HARDWARE LAB 1
Combinational Design
Digital Design: CPEN214

NAME____________________________

Introduction

The purpose of this experiment is to introduce you to the basics of digital design, wiring and testing logic circuits. In this lab, you will connect several logic gates to create simple circuits. The first is an arithmetic circuit similar to the Arithmetic Logic Unit (ALU) found in a computer processor. The second circuit is used in a simple home security system.

Assignment

Part I – Half adder
A half-adder is an arithmetic circuit that adds two bits A, and B, and generates two outputs, the SUM and CARRY.

Complete the truth table for the half-adder:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>SUM</th>
<th>CARRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<td>1</td>
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<td>1</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Using the K-Map method obtain the function that describes the SUM and CARRY for the half-adder circuit. Draw the logic diagram of the half-adder. Is it possible to implement the SUM function with only one gate? If you answered yes, what type of gate would it be? Explain.

Use the prototyping board and IC’s to build and test the half-adder circuit. Use the switches for the three inputs and LED’s to check the logic level of the outputs. Make sure that you have the power ($V_{CC}$) and ground (GND) connected correctly before testing the circuit.
Part II – Home security system

A home security system can be illustrated by a simple logic circuit as shown below. The ALARM is on if PANIC is on, OR the owners are NOT EXITING, the system is ENABLED, AND the WINDOW, DOOR, AND GARAGE are NOT SECURE (alternatively, not secure means one of the WINDOW, DOOR, OR GARAGE is off (0)). Note that the system is SECURE if WINDOW, DOOR, AND GARAGE are all on (1).

Build the circuit and test its behavior. Document the test results in a table.

Besides submitting the lab report, you need to demonstrate the performance of both circuits to the instructor. In your lab report, describe briefly any difficulties that you may have encountered in parts I and II.

The grading for this lab is as follows: 60 points demo (30 points for the half-adder circuit and 30 points for the home security circuit) and 40 points report (answers should be on separate piece(s) of paper stapled to this handout). Each item in the report checklist is worth 5 points.

Report checklist:
1. This lab handout with name
2. Completed Half-Adder table
4. Boolean expressions part I
5. Circuit Diagram part I
6. Answer to question part I
7. Security system results in a table form
8. Difficulties