

GATE 2009, ECE Question Number 39

Abstract

This project implements the GATE 2009 Q39 JK Flip-Flop counter using a Pico 2W, buttons, and LEDs. The system simulates a 3-state counter with the sequence $01 \rightarrow 10 \rightarrow 00 \rightarrow 01 \dots$. Button presses act as clock signals, and LEDs represent the outputs Q1 and Q2.

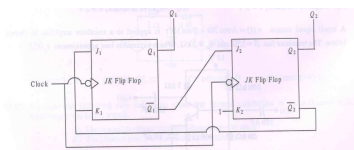


Figure: JK Flip-Flop logic diagram used in simulation

1. Components

Component	Qty
Pico 2W	1
Push Button (clock input)	1
LEDs (Q1, Q2)	2
220Ω Resistors	2
Breadboard	1
Jumper Wires	8
Micro-USB Cable	1

Table 1: List of components used

2. Setup and Connections

- **Button (Clock)** → GPIO 15 with a pull-down resistor.
- **LED Q1** → GPIO 16 via 220Ω resistor.
- **LED Q2** → GPIO 17 via 220Ω resistor.
- GND connections from Pico to breadboard.
- Button press triggers state change.

3. State Table for Q39

Press	Q2	Q1
Initial	0	0
1st	0	1
2nd	1	0
3rd	0	0
4th	0	1

Table 2: State transition sequence for 3-state counter

4. Analysis

- Flip-Flop 1 toggles on every clock ($J=Q2$, $K=1$)
- Flip-Flop 2 toggles based on $Q1$ ($J=Q1$, $K=1$)
- Implemented logic replicates JK Flip-Flop transitions
- LED outputs match state sequence: $01 \rightarrow 10 \rightarrow 00 \rightarrow \dots$

5. Circuit Image

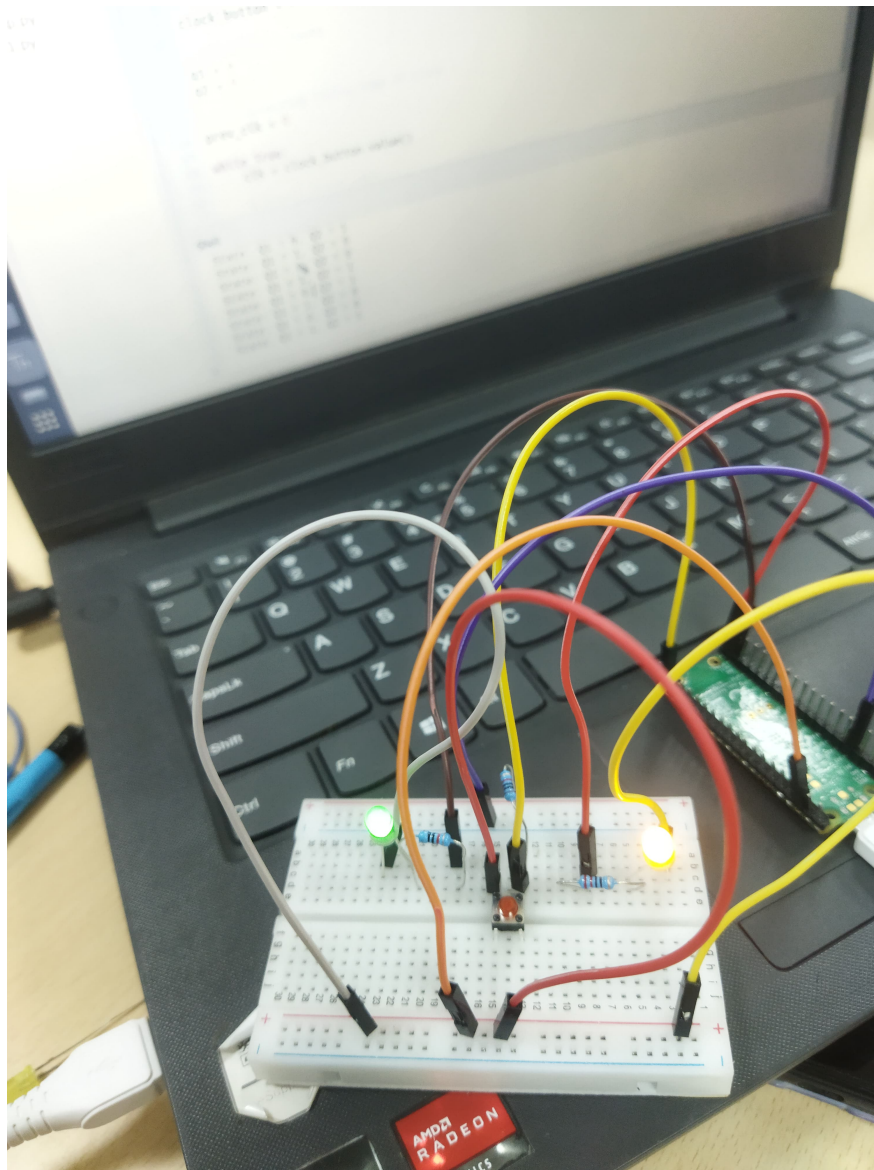


Figure: Real hardware setup using Pico2 W

6. Conclusion

This hardware implementation using Pico2W accurately simulates the JK flip-flop logic defined in GATE ECE 2009 Q39. The LED outputs reflect the correct 3-state sequence, and button input effectively acts as a manual clock pulse generator.

7. GitHub Code Link

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