Abstract

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

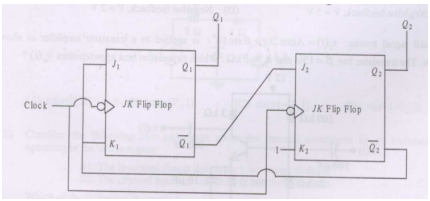

Figure: JK Flip-Flop logic diagram used in simulation

1. Components

Component	Qty
Raspberry Pi Pico W	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 $\rightarrow$ ...

5. Circuit Image

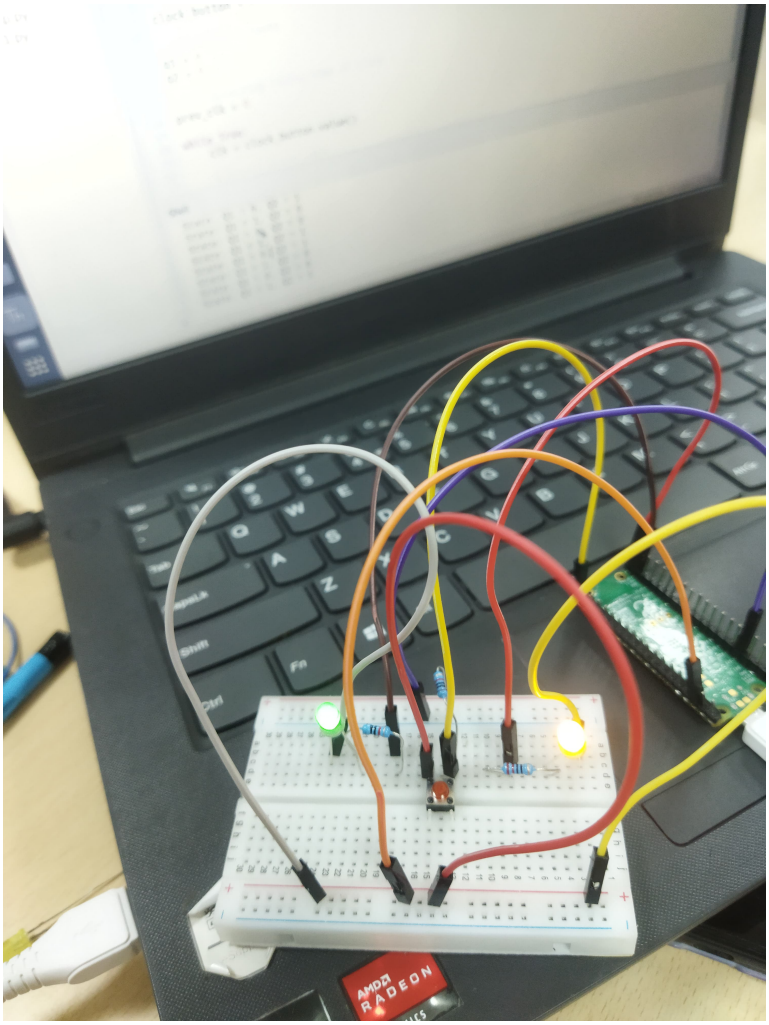

Figure: Real hardware setup using Raspberry Pi Pico W

6. Conclusion

This hardware implementation using Raspberry Pi Pico W 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/sathvi2710/fwc/tree/main/hardware`