<table>
<tr><td colspan="6">Theory of Logic Circuits</td></tr>
<tr><td>Academic year</td><td>Term</td><td rowspan="3">Makrokierunek</td><td>Exercise Supervisor</td><td>Group</td><td>Section</td></tr>
<tr><td rowspan="2">2018/2019</td><td>Thursday</td><td rowspan="2">KP</td><td rowspan="2">3</td><td rowspan="2">1</td></tr>
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Report from exercise number 4

Exercise performed on: 2019-04-25

Subject of the exercise:
Asynchronous sequential logic circuits

Section consists of:

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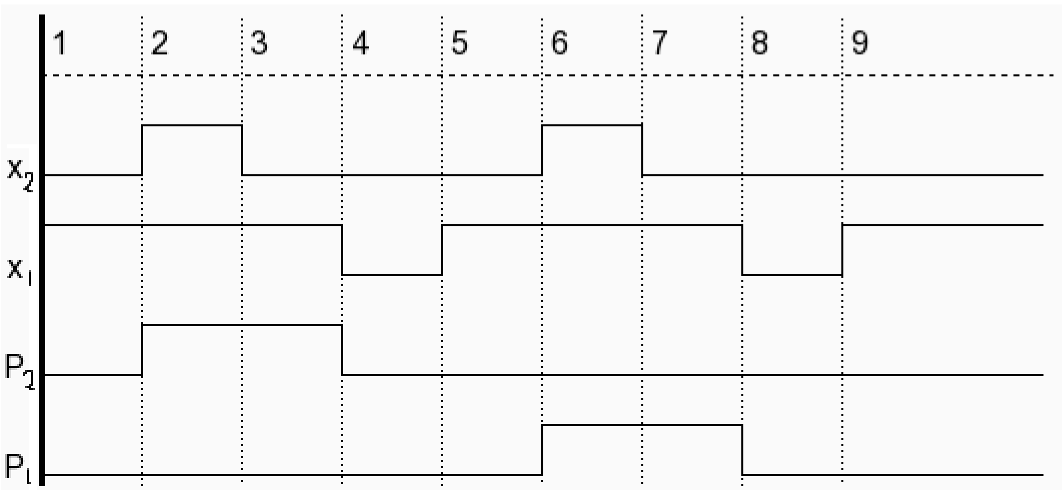
Wojciech Bieniek

Task 1

Implement with chosen by the supervisor elements (with or without sr latches), a circuit controlling the switching of two pumps. The pumps P1 and P2 (see fig.1) should be switched on alternately (only one pump can work at a time) when water exceeds the level of the sensor x2 (i.e. when x2 = 1). Working pump should be switched off when the water lever is below the sensor x1 (i.e. when x1 = 0). Assume that water level grows when pumps are off, and that it decreases when any pump is working.



x1x2	00	01	11	10	P1P2
0			1	(0)	00
1			(1)	2	01
2	3			(2)	01
3	(3)			4	00
4			5	(4)	00
5			(5)	6	10
6				(6)	10
7	(7)			0	00

q1q2\x1x2	00	01	11	10	P1P2
00	(7)		1	(0)	00
01	3		(1)	(2)	01
11	(3)		5	(4)	00
10	7		(5)	(6)	10

q1q2\x1x2	00	01	11	10
00	0		0	0
01	1		0	0
11	1		1	1
10	0		1	1

Q1

q1q2\x1x2	00	01	11	10
00	0		1	0
01	1		1	1
11	1		0	1
10	0		0	0

Q2

$Q_1 = Q_2\overline{x_1} + Q_1Q_2 + x_1Q_1$

$\overline{S1} = \overline{Q_2\overline{x_1}}$

$\overline{R1} = \overline{\overline{Q_2}\,\overline{x_1}}$

$Q_2 = Q_2\overline{x_2} + x_2\overline{Q_1} + \overline{Q_1}Q_2 = \overline{\overline{Q_2\overline{x_2}} * \overline{x_2\overline{Q_1}} * \overline{\overline{Q_1}Q_2}}$

$\overline{S2} = \overline{\overline{Q_1}x_2}$

$\overline{R2} = \overline{Q_1x_2}$

Q1\Q2	0	1
0	0	0
1	1	0

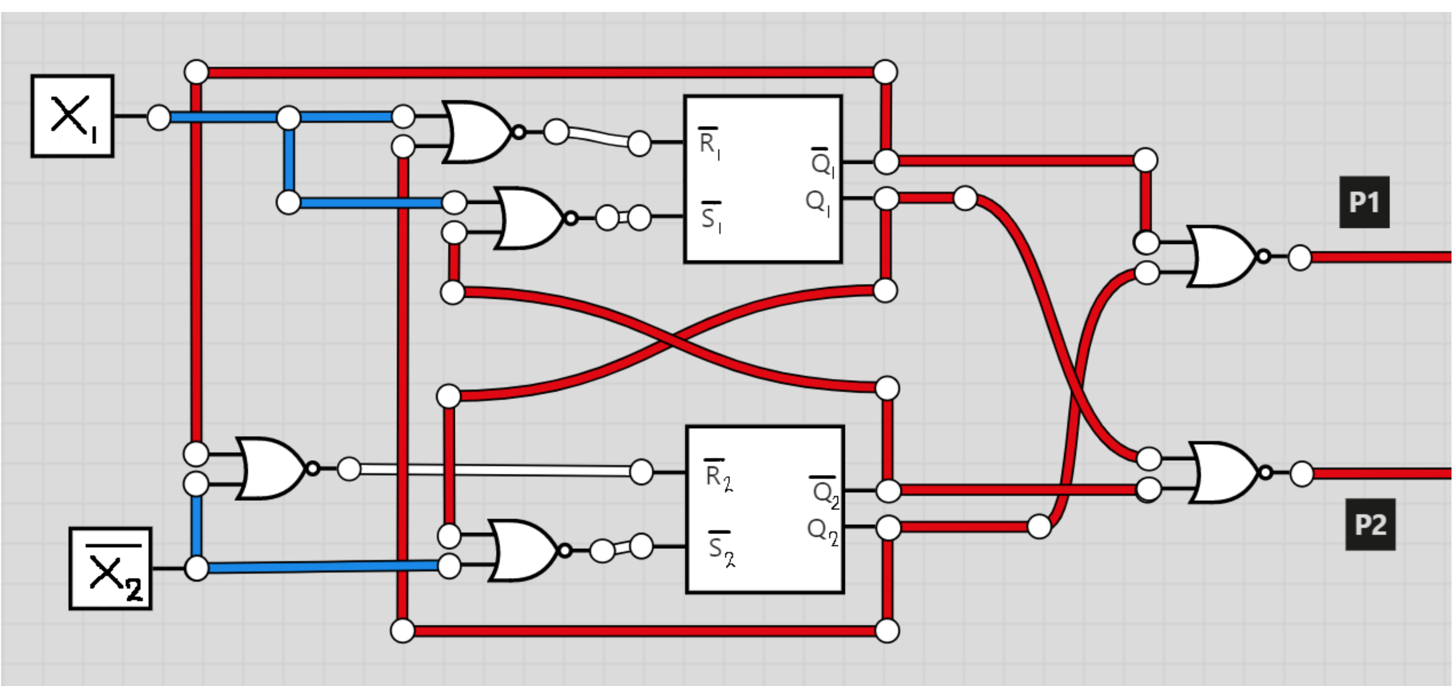
P1

Q1\Q2	0	1
0	0	1
1	0	0

P2

$P1 = Q1\overline{Q2} = \overline{\overline{Q1}+Q2}$

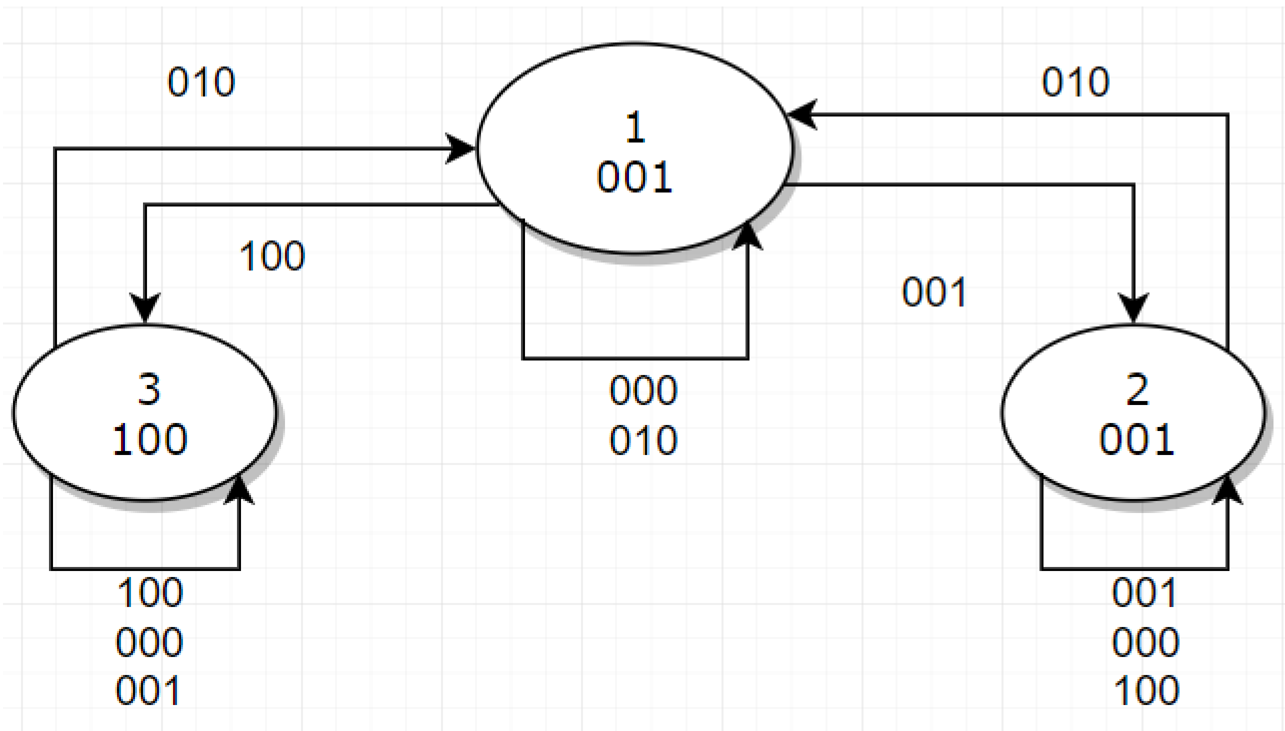
$P2 = \overline{Q1}Q2 = \overline{Q1+\overline{Q2}}$



Sorry about those upside-down flip-flops!

Task 2

Implement with chosen by the supervisor elements (with or without sr latches), a circuit controlling the operation of the inertial two-directional engine (fig 2). The engine can start to rotate only if it is stopped (RIGHT = 0, LEFT = 0, STOP = 1). The engine should start to rotate in right direction (RIGHT = 1) when button R is pressed for a short moment and it should keep rotating until button S is pressed. Pressing the R or L button when engine rotates right should be ignored. The engine should start to rotate in left direction (LEFT = 1) when button L is pressed for a short moment and it should keep rotating until button S is pressed. Pressing the L or R button when engine rotates left should be ignored. Similarly pressing S button when engine is stopped should not change its state. Pressing it when engine rotates in any direction should stop it by assigning outputs: RIGHT = 0, LEFT = 0, STOP = 1. Since all input buttons are monostable radio ones, it is assumed that only one of buttons S, L, R can be equal to one at a time.



xr xs xl	00	01	11	10
0 0 0	0	0	1	
0 0 1	0	1	1	
0 1 1				
0 1 0	0	0	0	
1 1 0				
1 1 1				
1 0 1				
1 0 0	0	0	1	

Q1

xr xs xl	00	01	11	10
0 0 0	0	1	1	
0 0 1	0	1	1	
0 1 1				
0 1 0	1	1	1	
1 1 0				
1 1 1				
1 0 1				
1 0 0	0	0	1	

Q2

$\overline{S_1} = \overline{Q_2 x_L}$

$\overline{r_1} = \overline{x_s}$

$\overline{S_2} = \overline{x_s}$

$\overline{r_2} = \overline{\overline{Q_1} x_R}$

Q1\Q2	0	1
0	1	0
1		0

Y_R

Q1\Q2	0	1
0	0	1
1		0

Y_S

Q1\Q2	0	1
0	0	0
1		1

Y_L

$Y_R = \overline{Q_2}$

$Y_S = \overline{Q_1}Q_2 = \overline{Q_1 + \overline{Q_2}}$

$Y_L = Q_1$