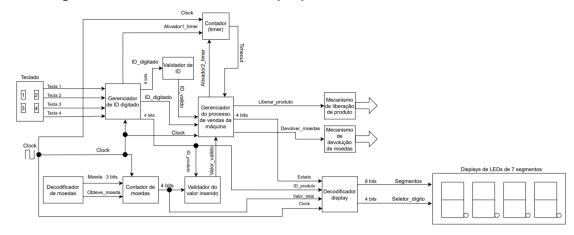
# Formalização do projeto de MEF

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### I. Diagrama de alto nível do circuito proposto



# II. Descrição sobre as entradas e saídas do circuito MEF controladora do sistema geral:

Essa máquina é responsável por gerenciar o processo de venda como um todo, ela indica em que estado a máquina de vendas se encontra. A máquina apresenta quatro entradas de 1 bits. Além disso, apresenta uma saída de 3 bits equivalente ao estado em que a máquina se encontra.

#### Entradas:

Entradas	Descrição
IDT	Esta entrada indica se o id do produto foi digitado.
IDV	Esta entrada é utilizada para verificar se o id digitado pelo usuário é válido ou não, isso, com base nos produtos existentes na máquina de vendas.
MV	Esta entrada é utilizada para verificar se a quantia de dinheiro colocada pelo usuário na máquina de vendas é igual ao valor do produto escolhido por ele.
Т	Esta entrada é utilizada para indicar se o tempo do contador acabou. Este contador rege o tempo de uma determinada operação da máquina de vendas.

### Saídas:

Saídas	Descrição
000	Esta saída indica que a máquina encontra-se em estado de espera.
001	Esta saída indica que a máquina está na etapa de validar ID.
010	Esta saída indica que a máquina está no estado verificar se o valor inserido pelo usuário é equivalente ao do produto selecionado.
011	Esta saída indica que a operação de venda foi concluída com sucesso.
100	Esta saída indica que o ID do produto digitado não é válido.
101	Esta saída indica que o valor das moedas inseridas pelo usuário não está de acordo com o preço do produto selecionado.

# MEF para o ID digitado

A máquina é responsável por determinar se o valor inserido pelo usuário para selecionar um item é referente a coluna ou a linha que identifica o item. A máquina apresenta uma entrada de 1 bit e uma saída de 2 bits que é equivalente ao estado em que a máquina está.

# Entrada:

Entrada	Descrição
APT	Indica se alguma das teclas do teclado da máquina de vendas foi acionada.

### Saídas:

Saídas	Descrição
00	Nesta saída a máquina indica que nenhuma tecla foi pressionada ainda no teclado.
01	Nesta saída a máquina indica que o teclado recebeu o primeiro acionamento de tecla, portanto, o valor proveniente das entradas do teclado é referente a linha que identifica o produto.
10	Nessa saída a máquina indica que o teclado já recebeu o primeiro acionamento e está aguardando o próximo, que será referente a coluna que identifica o produto
11	Nessa saída a máquina indica que o usuário pressionou uma das teclas do teclado pela segunda vez, portanto, o valor proveniente das entradas do teclado é referente a coluna que identifica o produto. Dessa forma, o ID do produto desejado pelo usuário é obtido.

# MEF para contabilizar as moedas

A máquina é responsável por obter o valor total de moedas inseridas pelo usuário. A máquina apresenta duas entradas, uma é a *Next\_State* de 4 bits e a outra a *got\_coin* de 1 bit. Além disso, a máquina apresenta uma saída *val\_tot* de 4 bits que é igual ao estados em que a máquina se encontra.

#### Entradas:

Entradas	Descrição
Next_State	Esta entrada é utilizada para verificar qual deve ser o próximo estado da máquina de acordo com o valor da moeda inserido pelo usuário.
got_coin	Esta entrada é utilizada para verificar se foi inserida alguma moeda pelo usuário na máquina de vendas.

#### Saídas:

Saídas	Descrição
0000	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 0,00 centavos.
0001	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 0,25 centavos.
0010	Esta saída indica que o valor total de moedas inseridos pelo usuário foi de 0,75 centavos
0011	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 1,00 real.
0100	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 1,25 real.
0101	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 1,50 real.
0110	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 1,75 real.
0111	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 2,00 reais.
1000	Esta saída indica que o valor total de moedas inseridas pelo usuário foi de 0,00 centavos.
1001	Esta saída indica que o valor total de moedas inseridas pelo usuário está acima do valor do produto mais caro disponível na máquina, portanto, é inválido.
1111	Esta saída indica que a máquina está no estado de espera da contabilização da moeda que acabara de entrar na máquina.

### III. Justificativa sobre o tipo de máquina utilizadas

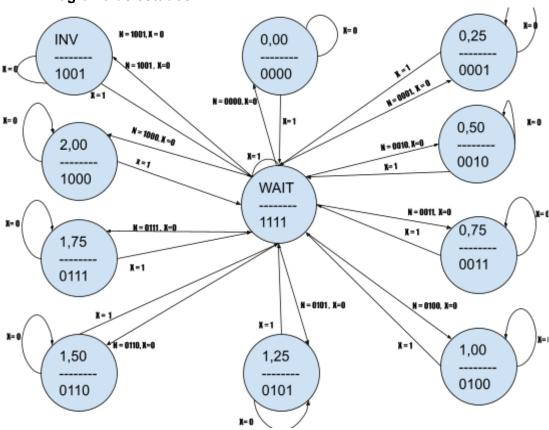
Todas as máquinas desenvolvidas utilizaram a arquitetura de Moore. Essa abordagem de máquina de estados apresenta uma facilidade para a obtenção das expressões de saídas, são mais robustas aos ruídos que podem ocorrer e são mais simples de implementar. Além disso, da maneira que projetamos nossa máquina de vendas, não se faz necessário em nenhum momento uma mudança imediata em suas saídas em decorrência das entradas, o que nos direcionou para a arquitetura de Moore ao invés de Mealy.

#### IV. Formalização do projeto

O circuito é composto por 3 máquinas de estados: MEF para contabilizar as moedas, MEF para obtenção do ID digitado pelo usuário e MEF geral para gerenciar o processo de vendas como um todo.

#### Formalização da MEF para contabilizar moedas:

#### 1. Diagrama de estados



#### 2. Tabela de transição

Estado Atual	Entradas	Próximo Estado		
E0 E1 E2 E3	X N	E0+ E1+ E2+ E3+		
0,00	0 xxxx	0,00		
0,00	1 xxxx	WAIT		
0,25	0 xxxx	0,25		

0,25	1	xxxx	WAIT
0,50	0	xxxx	0,50
0,50	1	xxxx	WAIT
0,75	0	xxxx	0,75
0,75	1	xxxx	WAIT
1,00	0	xxxx	1,00
1,00	1	xxxx	WAIT
1,25	0	xxxx	1,25
1,25	1	xxxx	WAIT
1,50	0	xxxx	1,50
1,50	1	XXXX	WAIT
1,75	0	XXXX	1,75
1,75	1	XXXX	WAIT
2,00	0	xxxx	2,00
2,00	1	xxxx	WAIT
INV	0	xxxx	INV
INV	1	xxxx	WAIT
WAIT	1	xxxx	WAIT
WAIT	0	0000	0,00
WAIT	0	0001	0,25
WAIT	0	0010	0,50
WAIT	0	0011	0,75
WAIT	0	0100	1,00
WAIT	0	0101	1,25
WAIT	0	0110	1,50
WAIT	0	0111	1,75
WAIT	0	1000	2,00
WAIT	0	1001	INV
WAIT	0	1111	WAIT

# 3. Minimização de estados

Não houve a necessidade de minimização de estados.

# 4. Codificaçã<u>o</u> de estados

	Flip-l		Estado	
E0	E1	E2	E3	-
0	0	0	0	0.00
0	0	0	1	0.25
0	0	1	0	0.50
0	0	1	1	0.75
0	1	0	0	1.00
0	1	0	1	1.25
0	1	1	0	1.50
0	1	1	1	1.75
1	0	0	0	2.00
1	0	0	1	INV
1	0	1	0	х
1	0	1	1	х
1	1	0	0	х
1	1	0	1	х
1	1	1	0	х
1	1	1	1	WAIT

# 5. Modificação da tabela de transição de estados

Esta	do A	.t	En	tradas	Estado P.r/ Exc.			Exc.
E0 E1 E2 E3			Х	N	E0	+ E1	+ E2	+ E3+
0 (	0 0	0	0	xxxx	0	0	0	0
0 (	0	0	1	xxxx	1	1	1	1
0 (	0 0	1	0	xxxx	0	0	0	1
0 (	0	1	1	xxxx	1	1	1	1
0 (	) 1	0	0	xxxx	0	0	1	0
0 (	) 1	0	1	xxxx	1	1	1	1

						_				
0	0	1	1	0	XXXX	0	0	1	1	
0	0	1	1	1	xxxx	1	1	1	1	
0	1	0	0	0	xxxx	0	1	0	0	
0	1	0	0	1	xxxx	1	1	1	1	
0	1	0	1	0	xxxx	0	1	0	1	
0	1	0	1	1	xxxx	1	1	1	1	
0	1	1	0	0	xxxx	0	1	1	0	
0	1	1	0	1	xxxx	1	1	1	1	
0	1	1	1	0	xxxx	0	1	1	1	
0	1	1	1	1	xxxx	1	1	1	1	
1	0	0	0	0	xxxx	1	0	0	0	
1	0	0	0	1	xxxx	1	1	1	1	
1	0	0	1	0	xxxx	1	0	C	) 1	
1	0	0	1	1	xxxx	1	1	1	1 1	
1	1	1	1	1	xxxx	1	1	1	1 1	
1	1	1	1	0	0000	0	0	C	0	
1	1	1	1	0	0001	0	0	C	) 1	
1	1	1	1	0	0010	0	0	1	I 0	
1	1	1	1	0	0011	0	0	1	1	
1	1	1	1	0	0100	0	1	C	0	
1	1	1	1	0	0101	0	1	C	) 1	
1	1	1	1	0	0110	0	1	1	0	
1	1	1	1	0	0111	0	1	1	l 1	
1	1	1	1	0	1000	1	0	C	0	
1	1	1	1	0	1001	1	0	0	1	
1		1	1	0	1111	1	1	1	1	
		اما			a mamár					

# 6. Escolha do elementos de memória

Os elementos de memórias escolhidos para a implementação da MEF foram os Flip-Flops do tipo D.

# 7. Construção da tabela de excitação

	Estad	o atual				Entradas				Próximo	o estado	
E0	E1	E2	E3	X	N0	N1	N2	N3	E0*	E1*	E2*	E3*
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	1	1	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	1	0	0	0	0
0	0	0	0	0	0	1	1	0	0	0	0	0
0	0	0	0	0	0	1	1	1	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	1	0	0	0	0
0	0	0	0	0	1	0	1	0	0	0	0	0
0	0	0	0	0	1	0	1	1	0	0	0	0
0	0	0	0	0	1	1	0	0	0	0	0	0
0	0	0	0	0	1	1	0	1	0	0	0	0
0	0	0	0	0	1	1	1	0	0	0	0	0
0	0	0	0	0	1	1	1	1	0	0	0	0
0	0	0	0	1	0	0	0	0	1	1	1	1
0		0		1		0			1		1	
	0		0		0		0	1		1		1
0	0	0	0	1	0	0	1	0	1	1	1	1
0	0	0	0	1	0	0	1	1	1	1	1	1
0	0	0	0	1	0	1	0	0	1	1	1	1
0	0	0	0	1	0	1	0	1	1	1	1	1
0	0	0	0	1	0	1	1	0	1	1	1	1
0	0	0	0	1	0	1	1	1	1	1	1	1
0	0	0	0	1	1	0	0	0	1	1	1	1
0	0	0	0	1	1	0	0	1	1	1	1	1
0	0	0	0	1	1	0	1	0	1	1	1	1
0	0	0	0	1	1	0		1	1	1	1	
							1					1
0	0	0	0	1	1	1	0	0	1	1	1	1
0	0	0	0	1	1	1	0	1	1	1	1	1
0	0	0	0	1	1	1	1	0	1	1	1	1
0	0	0	0	1	1	1	1	1	1	1	1	1
0	0	0	1	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	1	0	0	0	1
0	0	0	1	0	0	0	1	0	0	0	0	1
0	0	0	1	0	0	0	1	1	0	0	0	1
0	0	0	1	0	0	1	0	0	0	0	0	1
0	0	0	1	0	0	1	0	1	0	0	0	1
0	0	0	1	0	0	1	1	0	0	0	0	1
0	0	0	1	0	0	1	1	1	0	0	0	1
0	0	0	1	0	1	0	0	0	0	0	0	1
0	0	0	1	0	1	0	0	1	0	0	0	1
0	0	0	1	0	1	0	1	0	0	0	0	1
0	0	0	1	0	1	0	1	1	0	0	0	1
0	0	0	1	0	1	1	0	0	0	0	0	1
	0						0					
0		0	1	0	1	1		1	0	0	0	1
0	0	0	1	0	1	1	1	0	0	0	0	1
0	0	0	1	0	1	1	1	1	0	0	0	1
0	0	0	1	1	0	0	0	0	1	1	1	1
0	0	0	1	1	0	0	0	1	1	1	1	1
0	0	0	1	1	0	0	1	0	1	1	1	1
0	0	0	1	1	0	0	1	1	1	1	1	1
0	0	0	1	1	0	1	0	0	1	1	1	1
0	0	0	1	1	0	1	0	1	1	1	1	1
0	0	0	1	1	0	1	1	0	1	1	1	1
											1	
0	0	0	1	1	0	1	1	1	1	1		1
0	0	0	1	1	1	0	0	0	1	1	1	1
0	0	0	1	1	1	0	0	1	1	1	1	1
0	0	0	1	1	1	0	1	0	1	1	1	1
0	0	0	1	1	1	0	1	1	1	1	1	1
0	0	0	1	1	1	1	0	0	1	1	1	1
0	0	0	1	1	1	1	0	1	1	1	1	1
0	0	0	1	1	1	1	1	0	1	1	1	1
0	0	0	1	1	1	1	1	1	1	1	1	1
0	0	1	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	1	0	0	1	0
0	0	1	0	0	0	0	1	0	0	0	1	0
0	0	1	0	0	0	0		1			1	0
							1		0	0		
0	0	1	0	0	0	1	0	0	0	0	1	0
0	0	1	0	0	0	1	0	1	0	0	1	0
0	0	1	0	0	0	1	1	0	0	0	1	0
0	0	1	0	0	0	1	1	1	0	0	1	0
0	0	1	0	0	1	0	0	0	0	0	1	0
0				0	1	0	0	1	0	0	1	0
	0	1	0	U					0			
0			0	0	1	0	1	0	0	0	1	0
	0	1	0	0	1	0	1	0	0	0		0
0	0 0 0	1 1 1	0	0	1	0	1	0	0	0	1	0
0	0 0 0	1 1 1	0 0 0	0 0 0	1 1 1	0 0 1	1 1 0	0 1 0	0 0 0	0 0 0	1	0 0 0
0 0 0	0 0 0 0	1 1 1 1 1	0 0 0	0 0 0	1 1 1	0 0 1	1 1 0	0 1 0	0 0 0	0 0 0	1 1 1	0 0 0
0 0 0	0 0 0 0 0	1 1 1 1 1	0 0 0 0	0 0 0 0	1 1 1 1 1	0 0 1 1	1 1 0 0	0 1 0 1	0 0 0 0	0 0 0 0	1 1 1	0 0 0 0
0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0	0 0 0 0 0	1 1 1 1 1	0 0 1 1 1 1	1 1 0 0 1	0 1 0 1 0	0 0 0 0 0	0 0 0 0 0	1 1 1 1	0 0 0 0 0
0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 1 1 1 1 1	1 1 0 0 1 1	0 1 0 1 0 1 0	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 0	1 1 0 0 1 1 1 0	0 1 0 1 0 1 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1	0 0 0 0 0 0 0
0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 1 1 1 1 1	1 1 0 0 1 1	0 1 0 1 0 1 0	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 1 1 1 1 1 0	1 1 0 0 1 1 1 0	0 1 0 1 0 1 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0	1 1 1 1 1 1 1	0 0 0 0 0 0 0
0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 1 1	1 1 1 1 1 1 0 0 0	0 0 1 1 1 1 0 0	1 1 0 0 1 1 1 0 0	0 1 0 1 0 1 0 1 0	0 0 0 0 0 0 0 1 1 1	0 0 0 0 0 0 0 1 1 1	1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 1 1 1
0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 1 1 1	1 1 1 1 1 1 1 0 0 0 0	0 0 1 1 1 1 0 0 0	1 1 0 0 1 1 1 0 0 0	0 1 0 1 0 1 0 1 0 1 0	0 0 0 0 0 0 0 1 1 1 1	0 0 0 0 0 0 0 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 1 1 1 1
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0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 1 1 1 1 1	1 1 1 1 1 1 0 0 0 0 0	0 0 1 1 1 1 0 0 0 0	1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0	0 1 0 1 0 1 0 1 0 1 0 1 0	0 0 0 0 0 0 1 1 1 1 1 1	0 0 0 0 0 0 0 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 1 1 1 1 1 1	1 1 1 1 1 1 0 0 0 0 0 0	0 0 1 1 1 1 0 0 0 0 0	1 1 0 0 0 1 1 1 0 0 1 1 1 0 0	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1	0 0 0 0 0 0 1 1 1 1 1 1 1	0 0 0 0 0 0 0 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 0 0 0 0 0 0 0	0 0 1 1 1 1 0 0 0 0 1 1 1 1 1 0 0	1 1 0 0 0 1 1 0 0 0 1 1 0 0 0 1 1 0	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0	0 0 0 0 0 0 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 0 0 0 0 0 1 1 1 1 1 1 1 1
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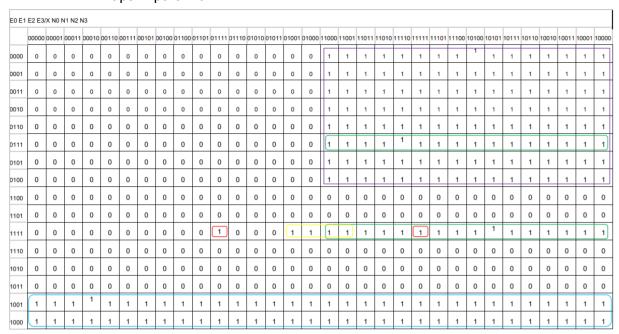
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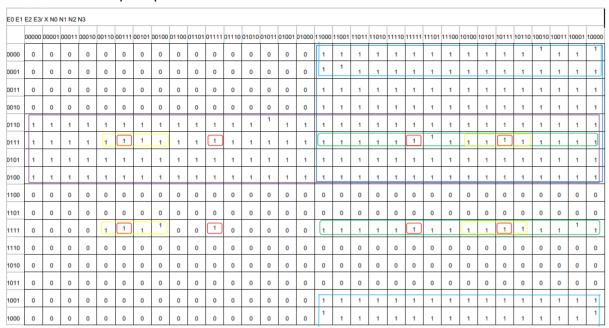
### 8. Obtenção das equações de excitação

Mapa K para D0:



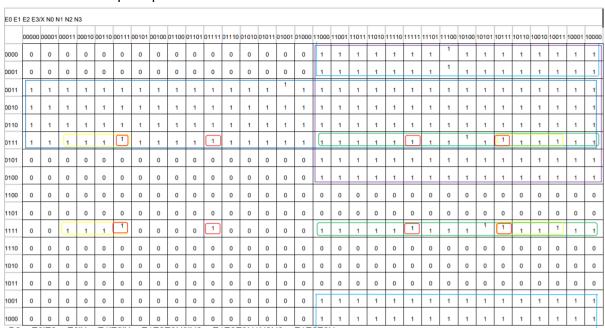
D0 = D0(E0, E1, E2, E3, X, N0, N1, N2, N3) = E0'X + E0E1'E2' + E0E1E2E3N0N1'N2' + E0E1E2E3N0N1N2N3 + E1E2E3X

#### Mapa K para D1:



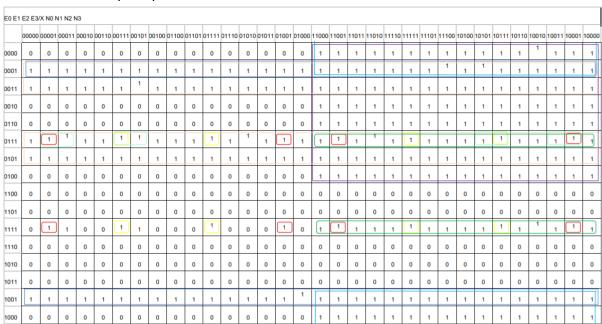
D1 = D1(E0, E1, E2, E3, X, N0, N1, N2, N3) = E0'X + E0'E1 + E1'E2'X + E1E2E3N0'N1 + E1E2E3N1N2N3 + E1E2E3X

#### Mapa K para D2:



D2 = D2(E0, E1, E2, E3, X, N0, N1, N2, N3) = E0'E2 + E0'X + E1'E2'X + E1E2E3N0'N2 + E1E2E3N1N2N3 + E1E2E3X

#### Mapa K para D3

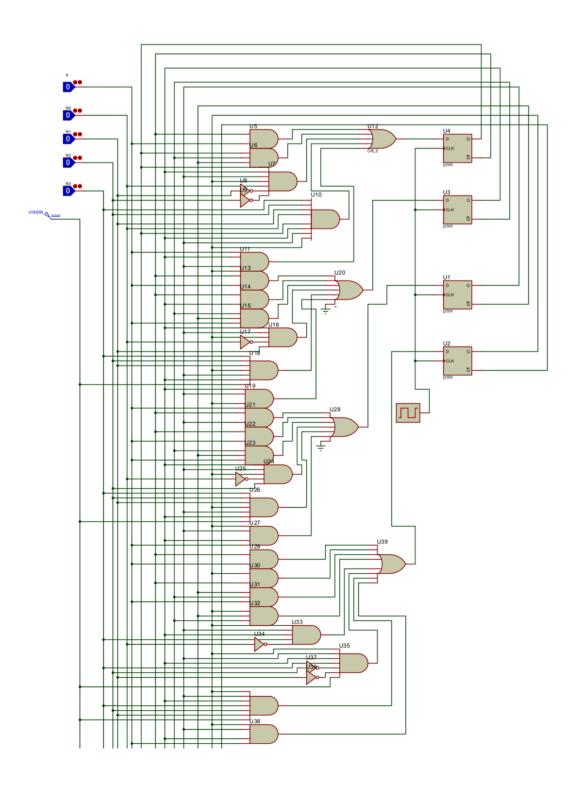


D3 = D3(E0, E1, E2, E3, X, N0, N1, N2, N3) = E0'X + E0'E3 + E1'E2'X + E1'E2'E3 + E1E2E3N0'N3 + E1E2E3N1'N2'N3 + E1E2E3N1N2N3 + E1E2E3X

#### 9. Equações de saída

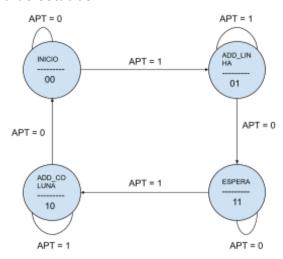
A saída da máquina será os seus estados, ou seja, as saídas do Flip-Flops. Saída = Q0, Q1, Q2, Q3

# 10. Desenho do circuito



# Formalização da MEF para o ID digitado:

# 1. Diagrama de estados



# 2. Tabela de transição de estados

Estado atual	Entrada	Próximo estado
Q0 Q1	APT	Q0* Q1*
INICIO	0	INICIO
INICIO	1	ADD_LINHA
ADD_LINHA	0	ESPERA
ADD_LINHA	1	ADD_LINHA
ESPERA	0	ESPERA
ESPERA	1	ADD_COLUNA
ADD_COLUNA	1	ADD_COLUNA
ADD_COLUNA	0	INICIO

# 3. Minimização de estados

Não houve a necessidade de minimização de estados.

# 4. Codificação de estados

Flip-l	lops	Estado
Q0	Q1	-
0	0	INICIO
0	1	ADD_LINHA
1	0	ADD_COLUNA
1	1	ESPERA

# 5. Modificação da tabela de transição de estados

Estado atual	Entrada	Próximo estado
Q0 Q1	APT	Q0* Q1*
00	0	00
00	1	01
01	0	11
01	1	01
11	0	11
11	1	10
10	1	10
10	0	00

# 6. Escolha dos elementos de memória

Os elementos de memórias escolhidos para a implementação da MEF foram os Flip-Flops do tipo D.

# 7. Construção da tabela de excitação

Estado	Estado atual		Próxim	o estado	
Q0	Q1	APT	D0	D1	
0	0	0	0	0	
0	0	1	0	1	
0	1	0	1	0	
0	1	1	0	1	
1	0	0	1	0	
1	0	1	1	1	
1	1	0	0	0	
1	1	1	1	1	

# 8. Obtenção das equações de excitação

Mapa K para D0:

Q0/Q1 APT	00	01	11	10
0	0	0	0	1
1	1	1	1	0

D0 = f(Q0, Q1, APT) = Q0Q1' + Q0APT + Q0'Q1APT'

# Mapa K para D1:

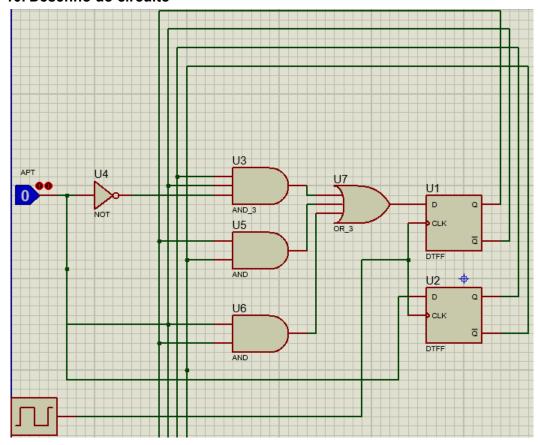
Q0/Q1 APT	00	01	11	10
0	0	1	1	0
1	0	1	1	0

$$D1 = f(Q0, Q1, APT) = APT$$

# 9. Obtenção das equações de saída

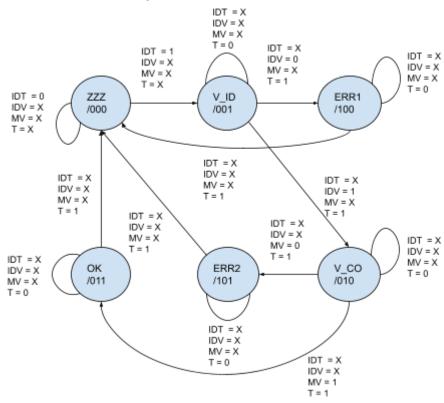
A saída da máquina será os seus estados, ou seja, as saídas do Flip-Flops. Saída = Q0, Q1.

#### 10. Desenho do circuito



### Formalização da MEF controladora do sistema geral:

### 1. Desenho dos diagramas de estados



### 2. Tabela de transição de estados

Q0 Q1 Q2	IDT IDV MV T	Q0* Q1* Q2*
ZZZ	0 X X X	ZZZ
ZZZ	1 X X X	V_ID
V_ID	XXX0	V_ID
V_ID	X 1 X 1	V_CO
V_ID	X 0 X 1	ERR1
V_CO	XXX0	V_CO
V_CO	X X 0 1	ERR2
v_co	X X 1 1	ОК
ок	XXX0	OK
ок	X X X 1	ZZZ
ERR1	XXX0	ERR1
ERR1	X X X 1	ZZZ
ERR2	XXX0	ERR2
ERR2	X X X 1	ZZZ

# 3. Minimização de estados

Não houve a necessidade de minimização de estados.

# 4. Codificação de estados

	Flip-Flops		Estado
Q0	Q1	Q2	-
0	0	0	ZZZ
0	0	1	V_ID
0	1	0	V_CO
0	1	1	OK
1	0	0	ERR1
1	0	1	ERR2

# 5. Modificação da tabela de transição de estados

Q1 Q2 Q3	IDT IDV MV T	Q1* Q2* Q3*
0 0 0	0 X X X	0 0 0
0 0 0	1 X X X	0 0 1
0 0 1	XXX0	0 0 1
0 0 1	X 1 X 1	0 1 0
0 0 1	X 0 X 1	1 0 0
0 1 0	XXX0	0 1 0
0 1 0	X X 0 1	1 0 1
0 1 0	X X 1 1	0 1 1
0 1 1	XXX0	0 1 1
0 1 1	X X X 1	000
100	XXX0	100
100	X X X 1	000
1 0 1	XXX0	1 0 1
1 0 1	X X X 1	0 0 0

# 6. Escolha dos elementos de memória

Os elementos de memórias escolhidos para a implementação da MEF foram os Flip-Flops do tipo D.

# 7. Construção da tabela de excitação

	Estado atual			Enti	adas			Próximo estado	
Q0	Q1	Q2	IDT	IDV	MV	Т	Q0*	Q1*	Q2*
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	1	0	0	0
0	0	0	0	1	0	0	0	0	0
0	0	0	0	1	0	1	0	0	0
0	0	0	0	1	1	0	0	0	0
0	0	0	0	1	1	1	0	0	0
0	0	0	1	0	0	0	0	0	1
0	0	0	1	0	0	1	0	0	1
0	0	0	1	0	1	0	0	0	1
0	0	0	1	0	1	1	0	0	1
0	0	0	1	1	0	0	0	0	1
0	0	0	1	1	0	1	0	0	1
0	0	0	1	1	1	0	0	0	1
0	0	0	1	1	1	1	0	0	1
0	0	1	0	0	0	0	0	0	1
0	0	1	0	0	0	1	1	0	0
0	0	1	0	0	1	0	0	0	1
0	0	1	0	0	1	1	1	0	0
0	0	1	0	1	0	0	0	0	1
0	0	1	0	1	0	1	0	1	0
0	0	1	0	1	1	0	0	0	1
0	0	1	0	1	1	1	0	1	0
0	0	1	1	0	0	0	0	0	1
0	0	1	1	0	0	1	1	0	0
0	0	1	1	0	1	0	0	0	1
0	0	1	1	0	1	1	1	0	0
0	0	1	1	1	0	0	0	0	1
0	0	1	1	1	0	1	0	1	0
0	0	1	1	1	1	0	0	0	1
0	0	1	1	1	1	1	0	1	0
0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	0	1	1	0	1
0	1	0	0	0	1	0	0	1	0
0	1	0	0	0	1	1	0	1	1
0	1	0	0	1	0	0	0	1	0
0	1	0	0	1	0	1	1	0	1
0	1	0	0	1	1	0	0	1	0
0	1	0	0	1	1	1	0	1	1
0	1	0	1	0	0	0	0	1	0
0	1	0	1	0	0	1	1	0	1
0	1	0	1	0	1	0	0	1	0
0	1	0	1	0	1	1	0	1	1
0	1	0	1	1	0	0	0	1	0
0	1	0	1	1	0	1	1	0	1
0	1	0	1	1	1	0	0	1	0
0	1	0	1	1	1	1	0	1	1
0	1	1	0	0	0	0	0	1	1
0	1	1	0	0	0	1	0	0	0
0	1	1	0	0	1	0	0	1	1
0	1	1	0	0	1	1	0	0	0
0	1	1	0	1	0	0	0	1	1
0	1	1	0	1	0	1	0	0	0
0	1	1	0	1	1	0	0	1	1
0	1	1	0	1	1	1	0	0	0
0	1	1	1	0	0	0	0	1	1
0	1	1	1	0	0	1	0	0	0
0	1	1	1	0	1	0	0	1	1
0	1	1	1	0	1	1	0	0	0
0	1	1	1	1	0	0	0	1	1
0	1	1	1	1	0	1	0	0	0
0	1	1	1	1	1	0	0	1	1
0	1	1	1	1	1	1	0	0	0
1	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	1	0	0
1	0	0	0	0	1	1	0	0	0
1	0	0	0	1	0	0	1	0	0
1	0	0	0	1	0	1	0	0	0
	0	0	0	1	1		1	0	
4		U	()	1	1	0	1		0
1	0	0	0	1	1	1	0	0	0

1 0 0 1 0 0 1	0 0
1     0     0     1     0     0     0     1       1     0     0     1     0     0     1     0	0 0
	0 0
1 0 0 1 0 1 1 0	0 0
1 0 0 1 1 0 0 1	0 0
1 0 0 1 1 0	0 0
1 0 0 1 1 1 0 1	0 0
1 0 0 1 1 1 1 0	0 0
1 0 1 0 0 0 1	0 1
1 0 1 0 0 0 1 0	0 0
1 0 1 0 0 1	0 1
1 0 1 0 0 1 1 0	0 0
1 0 1 0 1 0 0 1	0 1
1 0 1 0 1 0	0 0
1 0 1 0 1 1 0 1	0 1
1 0 1 0 1 1 0	0 0
1 0 1 1 0 0 1	0 1
1 0 1 1 0 0 1 0	0 0
1 0 1 1 0 1 0 1	0 1
1 0 1 1 0 1 1 0	0 0
1 0 1 1 1 0 0 1	0 1
1 0 1 1 1 0 1 0	0 0
1 0 1 1 1 0 1	0 1
1 0 1 1 1 1 0	0 0
1 1 0 0 0 0 0 0	0 0
1 1 0 0 0 0 1 0	0 0
1 1 0 0 0 1 0 0	0 0
1 1 0 0 0 1 1 0	0 0
1 1 0 0 1 0 0	0 0
1 1 0 0 1 0 1 0	0 0
1 1 0 0 1 1 0 0	0 0
1 1 0 0 1 1 0	0 0
1 1 0 1 0 0 0	0 0
1 1 0 1 0 0 1 0	0 0
1 1 0 1 0 1 0 0	0 0
1 1 0 1 0 1 0	0 0
1 1 0 1 1 0 0	0 0
1 1 0 1 1 0 1 0	0 0
1 1 0 1 1 0 0	0 0
1 1 0 1 1 1 0	0 0
1 1 1 0 0 0 0 0	0 0
1 1 1 0 0 0 1 0	0 0
1 1 1 0 0 1 0 0	0 0
1 1 1 0 0 1 1 0	0 0
1 1 1 0 1 0 0	0 0
1 1 1 0 1 0 1 0	0 0
1 1 1 0 1 1 0 0	0 0
1 1 1 0 1 1 0	0 0
1 1 1 0 0 0 0	0 0
1 1 1 0 0 1 0	0 0
1 1 1 0 1 0 0	0 0
1 1 1 1 0 1 1 0	0 0
1 1 1 1 1 0 0 0	0 0
1 1 1 1 1 0 1 0	0 0
	0 0
1     1     1     1     1     0     0       1     1     1     1     1     1     0	0 0

### 8. Obtenção das equações de excitação

Mapa K para D0:

Q0 Q1 Q2/IDT IDV MV T	0000	0001	0011	0010	0110	0111	0101	0100	1100	1101	1111	1110	1010	1011	1001	1000
000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
001	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0
011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
010	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
100	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1_

D0 = D0(Q1, Q2, Q3, IDT, IDV, MV, T) = Q1'Q2'Q3IDV'T + Q1'Q2Q3'MV'T + Q1Q2'T'

### Mapa K para D1:

Q0 Q1 Q2/IDT IDV MV T	0000	0001	0011	0010	0110	0111	0101	0100	1100	1101	1111	1110	1010	1011	1001	1000
000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
001	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0
011	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
010	1	0	1	1	1	1	0	1	1	0	1	1	1	1	0	1
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

D1 = D1(Q1, Q2, Q3, IDT, IDV, MV, T) = Q1'Q2'Q3IDVT + Q1'Q2T' + Q1'Q2Q3'MV

# Mapa K para D2:

Q0 Q1 Q2/IDT IDV MV T	0000	0001	0011	0010	0110	0111	0101	0100	1100	1101	1111	1110	1010	1011	1001	1000
000	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
001	1	0	0	1	1	0	0	1	1	0	0	1_	1	0	0	1
011	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
010	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

D2 = D2(Q1, Q2, Q3, IDT, IDV, MV, T) = Q1'Q2Q3'T + Q1'Q3T' + Q2'Q3T' + Q1'Q2'Q3'IDT

### 9. Obtenção das equações de saída

A saída da máquina será os seus estados, ou seja, as saídas do Flip-Flops. Saída = Q0, Q1, Q2.

# 10. Desenho do circuito

