DAYANANDA SAGAR UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING
DAYANANDA SAGAR UNIVERSITY
KUDLU GATE
BANGALORE - 560068

MINI PROJECT REPORT

ON

"SIMULATION STUDY OF ELEVTOR CONTROL"

SUBMITTED TO THE 3rd SEMESTER , DIGITAL CIRCUITS AND LOGIC DESIGN LABORATORY

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by

ARPITHA VENKATESH PRASAD (ENG18CS0046)

Under the supervision of
RAJANIKANTH NAGARAJ KASHI

DAYANANDA SAGAR UNIVERSITY

School of Engineering, Kudlu Gate, Bangalore-560068

CERTIFICATE

This is to certify that Mr./Ms. Arpitha Venkatesh Prasad bearing USN ENG18CS0046 has satisfactorily completed his/her Mini Project as prescribed by the University for the 3rd semester B.Tech. programme in Computer Science & Engineering during the year 2019-2020 at the School of Engineering, Dayananda Sagar University, Bangalore.

Date: ______________

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Signature of the faculty in-charge

Max Marks	Marks Obtained

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Signature of Chairman
Department of Computer Science & Engineering

DECLARATION

We hereby declare that the work presented in this mini project entitled "**Simulation Study of Elevator Control,**" has been carried out by us and it has not been submitted for the award of any degree, diploma or the mini project of any other college or university.

ARPITHA VENKATESH PRASAD (ENG18CS0046)

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of task would be incomplete without the mention of the people who made it possible and whose constant guidance and encouragement crown all the efforts with success.

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ARPITHA VENKATESH PRASAD (ENG18CS0046)

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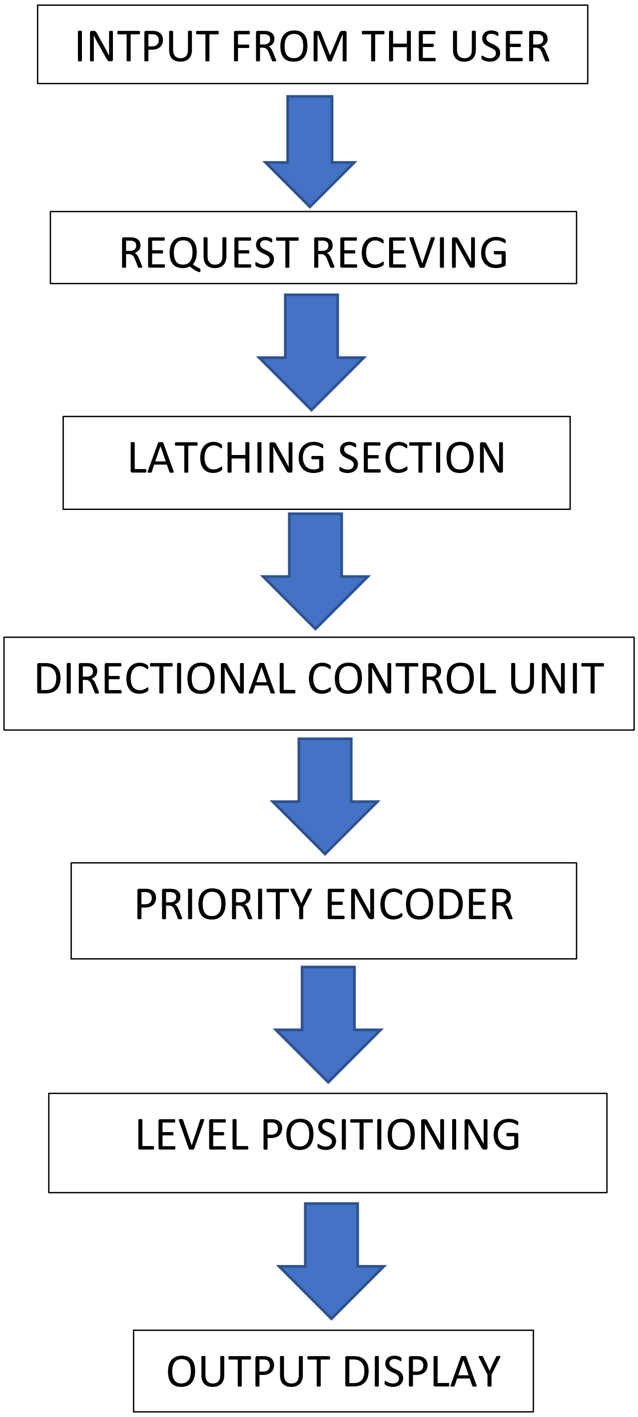
INTRODUCTION

Elevator is an inseparable part of a building structure. A simulation study of elevator control of a 3-storey building has been presented in this paper using digital logic circuits. Elevator control system of a building has been proposed in some literatures but a unique aspect of this work is that we have not included any microcontroller or Programmable Logic Controller (PLC) for logic implementation in this design, rather we have emphasized on developing logic equations by logic computation and using basic digital logic circuit components. At first, the probable events regarding the upward and downward movement of the elevator have been identified and they have been used as variables to form the logic equations to determine whether the present direction of the lift will be upward or downward. In this logic equation formation, the priority of the events is considered accordingly i.e. the requests have been served on priority basis. Once the direction of the lift is determined, the lift will change its level depending on its current position. The input keys from the elevator users standing inside or outside the lift and the output display showing present position and direction of the lift have been presented in this paper as observed in a standard 3-storey building elevator. We have used Logisim to simulate our designed circuit to show its functionality.

PROBLEM STATEMENT

The aim of the mini project is to develop an elevator control system. For the sake of simplicity, the building is a 3-storey building. There are two buttons on the panel, located on each floor (“up” and “down”). Such panels located on extreme floors have only one button. So, as it’s a 3-storey building the ground floor has only up button, the first floor has both up and down button, the second has only down button. There are three buttons inside the lift—ground, first and second.

FUNCTIONAL BLOCK DIAGRAM



SAMPLE INPUTS FROM USERS AND LIST OF EVENTS

SAMPLE INPUTS AND REQUESTED INSTRUCTION:

Position of the user	Symbol	Requested Instruction
Inside the elevator	I2	To go to 2nd floor
Inside the elevator	I1	To go to 1st floor
Inside the elevator	I0	To go to ground floor
Outside the elevator	O2d	To go downwards from 2nd floor
Outside the elevator	O1d	To go downwards from 1st floor
Outside the elevator	O1u	To go upwards from 1st floor
Outside the elevator	O0u	To go upwards from ground floor

LIST OF EVENTS:

Position of the elevator	Symbol	Event
At ground floor	S0	• I1 is pressed from inside • I2 is pressed from inside • O1d is pressed from outside • O1u is pressed from outside • O2d is pressed from outside
At 1st floor	S1	• I0 is pressed from inside • I2 is pressed from inside • O0u is pressed from outside • O2d is pressed from outside
At 2nd floor	S2	• I0 is pressed from inside • IF is pressed from inside • O1u is pressed from outside • O1d is pressed from outside • O0u is pressed from outside

LOGIC EQUATIONS AND TRUTH TABLES

LOGIC FORMULATION OF ELEVATOR DIRECTION:

We denote the event of upward and downward direction of an elevator at an instant to be Yu and Yd respectively. So, the expression of Yu and Yd should be:

Yu = Yd' (S0 (O1d + O1u + O2d + I1 + I2) + S1 (O2d + O1u + I2))

Yd = Yu' (S2 (O1u + O1d + O0u + I1 + I0) + S1 (O1d + O0u + I0))

LOGIC FORMULATION OF PRIORITY OF EVENTS:

After the direction of the elevator is determined, the priority of all the events associated with that direction must be set to determine the current position of the elevator.

PRIORITY OF EVENTS AT DIFFERENT ELEVATOR DIRECTIONS:

Direction of the elevator	Logic state	Events arranged in descending order of priority
Upward	Yu = 1, Yd = 0	• I1 • O1u • I2 • O2d • O1d
Downward	Yu = 0, Yd = 1	• I1 • O1d • I0 • O0u • O1u

TRUTH TABLE OF THE PRIORITY ENCODER FOR UPWARD DIRECTION:

O1d	O2d	I2	O1u	I1	Q2	Q1	Q0
X	X	X	X	1	1	1	1
X	X	X	1	0	1	1	0
X	X	1	0	0	1	0	1
X	1	0	0	0	1	0	0
1	0	0	0	0	0	1	1

TRUTH TABLE OF THE PRIORITY ENCODER FOR DOWNWARD DIRECTION:

O1u	O0u	I0	O1d	I1	Q2	Q1	Q0
X	X	X	X	1	1	1	1
X	X	X	1	0	1	1	0
X	X	1	0	0	1	0	1
X	1	0	0	0	1	0	0
1	0	0	0	0	0	1	1

LOGIC FORMULATION OF ELEVATOR POSITION:

Outputs from the encoder are passed to a decoder and the decoder outputs (Y7, Y6, Y5, Y4) are used for forming logic equation to find the current elevator position. The three binary bits S2, S1, and S0 denote the position of the elevator.

TRUTH TABLE FOR ELEVATOR POSITION WHEN THE ELEVATOR IS MOVING UP (Yu = 1, Yd = 0):

Q2	Q1	Q0	Y7	Y6	Y5	Y4	Y3	S2	S1	S0	Position
1	1	1	1	0	0	0	0	0	1	0	1^{st} floor
1	1	0	0	1	0	0	0	0	1	0	1^{st} floor
1	0	1	0	0	1	0	0	1	0	0	2^{nd} floor
1	0	0	0	0	0	1	0	1	0	0	2^{nd} floor
0	1	1	0	0	0	0	1	0	1	0	1^{st} floor

Therefore, S1 and S2 are calculated by

S2 = (Y4+Y5).Yu.Yd’

S1 = (Y3+Y6+Y7).Yu.Yd’

TRUTH TABLE FOR ELEVATOR POSITION WHEN THE ELEVATOR IS MOVING DOWN (Yu = 0, Yd = 1):

Q2	Q1	Q0	Y7	Y6	Y5	Y4	Y3	S2	S1	S0	Position
1	1	1	1	0	0	0	0	0	1	0	1^{st} floor
1	1	0	0	1	0	0	0	0	1	0	1^{st} floor
1	0	1	0	0	1	0	0	0	0	1	Ground floor
1	0	0	0	0	0	1	0	0	0	1	Ground floor
0	1	1	0	0	0	0	1	0	1	0	1^{st} floor

Therefore, S1 and S0 is calculated by

S1 = (Y3+Y6+Y7).Yd.Yu’

S0 = (Y4+Y5).Yd.Yu’

The overall expression is

$S0 = (Y4+Y5).Yd.Yu'$

$S1 = (Y3+Y6+Y7)(Yu \oplus Yd)$

$S2 = (Y4+Y5).Yu.Yd'$

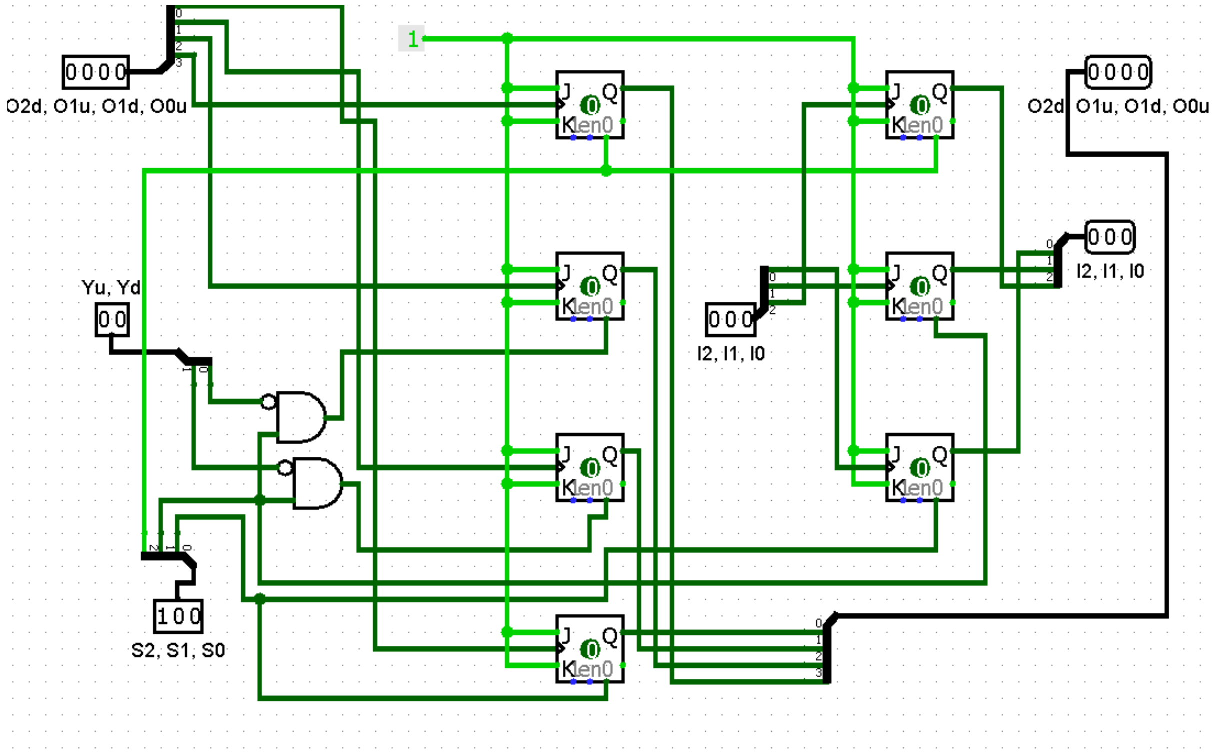
CIRCUIT DESIGN DESCRIPTION

Several literatures on elevator design architecture have divided their design in some sections and subsections to explain their functionality. Our proposed design architecture can grossly be divided into five sections: Input unit, Directional Control Unit, Priority Encoder, Level Positioning Control Unit, and Output Display Unit.

A. INPUT UNIT

Input unit consists of two major subsections: Request receiving section and latching section. A single pulse is provided to request an event. Since a number of instructions can be requested simultaneously and they must be served on priority basis, the rest of the instructions must be saved using a latching section. In our design, we have used J-K flip-flops as the latching section. As the two inputs of every flip-flop are shorted together and assigned a constant logic level 1, it essentially works as a T flip flop. The inputs from the request receiving section are fed as the clock inputs of the flip-flops. If any particular request is made twice consecutively, the clock pulse of the flip-flops works the same way consecutively and because of the consecutive toggling of data at J-K flipflop, that particular request is cancelled.

Latching Section



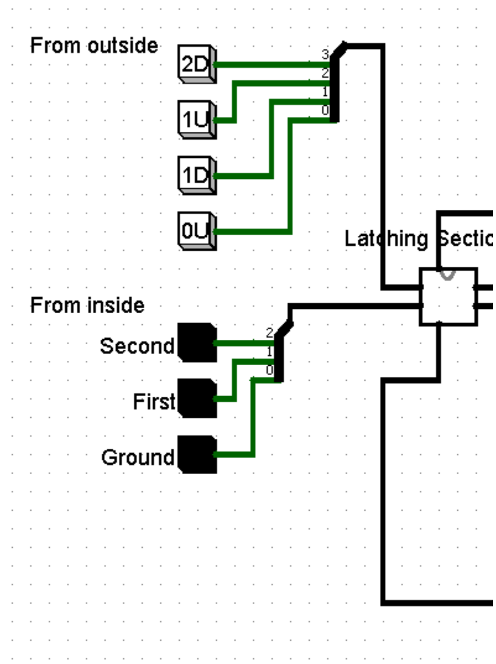
Inputs:

The various inputs for the elevator control circuit are O2d, O1u, O1d, O0u, I2, I1, I0

where O -> from the outside; I -> from the inside; 2, 1, 0 -> floor numbers; u, d -> up and down directions respectively. So, O0u would be high when a person outside the elevator presses the up button from the ground floor and I2 would be high when a person inside the elevator presses the button for second floor. However, if you press I2 when the elevator is at the second floor or if you press O1u when the elevator is at the first floor, the respective input will not be set high.

If you press a button by mistake, you can cancel the request by pressing it again.

Request Receiving Section



B. <u>DIRECTIONAL CONTROL UNIT</u>

The elevator moves up only (i) when the elevator is not currently moving down AND (ii) when at least one of the inputs O1d, O1u, O2d, I1, or I2 is pressed when the elevator is at the ground floor OR when at least one of the inputs 02d, 01u or I2 is pressed when the elevator is at the first floor.

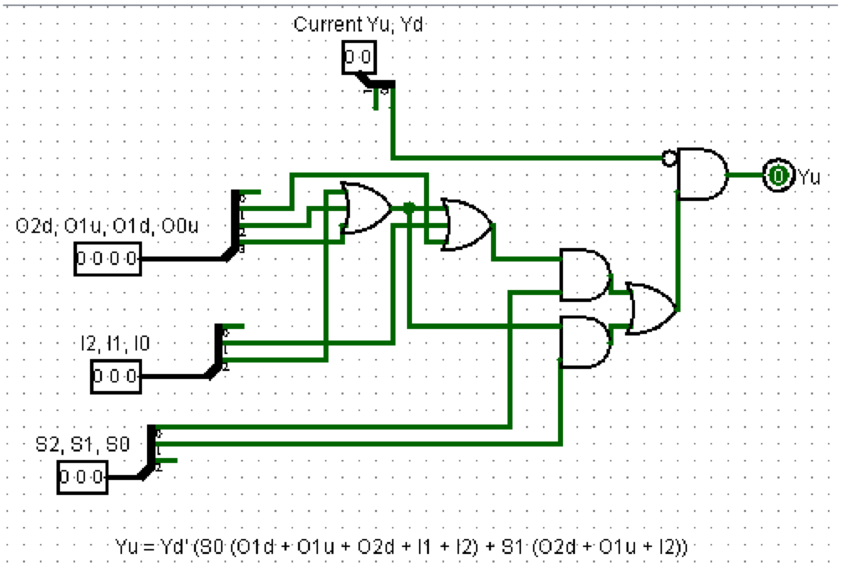
Upward Direction Indicator, Yu = Yd' (S0 (O1d + O1u + O2d + I1 + I2) + S1 (O2d + O1u + I2))

Following similar logic,

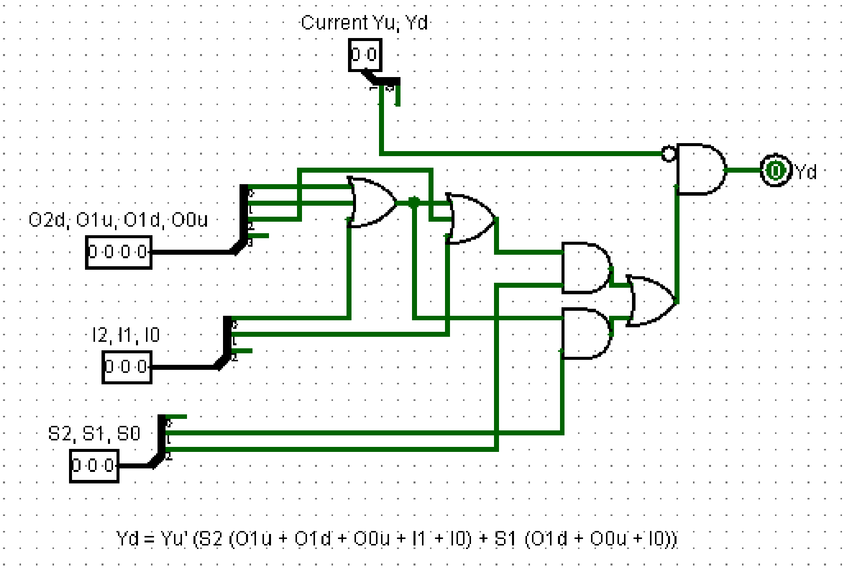
Downward Direction Indicator Yd = Yu' (S2 (O1u + O1d + O0u + I1 + I0) + S1 (O1d + O0u + I0)

This unit determines the upward or downward direction of the lift at an instant. The outputs of this unit, Yu and Yd, are used as the enablers of the priority encoders.

Circuit for finding Yu



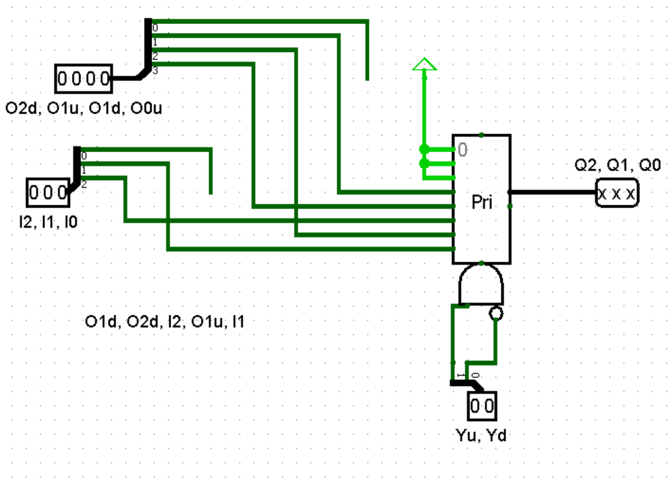
Circuit for finding Yd



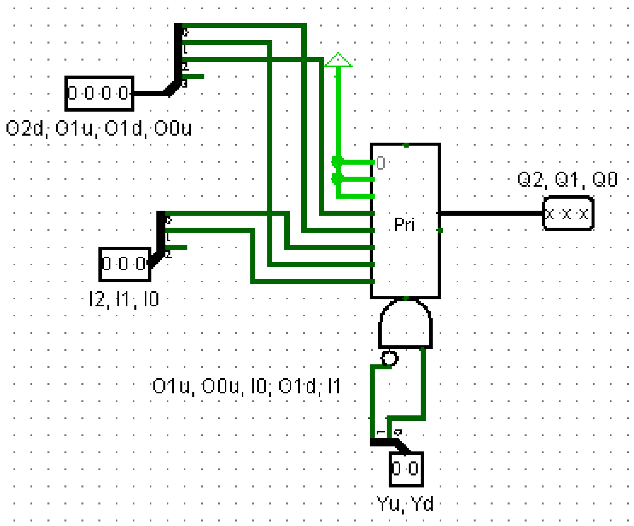
C. PRIORITY ENCODER

After the direction of the movement of the lift is decided, the next step is to set the priority of the requests stored in the latching section. Priority encoder serves this purpose. Two priority encoders have been used to assign the priority of the events associated with both the upward and the downward direction of the elevator. The 3-bit outputs from both the priority encoder helps to build the level positioning control unit to determine the current position of the lift.

Priority up encoder



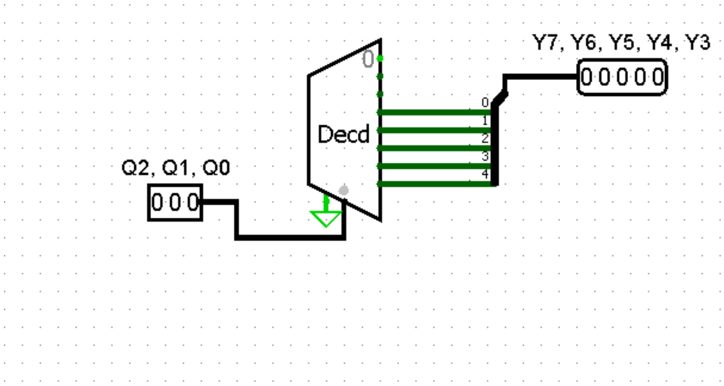
Priority down encoder



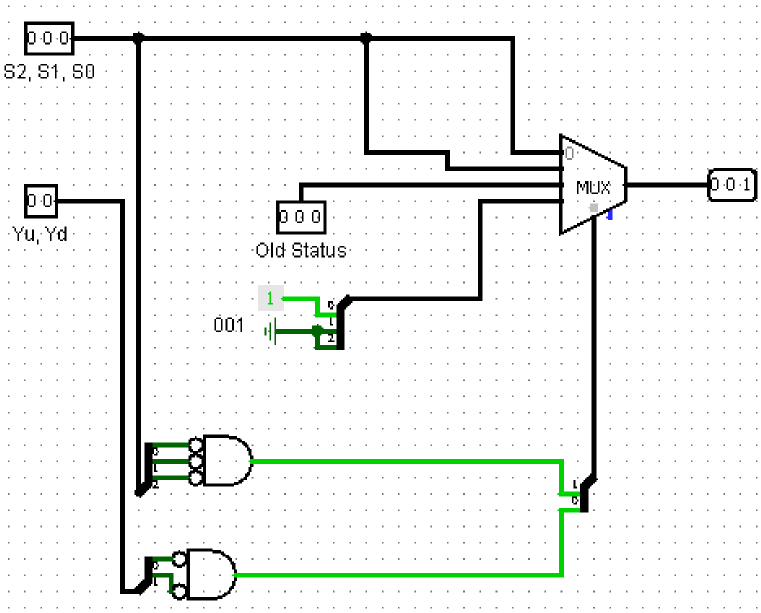
D. LEVEL POSITIONING CONTROL UNIT

Level positioning control unit consists of a decoder, multiplexer, and some combinational logic. This is the unit which determines the current level position and sends the data to the output section. This section is guided by the logic equations presented at equations of S2, S1 and S0 denote the current level position of the elevator. The multiplexer changes these values for special cases (such as setting of initial values).

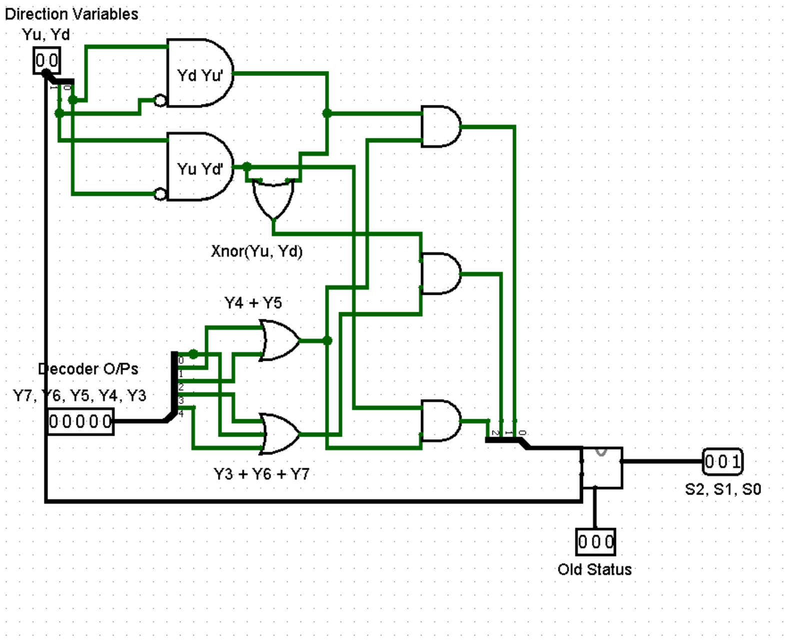
Decoder circuit



Multiplexer circuit for determining current status



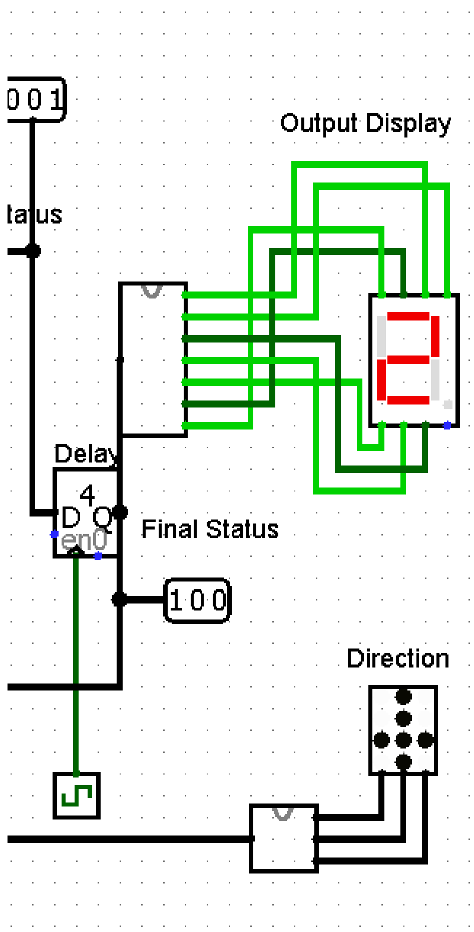
Circuit for calculating the status



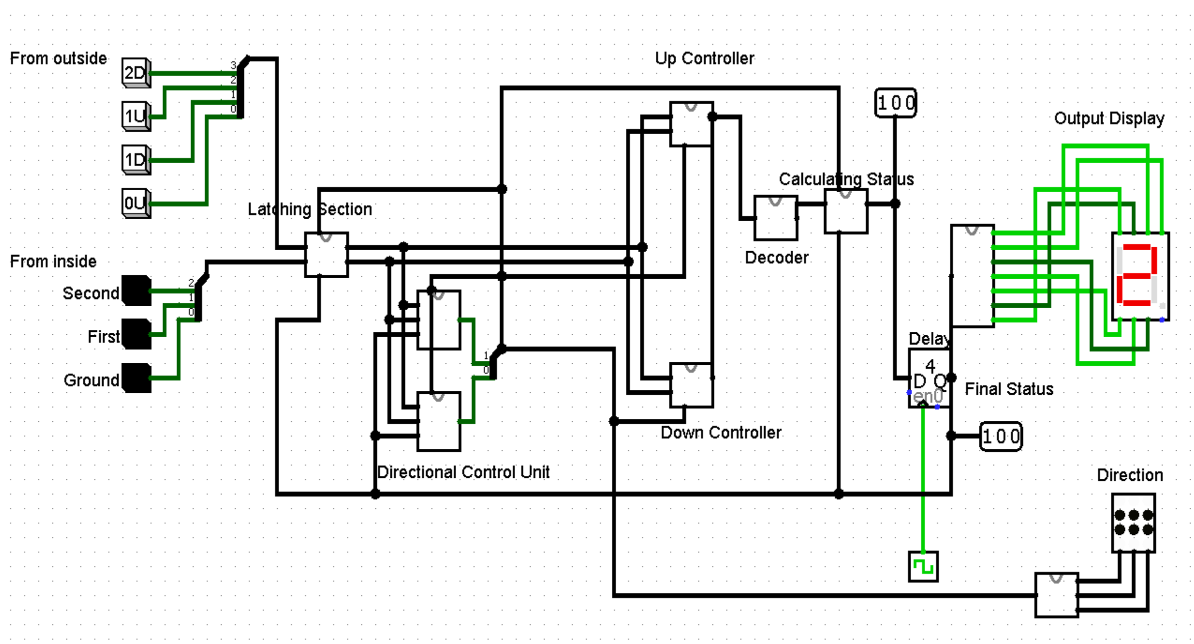
E. <u>OUTPUT DISPLAY UNIT</u>

Current level position determined by the level positioning control unit will be displayed in the output display. Since the requests are served consecutively, the level positions output from the level positioning control unit are passed through a PIPO register to delay changes in output.

Output Display Unit



THE ELEVATOR CIRCUIT



SAMPLE INPUT AND OUTPUT

(1) Passenger A enters the elevator at the ground floor while it is at a stop. They presses I2 to go to the second floor. At the same time, another passenger B at the first floor wants to go up to the second floor. They press O1u. The elevator goes up from the ground floor, stops at the first floor, then goes up to the second floor.

(2) Let's take the same case as (1) except that now B wants to go down to the first floor. They pressed O1d. The elevator goes up from the ground floor, stops at the second floor, then goes down to the first floor. B enters the elevator, presses I0, and the lift moves down to the ground floor.

(3) Passenger C is at the second floor and the elevator is currently moving from the ground floor to the second floor. C presses O2d and immediately realizes that they have forgotten to take something. C presses O2d again and the request is cancelled. The elevator stops at the first floor.

CONCLUSION

A digital design based elevator control system design of a 3-storey building has been presented in this report. Considering the probable events associated with the movement of the elevator, logic formulation has been done. Based on those logic equations, the circuit has been simulated with appropriate circuit components available at Logisim software package. We have obtained desired output at the output display section which proves the validity of our proposed circuit design.

REFERENCES

[1] **IOSR Journal of Engineering (IOSRJEN)**

Monzurul Islam Dewan, Md. Arafat Mahmud, Md. Tashfiq Bin Kashem, and Mushfika Baishakhi Upama, ***"A Simulation Study of Elevator Control of a Building using Digital Logic Circuit".***

[2] **The Logisim User's Guide and Tutorial**

Carl Burch