

# Digital System Design using HDL Lab Report

Experiment 5  
Structural vs behavioural description  
Pattern detector

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## 2 Pattern Detector

A Pattern Detector for pattern 101 is a digital circuit or system specifically designed to identify the binary sequence "101" occurrence in an incoming data stream. This type of detector monitors the stream of bits, checking each bit in sequence, and when the pattern "101" appears in the data, the detector triggers a response. The detector's operation is based on a state machine or a set of logic gates that process the incoming bits individually. The detector shifts through the stream and compares the current bits with the pattern, storing intermediate states to identify when "101" occurs in the correct order.

The pattern detector uses a finite state machine (FSM) approach in a typical implementation. The FSM has several states, each representing part of the "101" sequence that has been detected so far. Initially, the detector is in a starting state, waiting for the first bit of the pattern (a "1") to arrive. Once a "1" is detected, the system moves to the next state, waiting for a "0." If the "0" follows, it transitions to the next state, waiting for the final "1." If all three bits match in the correct order, the detector outputs a signal, indicating that the pattern "101" has been detected. If the sequence is interrupted by any other bit pattern, the FSM resets, and the detection process starts over from the beginning.

Such a pattern detector is useful in applications where detecting specific bit sequences is required, such as in data synchronization, error detection, or digital communication systems, where certain patterns are used to signify important information or trigger certain actions.

### 2.1 Structural implementation

Structural implementation was done using three D-flipflops as shown in figure 4. The output is shown in figure 5.

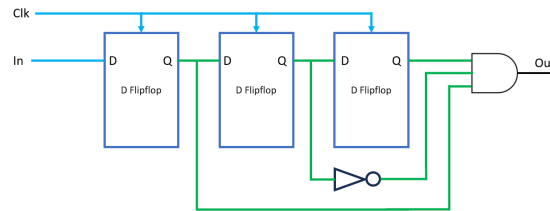


Figure 4: Pattern detector

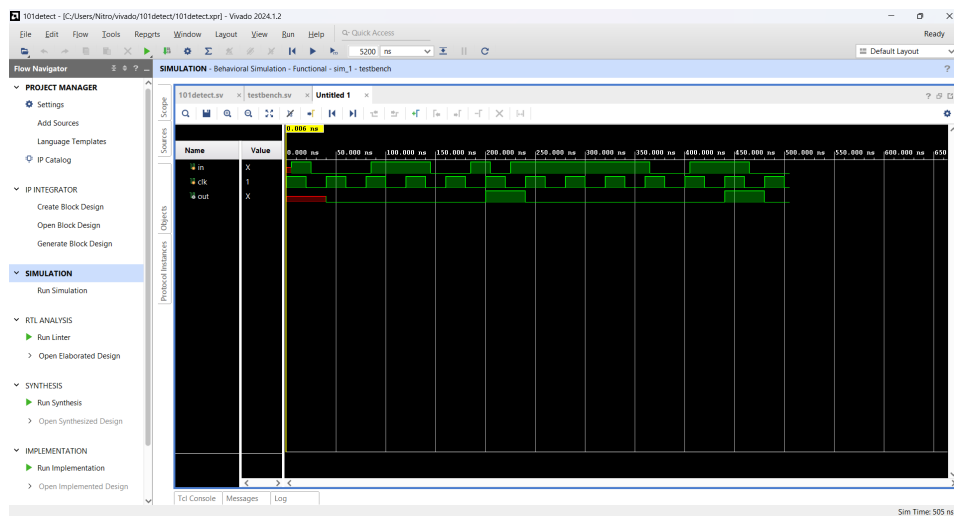


Figure 5: Pattern detector: Structural implementation output

## 2.2 Behavioural modelling

Behavioural modelling was performed, and the output shown in Figure 6 was obtained.

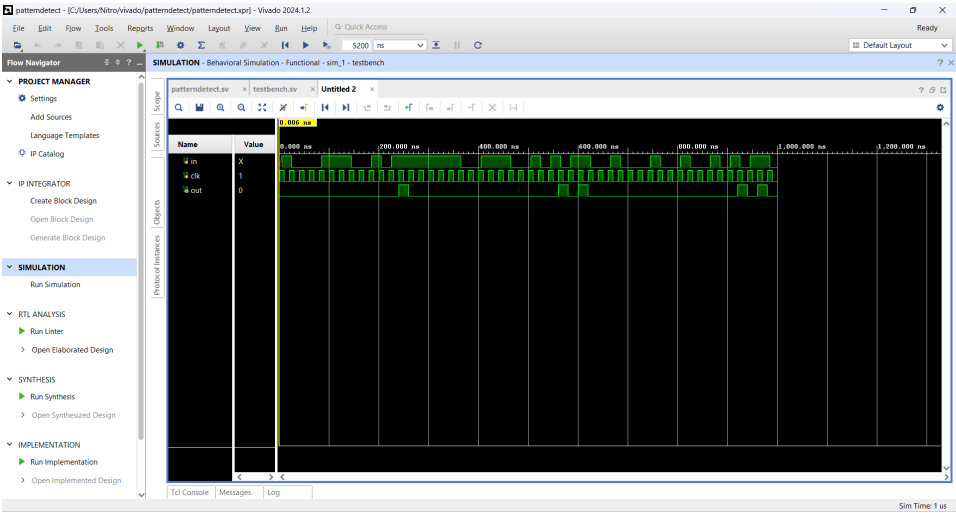


Figure 6: Pattern detector: Behavioural implementation output