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Faculty of Artificial Intelligence & Multimedia Gamming

BS – Multimedia Gamming

Digital Logic Design Lab

Digital Logic Design Lab # 01:

NOT, AND, OR Gate

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Lab Learning Objectives:

Upon successful completion of this experiment, the student will be able:

- To implement and verify **AND** gate operations using NI ELVIS III
- To implement and verify **OR** gate operations using NI ELVIS III
- To implement and verify **NOT** gate operations using NI ELVIS III

Lab Hardware and Software Required:

Platform: NI ELVIS III	✓ View User Manual: http://www.ni.com/en-us/support/model.ni-elvis-iii.html ✓ View Tutorials: https://www.youtube.com/playlist?list=PLvcPIuVaUMIWm8ziaSxv0gwtshBA2dh_M
Hardware: Digilent Digital Electronics Board for NI ELVIS III	✓ View NI DSDB Board Manual: http://www.ni.com/pdf/manuals/376627b.pdf
Software: NI Multisim 14.0.1 Education Version or newer	✓ Install Multisim: http://www.ni.com/gate/gb/GB_ACADEMICEVALMULTISIM/US ✓ View Help: http://www.ni.com/multisim/technical-resources/
Software: NI LabVIEW FPGA Vivado 2014.4	✓ Install: http://www.ni.com/download/labview-fpga-module-2015-sp1/5920/en/ **Note:** Digilent Driver (The installer above automatically downloads the installer below onto your computer) ✓ Navigate to: C:\NIFPGA\programs\Vivado2014_4\data\xicom\cable_drivers\nt64\digilent ✓ Install: install_digilent.exe

Background Theory:

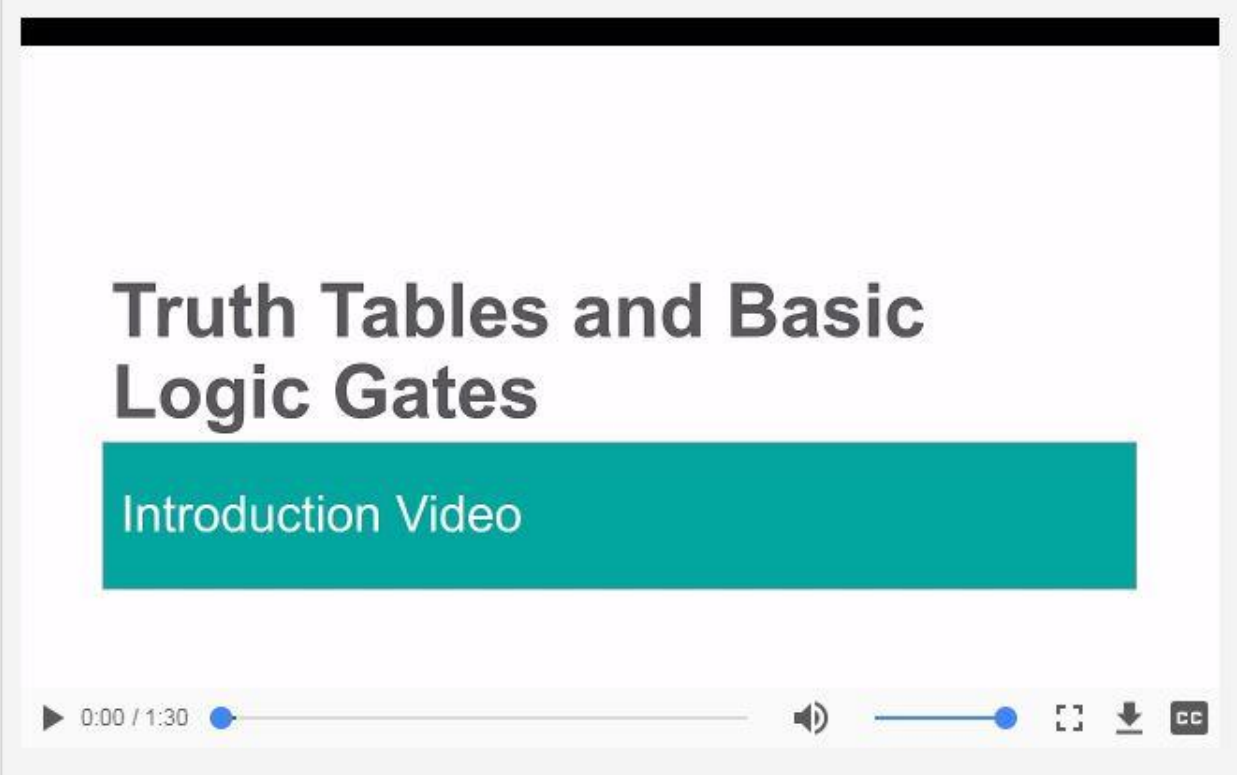

Figure 1-1 Video. View the video here: https://youtu.be/PhlGDrqqmj8

Video Summary

- Logic gates are the building blocks of all digital electronics
- AND and OR gates have at least two inputs and only one output
- NOT gates have one input and one output
- Inputs and outputs are expressed in binary (0's or 1's)

Truth Tables

One common way to express the particular function of a logic circuit is called a *truth table*. Truth tables show all permutations of the inputs with their corresponding output values in terms of logic level states. Logic level states are typically expressed as:

- 1 and 0
- HIGH and LOW
- True and False

This is an example of a truth table for two inputs:

A	B	O
0	0	0
0	1	1
1	0	1
1	1	1

Figure 1-2 Truth table for two inputs

A gate or logic circuit's truth table must have as many rows as there are possibilities of unique input combinations. For a single-input gate, like the inverter, there are only two input possibilities, namely 0 and 1. For a two-input gate there are four possibilities (00, 01, 10, and 11), and thus four rows for the corresponding truth table. For a three-input logic device, there are eight possibilities and so forth. The input columns are typically written in binary order as shown here:

A	B	C	O
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Figure 1-3 Truth table for three inputs written in binary

Logic Gates

Logic gates are physical devices that implement the Boolean functions of truth tables. The two most basic logic gates are the "AND" and the "OR".

- In the "AND" logic gate, the output is 1 if both the inputs for A and B are also 1. If one or all of the inputs for A and B are 0, then the resulting output is 0. This is summarized in the truth table below.
- Generally, the "AND" logic gate outputs the minimum value between the two input digits.
- The "AND" symbol is represented on the right. In this case, we can see two inputs (A and B) and one output.

A	B	O
0	0	0
0	1	0
1	0	0
1	1	1

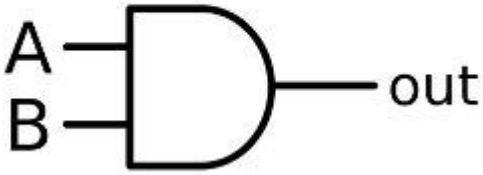

Fig 1-4 AND Truth Table

Fig 1-5 AND Logic Gate

- In the "OR" logic gate, the output is 0 if both the inputs for A and B are also 0. If one or all of the inputs for A and B are 1, then the resulting output is also 1. This is summarized in the truth table below.
- The "OR" logic gate outputs the maximum value between the two input digits.
- The "OR" symbol is represented below. As above, there are two inputs and one output.

A	B	O
0	0	0
0	1	1
1	0	1
1	1	1

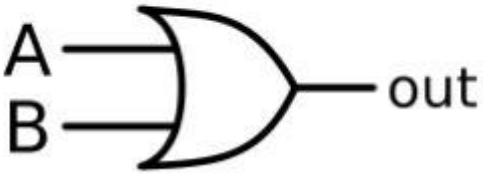

Figure 1-6 OR Truth Table

Figure 1-7 OR Logic Gate

- In the "NOT" gate the out is invert of input

Input	**Output**	
A	**LED (on / off)**	**Level (1 / 0)**
0	**on**	**1**
1	**off**	**0**

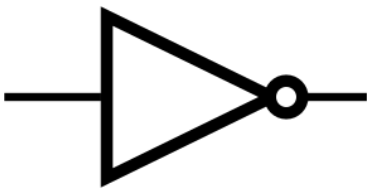

Figure 1-8 NOT Truth Table

Figure 1-9 NOT Logic Gate

74LS08 2-input AND gate IC:

In order to implement the AND operation using IC, the TTL 74LS08 2-input AND gate IC can be used. This IC contains four AND gates. It has 14 pin DIP configuration as shown in Fig 1.10:

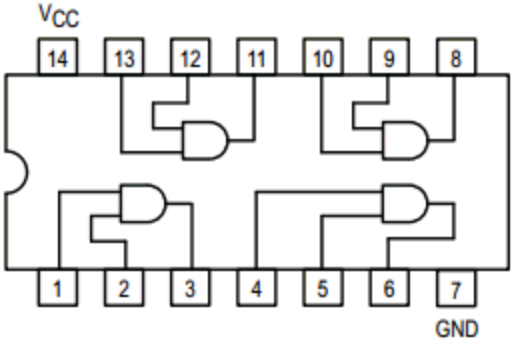

Fig 1.10: 74LS08 2-input AND gate IC pin configuration

74LS32 2-Input OR Gate IC:

In order to implement the OR operation using IC, the TTL 74LS32 2-input OR gate IC can be used. It has four OR gates with in the package. This IC has 14 pin DIP configuration as shown in Fig 1.11.

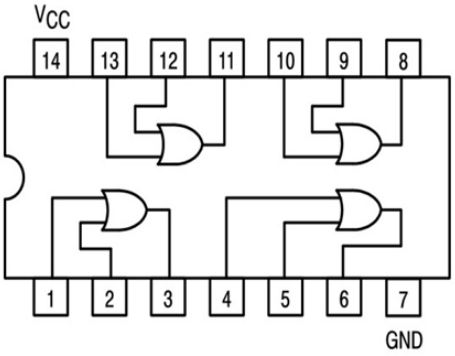

Fig 1.11: 74LS08 2-input AND gate IC pin configuration

74LS04 Inverted IC:

In order to implement the NOT gate operation using IC, the TTL 74LS04 IC can be used. This IC contains six inverters. It has 14pin Dual Inline Package (DIP) configuration as shown in Fig 1.12. The power supply connections are made to pin 7 and 14. This supply the operating voltage for all six NOT gates on the IC. Pin 1 is identified by a small indented circle next to it or by a notch cut out between pin 1and 14.

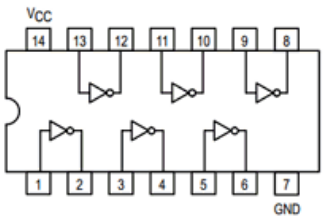

Fig 1.12: 74LS04 Inverter IC pin configuration

Lab Examples:

Build the following circuit using multiple AND/OR Gates in Multisim:

- Place an **OR** gate and **two AND** gates from the **Misc Digital** group.
- Place **three INTERACTIVE_DIGITAL_CONSTANT**s from the **Sources** group.
- Place one **PROBE_DIG_RED** from the **Indicators** group.
- Wire them as shown.

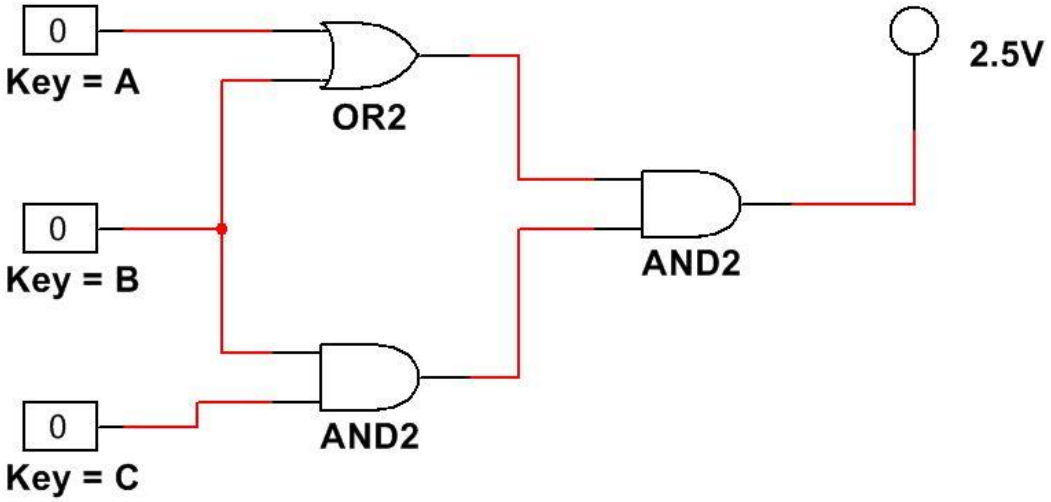

Figure 1-13 Circuit with AND OR Logic gates

- Click the **Run** button to begin simulating the circuit.

Figure 1-14 Run button

- Using the **A**, **B**, and **C** keys, vary the inputs into the circuit.

1-1 Record the results, as indicated by the probe, in the following truth table.

A	B	C	O
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

- When you're done, stop the simulation by clicking the **Stop** button.

Figure 1-15 Stop button

Lab Activities:

- Perform the logic of all the three gates NI ELVIS III kit with NI ELVIS Launcher installed in computer, and show the progress to your instructor.
- You are supposed to follow steps in link given below and observe the outputs. https://www.youtube.com/watch?v=KqmY_Sx4Kik