TIC-TAC-TOE GAME

With VGA Output and AI Single Player

A Final Project for ECE 2700, Fall 2019

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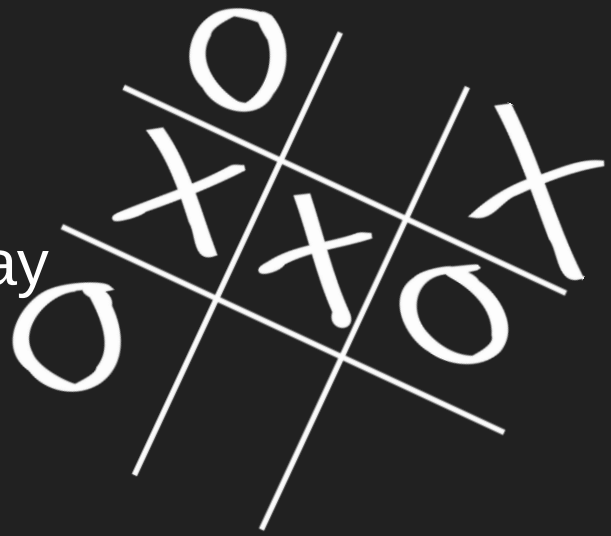
GAME DEMO:

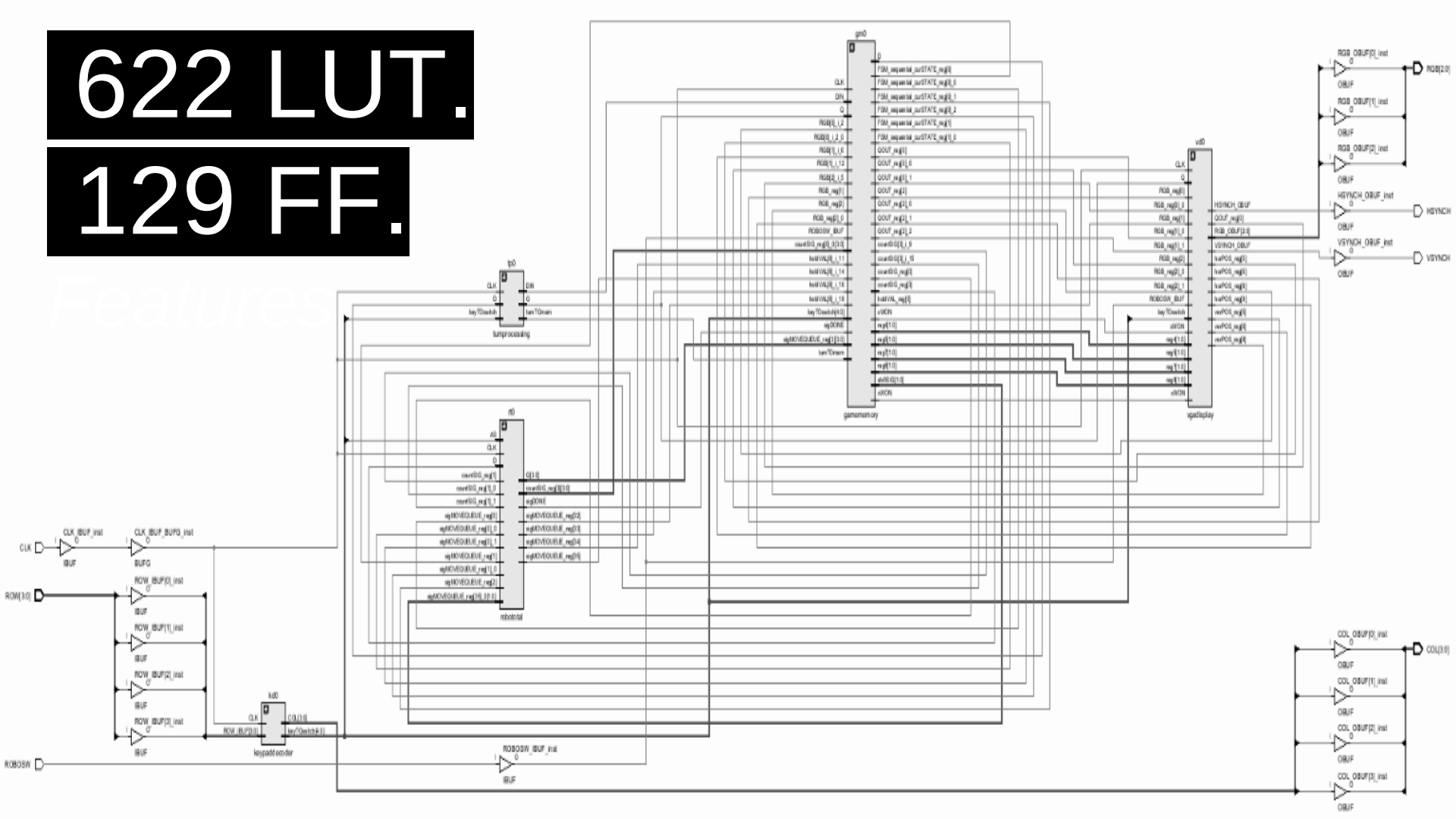
Features

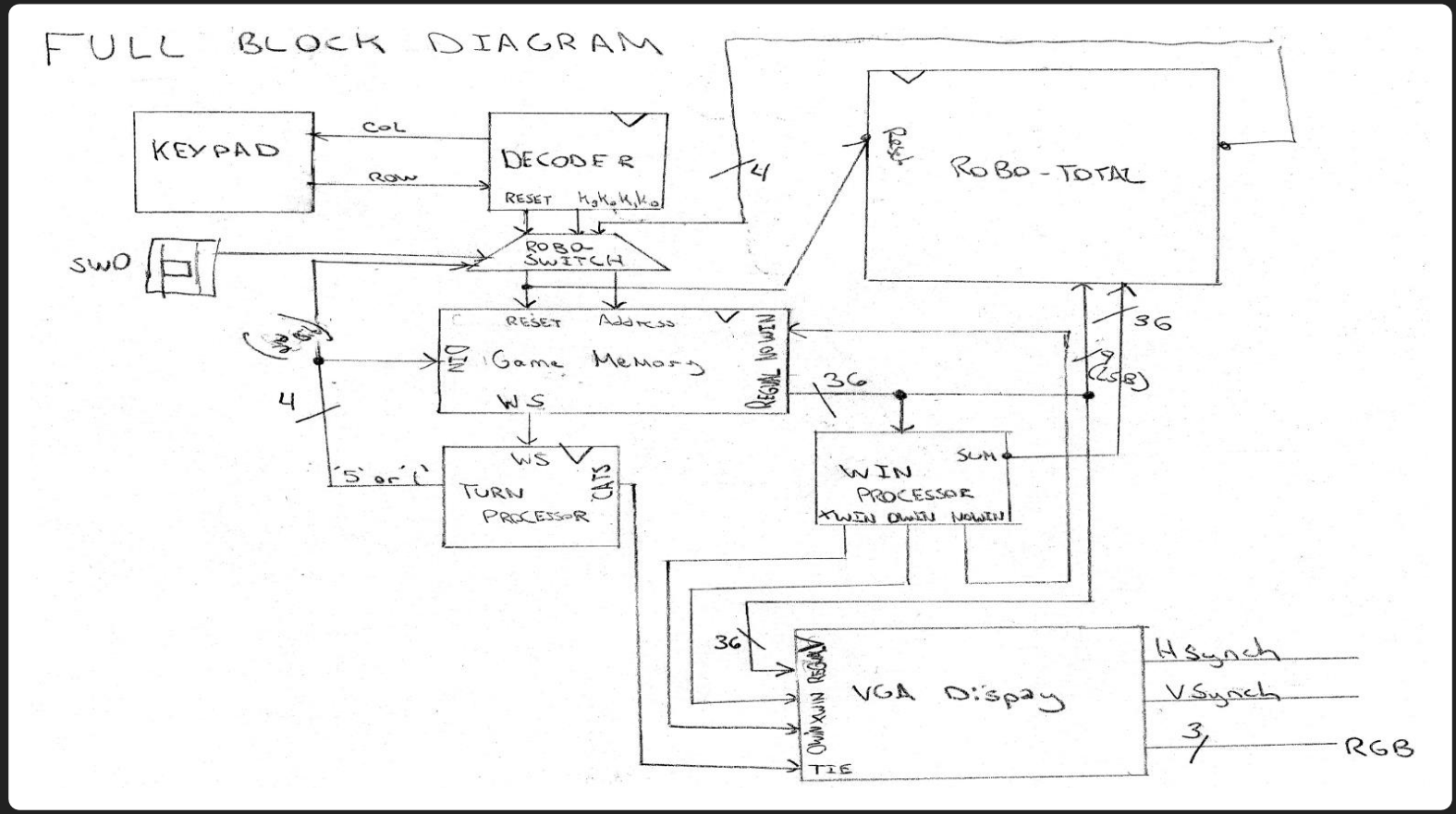


- Two Player Mode Tic-Tac-Toe Game Play
- Double Move Protection
- Win and Tie Notification
- Single Player Mode with Strategic AI
- Blazing 3-Bit Color in 640X480 Resolution at 60HZ

622 LUT.

129 FF.



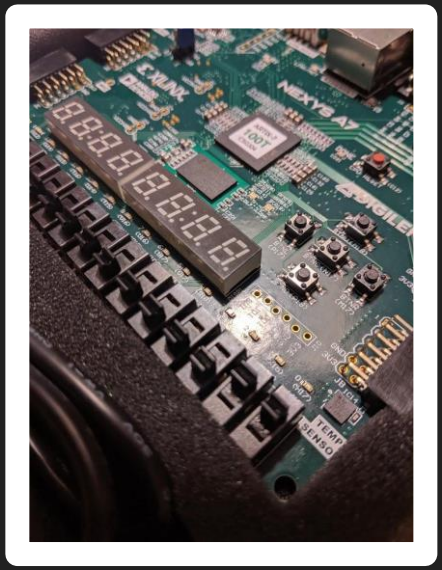


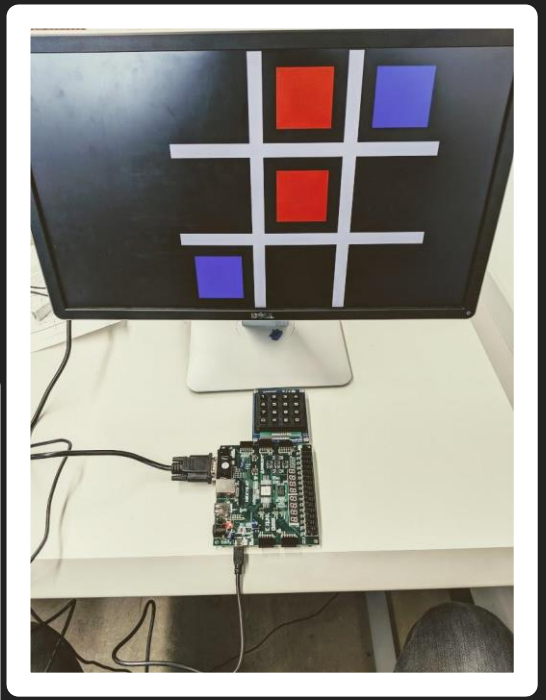
Palatable Full Block Diagram

INPUTS & OUTPUTS:

Keys 1-9
D Key Reset

Switch 0
For One Player



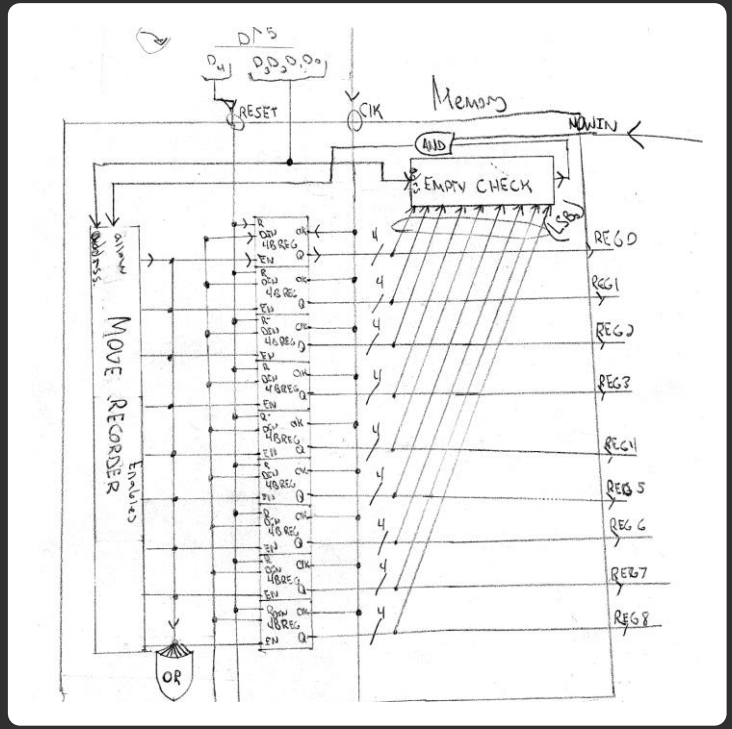


VGA Plug for Output to Any Monitor

MAIN COMPONENTS:

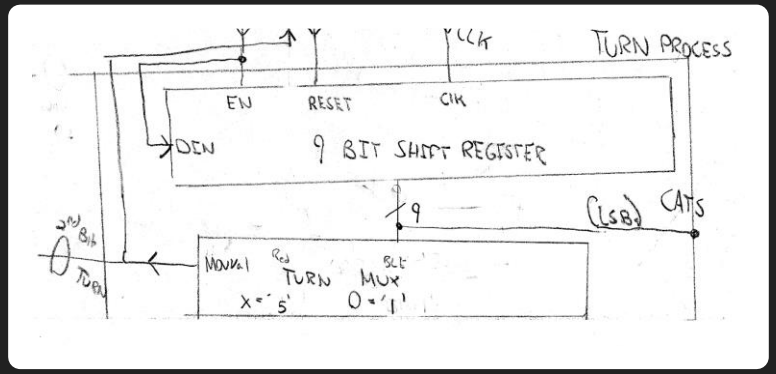
GAME MEMORY

- Consists of 8 4-Bit Registers
- Checks if Cell Empty before Allowing Play
- Disallows Play After a Win
- Successful Memory Write Changes Turns



MAIN COMPONENTS:

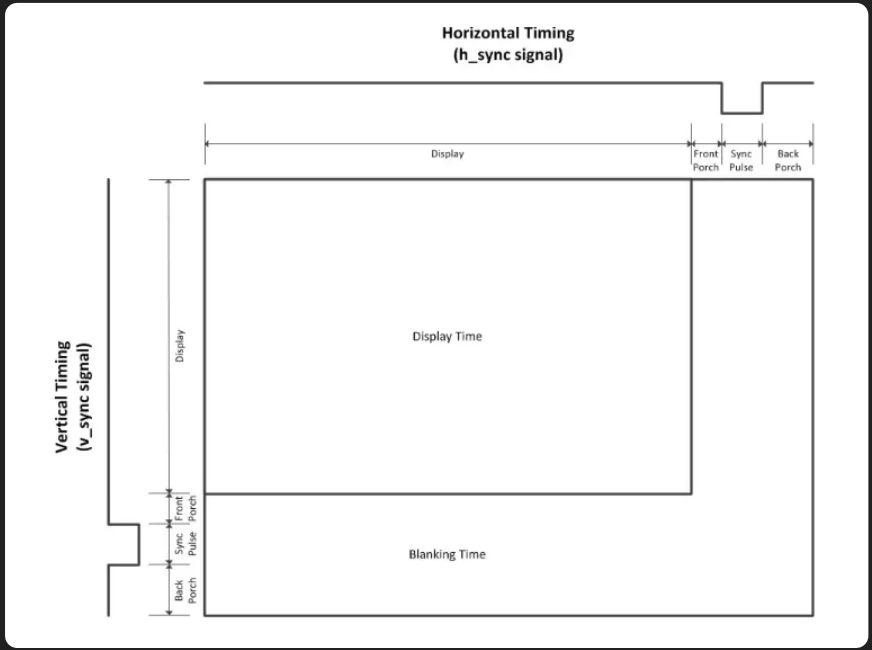
Turn Processor



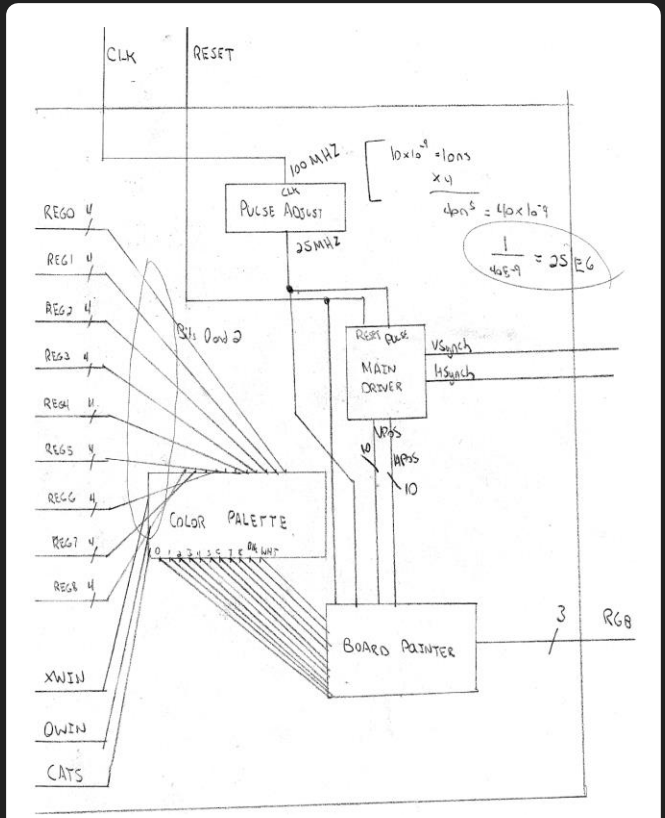
- A 9-Bit Shift Register and LUT
- Shifts ‘1’ to Vector when Memory Written
- Outputs ‘1’ for X Turn ‘5’ for ‘O’ Turn (Even/Odd)
- Outputs Tie if All 9 Bits ‘1’

MAIN COMPONENTS:

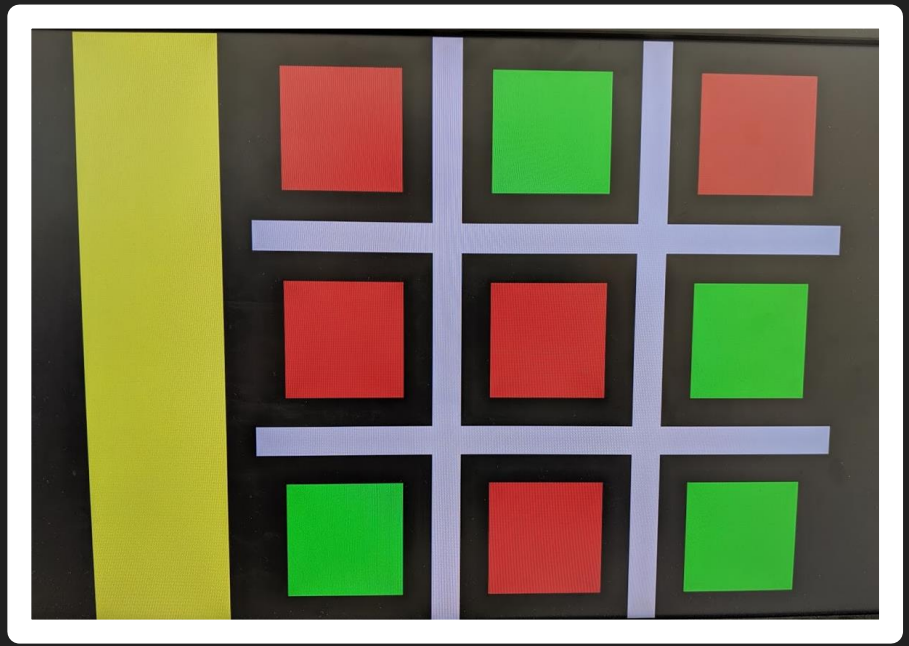
VGA Display



- Shifts Horizontal and Vertical Pixel Position
- Generates V-Synch & H-Synch from Positions
- Turns Display on In Monitor Space
- Defines Shapes, and Colors



VGA Display Block Diagram

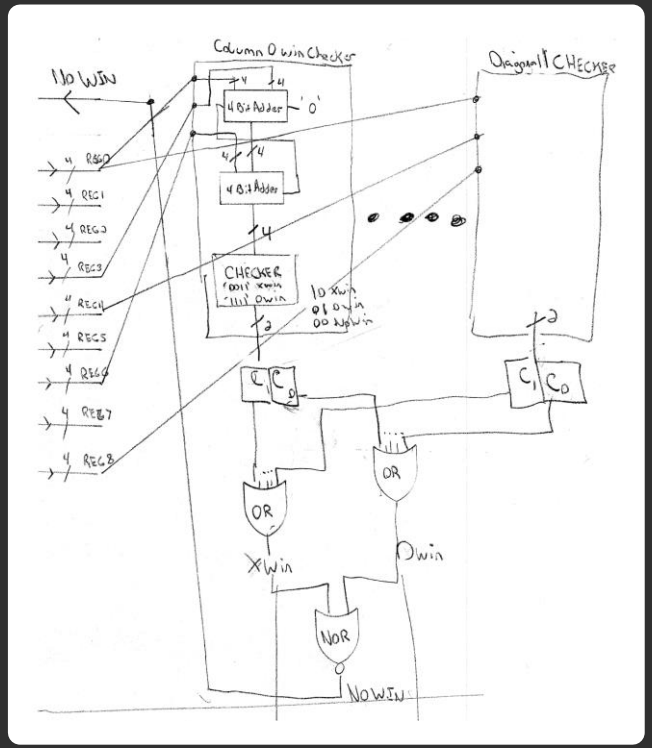


Sample Output

MAIN COMPONENTS:

Win Processor

- Sums Memory Values for Win Combinations (3 RW, 3 COL, 2 DIAG)
- If sum is 15, X wins, if 3 O Wins, Otherwise No Win
- Two 4-Bit Adders and Two Comparators



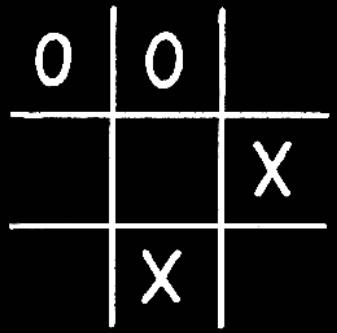
MAIN COMPONENTS:

Single Player AI

- Evaluates Each Cell, Assigns Values
- Finds Lowest Value, State Machine Puts Lowest Cells into Queue
- Counter Considers Choices, Selects Strategic Move
- Tries to win, tries to block win, only then employs strategic move

How the AI Plays:

Basic Board



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Memory View

1	1	0
0	0	5
0	5	0

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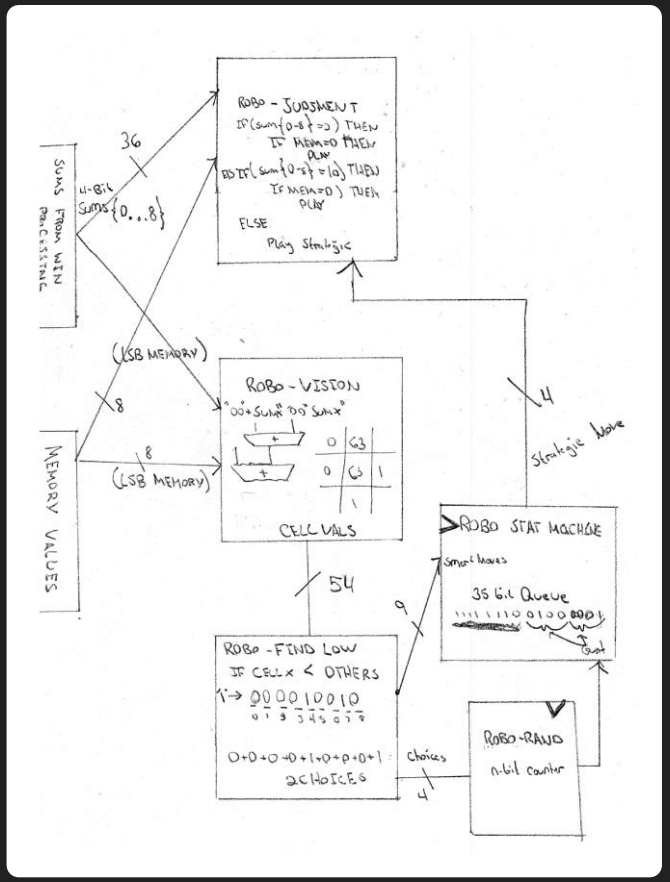
AI Cell Ranking

1	1	6	5
63	63	7	2
6	12	63	5
6	63	6	5

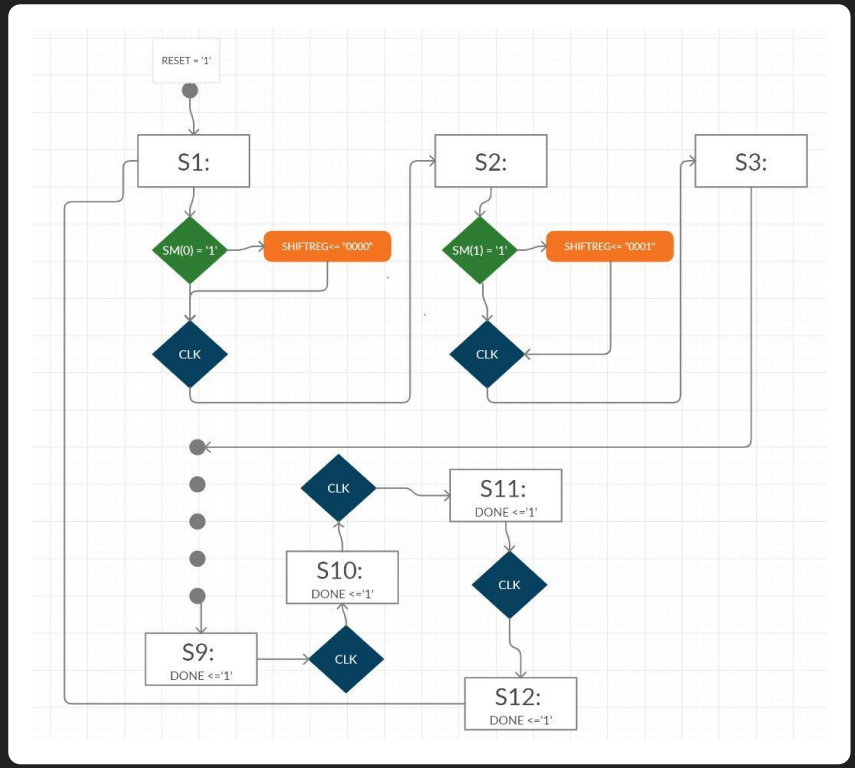
Cell Labels

0	1	2
3	4	5
6	7	8

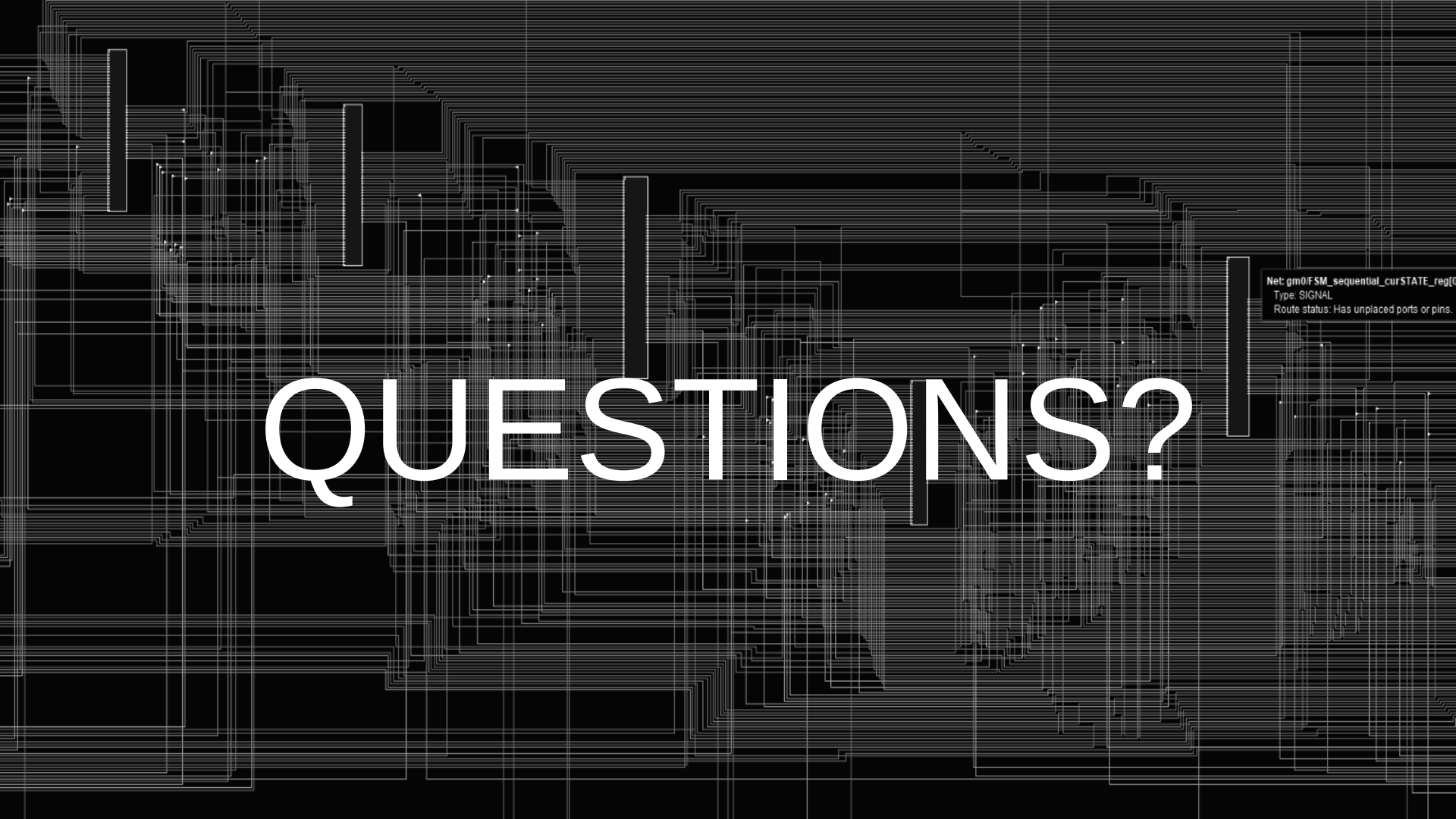
Cells 3, 6, and 8 share the lowest value of ‘6’ they are the optimal moves. ‘63’ Represents an occupied space. Border values are win sums. Row 0 = ‘2’ so O can win this turn.



AI Block Diagram



State Diagram for Robo-FSM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Type: SIGNAL
Route status: Has unplaced ports or pins.

QUESTIONS?