Кодирование внутренних состояний для модели Мили на RS-триггерах.

Для 9 состояний (a0-a8) минимально необходимо 4 ЭП.

|  |  |  |  |
| --- | --- | --- | --- |
| М0 = | 0  1  2  3  3  3  4  4  4  5  6  6  7  7  8 | 1  2  3  0  4  8  0  5  8  6  7  8  0  8  0 | 1  1  1  1  1  1  1  1  1  2  1  3  1  2  1 |

Упорядоченная матрица

|  |  |  |  |
| --- | --- | --- | --- |
| М = | 6  5  7  6  7  8  4  4  4  3  3  3  2  0  0 | 8  6  8  7  0  0  0  5  8  0  4  8  3  2  1 | 3  2  2  1  1  1  1  1  1  1  1  1  1  1  1 |

Закодируем первые два состояния

a6 = 0001, a8 = 0000

|  |  |  |
| --- | --- | --- |
| МI = | 5  7  6  7  8  4  4  4  3  3  3  2  0  0 | 6  8  7  0  0  0  5  8  0  4  8  3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 54 | 6  5 |

γ = 5

Bγ = 6 = 0001

= {1001, 0101, 0011}

= {1001, 0101, 0011}

W1001 = = 1

W0101 = = 1

W0011 = = 1

a5 = 0011

|  |  |  |
| --- | --- | --- |
| МII = | 7  6  7  8  4  4  4  3  3  3  2  0  0 | 8  7  0  0  0  5  8  0  4  8  3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 76  7 | 8  70 |

γ = 7

Bγ = {6, 8} = {0001, 0000}

= {0101, 1001} = {0010, 0100, 1000}

= {0101, 1001, 0010, 0100, 1000}

W0101 =  = 3

W1001 = = 3

W0010 = = 3

W0100 = = 3

W1000 = = 3

a7 = 0010

|  |  |  |
| --- | --- | --- |
| МIII = | 7  8  4  4  4  3  3  3  2  0  0 | 0  0  0  5  8  0  4  8  3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 3  4  7  8  0 | 0  0  0  0  1 |

γ = 0

Bγ = {7, 8} = {0010, 0000}

= {1010, 0110} = {1000, 0100}

= {1010, 0110, 1000, 0100}

W1010 = = 3

W0110 = = 3

W1000 = = 3

W0100 = = 3

a0 = 1000

|  |  |  |
| --- | --- | --- |
| МIV = | 4  4  4  3  3  3  2  0  0 | 0  5  8  0  4  8  3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 4  4  4  3 | 0  5  8  4 |

γ = 4

Bγ = {0, 5, 8} = {1000, 0011, 0000}

= {1001, 1010, 1100}  = {1011, 0111} = 0100

= {1001, 1010, 1100, 1011, 0111, 0100}

W1001 = = 5

W1010 = = 5

W1100 = = 7

W1011 = = 6

W0111 = = 8

W0100 = = 6

a4 = 1010

|  |  |  |
| --- | --- | --- |
| МV = | 3  3  3  2  0  0 | 0  4  8  3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 3  3  3  2 | 0  4  8  3 |

γ = 3

Bγ = {0, 4, 8} = {1000, 1010, 0000}

= {1100, 1001}  = {1110, 1011} = 0100

= {1100, 1001, 1110, 1011, 0100}

W1100 = = 5

W1001 = = 5

W1110 = = 6

W1011 = = 6

W0100 = = 6

a3 = 1001

|  |  |  |
| --- | --- | --- |
| МVI = | 2  0  0 | 3  2  1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 2 0 | 3  2 |

γ = 2

Bγ = {0, 3} = {1000, 1001}

= 1100 = {1101, 1011}

= {1100, 1101, 1011}

W1100 = = 3

W1101 = = 3

W1011 = = 3

a2 = 1101

|  |  |  |
| --- | --- | --- |
| МVII = | 0 | 1 |

|  |  |  |
| --- | --- | --- |
| Мγ = | 0 | 1 |

γ = 1

Bγ = 0 = 1000

= 1100

a1 = 1100

Карта Карно закодированных состояний

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| k3k2\k1k0 | 00 | 01 | 11 | 10 |
| 00 | a8 | a6 | a5 | a7 |
| 01 |  |  |  |  |
| 11 | a1 | a2 |  |  |
| 10 | a0 | a3 |  | a4 |

Эффективность кодирования: k = 25/19 = 1.32

Коды состояний для модели Мили на RS-триггерах

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Состояние | a0 | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 |
| Код | 1000 | 1100 | 1101 | 1001 | 1010 | 0011 | 0001 | 0010 | 0000 |

Прямая структурная таблица переходов и выходов автомата модели Мили на RS-триггерах

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Исходное состояние | Код am | Состояние перехода as | Код as | Входной сигнал X(am, as) | Выходные сигналы Y(am, as) | Функция возбуждения |
| a0 | 1000 | a0  a1 | 1000  1100 | ¬X0  X0 | -  y0, y1, y2 | -  S2 |
| a1 | 1100 | a2 | 1101 | 1 | y3, y4 | S0 |
| a2 | 1101 | a2  a3 | 1101  1001 | ¬X0  X0 | -  y1 | -  R2 |
| a3 | 1001 | a0  a4  a8 | 1000  1010  0000 | X1  ¬X1¬X2  ¬X1X2 | y12  y4, y5  y2, y9 | R0  S1R0  R3R0 |
| a4 | 1010 | a0  a5  a8 | 1000  0011  0000 | X3  ¬X3¬X4  ¬X3X4 | y11  y3  y2, y9 | R1  R3S0  R3R1 |
| a5 | 0011 | a6 | 0001 | 1 | y7 | R1 |
| a6 | 0001 | a5  a8  a8  a8  a7 | 0011  0000  0000  0000  0010 | ¬X5  X5¬X6¬X7X8  X5¬X6¬X7¬X8  X5¬X6X7  X5X6 | y3  y6  -  y2, y9  y8 | S1  R0  R0  R0  S1R0 |
| a7 | 0010 | a0  a8  a8 | 1000  0000  0000 | X3  ¬X3X8  ¬X3¬X8 | y11  y6  - | S3R1  R1  R1 |
| a8 | 0000 | a0  a8 | 1000  0000 | X9  ¬X9 | y10  - | S3  - |

Логические выражения для каждой функции возбуждения RS-триггера:

R0 = a3 v a6X5

R1 = a4¬X3X4 v a7 v a4X3 v a5

R2 = a2X0

R3 = a3¬X1X2 v a4¬X3

S0 = a1 v a4¬X3¬X4

S1 = a3¬X1¬X2 v a6¬X5 v a6X5X6

S2 = a0X0

S3 = a7X3 v a8X9

Логические выражения для функций выходов:

y0 = a0X0

y1 = a0X0 v a2X0

y2 = a0X0 v a3¬X1X2 v a4¬X3X4 v a6X5¬X6X7

y3 = a1 v a4¬X3¬X4 v a6¬X5

y4 = a1 v a3¬X1¬X2

y5 = a3¬X1¬X2

y6 = a6X5¬X6¬X7X8 v a7¬X3X8

y7 = a5

y8 = a6X5X6

y9 = a3¬X1X2 v a4¬X3X4 v a6X5¬X6X7

y10 = a8X9

y11 = a4X3 v a7X3

y12 = a3X1

После выделения общих частей в логических выражениях и некоторого их упрощения получаем логические уравнения для построения функциональной схемы управляющего автомата:

e0 = a0X0 (2)

e1 = a2X0 (2)

e2 = a6X5 (2)

e3 = a6¬X5 (2)

e4 = a4X3 (2)

e5 = a3¬X1X2 (3)

e6 = a3¬X1¬X2 (3)

e7 = a4¬X3 (2)

e8 = a7X3 (2)

e9 = a8X9 (2)

e10 = a3X1 (2)

e11 = a7¬X3X8 (3)

p1 = e2X6 (2)

p2 = e2¬X6X7 (3)

p3 = e2¬X6¬X7X8 (4)

p4 = e7X4 (2)

p5 = e7¬X4 (2)

q0 = e5 v p4 v p2 (3)

R0 = a3 v e2 (2)

R1 = p4 v a7 v e4 v a5 (4)

R2 = e1 (0)

R3 = e5 v e7 (2)

S0 = a1 v p5 (2)

S1 = e6 v e3 v p1 (3)

S2 = e0 (0)

S3 = e8 v e9 (2)

y0 = e0 (0)

y1 = e0 v e1 (2)

y2 = e0 v q0 (2)

y3 = a1 v p5 v e3 (3)

y4 = a1 v e6 (2)

y5 = e6 (0)

y6 = p3 v e11 (2)

y7 = a5 (0)

y8 = p1 (0)

y9 = q0 (0)

y10 = e9 (0)

y11 = e4 v e8 (2)

y12 = e10 (0)

Инверторы: ¬X1, ¬X2, ¬X3, ¬X4, ¬X5, ¬X6, ¬X7, ¬X8 (8)

Цена по Квайну:

Схема формирования начальной установки на RS-триггерах

