AGH University of Krakow

Project Documentation

LED Panel Light with Effects

Course

Design Labolatory

Electronics and Telecommunications, 3rd Year

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1. Introduction

This project involves developing a multifunctional system for controlling an LED panel using an Arduino microcontroller. The primary goal is to implement various lighting effects and allow the user to select them using a rotary encoder and an OLED display. The project is written in C++ following object-oriented programming principles.

2. Project Description:

2.1. Project Objective

The main objective of the project is to demonstrate the capabilities of programming microcontrollers in C++ by creating a system for controlling LEDs with a variety of lighting effects.

2.2. Key Features

- Displaying a user interface on an OLED screen (mode name and value).
- Control via a rotary encoder (changing modes or adjusting parameters).
- Implementation of different operating modes:
    - **Color Temperature (Kelvin):** Adjusting light color.
    - **Hue:** Controlling color in the HSL space.
    - **Brightness:** Adjusting LED power.
    - **Lighting Effects:** Simulating various effects such as::
        - Police Car Lights (Police),
        - Television Light Flicker (TV),
        - Camera Flashes (Paparazzi),
        - Fire Simulation (Fire),
        - Disco Light Show (Disco),
        - Fireworks (Firework).

3. Project Structure

The project is written following object-oriented programming principles and consists of the following files:

3.1. Main Project Files

- **Panel_ledowy.ino -** The main file handling the user interface and initializing the system.
- **Mode.h and Mode.cpp -** Base class for different operating modes (e.g., Temperature, Hue, Power).
- **Effect.h and Effect.cpp:** Base class for lighting effects and their implementations.
- **EffectMode.h i EffectMode.cpp -** Class that allows selecting and running effects.

3.2. Folder Structure

- **src/:** Folder containing all source files.

4. Installation & Setup

4.1. Hardware Requirements

- Arduino Nano v2 microcontroller.
- LED matrix compatible with the Adafruit NeoPixel library.
- OLED display with I2C interface.
- Rotary encoder with a button.

4.2. Software Requirements

- **Arduino IDE** with the following installed libraries:
    - Adafruit GFX,
    - Adafruit SSD1306,
    - Adafruit NeoPixel.

4.3. Steps to Run the Project

1. Open the project in **Arduino IDE**.
2. Configure the appropriate ports and pins in the configuration section.
3. Upload the code to the **Arduino microcontroller**.
4. Connect the **OLED display, LED strip, and rotary encoder** to their respective pins.
5. Start the system and control the effects using the rotary encoder.

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5. Functionality Overview

5.1. User Interface

- The **OLED display** presents the current mode and its value.
- The **rotary encoder** allows switching between modes and adjusting values.

5.2. Mode Descriptions

- **Temperature Mode:** Adjusts the light's color temperature (2900K–5600K).
- **Hue Mode:** Adjusts the light’s hue in the HUE color space (0–360).
- **Brightness Mode**: Controls LED brightness as a percentage (0–100%).
- **Effects Mode:** Runs various animated lighting effects.

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6. Potential Applications

The main **application** of this project is its **use in film production** as a tool to enhance and simulate lighting conditions on set. For example:

- When a **candle flame** is used as a light source, it often does not produce enough brightness to be effectively captured by a camera. The LED panel can simulate the flickering of the flame while providing additional illumination, ensuring that the scene appears natural and well-lit.
- Similarly, the **TV effect** can be used to create the illusion of a screen lighting up an actor's face, without the need for an actual television.
- The **firework effect** can be used in practical effects to simulate fireworks without the risk of real explosions.

Other possible applications include:

- **Decorative lighting** for indoor and outdoor applications.
- **Educational tool** for learning microcontroller programming.
- **Lighting system** for DIY projects, models, and artistic installations.

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8. Additional Information

- **GitHub Repository Link:** https://github.com/aleksnderm/LED_Panel
- **Screenshots & Photos:** Included in the repository.
- **Source Code:** Included in the repository.