ESKİŞEHİR TECHNICAL UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EEM 334 - Digital Systems II

LAB6 – SEQUENTIAL

DESIGN II

ROTATING SQUARE

1. PURPOSE

In this laboratory, you will design single input parallel output bidirectional shift register. Input of this shift register is connected to output bit. So, it maintains rotate operation.
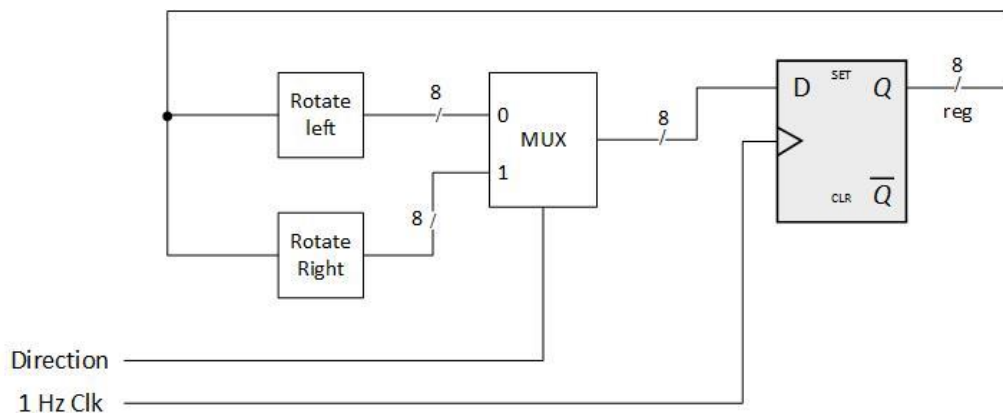

Figure 1: Block Diagram

According to output of this shift register, you will implement rotating squares on seven segments.
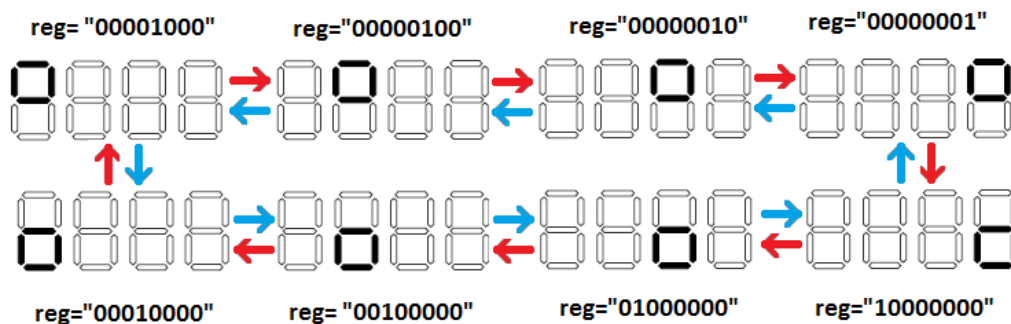

Figure 2: Pattern For Rotating Squares

2. BACKGROUND

Shift registers produce a discrete delay of a digital signal or waveform. A waveform synchronized to a clock, a repeating square wave, is delayed by "n" discrete clock times, where "n" is the number of shift register stages. Thus, a four stage shift register delays "data in" by four clocks to "data out". The stages in a shift register are delay stages, typically type "D" Flip-Flops.

Basic shift registers are classified by structure according to the following types:
- Serial-in/serial-out
- Parallel-in/serial-out
- Serial-in/parallel-out
- Universal parallel-in/parallel-out
- Ring counter
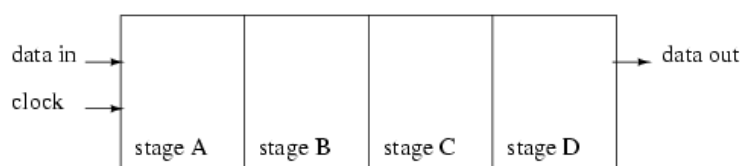
Serial-in, serial-out shift register with 4-stages

Ring Counter, shift register output fed back to input
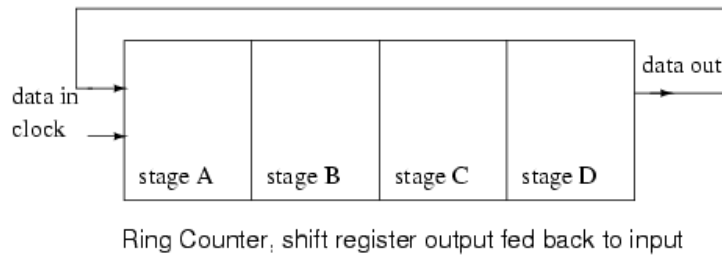
3. PROCEDURE

Firstly, you must change or rewrite seven_four.vhd. This code is used to show numbers (0, 1, …, 9) on seven segments. At this time, seven segments will show squares. Inputs in1, in2, in3 and in4 can be reduced 4 bits to 2 bits since there are three conditions (up square, down square or none of them).

Then, you have to design 8 bits shift register given in Figure 1. Set bit of this register will show current position of square. You will decide inputs of seven_four component according to this register.

Rotating square circuit must have following properties.

- It has 3 inputs. (Clock, enable and direction).
- 1 Hz clock must be implemented from 100 MHz input clock.
- Direction determines direction of the rotation. It can be clockwise or counterclockwise.
- Initial value of shift register is "00000001"
- When enable is set, rotation will begin. If it is disabled, square will remain at its current position.

Steps:

1. Implement the code.
2. Create UCF file. Connect enable and direction to switches. Connect corresponding seven segment pins.
3. Load the design to FPGA.
4. Verify results and show them to your assistant.
5. Wait for task.

Hints:

- You can use the clock which you implemented in previous laboratory.
- For shift register, you are free to use rol and ror operator. The IEEE.numeric_std library will need to be accessed for these functions. If you don't want to use this operators you can take input to a signal and concatenate it.