FACULTY OF COMPUTING
UTM Johor Bahru

Report on Mini Project

Subject : Digital Logic (SECR1013)
Section : 09
Group : M
Name of Lecturer : Ts. Dr. Nur Haliza binti Abdul Wahab
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Title : Lift Electronic Controller System
Link for video presentation : https://youtu.be/xgNCmyrQsPo?si=AKyhowYlK5107Par
Link for slides :
https://www.canva.com/design/DAF7t0EsqII/v1Nqa37jbTbiq17PTUZq8w/view?utm_content=DAF7t0EsqII&utm_campaign=designshare&utm_medium=link&utm_source=editor

Group Profile

 Name: Tan Xin Ying Matric Number: A23CS0276 E-mail: ying-04@graduate.utm.my Phone number: 016-5281587 Course: SECJH	 Name: Yap En Thong Matric Number: A23CS0284 E-mail: enthongy04@gmail.com Phone number: 010-8201396 Course: SECJH	 Name: Ong Ya Sian Matric Number: A23CS0260 E-mail: ongsian@graduate.utm.my Phone number: 019-4756134 Course: SECJH
	 Name: Anisa Chowdhury Matric Number: A23CS0288 E-mail: anisachowdhury@graduate.utm.my Phone number: 011-21689159 Course: SECJH	

Comments by Grader:

Dedication & Acknowledgement

This project is dedicated to Dr Nur Haliza Binti Abdul Wahab, our Digital Logic lecturer. We would like to thank her for her hard work and dedication in teaching us Digital Logic. Furthermore, she guided and described our mini-project in detail so that we could comprehend the entire procedure and carry it out successfully. Throughout the development of our mini project, she never failed to provide us with all of our requirements and explanations. We could say that without her explanation and determination, we would not have finished this project.

We also would like to express our gratitude to our coursemates and friends who helped us throughout the project. We are thankful to them for giving us advice on how to modify this mini-project and sharing knowledge with us. Similarly, we would like to thank UTM for the opportunity to work on this lift electronic controller system mini project, as we got to learn a lot from it.

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1.0 Background

A lecturer wishes to use the lift at Block N28a, Faculty of Computing, UTM to go UP from one level to another. To initiate this process, several steps are required. First and foremost, the lecturer must input the desired level, and then tap the lecturer ID Card against the reader for identity verification. Once identity has been verified, close the elevator door, and press the UP button. The lift will then proceed up one level at a time until it reaches the target level. The door will open while showing the level reached in a 7-segment display. Similarly, the reverse process occurs when the professor wants to go DOWN. The counting sequence will go down till it reaches the chosen floor. When there is an emergency, the professor can press the emergency button, which turns the LED light from GREEN to RED and sounds an alarm. The lift will stop functioning and halt on the current floor for the lecturer's safety.

2.0 Problems & Solutions

Problems:

1. Security Measures (User Card): Install an authentication system that needs a user ID card to use the lift. This keeps people from using the lift without permission and guarantees that only those who have a valid user ID card can use the lift.
2. Emergency Alarm System: Complies with safety regulations by having an alarm system that sounds in an emergency. This guarantees user safety by warning and holding the lift at its current level until help arrives.
3. Safety Measures (Passcode): Increases security by limiting lift use to authorised users, blocking access for those who input an invalid password, and requiring a valid passcode for lift operation.
4. Floor Levelling: Enhances the user experience by giving users real-time information about the lift's current floor, enabling them to reach their destination more efficiently.
5. User Interface and Accessibility: The lift system is more accessible and user-friendly thanks to its friendly interface that displays a welcome text to users upon entering the lift and reaching the desired level.

Suggested Solutions:

The block diagram of the components required is shown in Figure 1. Firstly, the user has to input his desired level. To ensure proper operation of the lift system, the user must tap his ID card on the scanner to verify his identity. Then the user is required to input a 6-bit password before starting to use the lift. This is to prevent unauthorized users from using the lift. We used a binary decoder to check whether the entered password was correct or not. If the entered password is invalid, the user cannot proceed to the next step. Once the password is correct, the lift door will CLOSE indicating that the lift is ready to use.

After entering the desired level the 3-bit comparator will compare it with the current level. If the comparator produces output 1, the lift will move. The number of floors will also be shown in the 7-segment display before the door opens notifying users with a welcome text that they have already reached their desired level. But if the comparator output is 0 then the desired level and the current level are the same, thus the lift will not move and the door will open displaying a welcome text.

In emergencies, users can press the emergency button. Whether the elevator is going down or up, it will stop moving and stop at the current level. The LED light will turn RED and the alarm will start ringing. This feature was created to enhance users' safety.

3.0 Block Diagram & Explanation

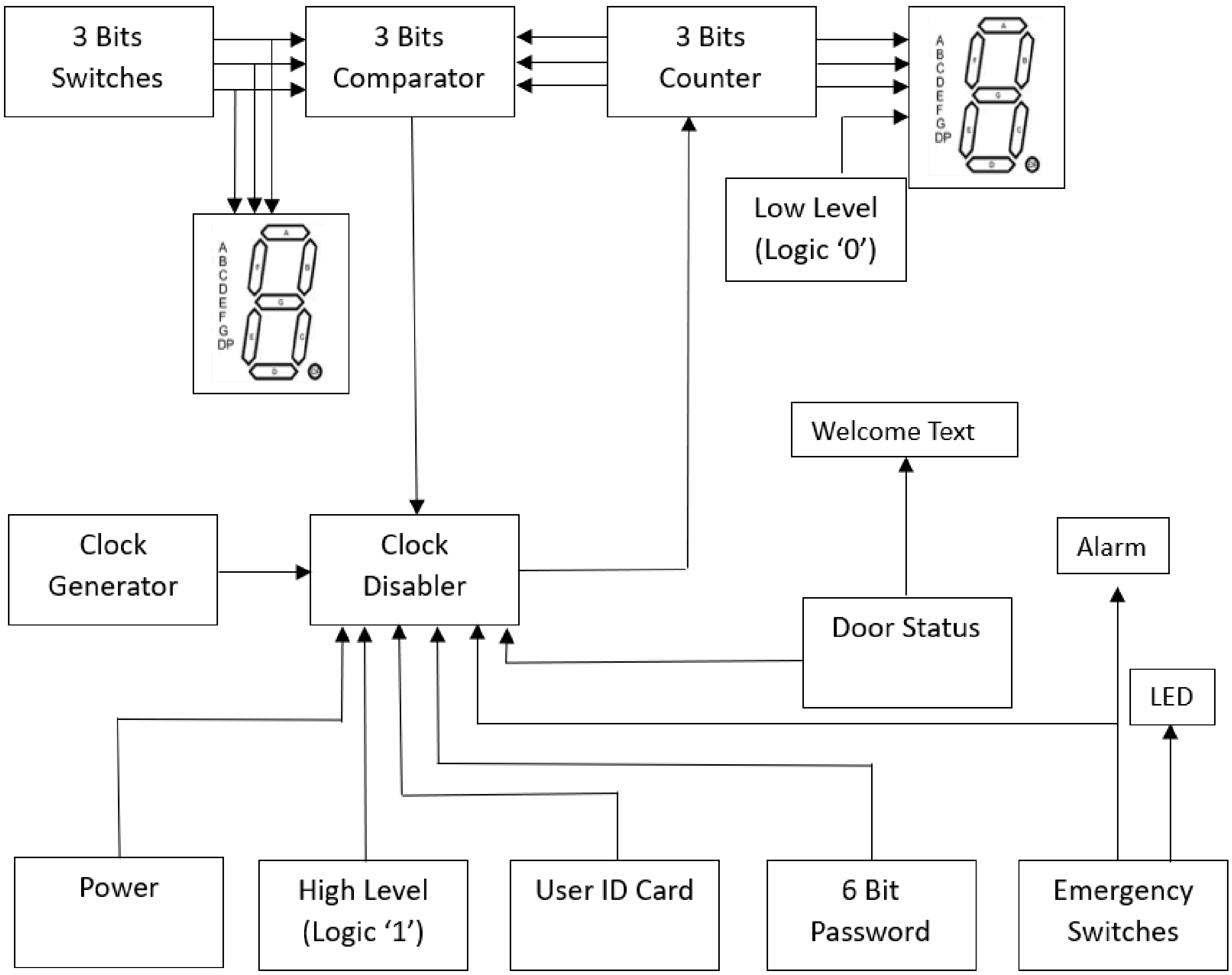

Figure 3.1: Complete block diagram for the lift electronic controller system

Explanation

3 Bits Switches

When we enter the desired level, the seven-segment decoder will show the decimal numbers. When the lift rises or falls, its number will be displayed one by one by the clock.

3 Bits Counter

We use 3 3-bit asynchronous counters and 1 input (X) to determine JK flip flop. For our case, if X is 0 the lift will count up and if X is 1 lift will count down.

Seven-Segment Decoder

We use a 7-segment decoder to display systems to convert binary input into signals that can control a 7-segment display.

Clock Disabler

All the components below are connected to AND Gate. The clock disabler is only active when all 8 inputs are 1 and it will stop the lift when it reaches the desired floor.If any connected component has any error, the lift will stay on the current floor.

Power

The power button input switch allows the user to choose whether to turn on or off the printer. Except for emergencies, the lift power is always on. It can be started at any time when people need to use it.

Clock Generator

It can produce a clock signal for use in synchronizing a circuit's operation.

High Level (Logic ‘1’)

It provides output constant HIGH to make the clock function at an active high.

Door Status

It has two states. The first state is when the door is open (0). Even if you enter the desired floor, the lift will not move. The second state is when the door is closed and you enter the desired floor so it will start moving.

User ID Card

The lift cannot move without the user card.

6 Bit Password

The password we set is 101100. Except for this password, all other passwords will be rejected and the elevator will not operate.

3 Bit Comparator

We use XNOR and NAND gates to compare the current floor and the desired floor. The XNOR Gate focuses on equality. When we enter the desired floor, it will be compared with the current floor. If the comparator produces output 1, the lift will move. If the comparator produces output 0, the lift will stay on the current floor.

Emergency switches

When this button is activated, the elevator will stop at the current floor and light up to indicate elevator failure. The alarm will also ring at the same time.

4.0 Requirement

Lift UP / Lift DOWN

The user gets a request to enter the desired floor when the lift is used and needs to ascend. To ensure proper operation of the elevator, the user must tap their user card after entering. Following that, each user must input their unique password. The comparator's output causes the elevator to climb gradually and halt at the desired floor when the door is closed. The number of floors will also be shown before the door opens, notifying users that they have already reached their destination. At the end, the door opens and the user enters.

Emergency

When encountering an emergency, users can press the emergency button. Whether the elevator is going down or up, it will start to stop moving and stop at the current floor. The LED light will light up and sound a warning to the outside world. This feature was created to keep users safe.

Lift Remain

After entering the chosen floor, we must tap the user card and input the password. The elevator will stop moving and the door will open when our desired floor and the current floor are the same.

5.0 System Implementation

To implement the circuit, we have constructed a JK Flip-flop transition table. From the table, we constructed the state diagram and truth table for each flip-flop.

5.1 JK FF Transition Table

X	Present State			Next State			JK FF Transition					
	Q2	Q1	Q0	Q2+	Q1+	Q0+	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	X	1
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1	0	0	0	0	0	0	0	X	0	X	0	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	1	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

5.2 Truth Table for J0, K0, J1, K1, J2, K2

J0 = X' + Q2 + Q1

X Q2 \ Q1 Q0	00	01	11	10
00	1	X	X	1
01	1	X	X	X
11	1	X	X	1
10	0	X	X	1

K0 = Q1' + Q0' + X + Q2'

X Q2 \ Q1 Q0	00	01	11	10
00	X	1	1	X
01	X	1	0	1
11	X	1	1	X
10	X	1	1	X

J1 = X'Q0 + XQ2Q0'

X Q2 \ Q1 Q0	00	01	11	10
00	0	1	X	X
01	0	1	X	X
11	1	0	X	X
10	0	0	X	X

K1 = X'Q2'Q0 + XQ0'

X Q2 \ Q1 Q0	00	01	11	10
00	X	X	1	0
01	X	X	0	0
11	X	X	0	1
10	X	X	0	1

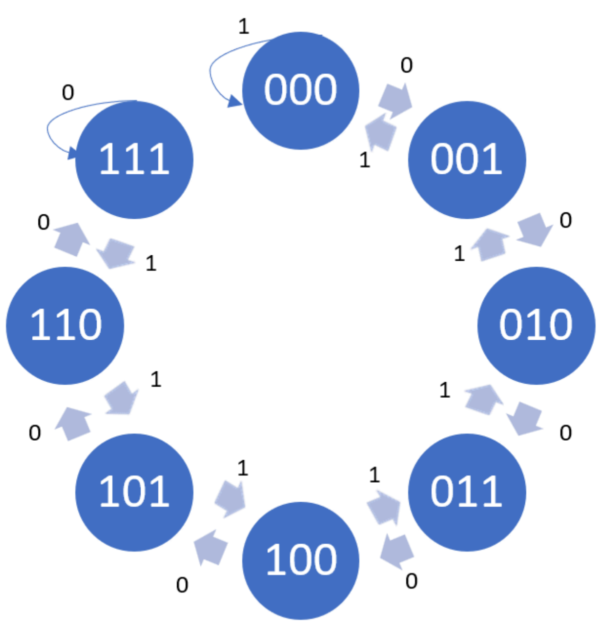
J2 = X'Q1Q0

X Q2 \ Q1 Q0	00	01	11	10
00	0	0	1	0
01	X	X	X	X
11	X	X	X	X
10	0	0	0	0

K2 = XQ1'Q0'

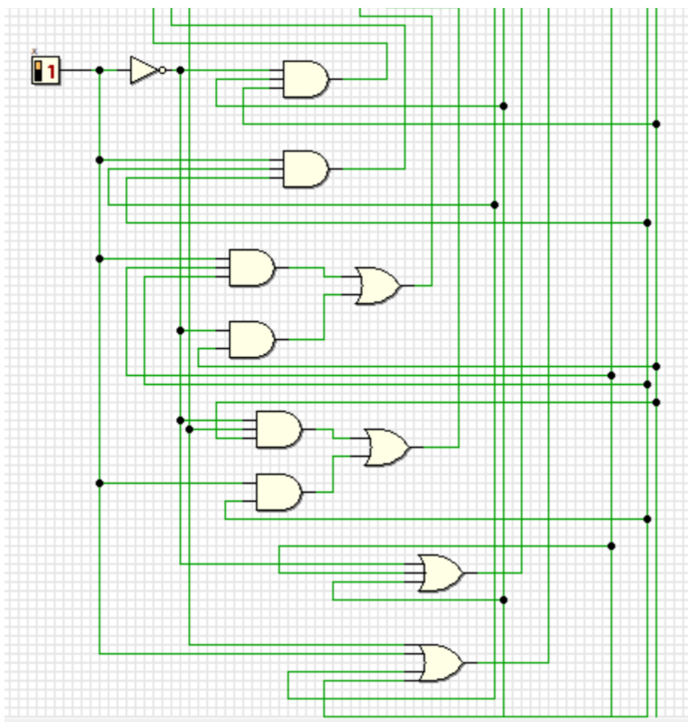
X Q2 \ Q1 Q0	00	01	11	10
00	X	X	X	X
01	0	0	0	0
11	1	0	0	0
10	X	X	X	X

5.3 State Diagram

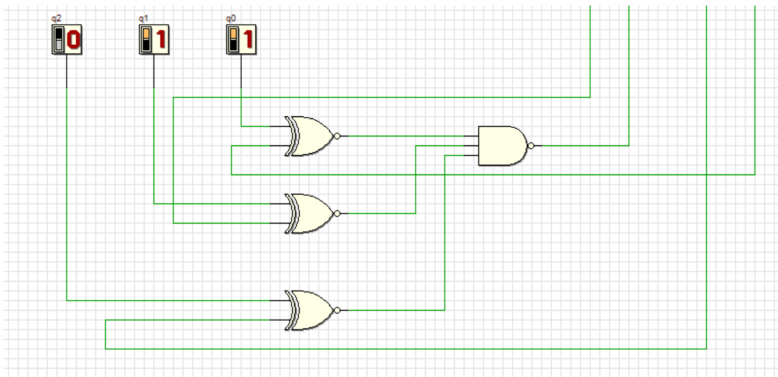


The state diagram shows that when counter up = 0, counter down = 1. It is a saturated counter sequence. This is because when the counter up reaches the highest value, the counter won't cycle back, instead it will saturate at the highest value. When the counter-down sequence reaches the lowest value, the counter will saturate at the lowest value. In our system, it is saturated at the lowest value, 000 and at the highest value, 111.

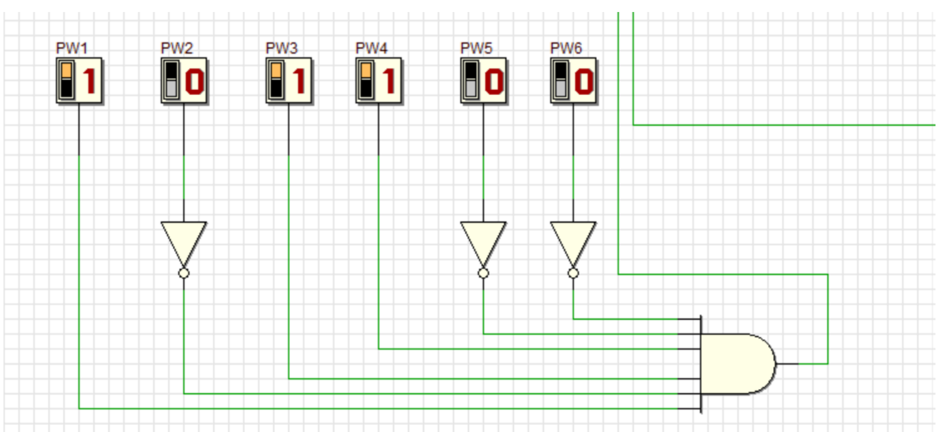
By using the truth tables, state diagram and transition table, we have constructed the full lift electronic controller system circuit in Deeds. Here are the circuit parts of the explanations.



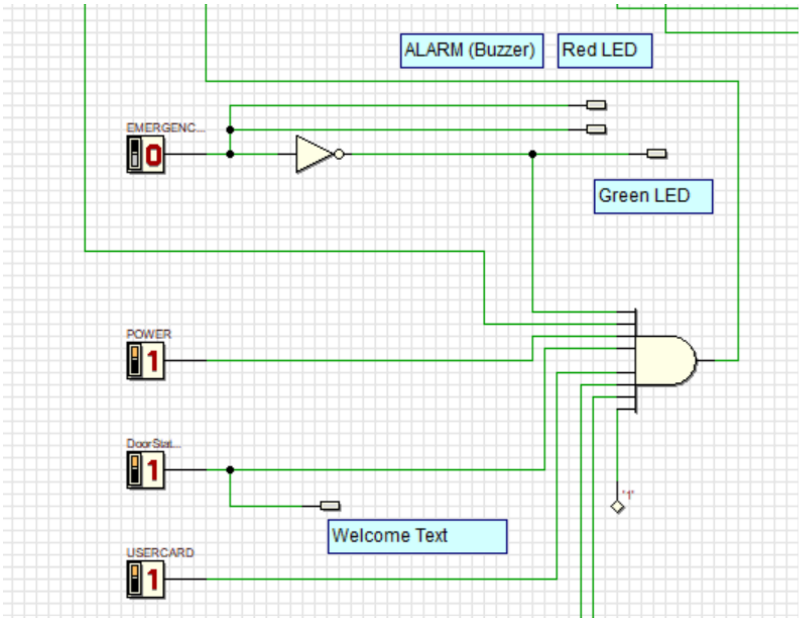
Switch X is used to control the counter up and down. When Switch X is 1, it is counting up. When Switch X is 0, it is counting down. The circuits represent the inputs of J0, K0, J1, K1, J2 and K2.



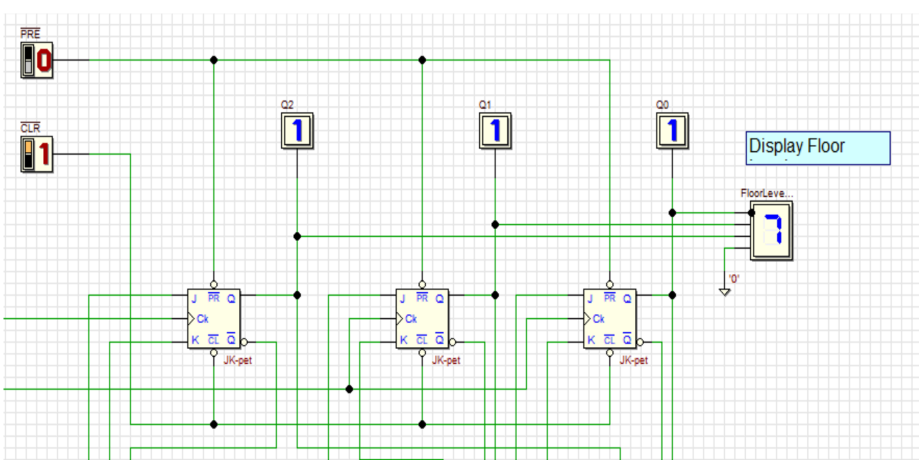
This circuit represents the desired level which requires user input. After the user inputs the desired level, the system will check whether the desired level is the same as the current level. If both are the same, the lift will not move and the lift door will open. To check for 3-bit equality, we use the XNOR gate. Then, combine the result by using a NAND gate to get an active LOW output, so that our lift can function. It means that if the current level and the desired level input are not equal, then the lift will move. Otherwise, it will stay at its current level.



This circuit shows the 6-bit binary user input passcode. It is an active HIGH circuit. To check whether the passcode is correct, a binary decoder is used. AND gate is implemented to get an active HIGH output. For example, we use 101100 as the passcode, so the decoder will produce a logic HIGH if 101100 is input by the user.

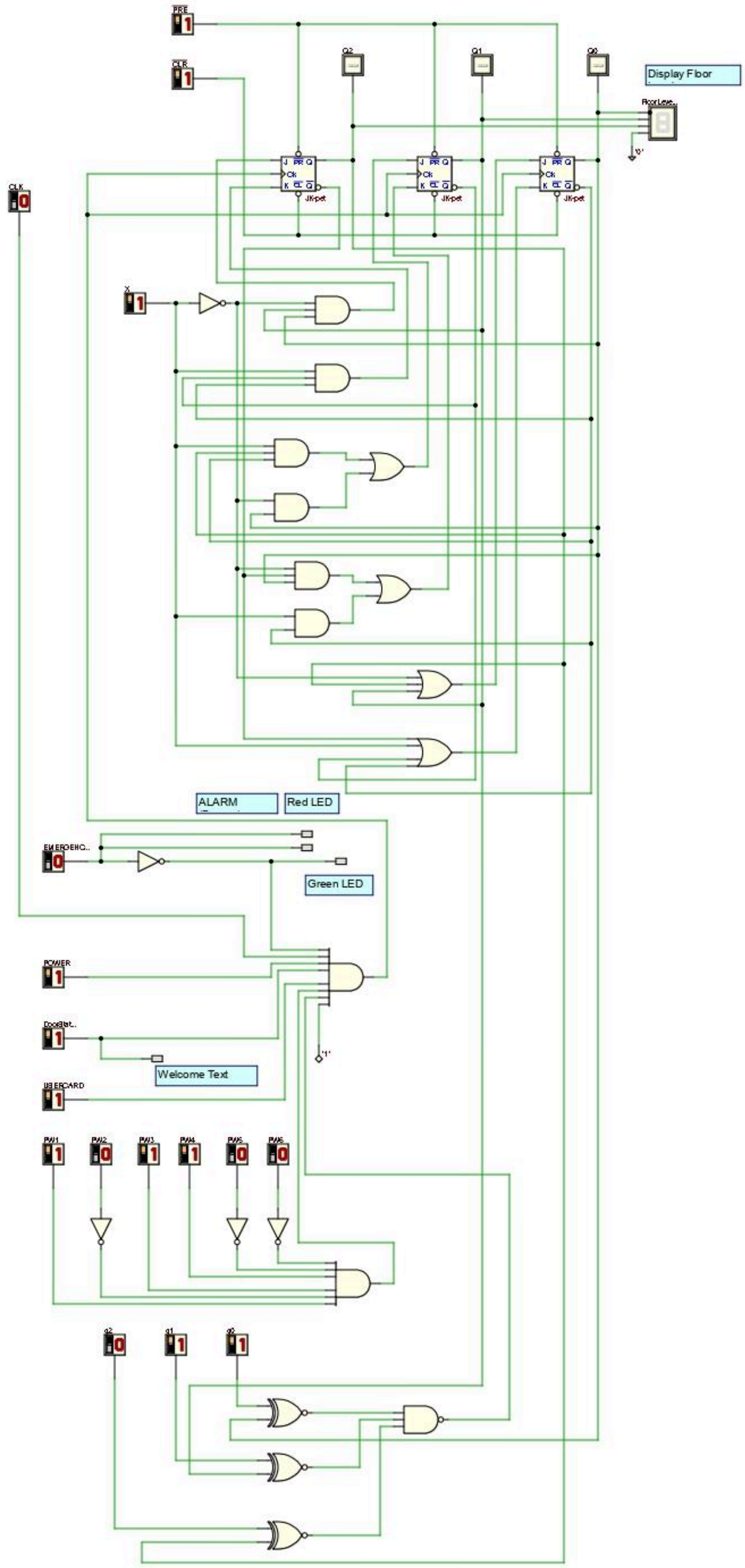


This circuit is to identify the working of the lift. An active HIGH AND gate is used to start the lift. It is connected to the passcode circuit. When the passcode input is verified, it will produce a HIGH output that connects to this AND gate. Besides, when the EMERGENCY switch is LOW, the lift is worked with a GREEN LED light. If the EMERGENCY switch is HIGH, the ALARM (buzzer) will be activated and the RED LED light is on. The power supply must be constantly HIGH, 1 to make sure the lift is functional. The Door Status must be closed (1) to start the lift function. When the door is closed, there will be a Welcome Text displayed. (e.g. Welcome to 3rd floor !) The USER CARD must be tapped (1) to run the lift. If not, the lift will not function.



This circuit shows the current level output using a 7-segment display. It will show the level once it is reached.

5.4 Full Deeds Drawing



6.0 Conclusion and Reflection

In summary, we have successfully integrated new features into our Lift Electronic Controller System, resulting in a notable improvement in security and efficiency. After addressing important issues with safety and user-system interaction, we created a working lift circuit that puts the comfort and well-being of passengers first. Our dedication to developing a complete solution is demonstrated by the addition of features including an emergency alarm system, floor levelling, welcoming text, passcode verification, and user's card verification.

Despite these successes, we are aware of some systemic flaws. Areas for improvement include the boring and less user-friendly binary passcode and the emergency alarm's low audibility when no one is near the lift. In the future, we want to include alpha-digit passcodes for better usability for users. Furthermore, adding a speech intercom system will enable users and elevator assistants to communicate verbally in real time, making the experience more secure and engaging. We also intend to install an alarm system to alert us when the lift becomes overweight and automate communication with the maintenance staff upon the activation of the emergency alarm. Future advancements will improve our lift controller system even further, resolving existing issues and delivering a more complete and user-friendly solution.

Apart from the system's advantages and disadvantages, it is important to remember that our lift controller system is currently intended to operate for seven levels, from level 0 (ground floor) to level 7. This is accomplished using a 3-bit JK count up and down counter. The system's scalability, which is easily adaptable to various scenarios should be highlighted. If a 4-bit counter is used, the system can support up to 15 floors; if a 5-bit counter is used, the system can support levels 0 through 31, offering flexibility for different building configurations.

7.0 Reference

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3. Electrical Knowhow. (2012, April). Elevator Control System. Electrical Knowhow. http://www.electrical-knowhow.com/2012/04/elevator-control-system.html

8.0 Appendix

Task Distribution

Deeds:
1. Yap En Thong
2. Ong Ya Sian

Slides:
1. Tan Xin Ying
2. Anisa Chowdhury
3. Ong Ya Sian
4. Yap En Thong

Report:
1. Yap En Thong
2. Tan Xin Ying
3. Anisa Chowdhury
4. Ong Ya Sian

Edit the presentation video:
1. Ong Ya Sian

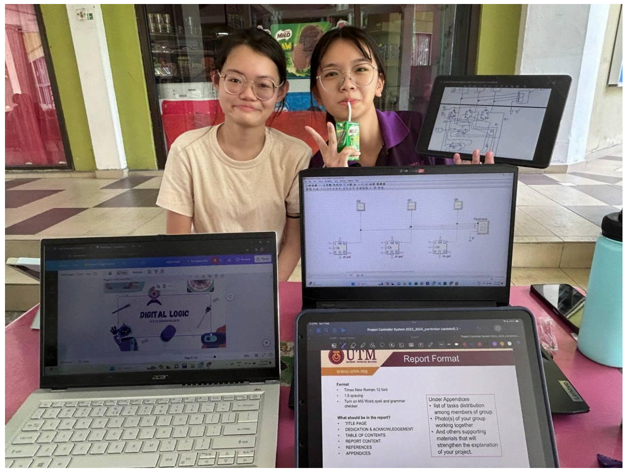

Figure 8.1 Photo of our group working together (Ong Ya Sian & Yap En Thong)

Figure 8.2 Photo of our group working together (Tan Xin Ying & Anisa Chowdhury)