Specification

Thursday, 19 March 2020 12:12 AM

Specification:

- Vending machine dispenses toilet paper rolls for $25/pack.
- Only one pack may be dispensed per transaction.
- The transaction accepts $5, $10, $20, $50 and not $100.
- Assume one banknote may be inserted at a time and inserted banknotes accumulate in deposited value.
- Vending machine has a release signal (REL) that releases a toilet paper pack upon successful transaction.
- Vending machine has a purchase button (PUR) to confirm the purchase:
    - If cumulative deposited value is $25 then REL is sent. This is a successful transaction.
    - If cumulative deposited is less than $25 then REL is NOT sent and transaction state maintained until the customer inserts more funds for a successful transaction.
- If cumulative deposited value is greater than $25 then the excess amount is automatically refunded.
- Vending machine has a refund button (REF) that can be pressed at any time during the process and will return the deposited amount.
- Assume that PUR and REF cannot be simultaneously pressed.
- Assume that the vending machine cannot hold a deposited amount of more than $25.

Formulation

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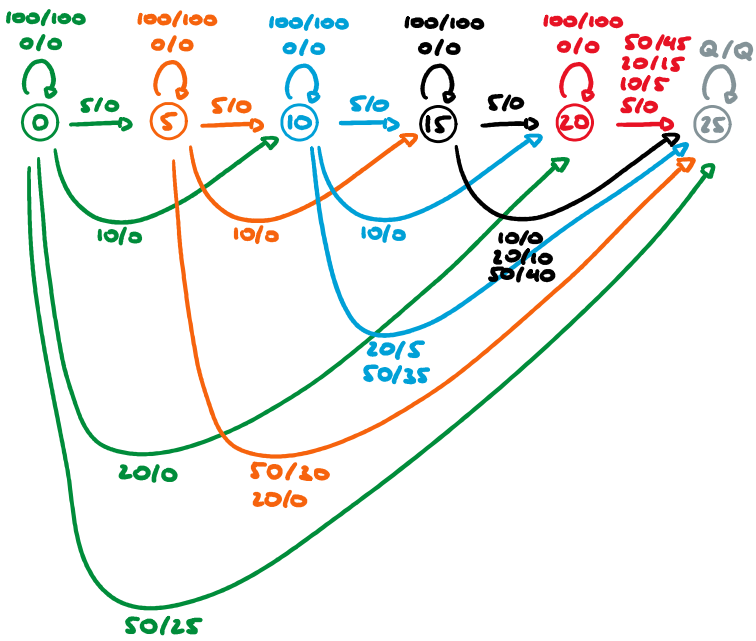
Each state represents the amount of deposited money in the vending machine. Q is used in place of X (don't care) to show state/value is the same - however the amount does not matter.

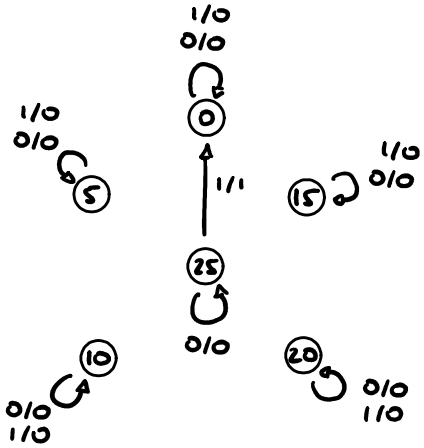
State Table of Automatic Refund Mechanism

Present State	Input	Next State	REF amount
Q	100	Q	100
Q	0	Q	0
0	5	5	0
0	10	10	0
0	20	20	0
0	50	25	25
5	5	10	0
5	10	15	0
5	20	25	0
5	50	25	30
10	5	15	0
10	10	20	0
10	20	25	5
10	50	25	35
15	5	20	0
15	10	25	0
15	20	25	10
15	50	25	40
20	5	25	0
20	10	25	5
20	20	25	15
20	50	25	45
25	Q	25	Q



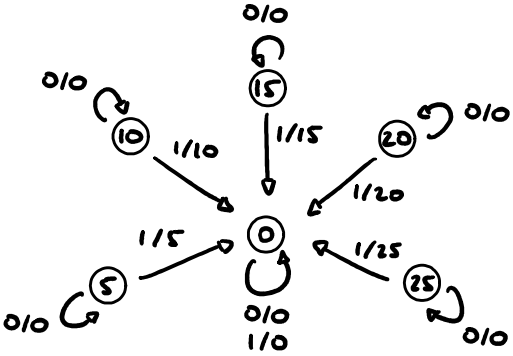
State Table of Purchase Button Press

Present State	PUR	Next State	REL
Q	0	Q	0
0	1	0	0
5	1	5	0
10	1	10	0
15	1	15	0
20	1	20	0
25	1	0	1



State Table of Refund Button Press

Present State	REF	Next State	REF amount
Q	0	Q	0
0	1	0	0
5	1	0	5
10	1	0	10
15	1	0	15
20	1	0	20
25	1	0	25



State table for purchase button press can be minimised by inspection:

Minimised State Table of Purchase Button Press

Present State	PUR	Next State	REL
Q	0	Q	0
Q	1	Q	0
25	1	0	1

No other minimisations.

State Assignment

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Refund Amount	Bool
0	0000
5	0001
10	0010
15	0011
20	0100
25	0101
30	0110
35	0111
40	1000
45	1001
50	1010
100	1011

Redrawn State Table of Automatic Refund Mechanism

Present State	Input	Next State	REF amount
Q	1011	Q	1011
Q	0000	Q	0000
0000	0001	0001	0000
0000	0010	0010	0000
0000	0100	0100	0000
0000	1010	0101	0101
0001	0001	0010	0000
0001	0010	0011	0000
0001	0100	0101	0000
0001	1010	0101	0110
0010	0001	0011	0000
0010	0010	0100	0000
0010	0100	0101	0001
0010	1010	0101	0111
0011	0001	0100	0000
0011	0010	0101	0000
0011	0100	0101	0010
0011	1010	0101	1000
0100	0001	0101	0000
0100	0010	0101	0001
0100	0100	0101	0011
0100	1010	0101	1001
0101	Q	0101	Q

Redrawn State Table of Purchase Button Press

Present State	PUR	Next State	REL
Q	0	Q	0
Q	1	Q	0
0101	1	0000	1

Redrawn State Table of Refund Button Press

Present State	REF	Next State	REF amount
Q	0	Q	0000
0000	1	0	0000
0001	1	0	0001
0010	1	0	0010
0011	1	0	0011
0100	1	0	0100
0101	1	0	0101

Flip-Flop Selection

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Equation Determination

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Optimisation

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Technology Mapping

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Verification

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