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Batch: COMETFWC019
Date: 10 July 2025

GATE 2009, ECE Question Number 60

Abstract

This project demonstrates the implementation of segment logic using only NOT and OR gates as described in GATE Q60. It implements outputs g, e, and d using an Arduino UNO.

1. Components

Component	Qty
Arduino UNO	1
Push Buttons	4
LEDs	3
220Ω Resistors	7
Breadboard	1
Jumper Wires	10
Laptop with Arduino IDE	1

Table 1: List of components used

2. Setup and Connections

- Connect buttons P1, P2, b, c to D2, D3, D4, and D5.
- Connect LEDs to D8 (g), D9 (e), and D10 (d) via 220Ω resistors.
- Use pull-down resistors for button pins.
- Ensure common GND for Arduino and components.

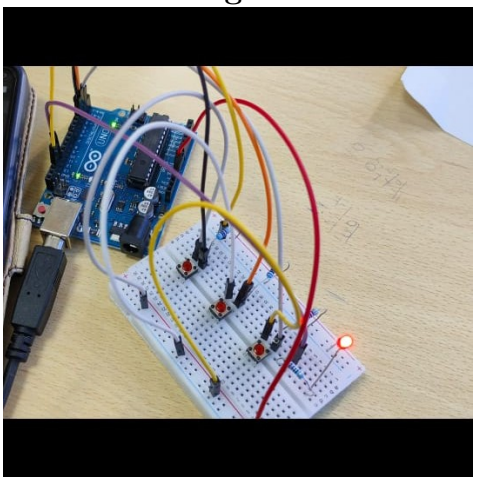
3. Logic Expressions

- $g = \overline{P1} + \overline{P2}$ (2 NOTs + 1 OR)
- $e = b + c$ (1 OR)
- $d = c + e$ (1 OR)

4. Pin Mapping

- **P1** – D2 (Input)
- **P2** – D3 (Input)
- **b** – D4 (Input)
- **c** – D5 (Input)
- **g LED** – D8 (Output)
- **e LED** – D9 (Output)
- **d LED** – D10 (Output)

5. Circuit Diagram



6. Hardware Code – Arduino (C++)

```
int P1 = 2;
int P2 = 3;
int b = 4;
int c = 5;

int g_led = 8;
int e_led = 9;
int d_led = 10;

void setup() {
  pinMode(P1, INPUT);
  pinMode(P2, INPUT);
  pinMode(b, INPUT);
  pinMode(c, INPUT);
  pinMode(g_led, OUTPUT);
  pinMode(e_led, OUTPUT);
  pinMode(d_led, OUTPUT);
}

void loop() {
  int val_P1 = digitalRead(P1);
  int val_P2 = digitalRead(P2);
  int val_b = digitalRead(b);
  int val_c = digitalRead(c);

  int g = (!val_P1) || (!val_P2);
  int e = val_b || val_c;
  int d = val_c || e;

  digitalWrite(g_led, g);
  digitalWrite(e_led, e);
  digitalWrite(d_led, d);

  delay(100);
}
```

7. GitHub Code Link

https://github.com/amuru052004/Likhitha_fwc/tree/main/Hardware

8. Conclusion

This document provides the successful hardware implementation of GATE Q60 using Arduino and minimal gates. The outputs g, e, and d have been verified using the logic: 2 NOT gates and 3 OR gates, and the results matched expected behavior.