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INTRODUCTION:

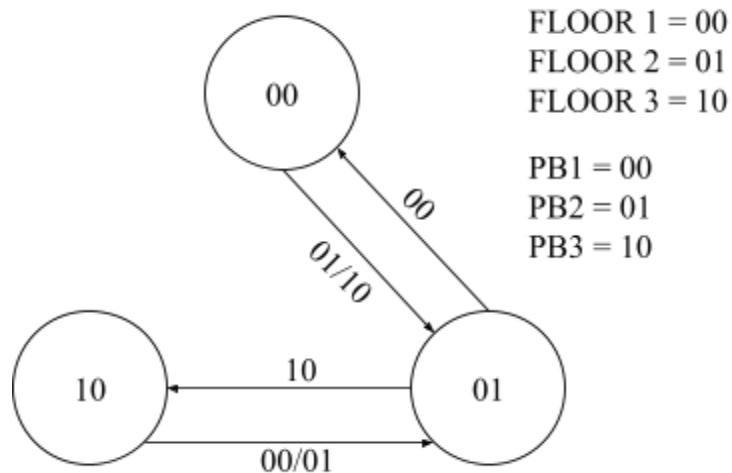
In this lab, a reconfigurable FPGA based elevator is created, which can be used to control a 3-floor elevator with specified inputs and outputs. With push buttons, the user can select the desired floor level of the elevator, while reed sensors on the elevator provide constant feedback on the cabin's current position. These variables are utilized and compared by the FPGA to control the elevator motor, which moves the cabin. A buzzer rings when the desired floor is reached and a 7-segment LED displays the floor level to the user.

EQUIPMENT:

EQUIPMENT	QUANTITY	PIN ASSIGNMENT
Push Buttons	3	PIN_D3, C3, A3
Reed-Switches	3	PIN_D5, A6, D6
Motor	1	PIN_B4, PIN_B12
Buzzer	1	-
Motor Driver Chip	1	-
7-Segment Display	1	-
Altera Cyclone IV	1	N/A
LED	3	N/A (Hardwired)
Breadboard	1	N/A (Hardwired)
10KΩ Resistors	6	N/A (Hardwired)

DIGITAL DESIGN:

STATE DIAGRAM



STATE/TRANSITION TABLE

Q₁	Q₀	F₁	F₀	Q₁₊	Q₀₊	J₁	K₁	J₀	K₀
0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	1	0	X	1	X
0	0	1	0	0	1	0	X	1	X
0	1	0	0	0	0	0	X	X	1
0	1	0	1	0	1	0	X	X	0
0	1	1	0	1	0	1	X	X	1
1	0	0	0	0	1	X	1	1	X
1	0	0	1	0	1	X	1	1	X
1	0	1	0	1	0	X	0	0	X

K-MAPS

		F ₁ F ₀			
		00	01	11	10
Q ₁ Q ₀	00	0	1	-	1
	01	X	X	-	X
	11	-	-	-	-
	10	1	1	-	0

$$J_0 = F_0 + (Q_1 \oplus F_1)$$

		F ₁ F ₀			
		00	01	11	10
Q ₁ Q ₀	00	X	X	-	X
	01	1	0	-	1
	11	-	-	-	-
	10	X	X	-	X

$$K_0 = F_0'$$

		F ₁ F ₀			
		00	01	11	10
Q ₁ Q ₀	00	0	0	-	0
	01	0	0	-	1
	11	-	-	-	-
	10	X	X	-	X

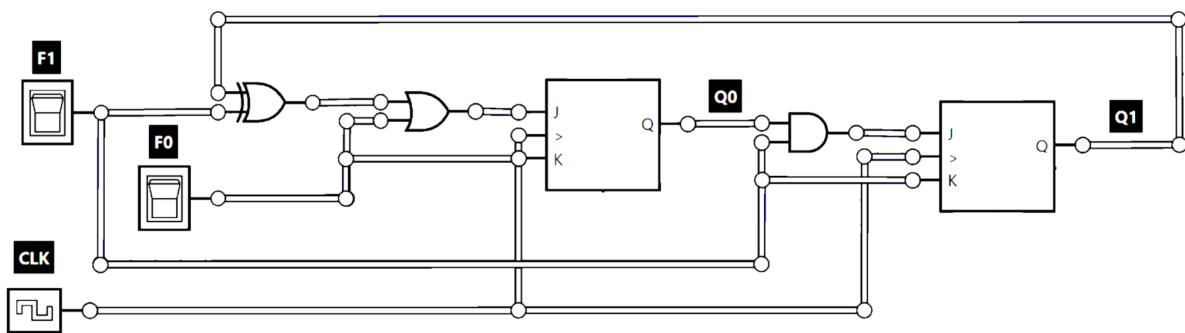
$$J_1 = Q_0 F_1$$

		F ₁ F ₀			
		00	01	11	10
Q ₁ Q ₀	00	X	X	-	X
	01	X	X	-	X
	11	-	-	-	-
	10	1	1	-	0

$$K_1 = F_1'$$

NOTE: Input and output cannot exceed state '10' therefore assume 'X' when input and/or output is '11'

CIRCUIT DESIGN

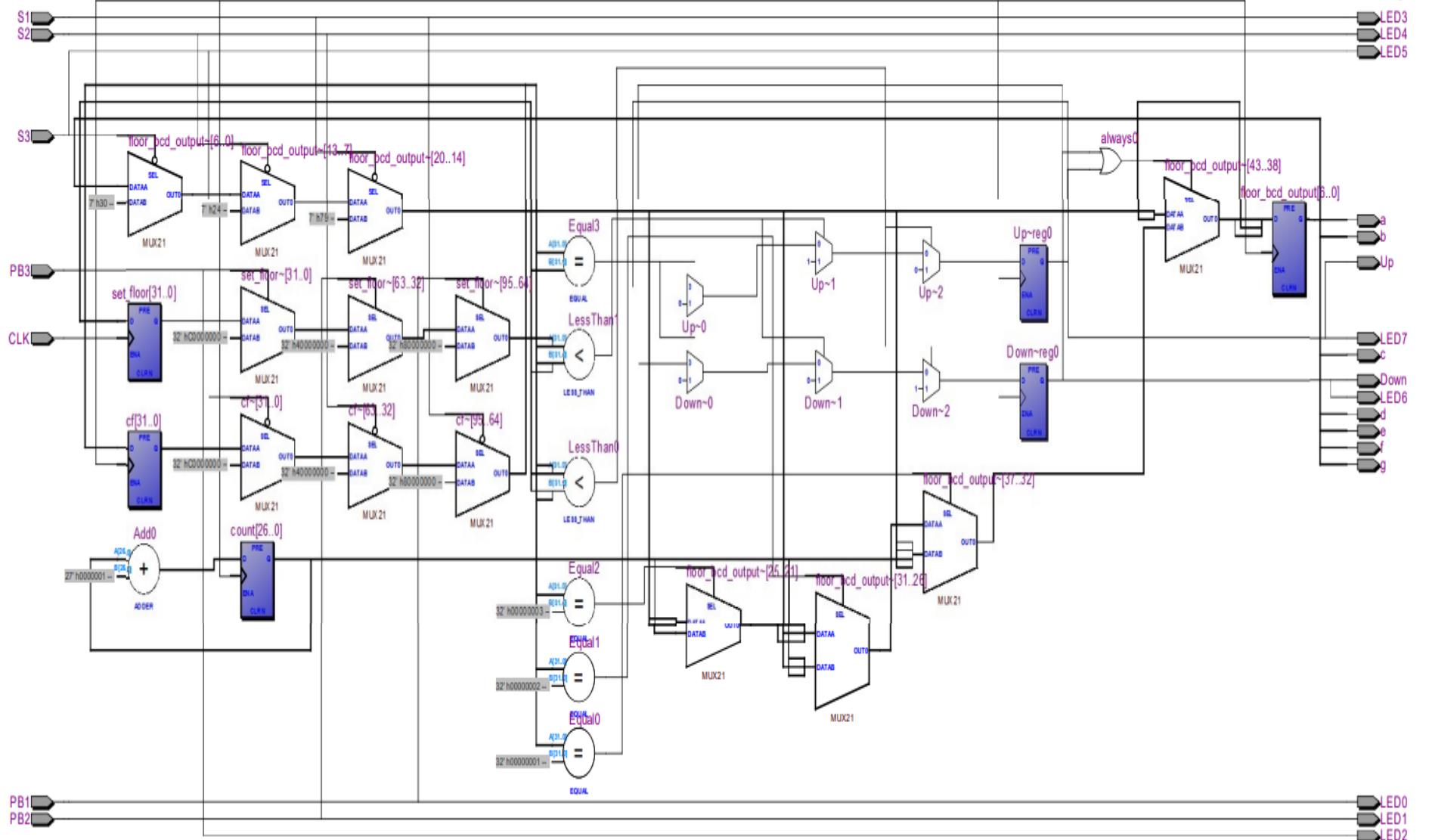


RTL Viewer for the VHDL Code.

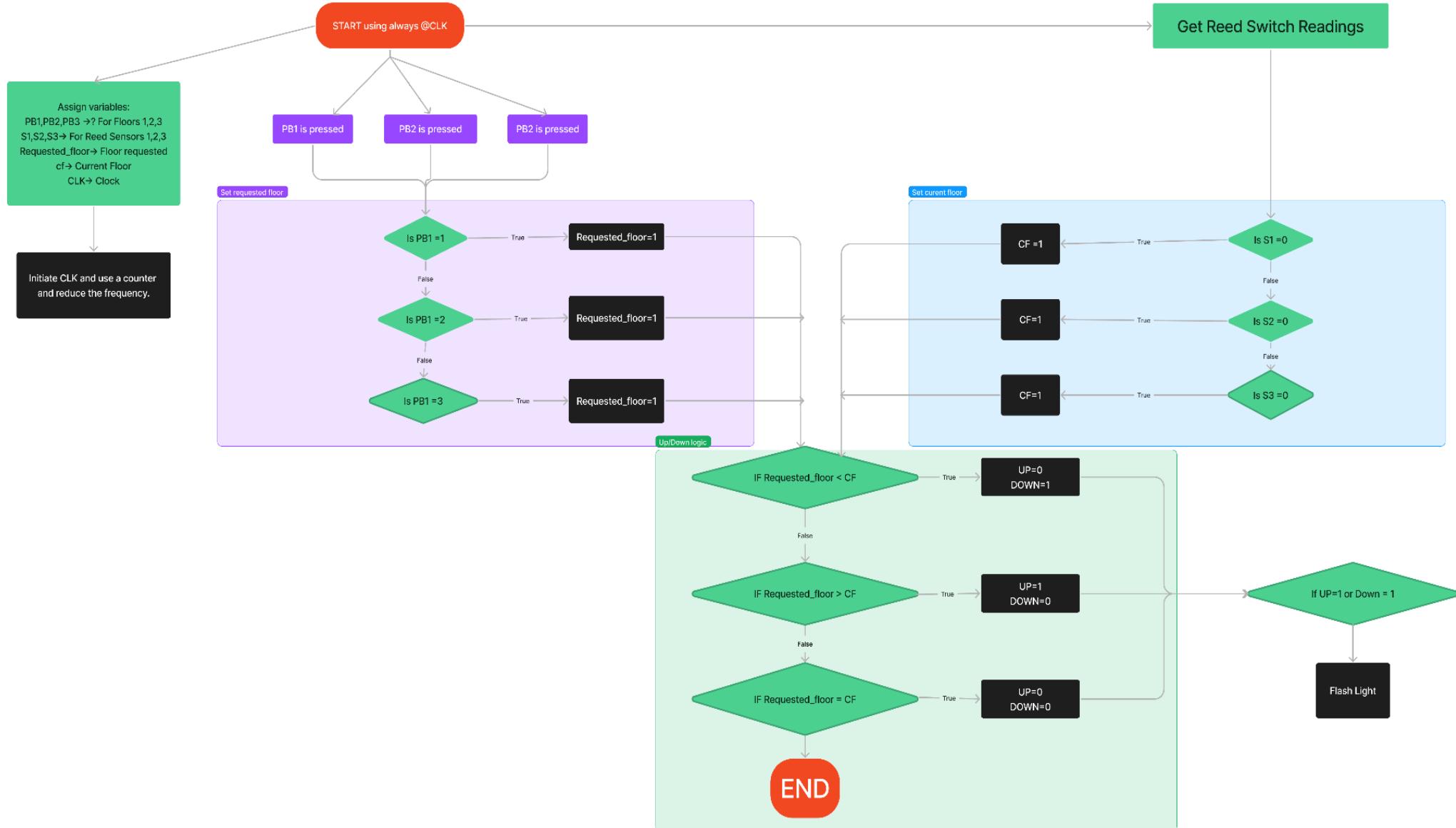
Date: December 08, 2022

elevator

Project: elevator



FLOW CHART:



IMAGES:

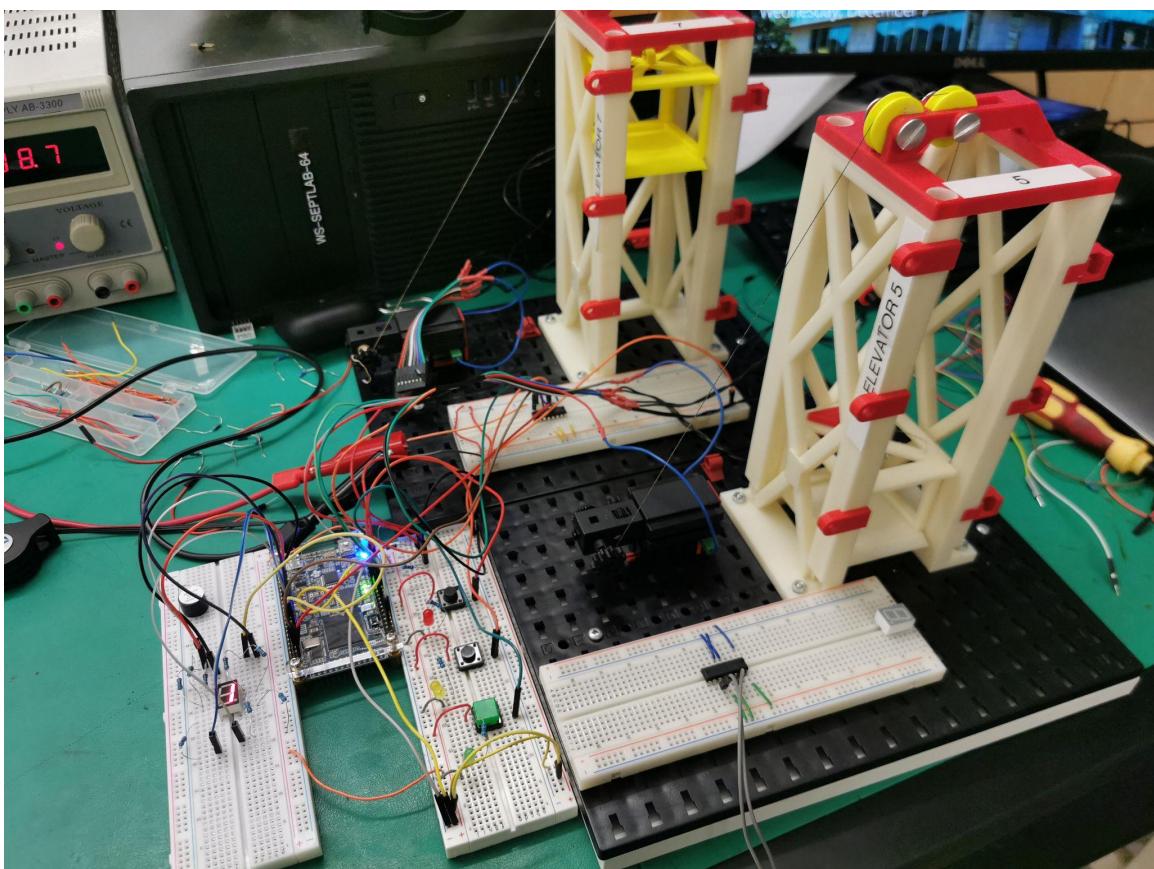


Figure 1: Elevator setup

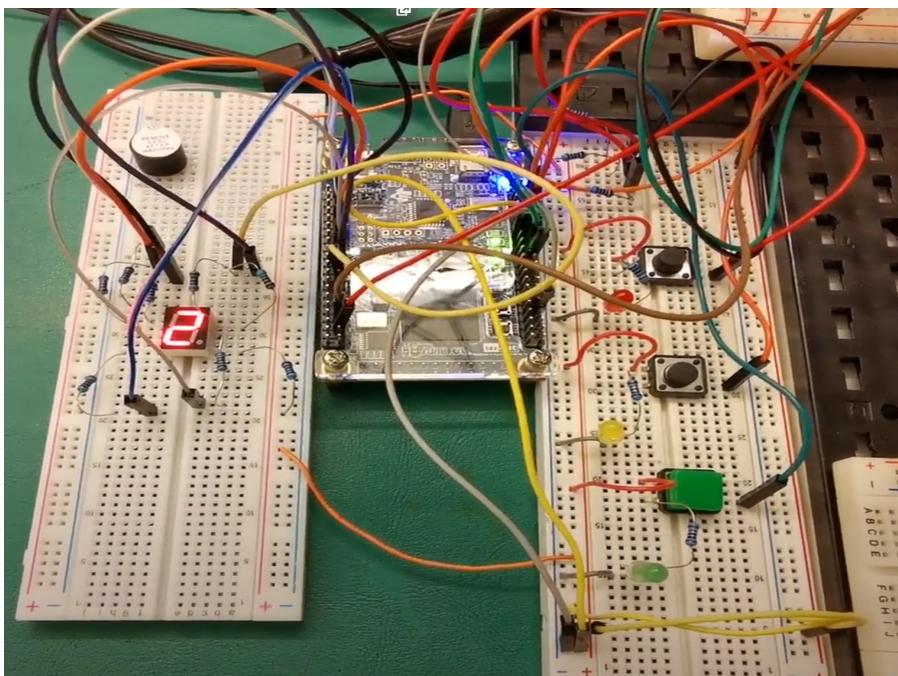
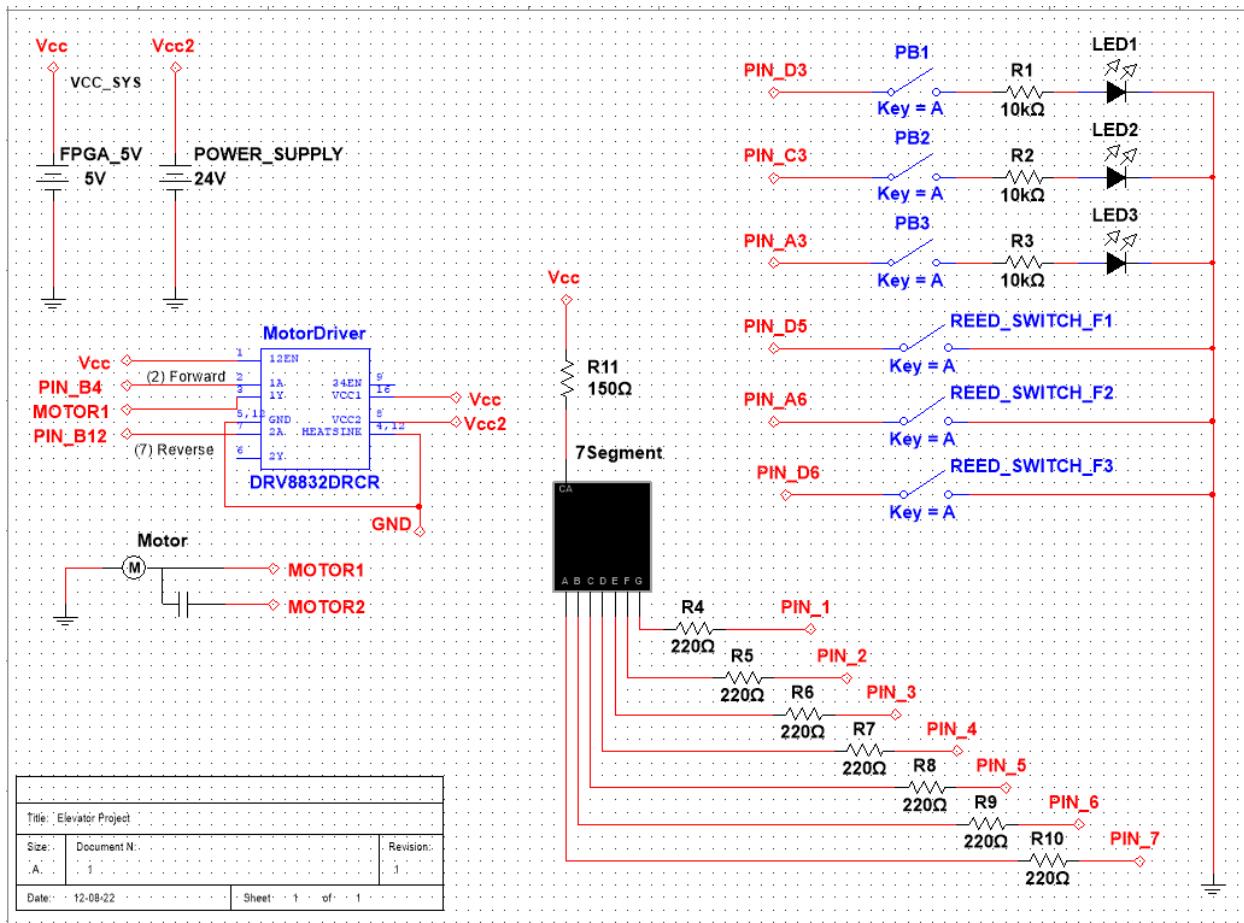


Figure 2: LCD & push-button wiring

WIRING DIAGRAM:



SUMMARY TABLE:

HARDWARE	TRIGGER	DESCRIPTION
Push Buttons (3)	- When a PB is pressed	- Cabin goes to corresponding floor
LEDs (3)	- When a PB is pressed - While cabin moves	- LED lights up - LED blinks
Buzzer (1)	- When cabin reaches set floor	- Buzzer beeps once
7 Segment Display (1)	- When cabin reaches any floor	- Display cabin's current floor
Motor (1)	- When a PB is pressed & set floor is greater than cabin floor - When a PB is pressed & set floor is less than cabin floor	- Motor rotates clockwise (Cabin goes up) - Motor rotates counter-clockwise (Cabin goes down)
Reed switch (3)	- When cabin passes by the sensor	- Sensor reads 'false' and updates cabin position

Table 1: Operation and Interface Control of a 3-floor Elevator