SECR013-02

ELEVATOR CONTROLLER SYSTEM

GROUP 9

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DEDICATION & ACKNOWLEDGEMENT

First and foremost, we would like to express our utmost gratitude to our lecturer, Dr Zuriahati binti Mohd Yunos for the invaluable guidance and unwavering encouragement. Her bold feedback drives our motivation in completing this project successfully.

Furthermore, we were thankful for our group members, Afif Shaqir, Adam, Syahmi Faris and Afiq Danish for their persistent commitments and efforts. All members display brilliant teamworks throughout the projects.

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BACKGROUND/OVERVIEW

Elevators become the most common type of vertical transportation in bringing people to their desired destination. The evolution of elevators were originally created in the 1800s for the purpose of transporting only goods. Then its design transitioned into carrying people instead of just goods in the 1850s. The early elevator was using a steam-powered system and can only travel at approximately 40 feet per minute. It travels very slowly and is considered as a luxurious experience rather than a means of transportation. As the time moved, taller buildings and skyscrapers started to be developed and became the cause of changing the power system of the elevator. Elevators then progressed into using a hydraulic power system and the speed was increased. Not only that, the electricity powered system was introduced and became the elevator's primary power source in 1880 and keeps advancing up until today.

The focus of this project is to understand how the elevator controller system functions. By implementing the knowledge that we obtained in Digital Logic courses, we will design a simple controller circuit for an elevator and briefly show how it works in the real world. This circuit will use a combination of specific flip-flops, basic logic gates and functions of combinational logic devices to make it run functionally.

PROBLEM STATEMENT

The objective is to create and put into operation a lift system that can service up to eight levels and signal the floor level with a three-bit binary code. The new lift system needs to be secure, reliable, effective, and easy to use.

In addition to reducing interruption to the current building structure, the new lift system needs to conform to all applicable standards and laws.

On top of that, we must add a few more features to the new lift that we must construct. The additional features we must add are door open/close, and access card or passcode.

SUGGESTED SOLUTION

Truth Table/State Table/Transition Table

Input	Present State			Next State			JK FF Transition					
X	$Q2$	$Q1$	$Q0$	$Q2_+$	$Q1_+$	$Q0_+$	$J2$	$K2$	$J1$	$K1$	$J0$	$K0$
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	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	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

Based on the truth table, the input x, indicates that the lift is going in bidirectional ways which are up and down respectively when the input of x is 0 and 1. The values of jk's are then converted into K-map in order to produce a circuit using deeds simulator.

K - Map

XQ2\Q1Q0	00	01	11	10
00	0	0	1	0
01	X	X	X	X
11	X	X	X	X
10	0	0	0	0

J2 = $\overline{X}Q0Q1$

XQ2\Q1Q0	00	01	11	10
00	X	X	X	X
01	0	0	0	0
11	1	0	0	0
10	X	X	X	X

K2 = $\overline{X}\ \overline{Q1}\ \overline{Q0}$

XQ2\Q1Q0	00	01	11	10
00	0	1	X	X
01	0	1	X	X
11	1	0	X	X
10	0	0	X	X

$J1 = \overline{X}Q0 + XQ2\,\overline{Q0}$

XQ2\Q1Q0	00	01	11	10
00	X	X	1	0
01	X	X	0	0
11	X	X	0	1
10	X	X	0	1

$K1 = X\,\overline{Q0} \;+\; \overline{X}\,\overline{Q2}\,Q0$

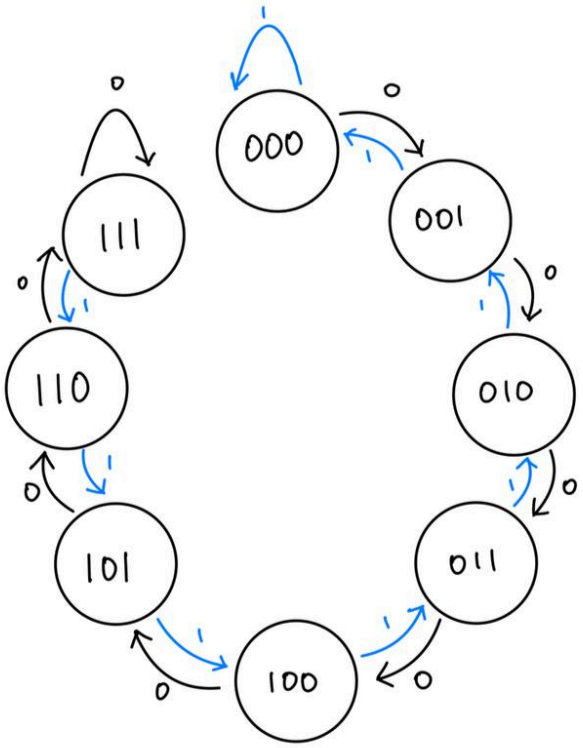
XQ2\Q1Q0	00	01	11	10
00	1	X	X	1
01	1	X	X	1
11	1	X	X	1
10	0	X	X	1

$J0 = Q1 + \overline{X} + Q2$

XQ2\Q1Q0	00	01	11	10
00	X	1	1	X
01	X	1	0	X
11	X	1	1	X
10	X	1	1	X

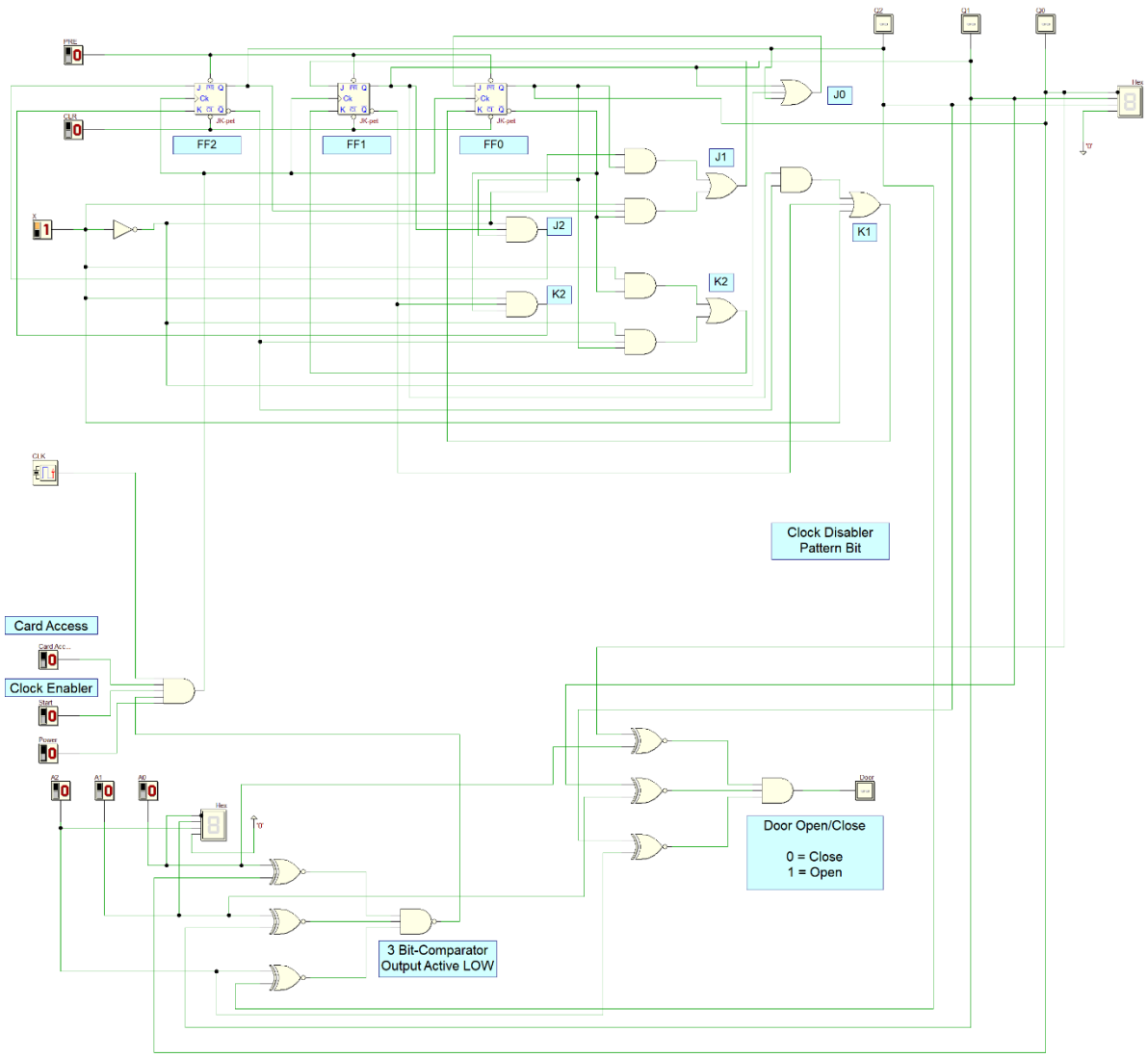
$K0 = X + \overline{Q1} + Q1\,\overline{Q2}$

State Diagram



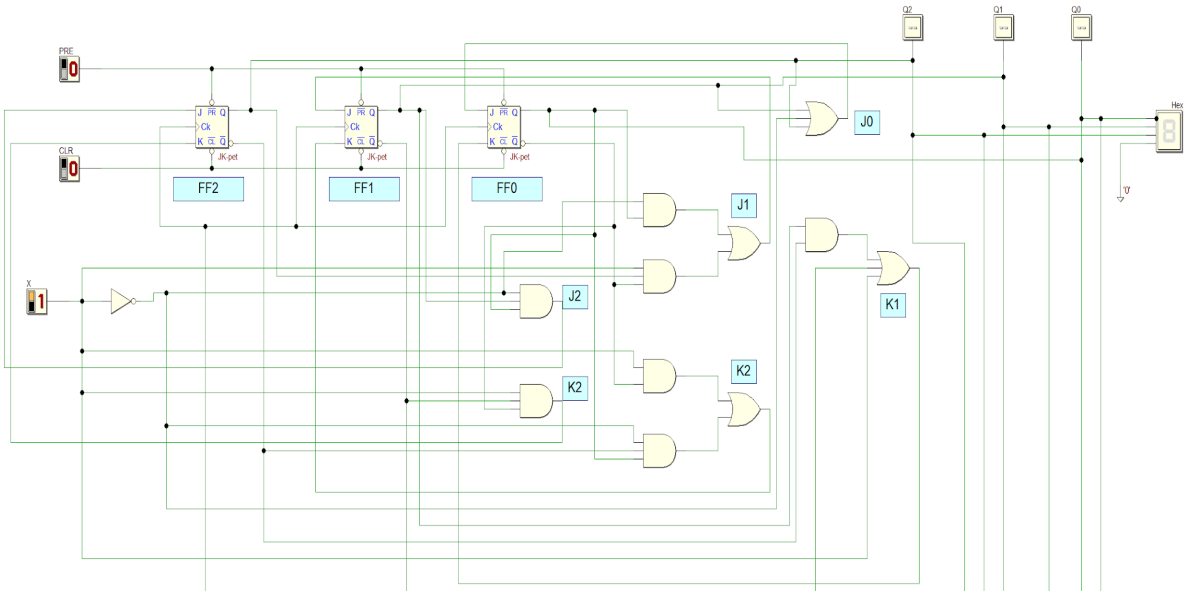
Lastly, the state diagram above shows that the counting sequence of the lift is saturated which implies the lift will repeat the maximum count for count up and minimum count for count down instead of repeating back to the first count.

SYSTEM IMPLEMENTATION



This J-K Flip Flops circuit is basically a design about an electronic controller for elevator or lift in a hotel building. This circuit is a combination with 4 components which is J-K Flip Flops, 3-Bit Comparator, Clock Enabler and Comparator for Door Open/Close.

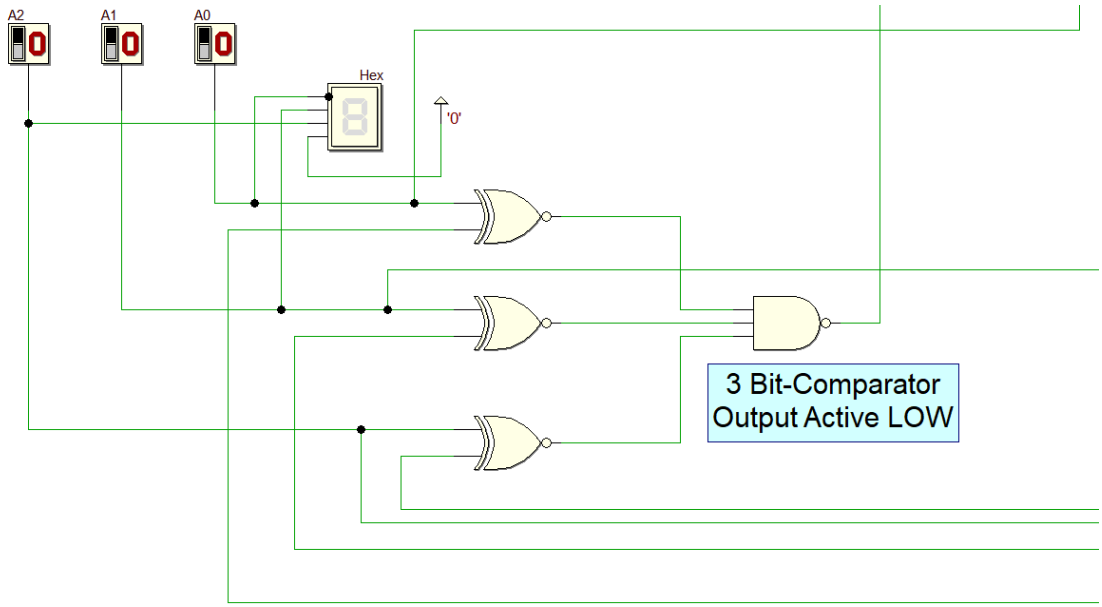
J-K Flip Flops



Using J-K Flip Flops, this circuit implements a 3-bit UP/DOWN counter. DEEDS simulator was used in its construction. A synchronous counter is used in the J-K Flip Flops circuit. Because all flip-flops are triggered in parallel, there is no cumulative time delay. As a result, this counter's maximum operating frequency will be significantly higher than the corresponding ripple counter.

Three gates are combined in these J-K Flip Flops: the AND, NOT, and OR gates. Every gate will receive a distinct input from the flip flop and provide one output to the flip flop component that corresponds to it. The elevator or lift's current condition and floor are indicated by a one-hexadecimal digit, seven-segment display at the end of the circuit. In addition, there are three output one bits that show the number of bits from 000 to 111: Q2 (MSB), Q1, and Q0 (LSB). This elevator/lift only has 8 floors, including the ground floor, hence the one-hex digit will only show 0 till 7. This is the reason the three one-bit outputs will only display from 000 to 111.

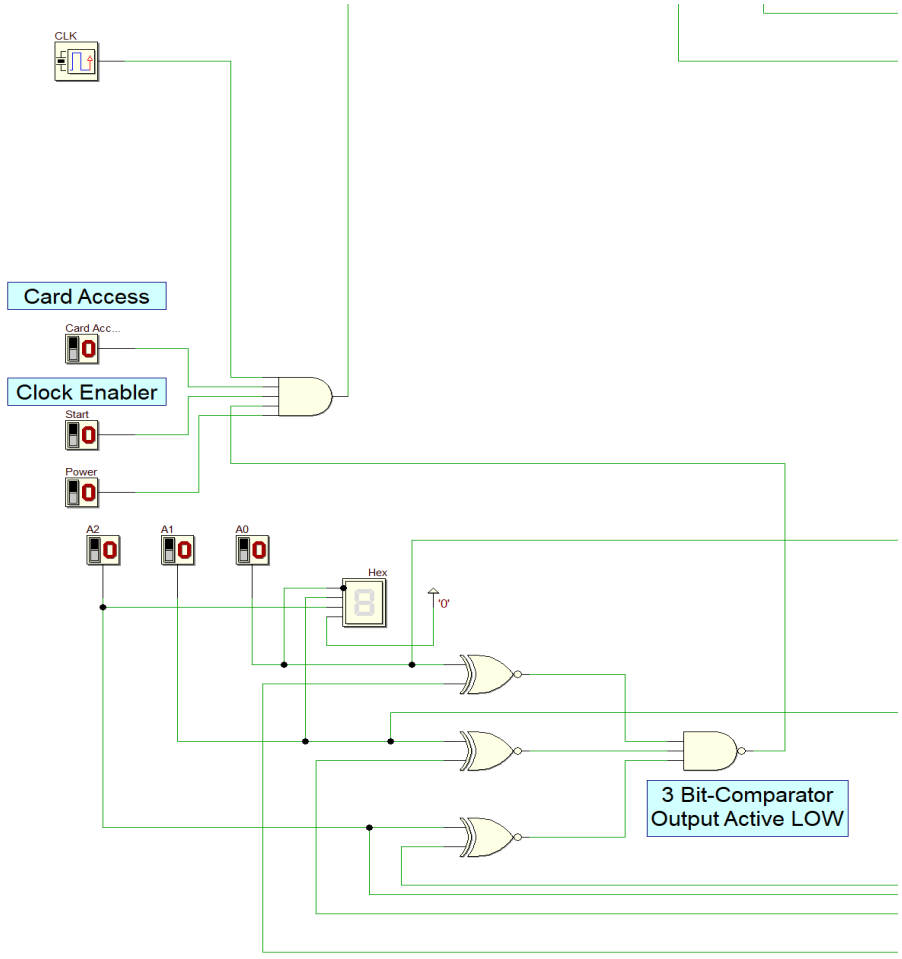
3-Bit Comparator



This circuit is a comparator for current state/floor and selected level floor using XNOR and NAND. The three one-bit output is indicating the selected floor 3-bit binary number, while the one-hex digit indicates the selected floor hexadecimal digit. If the user wants to go to the 7th floor, he/she will press the button 7 at the elevator/lift and the one-hex digit will display number 7.

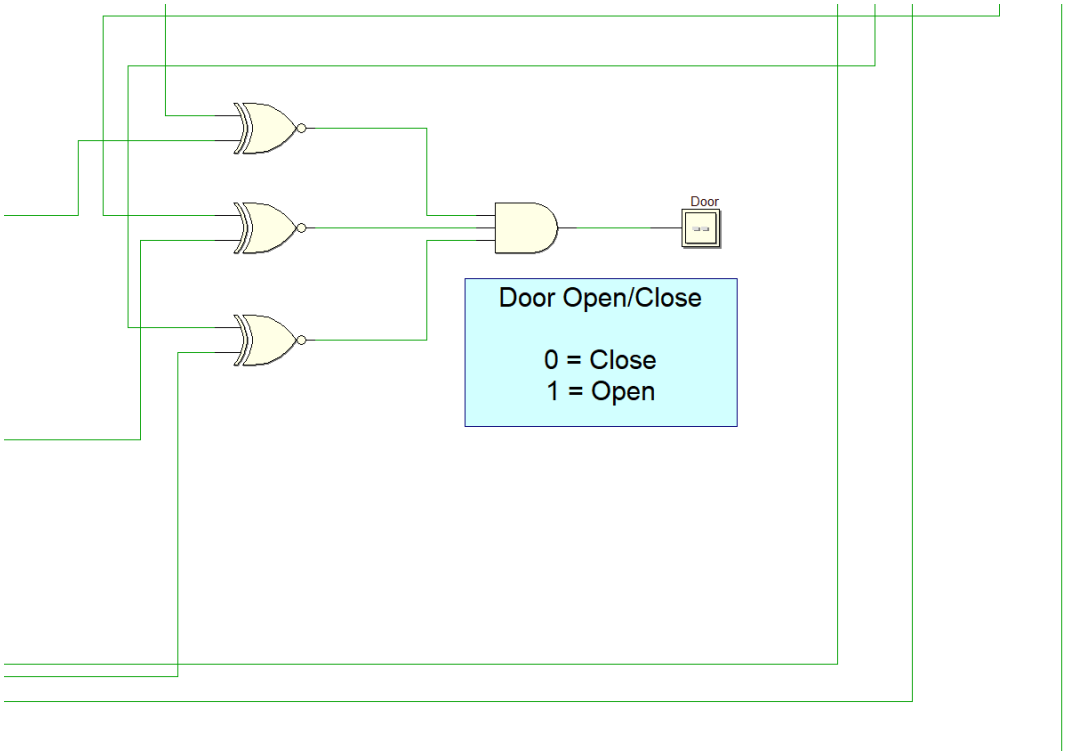
To know whether this comparator is active or not, if the comparator is EQUAL, then the NAND gate will generate output LOW. Gate NAND will give output active LOW. Thus, will disable the clock to J-K Flip Flops. If the comparator is NOT EQUAL, then NAND gate will generate output HIGH. Thus, the HIGH output will be passed to the clock enabler and will enable the clock to J-K Flip Flops.

Clock Enabler



Clock to the counter will enable when HIGH input goes to clock J-K Flip Flops. Gate AND will go HIGH when CLK (clock generator) are HIGH **and** Power is HIGH **and** Start is HIGH **and** Card Access is HIGH **and** output Comparator is NOT EQUAL.

Comparator Door Open/Close



This circuit uses XNOR and NAND as a comparison to determine if the door is open or closed. When a user presses button 7 on the elevator or lift, the door closes until it reaches the desired floor, at which point it opens to the seventh floor.

If the comparator is EQUAL, the AND gate will provide an output HIGH, indicating whether or not the comparator is active. This indicates that it will be open. Conversely, the AND gate will produce LOW output if the comparator is NOT EQUAL. This signified that the door is shut. Until the elevator or lift reaches the desired floor and opens the door, it will stay closed.

CONCLUSION & REFLECTION

Afiq - By completing this project, I gained knowledge on how the elevator circuit works in the real world. This enhanced my understanding about the function of the circuit in simpler terms. In addition, I get to sharpen my teamwork skills along in the making of the project. Lastly, I have applied the knowledge that I learned in this course and increased my understanding about the specific chapters such as Function of Combinational Logic and Counters. This project is useful to help me learn while working on the assignment.

Afif - In conclusion, the 3-bit elevator system operates with a basic binary code for efficient floor-level representation. Its simplicity allows straightforward control, ensuring effective elevator management and a reliable vertical transportation system. I am pleased with its adaptability, enabling the integration of features like access cards, door control, and passcode usage. This versatility enhances overall functionality, meeting modern requirements for efficient and secure vertical transportation.On top of that,this project strengthens my knowledge on flip-flops and counters.

Syahmi - I gained quite a bit about how the circuit and back end of the functionality operate from working on this small project with my teammate. Also, I learned how lifts and elevators operate. An elevator's floor level was indicated by a three-bit binary number. The elevator will, as a matter of information, compare the present floor's 3-bit value and the value of the 3-bit corresponding with the selected floor. The user will be able to use the elevator if the value remains the same and the door is opened. The extra functions, including the ability to recognize visitor cards from hotels and to sense when doors are open and closed, also make it enjoyable for us to get used to the function and how the circuit works.

Adam - In this project, I learned a lot especially on the concept of creating a circuit of a fully functional elevator that is implemented to every single one out there. By doing the circuit I gained the knowledge of constructing a circuit using flip flops that is connected with input, output and also basic gates. In the meantime, I fostered a sense of workmanship and social skills as we did this project as a team. I am also able to build a transition table, Karnaugh map and state diagram related to this project to further sharpen my theoretical skills.

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APPENDICES