Simple Clock with Colorful Lighting Design

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The clock is something a common object we use in daily life, yet it still reflects our schedule, habit and mood. Thanks to the examples and inspirations provided by my friend Xuyang Lin, who is a deep fun and user of Lutron products, I come up the idea to design a simple clock using Arduino and its small LEDs, having a lighting design corresponding to our life style, and having other small yet convenient functions as well. I want it to be simple yet carefully design, making it fun for its users.

Design Thoughts

I have 2 clock faces designed for my clock, the front one is for the morning (AM) and the rear one is for the afternoon (PM).

For the AM face, I choose Blue light for 0 o'clock as a indicator for users to go to sleep; Green lights for 1 to 3 o'clock to stand for a comfortable sleep; Yellow lights for 4 to 6 o'clock to reflect the rise of sun in the dawn; Red lights for 7 and 8 o'clock for the rush hours, and White lights for 9 to 11 o'clock to represent daily work.

For the PM face, I choose White light for 12 and 13 o'clock to represent daily work; Blue light for 14 to 16 o'clock to reflect the sunny and hot weather at these time; Yellow lights for 17 and 18 o'clock to represent dusk hours; Green lights for 19 to 21 o'clock to represent dinner and rest time; Blue lights for 22 and 23 o'clock to reflect reflect user's relaxing mood at the end of day.

I choose to not only lit up the LED corresponding to the specific hour, but also the 2 LEDs before this time, so that the user can know both the thing to do now, and the thing they did in the past. It can also increase the overall brightness and have better indication of current time. Since the Arduino does not have enough 24 pins for each hour, I choose to connect LED for the same hour in AM and PM together, that is, for example, to connect 1AM with 1PM. Because the LEDs in both faces with lit up at the same time, I choose to have an additional indicator LED at the upper right corner of each clock, so that the user can know whether it is AM or PM now.

Knowing about the weather is also very important for users to plan their clothing and commute methods, so I decided the use spare space at the bottom of the clock face to put some weather indicator LEDs. I use White LEDs to stand for sunny weather, Yellow LEDs for cloudy weather, Blue LEDs for rainy weather, Green LEDs for snowy weather, and Red LEDs for storm weather (as a warning). The weather indicator is changed once per day.

I choose to use a purple tissue box I took from my church as the body of the clock. It has a light purple looking, making it looking comfortable, concise, yet noble. It should have a ideal looking in darkness.

Technical Design

I used the Arduino UNO R3 as the control board and power source for LEDs. Since the number of pins are limited, the LEDs for the same hour and same weather for both front and rear faces are serially connected to the same pin on Arduino. The White, Blue, and Green LEDs need about 3V voltage, and the Red and Yellow LEDs need 2V voltage, while both digital and analog pins of Arduino can supply 5V, which makes the system just about enough voltage supply. Still, there are certain problems exist that needs to pay attention. For hour 5 and 6, as well as Cloudy and Storm weather indicator, which only Yellows and Reds are connecting with each

other, an additional 50 ohm (here as 47 ohm) resistor is needed to drop the voltage to 4V for safety. What's more, when connecting White and Blue LEDs together, the voltage supply is not sufficient enough, so the LED brightness is not ideal. The front and rear clock face indicator LED is a single White LED, so a 100 ohm resistor is needed to drop the voltage to 3V.

Since it is not possible to set the clock cycle to a complete 24 hours, I set the clock to cycle every 24 minutes instead of 24 hours, and each hour is represented as 1 minute instead of 1 hour. At the start of each minute, the next LED is turned on, and the previous third LED is turned off. At the end of minute 12, the front indicator LED is turned off and the rear indicator LED is turn on. At the start of each 24 minutes cycle, a random number is generated to represent the types of weather today. Arduino does not have a true built-in random functions, so an external true random library is needed.

As for the use of pins, I used pin 0 to 11 for 0 to 11 o'clock, A0 to A4 for 5 types of weather, A5 for front clock face indicator, pin 13 for rear clock face indicator. Both left and right side GND pins are used as well.

Building Process & Lessons Learned

There are several lessons I learned throughout the building process. First, Arduino does not have a true random function. The number it generates each time is the same, so I have to use third party library to solve that. Second, I am using pin 0 and 1 for 0 and 1 o'clock, and when serial print of Arduino is activated for debugging purpose, those two pins are staying at high, so serial print must be removed from final code for a proper LED shutdown. Third, Arduino delay function is not able to delay 1 minute at once, rather, it stopped at that state and failed to move on. The solution is to have a 1 to 10 for loop, each of the loop delay 6 seconds.

I didn't achieved the perfect design proposed here mainly because the tissue box has limited space inside for wiring, breadboard and Arduino itself. Plus, since it is only a tissue box, the side of it is not strong enough to hold the LED pins go through it, and the wires between these LEDs pull them outward, making the clock face looking very messy. A more serious problem is that the wire connection on these LED pins are not solid enough to stay a long time, and the connection failed from time to time. Still, I managed to achieve working result with a large breadboard.

As for the lessons learned, I would say that it is better to start earlier next time to deal with these unpredictable problems, and finding a better box that has thicker sides would definitely help me to achieve the ideal result.