UTM

UNIVERSITI TEKNOLOGI MALAYSIA

DIGITAL LOGIC PROJECT

PRIVATE ELEVATOR SYSTEM DESIGN

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SUPERVISED BY:

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Course: SECR1013

By:

Group 7
Section 03

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1. Dedication and Acknowledgement

This project is dedicated to our lecture, Dr. Fazrina. We would like to express our gratitude towards her for teaching us Digital Logic within this semester, and also your passion for the subject matter and your commitment to our learning experience have truly made a lasting impact on all of us. Not only that but we also have the opportunity to learn more about logic solving, digital circuits and components inside a machine that we almost use in our daily life.

We would also like to express our appreciation towards our group members, who are working really hard to accomplish this project until complete and manage to present it in the best way possible. Our contribution in this project truly inspires us to improve our critical thinking skill and problem-solving skills, along with our communication in a team.

2. The Background

In this project, we will make a private lift system which contains a password to go up and down. The user needs to enter a 4-bit number to represent a password. The full circuit is drawn using deeds and includes combinational circuit and sequential circuits.

Combinational Circuit Components Includes:

- 3-bit comparator
- 4-bit comparator
- 4-bit decoder
- Demultiplexer
- Multiplexer
- Basic gates
- Switches
- LEDs
- 7-segment display

Sequential Circuit Components Includes:

- 3-bit up/down counter
- Clock disabler

Enhanced Features:

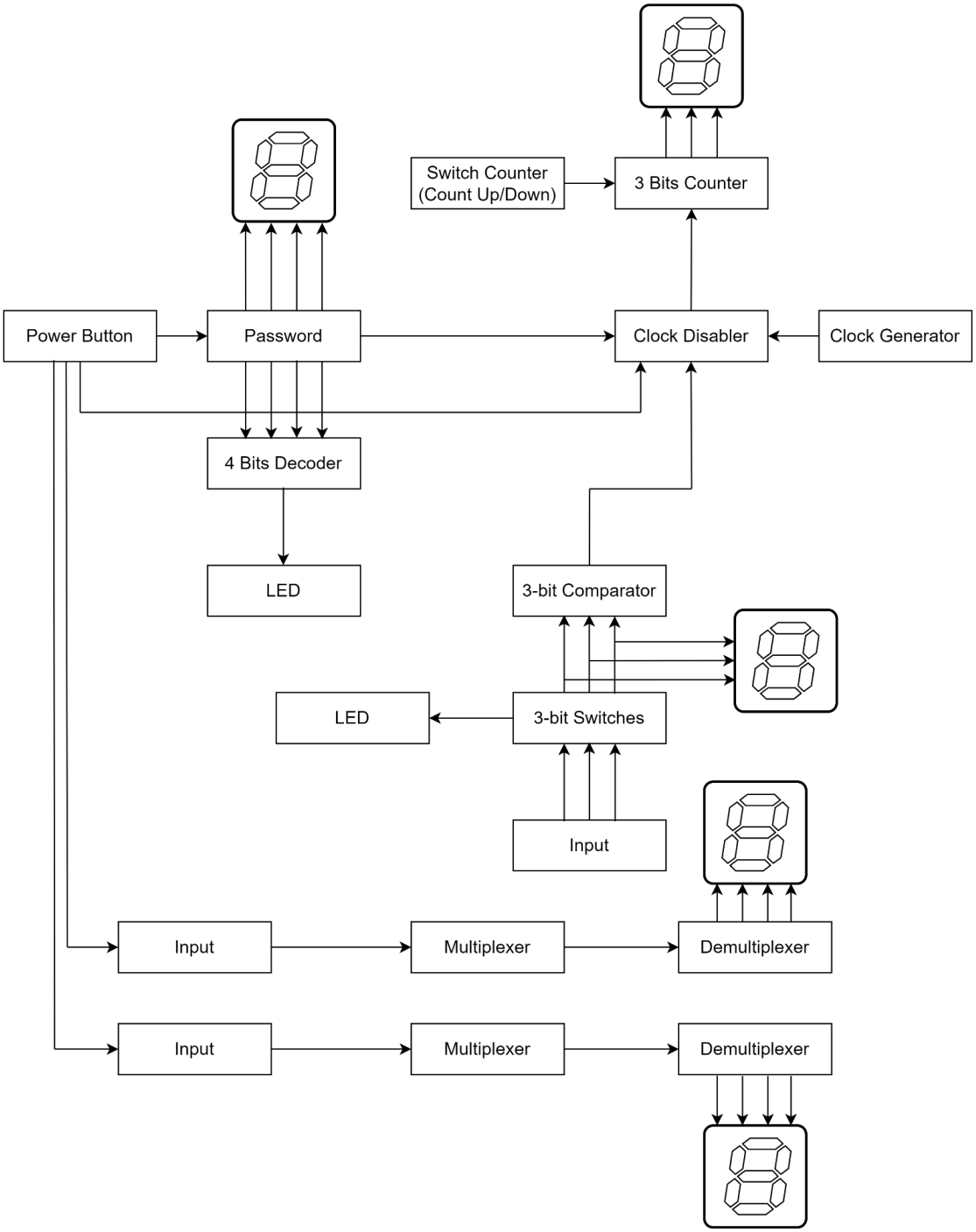
- 4-digit password
- Sound Notification
- Welcoming Note
- Door Open/Closes

3. Problem and Solution

Unauthorized use can often be a problem especially in the construction and real estate industries, offering private or custom elevator solutions for high-end residences, corporate offices, and luxury buildings. Therefore, we have implemented a password using 4-bit decoders to allow users to input a four-digit password. Firstly, the user has to turn on the power switch in order to enter the input the password (The password has already been set). If the password is incorrect then the user may not choose which floor for the elevator to go. If the password is correct then LEDs will light up and the user can proceed to go where they want (The maximum is seventh floor). After the user chooses the option floor, then the option will display using a seven-segment display. The 3-bit counter will count up if the desired floor is higher than the current floor and vice-versa. The 3-bit counter will stop counting if it reaches the chosen floor and LEDs will light up indicating the door of the elevator is open as well as the sound notification.

The complete process is shown in the Block Diagram below.

4. Block Diagram



5. The Requirements

Input Switch

The user can enter the number of floors from ground floor (0) to seventh floor (7).

Decoder

The 4-bit decoder is used to decode the 4 digit binary number password. The user will be provided a password with the help input switches and the power button must need to be opened first in order for the decoder to work.

Clock Disabler

The clock disabler will activate when all the four inputs are high (1) and it will start and loop the counter up or down until it reaches the desired input.

3-bit count up or down counter

The counter will begin to count up if the requested floor is higher than the current floor and vice versa, and will eventually stop until it reaches the desired floor. The maximum floor is only reached until 7th floor only. The floor count will show up using a 7-segment display.

7-Segment Display

The 7-segment display shows the user's password output and also will display the level indicator of both the desired floor and the current floor.

3-bit Comparator

The function of a 3-bit comparator is to compare the user's requested floor and the user's current floor.

Power Button

The power button input switch allows the user to enter a password as well as give a high input to the clock disabler.

LED

The LED on password will light up when the user entered is correct. Also when it reaches the user's desired floor, the LED will turn on indicating the elevator door will open, a sound notification will be heard and the “WELCOME” phrase will light up.

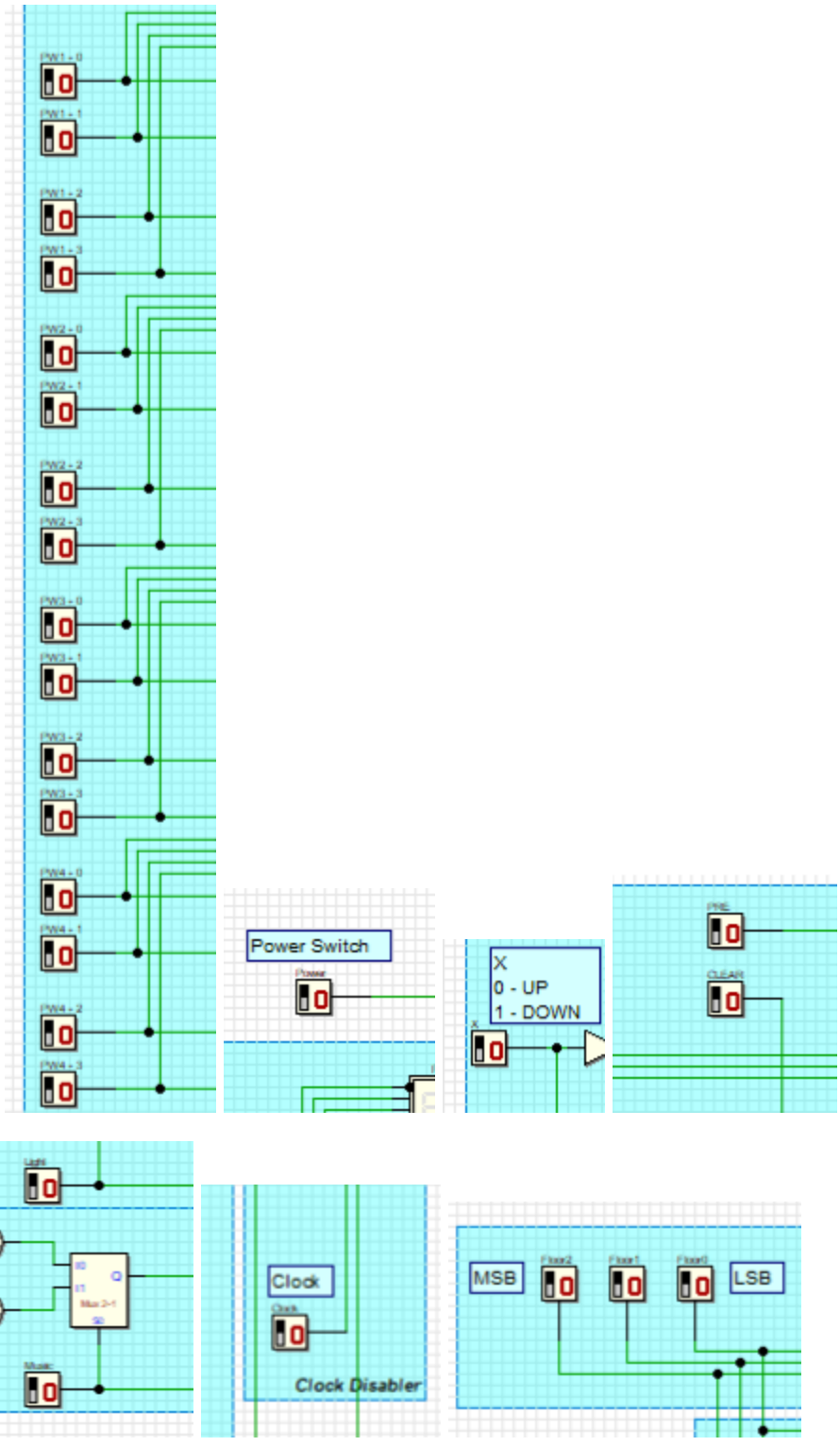
UP/DOWN Switch

The 3-bit counter will count up if this switch is low(0) and will count down if this switch is high(1).

6. System Implementation

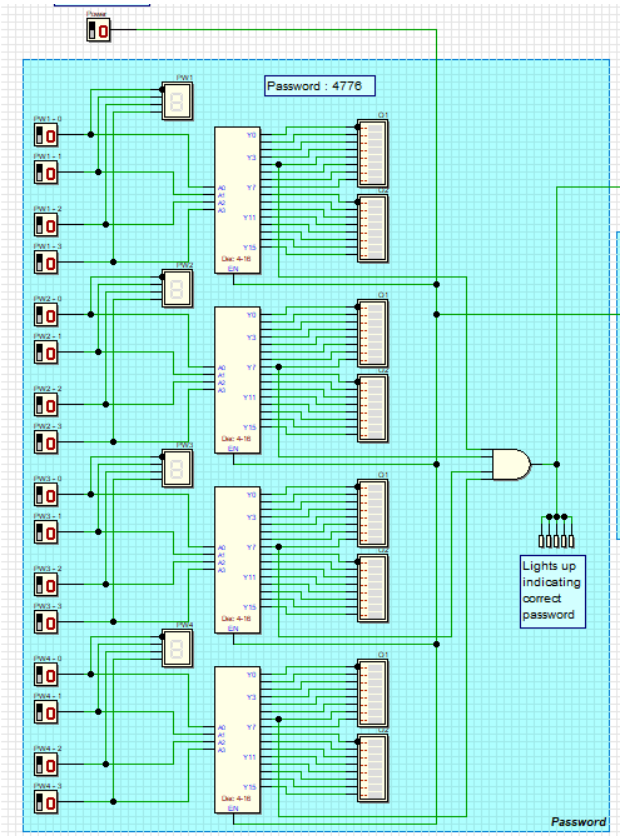
1. Input Switch

Firstly, there is a power button input switch to select either to turn on or off all the switches. There are 3 input switches for the user to input the number of floors that user wants to go. Each of the switches represents a single respectively, which are Input 1, Input 2 and Input 3. For example, Input 1 represents LSB, and Input 3 represents MSB. Hence, the user can enter input values in range from 0 to 7. The output of the input switch is connected to a 7-segment display to display the number of floors requested and also to the comparator. There are also 16 input switches for the user to input a 4-digit password connected to a 4-bit decoder to decode the set binary password. There are also input switches for counting up or counting down. The movement of the elevator will go up if this input switch is high and will go down if low. There are also two input switches which are Clear and Preset. Preset is used to set initial values of 1 to the output while Clear is used to reset the output to 0. The last input switches are the option for the user to adjust the light intensity and to turn the music. Both of the input switches are used for multiplexer and demultiplexer.


Power Switch
X
0 - UP
1 - DOWN
Clock
Clock Disabler
MSB
LSB

2. Decoder

We wish to create a four-digit password. We utilize four 4-bit decoders to decode the binary passwords. Each decoder represents a digit from the password. A power button input switch allows you to turn on or off the elevator . The 4-bit decoder enable pins are attached to the power button. This implies the decoder will only start working when the power button is pressed. Each decoder's output is coupled to two LED arrays (Q1 and Q2). When the user selects an input value between 0 and F for each decoder, it will light up. The output of the decoders is coupled to an AND gate, which is then connected to the LED. When the LED lights up, it indicates that the user has entered the right password. The output is coupled to an AND with the output of the clock disabler. When both the output from the decoder and clock disabler are high, only then will the flip-flops operate.

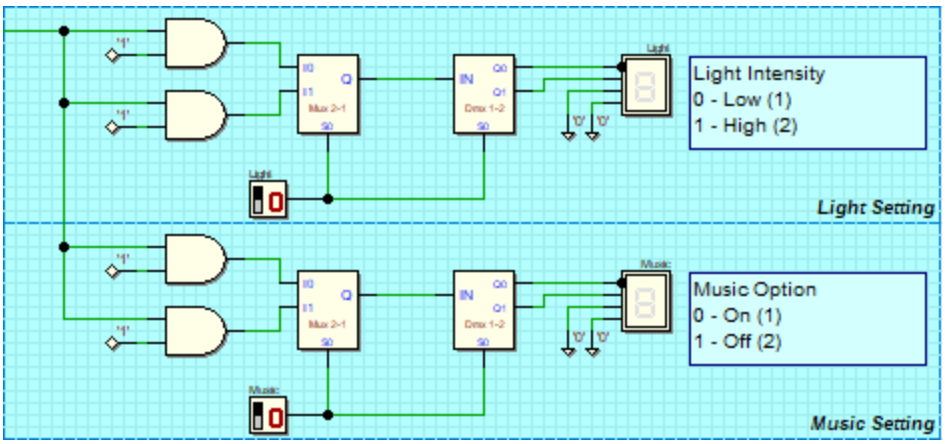


3. Multiplexer

There are two multiplexers that allow the user to select the ambiance in the lift. There is only one user input for each multiplexer. The first multiplexer's user input is Light, while the second multiplexer's user input is Music. Those inputs are used to specify the ambiance the user wishes in the lift. For the first multiplexer, when Light = 0 the light intensity in the lift will be low while when Light = 1 the light intensity in the lift will be high. For the second multiplexer, when Music = 0 the music in the lift will be turned on, while Music = 1 the music in the lift will be turned off. This feature can only be used when the power is turned on.

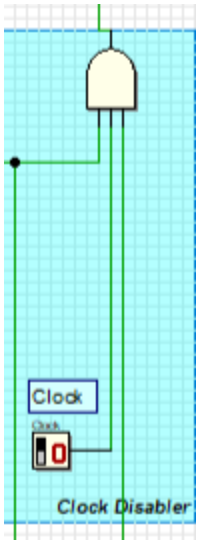
4. Demultiplexer

There are two demultiplexers connected to the outputs of the first and second multiplexers. The multiplexer's output determines the properties-type and properties-size set by the user. Therefore, each demultiplexer is connected to it. The output of both multiplexers is connected to a 7-segment display. After picking the attributes (type and size), the LED will light up according to the number of options (1 or 2). The 7-segment display displays the number of user selections (1 or 2) for the ambiance in the elevator.



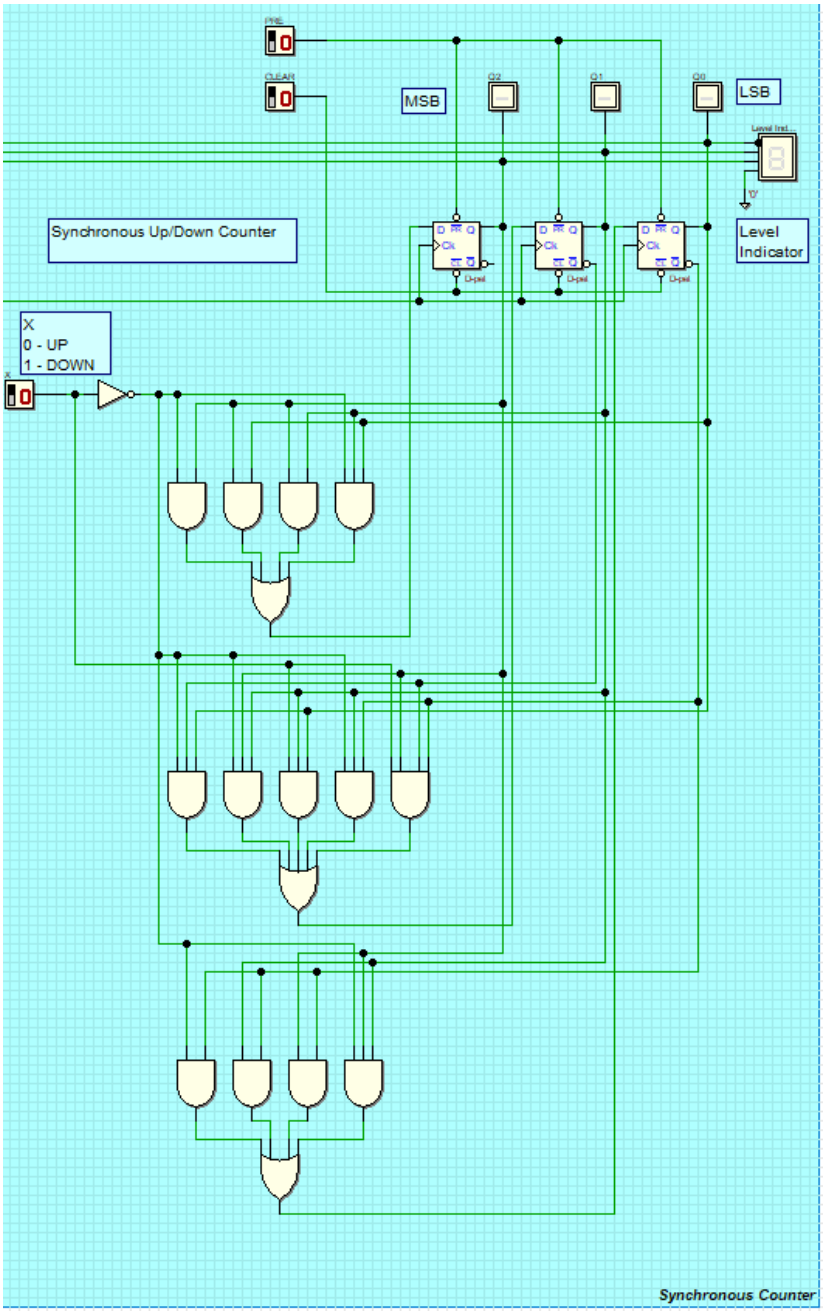
5. Clock Disabler

The clock disabler is set up using a 3-input AND gate. The AND gate has four inputs: clock source, power, and comparator. The clock disabler only works when all four inputs are high. The output of the 3-input AND gate is connected to the clock of the counter's flip-flop. The counter would start and stop when the desired number of floors was reached.



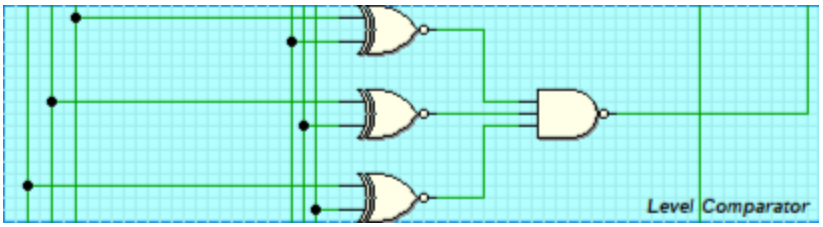
6. 3-bit, Synchronous Count Up/Down Counter

We used a 3-bit, D positive edge count up/down counter. The clock enabler controls whether the counter starts or stops counting. When the Preset and Clear inputs are on high, the flip-flops will start working. The output Q of each flip-flops (Q0, Q1 and Q2) will be displayed on all three output (one-bit) displays as well as a 7-segment display. The flips-flops will no longer function when the desired floor is reached.



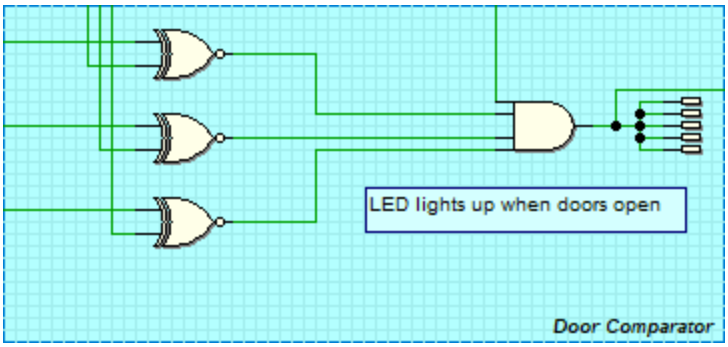
7. 3-bit Comparator

The comparator is set up by using three 2-input XNOR gates which are used to compare values from 2 sources, which are the input switches which are used to input the number of floors by the user and the 3-bit count up/down counter. The first XOR gate compares the least significant bit (LSB) of the 2 sources. If the number of floors requested and the number of the current floor are the same, the output will be 0, and it is sent to the NOT gate and converted into 1. The same principle can be applied for the second and the third XOR gate. Then, the signal from all three gates will be sent to a NAND gate to convert it into the opposite signal. Therefore, when the input of the NAND gate is received by the high input (1) given from input switches and the counter, in result the lift will not be able to move to the other floor.



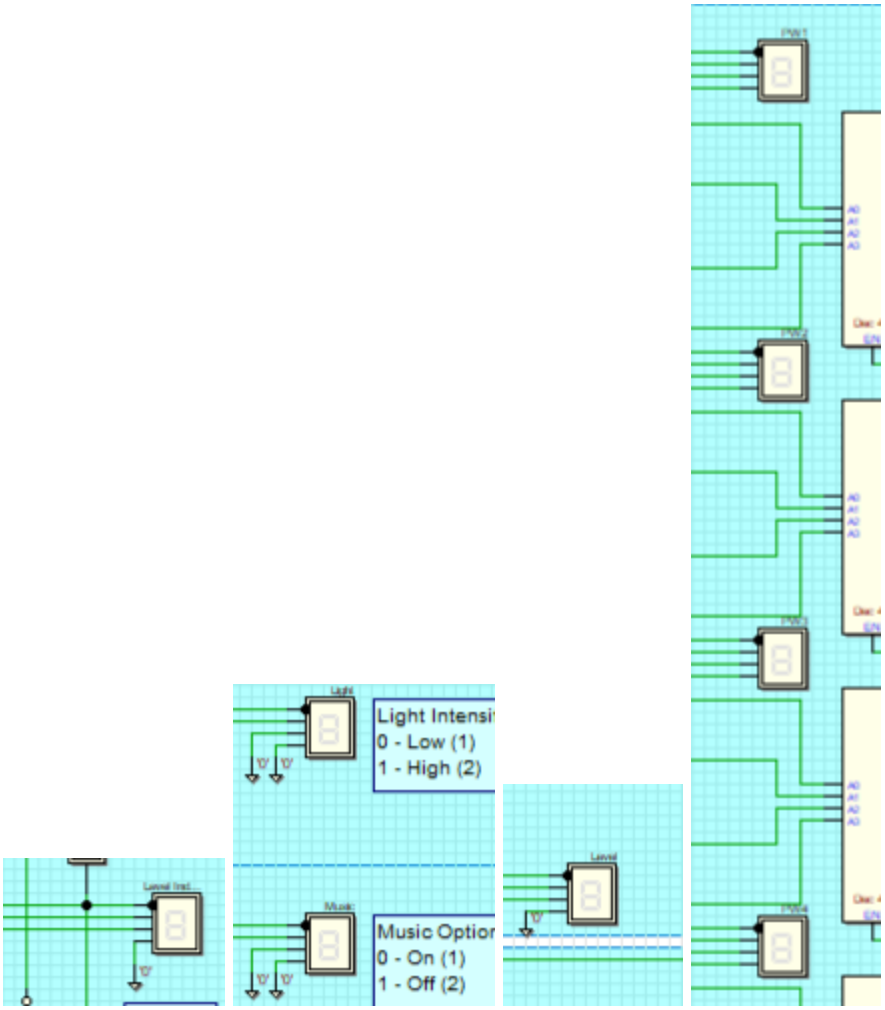
8. 4-bit Comparator

This comparator works almost the same as the 3-bit comparator, however, it has an extra for a 4-bit AND gate instead of NAND which is connected to the power button; when the power and the input floor has not been reached, the door will be closed and vice-versa.



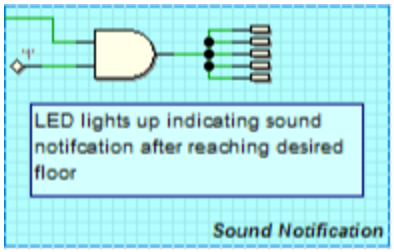
9. 7-Segment Display

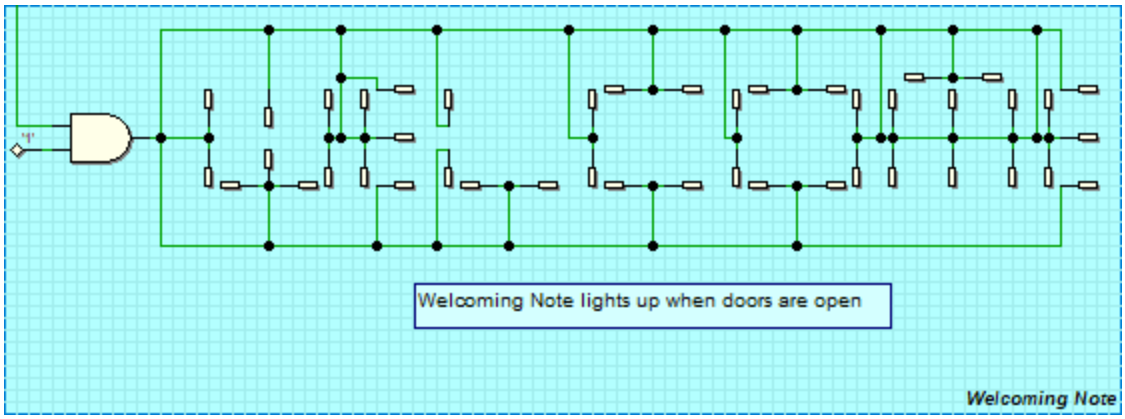
The 7-segment display will display the number based on the BCD value by converting the BCD code received into decimal numbers and letters. This component will display the decimal numbers 0 to 9 and letters from A to F by turning up the proper light of the 7-segment display. The password output, the user choice of requested floor, the current floor, light intensity preference and music optional are connected to a 7-segment display. Since our password numbers are in range between 0 to 15, this component will display from 0 to F. The user requested the floor and the current floor will display from 0 to 7. Lastly, the music and light intensity options only display either 1 and 2.



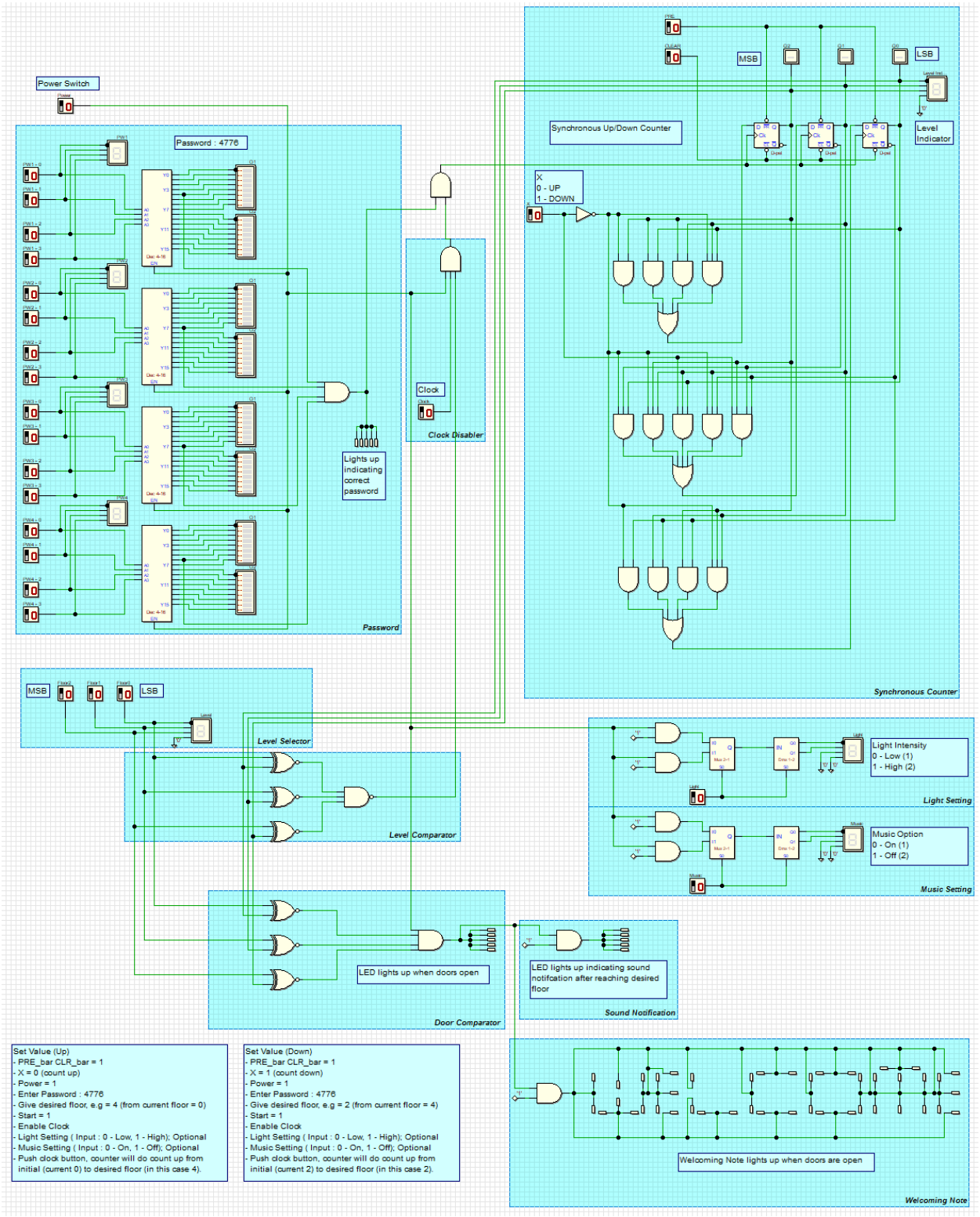
10. LED Features

The Sound Notification and Welcoming Note feature both take the input from the 4-bit comparator. If the output of the comparator is high then this feature will be functional.





7. Full DEEDS Circuit



8. Conclusion

In a nutshell, this project has a simple, user-friendly design. The circuit mainly consists of the 4-bit decoders, the input switches, seven segment displays and LEDs for outputs, a 3-bit comparator, 4-bit up counter and a multiplexer and demultiplexer. The password for security was a great addition to our circuit and was connected so that none of the other components works when it is wrong. The music optional and light intensity choices are very convenient when it comes to a variety of different people's tastes. One of the issues that we encountered is that the password is not too complicated to be figured out by the unauthorized user and it is also because of the limitation numbers or characters to set is password lock. In future projects, we are hoping to implement even more complex circuits with more exciting options, and we are looking forward to using our knowledge in related courses and applying it to real life situations.

9. References

1. Digital Logic Module
2. Digital Logic Lab

10. Appendices

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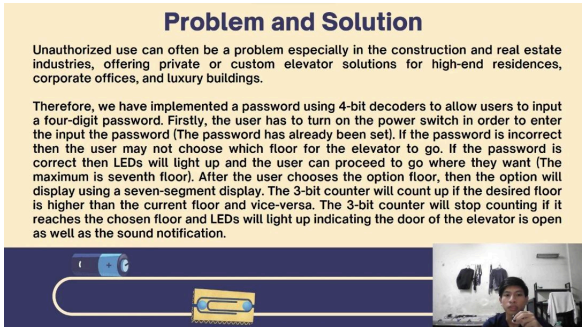
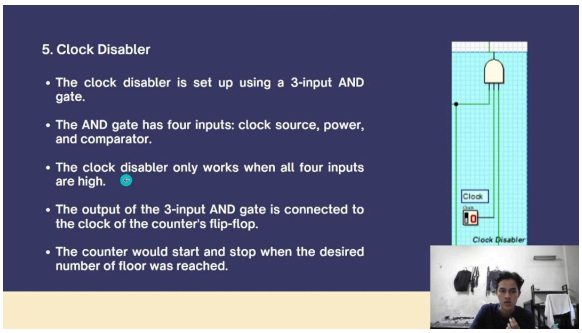
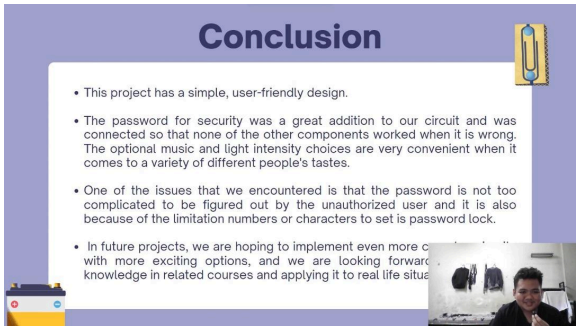
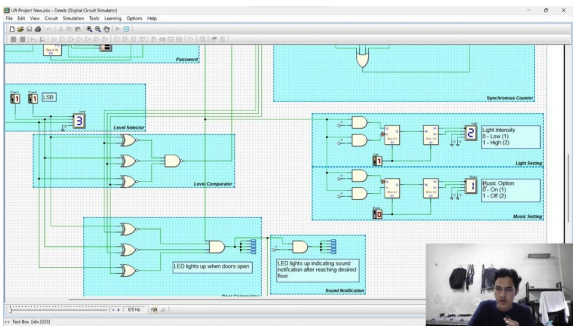
OUR PRESENTATION









Video link (Presentation) : DL_PRESENTATION.mp4

Video link (DEEDS Circuit) : DL_DEMO.mp4