VIETNAM NATIONAL UNIVERSITY, HO CHI MINH CITY
UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

COMPUTER ENGINEERING PROJECT (CO3004)

Renesas (VLSI Project 2021)

"BOUND FLASHER"

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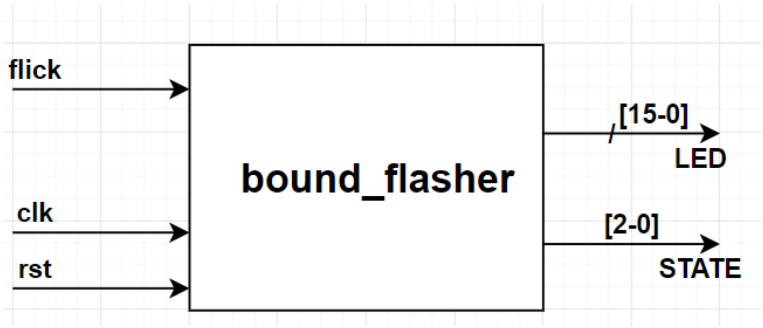
Contents

1 Interface



Signal	Type	Width	Description
flick	In	1	Asynchronous input signal to start the system or signal for kickback function
clk	In	1	Clock Signal, active high, pos edge
rst	In	1	Reset Signal, active low
LED	Out	16	LEDs status
S[0-6]	Out	3	States of the system

Figure 1: System and Signal description

2 Functional Implementation

- Create RTL code for the bound flasher with 16 LEDs
- System's Operation base on three input signal

- Reset
- Clock
- Flick

- System Operation :

- Clock signal is provided for system inspire of function status. The function operate state's transition at positive edge of the clock signal
- Reset signal:
  - LOW-ACTIVE Reset = 0: System is restarted to Initial State.
  - Reset = 1: System is started with initial state.

-States of the module :

- initial state, all lamps are OFF. If flick signal is ACTIVE, the flasher start operating:
- The lamps are turned ON gradually from LEDs [0] to LEDs [5].
- The LEDSs are turned OFF gradually from LEDs [5] to LEDs [0].
- The LEDSs are turned ON gradually from LEDs [0] to LEDs [10].
- The LEDSs are turned OFF gradually from LEDs [10] to LEDs [5]. LEDSs are turned ON gradually from LEDs [5] to LEDs [15].
- Finally, the LEDs s are turned OFF gradually from LEDSs [15] to LEDs [0], return to initial state.

-**Additional condition:** At each kickback point (LED[5] and LED[10]), if flick signal is ACTIVE, the lamps will turn OFF gradually again to the min lamp of the previous state, then continue operation as above description.

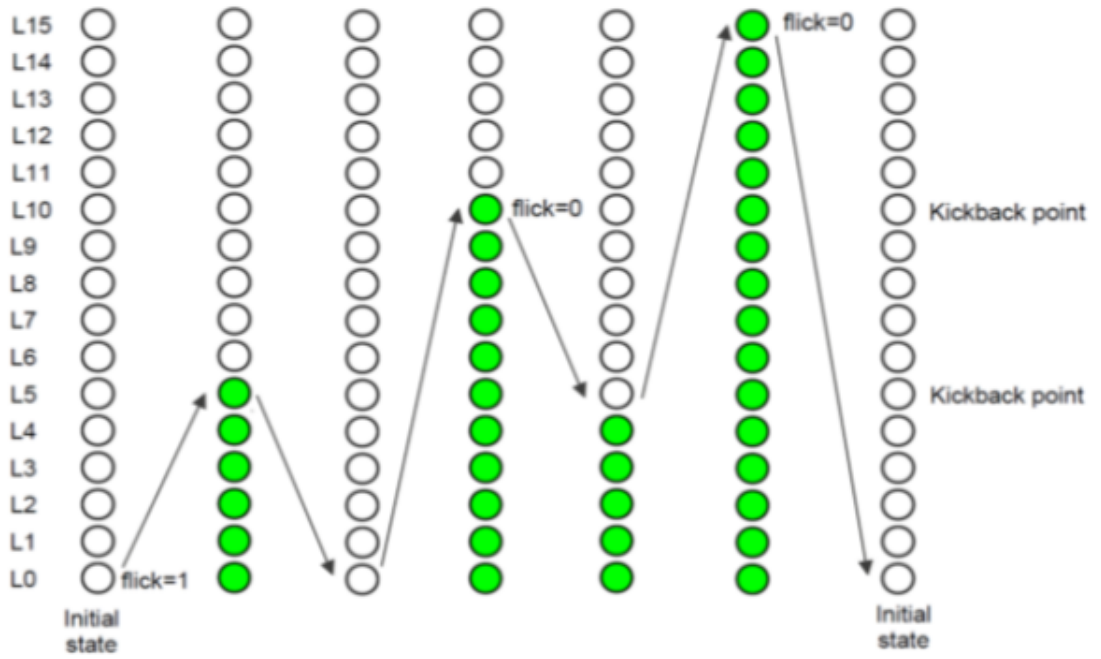


Figure 2: When flick =0 at kickback points

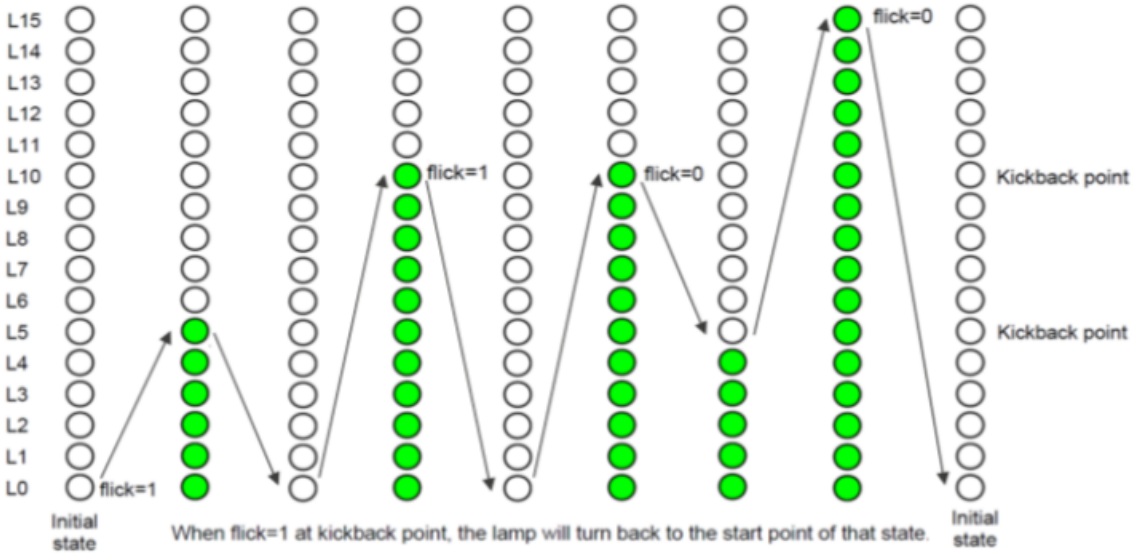


Figure 3: When flick=1 at kickback points (LED[10])

3 Internal Implementation

3.1 Block diagram

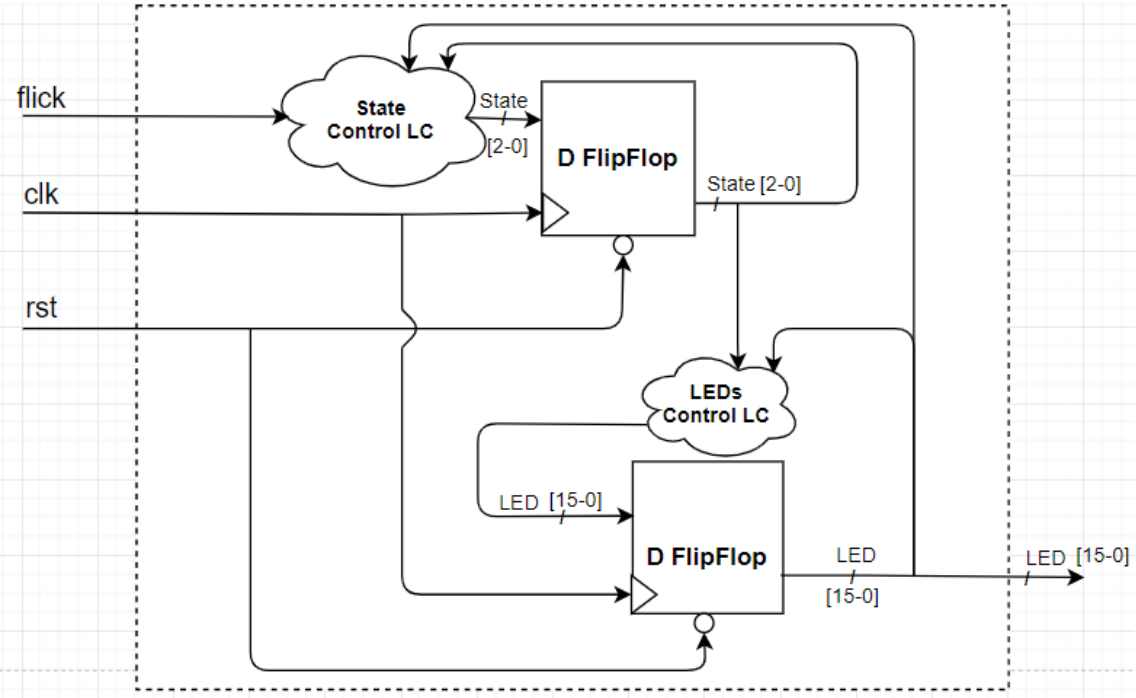


Figure 4: Block diagram

Block name	Function description
State Control LC	This block based on flick and current LED status to decide the State, which will display the LED.
LED Control LC	The block based on the State to turn on/off 16 LED to match each State.

Figure 5: Block Description

3.2 State Machine

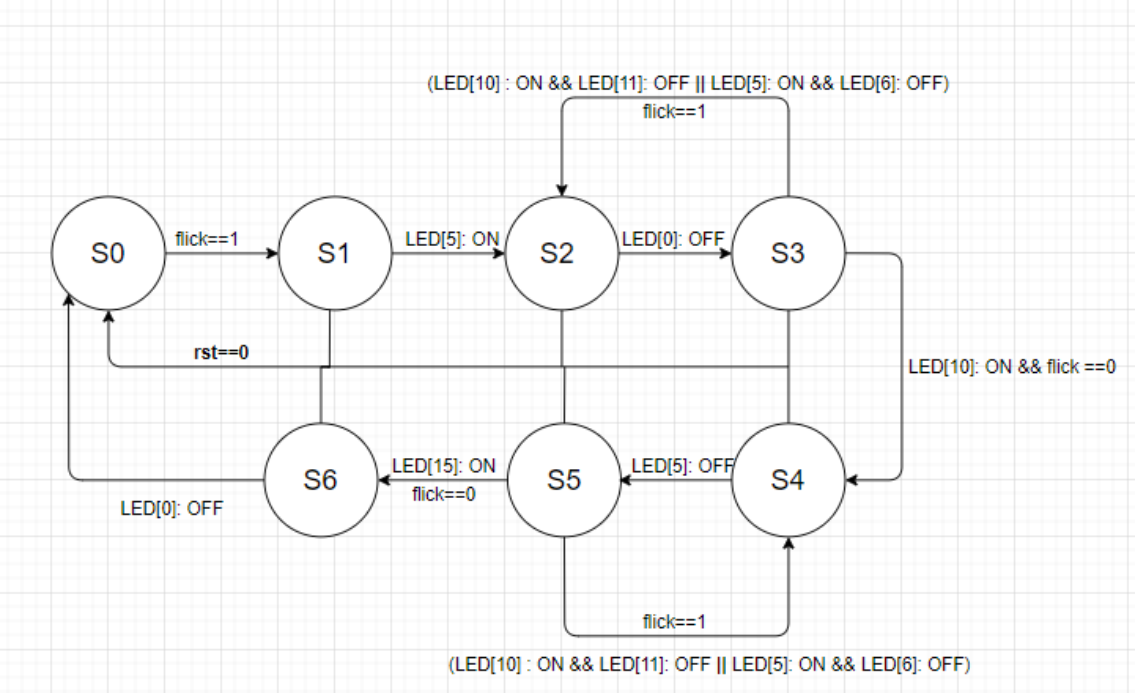


Figure 6: State Machine Diagram

Variable name	Description
rst	If reset = 0, the system will be reset immediately and return to the S0 state
flick	The input signal to start the system or check for kickback
LED[x]	The status of LED[x]

Figure 7: Variables Description

State	Description
S0	The initial state of the system, all LED are OFF, switchto **S1** if **flick == 1**
S1	Turn ON gradually until LED[5] : ON , then switch to **S2**
S2	Turn OFF all LED in order untill LED[0] : OFF, then switch to **S3**
S3	Turn on gradually from LED[0] to LED[10], then check for flick. If **flick == 0** go to **S4**. If **flick == 1** : + LED[10] : ON, LED[11] : OFF +LED[5] : ON, LED[6] : OFF Go back to **S2**.
S4	Turn off gradually from LED[10] to LED[5] then switch to **S5**
S5	Turn on the LED as normal flow, till LED[15] : ON then go to **S6** (if flick==0) If **flick == 1** then check for LED[5] and LED[10] as S3 then if happened go to **S4**
S6	Turn off gradually till LED[0] : OFF, then go to **S0**

Figure 8: State Explanation

4 History

Date of modify	Author	Modified section	Description
12/05/2021	Duc Le	First Created	None
01/06/2021	Duc Le	State Diagram, Block Diagram	Added diagrams
18/06/2021	Duc Le	Diagram and Figure, Functional requirements	Updated State diagram figure and description table. Update Block Diagram. Update new requirement.