SECTION B

SENSING DEVICES

ACTIVITIES

1. Respond When Any Bumper is Touched
2. Respond When Front and Rear Bumpers are Touched
3. Respond When This Bumper is Touched
4. All of the Bumper Commands Together
5. Respond When Sonar Activated
6. Measuring Sonar Distances
7. Using Sonar and Bumpers Together
8. Staying Out of the Way
9. Exploring Infrared
10. Find the Charger

ACTIVITY 1:
RESPOND WHEN ANY BUMPER IS TOUCHED

Robots are designed to help people. Robots should know how to use good manners and not just run around doing things out of control. You need some ways to tell the robot when it should start to do something and when it should stop. Here is one way to help RB5X behave.

New Robot Vocabulary

1. EXIT IF ANY BUMPER TOUCHED
2. BEGIN A LOOP
3. REPEAT THIS LOOP

Let's Experiment

Combining some movement commands, try to get the robot to perform these movements only when a bumper is touched. Think about where you should put the new commands in your robot task. Be sure to precede the command with START A LOOP and to follow it with REPEAT THIS LOOP. See if RB5X does what you expected.

Let's Experiment Some More

Now you have the robot doing its job only when it is told to. See if you can use the same command to also make the robot stop doing its job when it is told to. (HINT: EDIT the same task and decide how many times you should use the commands and where the commands should go. The WAIT command can be very helpful here.)

ACTIVITY 2: RESPOND WHEN FRONT AND REAR BUMPERS ARE TOUCHED

RB5X uses its bumpers in a variety of ways. It would be nice to tell the robot to do something only if a certain event occurs. Here is one command that allows you to do this.

New Robot Vocabulary

1. EXIT IF FRONT+REAR BUMPER PRESS

Let's Experiment

EDIT the task that you used in Activity 1, "Respond When Any Bumper is Touched." Replace one of the EXIT IF ANY commands with the new EXIT command. Which command would be the most logical to replace? Remember that you must touch the front and rear bumpers at the same time for RB5X to fully understand you.

Let's Experiment Some More

Using the same task again, add some more to it (other movements). At some point, use the STOP ALL MOTION command and then have RB5X wait to have the front and rear bumpers pressed before it continues. What kind of an effect does this give? Imagine what some good uses of this command might be.

ACTIVITY 3: RESPOND WHEN THIS BUMPER IS TOUCHED

Here is a way to tell RB5X to do something specific only if a certain bumper is pressed. This can be very helpful in writing robot tasks. It makes RB5X seem to be thinking about different things to do and making choices of behavior on its own.

New Robot Vocabulary

1. EXIT IF THIS BUMPER is touched: (#)

Let's Experiment

As you have noticed, RB5X has eight bumpers, which are numbered one through eight if you start with the bumper under the sonar and count in a clockwise direction.

You can use the new command to address any of the bumpers. You can have each bumper call up a different robot activity. EDIT the task used for Activity 2, "Respond When Front and Rear Bumpers are Touched." In each of the places where you call for bumpers to be pressed, substitute the new command and select a different bumper for each robot activity. See what happens.

Let's Experiment Some More

Now that you see how this works, add enough different activities to use all eight bumpers. What kind of an effect does this give? What are the limitations of this command?

ACTIVITY 4: ALL OF THE BUMPER COMMANDS TOGETHER

Now you know how each of the bumper commands works. Is it possible to use any or all of these commands together? There are some things to consider as you start to use many different kinds of bumper commands in one task. It is important that you use the commands in a logical order and that you use different commands for different kinds of robot behavior.

Let's Experiment

Think of the things you have already done. What is the basic command that puts RB5X on its best behavior? Which command is the least likely to be figured out by someone unfamiliar with the robot? How did you make the robot appear to decide on different kinds of behavior? Now how could all of these commands be put to good use in one task.

Design a series of activities for RB5X, with each activity starting with a bumper command. Decide which kind of bumper command is best for which activity. Write your task and see how the robot performs. It might be helpful here to have your robot task displayed on the screen while you watch the action. After you have used your task for a while, decide if there are ways it could be improved. Make any changes and try again.

ACTIVITY 5: RESPOND WHEN SONAR ACTIVATED

RB5X's sonar can detect objects and movement in front of the robot, allowing the robot to avoid them. This saves

wear and tear on RB5X, you, and the furniture! It also allows RB5X to move with more intelligence and to perform jobs like sentry duty.

New Robot Vocabulary

1. EXIT IF SONAR distance value is less than:

Let's Experiment

DEFINE a new task. Let's see if you can use the new command to make RB5X a sentry robot. How could the robot tell us if something had moved in front of it? (Remember that the sonar can be programmed to scan different distances: the value 95 is about 14-1/2" in front of the robot. Values smaller than this aren't as accurate.)

The use of the new command is similar to the bumper commands, but the results are different. See if you can find out how they are different. Follow your program closely while watching what the robot does.

Let's Experiment Some More

Now, use the sonar as a collision-avoidance aid. You can either DEFINE a new task or EDIT one of your previous tasks that includes forward movement. Use the commands that allow RB5X to "see" what is in front of it.

ACTIVITY 6: MEASURING SONAR DISTANCES

Now you have an idea of how RB5X "sees" objects in front of it. Different numerical values allow the robot to see things closer or farther away. Discovering what those values are is up to you.

Let's Experiment

Try setting the SONAR DISTANCE VALUE in your last program with different numbers. Try both smaller and larger numbers. Have something move in front of the robot and

measure where the robot "sees" the movement. Make notes of these different numbers and what they mean.

Let's Experiment Some More

Now you know what makes RB5X "see" things at different distances, find out what kinds of things RB5X can see. Can the robot see something move in front of it that is as small as a human hair? Can it see something as large as a chair? Can it see things that are transparent? When can it see these things? How do you think you can use this ability in other tasks?

ACTIVITY 7: USING SONAR AND BUMPERS TOGETHER

How can we combine sonar and bumpers to have RB5X respond to its environment in a more intelligent way? It would be nice if the robot could respond in the same manner regardless of whether it "sees" or "feels" something. There is a way to do this with the commands you already know.

Let's Experiment

Think of the ways you have used the EXIT commands. How could you use these commands in a robot task to get RB5X to respond either to an object in front of it or to touching something? Think about the way you have already used LOOP commands.

What would happen if you used more than one type of EXIT command between BEGIN A LOOP and REPEAT THIS LOOP? Either EDIT one of your previous tasks or DEFINE a new task and try using this arrangement. How does RB5X respond?

Let's Experiment Some More

If you didn't use the EXIT IF THIS BUMPER command in the task you just wrote, use it now to change the way RB5X performs that task. Which way do you like it best?

ACTIVITY 8: STAYING OUT OF THE WAY

It would be very handy for both you and RB5X if the robot could move around an area freely without running the risk of bumping into walls, funiture, or other moving objects. You have already learned how RB5X's sensors can help in getting around safely. What more needs to be added to create a program that lets RB5X stay out of the way in a busy place?

Let's Experiment

Think of the last robot task you wrote. Did RB5X have any problems using sonar and bumpers to avoid running over or into things? Can you think what needs to be added to be sure the robot can move around freely? What important commands are missing? EDIT your previous program and add the commands that are needed to help RB5X move around an unknown area easily. (If you have tried any voice/sound synthesis programming, you might have the robot say something like "Excuse me" when it detects something in its way.) Do you think this is a useful task for a robot?

ACTIVITY 9: EXPLORING INFRARED

RB5X has an infrared sensor or detector on its undercarriage. This allows the robot to tell the difference between light and dark places on the floor as it passes over them. Using this sensing capability, you can program RB5X to find a contrasting tape pattern on the floor, which you can provide for a variety of reasons. One reason might be to allow RB5X to find its battery charger on its own by following the tape.

New Robot Vocabulary

1. TURN ON INFRARED LED
2. TURN OFF INFRARED LED
3. EXIT IF THE TAPE IS SENSED
4. FOLLOW TAPE
5. MOVE FORWARD TIL TAPE NOT SENSED

Let's Experiment

With strongly contrasting tape, make a straight line on the floor. The robot was set at the factory to look for a white tape on a dark floor. (See Section E, "Getting A Charge," in the RB5X Reference Manual for instructions on accurately setting this LED or if you want to change the default to dark tape on a light floor.) If your floors are inbetween colors, you might want to use a large piece of dark paper or fabric and put white tape on it, for this experiment.

Using the new commands, DEFINE a new task that allows RB5X to move until it finds the tape and then to follow the tape to the end where the battery charger is. It might be helpful here to look at the detail of the commands listed in the RCL Programmer's Guide to see what is included in each task. This can help you decide which vocabulary you need.

Let's Experiment Some More

Now that your robot can find a straight tape, let's see if you can teach RB5X to find a tape that makes another pattern. In addition to the commands in this activity, you may need some commands from Section A, "Robot Movement." Can RB5X find the tape pattern? Could RB5X follow tape that made a more complex pattern?

ACTIVITY 10: FIND THE CHARGER

RB5X has the ability to know when it is running low on battery power, and to start searching for its charger to "plug" itself in and charge up. RCL has tasks already written to help RB5X find its charger. You may want to use these or you may want to try writing your own.

New Robot Vocabulary

1. EXIT IF BATTERY IS LOW
2. EXIT IF THE CHARGER IS TOUCHED
3. MAINTAIN CHARGE
4. X CHARGER FINDER

Let's Experiment

Besides the new robot vocabulary, you need commands from Activity 9, "Exploring Infrared." Read the detail of the tasks (commands) listed above in your RCL Programmer's Guide and see what each of these tasks tells RB5X to do. Try combining the tasks you think are needed to tell the EXIT IF BATTERY IS LOW command because the robot should ignore this if its battery is not low.)

See if RB5X can get to the charger and make proper contact. Once you have done this, think how and when you would use these tasks in other, larger tasks. Do you need to include a charger-finder routine in every program you create for the robot or only in some?