



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:

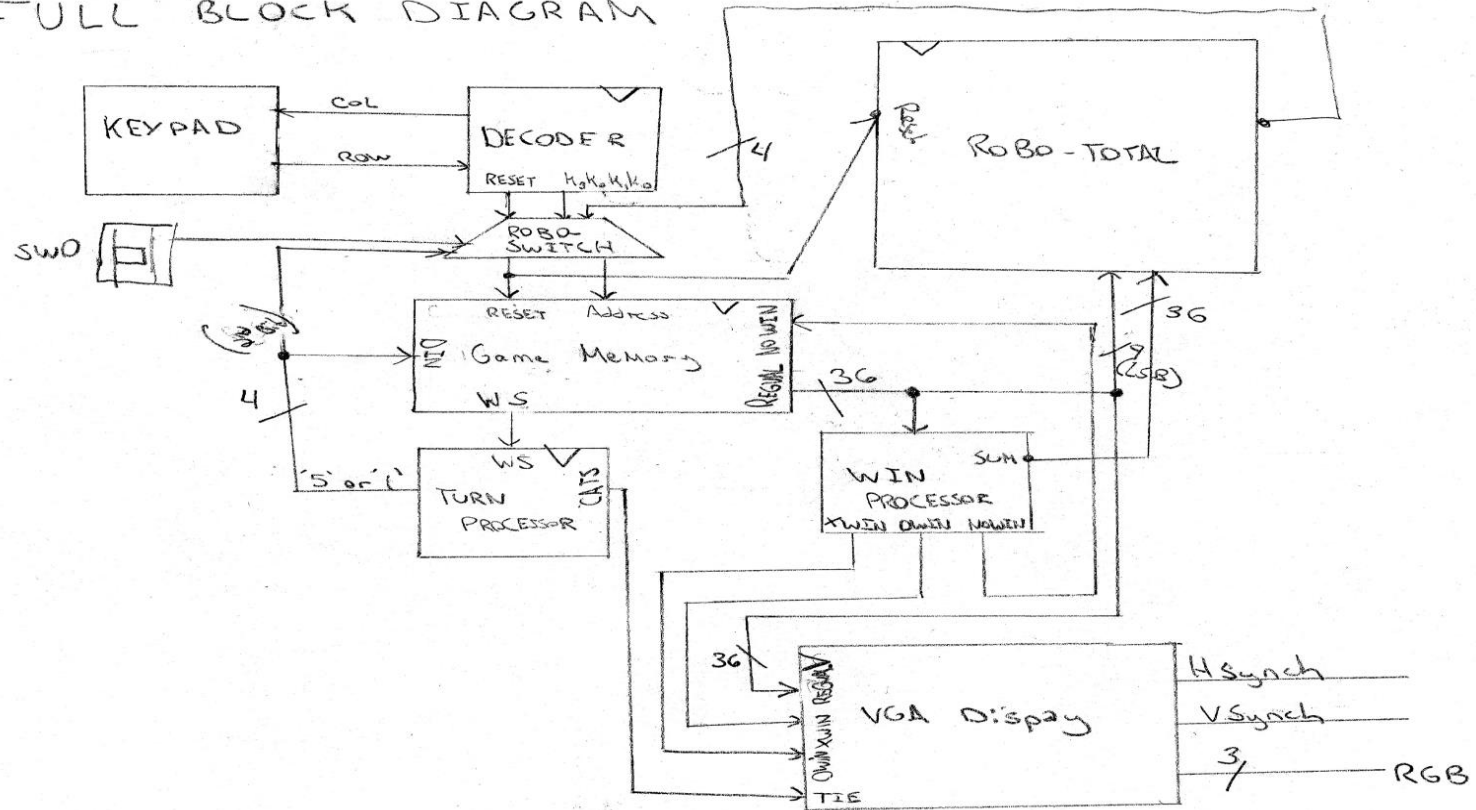
Features

- 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



129 FF.

FULL BLOCK DIAGRAM



Palatable Full Block Diagram

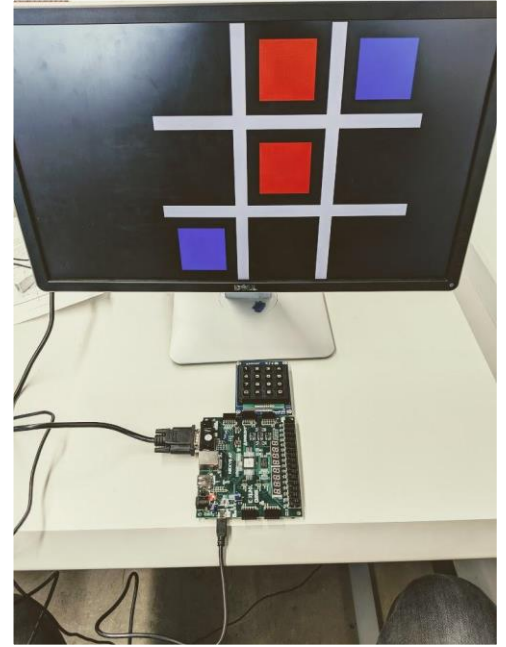
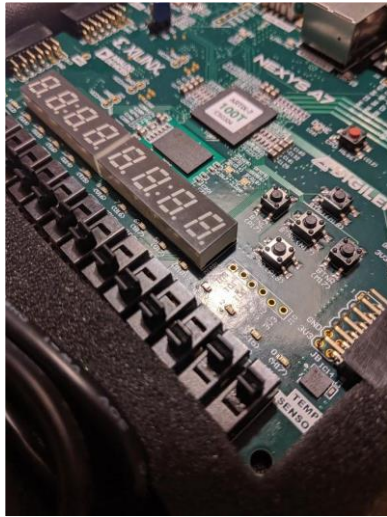
INPUTS & OUTPUTS:

Keys 1-9

Switch 0

D Key Reset

For One Player

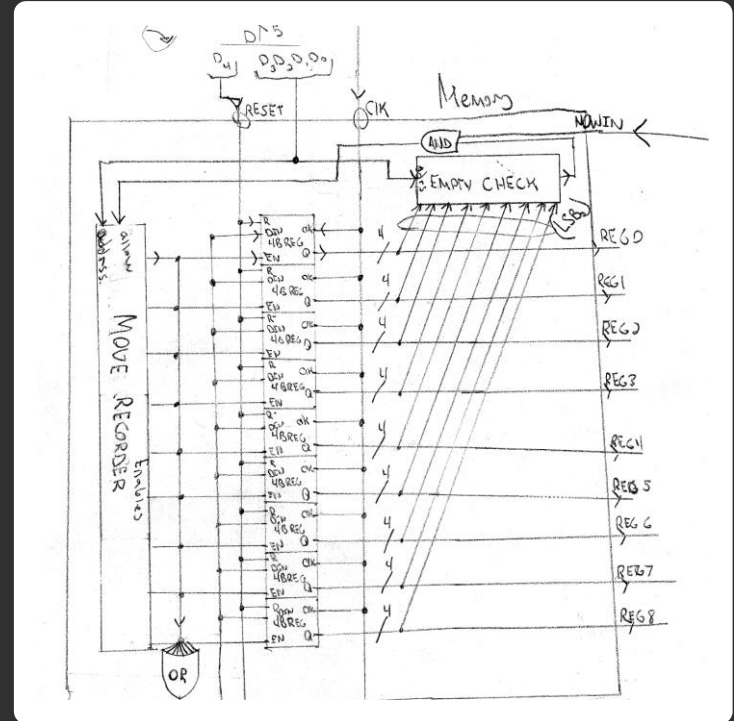


VGA Plug for
Output to Any
Monitor

MAIN COMPONENTS:

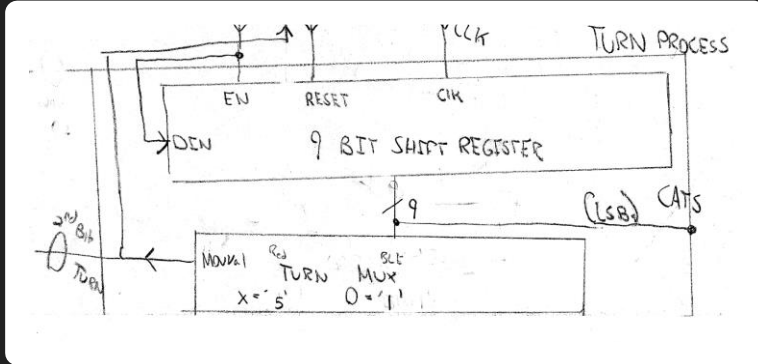
GAME MEMORY

- 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:

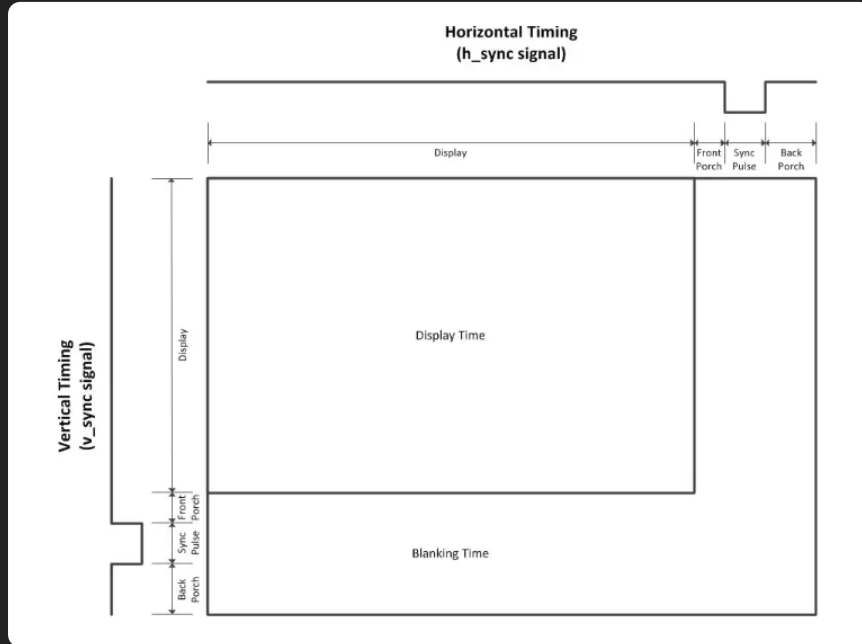
Turn Processor



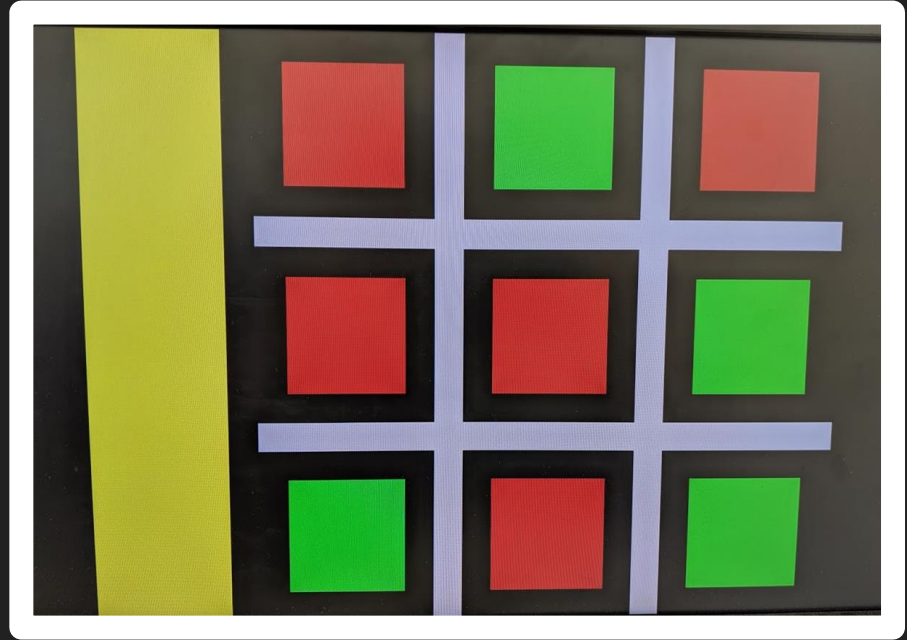
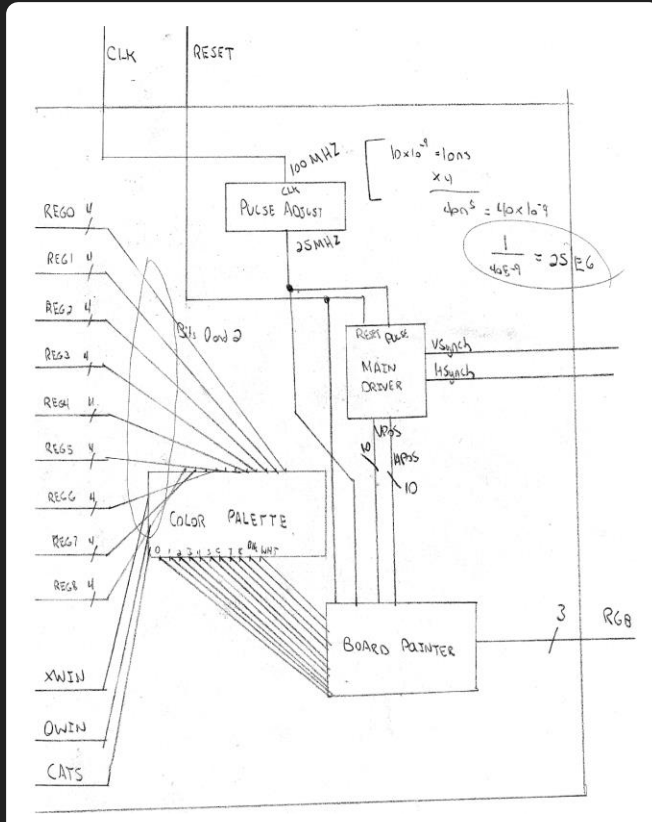
- A 9-Bit Shift Register and LUT
- Shifts '1' to Vector when Memory Written
- Outputs '1' for X Turn '5' for 'O' Turn (Even/Odd)
- Outputs Tie if All 9 Bits '1'

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



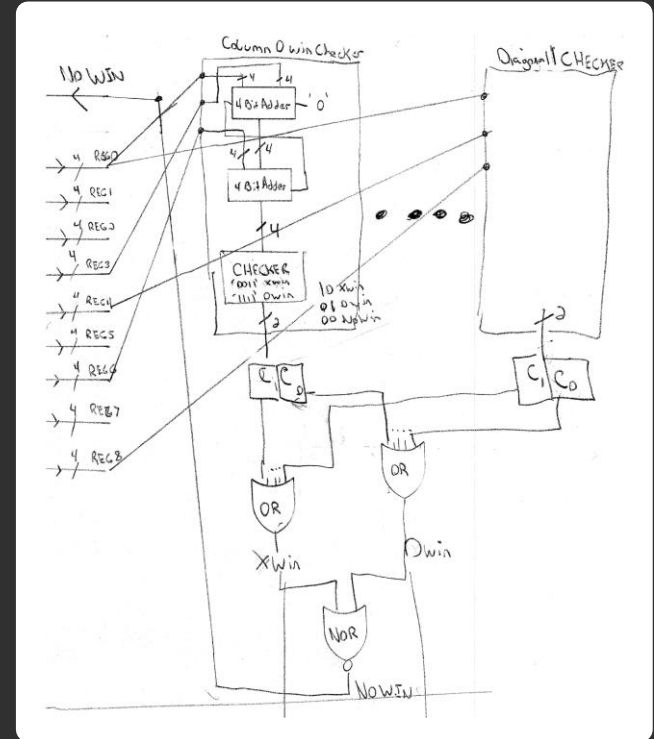
VGA Display Block Diagram Output

Sample

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

0	0	
		X
	X	

Memory View

1	1	0
0	0	5
0	5	0

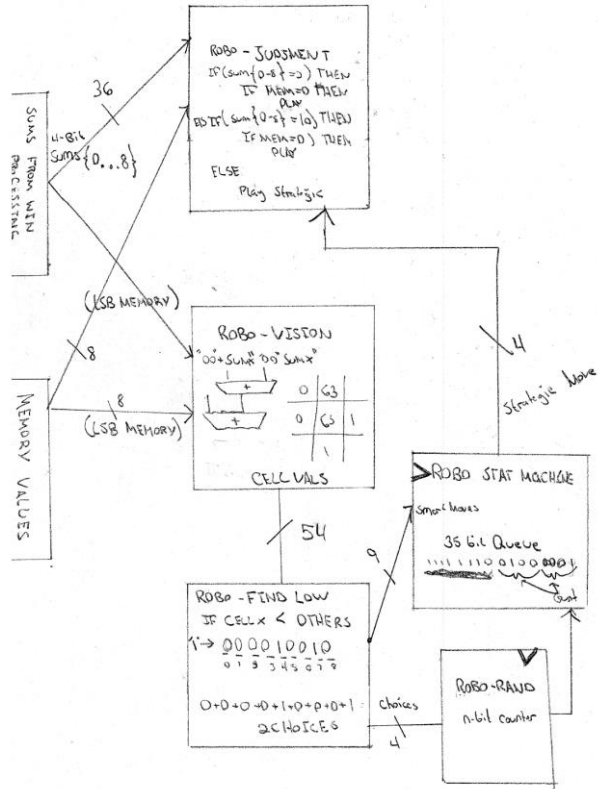
AI Cell Ranking

1	1	6	5	0
63	63	7	2	
6	12	63	5	
6	63	6	5	

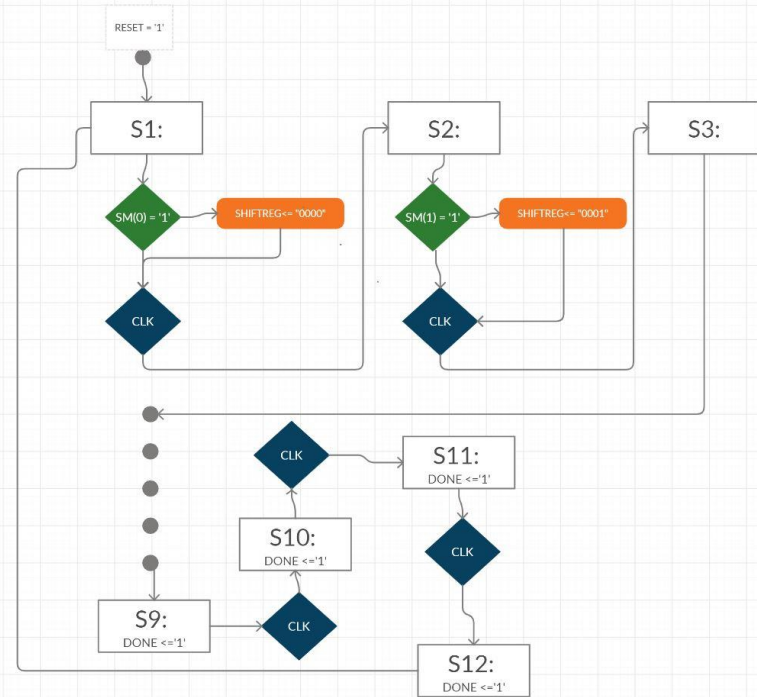
Cell Labels

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

The background of the slide is a dark gray or black surface covered with a complex, dense pattern of thin, light gray lines. These lines form a circuit board layout, with many horizontal and vertical segments, some branching out, and others forming loops. The pattern is more concentrated in the upper half and fades slightly towards the bottom. There are also several thicker, solid white vertical lines of varying heights scattered across the background, resembling vias or test points on a PCB.

QUESTIONS?

Net: gm0FSM_sequential_curSTATE_reg[0]
Type: SIGNAL
Route status: Has unplaced ports or pins.