

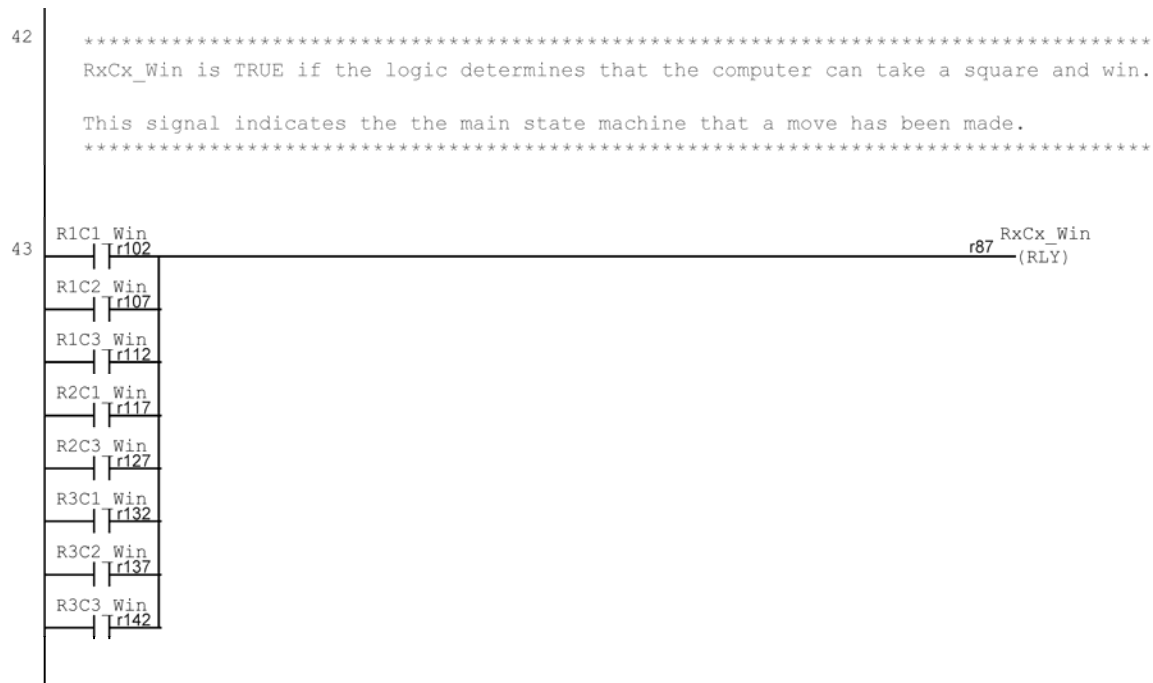
Figure 9 Win State Machine Hardware Actions

Each ladder rung represents the logic to determine if the computer can take a square on the board and if it can, will this result in the computer winning the game. Each run has an "OR" section that evaluates from top to bottom:

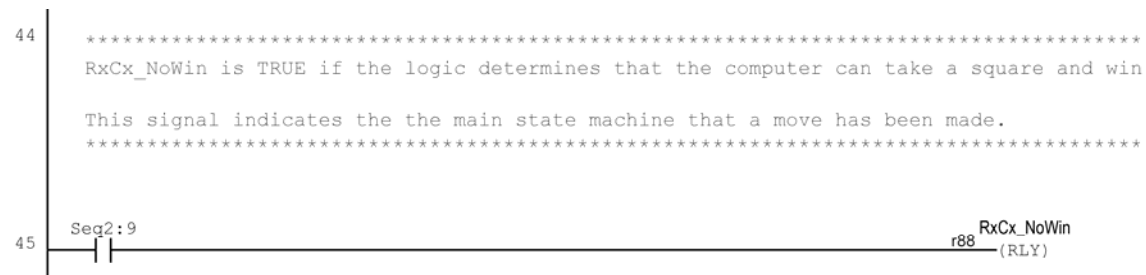
1. Win with this available square on the row (going across)
2. Win with this available square on the column (going vertically)
3. Win with this available square on the diagonal (only for corner squares)

The Win State machine is designed to advance through the rungs and test every square for a possible win. If a square is found that can result in a win a RELAY will be set to indicate this fact. There is a RELAY for each possible square. The RELAY for winning by claiming the top left corner is "R1C1_Win". There is a bit more work that the state machine needs to perform:

1. If the computer can win with this square, then the square must be claimed by the computer. The first square that can result in a win will terminate the state machine. No need to look for a 2nd way to win! One way is plenty.
2. Declare that the computer won by asserting the RxCxWin Relay. This is handled by the next bit of combinational logic:



3. If there is no winning move the Win state machine will advance to state Seq2:9 and assert the RxCx_NoWin RELAY. This RELAY is used to signal the main state machine Seq1 that all possible strategies to win the game have been tried. This allows the main state machine to advance to its next state:



3.2.2 Custom Functions?

The Win State Machine has no custom functions associated with it. It's all done in the open with ladder logic.

4 BLOCK STATE MACHINE SEQ3

The Block State Machine uses the PLC sequencer named Seq3 to manage the search for a square that the PLC can take that will block the human from winning. This state machine is essentially identical to the operation of the Win State machine. The Block state machine just evaluates moves using a different set of rules. I will show you the state diagram, but will leave it to you to look at the PLC code if you really need to know how this works.

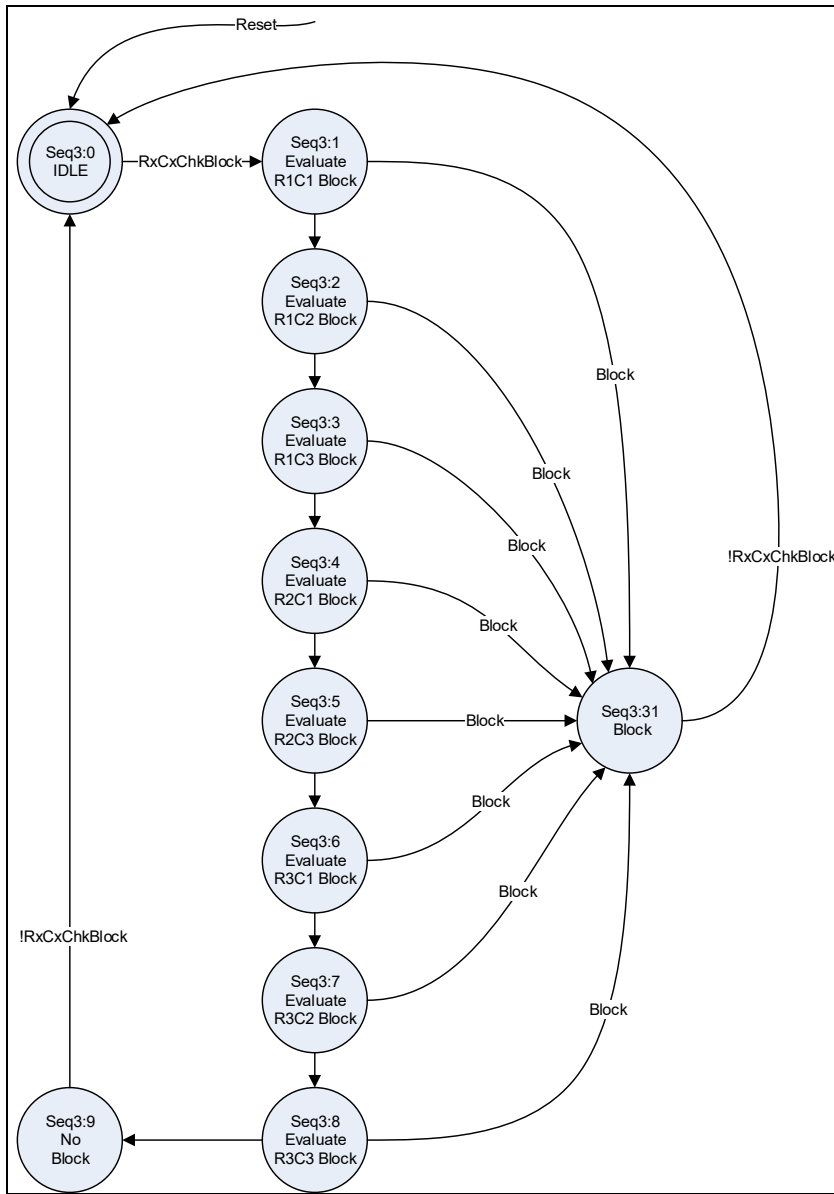


Figure 10 Block State Machine Diagram

5 SPECIAL STATE MACHINE SEQ4

The Special State Machine uses the PLC Seq4 to manage the search for a square that the PLC can take that will give the PLC an advantage. These rules looks for opportunities to create a fork (2 ways to win on the next move) or to block the human from creating a fork that would allow him or her to win in a subsequent move.

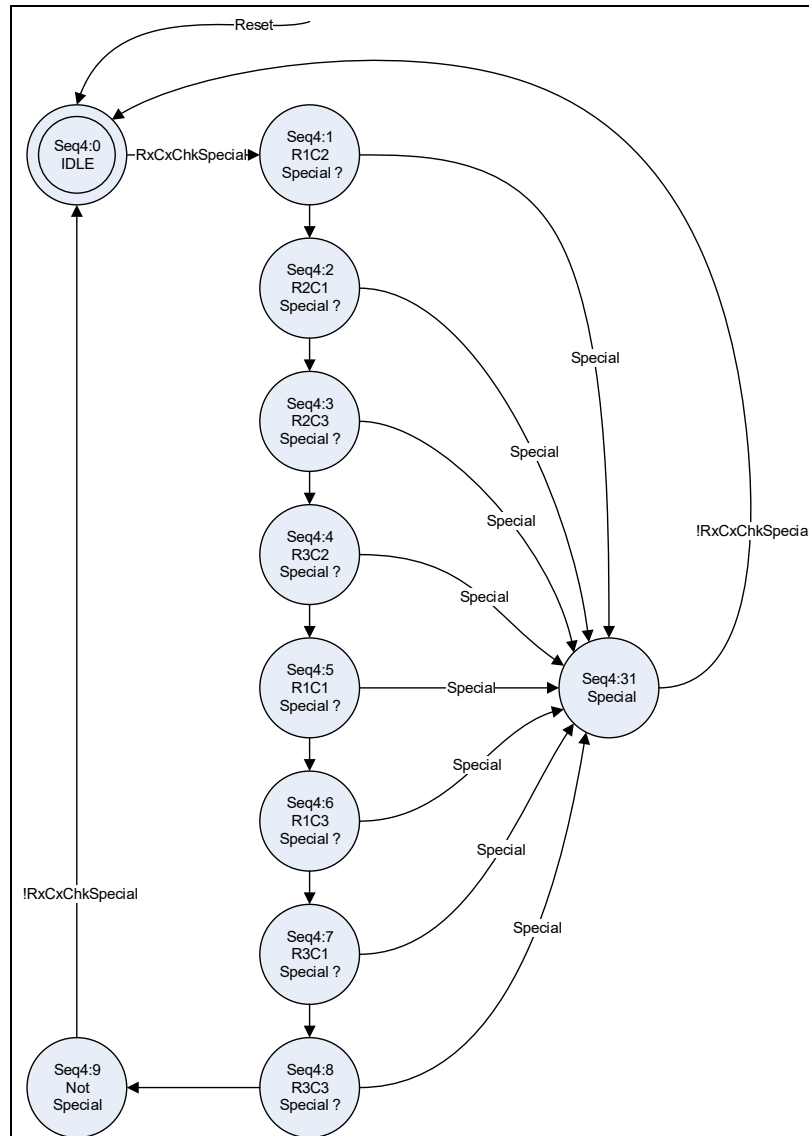


Figure 11 Special State Machine Diagram

6 MOVE STATE MACHINE SEQ5

The Move State Machine uses the PLC Seq5 to manage the search for a square that the PLC can take. At this point, the PLC can't win, the PLC does not need to block the human from winning