FACULTY OF COMPUTING

SEMESTER 1

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SECR1013 – DIGITAL LOGIC

SECTION 02

PROJECT TITLE : ELEVATOR CONTROLLER SYSTEM DESIGN

GROUP 5

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DEDICATION AND ACKNOWLEDGEMENT

This project has been an incredible journey, enriching our understanding of the subject matter and encouraging us to think creatively. The completion of this endeavor required countless hours of dedication and hard work, and we owe its success to the invaluable support we received from numerous individuals.

Furthermore, our deepest gratitude goes to our lecturer and project guide, Dr. Zuriahati, whose unwavering support and guidance were invaluable throughout the project's duration. Her contributions, providing us with the necessary knowledge and skills, played a crucial role in shaping the project and ensuring its successful completion.

We are also thankful to all those who directly or indirectly contributed to this project. To our families and friends, we express our sincere appreciation for their unwavering encouragement and understanding throughout this challenging yet rewarding journey.Their support has been a source of inspiration and motivation, making this achievement all the more meaningful.

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1.0 PROJECT BACKGROUND

In this project, we will implement a special electronic controller in an eight-story hotel lift system using a 3-bit bidirectional saturated counter. It is also protected by a 4 digit password, and has the ability to recognize visitor's hotel cards, and the ability to show whether the door is open or closed. The full circuit is drawn using the DEEDS application and includes a few combinational and sequential circuit components.

Combinational circuit components :

- 3-bits comparator
- 4-bits decoder
- Basic gates
- Hexadecimal display

Sequential circuit components :

- 3-bits bidirectional(up-down) saturated counter
- Clock enabler

Improved features :

- Visitor’s card hotel detector
- 4 digits password
- Door open or close indicator

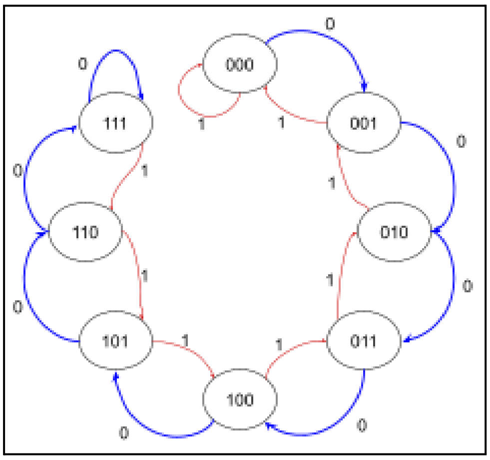
2.0 PROBLEM STATEMENT

The current design of the hotel elevator is not capable of efficiently serving an 8-story hotel and limits its functionality to a simple Up-Down movement with no additional features. This poses a challenge for both user convenience and safety. In addition, the lack of a systematic counting mechanism results in unsatisfactory elevator operation. Thus, the need for a more sophisticated control system becomes evident to enhance the user experience, ensure safety and enable seamless navigation across multiple floors.

To address the limitations of the existing design, we propose an improvement that involves implementing a 3-bit synchronous counter for Up-Down functionality in the elevator system. This counter, which uses JK flip-flops, will efficiently support the elevator's navigation over 8 floors. In addition, we are introducing key features such as visitor card detection for secure access, door open/close indication for user awareness and a passcode authentication system to enhance security.

3.0 PROBLEM SOLUTION

3.1 STATE DIAGRAM



3.2 STATE AND TRANSITION TABLE

Input X	Present State			Next State			JK Flip-Flop					
	Q2n	Q1n	Q0n	Q2n+1	Q1n+1	Q0n+1	J2	K2	J1	K1	J0	K0
0	0	0	0	0	0	1	0	X	0	X	1	X
0	0	0	1	0	1	0	0	X	1	X	X	1
0	0	1	0	0	1	1	0	X	X	0	1	X
0	0	1	1	1	0	0	1	X	X	1	X	1
0	1	0	0	1	0	1	X	0	0	X	1	X
0	1	0	1	1	1	0	X	0	1	X	X	1
0	1	1	0	1	1	1	X	0	X	0	1	X
0	1	1	1	1	1	1	X	0	X	0	X	0
1	0	0	0	0	0	0	0	X	0	X	1	X
1	0	0	1	0	0	0	0	X	0	X	X	1
1	0	1	0	0	0	1	0	X	X	1	0	X
1	0	1	1	0	1	0	0	X	X	0	X	1
1	1	0	0	0	1	1	X	1	1	X	1	X
1	1	0	1	1	0	0	X	0	0	X	X	1
1	1	1	0	1	0	1	X	0	X	1	1	X
1	1	1	1	1	1	0	X	0	X	0	X	1

3.3 KARNAUGH MAP (K-MAP)

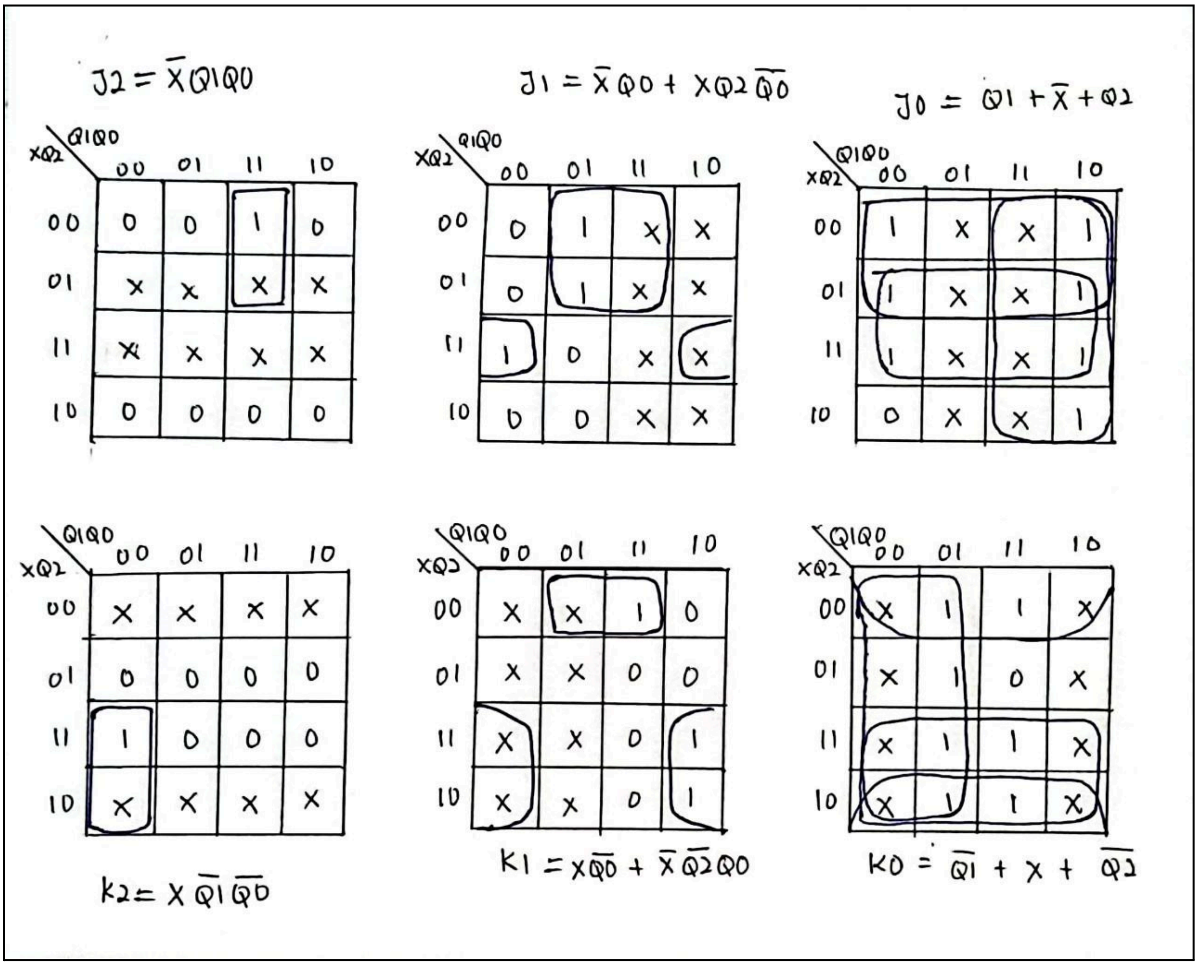


Figure 1

Excitation Table For JK Flip-Flop

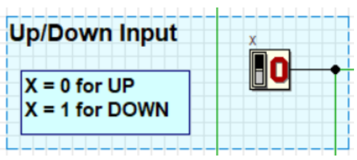
Present State	Next State	FF State	
Qn	Qn+1	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	o

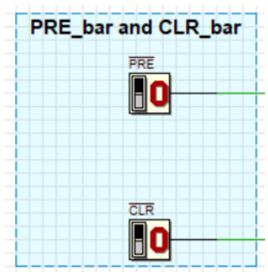
4.0 SYSTEM IMPLEMENTATION

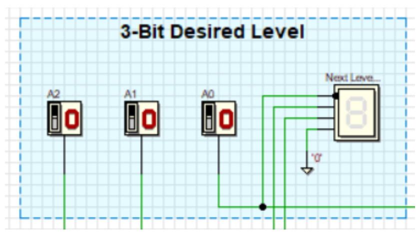
4.1 INPUT

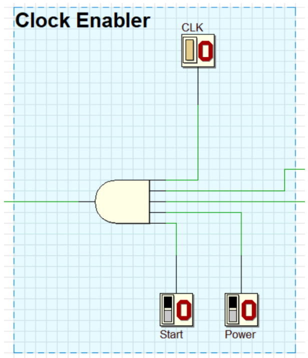
We implement 3 input switches, denoted as A0, A1, and A2, are for the users to input the desired level from 000 (Level 0) to 111 (Level 7). These switches are wired to the comparator and also a hexadecimal display to show the number in base-16. To determine the direction of the lift, we use an external input, Input X where X = 0 is for going up and X = 1 is for going down. Another 2 input switches denoted as PRE_bar is to set the initial value to 1 and CLR_bar is to reset the output to 0 when both input switches are set to 1(HIGH). Both PRE_bar and CLR_bar input are set to 1(HIGH) to allow the JK flip-flop to function as a synchronous counter.

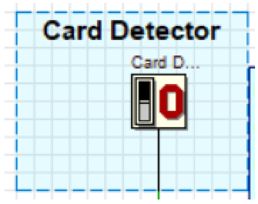
There are another 2 input switches denoted as Power and Start that represent the power and start button of the lift that are connected to the clock enabler and both have to be set to 1 to enable the clock and to operate the lift. The final 1 input switch denoted as Card Detector is set to 1 when a card is detected and vice versa. This lift design circuit is also protected with a 4 digit password where the user can input the password using 4 hexadecimal digit inputs that are connected to the decoder. The user can choose either to use a hotel visitor's card or password or both to use the lift. Finally, the push button represents the clock input connected to the clock enabler and its function is to enable the clock each time its input is 1 and move the lift up or down.

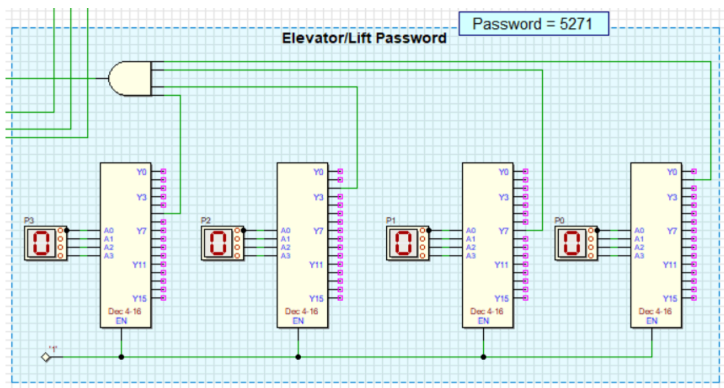






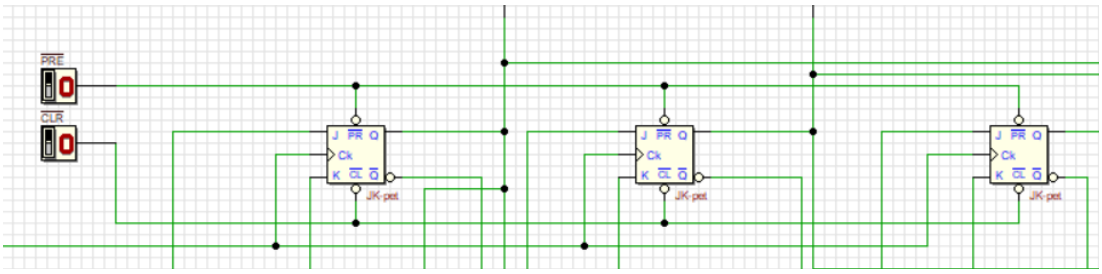






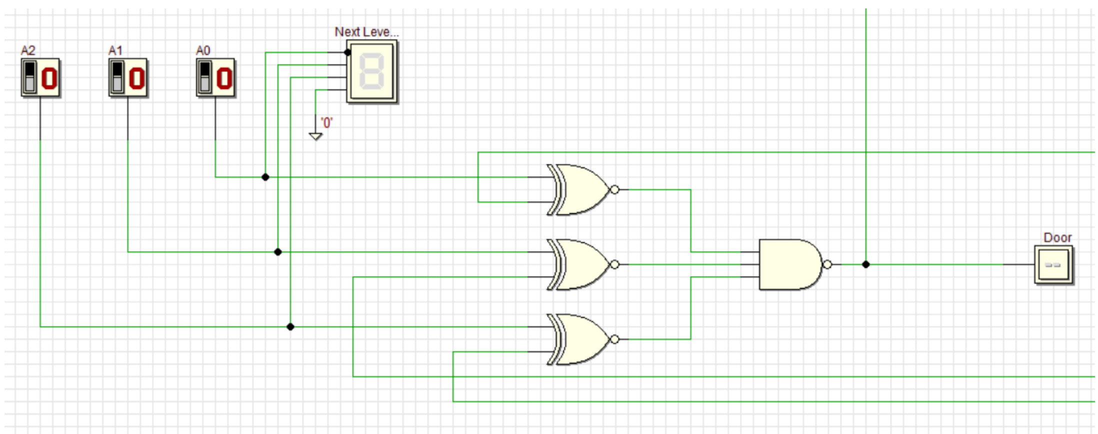
4.2 3-BITS UP-DOWN COUNTER

We implemented a 3-bit positive edge up-down counter with MOD 8 to support the 8 floors hotel elevator. This bidirectional counter allows the elevator to move up or down based on external or user input. We also used a saturated counter to restrict its count and ensure that the elevator stops at the desired floor. The counter will begin moving when it receives the correct signals or input. If the J and K inputs are high, match the correct password or detect a card, and the clock is enabled, it starts counting up or down with each button push. If the J and K signals are low, the password is wrong or no card is detected, it will stop. The elevator will also not continue moving when the clock is disabled or when it reaches the requested floor count.



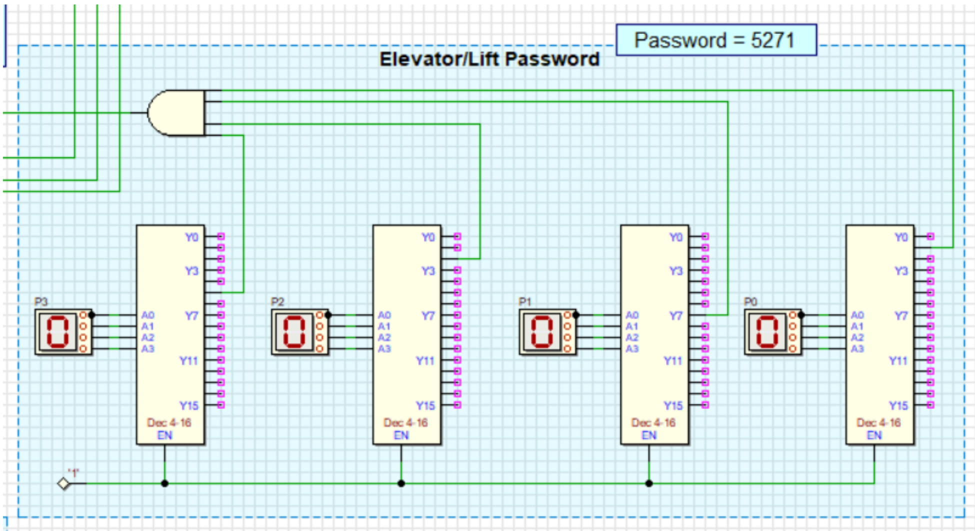
4.3 COMPARATOR

In this elevator system, we use a 3-bit comparator to compare the current floor of the elevator with the desired floor input. The comparator is built with three XNOR gates with 2 inputs. The first XNOR gate compares the least significant bit (LSB) of the two sources. If the bits of these two inputs are equal, the output will be 1. The same principle can be applied to the second and third XNOR gates. Then, we also use a 3-input NAND gate that receives the three outputs from XNOR. If all outputs are 1, the output for the NAND gate is 0. It indicates that the elevator has reached its destination floor and sends signals to disable clock input. For additional functions, we also add a door output to control the door of the elevator. If the NAND output is 0, the door is opened. On the other hand, if the NAND output is 1, the door is closed.



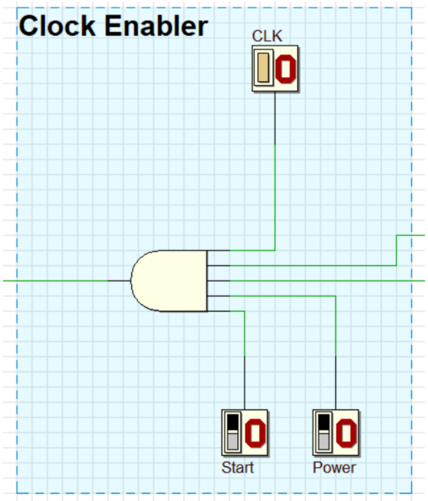
4.4 4-BITS DECODER

For the 4 digit password feature, we implement a 4-bits decoder for each digit. Each decoder is connected to one hexadecimal digit input denoted as P0,P1,P2,P3. The least significant number (LSB) is represented by the P0 decoder and input and the most significant number (MSB) is represented by the P3 decoder and input. Each decoder is connected to the same enable input which is the HIGH level input so that the decoders are always enabled for the user to put in the password. All four decoders are connected to one AND gate to ensure only one string of 4 digits numbers is the correct password. After the power input is set to 1(HIGH), the user can put in the password and the output can be 1 only if the user puts in the correct password.



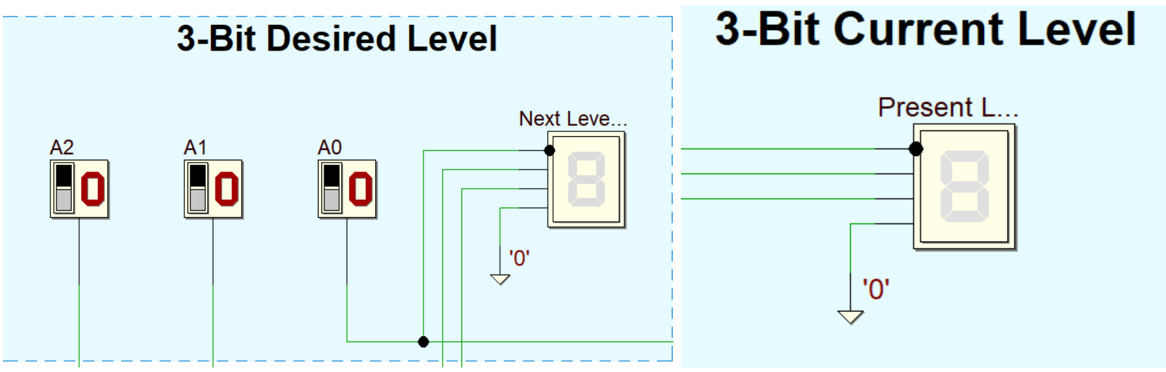
4.5 CLOCK ENABLER

The clock enabler uses a 5-input AND gate. The inputs of the AND gate are the clock source, power, start, the 3-bit comparator and the signal from the OR gate that connects to the card detector and elevator password. The gate AND will goes high when all five inputs are high. Therefore, without a card or when the wrong password is entered, the elevator will not move. Also, for the AND gate to generate output high, the output of the 3-bit comparator is not equal. The output high of the AND gate goes to clock JK flip-flop. Thus, will enable the clock to JK flip-flop and the counter can function.



4.6 HEXADECIMAL DISPLAY

The hexadecimal display or the 7-segment display can display hexadecimal numbers which are numbers 0 to 9 and letters from A to F. It will display the number based on the binary code received. Since the component is only connected to 3-bit, the component may only display the number ranging from 0 until 7. The number displayed by this component represents the current level where the elevator are and also the desired level the visitors wanted to go to. For instance, when input 000 received, the hexadecimal display will display number zero which means Level 0 or ground. As the elevator moves up or down, the hexadecimal display of current level will keep changing until the desired level is reached.



5.0 CONCLUSION AND REFLECTION

In summary, our project is an upgraded version of the recent one which only had a 2-bit up/down counter, could only reach 4 levels and used a D flip flop. Upgrading the 8-story hotel elevator system with a new electronic controller greatly improved its performance and user features. The addition of a 3-bit bidirectional saturated counter, along with combinational and sequential circuit components, enhanced the elevator's efficiency in navigating 8 floors. The introduction of a visitor's card hotel detector, a 4-digit password system and an open/close door indicator has made this system more secure and user-friendly.

Implementing a 4-digit password using decoder is a highly effective approach to strengthening the security of this system. Having a visitor's card detector also gained the ability to authenticate by tapping the card. This measure not only ensures that only authorized individuals can access the elevator but also enhances the overall security of the hotel environment. This implementation significantly contributes to the safety and security of users, aligning with modern security standards for electronic systems. But reliance on a push button makes the system more manual, causing delays in the elevator's arrival. Also, if the elevator needs to move continuously without waiting for users to press the button each time, this manual setup could be challenging.

Looking ahead, future work should focus on refining the design through testing, collecting the feedback and exploring new technologies. Further enhancements can be achieved by prioritizing emergency operation modes. Implement emergency operation modes that allow the elevator to operate continuously in specific situations such as during peak hours or emergency evacuations.

6.0 REFERENCES

1. Digital Logic Module
2. Digital Logic Lab

7.0 APPENDICES

No.	WORK DESCRIPTION	PERSON IN CHARGE
1.	Dedication and Acknowledgement	Anis Safiyya
2.	Project Background	Lubna Al Haani
3.	Problem Statement	Nawwarah Auni
4.	Problem Solution - State Diagram - State Transition Table - K-Map	Lubna Al Haani
5.	System Implementation - Input	Lubna Al Haani
6.	- 3-bits Bidirectional Counter - Comparator	Nawwarah Auni
7.	- 4-bits Decoder	Lubna Al Haani
8.	- Clock Enabler - Hexadecimal Display	Anis Safiyya
9.	Conclusion and Reflection	Nur Firzana
10.	References	All members
11.	Appendices	Nur Firzana
12.	Deeds Circuit	All members

Table 1 : Work Distribution Table

Figure 2 : Group 5 have a discussion together on 23th January 2024

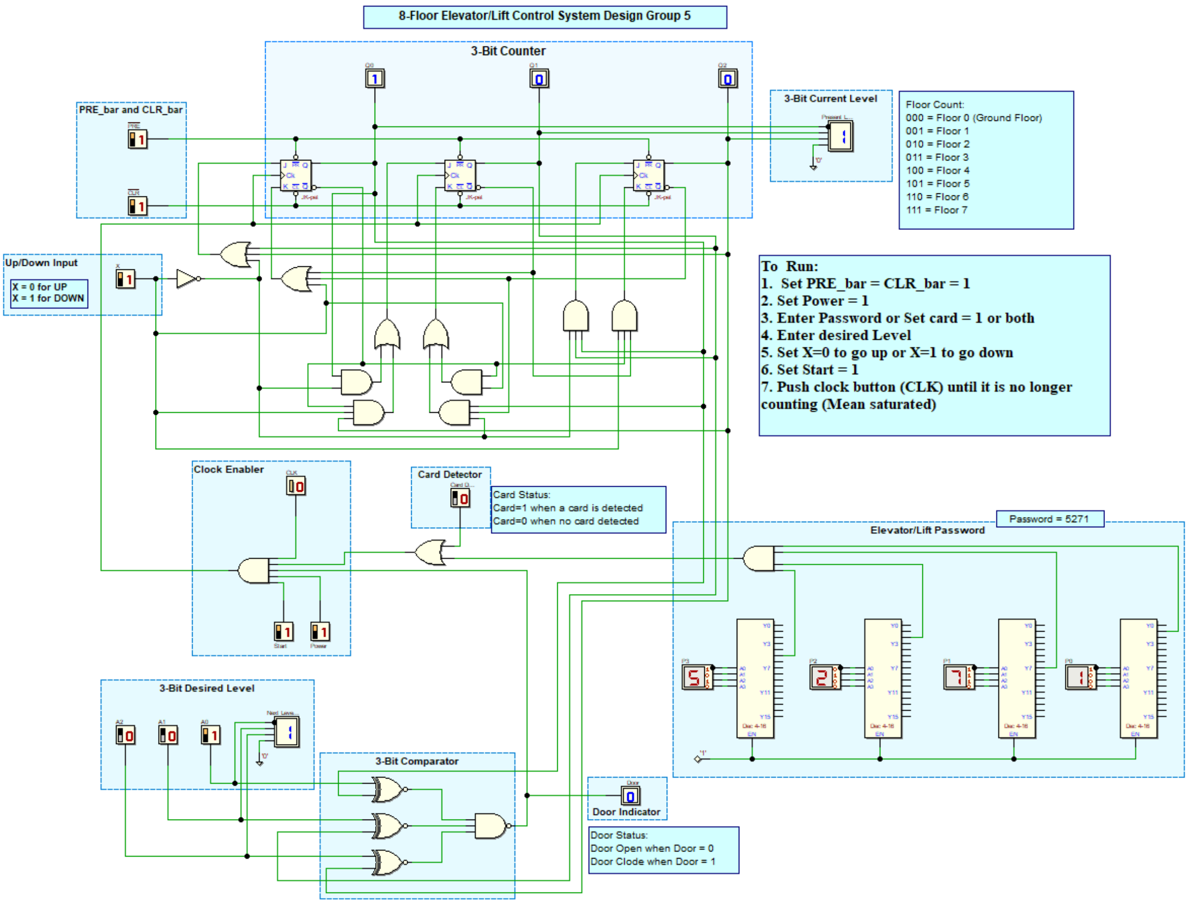


Figure 3 : Full Circuit using Deeds (Digital Circuit Simulator)