ECE 1315 DIGITAL LOGIC DESIGN

ECE Dept, UMD
April 25, Tuesday, 2006

EXPERIMENT # 12: Electric Wheel of Fortune

The purpose of this experiment is to learn about the usages of counters. In this lab, you will emulate a sort of an electric wheel that rotates numbers 0, 1, 2, ..., 59, and then when you press a switch, the rotating number stops at a random position creating the effect of "wheel of fortune." For counters, you will use two BCD counters, 74LS192. You should notice that a similar design can lead to designing a clock or a stop watch by just adding a few more components.

Experiment #12 Results

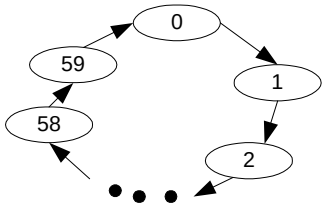
Your Name: _____

Witnessed by Instructor or TA: _____

Date _____

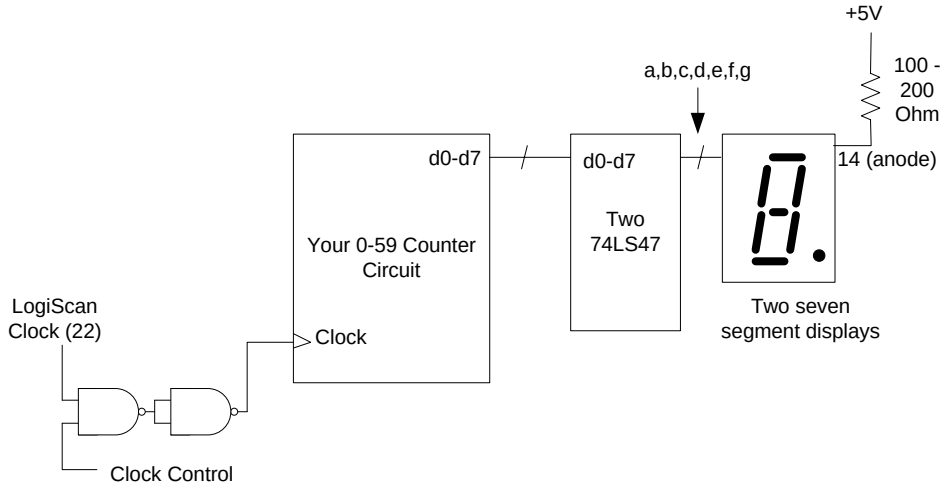
The main components you will need for this experiment are two seven-segment displays, two BCD to seven-segment decoders (74LS47), two BCD counters (74LS192), two 200 Ohm resisters, and one 4.7K Ohm resister. Get these parts with the help of TA. For the pin outs, please refer to the data sheet section attached at the end of this result section.

1. Design and build an up counter that cycles through (0, 1, 2, ... , 59) by cascading two BCD counters and loading a proper number. To simplify the design, you will let the counter start from 0, but it can be easily modified to start from 1 or any other number. The count 59 should trigger loading of 00 or clear.

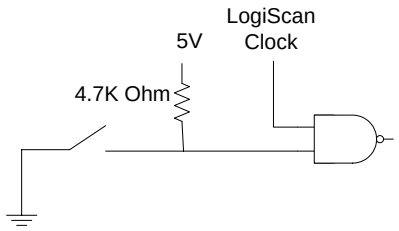


Your circuit should cycle through these sequences as long as the clock signal is applied. Connect the clock and the counter outputs to the LogiScan F0-F5 (6-bits for testing) and confirm the proper counting.

2. Add the seven-segment display circuits to the state outputs of your counter circuit as shown below.



The clock control is designed using the following circuit.



No physical switch is used for the above circuit. The switching effect is created by physically connecting and disconnecting the wire end. The switch should normally stay open. The circuit works as follows. When the switch is open, the gate receives 5V through the 4.7 Ohm resister. This type of resistor usage is called a pull-up resistor and has two purposes. First, it supplies Logic 1. Second, it prevents the dangerous 0 to 5V short circuit when the switch is closed. Going back to the circuit, the logic one in the clock-control input allows the LogiScan clock signal to pass through the NAND gate. Notice that the counter needs this clock to count. On the other hand, when the switch is closed, the NAND gate receives 0V from the ground. This logic-0 fixes the output of the NAND gate to logic-1 regardless of the LogiScan Clock input, which results in a stoppage of the counting.

For the connection of two seven-segment LED displays, please refer to the data sheet attached at the end. It is important to remember to connect a 200 ohm resister to each seven-segment display through the anode (pin 14). The power is supplied through this pin, but it needs a small resister to prevent from short-circuit and burning of LEDs.

Experiment with the different rates of clock speeds to emulate the effect of a spinning wheel. Find just about the right speed that will emulate a spinning wheel. Test stopping of the wheel by manually closing the switch. If it stops at a random number between 0-59 and the seven-segment display displays the random number, your circuit is working properly.

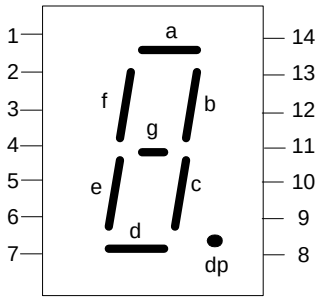
3. If the circuit works as intended, please show the result to your TA and have him sign.

--- Congratulations!!! There will be no more labs in this semester. You have successfully completed the last ECE 1315 Lab, which would be one of the milestones in learning the digital world. Hope you have enjoyed the design experiences of digital logic circuits, and wishing you the best and continuous successes in your future. --- Prof. Taek Kwon

Data Sheet

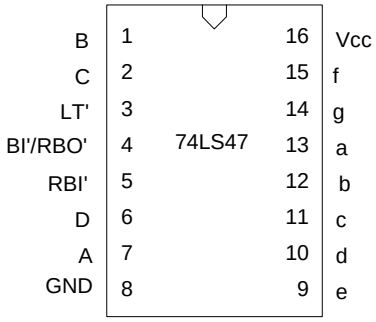
Seven-Segment Common-Anode LED Display

Pin	Description
1	Cathode a
2	Cathode f
3	Anode
4	No Pin
5	No Pin
6	No Pin
7	Cathode e
8	Cathode d
9	Cathode dp
10	Cathode c
11	Cathode g
12	No Pin
13	Cathode b
14	Anode



Anode should be connected to +5V through 200 Ohm resister. All cathodes are connected to 74LS47 a-g outputs (see below diagram).

Pin-outs of 74LS47 (BCD-to-Seven-Segment Decoder)



Notes:

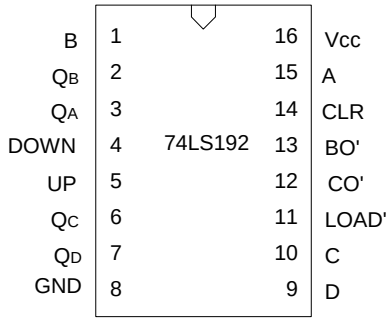
- D, C, B, A : Binary Inputs (D:MSB, A:LSB)
- a, b, c, d, e, f, g : Outputs for seven-segment LED display, Active low
- BI' : Blinking Input, leave it open or held high for normal operation
- BI'/RBO' : Blinking Input / Ripple Blinking Output, leave it open or held high for normal operation
- RBI' : Ripple Blinking Input, leave it open or held high for normal operation
- LT' : Lamp Test, held high for normal operation

74LS47 Function Table

Dec	Inputs						BI'/	Outputs						
	LT'	BRI'	D	C	B	A	RBI'	a	b	c	d	e	f	g
0	1	1	0	0	0	0	1	On	On	On	On	On	On	Off
1	1	X	0	0	0	1	1	Off	On	On	Off	Off	Off	Off
2	1	X	0	0	1	0	1	On	On	Off	On	On	Off	On
3	1	X	0	0	1	1	1	On	On	On	On	Off	Off	On
4	1	X	0	1	0	0	1	Off	On	On	Off	Off	On	On
5	1	X	0	1	0	1	1	On	Off	On	On	Off	On	On
6	1	X	0	1	1	0	1	Off	Off	On	On	On	On	On
7	1	X	0	1	1	1	1	On	On	On	Off	Off	Off	Off
8	1	X	1	0	0	0	1	On	On	On	On	On	On	On
9	1	X	1	0	0	1	1	On	On	On	Off	Off	On	On
10	1	X	1	0	1	0	1	Off	Off	Off	On	On	Off	On
11	1	X	1	0	1	1	1	Off	Off	On	On	Off	Off	On
12	1	X	1	1	0	0	1	Off	On	Off	Off	Off	On	On
13	1	X	1	1	0	1	1	On	Off	Off	On	Off	On	On
14	1	X	1	1	1	0	1	Off	Off	Off	On	On	On	On
15	1	X	1	1	1	1	1	Off	Off	Off	Off	Off	Off	Off
BI	X	X	X	X	X	X	0	Off	Off	Off	Off	Off	Off	Off
RBI	1	0	0	0	0	0	0	Off	Off	Off	Off	Off	Off	Off
LT	0	X	X	X	X	X	1	On	On	On	On	On	On	On

On: active low output,
Off: high output

Pin-Outs of 74LS192 (4-bit BCD Counter)



- D,C,B,A: BCD input (D:MSB, A:LSB)
- Q_D, Q_C, Q_B, Q_A: Counter output
- DOWN, UP: Down/UP clock input
- BO': Borrow output
- CO': Carry output
- CLR: Clears counter outputs
- LOAD': Loads input to counter output