Embedded Systems Design

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Laboratory Assignment – 1

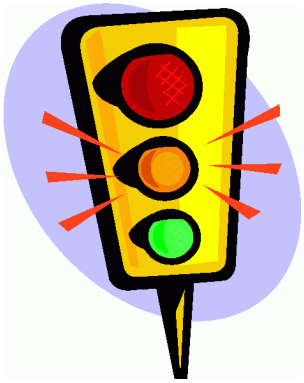
Preparation:

Go through Chapters 1-3 in "What's a Microcontroller?" (version 3.0) and perform all the activities described in these chapters on the Basic Stamp 2 HomeWork Board.

Assignment:

Using the knowledge you have gained from these activities, develop the following embedded systems using the Basic Stamp 2:

1. Traffic Light Controller



A traffic light structure is installed at the intersection of a highway and a farm road. There is one light controlling the traffic on the highway and another light controlling the traffic on the farm road. Each light can be in the red, yellow or green status. The status of the two lights is denoted by a pair of letters L_hL_f where the first letter indicates the status of the highway light, the second letter indicates the status of the farm light and each letter can be R, Y or G (denoting red, yellow and green respectively). Normally, the status is GR (the highway light is green and the farm road light is red). However, when a car approaches the highway from the farm road, a sensor triggers the following chain of status transitions:

$$GR \xrightarrow{1} YR \xrightarrow{2} RR \xrightarrow{3} RG \xrightarrow{4} RY \xrightarrow{5} RR \xrightarrow{6} GR.$$

Transitions 1, 2, and 3 each have a delay of 5 seconds, transition 4 has a delay of 10 seconds and transitions 5 and 6 each have a delay of 5 seconds.

Model the traffic light using 6 LEDs (2 green, 2 red, 2 yellow) from your kit. Use a pushbutton switch to model the arrival of a car on the farm road. When button is pushed, the lights should go through the above sequence of transitions. Design a circuit using some resistors to connect the LEDs and the pushbutton to the microcontroller. Write a PBASIC program to perform the above function.

Remember all the precautions discussed in the class and the current source/sink limitations of the microcontroller.

Include a photograph of your circuit setup in your report. Submit the PBASE program as a separate file.

2. Buzzer Light for Two Person Games

A two person *Jeopardy!* style game requires determining which of the players (A and B) pressed the buzzer button first, quickly reacting to the event of a bicolor LED changing color from red to green. Use two push button switches for the two players. Use two separate discrete LEDs to indicate which player won. Print the winning player's name (A or B) and their reaction times on the screen. Repeat the entire game forever in a loop. Randomize the time at which LED turns green to preclude possible cheating.

Include a photograph of your circuit setup in your report. Submit the PBASE program as a separate file.

In addition note that,

1. Your report must include a flow chart for your solution.
2. You must draw the circuit diagram and include a photograph of your circuit setup. You must describe the design decisions made during the circuit design process and any other alternative designs you have considered.
3. Your code must be well documented and must correspond to your flow chart.
4. You must use macros and subroutines wherever appropriate to improve modularity and maintainability of the code.
5. You must use a good template design for your program, following the coding practices you have noticed in your reading assignments.
6. You must discuss the algorithmic, circuit design and programming choices you have made while developing this solution.