

RTL_EXERCISE_1 BOUND FLASHER

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1. Interface

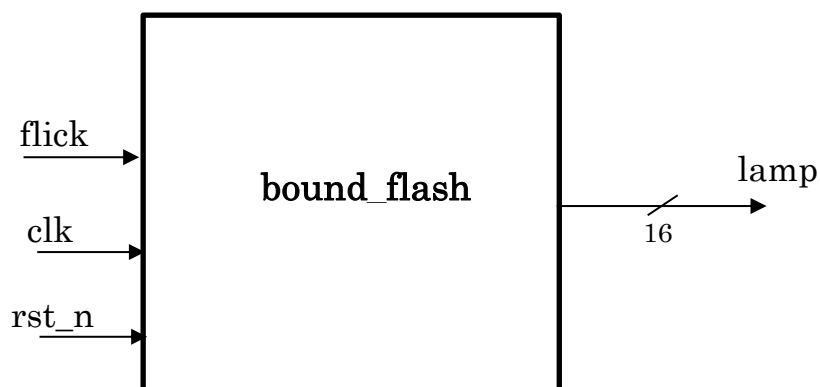


Figure 1: the figure of Bound Flasher System

Signal	Width	In/Out	Description
clk	1	In	Clock signal – Active High. The state of system is operated at positive edge of the clock signal
rst_n	1	In	Reset signal – Active Low. The system will return to initial state when rst_n = 0.
flick	1	In	Flick signal. To start the system or return to previous state.
lamp	16	Out	Output 16 lamp.

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 (set 1), the flasher start operating:

1. The lamps are turned ON gradually from lamp[0] to lamp[5].
2. The lamps are turned OFF gradually from lamp[5] (**max**) to lamp[0] (**min**).
3. The lamps are turned ON gradually from lamp[0] to lamp[10].
4. The lamps are turned OFF gradually from lamp[10] (**max**) to lamp[5] (**min**).
5. The lamps are turned ON gradually from lamp[5] to lamp[15].
6. Finally, the lamps are turned OFF gradually from lamp[15] to lamp[0], return to initial state.

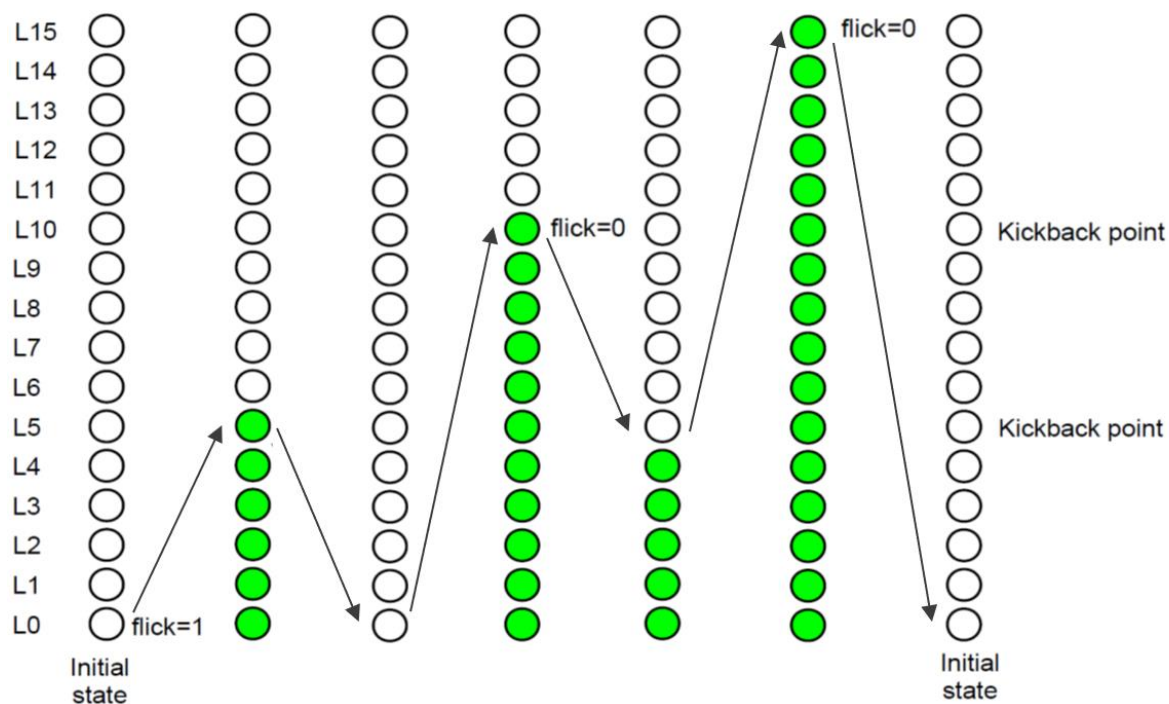
Additional condition:

- 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.

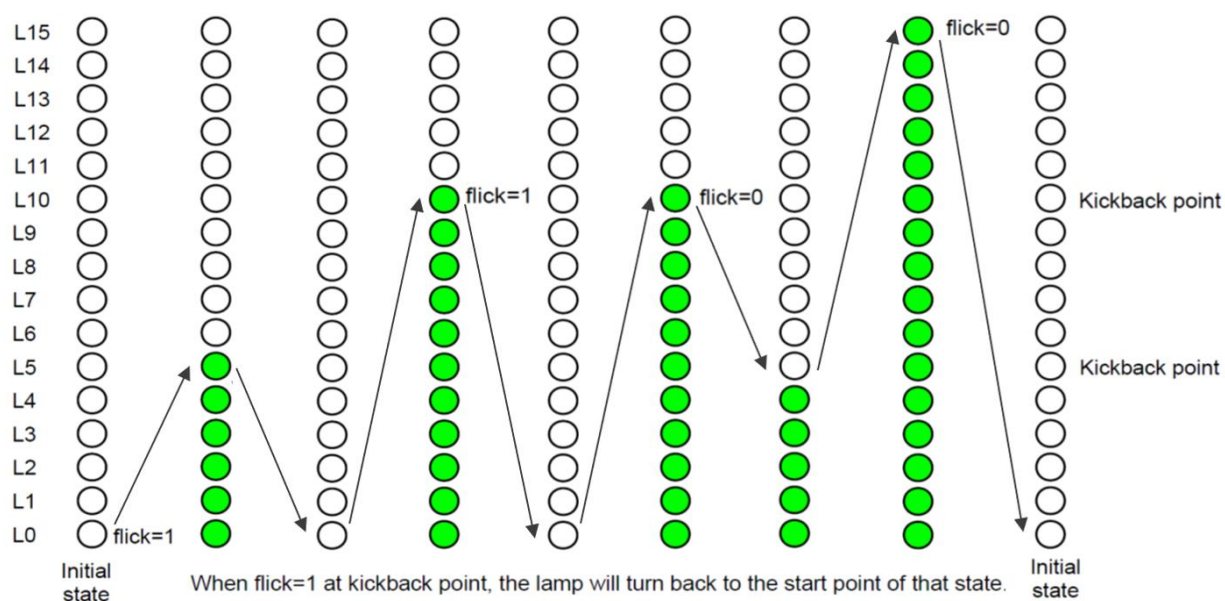
For simple, kickback point is considered only when the lamps are turned ON gradually, except the first state.

– Some insulations:

- When flick = 0 at kickback points



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



3. Internal implementation.

3.1. Overall.

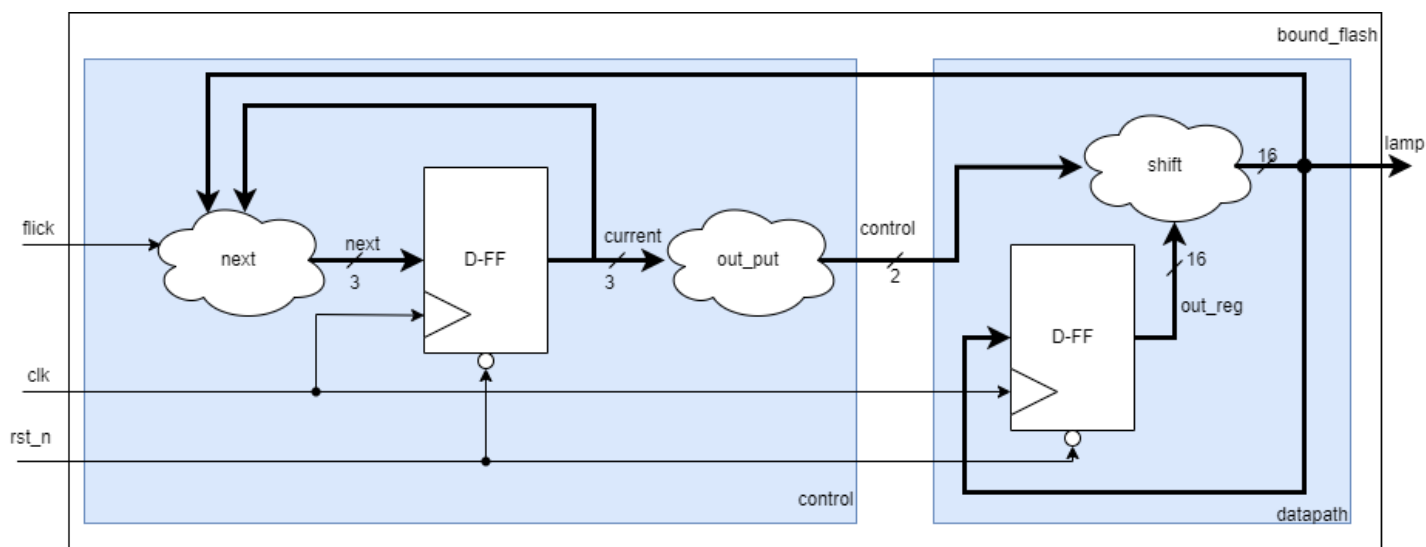


Figure 3.1: Block diagram of Bound Flasher

Signal	Width	In/Out	Description
clk	1	In	Clock signal – Active High.
rst_n	1	In	Reset signal – Active Low.
flick	1	In	Flick signal.
lamp	16	Out	Output 16 lamp.

Table 3.1: Block diagram of Bound Flasher Description

3.2. State Machine

When $\text{rst_n} == 1'b0$, current state of state machine will change state to INIIT.

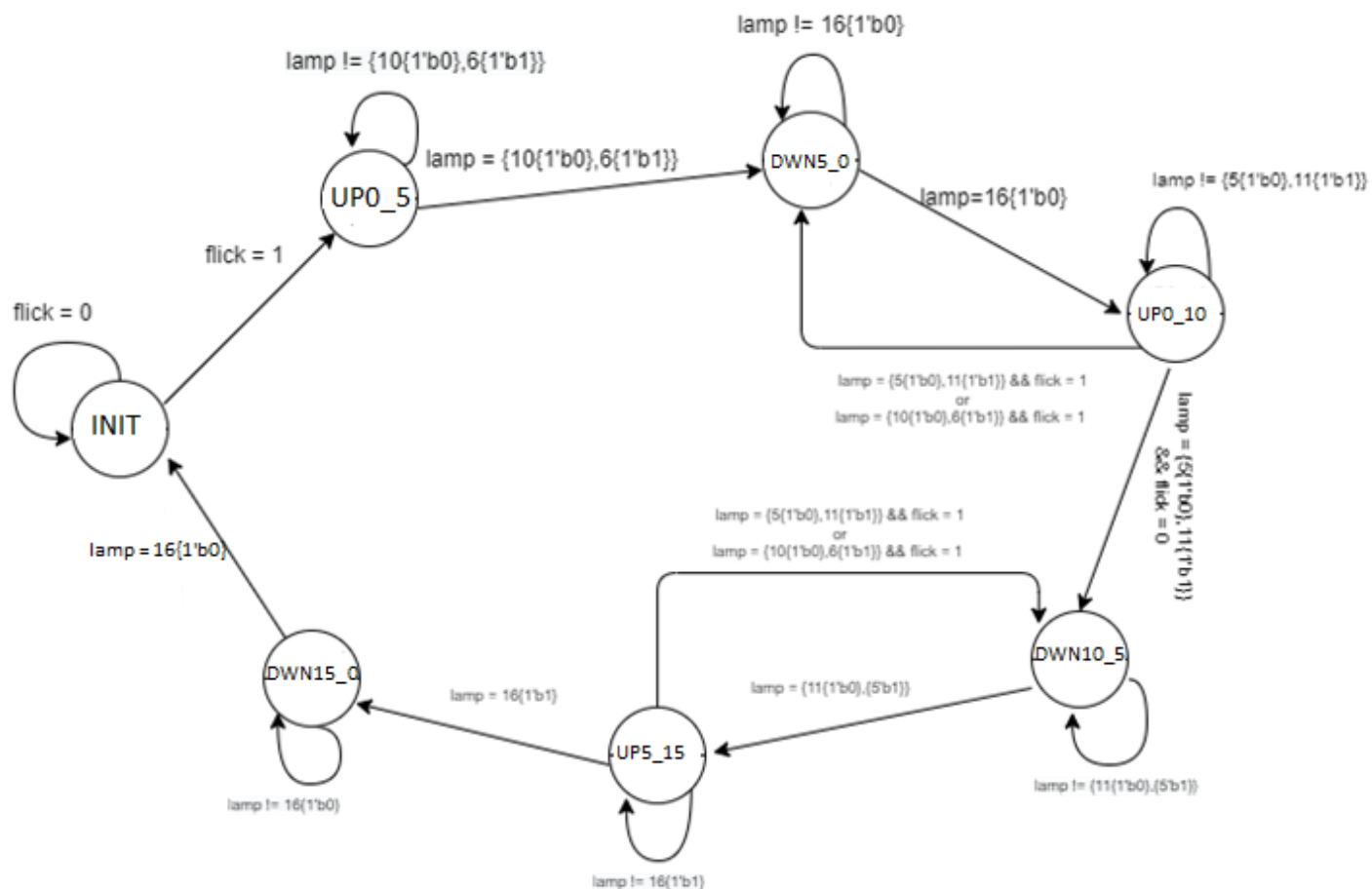


Figure 3.2: State Machine of Bound Flasher

Signal	Width	In/Out	Description
flick	1	In	Flick signal. To start the system or return to previous state.
lamp	16	In	Value of lamp to determine state lamp turn on or turn of.

Table 3.2: variable name of State machine

State name	Description
INIT	This is initial state of bound_flasher. At this state, all the lamps will be 0.
UP0_5	This state is when lamps turn on gradually from 16'b 0000_0000_0000_0001 to 16'b 0000_0000_0011_1111.
DWN5_0	This state is when lamps turn off gradually from 16'b 0000_0000_0011_1111 to 16'b 0000_0000_0000_0000.
UP0_10	This state is when lamps turn on gradually from 16'b 0000_0000_0000_0001 to 16'b 0000_0111_1111_1111.
DWN10_5	This state is when lamps turn off gradually from 16'b 0000_0111_1111_1111 to 16'b 0000_0000_0001_1111.
UP5_15	This state is when lamps turn on gradually from 16'b 0000_0000_0011_1111 to 16'b 1111_1111_1111_1111.
DWN15_0	This state is when lamps turn off gradually from 16'b 1111_1111_1111_1111 to 16'b 0000_0000_0000_0000. Then back to INIT state.

Table 3.3: state name of State machine

4. History

Date	Author	Modified part	Description
2022/11/8	Nguyễn Tấn Thiên	All	New creation
2022/12/3	Nguyễn Tấn Thiên	State machine	Diagram of state machine.
		Internal implementation	Block diagram of bound_flash.
		Interface	Change name of interface.