LED Coffee Table
Mock Design Review

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ECE 445
Table of Content

1. Block Diagram ................................................................. 3
2. Circuit Schematic .............................................................. 4
3. Calculation ................................................................. 5
5. Block Description ............................................................. 7
6. Requirements and Verifications ........................................... 8
7. Safety Statement ............................................................. 9
8. Citation ................................................................. 10
1. Block Diagram

![Block Diagram]

Legends:
Dashed = Signals
Solid = Power
2. Circuit Schematic
3. Calculation

Temperature and LED PWM Duty Cycle:

Since RGB color range is 0 ~ 255. There are $256 = 2^8$ values. So, we will need an 8-bit PWM resolution and split PWM into 256 steps, with $100%/256 = 0.39\%$ each step.

For example, when room temperature is 18 Celsius Degree, an object with 40 Celsius Degree is placed on table surface. PWM Duty cycle of blue LED should be $-40*(100/45)+100= 11.11\%$, which is around the 28th step of PWM.
4. Simulation

Temperature and LED PWM Duty Cycle:

We simulated the relationship between object temperature and LED PWM duty cycle. For our design objective, we expect the LEDs turn to blue when the object on table surface has temperature lower or equal to 0 Celsius degree and turn to red when their temperature is greater or equal to 45 Celsius Degree. And the LED color interpolates between blue and red as its temperature raises from 0 Celsius Degree to 45 Celsius Degree.

PWM (Pulse-Width Modulation) can be applied to control LED brightness due to human’s persistence of vision, which means if the LED light flashes fast enough, human brain will perceive the LED as continuously turned on and perceives its brightness according to its duty cycle, ratio of pulse width over pulse period. Based this fact and our design requirement, we simulated the relationship between object temperature and PWM duty cycle:
5. Block Description

Microcontroller:

Microcontroller will be ATmega328P, embedded in Arduino Uno, to run the main program of our product. Temp sensors and pressure sensors inputs signal to microcontroller. Then, microcontroller will interface will LED driver based on the received sensor signals. Our microcontroller will have a low operating voltage, which is 1.8V ~ 5.5V, and relatively high clock speed, which is 16MHz.
# 6. Requirements and Verifications

**Temp Sensor:**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Process 1 in Temp sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temp sensor (IR Thermopile)</strong></td>
<td>• Using libraries, check if you can obtain temp data from -41 Celsius degree and 124 Celsius degree</td>
</tr>
<tr>
<td>1. Sensible temperature range: -40 Celsius Degree ~ +125 Celsius Degree, ± 1 Degree tolerance with respect to true temperature</td>
<td>• Ensure temperature can’t be measured at -41 C and 124C</td>
</tr>
<tr>
<td>2. 5V ± 5% operating voltage</td>
<td>Verification Process 2 in Temp sensor</td>
</tr>
<tr>
<td></td>
<td>• Using libraries, obtain temp data and compare received values to thermometer</td>
</tr>
<tr>
<td></td>
<td>• Ensure comparison is at +/- 1C</td>
</tr>
<tr>
<td></td>
<td>Verification Process 3 in Temp sensor</td>
</tr>
<tr>
<td></td>
<td>• Point IR signal to temp sensor</td>
</tr>
<tr>
<td></td>
<td>• Ensure LED resistor is glowing</td>
</tr>
</tbody>
</table>
7. Safety Statement

- Do not modify components of the circuitry without supervision.
- Do not use the device in high temperature environments. (85 C)
- Keep device away from directly contacting liquids
- Do not turn on the device or touch when any wires are improperly connected or exposed
- Do not generate voltage greater than 5.5V to prevent overheating.
8. Citation

   http://www.instructables.com/id/Aurora-9x18-RGB-LED-art/