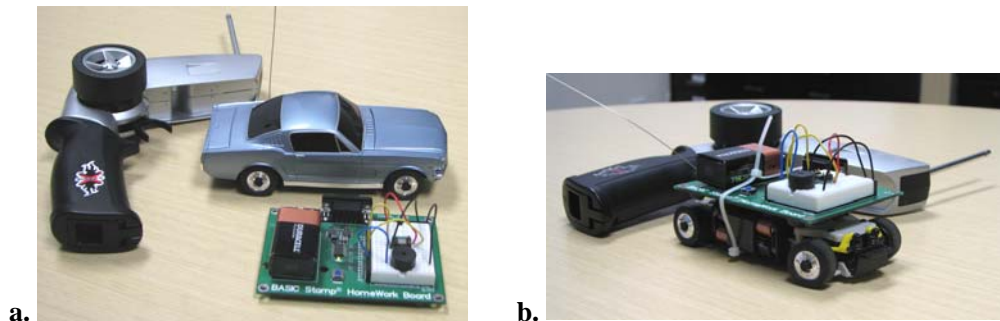
> ⚠️ **Avoid accidental short-circuits.** Make sure your board is mounted on the car so that exposed metal underneath the board has no way of coming in contact with any of the RC car's metal parts or electrical connections.

How it Works

Figure 6-5 shows a graph of the accelerometer's y-axis measurements as the car accelerated forward, slowed to a stop, and then accelerated backwards. The measurements were acquired with DatalogAcceleration.bs2 from Activity #4. After displaying them in the Debug Terminal, they were shaded, copied and pasted into Windows Notepad. From there, they were imported into the Microsoft Excel spreadsheet program and then graphed.
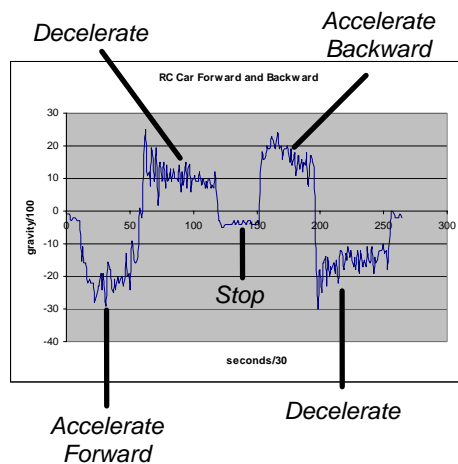

Figure 6-5
RC Car Accelerometer Y-Axis Measurements

The reason the forward acceleration is negative is because the y_m sensing axis is pointing to the back of the RC car as shown in Figure 6-6. So, as the car is accelerating forward, the acceleration is negative. When a car slows down, it is actually accelerating backwards. This is shown in Figure 6-5. First, the car accelerated forward, then it applied the breaks and slowed down (decelerated). The y measurement was positive, so acceleration was negative. After a brief stop, the car accelerated backwards. Notice that the y is again positive. Then, when it slows down (decelerates) from its backwards speed

to stop again, the car is, in effect, accelerating forward, and the y measurement is negative again.
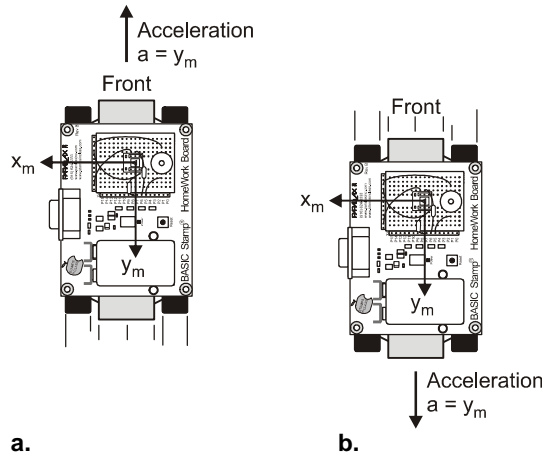

Figure 6-6
RC Car Acceleration vs Accelerometer Sensing Axes

If you're driving a car, when the car accelerates forward, you can feel the seat pushing you forward. Well, if you make a sharp right turn, the left side of the car pushes you to the right. That's because you are accelerating right as you turn. This is shown in Figure 6-7, which illustrates how an object can be traveling forward at a constant velocity, and to make it turn, it always has to be accelerating toward the center of the circle it is traveling in.
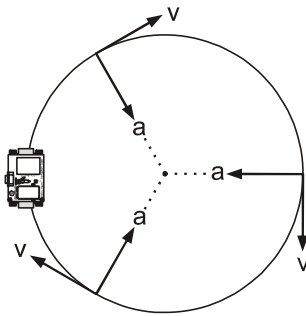

Figure 6-7
Traveling in a Circle

This causes continuous acceleration toward the center.

Figure 6-8 shows a graph of the accelerometer's x-axis measurements as the RC car is first driven in circles turning left, then in circles turning right. Notice how the x-axis measurement shows positive acceleration as the RC car circles to the left, and negative acceleration as the car circles to the right.
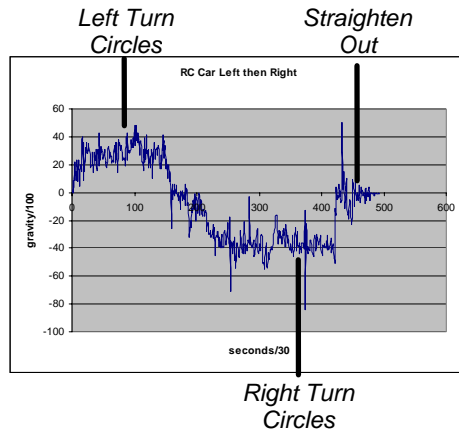

Figure 6-8
RC Car Accelerometer Measurements while Driving in Circles

Figure 6-9 shows how the accelerometer's x-axis is oriented, and the acceleration it measures. For a left turn, the car is accelerating to the left, which for the accelerometer is a positive x-axis acceleration measurement. When it turns right, acceleration is in the opposite direction of the positive x-axis, so the x-axis measurement it negative.

Figure 6-9: Sensing Acceleration during Turns

a.　　　　　**b.**
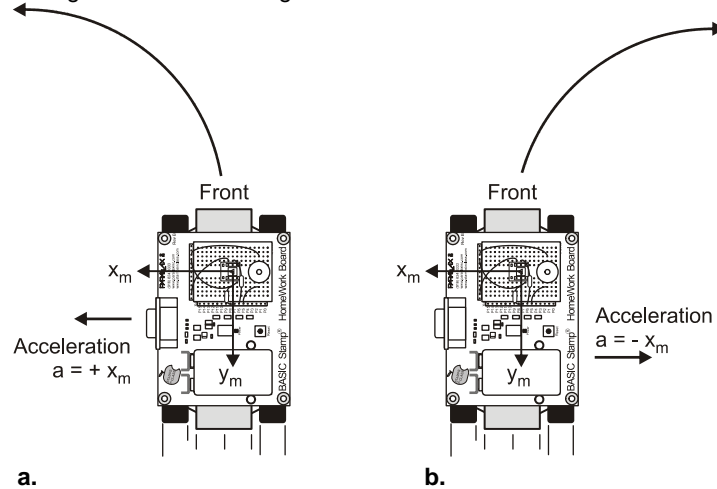
Procedure

The procedure for measuring and then graphing RC car acceleration is as follows.

- √ Attach your board to the RC car.
- √ Download DatalogAcceleration.bs2 into the BASIC Stamp.
- √ Set the car down in open area and press/release the board's Reset button.
- √ Wait for the countdown to indicate that datalogging has started.
- √ Drive the car through these maneuvers, in about 15 seconds:
    - o Accelerate the car forward, then come to a stop.
    - o Accelerate the car backward, then come to a stop.
    - o Drive in a figure-eight.
- √ When the board beeps again (after about fifteen seconds) it means the datalogging is over. Connect the board back to your PC.
- √ Run DatalogAcceleration.bs2 again.
- √ Click the Debug Terminal's transmit windowpane.
- √ Type D to display the data.
- √ Use your mouse to shade the table headings and all the measurements in the Debug Terminal's blue receive windowpane. (Don't shade the menu.)

√ Press CRTL + C to copy the records.
√ Open Notepad.
√ Click Edit and select Paste.
√ Save the file.

These next instructions explain how to import the .txt file into Microsoft Excel 2002 and graph it. If you are using a different spreadsheet program, the keywords such as space delimited, XY scatter plot may provide leads on how to accomplish it with your particular spreadsheet software.

√ In Excel, click File and select Open.
√ In the files of type field, select All files (*.*).
√ Find the .txt file you saved with notepad, select it, and click the Open button.
√ In Text Import Wizard Step 1, click the Delimited radio button, then click Next.
√ Click the checkbox next to Space to indicate that the file is space delimited.
√ Make sure the checkbox for "Treat consecutive delimiters as one" box is also checked, then click next.
√ Make sure the radio button for General column data format is selected, then click finish.
√ Your spreadsheet should be three columns wide and about 503 rows long.

The next step, which is also documented for Microsoft Excel 2002, is to run the chart utility and tell it what to graph and how you want it to look.

√ Place the cursor in a cell somewhere to the right of your three columns of data.
√ Click Insert and select Chart.
√ In the Standard Types tab, select XY (Scatter). Also click the graphic that configures it to "Scatter with data points connected to smoothed Lines without markers". Then, click Next.
√ Assuming your y-axis data is begins in C3 and ends in C503, type C3..C503 in the Data range. Click the radio button next to Columns to indicate that the series of data points is in a column. Then, click Next.
√ Fill in the chart title and axis information, then click Finish.
√ Repeat for the x-axis.

Only portions of each graph are relevant. Keep in mind that the data that will make sense for the y-axis is the portion of time the car accelerated forward and backward. Likewise, the part of the graph that will make sense for the x-axis is the portion of the graph when the car was turning.