



SECR1013-03 DIGITAL LOGIC

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TOPIC: LAB 4 (XEROX PRINTING MACHINE) REPORT

DEDICATION & ACKNOWLEDGEMENT

First, we would like to thanks our lecturer, Dr. Firoz for his hard work and effort in teaching us the subject digital logic and help us when we are facing problem on the academic. We would also like to thanks the lab assistants that always offer their help without doubt while we are doing our lab experiment for digital logic.

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1. BACKGROUND

On 17 December 2019, my partner and I have conducted a lab experiment at UTM Digital Teaching Lab on the topic “MINI PROJECT, photocopy (XEROX) machine)” under the guide of Dr. Firoz. This mini project will implement 3 different components on a single GAL device which is 3-bit Count Up Counter, 3-bit Comparator, and Clock Disabler.

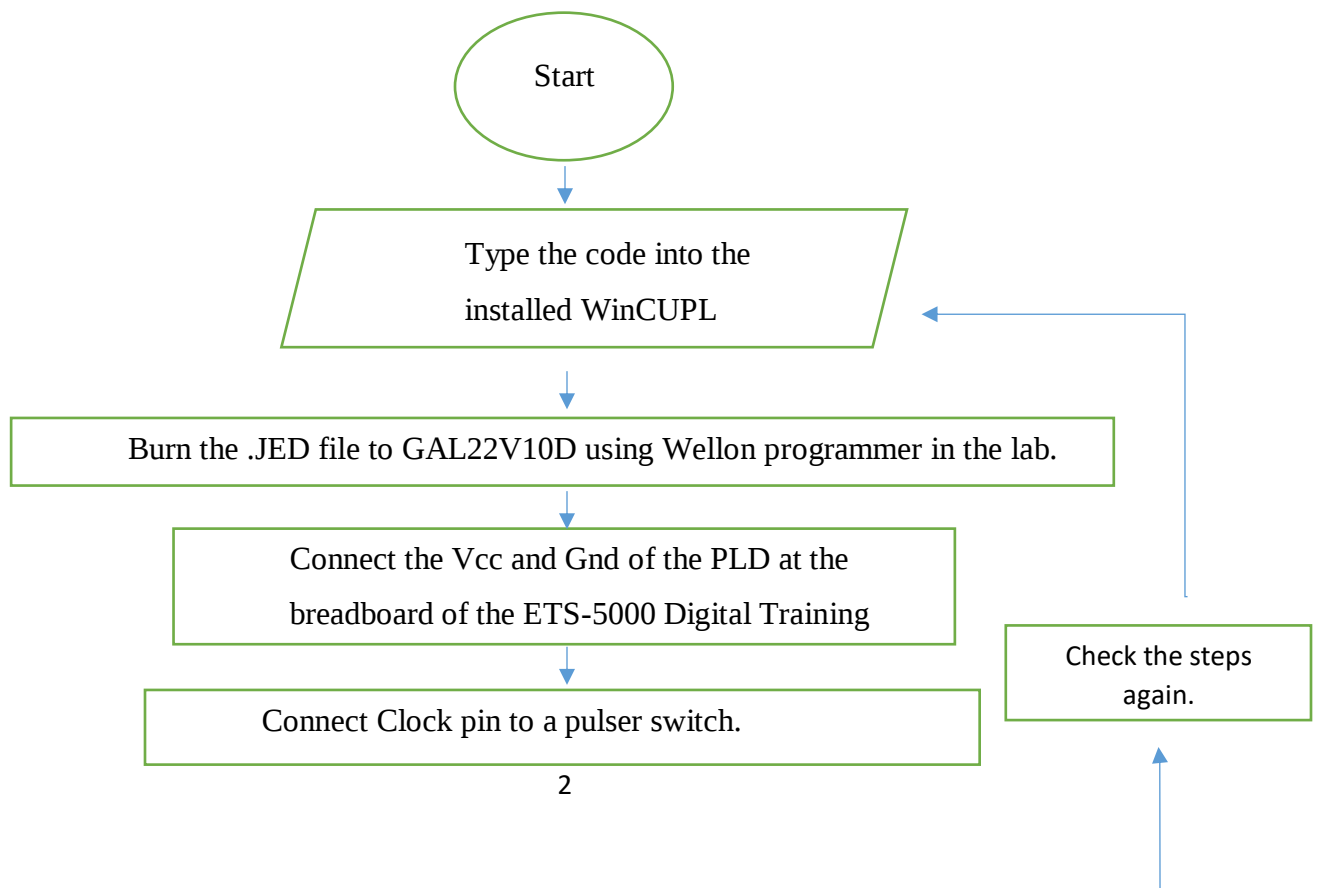
2. PROBLEM

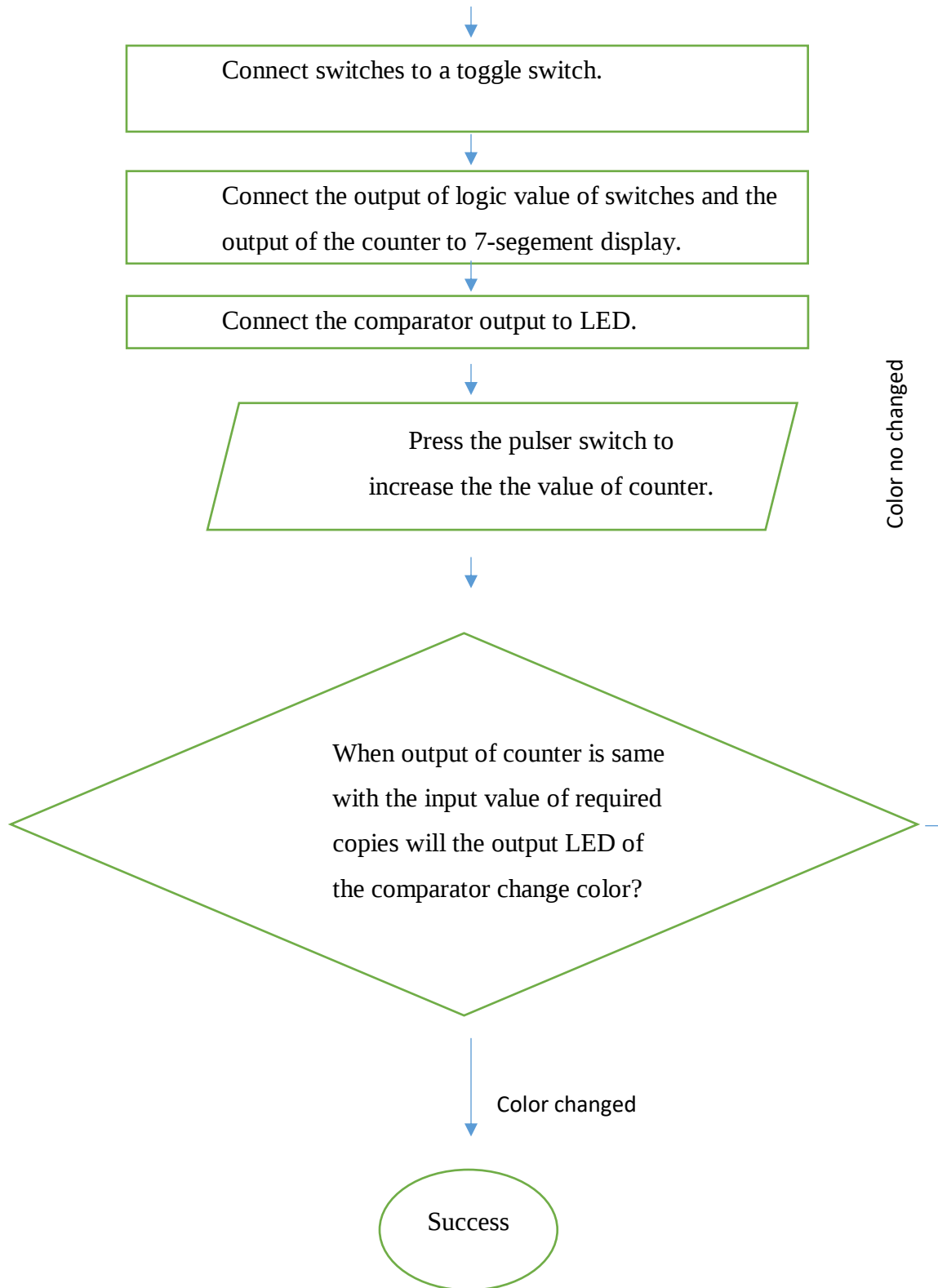
User will initially enter the desired amount of copies, the counter will count the number of copies that has been photocopied. The machine will stop once it reach the desired number of copies and produce an output to indicate the result of comparator.

3. OBJECTIVES

The objectives of this laboratory are to learn the development of a PLD and a simple Hardware Description Language.

4. FLOWCHART





5. COMPONENT

Switches, counter, comparator, clock enabler.

6. MATERIAL AND SOFTWARE USED

a. Breadboard

-It is a solderless device for temporary prototype with electronics and test circuit designs. We do the experiment on this board.

b. GAL 22V10

-It is a programmable logic device that implement as CMOS-based generic array logic and we used it as counter and comparator in this experiment.

c. ETS-5000 Digital Training Kit

-It is design for beginner to enhance the knowledge of advance digital theory. We use this training kit to control the input, output, ground and voltage supply for the circuit.

d. Wellon Universal Programmer& Tester

-It is a device that come with its software to use the .JED file that programmed to burn into the GAL22V10.

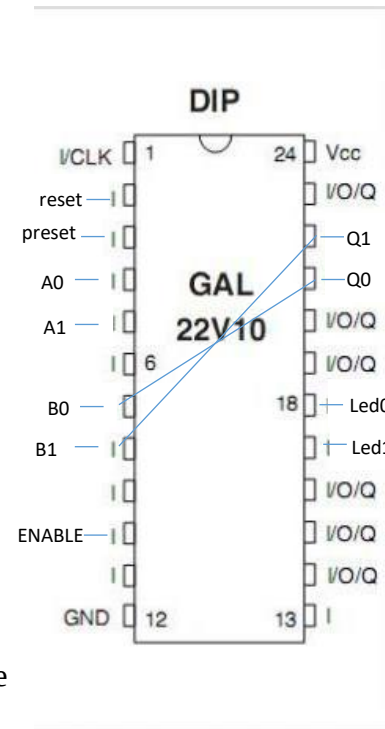
e. WinCUPL 5.0 Software

-WinCUPl is a complete and east to use design software suitable for all Atmenl SPLDs and CPLDs (WinCupl 5.3, 2019). The software is used to program the code for the 2-bit and 3-bit counter process for the GAL22V10.

7. CIRCUIT IMPLEMENTATION

2-BITS CIRCUIT

The pin 1 is connect to the pulser switch. The pin 2 is connect to the active high reset input which is switch 0. The pin 3 is connect to the active high preset input which is switch 1. The pin 4 as bit 0 of comparator A is connect to the bit 0 binary input of the amount of copies which is switch 2 and also the pin A of digital display 2. The pin 5 as bit 1 of comparator A is connect to the bit 1 binary input of the amount of copies which is switch 3 and also the pin B of digital display 2. The pin C and D of digital display 2 is connect to ground. The pin 7 as bit 0 of comparator B is connect to the pin 21 which is the bit 0 of the counter and also the pin A of digital display 1.

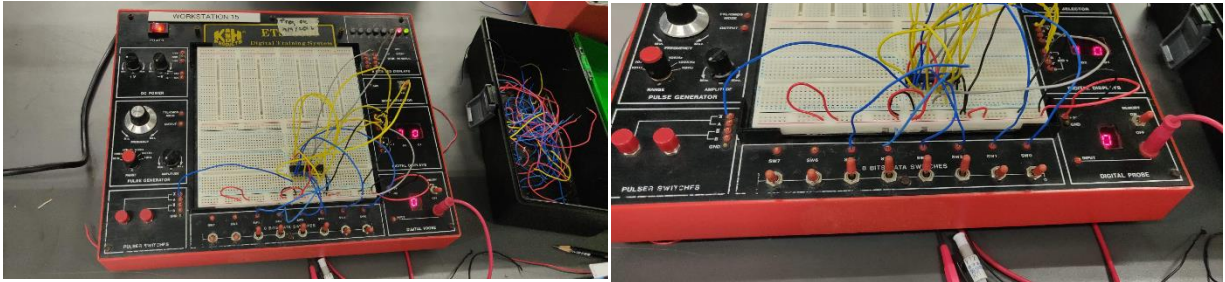


The pin 8 as bit 1 of comparator B is connect to the pin 22 which is the bit 1 of the counter and also the pin B of digital display 1. The pin C and D of digital display 1 is connect to ground. The pin 10 as enable pin is connect to the active high input which is switch 5. The pin 12 is connect to ground. The pin 17 is the output pin that high when the A and B is not equal is connect to led1. The pin 18 is the output pin that high when the A and B is equal is connect to led0. The pin 21 is the output pin for bit 0 of counter. The pin 22 is the output pin for bit 1 of counter. The pin 24 is connect to the 5V power supply.

3-BITS CIRCUIT

The pins that in 2-bit circuit is also apply same in 3-bit but with some additional pin. The pin 6 as bit 2 of comparator A is connect to the bit 2 binary input of amount of copies which is switch 4 and also the pin C of digital display 2. The pin 9 as comparator B is connect to the pin 23 which is the bit 2 of the counter and also connect to the pin C of digital display 1. The pin 23 is the output pin for bit 2 of counter.

a. PHYSICAL CIRCUIT IMPLEMENTATION



The 7-segment display D2 will display the input of desired copies and the D1 will display the counter value. After finish the wiring, we start the project by opening the power supply and turn on the enable pin by turning on the switch 5. We turn on the switches for comparator A to the value of number of copies we desired. When we press the pulser switch which each time indicate one copy produced, the value of counter increase and show the decimal output at digital display D1. When the counter value is same with the input of desired copies, the led0 will turn red and led1 will turn green as indicated the two value compare by comparator is same which mean the project had succeed. Turn on the switch 0 which is for reset pin will reset the counter and the project can be start over again.

8. DISCUSSION

To summarize, this project was completed with success. Using a PLD that have the function of counter and comparator had help the project to reduce the amount of IC. The project about comparing the input number of desired copies with the number of copies made produce desire output when the both value is same. My partner and I had shown partnership between us by dividing the job as Nishat do the wiring on the breadboard meanwhile me, Wen Jun do the coding and the burning process into the PLD. We had fully understood the instruction of the lecturer and be the first who complete the project. However, we do faced a problem that the coding for the 3-bit circuit is wrong while testing, we immediately start checking from the coding to the wiring and found out that the coding is wrong, we burn the modified program into the PLD and get the correct output. After discussing, my partner and I suggest that the system can be added a buzzer

as an indicator that the amount of copies had reach desired amount. Beside, to understand more on the PLD, we can add password to compare and only start printing when the input is same with the password.

9. CONCLUSION

In conclusion, this project had definitely increase our knowledge and soft skill. My partner and I had learned the basic knowledge of steps to program a PLD. We also learn the theory of counter, comparator through active learning. As a computer science student, we not only should learn about the coding and the program but also understand the concept behind the programming such as the hardware, connection and wireless to easier the process of problem solving and create a simpler and shorter code for the program.

10. References

- WinCupl 5.3. (2019, Decemeber 17). Retrieved from WinCUPL:
<https://wincupl.software.informer.com/5.3/>
- Yusoff, A. B. (2018). *Digital Logic*. Johor: DESKTOP PUBLISHER.

11. APPENDIX

a. 2-bit

```
Name XeroxMachine2BIT ;
PartNo 00 ;
Date 07/12/2017 ;
Revision 01 ;
Designer Engineer ;
Company UTM ;
Assembly None ;
Location ;
Device G22V10 ;

/* ***** INPUT PINS ***** */
PIN 1 = clk ;          /* clock */
PIN 2 = reset ;        /* reset */
PIN 3 = preset ;       /* preset */
PIN 4 = a0 ;           /* Comparator A */
PIN 5 = a1 ;           /* */
PIN 7 = b0 ;           /* Comparator B */
```

```

PIN 8 = b1 ;          /* */
PIN 10 = startPrt ;   /* Start Printing */

/* ***** OUTPUT PINS ***** */
PIN 17 = diffCmp ;    /* XOR (A B not equal HIGH) */
PIN 18 = sameCmp ;    /* XNOR (A B equal HIGH) */
PIN 21 = q0 ;         /* output counter */
PIN 22 = q1 ;         /* output counter */

/***** Function Comparator*****/
sameCmp = !(a0$b0)&!(a1$b1);
diffCmp = !sameCmp ;

/**** Function Clock Enabler *****/
clkEn=startPrt & diffCmp;

/**** Function Counter 2 Bit UP *****/
field count=[q1..0];
$define s0 'b' 00
$define s1 'b' 01
$define s2 'b' 10
$define s3 'b' 11

count.ar=reset;      /* connect reg AR to reset (Asyn Mode) */
count.sp=preset;     /* connect reg AR to preset (Syn Mode) */

sequence count{
    present s0 if clkEn next s1;
    default next s0;
    present s1 if clkEn next s2;
    default next s1;
    present s2 if clkEn next s3;
    default next s2;
    present s3 if clkEn next s3;
    default next s3;
}

```

b. 3-bit

```

12. Name XeroxMachine2BIT ;
13. PartNo 00 ;
14. Date 07/12/2017 ;
15. Revision 01 ;
16. Designer Engineer ;
17. Company UTM ;
18. Assembly None ;
19. Location ;
20. Device G22V10 ;
21.
22. /* ***** INPUT PINS ***** */
23. PIN 1 = clk ;      /* clock */
24. PIN 2 = reset ;    /* reset */
25. PIN 3 = preset ;   /* preset */
26. PIN 4 = a0 ;       /* bit 0 of Comparator A*/
27. PIN 5 = a1 ;       /* bit 1 of Comparator A*/
28. PIN 6 = a2;        /* bit 2 of Comparator A*/
29. PIN 7 = b0 ;       /* bit 0 of Comparator B*/
30. PIN 8 = b1 ;       /* bit 1 of Comparator B*/
31. PIN 9 = b2;        /* bit 2 of Comparator B*/
32. PIN 10 = startPrt ; /* Start Printing */
33.
34. /* ***** OUTPUT PINS ***** */
35. PIN 17 = diffCmp ; /* XOR (A B not equal HIGH) */
36. PIN 18 = sameCmp ; /* XNOR (A B equal HIGH) */
37. PIN 21 = q0 ;      /* output counter */
38. PIN 22 = q1 ;      /* output counter */
39. PIN 23 = q2 ;      /* output counter */
40.

```

```

41. /***** Function Comparator*****/
42. sameCmp = !(a0$b0)&!(a1$b1)&!(a2$b2); /* when the comparator A and B is same*/
43. diffCmp = !sameCmp ; /* when the comparator A and B is
    not same*/
44.
45. /**** Function Clock Enabler *****/
46. clkEn=startPrt & diffCmp;
47.
48. /**** Function Counter 2 Bit UP *****/
49. field count =[q2..0];
50. $define s0 'b' 000
51. $define s1 'b' 001
52. $define s2 'b' 010
53. $define s3 'b' 011
54. $define s4 'b' 100
55. $define s5 'b' 101
56. $define s6 'b' 110
57. $define s7 'b' 111
58.
59. count.ar=reset; /* connect reg AR to reset (Asyn Mode) */
60. count.sp=preset; /* connect reg AR to preset (Syn Mode) */
61.
62. sequence count{
63.     present s0 if clkEn next s1;
64.         default next s0;
65.     present s1 if clkEn next s2;
66.         default next s1;
67.     present s2 if clkEn next s3;
68.         default next s2;
69.     present s3 if clkEn next s4;
70.         default next s3;
71.     present s4 if clkEn next s5;
72.         default next s4;
73.     present s5 if clkEn next s6;
74.         default next s5;
75.     present s6 if clkEn next s7;
76.         default next s6;
77.     present s7 if clkEn next s7;
78.         default next s7;
79. }

```