IERG1000 Project 2– Lab-1
Breadboard and basic components

Objectives

- To understand the arrangement of breadboard;
- To understand how to get power (3.3V) from USB through ESP32 module;
- To built a simple circuit with resistor, LED and wires;
- To understand the method of checking circuit with partner.
- To understand how to test wire that is broken.

Component Software

- ESP32 microprocess module (x1);
- Micro USB cable for ESP32 (x1);
- Breadboard (x1);
- A bunch of wires for breadboard;
- 1K ohm resistor (x1);
- LED (x1);

Important notes:

Short circuit will damage the microprocessor (ESP32) module.

- For safety, disconnect the power when you do wiring.
- Check the circuit with **Reverse Procedures**.

Experiment 1.1: Understand the structure of breadboard.

Breadboard is a common and low-cost platform for electronic circuit evaluation. You have to get acquaint with the arrangement. In the experiment kit, you can get a piece of breadboard that is mounted on an acrylic board, with three modules pre-inserted onto it. There are a lot of holes on the breadboard, we have separated them in to five regions A, B, C, D and red & blue lines (Figure-1.1).

In Region-A and Region-C, there are some holes 'a', 'b', 'c', 'd' and 'e' inline vertical. In Region-B and Region-D, there are some holes named 'f', 'g', 'h', 'i' and 'j'. The last region comprises four RED lines and four Blue lines marked '+' and '-'.

The holes 'a' to 'e' (vertical/column) are intrinsically connected in each row for rows from 1 to 30). Similar arrangement applies to holes 'f' to 'j'. Holes next to the same RED /Blue lines are intrinsically connected vertically. If you turn over the breadboard (Figure-1.2), you can find a lot of **metal strips** connecting the holes in groups.

There are three modules, namely ESP32 module, OLED module and thermo-sensor module having been pre-inserted to the breadboard (Figure-1.3). **Do not unplug** them unless really needed, as un-plugging / re-plugging may damage their pins easily. The plastic holder for each module can prevent your mis-alignment during wiring. **Notes:** you may need to unplug the temperature sensor (AHT10) to check the names of the pins. A slot on the plastic holder is for aligning the sensor to the breadboard.

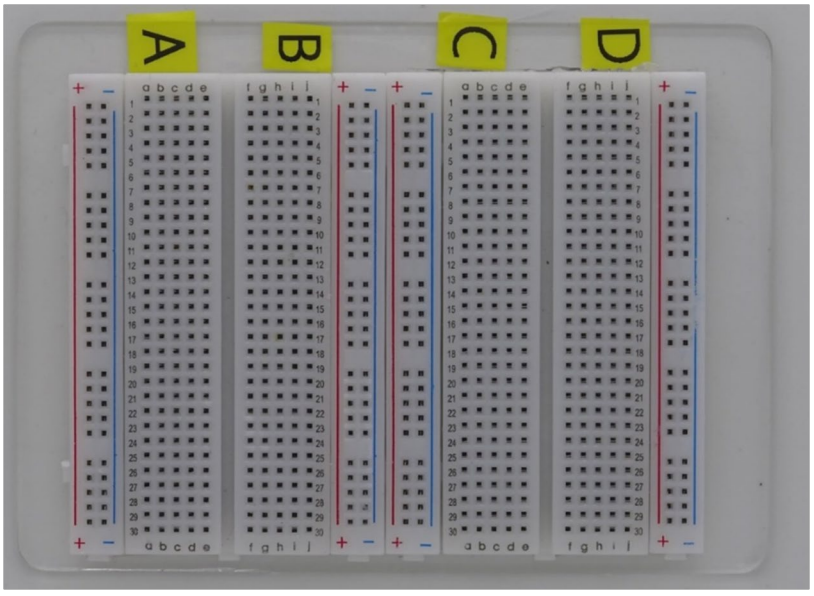

Figure-1.1 Breadboard top view

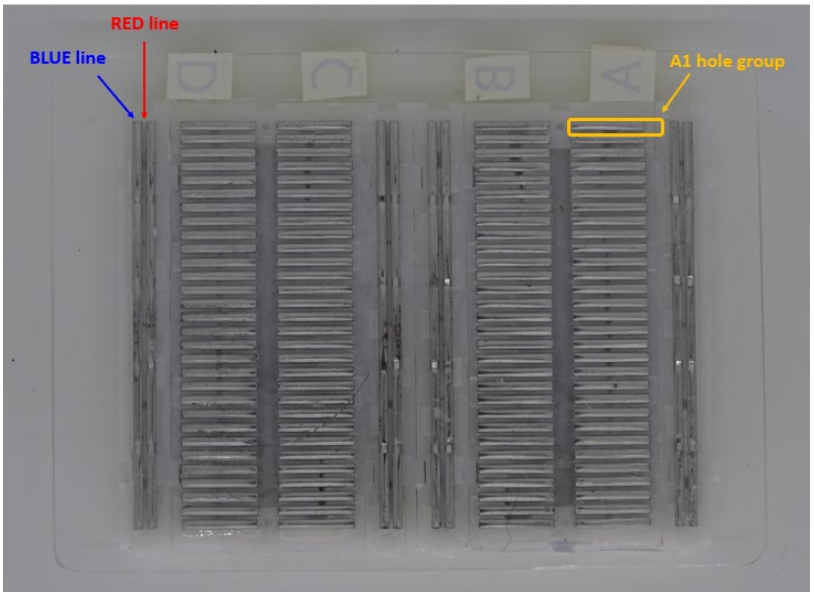

Figure-1.2 Breadboard bottom view

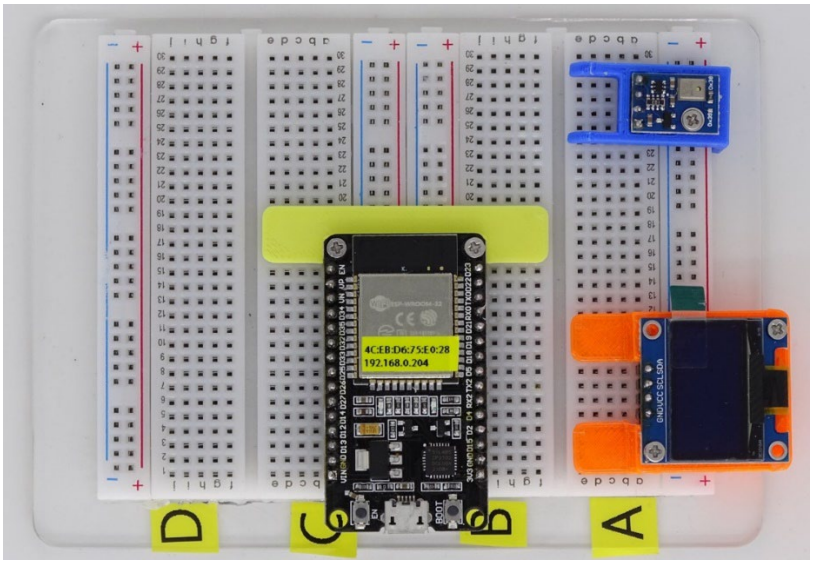

Figure-1.3 Breadboard with IERG1000 modules

Procedures:

1. Compare the top view (Figure-1.1) and the bottom view (Figure-1.2) to understand the arrangement of the breadboard.
2. Check out the hole group D1f, D1g, D1h, D1i and D1j. They are connected together. **This is important to understand how to name the holes and follow the procedures for building the circuit.**
3. Enumerate four hole-groups (e.g. hole group A1=A1a, A1b, A1c, A1d, A1e) they are in Zone-A, B, C and D (each zone with one group). How many holes are there in a hole-group?
4. How many separated groups of RED lines and Blue lines are there? Are all RED/BLUE lines connected together? Describe, if they are not.
5. Find out the hole group (**available hole** names) and jot down their names (fill in the following table). We will use them in this project. This table is very important in this project. Any misinterpreted breadboard connection will damage the modules and cannot complete the project.

Note: Unplug the temperature sensor module and turn over to see the pin names.

OLED – GND	A5b, A5c, A5d, A5e
OLED – VCC	
OLED – SCL	
OLED - SDA	
Temperature Sensor – VIN	A25c, A25d, A25e
Temperature Sensor – GND	
Temperature Sensor - SCL	
Temperature Sensor – SDA	
ESP32 – 3V3	B1f, B1g, B1h, B1i
ESP32 – GND	B2f, B2g, B2h, B2i, C2b, C2c, C2d, C2e
ESP32 – D21	
ESP32 – D22	
ESP32 – D34	C12b, C12c, C12d, C12e

6. (Challenge Question) How to join hole groups C27a-e to C28f-j?

Experiment 1.2: To illuminate a LED.

Light-emitting diode (LED) (Figure-2.1) is common component for lighting, instead of the electrical bulbs. LED is polarized. When the current flow from Anode (+, long pin) to cathode (-, short pin), the LED will be lit with this forward current. This current is very weak (~10mA) and the LED we provided will be burnt/damaged by applying such large forward current (>50mA). If the applied current is reversed, the LED will not be lit and may be even damaged (breakdown) by tens of volts.

To limit the LED forward current, we add a resistor from few hundreds to kilo ohms in series (Figure-2.2) to the circuit to limit the current, we call this resistor as a current limiter (actual calculation as Ohm's Law).

This project will be powered by your own computer through a USB port. A micro USB cable is provided. USB is typically 5V-powered. A voltage regulator is built on the ESP32 board to regulate the input 5V (from USB) and the output at ESP32's pin ib (breadboard B1j) to 3.3V (denoted as 3V3).

In Figure-2.3, which is modified from Figure-2.2, we add some nodes named P, Q, R and S that can help you build the circuit on the breadboard. The nodes are some hole groups on the breadboard.

On the breadboard, there are some hole groups near RED and BLUE lines. We will use the REDs for the positive voltage (3V3 in this project) and the BLUEs for the reference point (GND in this project), which are named as power groups. Positive and negative power groups may be separated, you can use wires to join them together.

Resistor is non-polar component, with two pins as the individual terminals. The color bands indicate its resistance. The color code of 1K-ohm resistor is brown-black-red-gold (4 bands) or brown-black-black-brown-brown (5 bands). Refer to this page https://resistorcolorcodecalc.com for more information.

Operating electronics components/modules requires power. The reference node (pin) named as *GND* typically, the positive node may be named as *VIN, VCC, VDD, 5V, 3V3* or *V+,* etc. They are related to the technologies or materials involved. Anyway, we can understand they are power pins. In this project, we use 3V3 (VIN) and GND.

Notes: DO NOT directly-connect/short POSITIVE power group to GND power group. This will lead to short-circuit with high current, high temperature and high power.

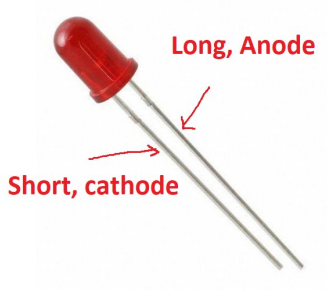

Figure-2.1. LED

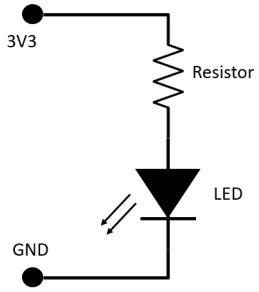

Figure-2.2 LED circuit with a resistor

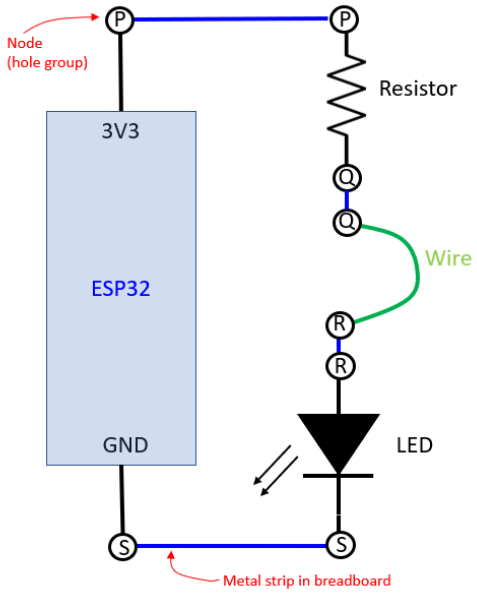

Figure-2.3. LED circuit with nodes

Procedures:

1. Build the circuit as in Figure-2.3.
2. Connect ESP32(3V3) to one of the RED groups (as positive power source, node-P).
3. Connect ESP32(GND) to the BLUE group at the top D-zone (as reference point, zero-volt, ground, node-S).
4. Insert the LED; Anode (long pin) to D30j (node-R), Cathode (short pin) to GND (node-S, procedure-3).
5. Insert the 1K-ohm resistor with one terminal connecting to a RED group (node-P, procedure-2) and another terminal to C30a (node-Q). At this moment Wire (Q-R) has not been inserted yet.
6. Plug the provided USB cable to ESP32. Before this step, you **should UN-powered the circuit during the connection.**
7. Insert a jumper wire to C30e (node-R) and D30f (node-Q) to connect the two hole-groups (node-R and node-Q) to form a complete circuit, the LED will be lit when you insert the wire to complete the circuit.

Notes: When you re-construct your circuit, you have to unplug and re-plug the wires. Please hold the plastic ends of the wires. Do not pull wires at the middle point, which may damage the wires. You can use procedure-7 to check the wires whether they are working properly or not.

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