Important Notes:
1. Please put your comments to your program; otherwise, there will be some points off for not doing so.
2. All programs should be printed from either MATLAB or PBASIC editor. (not from MS Word)
3. Labs are individual work. You can ask your lab-mates, but you never turn in your work as a group. That means your code will be different from the person you asked questions to.

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Lab Objectives

By the end of this lab you should be able to:

1. **Identify** how to use *DO...LOOP* to repeatedly get information from a sensor.
2. **Create** a program that uses sensor information to dictate the behavior of the robot.

Infrared Object Detection Sensors

The scribbler is equipped with a set of sensors that can detect if objects are in front of it. It accomplishes this by using two infrared emitters and one infrared detector. It detects if something is in front of it by first shining an infrared light forward, if something is in front of it the light will bounce off the object and will be picked up by the infrared detector.

The picture above shows this bouncing of an infrared light off a sneaker. The infrared light tends to bounce well off of shiny, light-colored objects.

The detector is constructed so that if it ‘sees’ an infrared light source that is blinking at 38.5 kHz (38,500 blinks per second), if it sees this ‘blinking it will then send a ‘low’ signal to the microcontroller in the scribbler, if it doesn’t see a blinking light then it will send a ‘high’ signal. The pin going to the detector is pin number 6. The detector is in on the front middle of the scribbler and the two emitters are on the right and left side. To get the infrared emitters to emit a blinking light at 38.5kHz we will use the *FREQOUT* command. The left emitter is pin 15.
and the right emitter is pin 14. After we make the emitter blink we will immediately check and store the value from the detector. Since there is only one detector we need to keep track of which light we blinked before we check the detector. So, for instance if we would want to see if something was in front of the right side of the robot would write.

```plaintext
InfDetect    PIN 6
InfRightEmit PIN 14

eyeRight VAR Bit

DO
   FREQOUT InfRightEmit, 1, 38500
   eyeRight = InfDetect

   DEBUG HOME, BIN eyeRight
LOOP
```

This will make the debug window display either a '0' when something is in front of the robot and a '1' when something isn't in its way. Notice we have a couple of commands we haven’t seen before. These are there to make our life a bit easier once our programs start getting complicated. The first part is called a PIN directive. This is just an easy way for us not to have to remember the pin numbers for all of the different parts of the scribbler. For instance if we were to constantly use the left LED in a program we might put the directive:

```plaintext
LeftLED    PIN 10
```

Then for instance if we want to turn on the left LED all we would have to do is:

```plaintext
HIGH LeftLED
```

You only have to write a PIN directive once in a program, and then you can forget about it! We can also use the PIN directive for inputs, which is how we are saving the status of the detector after we turn on the right emitter.

The other command is HOME, we use this command to reset the cursor in the debug window to the upper left corner. This has the effect of making the debug output overwrite the previous output. That way you don't have to constantly look at scrolling numbers to figure out what’s going on.

**Decisions With Sensors**

Once we have some sensor information it would be nice to make the robot do something in particular depending on what the sensors 'see'. We usually do this with IF...THEN commands. Another aspect to
IF...THEN...ELSE commands are what we call logical operators, these are used inside of the IF...THEN commands. The four different logical operators are as follows, AND, OR, NOT, XOR. We use these commands just as we would use them in natural language. If for instance we had a light sensor and one of our object detectors and we would want the robot to beep if it was bright out AND something was in front of it, then we might make the following command.

```
IF (eyeRight = 0) AND (light > 500)
  FREQOUT 11, 500, 523
ENDIF
```

Notice how we use AND just like we would in a sentence, OR works the same way. The NOT command is pretty simple too.

```
IF (eyeRight = 0) AND NOT (light > 500)
  FREQOUT 11, 500, 523
ENDIF
```

This would simply be the same as before but now the scribbler will beep if something is in the way and it ISN'T bright outside. We won't worry about XOR quite yet.

Note: There are some scribblers which have bad light sensors. Even if so, it does not matter for you to worry about not being able to do exercises. You do NOT have to use the light sensors on your scribblers.

**Exercises**

1. Program your scribbler to make the left LED turn on when something is front of the left side, and turn on the right LED when something is on the right side.
2. Do the same as in exercise 1 but make it so that if something is both in front of the right and left side then turn on the center LED.
3. Make your robot go forward if it sees something on the right side make it turn left, if it sees something on the left make it turn right. If something is directly in front of it make it stop.