SMART HIGHWAY LIGHTPOSTS

MOCK DESIGN REVIEW

TA: ANKIT JAIN

ECE 445

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February 16, 2016
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Block Diagram:

Figure 1. General Block Diagram. Orange lines represent power and black are for signals.

Block Description of Sensor Circuit:

**Power Source**
This is our power supply to the circuit. We plan on using a 5V power source using a battery which delivers a 25mA current.

**Microcontroller**
This is the microcontroller for each sensor. This microcontroller will take in data from the photonic sensor. When the microcontroller sends a transmit signal, the data will then be sent to the transmitter to transmit signals to the main control circuit. This will be done periodically to ensure the data that is sent is updated.

**Transmitter**
This section contains our transmitter. With this single channel transceiver, we are able to send signals to one of the receivers on the central control circuit. One transmitter can link up to one of the receivers using a specific frequency.

**Ultrasonic sensor**
This section contains our ultrasonic sensor, these sensors have a range of up to 26 feet and can detect if an object is in its path. This is used to determine if there is a car in the lane in front of the
sensor. When a car is detected, we will have the data from the ultrasonic sensor sent immediately to the transmitter regardless of the periodicity we originally have it cycle.

**Circuit Schematic of Sensor Circuit:**

![Circuit Diagram of Sensor Circuit.](image-url)
**Requirements and Verification for Sensor Circuit:**

<table>
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<tr>
<th>Requirements</th>
<th>Verification</th>
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| **1. Ultrasonic sensors**                                                    | 1) Connect the ultrasonic sensor to the microprocessor. Then analyze input data to determine the determined distance. Correct determined distance if different from actual distance by adding code.  
2-3) Measure the voltage in parallel using an DMM and make sure the voltage swing is less than 0.25V. Measure the current in series again using an oscilloscope and make sure the peak amplitude doesn’t exceed the max current.  
** For steps 2-3: The same process is used for determining the voltage and current limits for the rest of the parts. |
| 1) Detects objects within specified range. And are within +5ft accuracy.      |                                                                                                                                               |
| 2) Operating range of 4.5V+- 0.25V. Doesn’t exceed 5.5V (Max voltage)         |                                                                                                                                               |
| 3) Doesn’t exceed 2Ma current (Max current)                                   |                                                                                                                                               |
| **2. Transmitter**                                                           | 1) Make sure the receiver is connected to a microcontroller and a transmitter to one as well. Ensure a link is connected with one transmitter.  
Send a **turn LED-on** signal from transmitter using a microcontroller. If the Receiver accepts the signal, have it light an LED in a different I/O pin on.  
2) Repeat step 1, but this time use all 8 channels to check all channels.  
3) Repeat step 1, but this time spread the receiver and transmitter to ~0.5 miles apart.  
4) Test current and voltage with oscilloscope. ** |
| 1) Sends a signal.                                                            |                                                                                                                                               |
| 2) Each channel can send a signal                                            |                                                                                                                                               |
| 3) Can receive a signal within 0.5 miles                                      |                                                                                                                                               |
| 4) Operating range of 4.5V+- 0.25V. Doesn’t exceed 5.3V (Max)                |                                                                                                                                               |
| 5) Doesn’t exceed 13mA (Max)                                                  |                                                                                                                                               |
| **5) Microcontroller**                                                        | 1) Attach LEDs to selected output pins and program the microprocessor to send a high voltage signal to the selected I/O ports.  
2) Compare the read current values from the sensors and compare with the determined values in the microcontroller. |
| 1) Properly sends and receives data.                                         |                                                                                                                                               |
| 2) Obtains sensors and receivers data correctly                             |                                                                                                                                               |
| **6) Power Supply**                                                           | 1) Test this output voltage using an DDM to determine the variation is within our limits.  
2) Use a oscilloscope to determine the output current through a resistor.     |                                                                                                                                               |
| 1) Have a voltage of 4.5 +/-0.25 V. The current must not exceed 100mA.        |                                                                                                                                               |
**Calculation:**

From the microcontroller’s datasheet, we can obtain the following information:

Voltage: \( V = 4.5 \pm 0.25 \text{ V} \)

Maximum current: \( I = 100 \text{mA} \)

Therefore the maximum current consumption of the microcontroller will be:

\[ P = I \times V = 475 \text{mW} \]

**Safety statement:**

We are planning to test out project using bicycles. Our initial idea is to use four bicycles, as we consider this amount of bicycles enough to emulate different situations that occur in a highway. Bicycles belong to both of us, Kevin Obrzut and Maria del Carmen Alvarez. Any damage our bicycles may suffer will be our own responsibility and the University of Illinois will not be at fault.

**Safety gear**

The bicycle riders will be wearing a helmet to protect themselves from any kind of damage in case they fall. No more protection is required due to the low speed the bicycles will be reaching.

**Testing environment**

To test our project we will use an indoor hallway. We will not allow people to get into the area where we will be testing our project, to ensure nobody gets injured.

**Circuit Safety**

No high voltage or high current will be used in our project; therefore general lab safety procedures will be used. Care will be taken when soldering components to prevent getting burnt. Power supplies will be turned off when modifying any circuit parts.
References:

