IIITB COMET FOUNDATION

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GATE 2009, ECE Question Number 37

Abstract

(GATE 2009, Question No. 37 – Minimum number of 2-to-1 MUXes to implement AND and XOR gates)

This project demonstrates the logic implementation of a 2-input AND gate and a 2-input XOR gate using MicroPython and Raspberry Pi Pico.

1. Components

Component	Qty
Raspberry Pi Pico	1
USB Cable (Micro-USB)	1
Push Buttons	2
LEDs	2
220Ω Resistors	4
Jumper Wires (M-M)	10
Breadboard	1
Laptop with Thonny IDE	1

Table 1: List of components used

2. Setup and Connections

1. Connect push buttons to GPIO pins GP14 and GP15.
2. Attach LEDs to GP16 (AND output) and GP17 (XOR output) via 220Ω resistors.
3. Use pull-down configuration for button inputs.
4. Connect all grounds to Pico GND.
5. Power and program the Pico using Thonny IDE.

3. Implementation Steps

1. Assemble the circuit on the breadboard.
2. Connect Pico to PC and open Thonny.
3. Write and upload MicroPython code.
4. Press buttons and observe LED behavior.

4. Truth Table

A	B	$A \cdot B$	$A \oplus B$
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

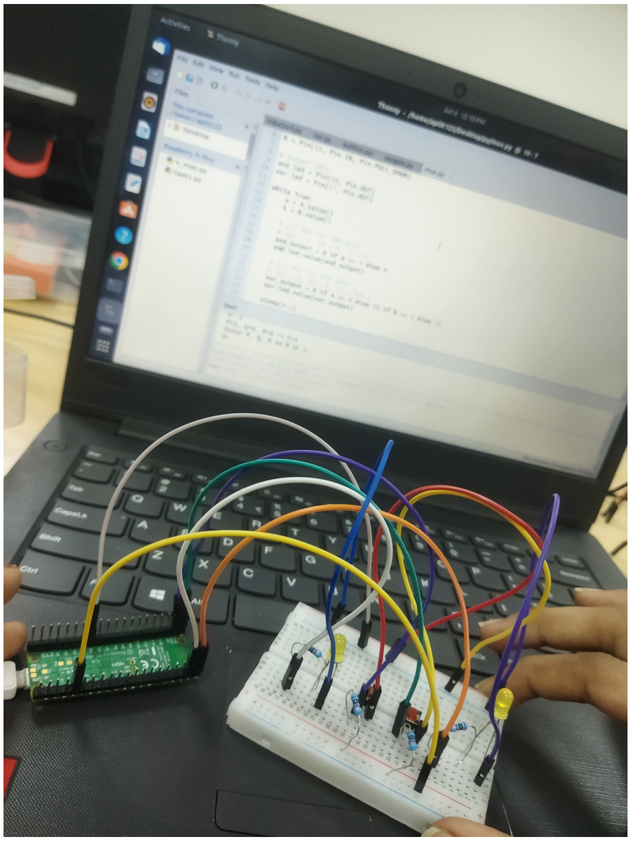
5. Boolean Expressions

- AND Gate: $F_{AND} = A \cdot B$
- XOR Gate: $F_{XOR} = A \cdot \overline{B} + \overline{A} \cdot B$

6. Input and Output Pins

- **A (Input)** – GP14
- **B (Input)** – GP15
- **AND Output LED** – GP16
- **XOR Output LED** – GP17

7. Circuit Screenshot



8. Hardware Code – MicroPython (Thonny IDE)

```
from machine import Pin
import utime

# Define input pins
A = Pin(14, Pin.IN, Pin.PULL_DOWN)
B = Pin(15, Pin.IN, Pin.PULL_DOWN)

# Define output pins
and_led = Pin(16, Pin.OUT)
xor_led = Pin(17, Pin.OUT)

while True:
    a_val = A.value()
    b_val = B.value()

    # AND gate
    and_output = a_val and b_val
    and_led.value(and_output)

    # XOR gate
    xor_output = (a_val and not b_val) or (not a_val and b_val)
    xor_led.value(xor_output)

    print("A␣=", a_val, "B␣=", b_val,
          "AND␣=", and_output, "XOR␣=", xor_output)

    utime.sleep(0.1)
```

9. GitHub Code Link

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