Task 2

In this section, the objetive is to recognize a sequence of 4 bits that come in a synchronized way. If the sequence is recognized, an output is turned on. Using a Moore's state machine, the resulting diagram is as shown below.

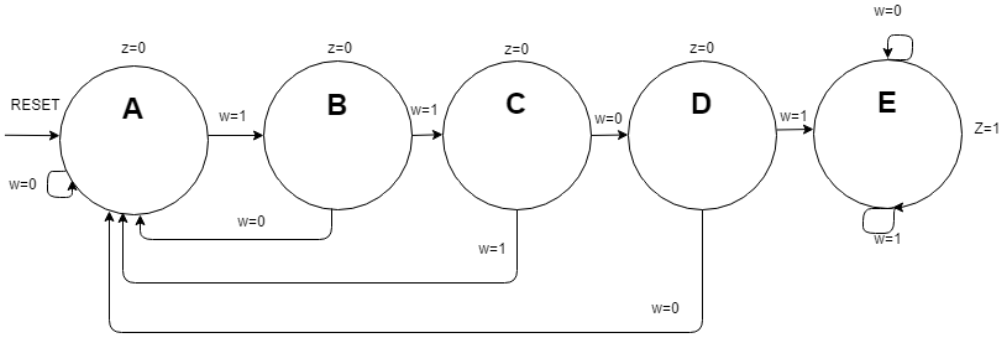

Figure 1: Moore state machine diagram

Notice that when the sequence is recognized, the machine needs to be reseted to detect a new combination. With the diagram, the following transition table is made.

Estado Actual		Estado Siguiente		Salidas
	y3 - y2 - y1	W		Z
		0	1	
A	000	A	B	0
B	001	A	C	0
C	010	D	A	0
D	011	A	E	0
E	100	E	E	1

Figure 2: Moore state machine - Transitions

Using Karnaugh's maps, the functions for the diferent states and the output are made as follows.

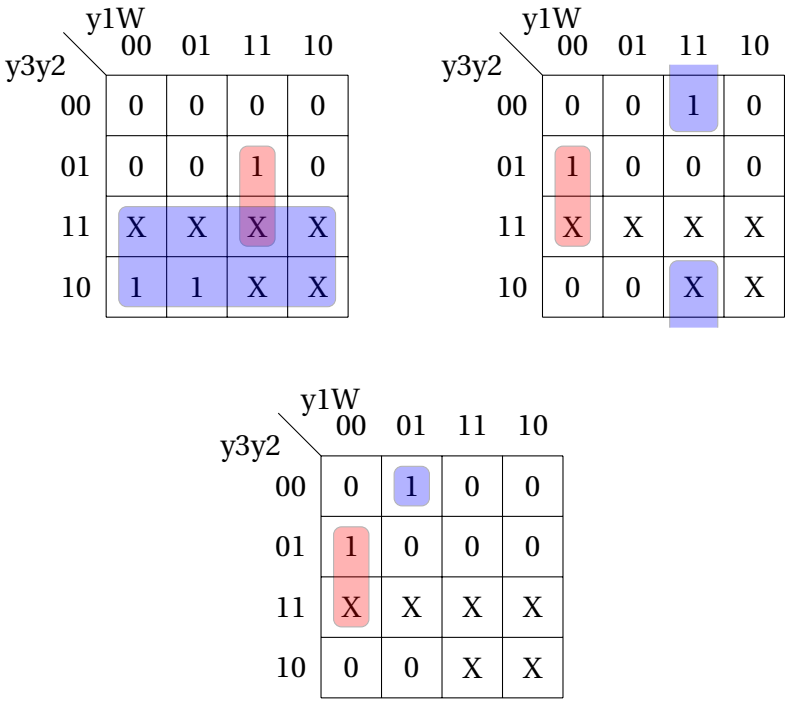

Figure 3: Maps for Y_3 (left), Y_2 (right), and Y_1 (center) functions.

Where $Y_3 = y_3 + y_2 \cdot y_1 \cdot W$, $Y_2 = y_2 \cdot \overline{y_1} \cdot \overline{W} + \overline{y_2} \cdot y_1 \cdot W$, and $Y_1 = \overline{y_3} \cdot \overline{y_2} \cdot \overline{y_1} \cdot W + y_2 \cdot \overline{y_1} \cdot \overline{W}$. Frome the table of transitions, $Z = y_3$.

With the functions, the state machine is implemented using three D Flip Flops as shown below.

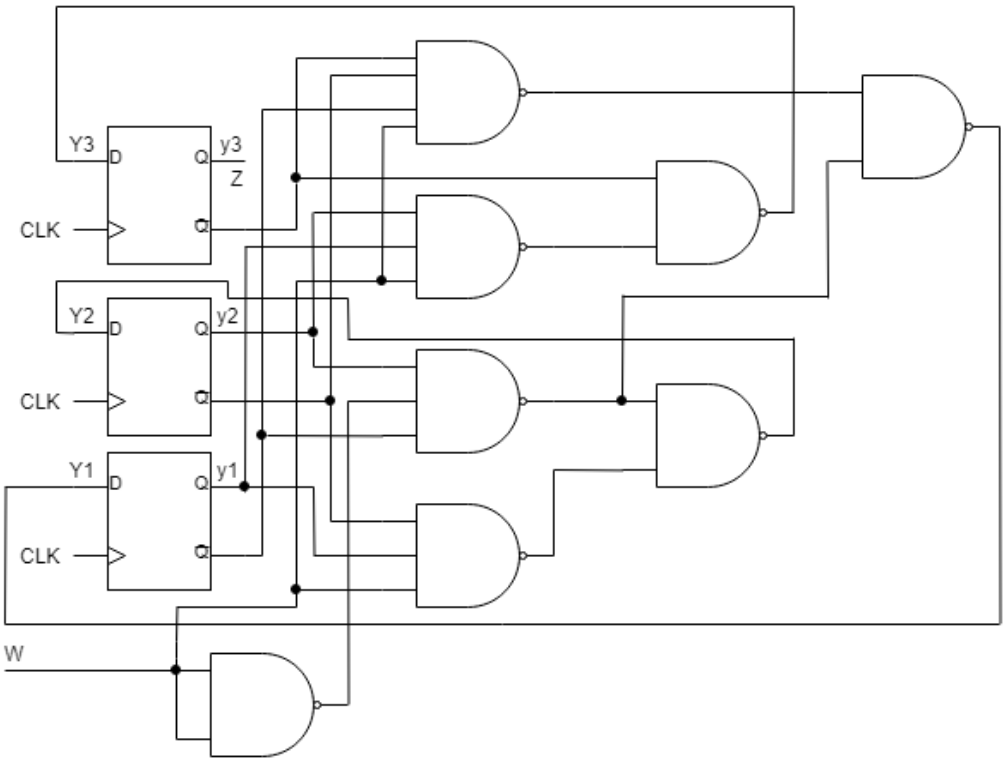

Figure 4: Moore state machine - Circuit implementation

Now, the same system is implemented using a Mealy's state machine, wich resulting diagram is shown below.

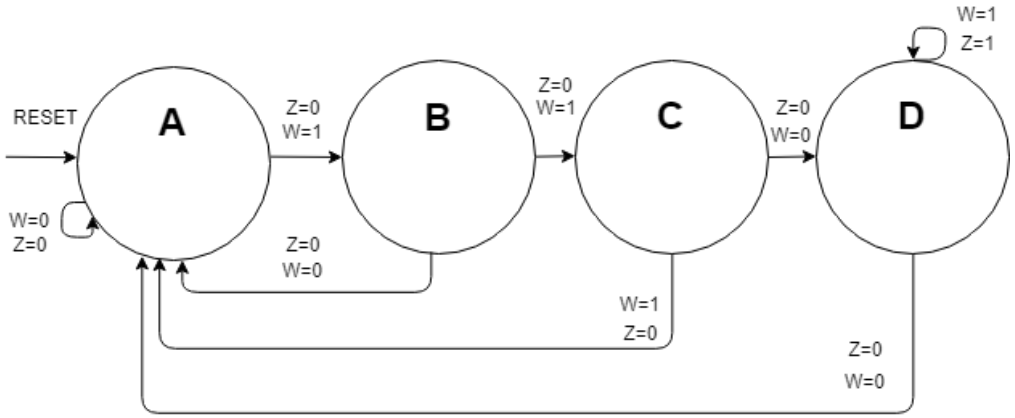

Figure 5: Mealy state machine diagram

Using the diagram, a table with the state transitions is made.

Estado Actual	Estado Siguiente		Salidas	
	y2 - y1	W		Z	
		0	1	W=0	W=1
A	00	A	B	0	0
B	01	A	C	0	0
C	10	D	A	0	0
D	11	A	D	0	1

Figure 6: Mealy state machine - Transitions

Using Karnaugh's maps, the functions for the states and the output are made below.

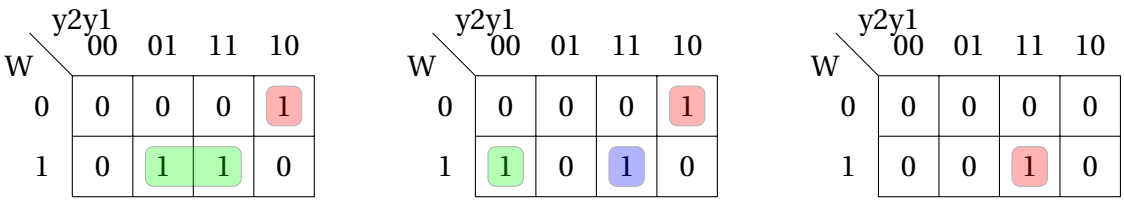

Figure 7: Maps for Y_2 (left), Y_1 (center) and Z (right) functions.

Where $Y_2 = W \cdot y_1 + \overline{W} \cdot y_2 \cdot \overline{y_1}$, $Y_1 = W \cdot \overline{y_2} \cdot \overline{y_1} + W \cdot y_2 \cdot y_1 + \overline{W} \cdot y_2 \cdot \overline{y_1}$, and $Z = W \cdot y_2 \cdot y_1$. With the defined functions, the state machine is implemented with 2 D Flip Flops. In this case is used one less flip flop, and the machine can used again without reset it.

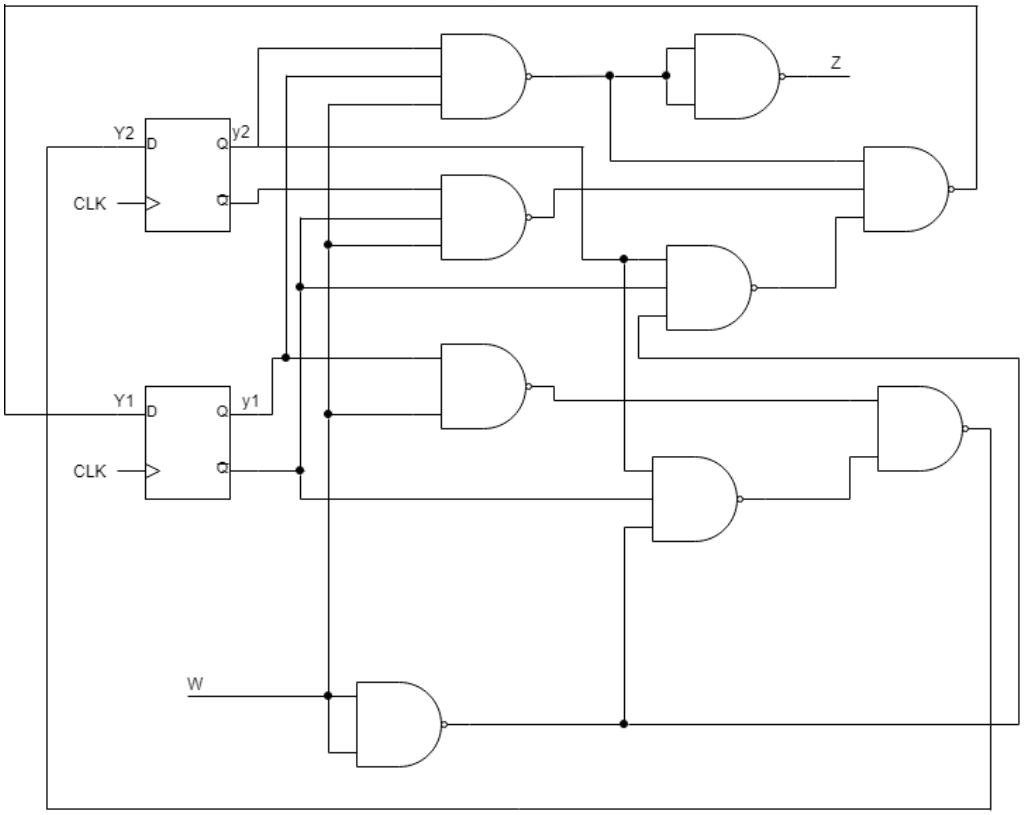

Figure 8: Mealy state machine - Circuit implementation