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i) Here, designer realise how output of the system depends on the input. Output and input should be identified from the derived scenario.

The truth table establishes all the relationships between the inputs and outputs for all the possible input combinations. In truth table, while more than two input high, output will be high because alarm turn off when more than 2 people enter the room. After that, Construct the Karnaugh map and find the boolean expression from the map. Then minimize the expression and draw the logic system for the expression. Now, the implementation of the drawn circuit will be the representation for the digital ~~design~~ design.

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Here, 4 people are allowed in a room. If more. than

2 people enter the room at the same time, an

alarm goes off.

A = 1st people

B = 2nd people

C = 3nd people

D = 4th people

E = alarm state

On = 1

Off = 0

A	B	C	D	E
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Karnaugh Map:

AB \ CD	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	0	1	1	1
10	0	0	1	0

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Group 1: $7, 15 \rightarrow BCD$
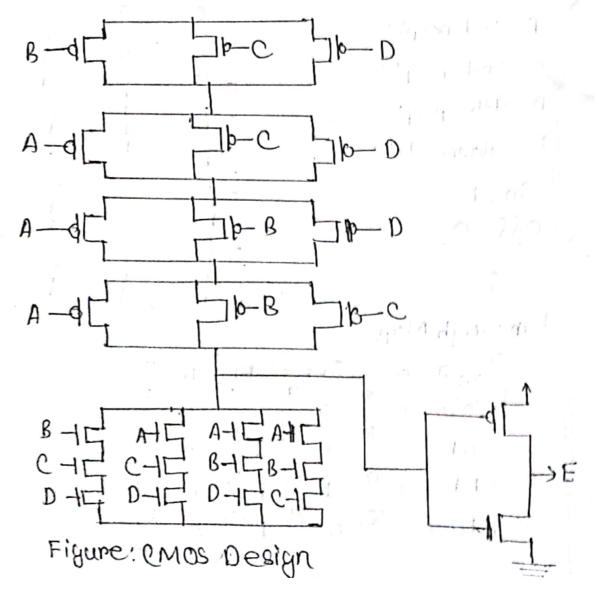
Group 2: $15, 11 \rightarrow ACD$

Group 3: $13, 15 \rightarrow ABD$

Group 4: $14, 15 \rightarrow ABC$

$\therefore$ SOP : $BCD + ACD + ABD + ABC$

Here, $E = \overline{BCD + ACD + ABD + ABC}$

Figure: CMOS Design

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ii) Here,

C = 4
O = 2
V = 1
1 = 9
D = 5

$M = C + O + V + 1 + D$
$= 4 + 2 + 1 + 9 + 5$
$= 21$

$N = 100 - M = 100 - 21 = 79$

Now, $M5 Hz = 215 Hz \angle 250 Hz$

So, the frequency of the circuit $f = 400 Hz$

$N = 79\%$

$C = 50 \mu F$

$T = \frac{1}{400} = 0.0025 s$

$T_H = \frac{79}{100} \times 0.0025 = 0.001975 s = 1.975 ms$

$T_L = 0.21 \times 0.0025 = 0.000525 s = 0.0525 ms$

$T_L = R_2 C \times 0.693$

$\Rightarrow R_2 = \frac{T_L}{0.693 \times C} = \frac{0.0525}{0.693 \times 50} = 1.51 \Omega \ 15.15 \Omega$

$$T_H = 0.693 (R_1 + R_2)C$$

$$\Rightarrow 1.975 = 0.693 \left(R_1 + \frac{15.15}{1.5.15} \right) \times 50$$

$$\Rightarrow R_1 + \frac{15.15}{1.5.1} = \frac{1.975}{0.693 \times 50}$$

$$\Rightarrow R_1 = 56.99 - \frac{15.15}{1.5.1} \quad 15.15$$

$$\Rightarrow R_1 = 41.84 \, \Omega$$

Figure: Sensor circuit of Alarm