

ECE 445 - Senior Design Project



Auto-Adjusted Smart Desk Lamp for Healthy Lighting

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ECE 445 – Senior Design Project

Slide 2: Project Objective & Goals

Objective:

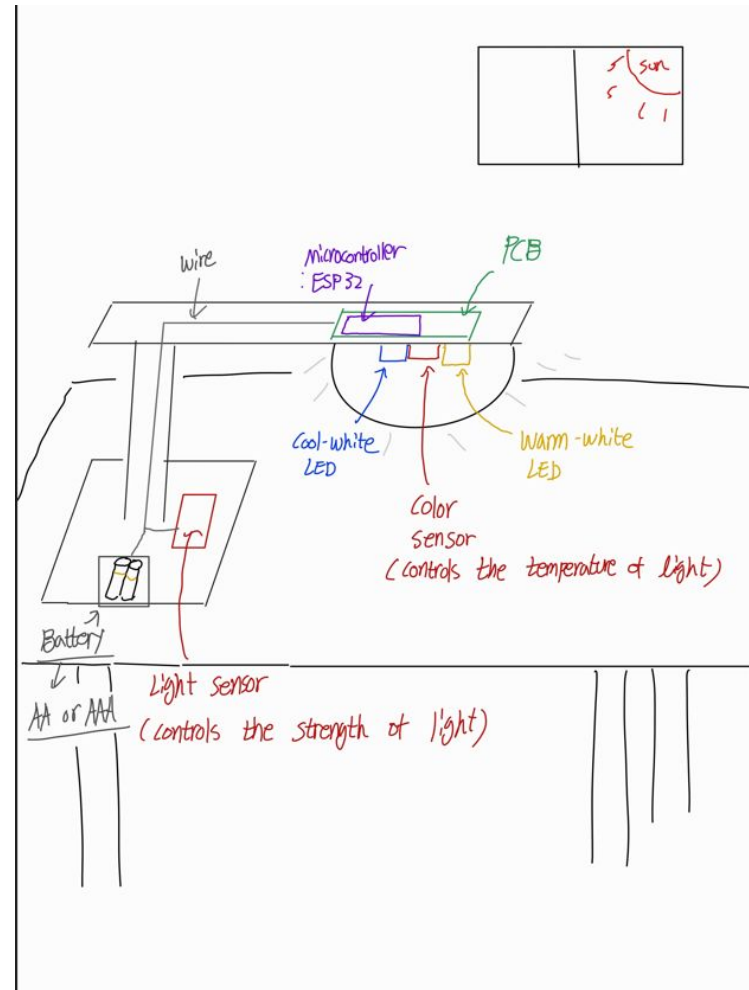
- Design a desk lamp that automatically adjusts brightness and color temperature for healthy, comfortable indoor lighting.

Goals:

- Automatic adjustment to the lighting condition of surrounding place
- Smooth automatic dimming (no sudden jumps).
- Adapt to ambient daylight + monitor brightness.

Slide 3: Conceptual Design




- **2 Sensors:** 1 measure room light + 1 color temperature.
- **MCU (ESP32):** processes data, decides lamp output.
- **LED Driver:** powering the LED
- **LED Sources:** warm-white + cool-white LEDs for adjustable CCT.



Slide 4: Light Sensors (Options Under Review)

Ambient Light / Intensity Sensors:




TSL2591

-  Very wide dynamic range (0.000118–88,000 lux) → works in dim + bright light.
-  High resolution, good for eye-strain-related adjustments.
-  Slightly more complex to configure.

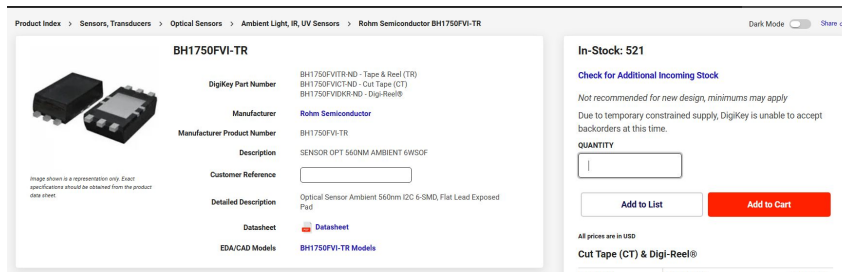
👉 **Best for accuracy and wide conditions (e.g., near a window).**

<https://www.digikey.com/en/products/detail/ams-osram-usa-inc/TSL25911FN/4162547>

BH1750 ← Preferred due to simplicity

-  Super easy to use (I²C, plug-and-play).
-  Cheap, widely available.
-  Lower precision, narrower lux range than TSL2591.

👉 **Best for simplicity/low cost, fine for desk lamp control indoors.**



The screenshot shows the DigiKey product page for the BH1750FVI-TR sensor. The page includes a product image, a table of specifications, and a sidebar with stock information. The main content area displays the following details:

BH1750FVI-TR	
DigiKey Part Number	BH1750FVITR-ND - Tape & Reel (TR) BH1750FVITR-ND - Cut Tape (CT) BH1750FVITR-ND - Digi-Reel®
Manufacturer	Rohm Semiconductor
Manufacturer Product Number	BH1750FVI-TR
Description	SENSOR OPT 560NM AMBIENT 6WSOF
Customer Reference	
Detailed Description	Optical Sensor Ambient 560nm I2C 6-SMD, Flat Lead Exposed Pad
EDA/CAD Models	BH1750FVI-TR Models

The sidebar on the right shows the following information:

- In-Stock: 521**
- [Check for Additional Incoming Stock](#)
- Not recommended for new design, minimums may apply
- Due to temporary constrained supply, DigiKey is unable to accept backorders at this time.
- QUANTITY**
-
- [Add to List](#) [Add to Cart](#)
- All prices are in USD
- Cut Tape (CT) & Digi-Reel®

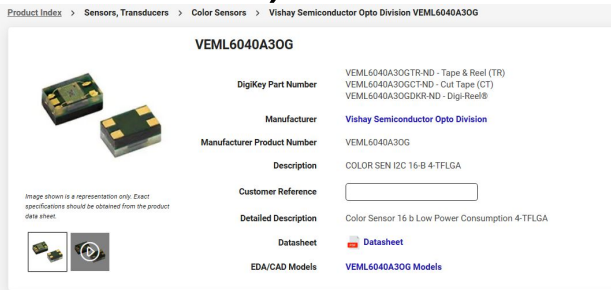
- <https://www.digikey.com/en/products/detail/rohm-semiconductor/BH1750FVI-TR/2041441?s=N4lgTCBcDaIEIAkCMB2ArABhAXQL5A>
- https://www.amazon.com/s?k=bh1750&hvadid=693870254154&hvdev=c&hvexpln=67&hvlocphy=9022196&hvnetw=g&hvocij=13948894794215514942--&hvqmt=e&hvrnd=13948894794215514942&hvtargid=kwd-301548640303&hydadcr=15786_13524375&mcid=33860f70e0703e629d47168e07bc85b3&tag=googhydr-20&ref=pd_sl_60k1x8pm28_e_p67

Slide 5: Color Sensors (Options Under Review)

VEML6040 ← preferred

- Small, low-cost RGBW color + lux sensor.
- Can directly estimate CCT (color temperature).
- Not as advanced as AS72651

👍 **Best small, efficient module for applications without super-high precision**



<https://www.digikey.com/en/products/detail/vishay-semiconductor-opto-division/VEML6040A30G/5168308?s=N4lgTCBcDaiGoFEcyAZAbABgCwZAXQF8g>

AS72651-BLGT

- UART and I2C output, can save measurements to registers
- More complex to work with- has more pins and more complicated output
- More expensive

👍 **More advanced outputs**

<https://www.digikey.com/en/products/detail/ams-osram-usa-inc/AS72651-BLGT/7428279>

Slide 5: LED White Lighting Sources

- **Warm White (2700–3000K)** – natural indoor / evening light.

<https://www.digikey.com/en/products/detail/cree-led/JK2835AWT-P-U27EB0000-N0000001/8020322>

- **Cool White (6000–6500K)** – daylight / productivity light.

<https://www.digikey.com/en/products/detail/cree-led/JB3030AWT-P-H65EA0000-N0000001/8020345>

- Approach: Mix both channels (PWM control) to reach ~2700K–6500K range.
(Insert diagram showing LED mixing → perceived color temperature)



Slide 6: 2-LED Drivers that powers 2-LEDs

LDD-350L

https://www.digikey.com/en/products/detail/mean-well-usa-inc/LDD-350L/7704754




Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

LDD-350L

DigiKey Part Number 1866-3109-ND

Manufacturer [MEAN WELL USA Inc.](#)


Manufacturer Product Number LDD-350L

Description LED DRIVER CC BUCK 2-32V 350MA

Manufacturer Standard Lead Time 12 Weeks

Customer Reference

Detailed Description 350mA 2 ~ 32V Constant Current LED Driver Buck Topology 1 Output

Datasheet  [Datasheet](#)

In-Stock: 2,732

[Check for Additional Incoming Stock](#)

QUANTITY

Add to List

Add to Cart

All prices are in USD

Tube

QUANTITY	UNIT PRICE	EXT PRICE
1	\$3.12000	\$3.12

Note: Due to DigiKey value-add services the packaging type may change when product is purchased at quantities beneath the standard package.

Product Attributes

TYPE	DESCRIPTION	SELECT ALL
Category	Power Supplies - Board Mount LED Drivers	<input type="radio"/>

Slide 7: Microcontroller Choice

Slide 6: Microcontroller Choice

- **ESP32** (primary candidate):
 - Multiple ADC/I²C channels for sensors.
 - PWM outputs for LED dimming.

Reference link for alternative RGB Led project from youtube

[esp32_datasheet_en.pdf](#)

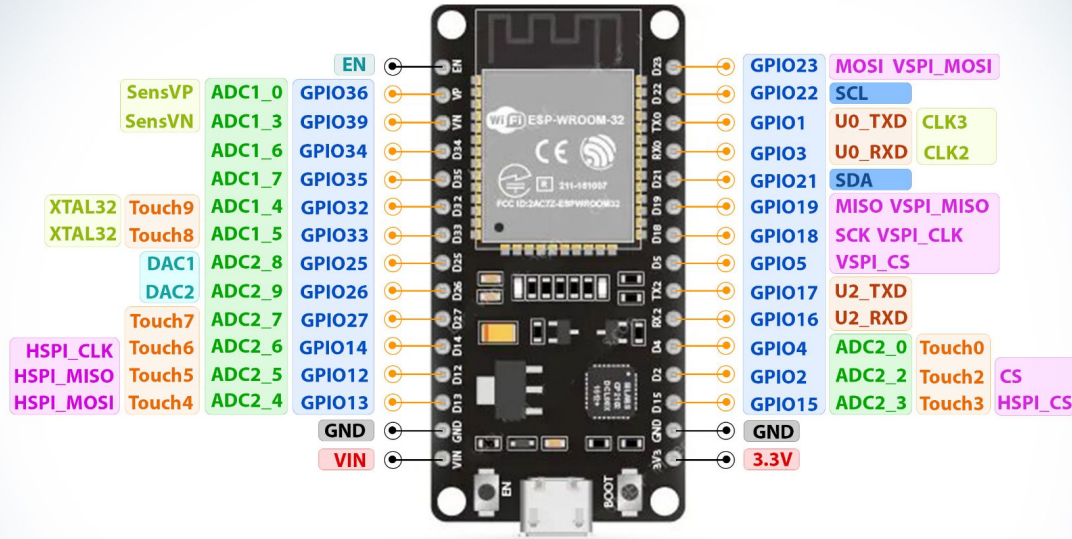
<https://www.youtube.com/watch?v=IMaDJlYp29s>



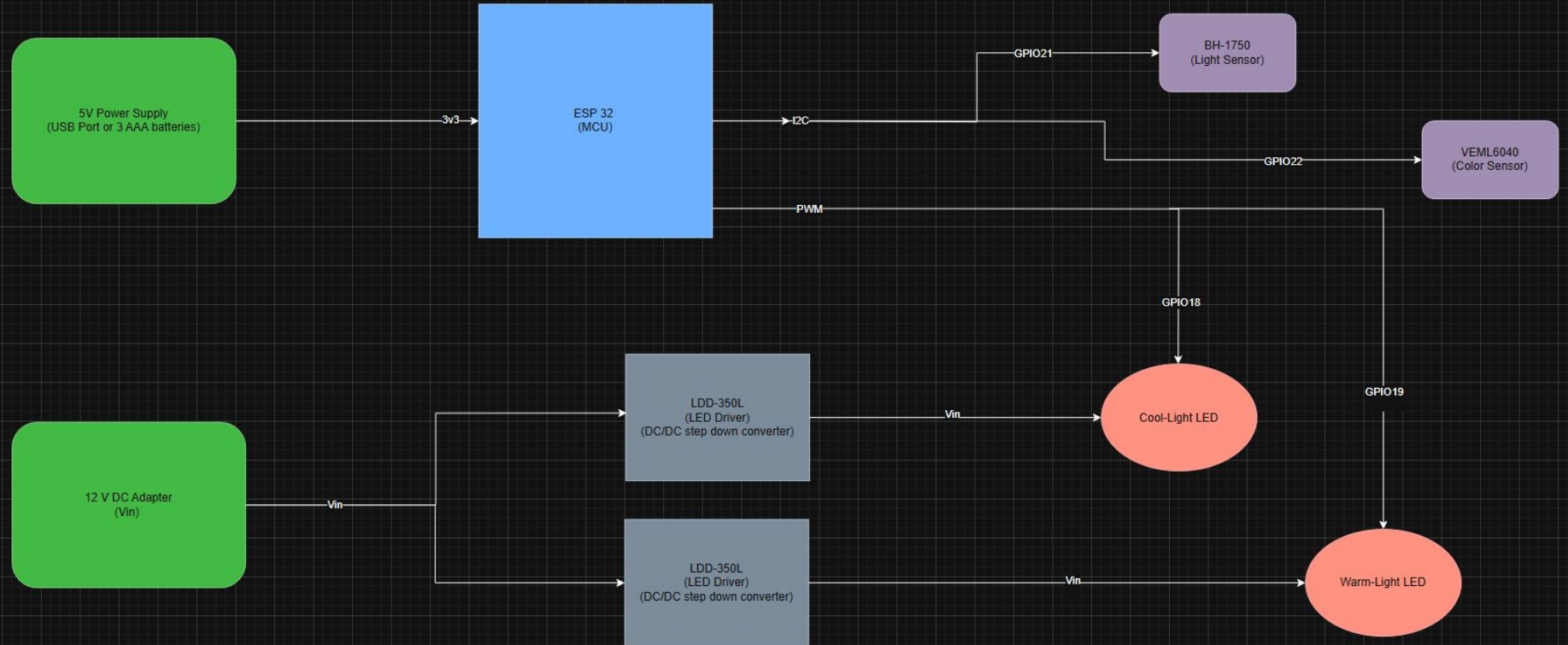
Slide 8 : Block diagram with checklists

- Are power lines labeled with voltage?
- Will microcontrollers have enough pins?
- Will chips tolerate the signals they are being fed (e.g. is the voltage too high?)
- Do students know and understand the interfaces they are using with the chips? (e.g. “data” on their block diagram should be explained)

ESP32 DEV. BOARD PINOUT



Block Diagram



Block Diagram

