RTL_EXERCISE_1 BOUND FLASHER

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RTL_Exercise1 Bound Flasher

Contents

1. Interface

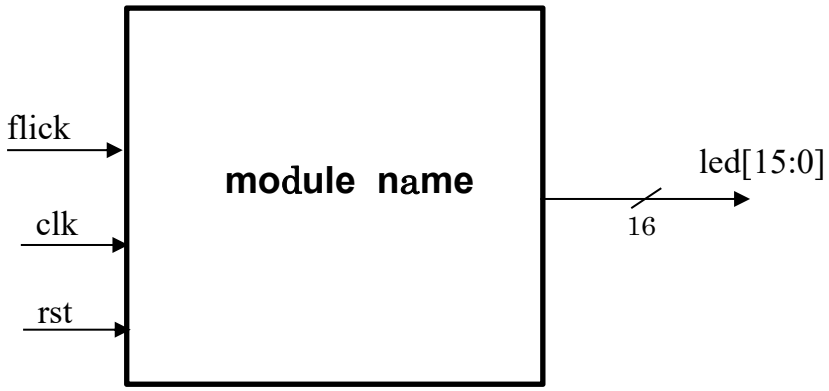


Figure 1: the figure of Bound Flasher System

Signal	Width	In/Out	Description
flick	1	In	Consider going back to previous min led state when at kickback point. Positive level triggering
clk	1	In	Positive edge triggering Clock signal.
rst	1	In	Positive edge triggering Turn off all leds
led	16	Out	The state of LEDs [0:15] Active indicates led on, otherwise indicates led off

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.

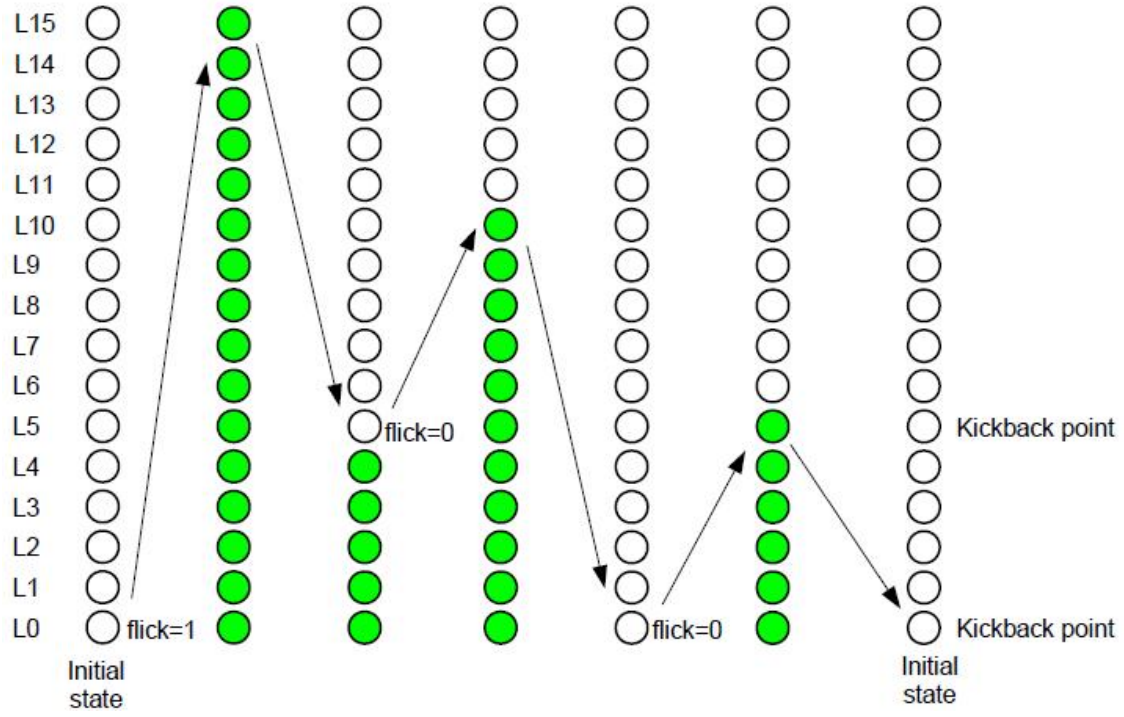
–At the initial state, all lamps are OFF. If flick signal is ACTIVE, the flasher start operating:

- The lamps are turned ON gradually from LEDs [0] to LEDs [15].
- The LEDSs are turned OFF gradually from LEDs [15] to LEDs [5].
- The LEDSs are turned ON gradually from LEDs [5] to LEDs [10].
- The LEDSs are turned OFF gradually from LEDs [10] to LEDs [0].
- The LEDSs are turned ON gradually from LEDs [0] to LEDs [5].
- Finally, the LEDs s are turned OFF gradually from LEDSs [5] to LEDSs [0], return to initial state.

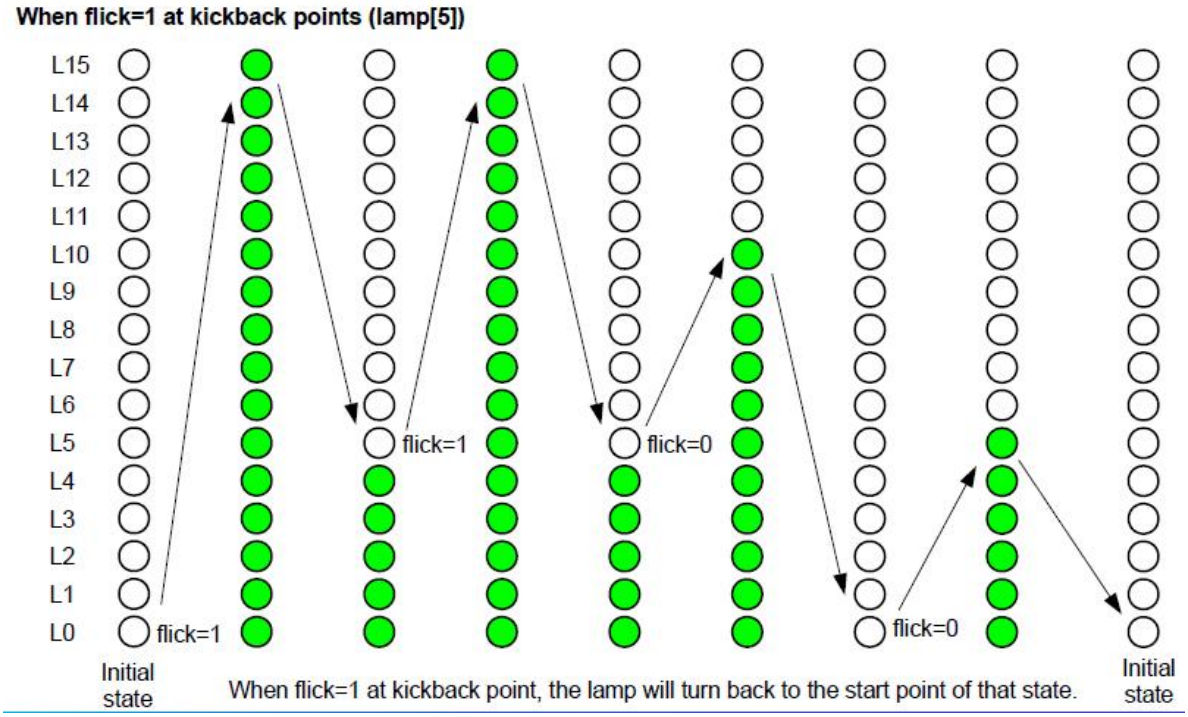
–Additional condition: At each kickback point (LEDs [5] and LEDs [0]), if flick signal is ACTIVE, the LEDs will go back and repeat that STATE. For simple, kickback point is considered only when the LEDs s are turned OFF gradually, except final state.

–Some insulations:

•When flick = 0 at kickback points



•When flick = 1 at kickback points (lamp[5])



3. Internal implementation.

3.1. Overall.

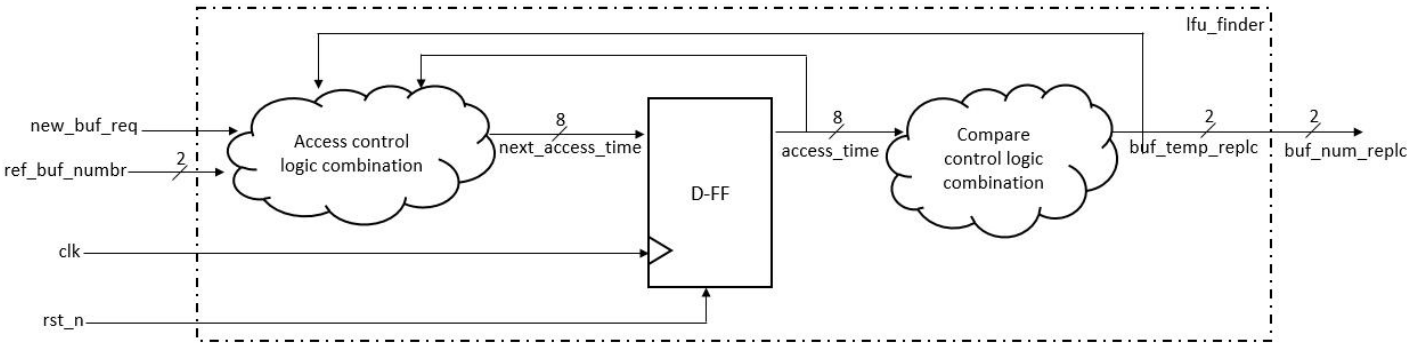


Figure 3.1: Block diagram of Bound Flasher

Block diagram	Type	Width	Description
State control logic combination	Combinational logic	16	There are sequences of logic states. Each state describes the status of current lamps based on the value of flick.
Lamp control logic combination	Combinational logic	16	The block diagram based on the current state to display the status of 16 LEDs' signals and their changeable direction.
flick	Input	1	Positive level triggering. Consider going back to previous min led state when at kickback point.
rst	Input	1	Positive edge triggering. Turn off all leds.
clk	Input	1	Positive edge triggering Clock signal
led	Output	16	The state of LEDs[0:15]. Active indicates led on, otherwise indicates led off.

Table 3.1: Block diagram of Bound Flasher Description

3.2. State Machine

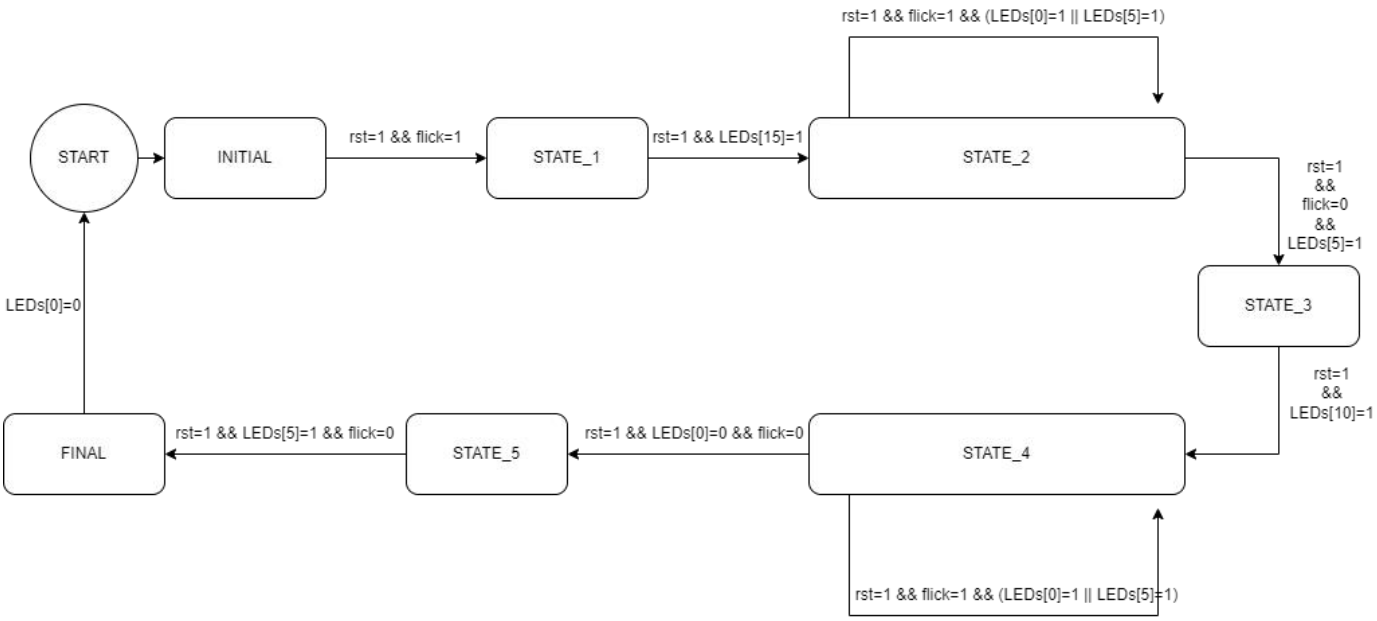


Figure 3.2: State Machine of Bound Flasher

Variable name	Description
rst	Asynchronous signal input. When rst = 0, the state will return to the initial state.
flick	When the output (led) is turned OFF (=0) gradually, at LEDs[5] or LEDs[0], if flick = 1, the LEDs will go back and repeat that STATE
LEDs	16 bits output represents 16 lamps. LEDs[0] is the LSB and LEDs[15] is the MSB.

Table 3.2: Variable name of State machine

State name	Description
INITIAL	All LEDs is OFF (16 bits output = LED[0:15] = 0). If flick = 1, then state will change to STATE_1.
STATE_1	The lamps are turned ON gradually from LEDs[0] to LEDs[15]. If reset = 0, the state will return to INITIAL. If LEDs[15] is ON, the state will change to STATE_2.

STATE_2	The LEDSs are turned OFF gradually from LEDs[15] to LEDs[5]. If reset = 0, the state will return to INITIAL. If (flick=1 and LEDs[5]=1) or (flick=1 and LEDs[0]=1), the LEDs will go back and repeat that STATE. Else, if LEDs[5] is ON, the state will change to STATE_3.
STATE_3	The LEDSs are turned ON gradually from LEDs[5] to LEDs[10]. If reset = 0, the state will return to INITIAL. If LEDs[15] is ON, the state will change to STATE_4.
STATE_4	The LEDSs are turned OFF gradually from LEDs[10] to LEDs[0]. If reset = 0, the state will return to INITIAL. If (flick=1 and LEDs[5]=1) or (flick=1 and LEDs[0]=1), the LEDs will go back and repeat that STATE. Else, if LEDs[0] is OFF, the state will change to STATE_5.
STATE_5	The LEDSs are turned ON gradually from LEDs[0] to LEDs[5]. If reset = 0, the state will return to INITIAL. If LEDs[5] is ON, the state will change to STATE_4.
FINAL	The LEDs are turned OFF gradually from LEDSs[5] to LEDSs[0], If LEDs[0] is OFF, the state will return to initial state.

Table 3.3: State name of State machine

4. History

Date	Author	Modified part	Description
2023/02/15		All	New creation
2023/02/18		Interface	Description of signals in Bound Flasher
2023/02/22		Functional implementation	Input, Output
2023/02/26		State machine + Block diagram	Decribe in detailed state machine and block diagram