Creating an FSM for a Soda Dispensing Machine

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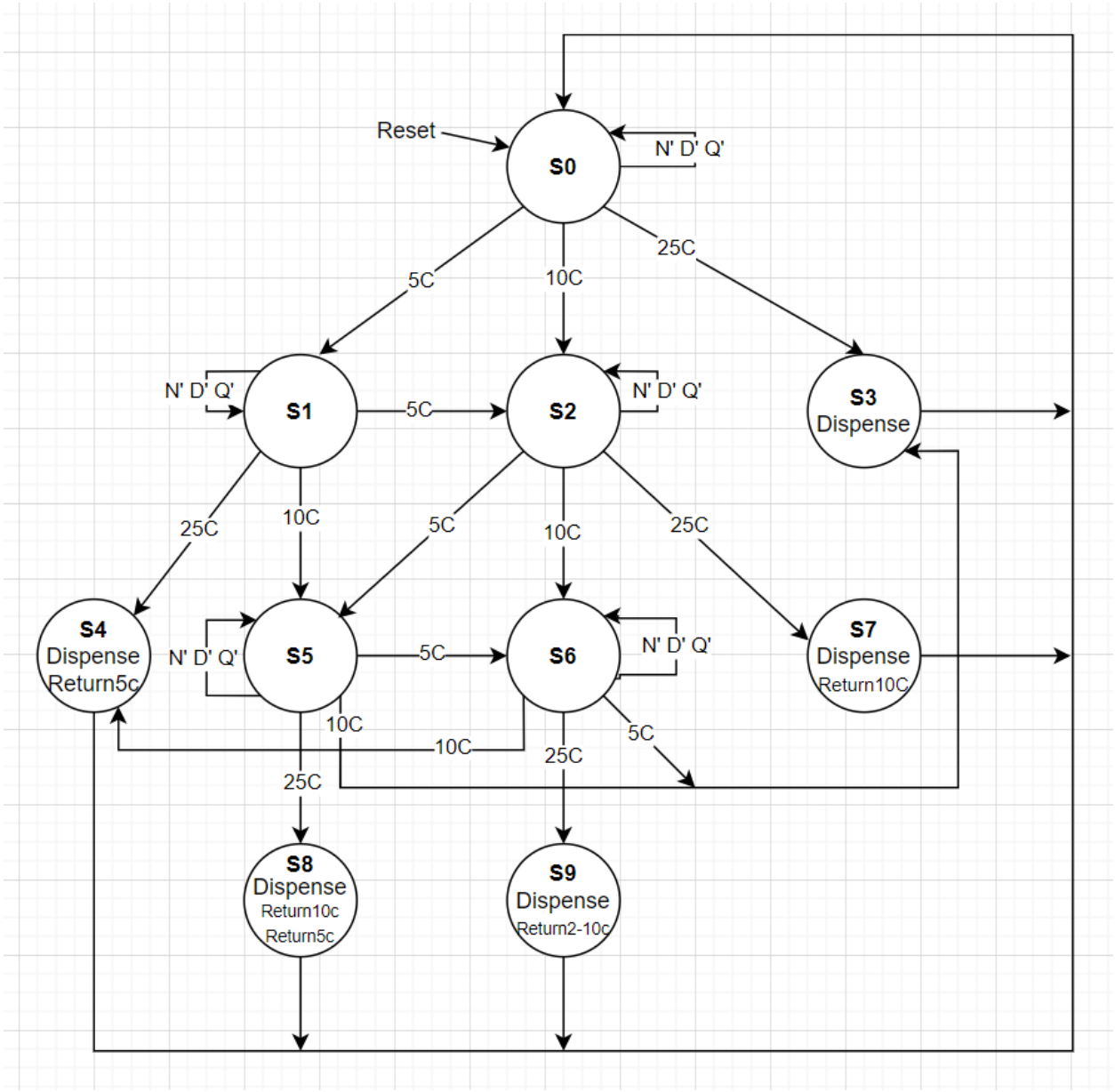
Finite State Machine (FSM) Diagram



State Transition Table

Current State	Inputs			Next State
S	5 cents (N)	10 cents (D)	25 cents (Q)	S'
S0	0	0	0	S0
S0	0	0	1	S3
S0	0	1	0	S2
S0	1	0	0	S1
S1	0	0	0	S1
S1	0	0	1	S4
S1	0	1	0	S5
S1	1	0	0	S2
S2	0	0	0	S2
S2	0	0	1	S7
S2	0	1	0	S6
S2	1	0	0	S5
S3	X	X	X	S0
S4	X	X	X	S0
S5	0	0	0	S5
S5	0	0	1	S8
S5	0	1	0	S3
S5	1	0	0	S6
S6	0	0	0	S6
S6	0	0	1	S9
S6	0	1	0	S4
S6	1	0	0	S3
S7	X	X	X	S0
S8	X	X	X	S0
S9	X	X	X	S0

State Encoding Table

State	Encoding
S0	0000000001
S1	0000000010
S2	0000000100
S3	0000001000
S4	0000010000
S5	0000100000
S6	0001000000
S7	0010000000
S8	0100000000
S9	1000000000

State Transition Table Encoded 1

Current State	Inputs			Next State
S	5 cents (N)	10 cents (D)	25 cents (Q)	S'
0000000001	0	0	0	0000000001
0000000001	0	0	1	0000001000
0000000001	0	1	0	0000000100
0000000001	1	0	0	0000000010
0000000010	0	0	0	0000000010
0000000010	0	0	1	0000010000
0000000010	0	1	0	0000100000
0000000010	1	0	0	0000000100
0000000100	0	0	0	0000000100
0000000100	0	0	1	0010000000
0000000100	0	1	0	0001000000
0000000100	1	0	0	0000100000
0000001000	X	X	X	0000000001

0000010000	X	X	X	0000000001
0000100000	0	0	0	0000100000
0000100000	0	0	1	0100000000
0000100000	0	1	0	0000001000
0000100000	1	0	0	0001000000
0001000000	0	0	0	0001000000
0001000000	0	0	1	1000000000
0001000000	0	1	0	0000010000
0001000000	1	0	0	0000001000
0010000000	X	X	X	0010000000
0100000000	X	X	X	0100000000
1000000000	X	X	X	1000000000

State Transition Table Encoded 2

Current State										Inputs			Next State									
S_9	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	S_0	5c (N)	10c (D)	25c (Q)	S'_9	S'_8	S'_7	S'_6	S'_5	S'_4	S'_3	S'_2	S'_1	S'_0
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	1	0	0	1							1			
0	0	0	0	0	0	0	0	0	1	0	1	0								1		
0	0	0	0	0	0	0	0	0	1	1	0	0									1	
0	0	0	0	0	0	0	0	1	0	0	0	0									1	
0	0	0	0	0	0	0	0	1	0	0	0	1						1				
0	0	0	0	0	0	0	0	1	0	0	1	0					1					
0	0	0	0	0	0	0	0	1	0	1	0	0								1		
0	0	0	0	0	0	0	1	0	0	0	0	0								1		
0	0	0	0	0	0	0	1	0	0	0	0	1			1							
0	0	0	0	0	0	0	1	0	0	0	1	0				1						
0	0	0	0	0	0	0	1	0	0	1	0	0					1					
0	0	0	0	0	0	1	0	0	0	X	X	X										1
0	0	0	0	0	1	0	0	0	0	X	X	X										1
0	0	0	0	1	0	0	0	0	0	0	0	0					1					
0	0	0	0	1	0	0	0	0	0	0	0	1		1								
0	0	0	0	1	0	0	0	0	0	0	1	0							1			
0	0	0	0	1	0	0	0	0	0	1	0	0				1						
0	0	0	1	0	0	0	0	0	0	0	0	0				1						
0	0	0	1	0	0	0	0	0	0	0	0	1	1									
0	0	0	1	0	0	0	0	0	0	0	1	0						1				
0	0	0	1	0	0	0	0	0	0	1	0	0							1			
0	0	1	0	0	0	0	0	0	0	X	X	X										1
0	1	0	0	0	0	0	0	0	0	X	X	X										1
1	0	0	0	0	0	0	0	0	0	X	X	X										1

State Transition Equations

$S'_9 = S_6Q$
$S'_8 = S_5Q$
$S'_7 = S_2Q$
$S'_6 = S_2D + S_5N\ S_6N'D'Q'$
$S'_5 = S_1D + S_2N + S_5N'D'Q'$
$S'_4 = S_1Q + S_6D$
$S'_3 = S_0Q + S_5D + S_6N$
$S'_2 = S_0D + S_1N + S_2N'D'Q'$
$S'_1 = S_0N + S_1N'D'Q'$
$S'_0 = S_0N'D'Q' + S_3 + S_4 + S_7 + S_8 + S_9$

Output Encoding Table

Output	Encoding
Dispense	0001
Return5c	0010
Return10c	0100
ReturnTwo10c	1000

Output Table

										Output																
Current State										Dispense				Return 5 Cents				Return 10 Cents				Return Two 10 Cents			
S_9	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	S_0	D_{A3}	D_{A2}	D_{A1}	D_{A0}	D_{B3}	D_{B2}	D_{B1}	D_{B0}	D_{C3}	D_{C2}	D_{C1}	D_{C0}	D_{C3}	D_{C2}	D_{C1}	D_{C0}
0	0	0	0	0	0	0	0	0	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0	0	0	0	0	0	0	0	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0	0	0	0	0	0	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0	0	0	0	0	0	1	0	0	0	0	0	0	1	X	X	X	X	X	X	X	X	X	X	X	X
0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	X	X	X	X	X	X	X	X
0	0	0	0	1	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0	0	0	1	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0	0	1	0	0	0	0	0	0	0	0	0	0	1	X	X	X	X	0	1	0	0	X	X	X	X
0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	X	X	X	X
1	0	0	0	0	0	0	0	0	0	0	0	0	1	X	X	X	X	X	X	X	X	1	0	0	0

Output Equations

Dispense: $D_{A0} = S_9 + S_8 + S_7 + S_4 + S_3$

Return5c: $D_{B0} = S_4 + S_8$

Return10c: $D_{C0} = S_7 + S_8$

ReturnTwo10c: $D_{D0} = S_9$