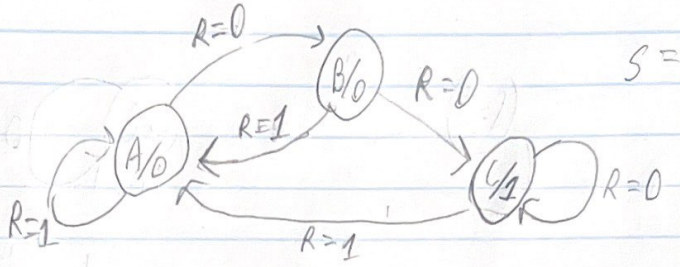
1. You will need 10 bits for the channels because you can get 1024 options which is enough for each state (channel) You will then need 4 more bits for the volume, has 16 options, enough for 12 levels.

2.



S=1 only at state C

3.

Current state	output
A	1
B	0
C	1

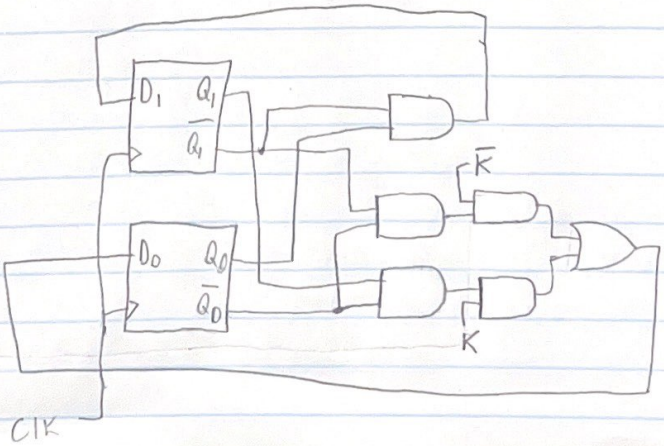
3 states can be represented in 2 bits, so 2 DFFs needed

current	input	Next
A	0	B
A	1	A
B	0	C
B	1	C
C	0	A
C	1	B

$\Rightarrow$

Q_1 Q_0	K	D_1 D_0
0 0	0	0 1
0 0	1	0 0
0 1	0	1 0
0 1	1	1 0
1 0	0	0 0
1 0	1	0 1

$D_0 = \overline{Q_1}\,\overline{Q_0}\,\overline{K} + Q_1\overline{Q_0}\,K$ $\quad D_1 = \overline{Q_1}\,Q_0$



4. Sensor options

L	R	
0	0	
0	1	0101 - veers left (turn right)
1	0	1010 - veers right (turn left)
1	1	0000 - on line (go straight

States: Going forward, turning right
turning left