RTL_EXERCISE_1 BOUND FLASHER

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RTL_Exercise1 Bound Flasher

Contents

1. Interface

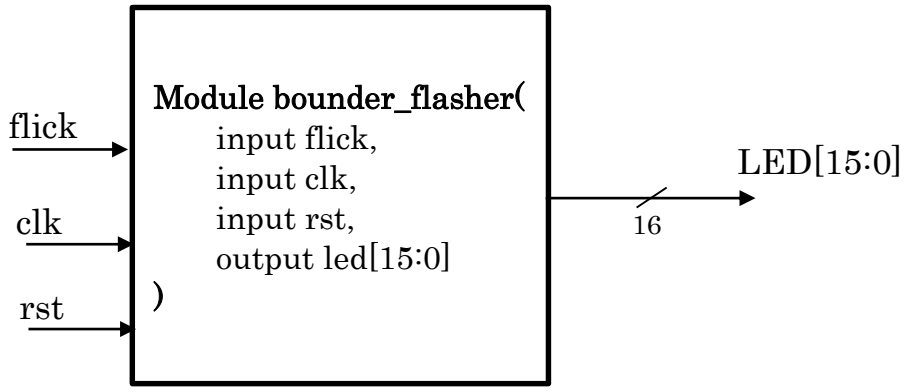


Figure 1: the figure of Bound Flasher System

Signal	Width	In/Out	Description
flick	1	In	When the output led turns on gradually, at LED[5] or LED[10] if the flick=1 the output will turn back to the previous state.
clk	1	In	Operate state's transition at the rising edge of the clock signal.
rst	1	In	When reset is high, return to initial state.
LED	16	Out	Led display depends on the state.

Table 1: Description of signals in Bound Flasher

2. Functional implementation.

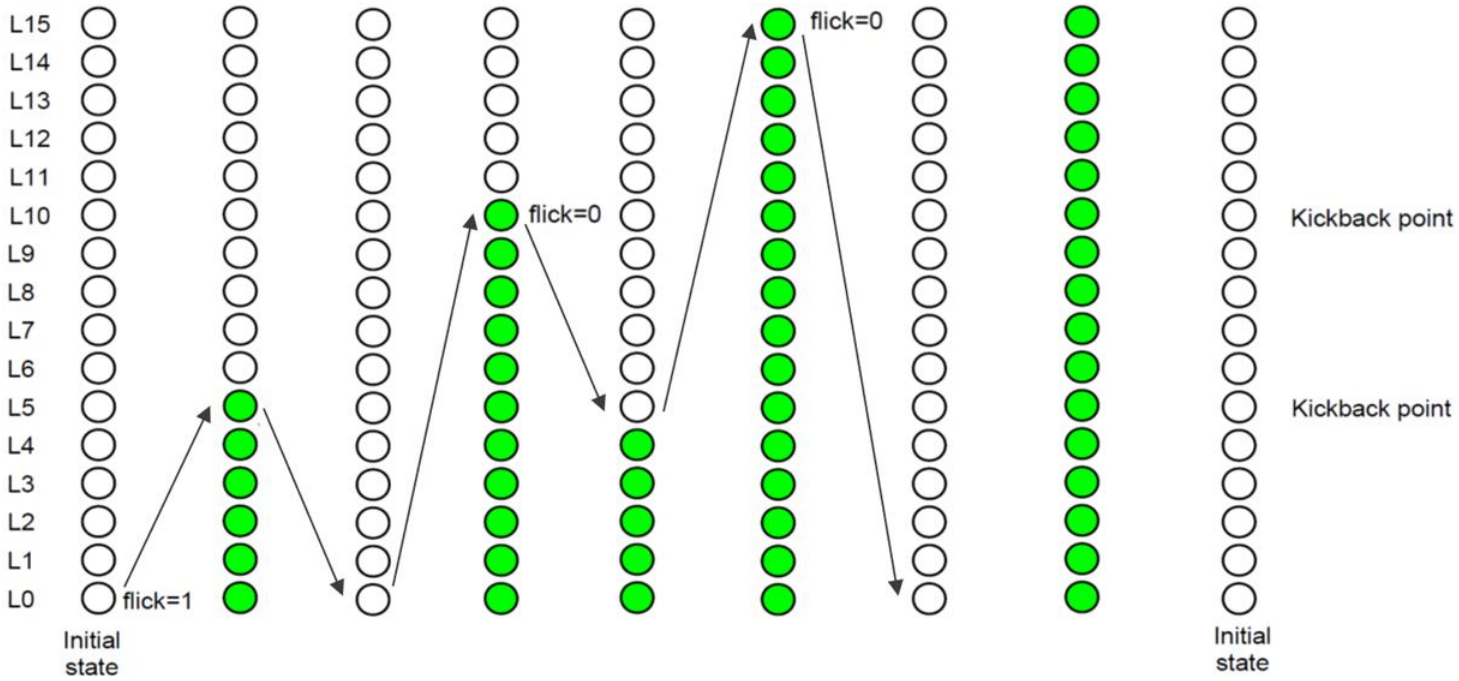
- Implement a 16-bits LEDs system
- System's Operation base on three input signal
  - Reset
  - Clock
  - Flick
- The system specification
  - Clock signal is provided for system inspire of function status. The function operate state's transition at positive edge of the clock signal.
  - Reset signal:
    - LOW-ACTIVE Reset = 0: System is restarted to Initial State.
    - HIGH-ACTIVE Reset = 1: System is started with initial state.
- Flick signal: special input for controlling state transfer.
- At the initial state, all lamps are OFF. If flick signal is ACTIVE, the flasher start operating:
  - The lamps are turned ON gradually from lamp[0] to lamp[5]**.**
  - The lamps are turned OFF gradually from lamp[5] **(max)** to lamp[0] **(min)**.
  - The lamps are turned ON gradually from lamp[0] to lamp[10].
  - The lamps are turned OFF gradually from lamp[10] **(max)** to lamp[5] **(min)**.
  - The lamps are turned ON gradually from lamp[5] to lamp[15].
  - The lamps are turned OFF gradually from lamp[15] to lamp[0].
  - Finally, the lamps are turned ON then OFF simultaneously (blink), return to the initial state.

Additional condition:

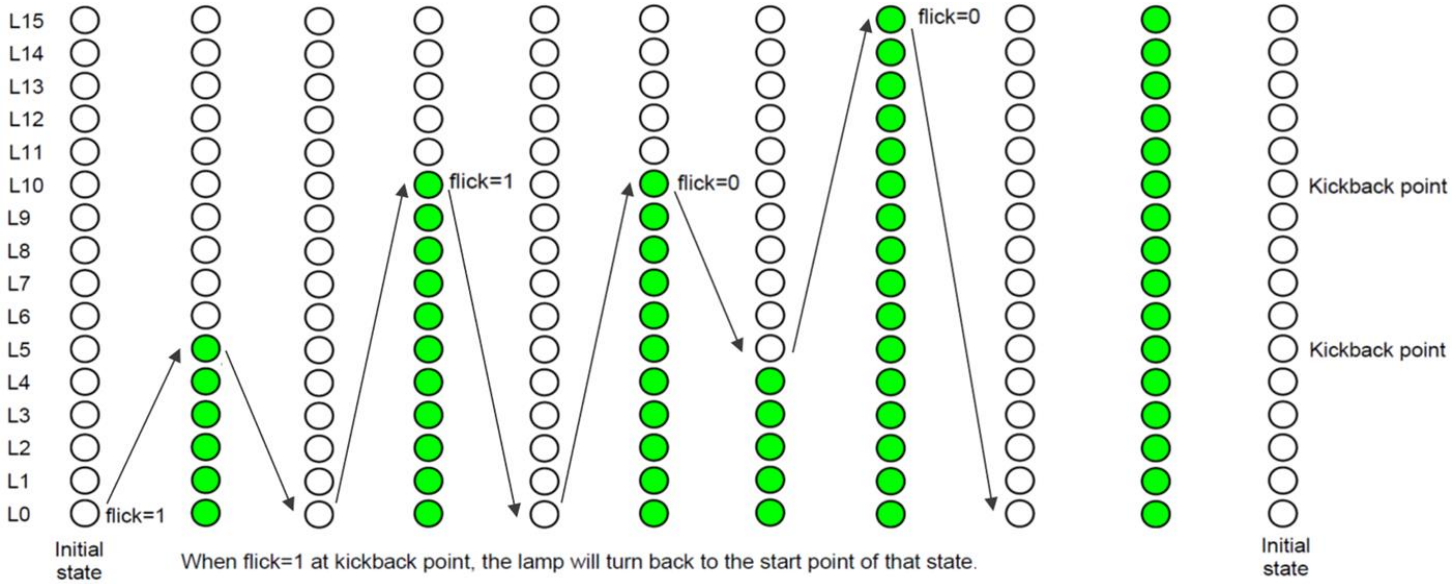
- At each kickback point (lamp[5] and lamp[10]), if flick signal is ACTIVE, the lamps will turn OFF gradually again to the **min** lamp of the previous state, then continue operation as above description.

For simplicity, kickback point is considered only when the lamps are turned ON gradually, except the first state.

- Some insulations:
  - When flick = 0 at kickback points



  - When flick = 1 at kickback points (lamp[10])



3. Internal implementation.

3.1. Overall.

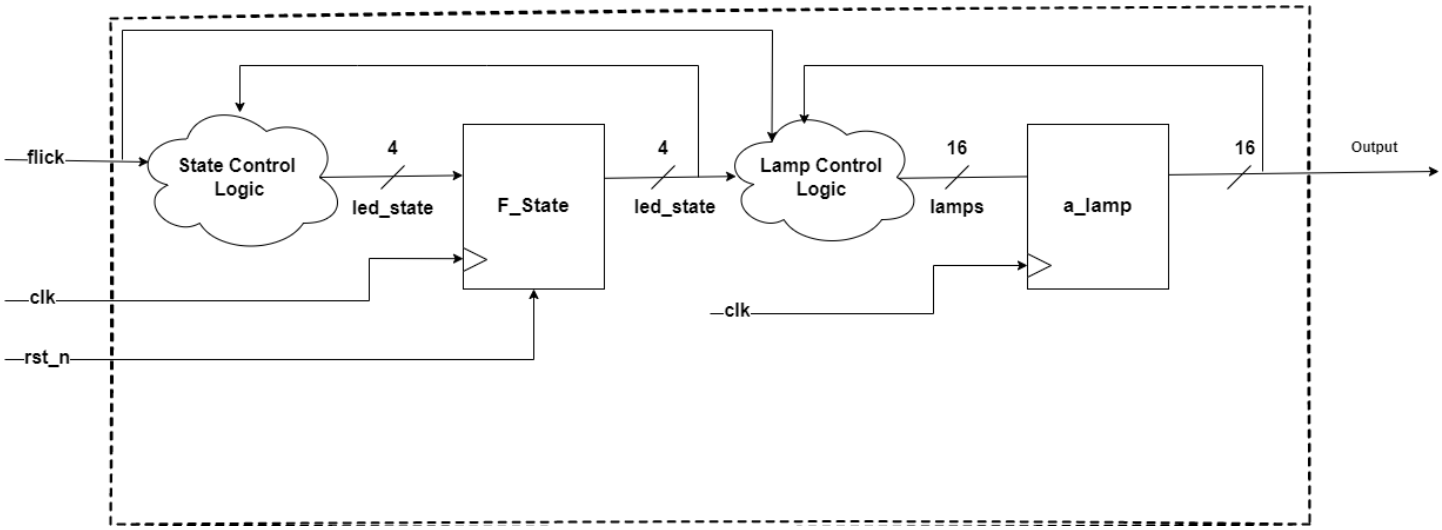


Figure 3.1: Block diagram of Bound Flasher

Element name	Element description
State control logic	Combinational logic block used to control the logic of the state, combining with the input, ie, when one state progresses to the next with the right input.
F_State	A flip flop used to control the states seen in the state machine in the following part.
Lamp control logic	Combinational logic block used to control which lights should be turned on or off during a particular state.
a_lamp	A flip flop used to control the actual lamps, with one clock cycle corresponding to one light being turned on or off.

Table 3.1: Block diagram of Bound Flasher Description

3.2. State Machine

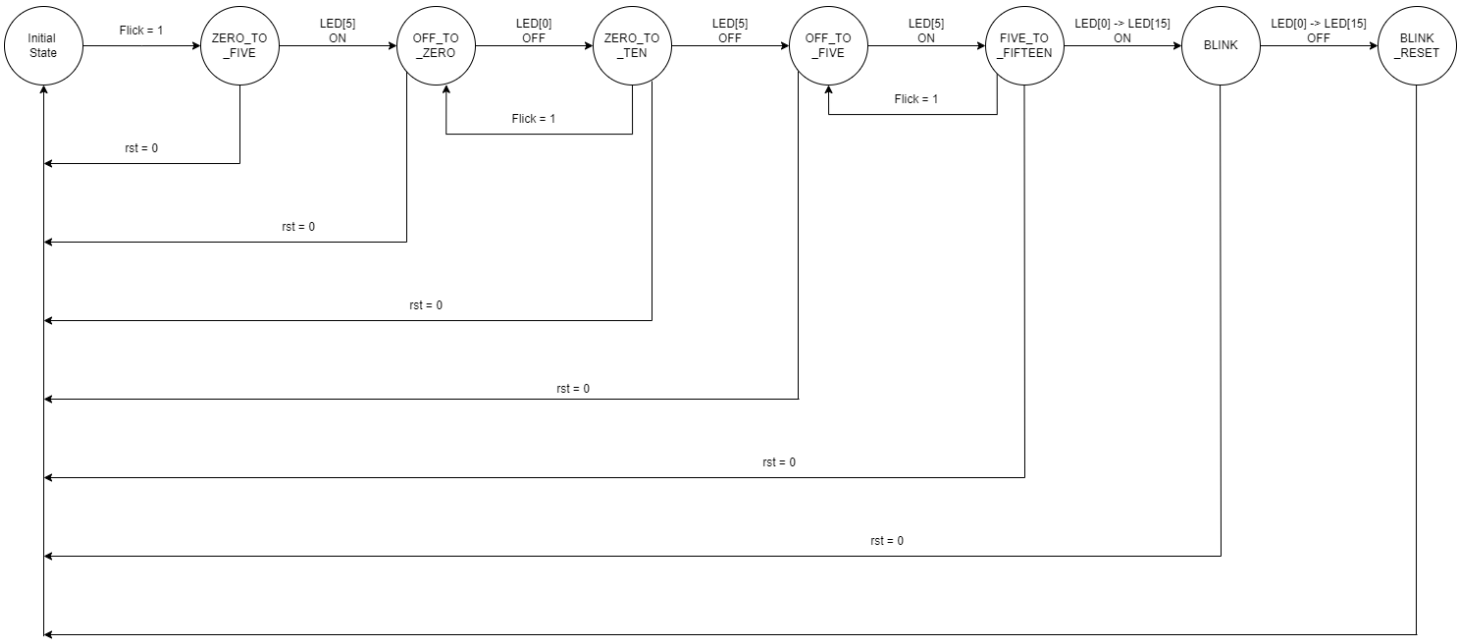


Figure 3.2: State Machine of Bound Flasher

Variable Name	Possible value
flick	Asynchronous input signal. At kickback points (LED[5] & LED[10]), if flick signal = 1, the LEDs will turn OFF gradually again to the **min** LED of the previous state.
LED	16-bit output, LED[0] is the Least Significant Bit, LED[15] is the Most Significant Bit

Table 3.2: Variable name of State machine

State Name	Explanation
Initial State	All LEDs are OFF (from LED[0] to LED[15]). If flick signal = 1 then moving to **State ZERO_TO_FIVE**.
ZERO_TO_FIVE	The LEDs are turned ON gradually from LED[0] to LED[5], then moving to **State OFF_TO_ZERO**.
OFF_TO_ZERO	The LEDs are turned OFF gradually from LED[5] to LED[0]. If LED[0] is OFF then moving to **State ZERO_TO_TEN.**
ZERO_TO_TEN	The LEDs are turned ON gradually from LED[0] to LED[10]. When LED[5] is ON, flick signal =1 but LED[6] is OFF, then moving back to **State OFF_TO_ZERO.** If (LED[10] is ON && flick signal = 0) then moving to

	State OFF_TO_FIVE. Otherwise, if (LED[10] is ON && flick signal = 1) then moving to **State OFF_TO_FIVE.**
OFF_TO_FIVE	The LEDs are turned OFF gradually from LED[10] to LED[5]. If LED[5] is OFF then moving to **State FIVE_TO_FIFTEEN**.
FIVE_TO_FIFTEEN	The LEDs are turned ON gradually from LED[5] to LED[15]. If (LED[5] is ON && LED[6] is OFF) and flick signal = 1 then moving to **State OFF_TO_FIVE**. If (LED[15] is ON && flick signal = 0) then moving to **State BLINK**
BLINK	The LEDs are turned ON immediatelly from LED[0] to LED[15] then moving to **State BLINK_RESET**.
BLINK_RESET	The LEDs are turned OFF immediatelly from LED[15] to LED[0] then moving to **State Initial State**.

Table 3.3: State name of State machine

4. History

Date	Author	Modified part	Description
2020/02/22	Gia Huy	Design & Textbench	Complete the source code
2022/03/01	Gia Huy	Word, excel	Complete the report