DSL Writeup

ASSIGNMENT NO: 9

Batch: B2

Group members: UCE2021531 – Shweta Katkar

UCE2021533 – Bhakti Khokad

Title of Mini Project: Xerox Machine

1. Give your Problem statement.

    - To design a Xerox machine that required end-user to input the password to active the component.
    - Once the component has been activated, the machine will allow user to select the properties of printing such as paper size, colour and printer mode.
    - If no properties is selected, the machine will use the default properties.

    Lastly, machine will require a user to enter the amount of copies, therefore the machine counter will count the number of copies that has been photocopied. The machine will stop once the required number of copies reached.

2. Discuss about the tool you have worked on for your mini project.

    We have performed mini project on platform called Deeds DcS.

    Deeds covers the following areas of digital electronics

    - Combinational logic networks (from simple gates to decoders, mux, demux, adders, ALUs...)
    - Sequential logic networks (flip-flops, registers, counters...)
    - Finite State Machines design
    - Custom circuit blocks design
    - Micro-computer programming (at assembly level)
    - Micro-computer interfacing and debugging
    - FPGA programming and testing

3. Discuss background/motivation about the mini project.

This mini project involved the user which will initially enter amount of copies needed. The counter will count the number of copies that had been photocopied. The machine will stop once the required number of copies produced had been reached.

There are three core components involved in this mini project, which are counter, comparator and clock disabler.

Counter will be used to determine the number of copies that has been made while the comparator will determine whether the required number of copies has been met. Once the number of copies has been met, the clock disabler will disable the clock and stop the counter from counting. The machine will display the required number of copies and the amount that has been produced.

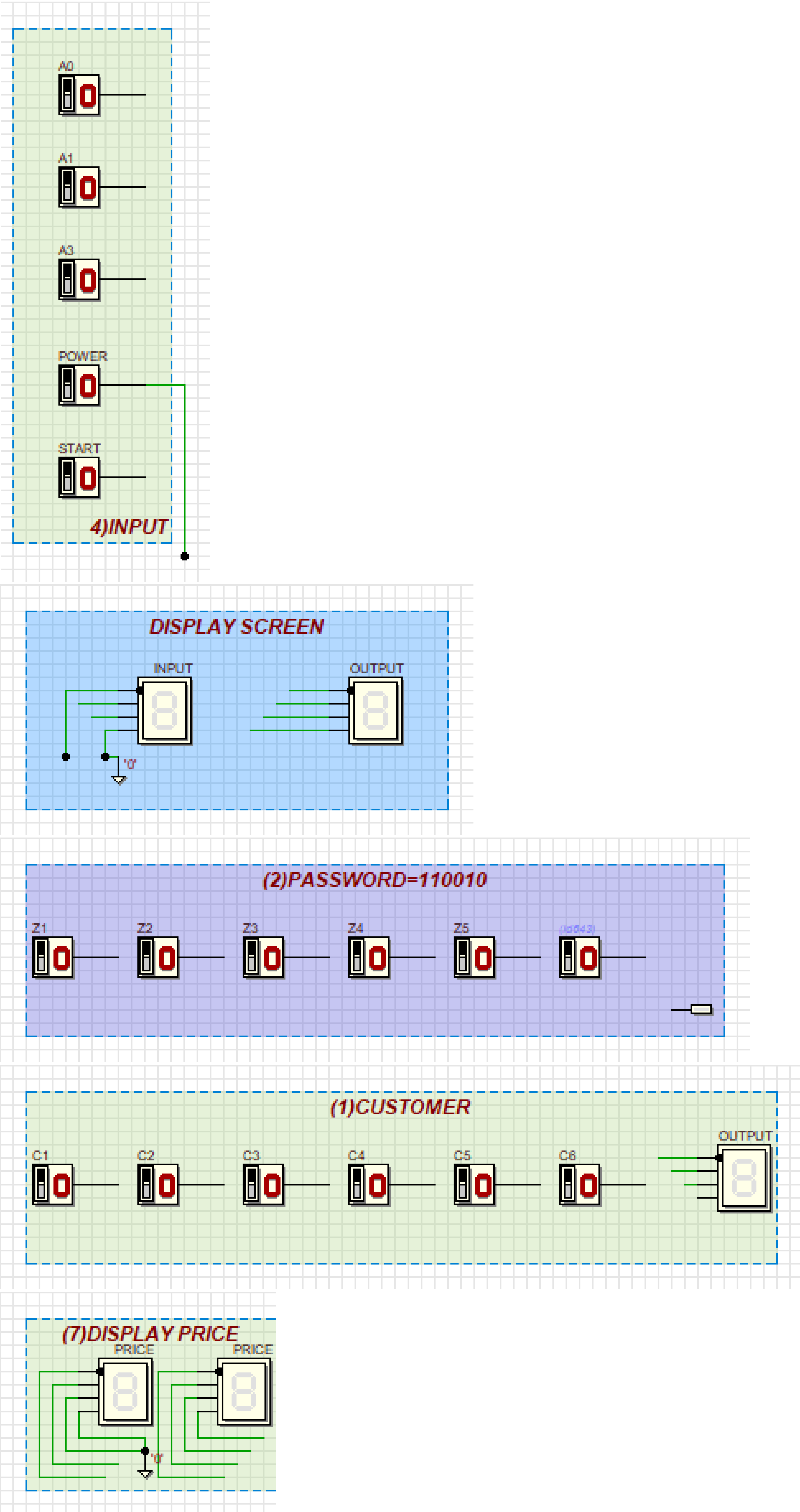
4. Give the objectives of your mini project.

This mini project on Programmable Logic Devices (PLD) Photocopying Xerox Machine have a few objectives to be accomplished upon the end of the project. The objectives of this laboratory are to introduce the students to the development of a PLD device. A programmable logic device (PLD) is an electronic component used to build reconfigurable digital circuits. Before the PLD can be used in a circuit it must be programmed (reconfigured) by using a specialized program.

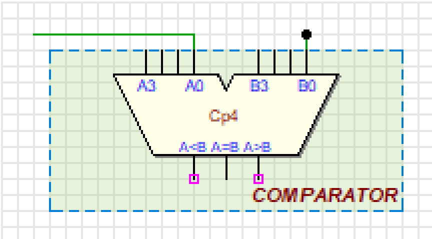
Second, this lab also introduces the students to a simple Hardware Description Language. In computer engineering, a hardware description language (HDL) is a specialized computer language used to describe the structure and behaviour of electronic circuits, and most commonly, digital logic circuits. A hardware description language enables a precise, formal description of an electronic circuit that allows for the automated analysis and simulation of an electronic circuit. A hardware description language looks much like a programming language such as C; it is a textual description consisting of expressions, statements and control structures. One important difference between most programming languages and HDLs is that HDLs explicitly include the notion of time.

5. Discuss in detail about the components used in your mini project.

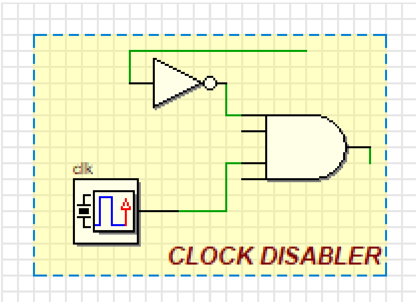
- Input, Output switch
- High level (Logic 1), Low Level (Logic2)
- Test led


A0
A1
A3
POWER
START
4)INPUT
DISPLAY SCREEN
INPUT
OUTPUT
'0'
(2)PASSWORD=110010
Z1
Z2
Z3
Z4
Z5
(1)CUSTOMER
C1
C2
C3
C4
C5
C6
OUTPUT
(7)DISPLAY PRICE
PRICE
PRICE
'0'

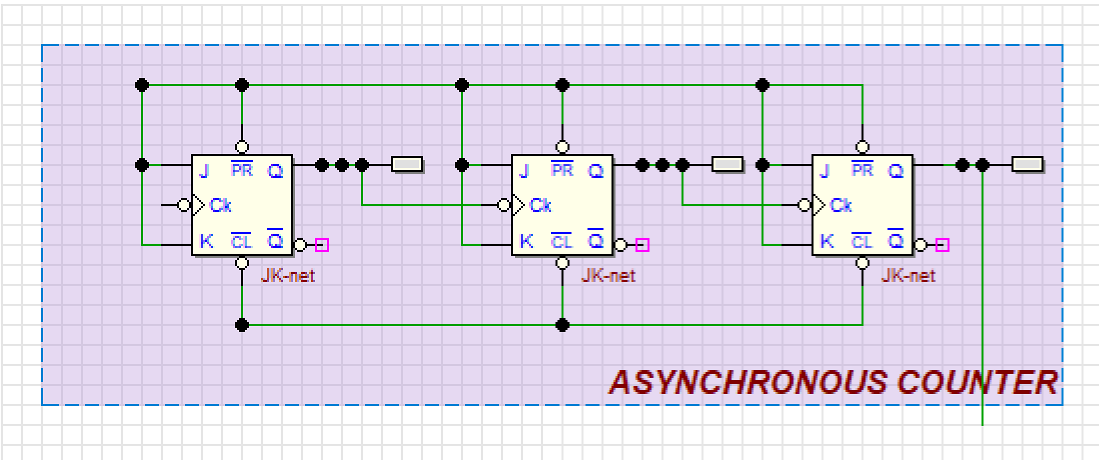
- **3 bit Comparator**: A comparator circuit compares two voltages and outputs either a 1 (the voltage at the plus side) or a 0 (the voltage at the negative side) to indicate which is larger. Comparators are often used, for example, to check whether an input has reached some predetermined value.



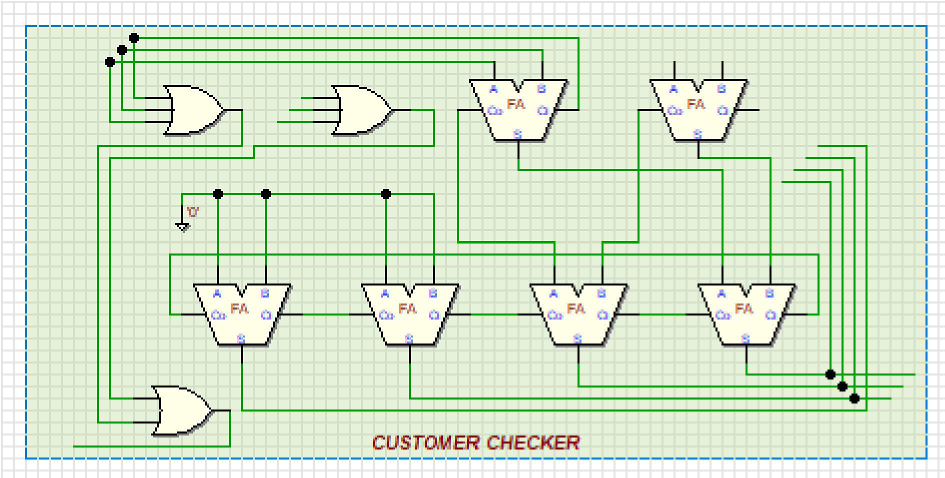
- Clock disabler



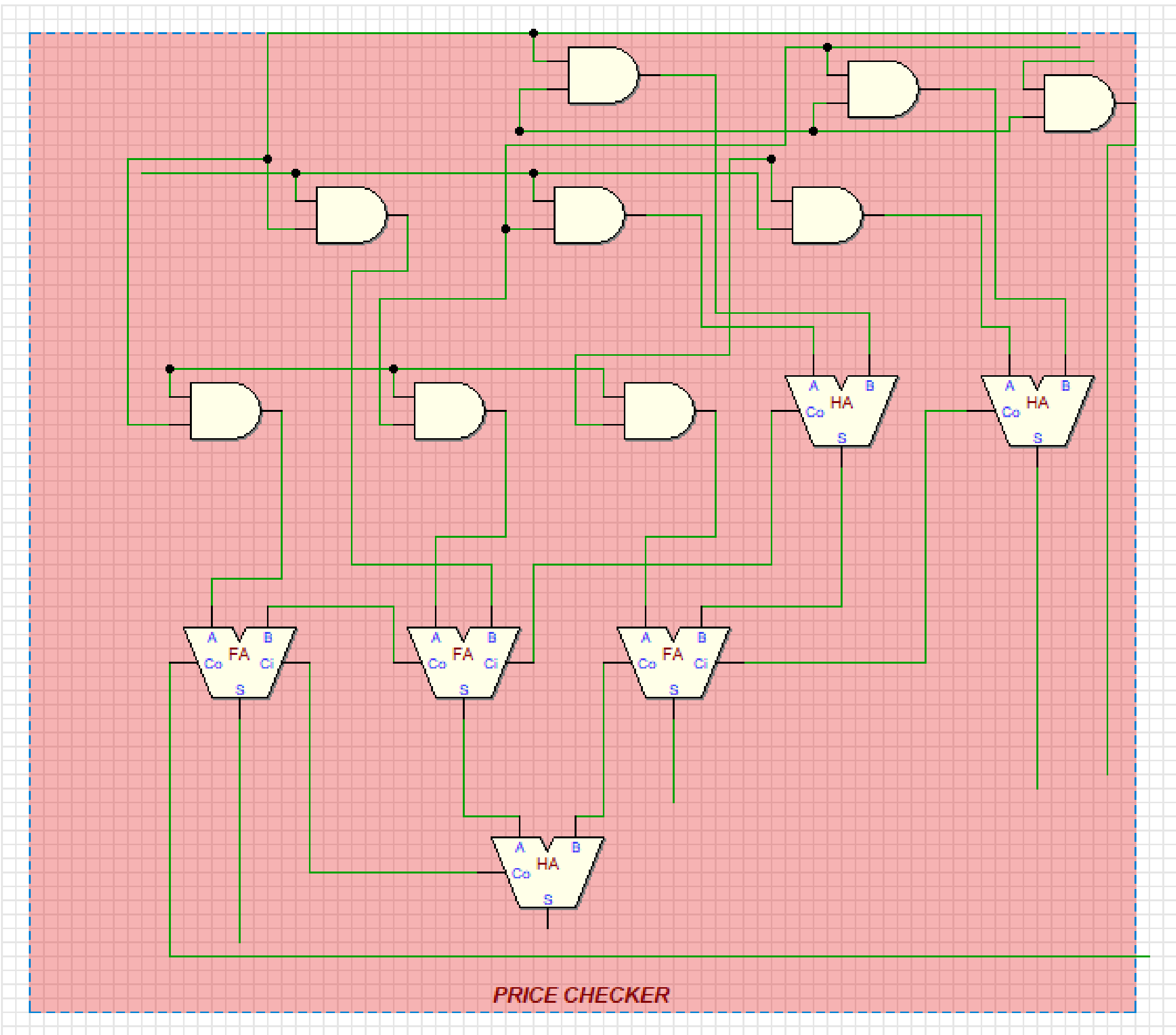
- 3 bit asynchronous counter using JK flip flop



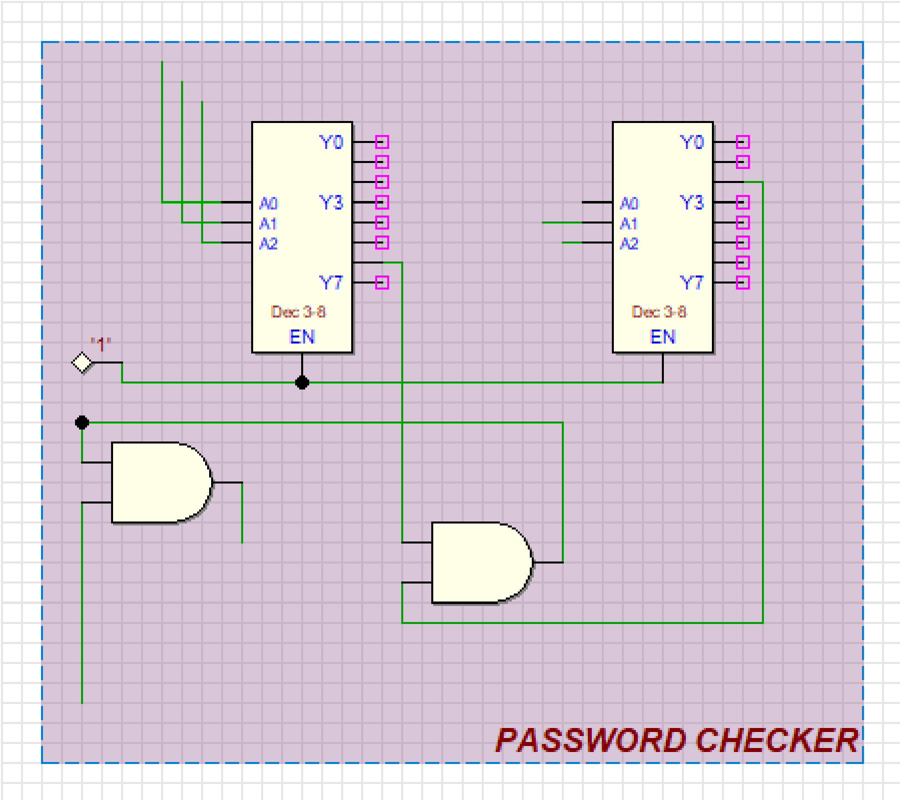
- **Full adder:** A full adder circuit is central to most digital circuits that perform addition or subtraction. It is so called because it adds together two binary digits, plus a carry-in digit to produce a sum and carry-out digit. It therefore has three inputs and two outputs.



- **Half adder**: A half adder is a type of adder, an electronic circuit that performs the addition of numbers. The half adder is able to add two single binary digits and provide the output plus a carry value. It has two inputs, called A and B, and two outputs S (sum) and C (carry).



- **3 bit Decoder**: A decoder is a device that generates the original signal as output from the coded input signal and converts n lines of input into 2n lines of output. An AND gate can be used as the basic decoding element because it produces a high output only when all inputs are high



- **AND gate , OR gate, NOR gate**

6. Give detailed design of the mini project.

Step by step how to use:-

- Key-in the number of customer.
- Key-in the correct 6-digit password.
- Right click the clock in 'CLOCK DISABLER' to set auto counter.
- Switch the Power to on(1/HIGH)
- Set the Input in 3 digit binary.
- Press Start to perform the system.
- The total price will be display in 'Display Price'.

- This project will implement 3 different components on a single PLD device, those components are

1) Count Up Counter Comparator Decoder (Pattern Detector) – Clock Enabler

2) 2 bit Switches, 2 bit Comparator, 2 bit Counter.

- Enabler BLOCK DIAGRAM COMPONENT

  (1): USER INPUT User will insert the number of copies they want printed. Use 2-bit switches. It is sent to two components:

  A. 7-bit display to show the input number in decimal.

  B. As input to Comparator 2 bit Comparator Switches

  (2): COUNTER - Build a 2-bit count-up counter using Asynchronous J-K flip-flops. 2 bit Comparator Counter - Counter input = Clock. The counter will increase when User click the clock. Clock Enabler ► Counter output: A. 7-segment display to show the current count in decimal

  B. As input to Comparator COMPONENT

  (3): COMPARATOR 2 bit 2 bit Switches 2 bit Comparator Counter Clock Comparing between the number of photocopy needed vs copies created. - 2 types of input - Input A from Output of Component 1 (user input) Input B from Output of Component 2 (counter) - l output, sent to Clock Enabler. TRUE: A > B (no of copies have not reached) ► FALSE: A = B (no of copies reached) Enabler COMPONENT

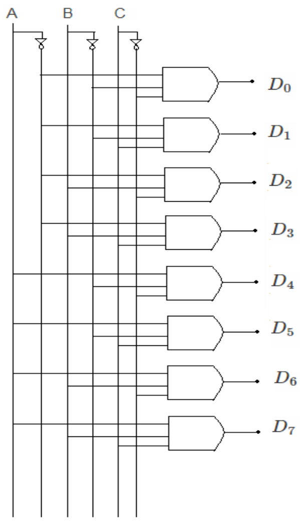
  (4): CLOCK ENABLER 2 input 2 bit Comparator 2 bit Counter

  1) external clock

  2) Output from Comparator (true or false) I output, sent to Counter. ► If true, keep on making copies (count-up) If false, stop counting.

- **Decoder**

  Circuit diagram:



Truth table:

A	B	C	D0	D1	D2	D3	D4	D5	D6	D7
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Equations:

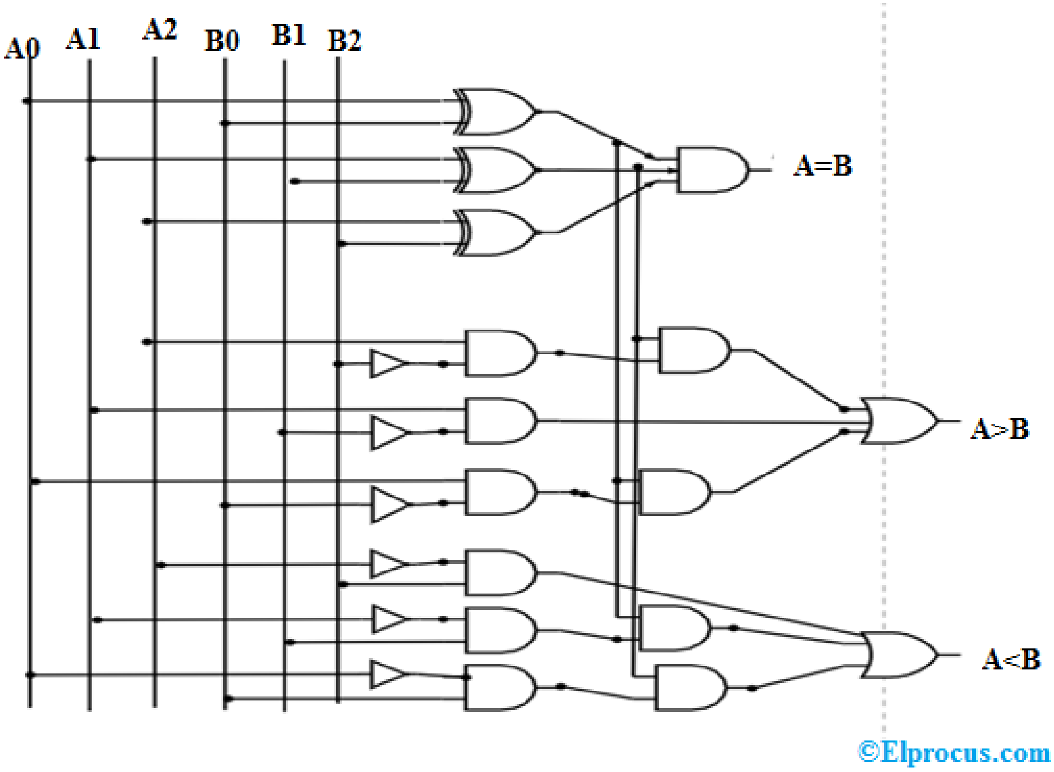
$D_0 = \bar{A}\bar{B}\bar{C}$, $D_1 = \bar{A}\bar{B}C$, $D_2 = \bar{A}B\bar{C}$,

$D_3 = \bar{A}BC$, $D_4 = A\bar{B}\bar{C}$, $D_5 = A\bar{B}C$,

$D_6 = AB\bar{C}$, $D_7 = ABC$

- **Comparator**

Circuit diagram:



Truth table:

A2	A1	A0	B2	B1	B0	A>B	A<B	A=B
0	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	1	0
0	0	0	0	1	0	0	1	0
0	0	0	0	1	1	0	1	0
0	0	0	1	0	0	0	1	0
0	0	0	1	0	1	0	1	0
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
1	1	1	0	0	0	1	0	0
1	1	1	0	0	1	1	0	0
1	1	1	0	1	0	1	0	0
1	1	1	0	1	1	1	0	0
1	1	1	0	0	0	1	0	0
1	1	1	1	0	1	1	0	0
1	1	1	1	1	0	1	0	0
1	1	1	1	1	1	0	0	1

Equations:

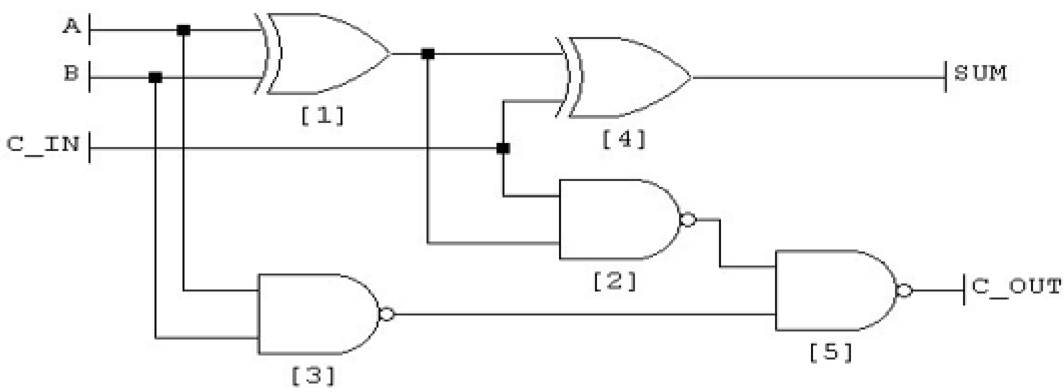
A=B = (A0’B0’ + A0B0)(A1’B1’ + A1B1)(A2’B2’ + A2B2)

A<B = A2’B2 + [(A2’B2’ + A2B2) * A1’B1] + [(A2’B2’ + A2B2) *[(A1’B’ + A1B1) * A0’B0]

A>B = A2B2’ + + [(A2’B2’ + A2B2) * A1B1’] + + [(A2’B2’ + A2B2) * [(A1’B’ + A1B1) * A0B0’]

- **Full adder**

  Circuit diagram:



Truth Table:

Inputs			Outputs	
A	B	C – IN	Sum	C - Out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

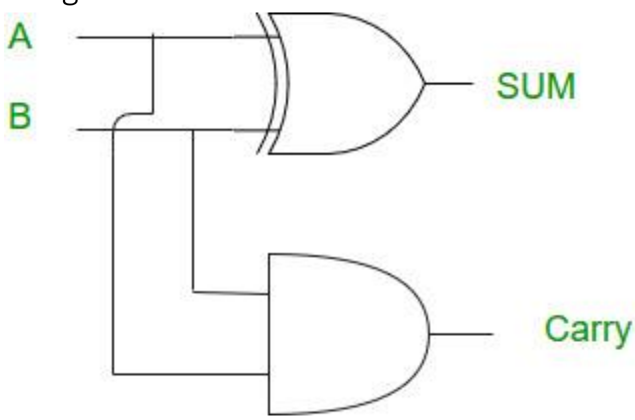
Equations:

Logical Expression for SUM: = A’ B’ C-IN + A’ B C-IN’ + A B’ C-IN’ + A B C-IN = C-IN (A’ B’ + A B) + C-IN’ (A’ B + A B’) = C-IN XOR (A XOR B) = (1,2,4,7)

Logical Expression for C-OUT: = A’ B C-IN + A B’ C-IN + A B C-IN’ + A B C-IN = A B + B C-IN + A C-IN = (3,5,6,7)

- **Half adder**

  Circuit Diagram:



Truth table:

A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Equations:

S = a$\oplus$b

C = a*b

7. Discuss the learnings from the mini project you experienced.

We explored some new things. Practical knowledge is very important. As we performed these topics hands on it has been easy to learn and remember. This project helped us to enhance our team work .Xerox Machine is a real life example so while performing this project we learned how it functions in real.