# 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:**

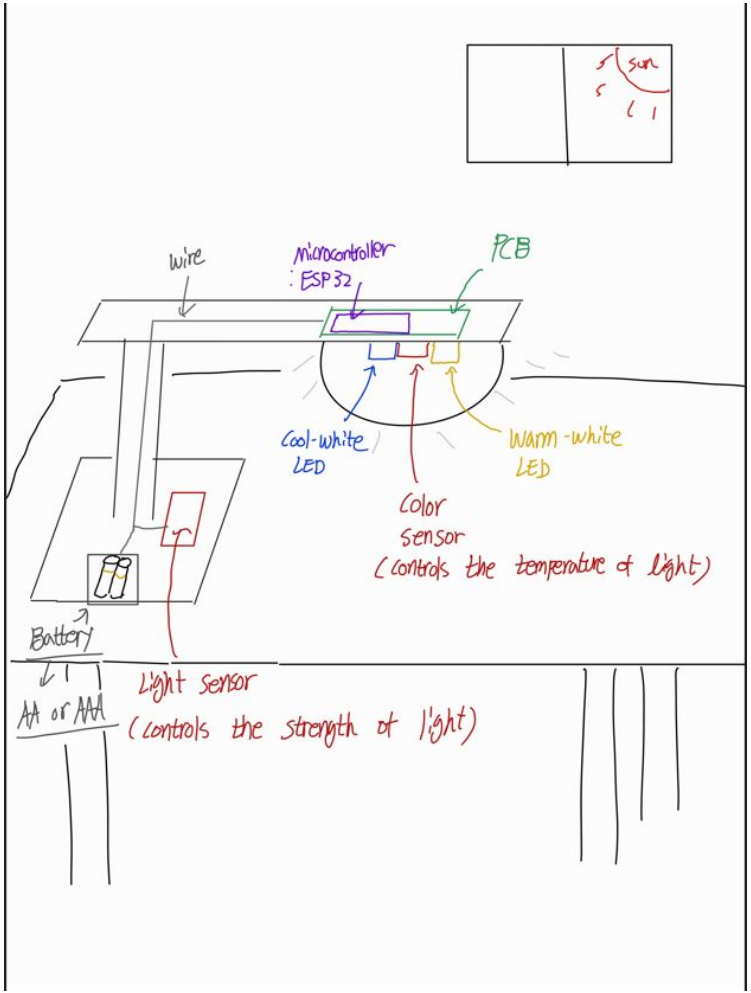
- Design a desk lamp that automatically adjusts brightness and color temperature for healthy, comfortable indoor lighting.

**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.

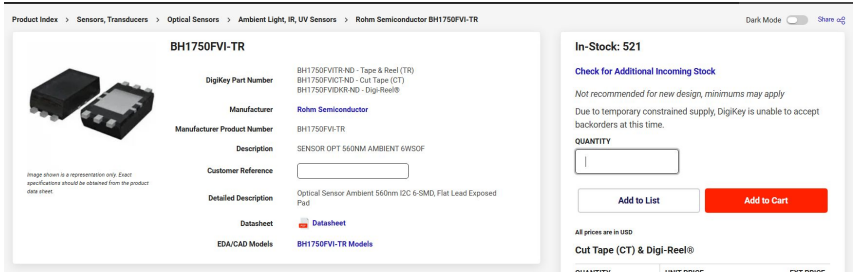
👉 **Best for accuracy and wide conditions (e.g., near a window).**

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

## BH1750 ← Preferred due to simplicity

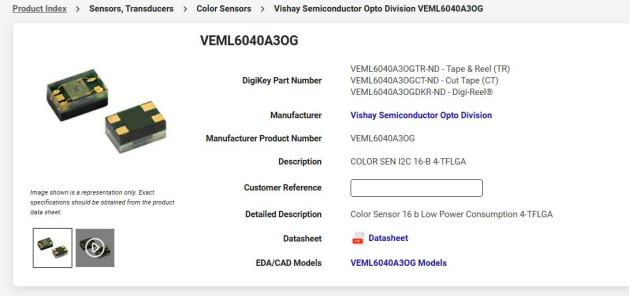
- ✅ Super easy to use (I²C, plug-and-play).
- ✅ Cheap, widely available.
- ⚠️ Lower precision, narrower lux range than TSL2591.

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




- https://www.digikey.com/en/products/detail/rohm-semiconductor/BH1750FVI-TR/2041441?s=N4IgTCBcDaIEIAkCMB2ArABhAXQL5A
- https://www.amazon.com/s?k=bh1750&hvadid=693870254154&hvdev=c&hvexpln=67&hvlocphy=9022196&hvnetw=g&hvocijid=13948894794215514942--&hvqmt=e&hvrand=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/VEML6040A3OG/5168308?s=N4IgTCBcDaIGoFECyAZAbABgCwZAXQF8g

**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.

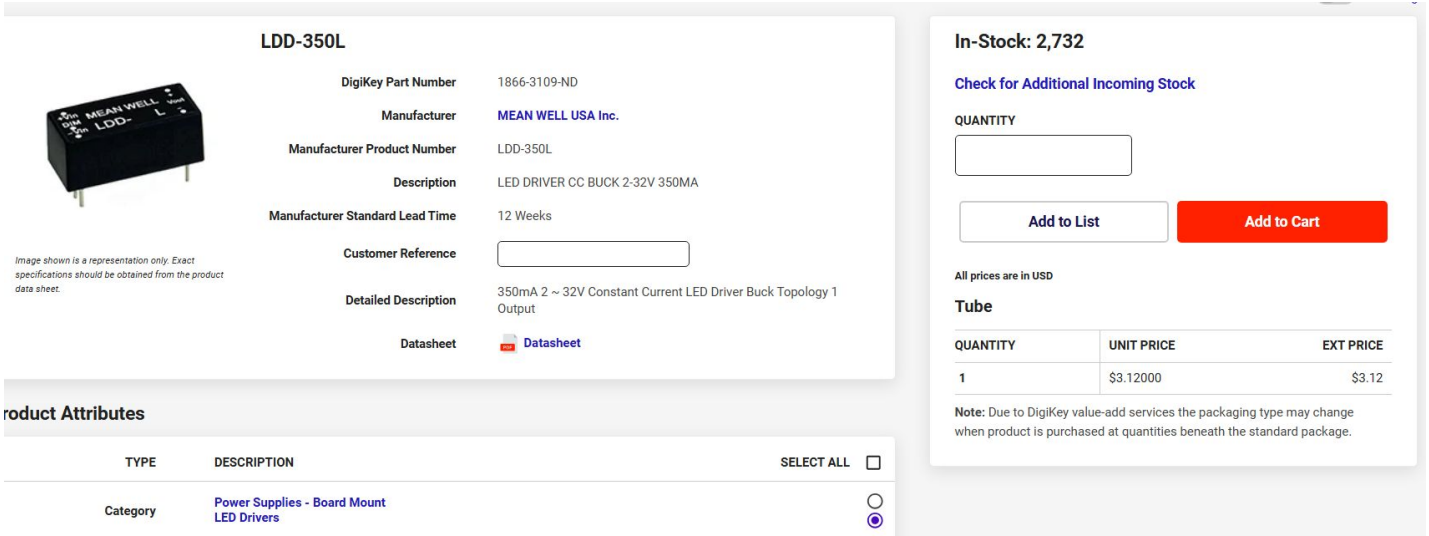
  https://www.digikey.com/en/products/detail/cree-led/JB3030AWT-P-H65EA0000-N0000001/8020345

- 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**



# 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

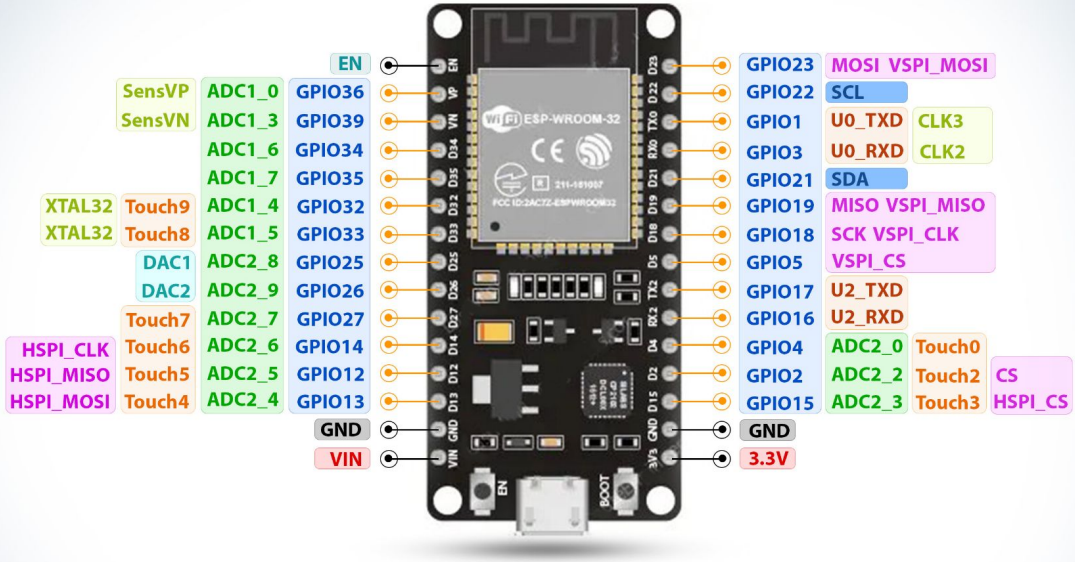
esp32_datasheet_en.pdf

https://www.youtube.com/watch?v=lMaDJlYp29s

# 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)

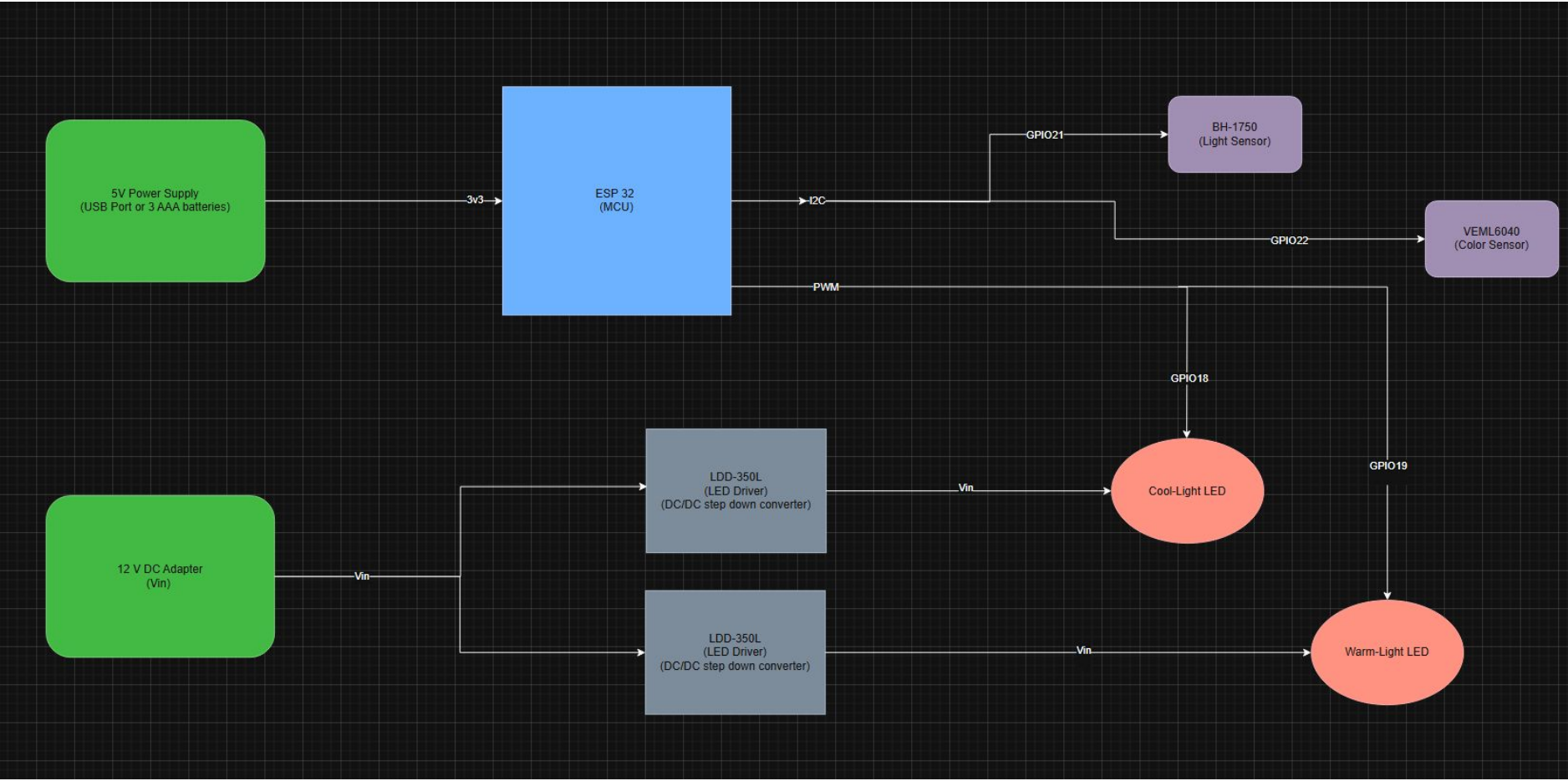
# ESP32 DEV. BOARD PINOUT




Power GND EN GPIO SPI I2C

ADC DAC Touch UART Control PWM

# Block Diagram



# Block Diagram