International Institute of Information Technology

Introduction to IoT(Spring 2025)

Lab 2

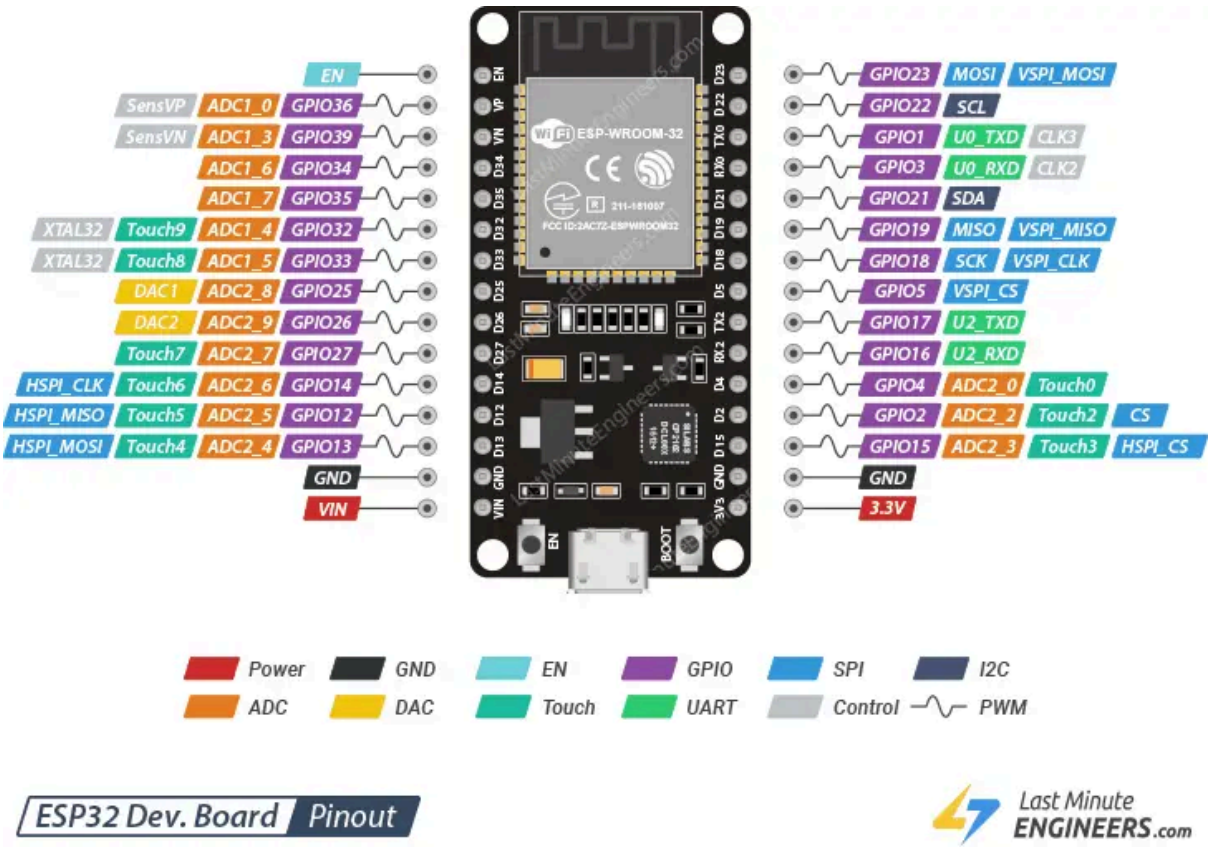
Experiment 1 : Light Dependent Resistor (LDR)

A **L**ight **D**ependent **R**esistor (LDR) is a variable resistive component that changes its resistance based on the intensity of light it is exposed to. In darkness, its resistance is very high, while in bright light its resistance is very low.We will study the behavior of a Light Dependent Resistor (LDR) and its response to varying light intensity using ESP32. LDR sensors available as discrete components or as a tiny module as shown below.

The ESP32 analog pins convert the incoming voltages to an integer between 0 and 4095. This integer value is mapped against the analog input voltage from 0V to 3.3V which is by default the ADC reference voltage in ESP32.

LDR sensor module

Discrete LDR sensor



Components

ESP32 development board , LDR module , discrete LDR sensor , 200 ohms resistor (for voltage divider), LED (for indication) , A source of light (phone torch), Light Meter mobile app.

Task 1 (LDR sensor module)

Circuit Connections

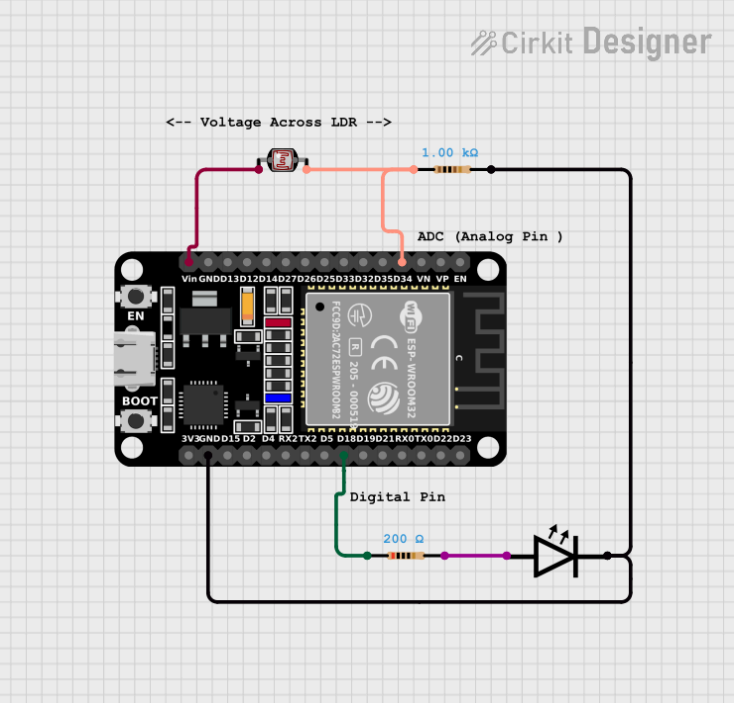
- Connect the VCC pin of the LDR module to the 5V pin of the ESP32.
- Connect the GND pin of the LDR module to the GND pin of the ESP32.
- Connect the D0 (Digital Output) pin of the module to any digital pin (as input) of the ESP32.
- Connect the long leg (anode) of the LED to any GPIO of the ESP32 via a 220 ohms resistor.
- Connect the short leg (cathode) of the LED to GND.

- Write the code to read the digital output of the LDR module and turn on / off the LED depending on the light conditions. Observe the value of the digital out on the Serial monitor. Your code should turn on the LED when the ambient light dims and turn OFF when the ambient light is bright.
- Use the screwdriver(or anything suitable!) to rotate the tiny potentiometer on the module and observe the changes.
- Can you estimate at what brightness level the LED turns on or off ? What can you do to ensure the LED turns ON at a lower brightness level than the current one? Include these answers in your report.

Task 2a (Discrete LDR sensor)

Circuit Connections

1. Connect one terminal of the discrete LDR to a 5V pin on the ESP32.
2. Connect the other terminal of the LDR to an analog input pin on ESP32 and to a 200 ohms.
3. Connect the other end of the 200 ohms to GND.
4. Connect the long leg (anode) of the LED to any GPIO via any resistor (<= 1K ohm).Connect the short leg (cathode) of the LED to GND.



Experiment

- We would like to measure light intensity in the units of Lux . Write a code to read and observe the ADC values from the LDR on Serial Monitor by manipulating the ambient light falling on the sensor (either using a flashlight directly or blocking the light). **Note the max. value of the ADC**

- Characterizing the LDR:
  Place , beside the LDR, a smartphone with a LightMeter app to acquire the lux. Make sure that the light falls equally on the LDR and on the smartphone.

  Write a code to measure the voltage and resistance across the LDR (display on Serial Monitor) and the corresponding lux value indicated by the LightMeter app. Record these values and repeat this process for many different lighting levels from dark to bright.

  Try to get an approximate relationship between the reading of the LightMeter app and the resistance value of the LDR.

- Use the above relation and compute & display the light intensity in units of lux on serial Monitor.

Task 2b:

Threshold Test:

Choose a suitable light intensity threshold and check the LED behavior. The LED should turn ON when the LDR value remains below the threshold (dim light condition) and LED should remain OFF when above the threshold (bright light condition).

Experiment 2 : Capacitive Touch

The ESP32 has 10 capacitive touch GPIOs. These GPIOs can sense variations in anything that holds an electrical charge, like the human skin. So they can detect variations induced when touching the GPIOs with a finger. These pins can be easily integrated into capacitive pads, and replace mechanical buttons.

Additionally, the touch pins can also be used as a wake-up source when the ESP32 is in deep sleep. These pins have been labelled as *TOUCH* in the pinout diagram.

Read the value from a capacitive touch pin and print it to the serial monitor. Make an LED glow when a touch is detected.

Components:

- An LED
- Jumper wire
- 200 ohm resistor

Circuit Connections:

1. Connect one end of the 200 ohms resistor to D1 (or any digital pin) and the other end to the LED's longer leg (positive leg/anode). Connect the shorter leg (negative leg/cathode) to GND.

2. The value of the resistor in series with the LED may be of a different value than 200 ohm. The LED will light up with values up to 1K ohm.

3. Connect a wire to one of the capacitive touch pins on the ESP32 and leave the other end free to touch.

PseudoCode:

1. Define the LED and touch pins
2. In the Setup function:

a. Use Serial.begin() to begin the serial communication

b. Declare the LED pin as a digital output pin and set it to LOW.

3. In the Loop function:

a. Read the value from the touch pin using touchRead() and print to the serial monitor.

b. If the value is less than a certain threshold (calibrate to detect touch consistently) make the LED glow.

Experiment 3 :

Combine the above Experiments-1 (Task 2a, "Threshold Test") and Experiment-2 to create a system in which the threshold value of the LDR can be increased or decreased by a fixed factor, when applying the touch.

Print the new threshold value on the serial monitor and ensure the LED turns ON or OFF based on the new threshold value.

References

ESP32 Series Datasheet
Voltage Divider Circuit Explanation
Lux Meter
Capacitive Touch on ESP32
ESP32 with LDR modules