Lecture 6 – Follow That Light!

Light Sensors

- A portion of the Scribbler schematic diagram is shown on the following slide.
- Pins 0, 1 and 2 are connected to the right, middle and left light sensors respectively.
- To determine the light level first take a pin HIGH. This raises the voltage at the sensor to almost 5 V. We then change the pin to an input pin and measure how long it takes the voltage to fall to 1.4 V using RCTIME.

The Scribbler's Light Sensors

- The Scribbler contains three forward looking light sensors. The particular light sensors used on the Scribbler are known as Cadmium Sulphide (CDS) photoresistors. The resistance of a photoresistor decreases with increasing light intensity. (The brighter the light the smaller the resistance.)
- The light sensors are deeply set in the Scribbler to narrow their focus. The side sensors look 30 degrees off of center.

The syntax for RCTIME is

```
RCTIME Pin, State, Variable
```

RCTIME changes the direction of Pin to input and measures how long it takes the Pin to change from the initial State to the opposite state (High to Low or Low to High). The time (in units of 2 us) is stored in Variable (usually a Word variable).

The voltage at the light sensor decreases with time according to the following formula:

```
v(t)=V_0 e^{-t/(R_{sensor} C)}
```

where \( V_0 \) is the initial voltage (5 V), \( R_{sensor} \) is the resistance of the sensor and \( C \) is the value of capacitance.

Solving for \( t \) we have:

```
t = R_{sensor} C \ln(V_0/v(t))
```
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• The state threshold voltage is 1.4 V, using $V_0 = 5$ V and solving for the threshold time gives:

$$t_{\text{threshold}} = 1.27 R_{\text{sensor}} C$$

• The sensor resistance decreases with increased light intensity, so smaller threshold times correspond to brighter light.

---

DO
HIGH LT_LS
HIGH CT_LS
HIGH RT_LS
PAUSE 3 'Let V rise to 5
RCTIME LT_LS, 1, dark
DEBUG CLS; HOME, DEC dark, ", ",
RCTIME CT_LS, 1, dark
DEBUG DEC"dark,"", "
RCTIME RT_LS, 1, dark
DEBUG DEC"dark
PAUSE 500
LOOP

---

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• The program (01_Light_Sensor.bs2) displays the RCTIME value for each of the sensors. Download and run the program. What happens if you cover a sensor with a finger?

- RT_LS PIN 0
- CT_LS PIN 1
- LT_LS PIN 2

dark VAR Word

---

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Light Sensors

• You may have noticed that the light sensors are not identical. To follow a light we need to track changes in the RCTIME value instead of comparing absolute levels.

• When your program first starts you will need to record the initial ambient light levels for all three sensors.

• We will explore playing with the light sensors in our final project.

---

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Using EEPROM Memory

• You can store, read and write values in the 2 kB EEPROM using the PBASIC DATA, READ, and WRITE commands. Your program is stored at the high end of the EEPROM so you will normally use low addresses for storing your own data.

• Selecting "Memory Map" from the Run menu will display the current memory layout of your program. (NOT of the actual EEPROM contents.)

---

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Using EEPROM Memory

• DATA stores values when the program is downloaded. READ and WRITE are used to access data when the program is running.

• Here is a snippet that prevents your program from running until RESET is pressed:

DATA @0, 0 '0 when downloaded
reset VAR Byte
READ 0, reset
IF (reset = 1) THEN Main:
WRITE 0, 1 'Write 1 on 1st run
STOP