SCHOOL OF COMPUTING
Faculty of Engineering

SEMESTER 1

SESSION 2019/2020

SCSR1013

DIGITAL LOGIC

REPORT FOR

MINI PROJECT PHOTOCOPYING (XEROX) MACHINE

PREPARED BY:

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LECTURER- DR. Firoz bin Yusuf Patel Dawoodi

DEDICATION

Our project is dedicated to our beloved teacher DR. Firoz bin Yusuf Patel Dawoodi. In addition, it is also for all lecturers who are willing to teach us. And to our friends who are continuously supporting us no matter who we are, where we are from.

Our beloved
DR. Firoz bin Yusuf Patel Dawoodi

ACKNOWLWDGEMENT

We would like to say how grateful we are and say thank you to Dr. Firoz bin Yusuf Patel Dawoodi for everything he has done for us throughout the semester. No words can express our respect and admiration for you as a teacher. You always make the class interesting. We have enjoyed every single minute of your class and learned a lot. You're making an impact on

students ' lives in your class, and they're going to remember you for years to come. Thank you for your life's positive change.

Being a teacher can't be easy. It takes a lot of hard work and sacrifice. You doubtlessly spend a lot of time worrying about the students in your class at the expense of your personal time. For example, you have spent your extra time for our group in this lab session. We thank you sincerely for caring so much. We know that teaching is a difficult work, but you are pouring into it your heart and soul. We are inspired by your love as parents.

We also want to thank our laboratory assistants who support us a lot during the work of the laboratory. They have given encouragement and comfort when without any grievances we experienced difficulties. They help us in identifying the problem we face in conducting the circuit and direct us to solve it quickly. During the lab session, they were very cooperative, which helped us to complete the project a lot.

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BACKGROUND

In this project, we will implement 3 different components on a single ATMEL device. These components including:

1. 3-bit Count up Counter
2. 3-bit Comparator
3. Clock Disabler

THE PROBLEM

User will initially enter amount of copies; the counter will count the number of copies that has been photocopied. The machine will stop once the required number of copies produced.

OBJECTIVES

The objectives of this laboratory are to introduce the students to:

1. Understand the development of a PLD device.
2. Learn a simple Hardware Description Language.

COMPONENT

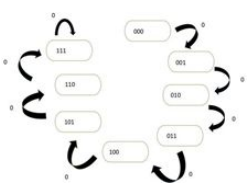
1. Counter

• We used State Diagram (For 3Bit Asynchronous Counter)

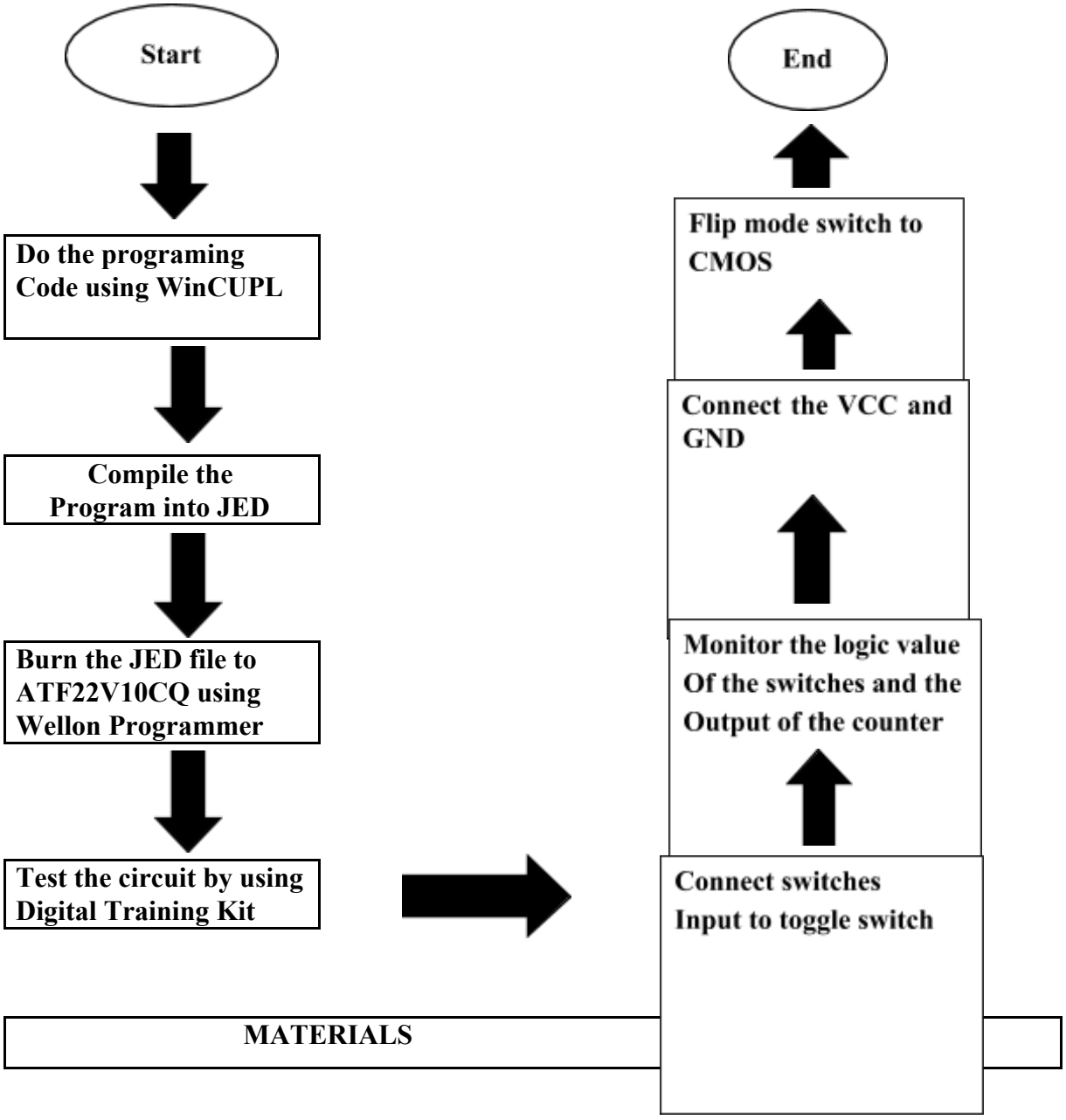
2. **3-bit Comparator:** To compare whether the amount of copies required and also the amount of printed copies has been met

3. Input Switches : To set the initial amount of copies that user want to print

4. Clock Disabler : To stop the operation of the counter when the amount of copies and printed copies has been met.



FLOWCHART



MATERIALS

The materials of this laboratory are:

1. Breadboard
2. ATMEL 22V10 – 1 unit
3. ETS-5000 Digital Training Kit
4. 4.Wellon Universal Programmer & Tester
5. WinCUPL 5.0 Software

1. Handouts:

   a. “WinCUPL user manual”
   b. “ATMEL 22V10 Data Sheet"
   c. “How to use Wellon Programmer”
   d. “How to use Win CUPL 5”

1. ATMEL 22V10

The ATMEL22V10 is a collection of programmable-logic gadgets from Lattice Semiconductor, implemented as CMOS-based standard array common sense ICs, and reachable in twin inline packages or plastic leaded chip carriers. It is an instance of a wellknown manufacturing GAL device that is frequently used in instructional settings as a basic PLD.

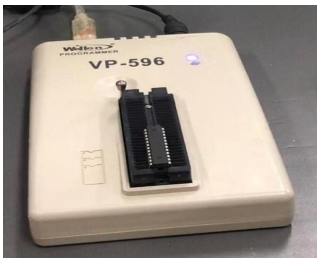
The ATMEL22V10 has 12 input pins, and 10 pins that can be configured as both inputs or outputs, and exists in a number of switching speeds, from 25 to four ns. Each output is driven via an output-logic microcell, with an output-enable product term, and a variable range of product terms, ranging from eight to sixteen. Each OLMC might also be set to output as inverting or non-inverting, and be placed into both registered or combinatorial mode. In registered mode, every microcell actively uses a D-flip-flop to hold a country underneath control of the facts enter from the good judgment component of the microcell and the rising facet of the clock signal, while in combinatorial mode the flip-flop is eliminated from the microcell and the outputs are pushed immediately through the logic. In the latter mode, the pin may additionally also dynamically change between input and output primarily based on the product term. In both modes the pin cost is fed back into the array as a product term. Combinations are set using an E2PROM.The output registers can be preloaded into a potentially invalid country for testing via a ATMEL22V10 programmer. Inputs and outputs include lively pull-ups and are transistor-transistor common sense compatible due to highimpedance buffers. A person digital signature area is included for small print such as person ID codes, revision IDs, or asset tagging on legit Lattice Semiconductor units, as nicely as a static ES section for compatibility with non-Lattice Semiconductor ATMEL22V10 units. In addition, a protection cellphone is covered which, when set, disallows the retrieval of the array common sense from the chip, until a new set of logic is set.

2. WinCUPL

WinCUPL is a software package that runs on a PC. It performs most of the work in translating a PLD design into a programming file. The programming file can be used to program an IC to implement the desired logic functions. Marquette University (College of Engineering) has a site license for CUPL.

- Translates PLD Design into programming file.
- CUPL expressions written in Sum of Products form. Limit of 7 product terms

3. WELLON



Wellon is a programming inserter machine. To use it, it requares a software of its own system. This programmer is for a range of devices, including lots of memory chips, PIC microcontrollers, EEPROMs, dsPIC, AVR and other microcontrollers like AT89, plus PLDs and flash memory. Over 22,000 devices are supported.

CIRCUIT IMPLEMENTATION

At first, for 2-bit and 3-bit Xerox machine we have to connect the pins of the circuit according to the diagrams. Then for 2-bit we can connect the A0, A1 input pin to the display of BCD1 respectively A, B and C, D of BCD1 into the GND. Additional to that, the Q0, Q1 pin will have a connection with the display of BCD2 respectively with A, B and C, D of BCD2 will go to GND. Again for 3-bit we can connect the A0, A1, A2 input pin to the display of BCD1respectively A, B, C and D of BCD1 into the GND. Additional to that, the Q0, Q1, Q2 pin will have a connection with the display of BCD2 respectively with A, B, C and D of BCD2 will go to GND.

Figure 3: 3 bit Xerox machine Circuit

PHYSICAL SYSTEM IMPLEMENTATION

The photo shown below is the complete wiring for 3 bit Xerox system using 3-bit comparator shown in figure 4.

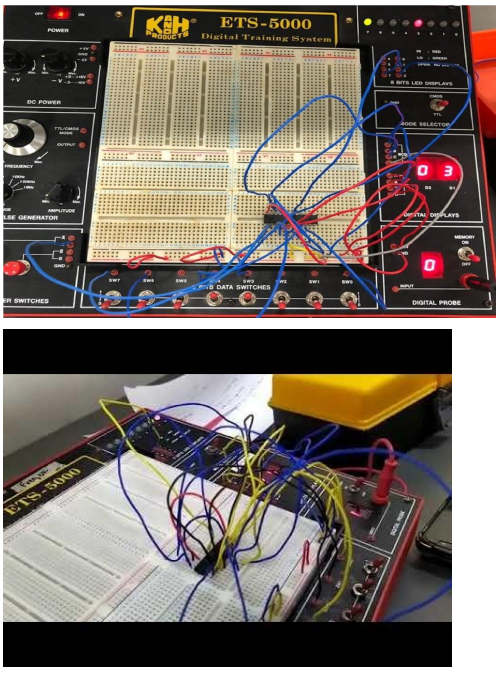


Figure 4: ETS-5000 TRAINING KIT

DISCUSSION

As a summary of this project. This mini project is about the Programmable Logic Device (PLD) photocopying (XEROX) machine. This project has introduced to us the development of a PLD device and the simple Hardware Description Language, we used the ETS-5000 Digital Training Kit and the software which are Wellon universal Programmer and WinCUPL 5.0 Software to design the 2-bit and 3-bit Xerox System. The components we used is just the simple components such as switches, counter, comparator, and clock disabler. All of these components is implemented as a WinCUPL code that will be programmed into GAL22V10 device. The IC is connected by following the circuit implementation and tested on the ETS5000 Digital Training Kit to confirm the design of Xerox System.

The strength that is needed to complete this mini project is the problem-solving skills and thinking skills. This is because this mini project requires us to design a 2-bit and 3-bit Xerox

System and there must be having some problems that we do not know before. We need to have skill to solve the unexpected problem of the Xerox System when we will do our mini project.
we faced some Problem while doing this mini project. We burnt the code into the chip but first time we failed for the 2 bit. We did everything correct the process showed us it's failed. Then we burnt again that time it was correct actual the problem was we connected the chip before make setting in the application. Then we faced another problem when we switch it from 2-bit to 3-bit. The code and some were had to change. We did everything correctly as our knowledge but got the wrong pulse. The check again we found we made an unusual connection with the GND when we removed that is was worked perfectly.

CONCLUSION

In a nutshell, we successfully completed the project. We able to propose a solution based on the problem that we figure out and the circuit can function well. Is a fact that, real Xerox machine will have a more complex circuit design inside it but this project increases our knowledge on how does the Xerox machine work and the simple circuit inside it. Now we know that the main design of Xerox machine is consist of decoder, counter, comparator and clock disable.

After this project, we realize that we lack of knowledge on conducting practical circuit project. Although we know the theory but if we lack on practical we still not able to conduct a complex circuit. The weakness of us on this project is not able to implement adder on this circuit design. This is because we do not have the idea on how to design adder in our circuit and how it would count the money for us. If we manage to design the adder in our circuit, then our circuit will be more

Although we encountered some problems but fortunately we managed to solve these problems. We also gained a lot of experience from this project. We understand that practical applications are as important as studying the theory because it provides better understanding on how the components functioning. Besides, we have

learned a how to use WinCUPL software and Wellon Universal Programmer & Tester to overwrite or program the PLA.
If we manage to design the adder circuit then our circuit will be better, as this imply that we know how to use the adder. Although we had finished our project, we will still figure out how to use the adder component.

REFERENCES

1. Abd.Bahrim Yusoff, Mazleena Salleh, Mohd Fo'ad Rohani, Ismail Fauzi Isnin..Retrieved from: Digital logic (fifth edition)
2. Neso Academy Retrieved from: youtube/nesoacademy
3. Thomas L.Floyd.Digital Fundamentals(ELEVENTH EDITION)

Appendix

The program source code of 3-bit 2-bit XEROX System

The program source code of the 3-bit XEROX System with comments

```
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 6 = a2 ;                 /* */
PIN 7 = b0 ;                 /* Comparator B */
PIN 8 = b1 ;
PIN 9 = b2 ;                 /* */
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 */
PIN 23 = q2 ;

/***** Function Comparator************************/
sameCmp = !(a0$b0)&!(a1$b1)&!(a2$b2);
diffCmp = !sameCmp ;

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

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;       /* state 00 go to 01 */
       present s1 if clkEn next s2;
              default next s1;       /* state 01 go to 10 */
       present s2 if clkEn next s3;
              default next s2;       /* state 10 go to 11 */
       present s3 if clkEn next s3;
              default next s3;       /* state 11 go to 11 */
}
```

```
Name XeroxMachine3BIT ;
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 6 = a2 ;                 /* */
PIN 7 = b0 ;                 /* Comparator B */
PIN 8 = b1 ;
PIN 9 = b2 ;                 /* */
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 */
PIN 23 = q2 ;

/***** Function Comparator************************/
sameCmp = !(a0$b0)&!(a1$b1)&!(a2$b2);
diffCmp = !sameCmp ;

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

/*** Function Counter 3 Bit UP ********************/
field count =[q2..0];
$define s0 'b' 000
$define s1 'b' 001
$define s2 'b' 010
$define s3 'b' 011
$define s4 'b' 100
$define s5 'b' 101
$define s6 'b' 110
$define s7 'b' 111

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 s4;
              default next s3;
      present s4 if clkEn next s5;
              default next s4;
       present s5 if clkEn next s6;
              default next s5;
       present s6 if clkEn next s7;
              default next s6;
       present s7 if clkEn next s7;
              default next s7;
}
```