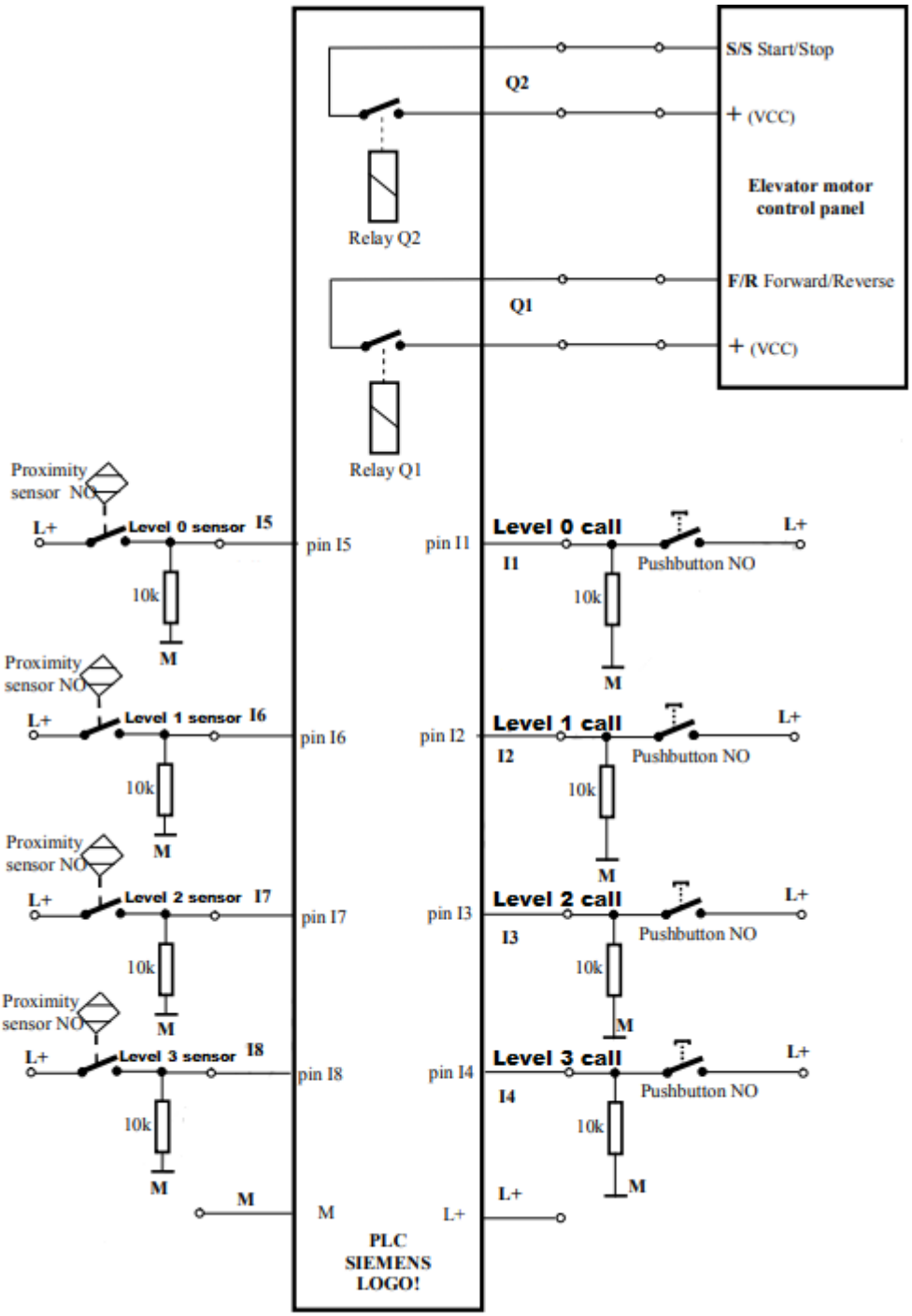
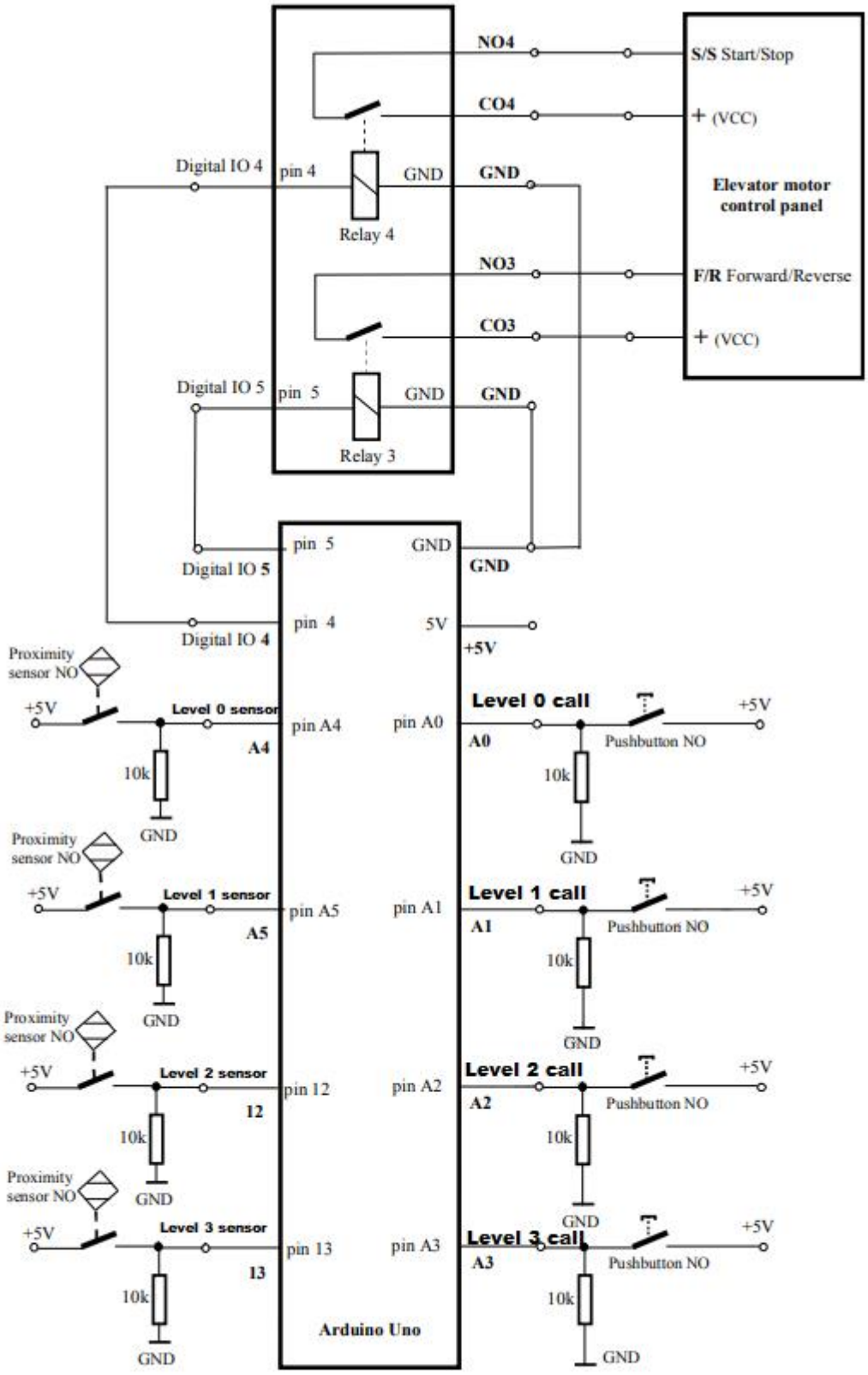
PLC connection diagram:



Arduino connection diagram:



Assumptions

I1 P_1 - button for sending the elevator to the 0th floor

I2 P_2 - button for sending elevator to the 1st floor

I3 P_3 - button for sending elevator to the 2nd floor

I4 P_4 - przycisk wysyłania windy na 3 kondygnację

I5 P_5 - elevator presence sensor on the 0th floor

I6 P_6 - elevator presence sensor on the 1st floor

I7 P_7 - elevator presence sensor on the 2nd floor

I8 P_8 - elevator presence sensor on the 3rd floor

Controlling the elevator motor

F/R, S/S – motor control inputs connected to PLC outputs

F/R output Q1

S/S z output Q2

F/R (direction bit)	S/S (stop bit)	Reaction
0	1	stop
0	0	↑(go up)
1	0	↓(go down)
1	1	forbidden combination

Controlling the elevator motor (ARDUINO)

Pin 5 - F/R (direction bit) - Q1

Pin 4 - S/S (stop bit) - Q2

The #define directives in Arduino sketch

```
#define Button1Pin A0
#define Button2Pin A1
#define Button3Pin A2
#define Button4Pin A3
#define Sensor1Pin A4
#define Sensor2Pin A5
#define Sensor3Pin 12
#define Sensor4Pin 13
#define OutputQ1Pin 5
#define OutputQ2Pin 4
```

Definition of state machine states

0 - elevator sets on the 3rd floor - initial state

1 - elevator is on the 0th floor

2 - elevator is on the 1st floor

3 - the elevator is on the 3rd floor

4 - elevator moves from 0 to 1 floor

5 - elevator moves from 0 to 3rd floor

6 - elevator moves from 1st to 3rd floor

7 - elevator moves from 1 to 0 floor

8 - elevator moves from 3 to 1 floor

9 - elevator moves from 3 to 0 floor

The way to encode the states of a state machine

Stan	X1	X2	X3	X4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

State machine transition diagram

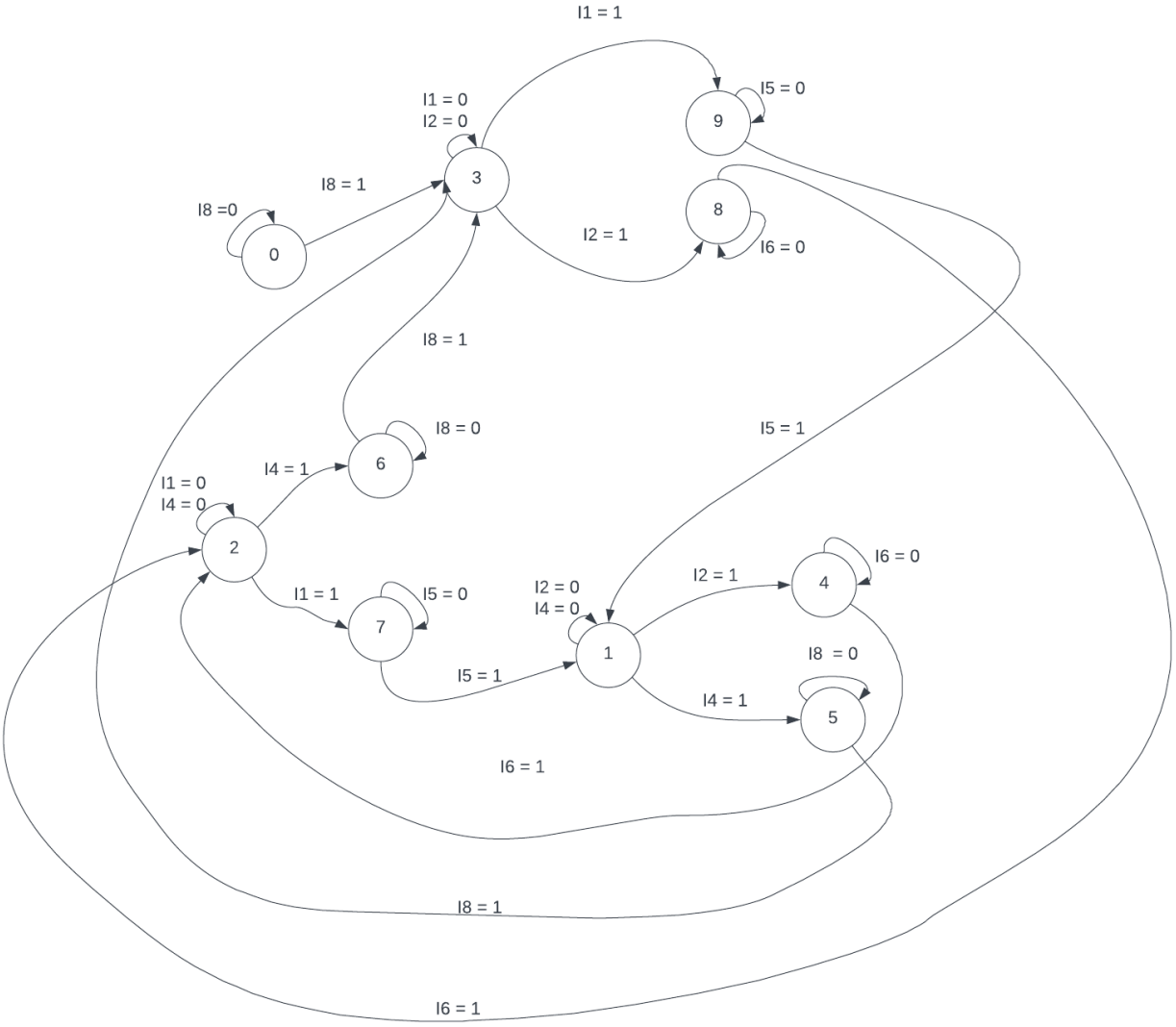


Table of state transitions

X1(t)	X2(t)	X3(t)	X4(t)	I1	I2	I4	I5	I6	I8	X1(t+1)	X2(t+1)	X3(t+1)	X4(t+1)
0	0	0	0	-	-	-	-	-	0	0	0	0	0
0	0	0	0	-	-	-	-	-	1	0	0	1	1
0	0	0	1	-	1	-	-	-	-	0	1	0	0
0	0	0	1	-	-	1	-	-	-	0	1	0	1
0	0	1	0	1	-	-	-	-	-	0	1	1	1
0	0	1	0	-	-	1	-	-	-	0	1	1	0
0	0	1	1	1	-	-	-	-	-	1	0	0	1
0	0	1	1	-	1	-	-	-	-	1	0	0	0
0	1	0	0	-	-	-	-	1	-	0	0	1	0
0	1	0	0	-	-	-	-	0	-	0	1	0	0
0	1	0	1	-	-	-	-	-	1	0	0	1	1
0	1	0	1	-	-	-	-	-	0	0	1	0	1
0	1	1	0	-	-	-	-	-	1	0	0	1	1
0	1	1	0	-	-	-	-	-	0	0	1	1	0
0	1	1	1	-	-	-	1	-	-	0	0	0	1
0	1	1	1	-	-	-	0	-	-	0	1	1	1
1	0	0	0	-	-	-	-	1	-	0	0	1	0
1	0	0	0	-	-	-	-	0	-	1	0	0	0
1	0	0	1	-	-	-	1	-	-	0	0	0	1
1	0	0	1	-	-	-	0	-	-	1	0	0	1
0	0	0	1	-	0	0	-	-	-	0	0	0	1
0	0	1	0	0	-	0	-	-	-	0	0	1	0
0	0	1	1	0	0	-	-	-	-	0	0	1	1

State transition functions:

The expressions highlighted in red can be simplified as follows ABC(!D) + ABC(D) = ABD(D + !D) = ABC1 = ABC

X1 state transition function::

X1 = !X1!X2X3X4I1 + !X1!X2X3X4I2 + X1!X2!X3!X4!I6 + X1!X2!X3X4!I5

X2 state transition function::

X2 = !X1!X2!X3X4I2 + !X1!X2!X3X4I4 + !X1!X2X3!X4I1 + !X1!X2X3!X4I4 + !X1X2!X3!X4!I6 + !X1X2!X3X4!I8 + !X1X2X3!X4!I8 + !X1X2X3X4!I5

X3 state transition function::

X3 = !X1!X2!X3!X4I8 + !X1!X2X3!X4I1 + !X1!X2X3!X4I4 + !X1X2!X3!X4I6 + !X1X2!X3X4I8 + !X1X2X3!X4I8 + !X1X2X3!X4!I8 + !X1X2X3X4!I5 + X1!X2!X3!X4I6 = !X1!X2!X3!X4I8 +

!X1!X2X3!X4I1 + !X1!X2X3!X4I4 + !X1X2!X3!X4I6 + !X1X2!X3X4I8 + !X1X2X3!X4 + !X1X2X3X4!I5 + X1!X2!X3!X4I6 + !X1!X2X3!X4!I1!I4 + !X1!X2X3X4!I1!I2

X4 state transition function::

X4 = !X1!X2!X3!X4I8 + !X1!X2!X3X4I4 + !X1!X2X3!X4I1 + !X1!X2X3X4I1 + !X1X2!X3X4I8 + !X1X2!X3X4!I8 + !X1X2X3!X4I8 + !X1X2X3X4I5 + !X1X2X3X4!I5 + X1!X2!X3X4I5 + X1!X2!X3X4!I5 = !X1!X2!X3!X4I8 + !X1!X2!X3X4I4 + !X1!X2X3!X4I1 + !X1!X2X3X4I1 + !X1X2!X3X4 + !X1X2X3!X4I8 + !X1X2X3X4I + X1!X2!X3X4 + !X1!X2!X3X4!I1!I4 + !X1!X2X3X4!I1!I2

Output function table:

X1	X2	X3	X4	F/R (Q1)	S/S (Q2)
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0	0	1
0	0	1	1	0	1
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	1	1	1	0
1	0	0	0	1	0
1	0	0	1	1	0

Output functions:

The expressions highlighted in red can be simplified as follows ABC(!D) + ABC(D) = ABD(D + !D) = ABC1 = ABC

Q1 output function:

Q1 = !X1X2X3X4 + X1!X2!X3!X4 + X1!X2!X3X4 = !X1X2X3X4 + X1!X2!X3

Q2 output function:

Q2 = !X1!X2!X3X4 + !X1!X2X3!X4 + !X1!X2X3X4