Lab Report 1

Course Name: Microprocessors and Microcontrollers Laboratory

Course Code: CSE 4326

Section: D

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Submission Date: 04/06/2023

Experiment no. 1

LED Control with Push Button using AB+C Logic Function

Objective:

Implement the following logic function (AB+C) using push button. Discuss in which cases the LED will be lit.

Equipment:

- Arduino Uno R3
- Arduino IDE (Compiler)
- Proteus (Simulator)

Introduction:

This experiment focuses on implementing the "AB+C" logic function using an Arduino Uno microcontroller in the Proteus simulation software. By connecting three push buttons and an LED, we can observe how the LED's illumination status changes based on different combinations of button presses. This experiment provides a practical understanding of logic functions, Arduino programming, and circuit simulation, showcasing the integration of hardware and software in electronic systems.

Components and its Functions:

1. **Arduino Uno R3:** This is the microcontroller board that will execute the code and control the input and output pins.
2. **Push Button:** These are used to provide the input signals A, B, and C to the Arduino Uno. They can be pressed or released to change their state from LOW to HIGH or vice versa. The state of the buttons determines the output of the function, affecting the LED's illumination.
3. **Light Emitting Diode (LED):** This is used to display the output signal of the function AB+C. It will light up when the output is HIGH and turn off when the output is LOW.
4. **Current-Limiting Resistor (220 Ω):** The current-limiting resistor is connected in series with the LED. Its purpose is to regulate the current flowing through the LED, preventing excessive current and protecting the LED from damage.

5. **Power (5V):** The Arduino Uno provides a 5V power supply that is necessary for the operation of the push buttons and the LED. This power is used to energize the components and enable their functionality.

6. **Ground (GND):** The ground connection serves as the reference point for the electrical circuit. It ensures a common voltage reference across all components in the circuit. The ground connection completes the circuit by providing a path for the current to flow back to the power source.

7. **Jumper Wires:** They are used to establish temporary electrical connections between components in the circuit. They provide flexibility for circuit design, quick modifications, and troubleshooting. Proper insertion and secure connections are essential for reliable circuit operation.

Circuit Diagram:
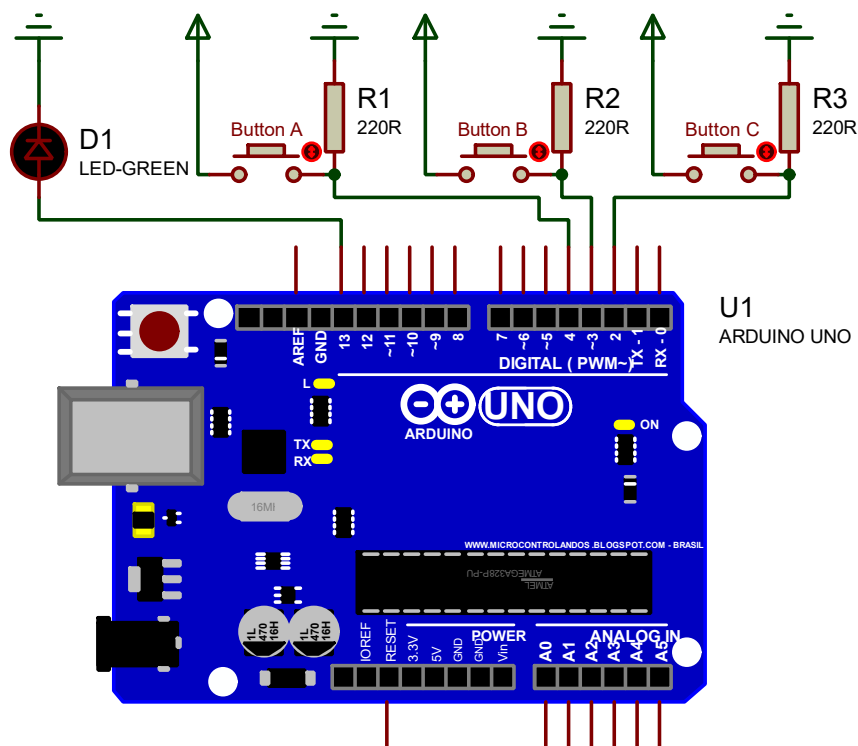
Discussion:

The LED light will be lit when the output of the function AB+C is true, and it will not be lit when the output is false. The output depends on the states of the push buttons A, B, and C, which can be either pressed (HIGH) or not pressed (LOW).

Case	A	B	C	AB	AB + C	LED
1	0	0	0	0	0	Off
2	0	0	1	0	1	On
3	0	1	0	0	0	Off
4	0	1	1	0	1	On
5	1	0	0	0	0	Off
6	1	0	1	0	1	On
7	1	1	0	1	1	On
8	1	1	1	1	1	On

The function AB+C is false when both A and B are false, or C is false. This means that there are three cases where the LED light will not be lit:

Case 1: In this case, none of the push buttons are pressed, and the logic function evaluates to 0. Therefore, the LED remains off.

Case 3: In this case, only push button B is pressed. The logic function evaluates to 0 since A is not pressed. Consequently, the LED remains off.

Case 5: In this case, only push button A is pressed. The logic function evaluates to 0 since B is not pressed. Hence, the LED remains off.

The function AB+C is true when either both A and B are true, or C is true. This means that there are five cases where the LED light will be lit:

Case 2: Here, only push button C is pressed. According to the logic function, the output will be equal to the value of C, which is 1. Hence, the LED will be lit.

Case 4: Push buttons B and C are pressed. The logic function evaluates to 1 since B is pressed, and the output is equal to the value of C. As a result, the LED will be lit.

Case 6: Push buttons A and C are pressed. The logic function evaluates to 1 because A is pressed, and the output is equal to the value of C. Consequently, the LED will be lit.

Case 7: Both push buttons A and B are pressed. The logic function evaluates to 1 since both A and B are pressed. Therefore, the LED will be lit.

Case 8: In this case, all three push buttons (A, B, and C) are pressed. The logic function evaluates to 1, regardless of the value of C. Thus, the LED will be lit.

Arduino Code:

```
#define LED 13
#define A 4
#define B 3
#define C 2

int aState = 0;
int bState = 0;
int cState = 0;

int result = 0;

void setup() {
  pinMode(LED, OUTPUT);
  pinMode(A, INPUT_PULLUP);
  pinMode(B, INPUT_PULLUP);
  pinMode(C, INPUT_PULLUP);
}

void loop() {
  aState = digitalRead(A);
  bState = digitalRead(B);
  cState = digitalRead(C);

  result = (aState && bState) || cState;

  if (result == 1) {
    digitalWrite(LED, HIGH);
  }
  else {
    digitalWrite(LED, LOW);
  }
}
```