UTM

UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING

SECR 1013 DIGITAL LOGIC

REPORT FOR MINI PROJECT LAB 4

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DEDICATION & ACKNOWLEDGEMENT

This project is dedicated to our Digital Logic lecturer, Dr Nur Haliza Binti Abdul Wahab. We want to to thank her for her hard work and dedication for teaching us Digital Logic during this pandemic season. It was a challenge to teach asynchronously as she had to record the lectures and upload them in Youtube, so that we are able to watch the lectures and do revision. Furthermore, she also guided us and explained to us thoroughly about our mini project so that we can understand the whole process and able to carry out the project smoothly.

We also would like to express our gratitude to our course mates and friends who had helped us and throughout the project. Although until now we haven't met each other due to the stay-at home rules, we are really thankful for them for giving us advice on how to modify the Xerox machine and sharing information with us. They patiently helped us and answered our questions as we discussed together via social media platforms.

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OBJECTIVE

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

MATERIALS

1. Breadboard
2. ATMEL 22V10 - 1 unit
3. ETS-5000 Digital Training kit
4. Wellon or Hi-Lo ALL-11 Universal Programmer & Tester
5. WinCUPL 5.0 Software
6. Handouts:
   - "WinCUPL user manual"
   - "ATMEL22V10 Data Sheet"
   - "How to use Hi-Lo Programmer"
   - "How to use Wellon Programmer"
   - "How to use Win CUPL 5"

BACKGROUND

This mini project will implement 3 different components on a single ATMEL device. Those components are : 1. Count Up Counter

2. Comparator
3. Clock Disabler

Students have to familiarize themselves before doing this experiment with the WinCUPL compiler and the universal programmer.

THE PROBLEM

To initialise or close the Xerox machine, a switch is acquired as a power button to switch on/off the xerox machine. In order to prevent unauthorised usage of the machine, user is required to enter a password to access the other xerox machine components. An output component is used to implement that the entered password is true. If entered an invalid password, the machine will not proceed to the next step. Then, the user is required to select the properties of printing. The properties are printing properties which include colour print and grayscale print while the layout properties are portrait and landscape. An output component is required to verify this process. After that, the users have to input the number of copies they want to print, which the range starts from 0 to 7. The users also have to enter code of printing properties so the machine could calculate the total price of the printing. Next, user need to set the PRESET and CLEAR button to reset the counter. The photocopy machine contains a counter to count the number of copies that have been photocopied. Two one-digit 7-segment display is used to show the amount of required copies and photocopied copies. A two-digit 7-segment display is used to show the printing price. A comparator will compare the number of required copies and photocopied copies. The machine will stop once the required number of copied produced.

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.

PROPOSED SOLUTION

The block diagram of the components required is shown in Figure 1. Firstly, to initialise the photocopy machine, user is required to turn on the power button to power on the photocopied machine components. Then, user is required to input a 4-bit password before starting to use this photocopying machine. This is to prevent unauthorised usage of the machine. If the entered password is incorrect, the user cannot proceed to the next step. Once the password is correct, the LED will light up to indicate that the machine is ready for use.

Then, the users have to select the properties of printing. The properties are printing properties which include colour print, grayscale print, portrait and landscape. The properties are either colour printing with portrait or landscape or grayscale with portrait or landscape. A multiplexer is used to accept the input from user when selecting the properties and a demultiplexer is used to determine the choice that the user had chosen. The 7-segment display would show either “1” or “2” to represent the corresponding properties. Three core component that used in counting the copied required are 3-bit comparator, 3-bit JK positive edge count up counter and a clock enabler. The Counter is used to count the number of copied that has been printed. The Comparator will compare the number of copied required (input) with number of printed copied (count). Once the number of copied are equal to number of printed copies, the clock enabler would be disable the clock and stop counter from counting.
To implement this, user has to input the number of required copies by using 3 input switches which accept 3 bits digit which is from “0” to “7”. Another 3 bit input is used to allow the user to enter the binary code of printing properties from “001” to “100”. The price for each printing properties is included as caption in the Deeds circuit diagram. The machine would multiply the price with the number of copies through 3 bits multiplier which is constructed using half adders and full adders. Then, the total price is displayed to the user through a 2-digit 7-segment display.

Next, user need to configure the PRESET followed by CLEAR to “1” to reset the counter. Two 7-segment LEDs will be connected to the device to show both the amount of required copies and photocopied copies. If the amount is different, then it will continue photocopy until both the values are same. After that, the photocopy machine will stop printing and counting. The printing process has been ended. If the user wants to continue the use of the xerox machine, he or she just need to repeat the step of choosing properties, input number of copies required and reset the PRESET and CLEAR to 1.

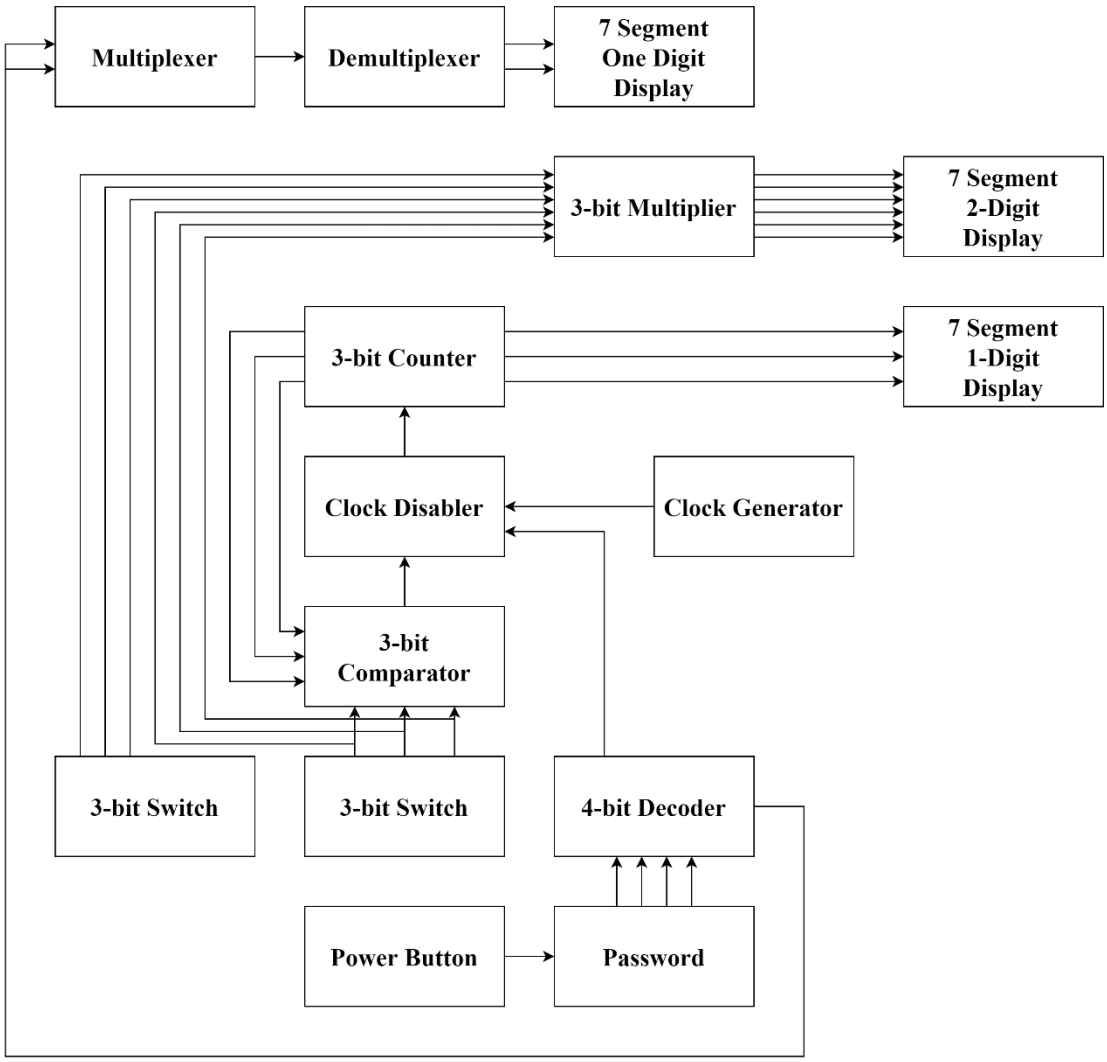


Figure 1

COMPONENTS & REQUIREMENT

1. Input Switches

To set the required number of copies.

2. 3-bit Comparator :

To compare the number of copies required with the number of copies produced.

3. Clock Disabler :

To stop the operation of the counter. If copies printed are less than required copies, the counter will continue to count up. If the required copies has been met, the counter will stop counting.

4. 3-bit JK positive edge count-up Counter :

To count the number of copies that has been printed.

5. Multiplexer

To allow user choose the printing properties.

6. Decoder

To decode the specified the combination of bits on the input which would be accepted as the correct password.

7. Demultiplexer

To determine the printing properties chose by the user.

8. 7 Segment Display

To display the required number of copies, amounts of printed copies, total price in hexadecimal base.

9. Adder

To perform the multiplication of the amount of copies required with the price of corresponding printing properties and calculate the total price.

SYSTEM IMPLEMENTATION

1. Password

We use a 4-bit decoder to decode the set of binary passwords. The enable pin of 4-bit decoder is connected to power button by which mean the decoder will only activate when the power button is activated. The user will then need to input the password which is '1001' or in decimal, 9. The output of the decoder is connected to a LED. Once the user has inputted the valid password, the output of this decoder will light up. Once the LED light up, it will allow the photocopy machine to work. The output of decoder is connected to multiplexer, this mean in order to activate the properties selection state, the password had to be correct.

2. Printing Properties

Two 2-to-1 multiplexers are used to allow the user choose the printing properties that the user wants. User would enter an input at S0 to choose the properties that the user need. Each multiplexer control a specific printing properties. For page layout, the printing properties would be landscape if the input is "0" and portrait if "1". For ink properties, the printing properties would be grayscale if the input is "0" and colour if "1". All these properties are connected to the 4-bit decoder in which if the user enter an invalid password, the machine can't proceed to this step. Demultiplexer are connected to output of multiplexer thus this component is use to determine the properties that the user had chosen.

3. Input Switch

There are 2 sets of 3 switches allocated for the user to input the number of copies they required and the code of printing properties. Each of the switches represents a single bit respectively, which are A0, A1 and A2. A0 represent LSB and A2 represent MSB. Hence, the user can input value ranging from "0" to "7" only. The output of input switches is connected to the 7-segment display, comparator and 3-bit multiplier.

4. **3-bit count-up Counter**

The 3-bit counter that we use is 3-bit JK positive edge count-up counter. The counter would start to count when the clock is enabled. It will start counting if the J and K input are connected to high input. In our case, we use power button to implement the active high input, if password entered is correct and the clock enabler is being active. It will stop when the clock pulse is no longer received or reached the number of counts initialised by the user.

5. **3-bit Comparator**

The comparator uses three 2-input XOR gates to compare value from two sources, which are the input switches and the counter. The first XOR gate compare the least significant bit (LSB) of the two sources. If they are same, the output will be "0" and it is sent to the NOT gate and convert it into "1". The same rule is applied for the second and the third XOR gate. Then the signal from all the three gates will be sent to a NAND gate to convert it into opposite signal. Therefore, when all the XOR gate received the same input from input switches and the counter, it will send an output "0" to clock disabler to stop the photocopying machine.

6. **Clock Disabler**

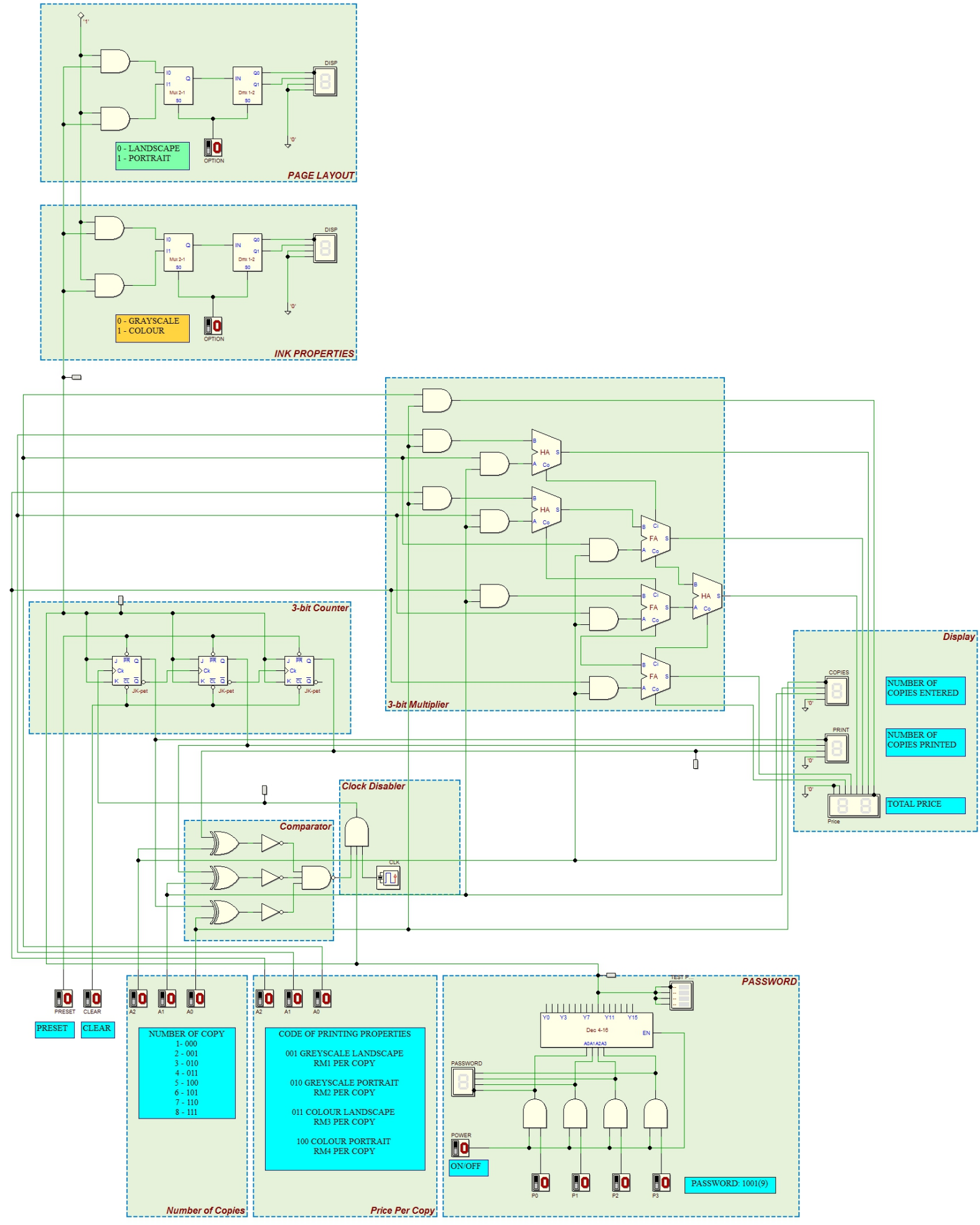
The clock Disabler is set up by using a 3-input AND gate. The input of the AND gate is the clock source, signal sent by the decoder and a signal sent by the comparator. The disabler would only be active when all three inputs are high. It is used to stop the operation of the counter when the amount of copies and printed copies has been met.

7. **Display System**

This component displays the number by converting the binary code received and into hexadecimal. Four 1-digit 7-segment displays are used in which the first of them shows the required copies and the second shows the printed copies while the reset display the printing properties. Since the maximum input for the number of copies is only “7”, the forth input of the 7-segment display is connected to the ground and user could directly read the number on the display. However, we also use a 2-digit 7-segment display to show the printing price. This 2-digit 7-segment display would receive 6-bit input and the seventh and eighth inputs are connected to ground. Since the maximum input of this display exceeds “9” in which the display would start to represent the number with letter “ABCDEF” in hexadecimal, the user have to convert the hexadecimal output by themselves into decimal in order to read the actual output.

8. **3-bit multiplier**

Two types of adder which are half adder and full adder are used to construct a 3-bit multiplier that multiply the number of copies required with the code of the printing properties that represents a specific price per copy. This multiplier circuit would produce a 6-bit output in which the maximum number is “49” in decimal or “31” in hexadecimal. Therefore, a 2-digit 7-segment display is used to show the output and the user has to convert the hexadecimal output into decimal to read the actual output.


PAGE LAYOUT
0 - LANDSCAPE
1 - PORTRAIT
OPTION
INK PROPERTIES
0 - GRAYSCALE
1 - COLOUR
OPTION
3-bit Counter
3-bit Multiplier
Display
COPIES
NUMBER OF COPIES ENTERED
PRINT
NUMBER OF COPIES PRINTED
TOTAL PRICE
Clock Disabler
Comparator
PRESET
CLEAR
NUMBER OF COPY
1- 000
2 - 001
3 - 010
4 - 011
5 - 100
6 - 101
7 - 110
8 - 111
Number of Copies
CODE OF PRINTING PROPERTIES
001 GREYSCALE LANDSCAPE
RM1 PER COPY
010 GREYSCALE PORTRAIT
RM2 PER COPY
011 COLOUR LANDSCAPE
RM3 PER COPY
100 COLOUR PORTRAIT
RM4 PER COPY
Price Per Copy
PASSWORD
POWER
ON/OFF
PASSWORD: 1001(9)

CONCLUSION

We were able to complete this project on time after overcoming all the obstacles and time constraints. We were lagging behind when we got this project because this project was given right before our finals study week. Nevertheless, we still could manage to complete this project successfully with the commitment of our team and the help from other friends that are also doing the same project. Since this is our last lab and project assignment for this semester, we put in our best effort to make sure our final product for this project to be flawless and refined. We are proud of our final product for this project and we hoped to have more of this kind of project in the future.

This project helped us to gain deeper understanding on logic circuits as we only learned the theories in lectures and never had a chance to apply them in real life situations. At first, it was quite difficult for us as we were unable to understand the configuration of a Xerox machine and we were unsure on where to begin. Thus, we spent some time understanding the process and sought help from our course mates and friends who are friendly and kind. After some explanations we were finally able to understand the process and then began to plan out the modification for our Xerox machine and thus carried out the project. Thus, making this project has helped us apply our theoretical knowledge into practical work and make us much better in understanding the overall topics in our course.

Our greatest strength while conducting this project is we were able to communicate well although we were bound physically due to the COVID-19 pandemic which required us to stay at home. Any questions and problems that we faced while connecting the circuits, we will ask and discuss together through Whatsapp. After that we will come out with solutions together to solve the problem. Despite all of the obstacles and resistance that we faced, we managed to adapt and improvise whatever way we could to complete our project successfully.

Although all of our enhancement works perfectly, we do have certain things that we think we need to improve. Our current price display would display the value in hexadecimal, hence we hoped to improve our design by converting the

hexadecimal to decimal so that users could see the price display in decimal value because it is much more comprehensive to every user.

APPENDIX

Video demonstration:

https://youtu.be/-aJNtGv4YwQ