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Date: 10 July 2025

GATE 2009, ECE Question Number 59

Abstract

This project uses an Arduino UNO and a 7-segment display to simulate a vending machine logic system from GATE 2009 Question 59. Based on two inputs (P1, P2), prices are displayed: 0, 2, 5, or E.

1. Components

Component	Qty
Arduino UNO	1
Push Buttons (P1, P2)	2
7-Segment Display (Common Cathode)	1
220Ω Resistors	7
Breadboard	1
Jumper Wires	12
Laptop with Arduino IDE	1

Table 1: List of components used

2. Setup and Connections

- Connect push button P1 to D2 and P2 to D3 with pull-down resistors.
- Connect 7-segment display segments:
  - a → D4, b → D5, c → D6, d → D7, e → D8, f → D9, g → D10
- Connect each segment pin through a 220Ω resistor.
- Common cathode pin of display to GND.
- Arduino GND connected to breadboard GND.

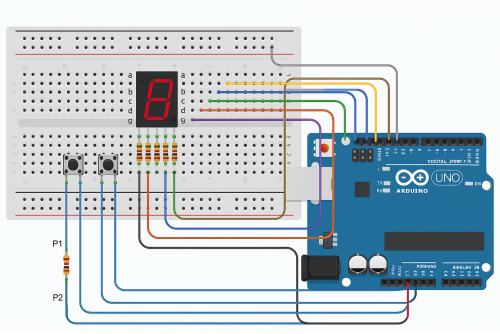
3. Logic Summary

- Inputs: P1, P2 (1 = pressed, 0 = not pressed)
- Segment g: $g = P1 + P2$
- Segment e: $e = b + c$
- Segment d: $d = c + e$
- Display outputs: 0, 2, 5, or E depending on input

4. Pin Mapping

- **P1** – D2 (Input)
- **P2** – D3 (Input)
- **7-Segment Display:**
  - a – D4, b – D5, c – D6, d – D7
  - e – D8, f – D9, g – D10

5. Circuit Diagram



6. Hardware Code – Arduino (C++)

```
int P1 = 2;
int P2 = 3;

int seg_a = 4;
int seg_b = 5;
int seg_c = 6;
int seg_d = 7;
int seg_e = 8;
int seg_f = 9;
int seg_g = 10;

void setup() {
  pinMode(P1, INPUT);
  pinMode(P2, INPUT);

  pinMode(seg_a, OUTPUT);
  pinMode(seg_b, OUTPUT);
  pinMode(seg_c, OUTPUT);
  pinMode(seg_d, OUTPUT);
  pinMode(seg_e, OUTPUT);
  pinMode(seg_f, OUTPUT);
  pinMode(seg_g, OUTPUT);
}

void loop() {
  int val_P1 = digitalRead(P1);
  int val_P2 = digitalRead(P2);

  if(val_P1 == 0 && val_P2 == 0) { // Display '0'
    digitalWrite(seg_a, 1);
    digitalWrite(seg_b, 1);
    digitalWrite(seg_c, 1);
    digitalWrite(seg_d, 1);
    digitalWrite(seg_e, 1);
    digitalWrite(seg_f, 1);
    digitalWrite(seg_g, 0);
  }
  else if(val_P1 == 1 && val_P2 == 0) { // Display '2'
    digitalWrite(seg_a, 1);
    digitalWrite(seg_b, 1);
    digitalWrite(seg_c, 0);
    digitalWrite(seg_d, 1);
    digitalWrite(seg_e, 1);
    digitalWrite(seg_f, 0);
    digitalWrite(seg_g, 1);
  }
  else if(val_P1 == 0 && val_P2 == 1) { // Display '5'
    digitalWrite(seg_a, 1);
    digitalWrite(seg_b, 0);
    digitalWrite(seg_c, 1);
    digitalWrite(seg_d, 1);
```

```
    digitalWrite(seg_e, 0);
    digitalWrite(seg_f, 1);
    digitalWrite(seg_g, 1);
  }
  else { // Display 'E'
    digitalWrite(seg_a, 1);
    digitalWrite(seg_b, 0);
    digitalWrite(seg_c, 0);
    digitalWrite(seg_d, 1);
    digitalWrite(seg_e, 1);
    digitalWrite(seg_f, 1);
    digitalWrite(seg_g, 1);
  }

  delay(100);
}
```

7. Analysis

7.1 Truth Table

P1	**P2**	**Display**
0	0	0
1	0	2
0	1	5
1	1	E

7.2 Segment Activation

Digit	a	b	c	d	e	f	g
0	1	1	1	1	1	1	0
2	1	1	0	1	1	0	1
5	1	0	1	1	0	1	1
E	1	0	0	1	1	1	1

7.3 Derivations

- $g = P1 + P2$
- $e = b + c$
- $d = c + e$

8. Conclusion

This hardware implementation using a 7-segment display successfully models vending machine logic using basic input and output pins of Arduino UNO. The results are validated against GATE 2009 Question 59 output specifications.