NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH

DEPARTMENT OF ELECTRICAL ENGINEERING

INTELLIGENT ROOM LIGHTING SYSTEM

AAYUSHI MULEY
521102

ANIKET RAJ
521112

ASHISH
521116

KARISHMA TAJ
521159

OBJECTIVE

Creating an intelligent room lighting system that dynamically adjusts LED intensity based on ambient light conditions.

OVERVIEW

- PURPOSE
- COMPONENTS NEEDED
- WORKING PRINCIPLE
- BLOCK DIAGRAM
- PIN DIAGRAM
- CIRCUIT CONNECTIONS
- CONNECTIONS
- PROGRAM
- CONCLUSION

PURPOSE

- The purpose of the Room Light Controller project is to create an innovative and energy-efficient solution for intelligently managing room lighting.
- Traditional lighting systems often lack adaptability to changing ambient conditions, leading to unnecessary energy consumption and suboptimal user comfort.
- This project aims to address these challenges by leveraging embedded system technology.

COMPONENTS NEEDED:

1. STM32 Microcontroller:

This will be the brain of our system. The STM32F407 is part of the STM32 family, which is based on the ARM Cortex-M processor architecture.

- Processor Core: The STM32F407 features a 32-bit ARM Cortex-M4 core with Floating Point Unit (FPU), which makes it suitable for applications requiring signal processing or floating-point calculations.

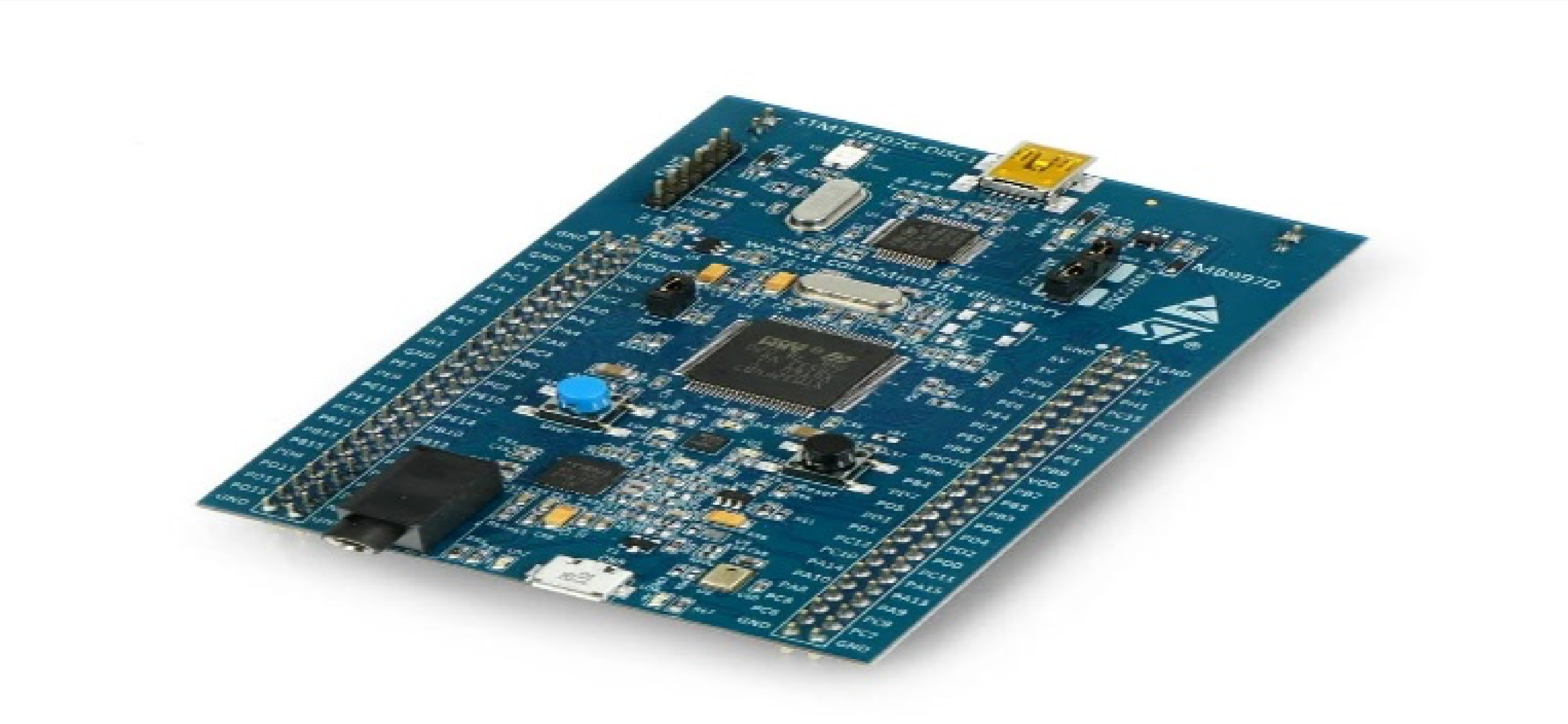
- Clock and Speed: It typically operates at clock speeds of up to 168 MHz, providing a good balance between performance and power consumption.

- Memory: It comes with Flash memory for program storage and various configurations of SRAM for data storage. The amount of Flash and SRAM can vary between different variants of the STM32F407.

- **Peripherals**: The microcontroller has a rich set of peripherals, including timers, communication interfaces (USART, SPI, I2C, etc.), ADC (Analog-to-Digital Converter), DAC (Digital-to-Analog Converter), USB, and more.

- **GPIO (General-Purpose Input/Output)**: It provides a set of GPIO pins that can be configured for various digital and analog functions.

- **Development Environment**: The STM32 microcontrollers are typically programmed using the STM32CubeIDE or other development environments that support ARM Cortex-M development.



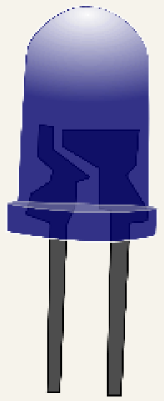
2. LDR SENSOR (Light Dependent Resistor):

Used to measure the ambient light intensity.

- **Principle of Operation:**

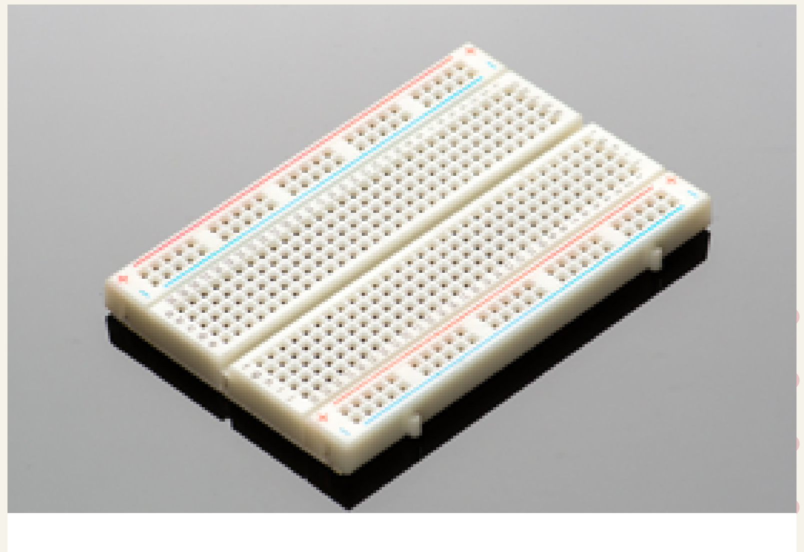
LDRs operate on the principle of photoconductivity. When exposed to light, the semiconductor material within the LDR absorbs photons, which in turn increases the number of charge carriers and decreases the resistance of the material.

3. **<u>LEDs</u>:** These are the lights we will control based on ambient light.



4. **<u>Resistors</u>:** To form voltage dividers with the LDR.

5. **<u>Breadboard and Jumper Wires</u>:** To assemble and connect the components.



6. **<u>Power Supply</u>:** To power the STM32 and LEDs.

WORKING PRINCIPLE:

1. **Light Sensing with LDR:**
    - The project utilizes a Light Dependent Resistor (LDR) as the primary light-sensing element.
    - The LDR is connected in a voltage divider configuration with resistors, forming a circuit that produces an analog voltage proportional to the ambient light intensity.

2. **Microcontroller (STM32) Processing:**
    - The analog voltage output from the LDR circuit is fed into the STM32 microcontroller's Analog-to-Digital Converter (ADC).
    - The STM32 processes this analog input and converts it into a digital value representing the current ambient light level.

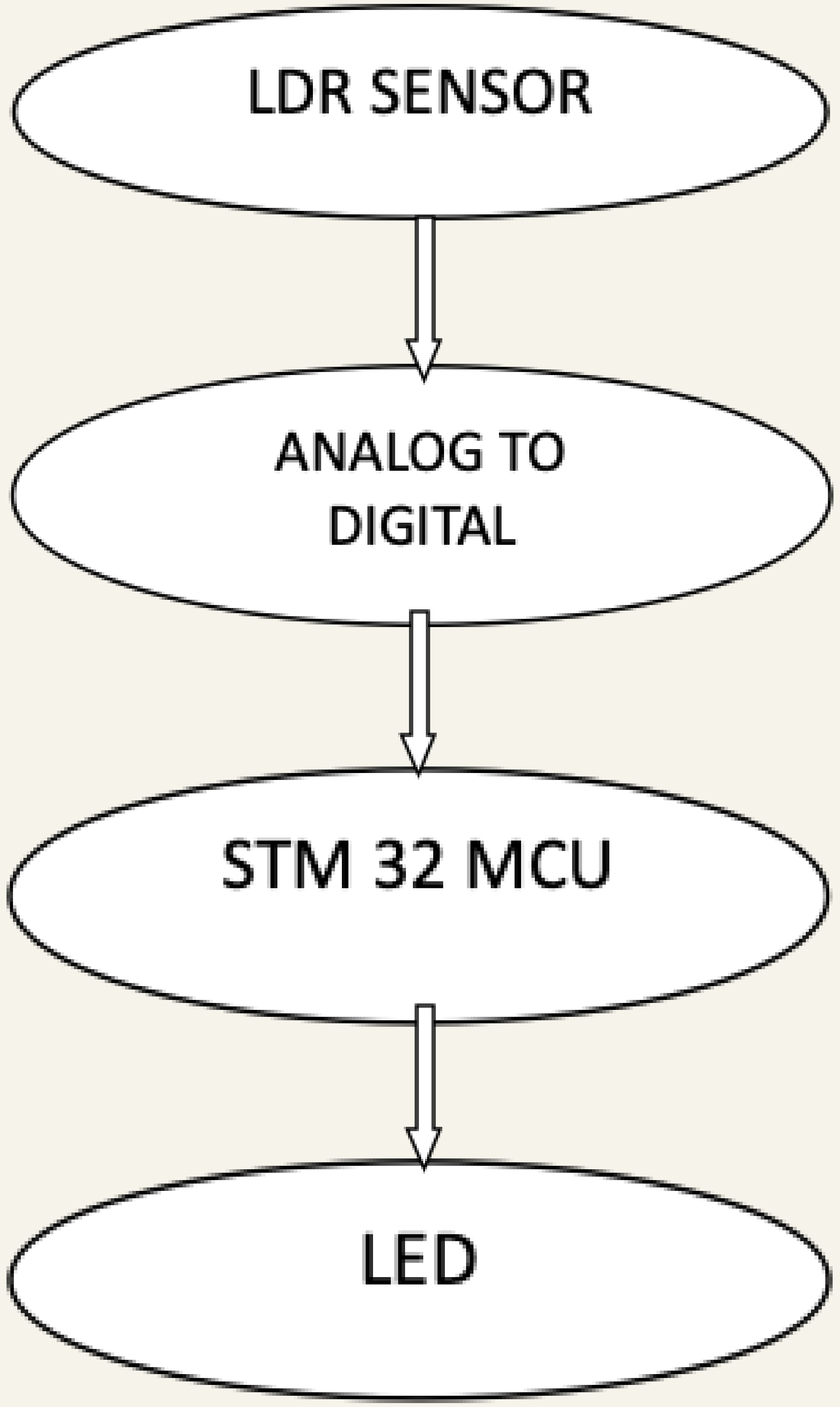
3. LED Intensity Control with PWM:

- Based on the digital light level reading, the microcontroller determines the appropriate intensity for the room lighting.
- Pulse Width Modulation (PWM) is employed to control the brightness of the LEDs. The STM32 generates PWM signals, varying the duty cycle to adjust the average power delivered to the LEDs.

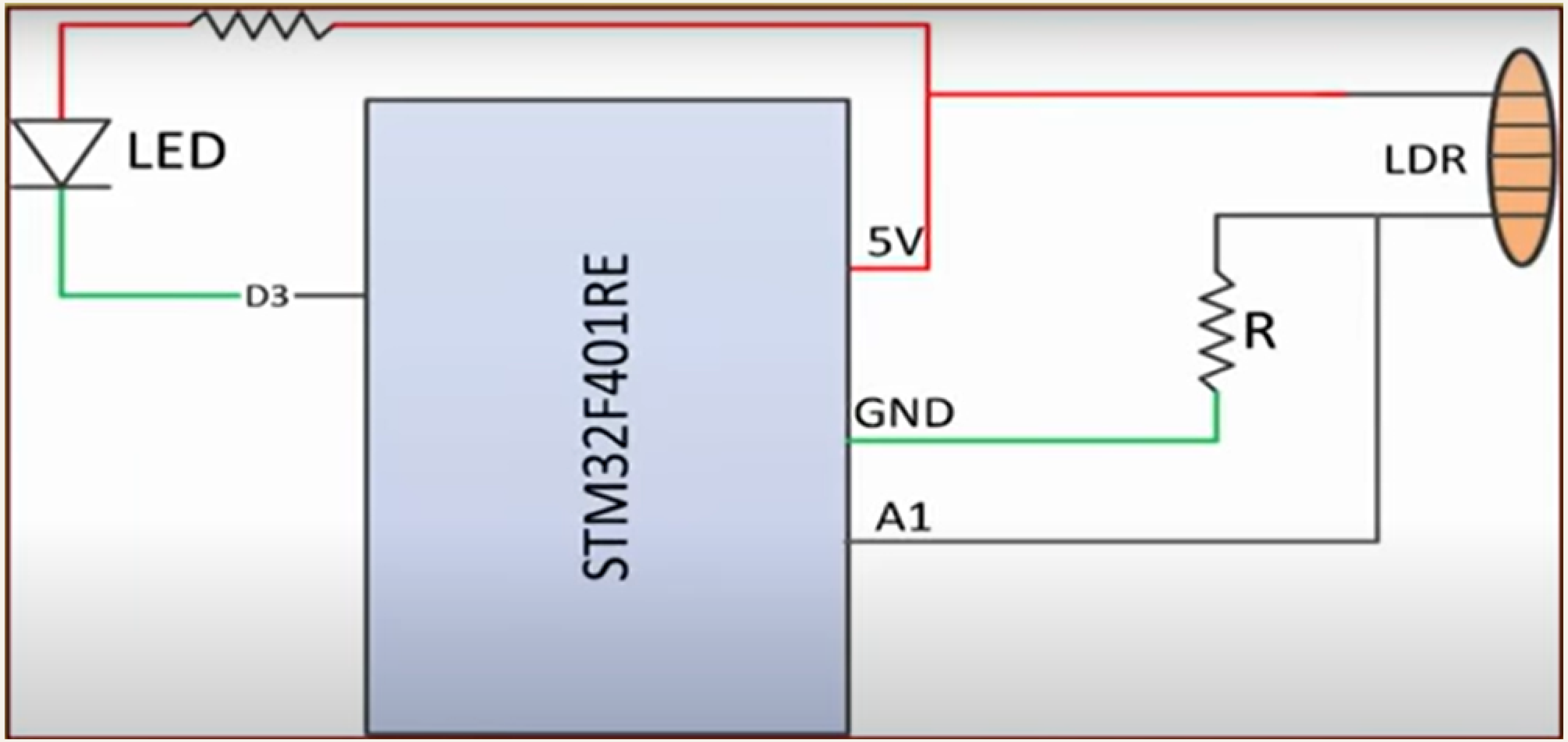
4. Real-time Adjustment:

- The system continually monitors the ambient light level, making real-time adjustments to the LED intensity.
- If the ambient light is low, indicating a darker environment, the LED intensity is increased to provide adequate illumination.
- Conversely, if the ambient light is high, suggesting sufficient natural light, the LED intensity is decreased to conserve energy.

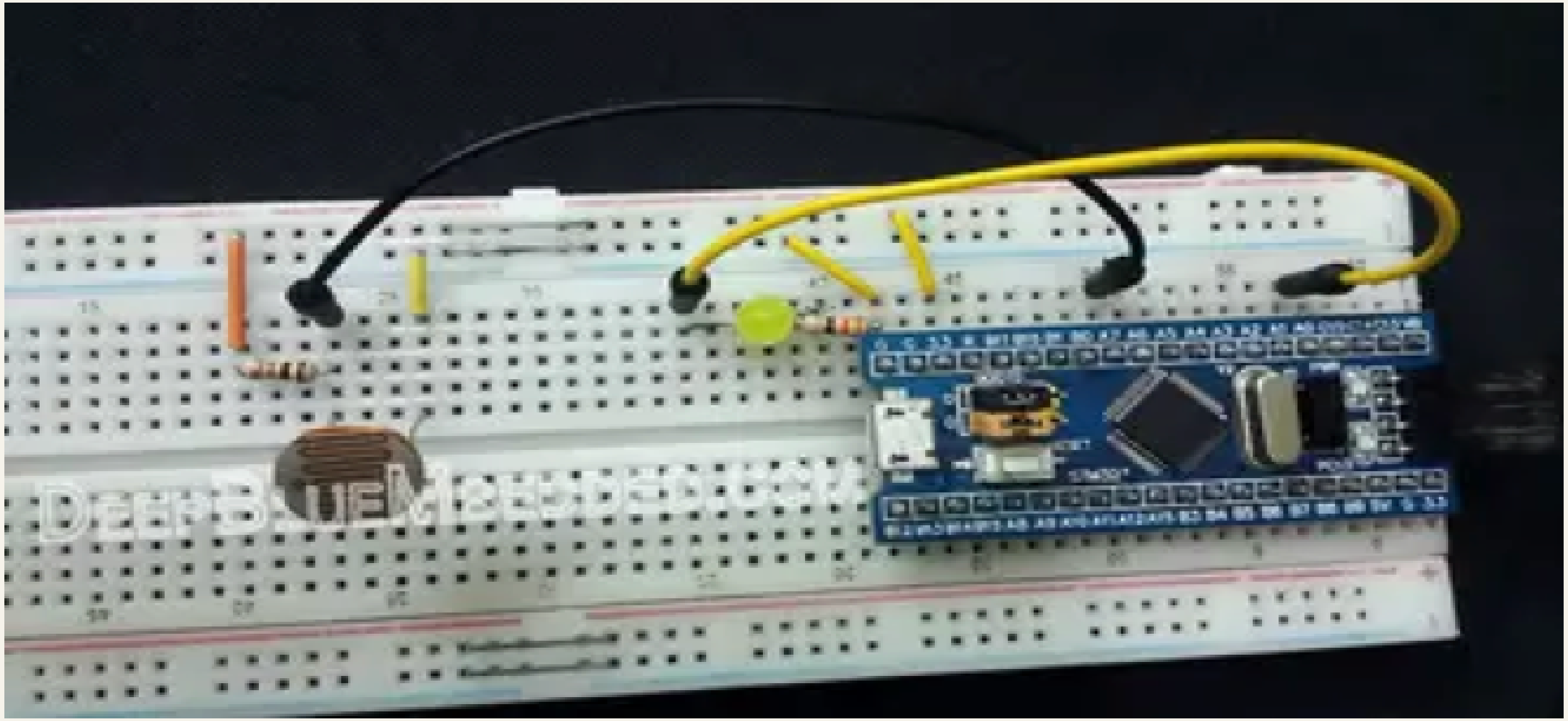
BLOCK DIAGRAM



PIN DIAGRAM



CIRCUIT CONNECTIONS



CONNECTIONS

1. **LDR Sensor:**
    - Connect one leg of the LDR to the 5V (VDD) on the STM32 board.
    - Connect the other leg of the LDR to one leg of a resistor (e.g., 10kΩ).
    - Connect the other leg of the resistor to GND (Ground) on the STM32 board.
    - Connect the junction between the LDR and the resistor to pin PA0 (Analog Input) on the STM32 board.

2.LED:

- Connect the longer leg (anode) of the LED to a current-limiting resistor (e.g., 10KΩ).
- Connect the other leg of the resistor to pin PA5 (PWM Output using TIM2_CH1) on the STM32 board.
- Connect the shorter leg (cathode) of the LED to GND (Ground) on the STM32 board.

3.Power Supply:

- Connect the 5V (VDD) on the STM32 board to the power rail of breadboard.
- Connect GND (Ground) on the STM32 board to the ground rail of breadboard.

PROGRAM

```
#include "main.h"

ADC_HandleTypeDef hadc1;
TIM_HandleTypeDef htim2;

void SystemClock_Config(void);
static void MX_GPIO_Init(void);
static void MX_ADC1_Init(void);
static void MX_TIM2_Init(void);
```

```
int main(void)
{
    uint16_t AD_RES = 0, Vamb, DC_Multiplier;
    HAL_Init();
    SystemClock_Config();
    MX_GPIO_Init();
    MX_ADC1_Init();
    MX_TIM2_Init();
    HAL_TIM_PWM_Start(&htim2, TIM_CHANNEL_1);
    // Calibrate The ADC On Power-Up For Better Accuracy
    HAL_ADCEx_Calibration_Start(&hadc1);

    // Read The Sensor Once To Get The Ambient Level
    // & Calculate The DutyCycle Multiplier
    HAL_ADC_Start(&hadc1);
    HAL_ADC_PollForConversion(&hadc1, 1);
    Vamb = HAL_ADC_GetValue(&hadc1);
    DC_Multiplier = 65535/(4096-Vamb);

    while (1)
    {
        // Start ADC Conversion
         HAL_ADC_Start(&hadc1);
        // Poll ADC1 Peripheral & TimeOut = 1mSec
         HAL_ADC_PollForConversion(&hadc1, 1);
        // Read The ADC Conversion Result & Map It To PWM DutyCycle
         AD_RES = HAL_ADC_GetValue(&hadc1);
         TIM2->CCR1 = (AD_RES-Vamb)*DC_Multiplier;
         HAL_Delay(1);
    }
}
```

CONCLUSION

- The room light controller project utilizing an LDR sensor, LED, and STM32 microcontroller provides an efficient and innovative solution for adaptive lighting in various environments. By integrating the LDR sensor to measure ambient light levels and the STM32 microcontroller to control the LED based on these readings, we've created a responsive and energy-efficient system.

- The system's ability to dynamically respond to changes in ambient light, whether for energy conservation or user comfort, highlights the adaptability and potential applications of such smart lighting solutions. The inclusion of additional features, such as manual controls or remote capabilities, can further enhance the user experience and flexibility of the system.

THANK YOU