STM32-Based Smart Lighting Control System

Group 17

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1. Executive Summary with Concept of Operations

The STM32-Based Smart Lighting Control System is an automated lighting solution designed to manage and optimize indoor lighting according to ambient conditions and user preferences. This system is ideal for smart home environments and workspaces where lighting needs to be comfortable, energy-efficient, and customizable.

Concept of Operations:

The system detects external light intensity using a BH1750 illuminance sensor, adjusting the LED brightness automatically based on pre-set thresholds. Users can adjust brightness, set rest timers, and monitor room temperature using a mobile app, which also allows for remote control via an ESP8266 Wi-Fi module. The system also includes temperature monitoring (using a DHT22 sensor) and manual adjustment buttons on the device for easy access. Additionally, the app provides lighting modes such as "Reading" for high brightness and "Movie" for low brightness to meet different ambient needs.

2. Market Analysis

a) Target Market

Home automation enthusiasts, office users, and individuals looking for a customizable lighting solution with energy-saving capabilities.

b) Competition

Competing products include other smart lighting systems like those from Lutron and Philips Hue. Our solution stands out due to its affordability, use of a customizable app interface, and unique preset modes for specific lighting needs.

c) Pricing Estimate

Approximately $50-70, keeping the product affordable compared to other premium smart lighting systems.

3. Requirements

Power Supply: **Must** use a 5V USB power supply and may with battery backup for reliability.

Light Adjustment: **Should** automatically adjust LED brightness in response to external light intensity, with the ability to manually control brightness levels.

Temperature Monitoring: **Must** display ambient temperature, allowing users to make adjustments based on environmental conditions.

Connectivity: **Must** provide Wi-Fi connectivity via ESP8266 for remote monitoring and

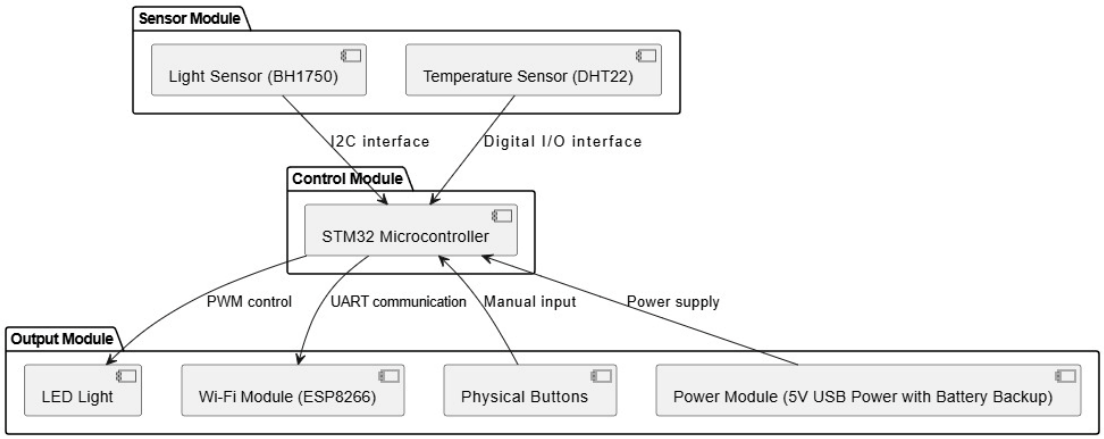
control via an app.

User Interface: **should** include a simple initial app interface with labeled options and **must** physically buttons for settings adjustments.

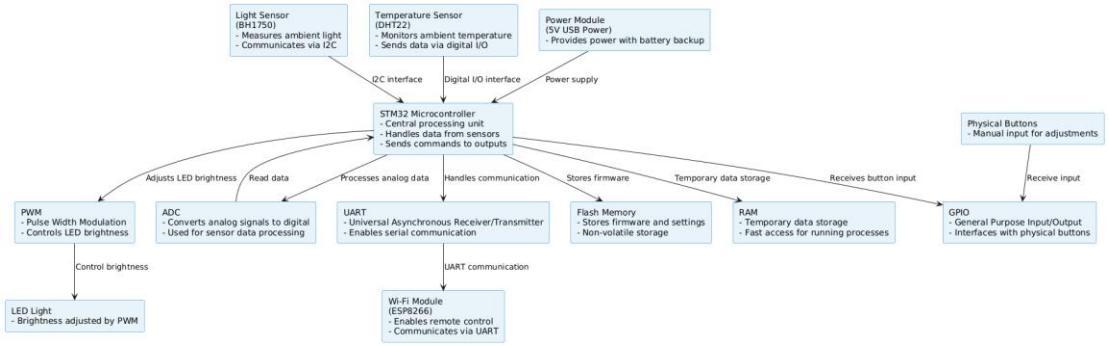
Mode Settings: Should support multiple modes, such as "Reading" for high brightness and "Movie" for low brightness, tailored to different user activities.

4. System Architecture

Level 0 Block Diagram



Level 1 Block Diagram



5. Design Specification

Illuminance Sensor: BH1750, connected via I2C, provides light intensity data.
Temperature Sensor: DHT22, monitors ambient temperature.
Wi-Fi Module: ESP8266, enables app connectivity for remote adjustments.
Processor: STM32 microcontroller, programmed in Arduino IDE.
Power: 5V USB power with battery backup.
App Interface: Initial simple interface with labeled options for functions.

Light Intensity Control:

- The photoresistor converts light intensity to a 0–100 range. Brightness is divided into ten levels (0–10).

- Example setting: If the user sets brightness to level 10, then when the detected light intensity falls between 10 and 20, the brightness adjusts to level 9.

Preset Modes:

Reading Mode: Higher brightness.

Movie Mode: Lower brightness for ambiance.

Physical Buttons: Allow for manual adjustment of brightness and mode selection.