Exercise 2: Logic With The LED
The LiFi-project

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Overview

In the second exercise ...

Here are the relevant sections of the online script. Make sure you read everything carefully in order to solve this exercise:

- 5 - The LED
- 6 - Code Systems
- 7 - Morse Code

Your Tasks

To pass this exercise, you must complete the following tasks and submit your results via ILIAS. You find the details on the form of submission at the end of this document.

1. Colors By Menu

In the LiFi prototype, the LED will act as the sender of information. This requires frequent changes of the LED's color and turning it off at times. To practice this, create a program that changes the LED's color based on the user's keyboard input. More specifically:

- Write a program that initially turns off the LED and then waits for the user to enter a key on the keyboard and confirm the input with the enter key.

- The input can be any of the following letters: "r", "g", "b", "y", or one of the keywords "off" or "exit". All other input is invalid and should result in an error message: *"Invalid input. Please type either r, g, b, y, or off/exit."*

- Each of the four letters represents a color (r = red, g = green, b = blue, y = yellow) to which the LED should be set after the user confirms her choice with the enter key.

- The keyword "off" should turn off the LED. If it is already off, then nothing happens and a warning message is printed: *"LED is already off"*.

- The keyword "exit" should exit the program after it printed a short good bye message.

2. Hexadecimal Conversion

Write a program that prompts the user for an RGB code expressed in hexadecimal (e.g. `#00FF00`). On hitting enter, the program should convert the hexadecimal code and turn the LED on in the respective color.

Hint: You can use the `int()` function in Python to parse a hexadecimal number to its decimal equivalent:

```python
hex = "FF"
dec = int(hex, 16)
print(dec)
# 255
```

3. SOS With Morse Code

Write a program that reads a text sequence containing only capital letters from A-Z from the keyboard and translates it into Morse code. The result should be emitted using the LED. Choose any color you like. Select a unit length that allows a trained human to decode the message.

More Exercises To Practice

The following tasks are for you to practice your skills. They are optional and not part of the submission or interview.

4. Random Color Sequence (optional)

Write a program that randomly chooses a color from the RGB spectrum and sets the LED to that color for a constant duration d. The program should change the LED's color a configurable number of times until it exits.

What happens when all RGB values are very small by chance? How could you prevent this from happening and improve the program?

5. Traffic Light (optional)

Write a program that simulates the LED as a traffic light. The traffic light should start with a red-phase that lasts d_{red} seconds. The red-phase is followed by a transition-phase from red to green, where the LED turns orange for d_{orange} seconds before it turns green and enters the green-phase. The green-phase lasts d_{green} seconds and is yet again followed by a transition-phase, this time from green to red. The orange light again lasts for d_{orange} seconds. Choose useful values for the three duration parameters d_{red}, d_{green}, and d_{yellow}. Make sure that

$$d_{red} > d_{green} > d_{orange}$$

holds true.

More Questions To Practice

Try to answer the following questions to practice your understanding of the topics around the LiFi-project.

6. Code Systems

- How many colors could we encode if we used only 7 bits instead of 8 for each of the base colors red, green, and blue?

- Would it make sense to create an extended version of the RGB code that adds an extra byte for each of the base colors? How many colors would we be able to encode then? Find arguments for and against this idea!

- We did not always enjoy the full 16,777,216 colors on our computer screens. Do some research on how color codes evolved over the history of digital computers. Can you find some screenshots from long gone times?

- Is Morse code a binary code system?

Submission

For this exercise, please submit your working Python code via the designated submission folder in ILIAS.