CE-8 Lab 8 & 9: Putting it all together and come up with cool ideas

Lab Objectives

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

1. **Come up with a project idea, that sums up all what we have learnt about the scribbler robot**, by that we mean you should use some combination of the sensors: the light sensors, line sensors, stall sensors, as well as the obstacle detectors. It would be nice to add the LED indicators, but it's up to you to add sounds.

Putting It All Together

So you've made some small programs so far, but what have we really done with the scribbler that makes us say, that's **COOL**! Well, hopefully after the next two labs we will have accomplished that.

**Project Examples**

1. Line following behavior: you should make a black line (straight and curved segments) as a track for the scribbler to follow, with some traffic lights. Using traffic lights: with lights on then your scribbler should stop until the light goes off. Also use some obstacles to avoid (if there is an obstacle then take an alternative route). There are some tracks that can be printed from the scribbler web site, or you can just stick black tape on the ground to make your own track.

2. Designing your robot to work its way through an obstacle course. The basic layout of the course is a series of 'hallways' with lights along the way. Your robot will have to 'hit' each of these lights and then move on to the next one. Only one light will be on at any given time so you don't have to worry about distinguishing between two light sources. After you a hit a light it will turn off (hopefully) and the next one will turn on.

For those of you who haven't been keeping a copy of your code, below is a demo program with all of the code needed to access the various sensors.

```
' {$STAMP BS2}
' {$PBASIC 2.5}

' I/O Declarations

LightRight PIN 0 ' right light sensor
LightCenter PIN 1 ' center light sensor
LightLeft PIN 2 ' left light sensor
LineEnable PIN 3 ' power to line follower IR emitters
LineRight PIN 4 ' right line follower IR detector
LineLeft PIN 5 ' left line follower IR detector
ObsRx PIN 6 ' obstacle sensor IR detector
LedRight PIN 8 ' right green LED
LedCenter PIN 9 ' center green LED
LedLeft PIN 10 ' left green LED
ObsTxRight PIN 14 ' right obstacle sensor IR emitter
ObsTxLeft PIN 15 ' left obstacle sensor IR emitter
' Variable Declarations
```
light_left_value VAR Word
light_center_value VAR Word
light_right_value VAR Word
object_right VAR Bit
object_left VAR Bit

' I/O Initialization

LOW ObsTxRight
LOW ObsTxLeft

'Turn on the Line Sensor IR LEDs

  HIGH LineEnable

DO

  DEBUG HOME
  ' light sensors
  ' Set the pins high to charge the capacitors
  HIGH LightLeft
  HIGH LightCenter
  HIGH LightRight

  ' Wait while the capacitor charges
  PAUSE 3

  ' Time how long it takes each one to discharge
  RCTIME LightLeft, 1, light_left_value
  RCTIME LightCenter, 1, light_center_value
  RCTIME LightRight, 1, light_right_value

  ' Display light sensor values
  DEBUG "Left light sensor value = ", DEC5 light_left_value, CR
  DEBUG "Center light sensor value = ", DEC5 light_center_value, CR
  DEBUG "Right light sensor value = ", DEC5 light_right_value, CR

  PAUSE 200

  ' line sensors

  IF (LineRight = 1) THEN
      DEBUG "Right= Black"
  ELSE
      DEBUG "Right= White"
  ENDIF

  DEBUG CR

  IF (LineLeft = 1) THEN
      DEBUG "Left= Black"
  ELSE
      DEBUG "Left= White"
PAUSE 100

' object sensors
' Output IR light modulated at the right frequency
FREQOUT ObsTxRight, 1, 38500

' Check if reflected light was detected
object_right = ObsRx

IF object_right = 0 THEN  ' object detected
    HIGH LedRight  ' turn on right green user LED
ELSE  ' object not detected
    LOW LedRight  ' turn off right green user LED
ENDIF

' Turn off the right-side IR LED
LOW ObsTxRight

' Do the same thing for the left-hand side
FREQOUT ObsTxLeft, 1, 38500

' Check if reflected light was detected
object_left = ObsRx

IF object_left = 0 THEN  ' object detected
    HIGH LedLeft  ' turn on left green user LED
ELSE  ' object not detected
    LOW LedLeft  ' turn off left green user LED
ENDIF

' Turn off the left-side IR LED
LOW ObsTxLeft

ENDIF

Basic Maneuvers

<table>
<thead>
<tr>
<th>Maneuver</th>
<th>Strategy</th>
<th>P12 Duration</th>
<th>P13 Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Turn</td>
<td>Make right wheel turn slower than left wheel</td>
<td>2500</td>
<td>3000</td>
</tr>
<tr>
<td>Left Turn</td>
<td>Make left wheel turn slower than right wheel</td>
<td>3000</td>
<td>2500</td>
</tr>
<tr>
<td>Spin Right</td>
<td>Turn wheels in opposite directions</td>
<td>1000</td>
<td>3000</td>
</tr>
<tr>
<td>Spin Left</td>
<td>Turn wheels in opposite directions</td>
<td>3000</td>
<td>1000</td>
</tr>
<tr>
<td>Back up to the left</td>
<td>Reverse both wheels, left wheel slower</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>Back up to right</td>
<td>Reverse both wheels, right wheel slower</td>
<td>1500</td>
<td>1000</td>
</tr>
<tr>
<td>Full Reverse</td>
<td>Use smallest Duration argument for both motors</td>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>
Things to turn in for the grade

1. Lab report explaining clearly your project idea and how to achieve it
2. Demo for the project running
3. Source code for your program

YOU CAN DO IT 😊