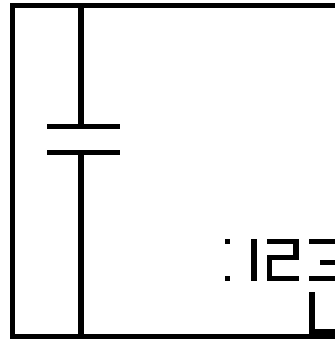# Recognition of Hand-Drawn Circuits

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Project Goals

- Input a hand-drawn circuit
- Recognize components and values
- Understand connectivity
- Generate primitive SPICE netlist

- Output to LCD monitor

Layout

- Draw components on 8x8 grid
- Each grid block 64x64 pixels
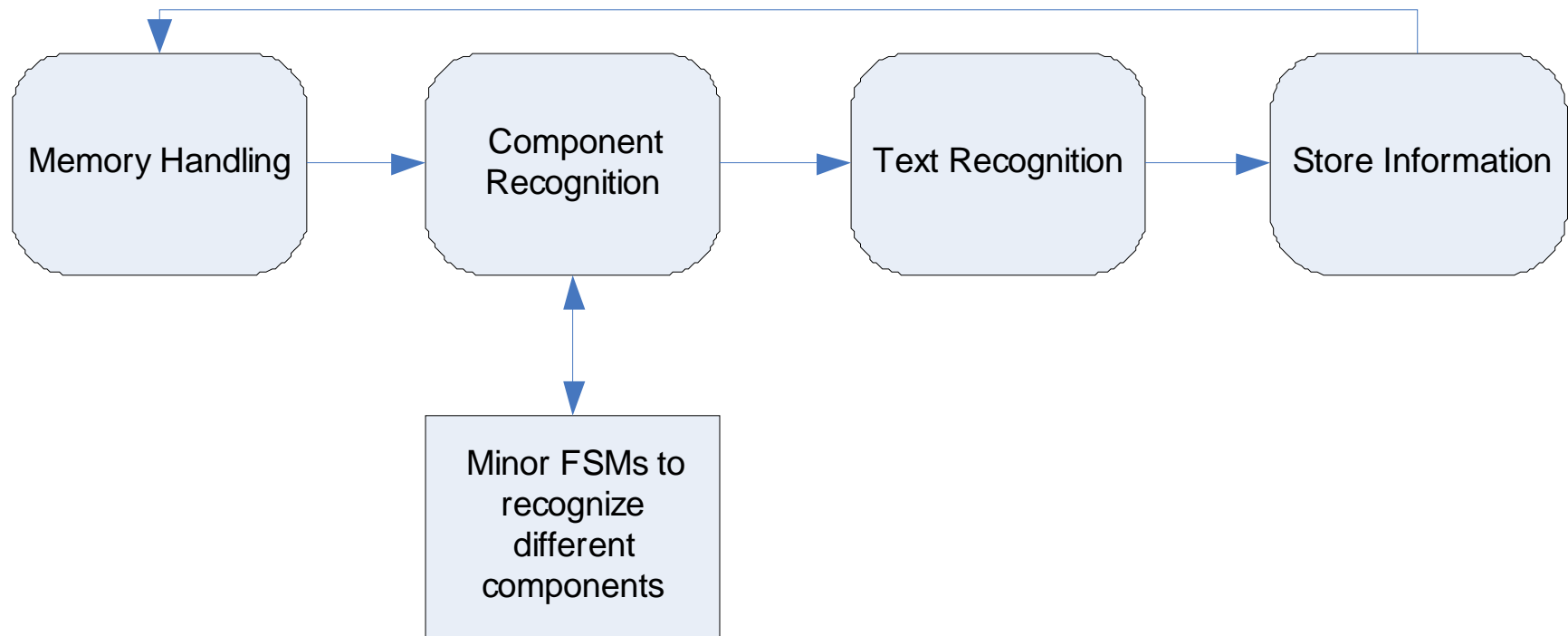 - Component area
 - Text area

- Monochromatic image (binary)

Drawing Rules

- Entire component must fit in one grid block
- Appropriate borders must be crossed
- Component must avoid designated text area
- Drawings must be "reasonably" accurate
- Limited number of components

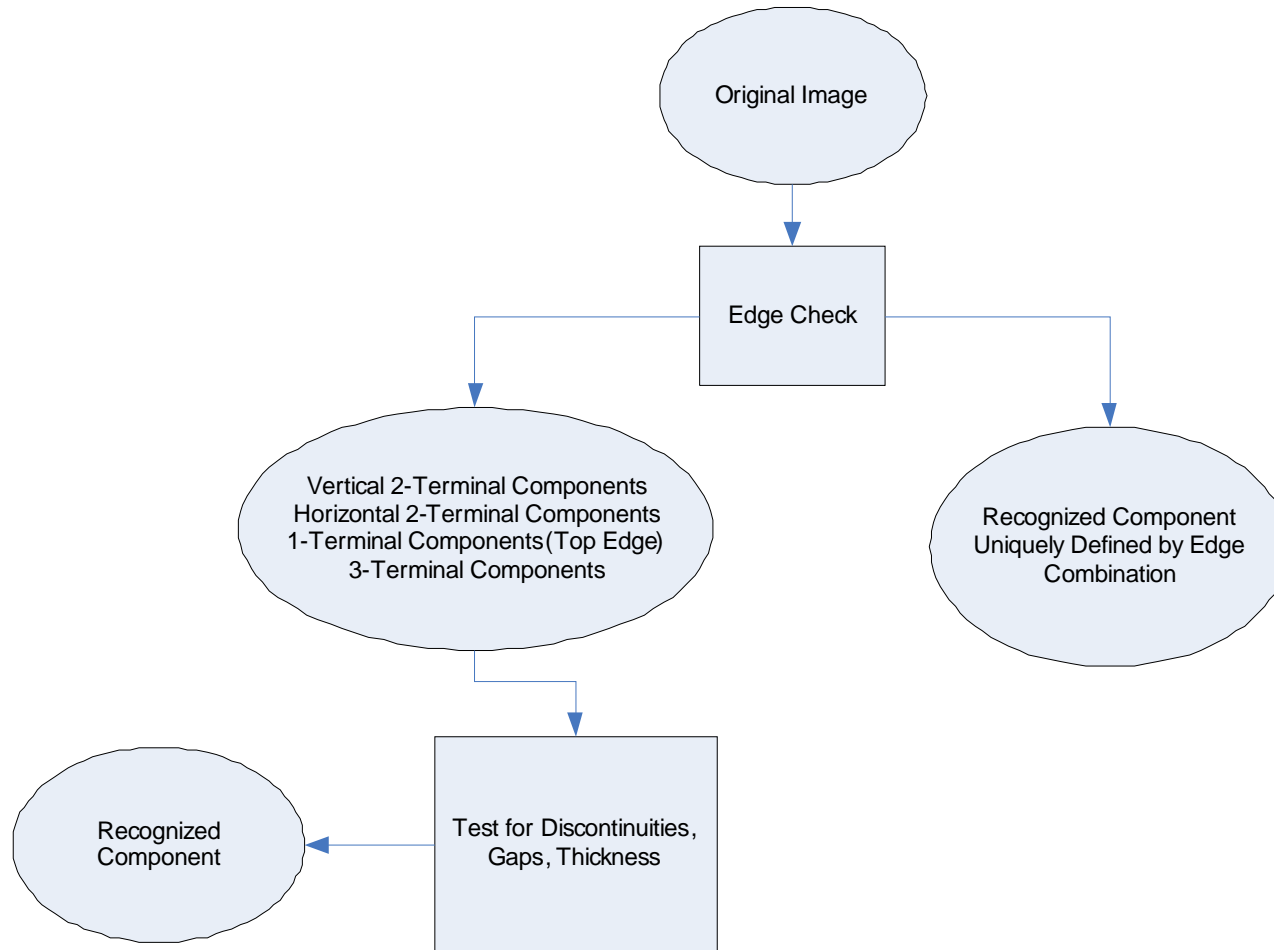- Text must follow separate text grid

Recognition

Component Recognition

- Decision tree method
- Identify important characteristics
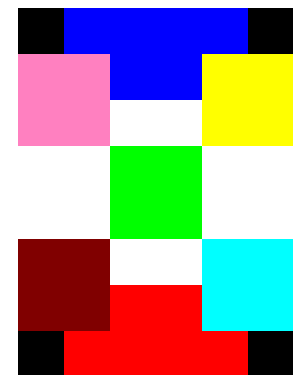 - Number of terminals
  - Continuous?
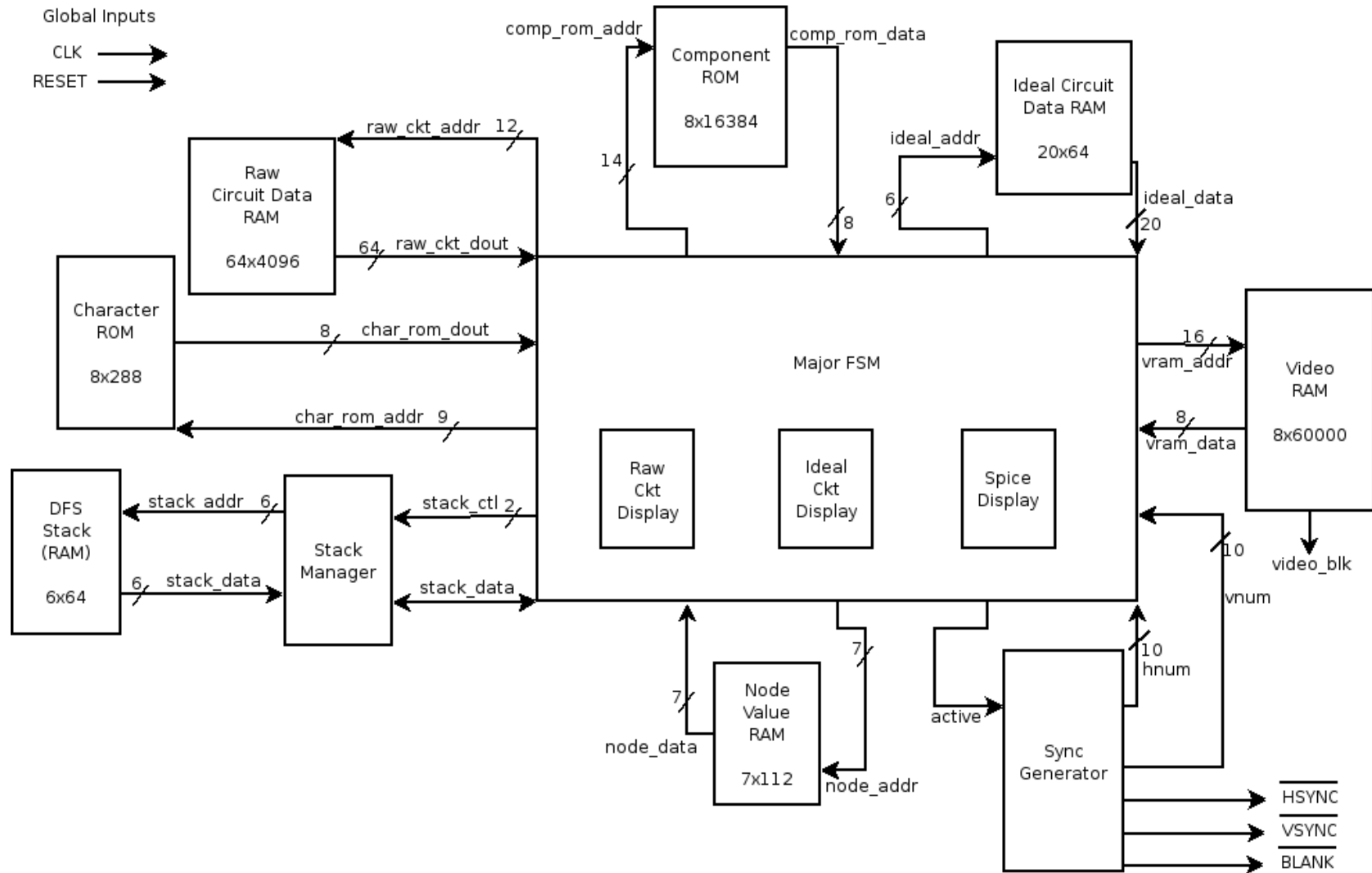 - Important "Gaps"
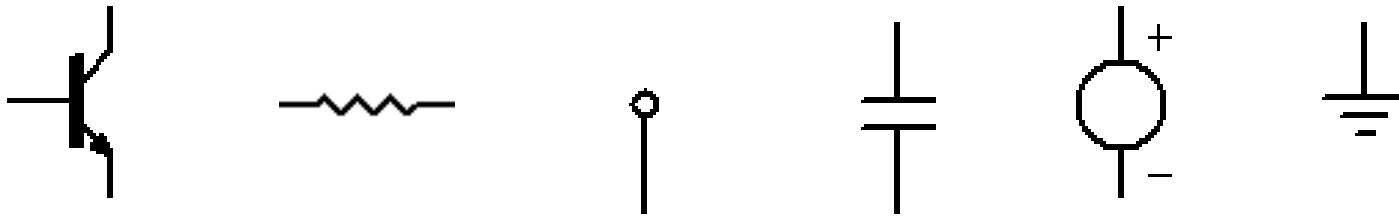
Decision Tree

Text Recognition

- Recognize text in 8x6 blocks

- Use pads to recognize 10 numbers and 7 letters

- Currently, users need to use straight lines
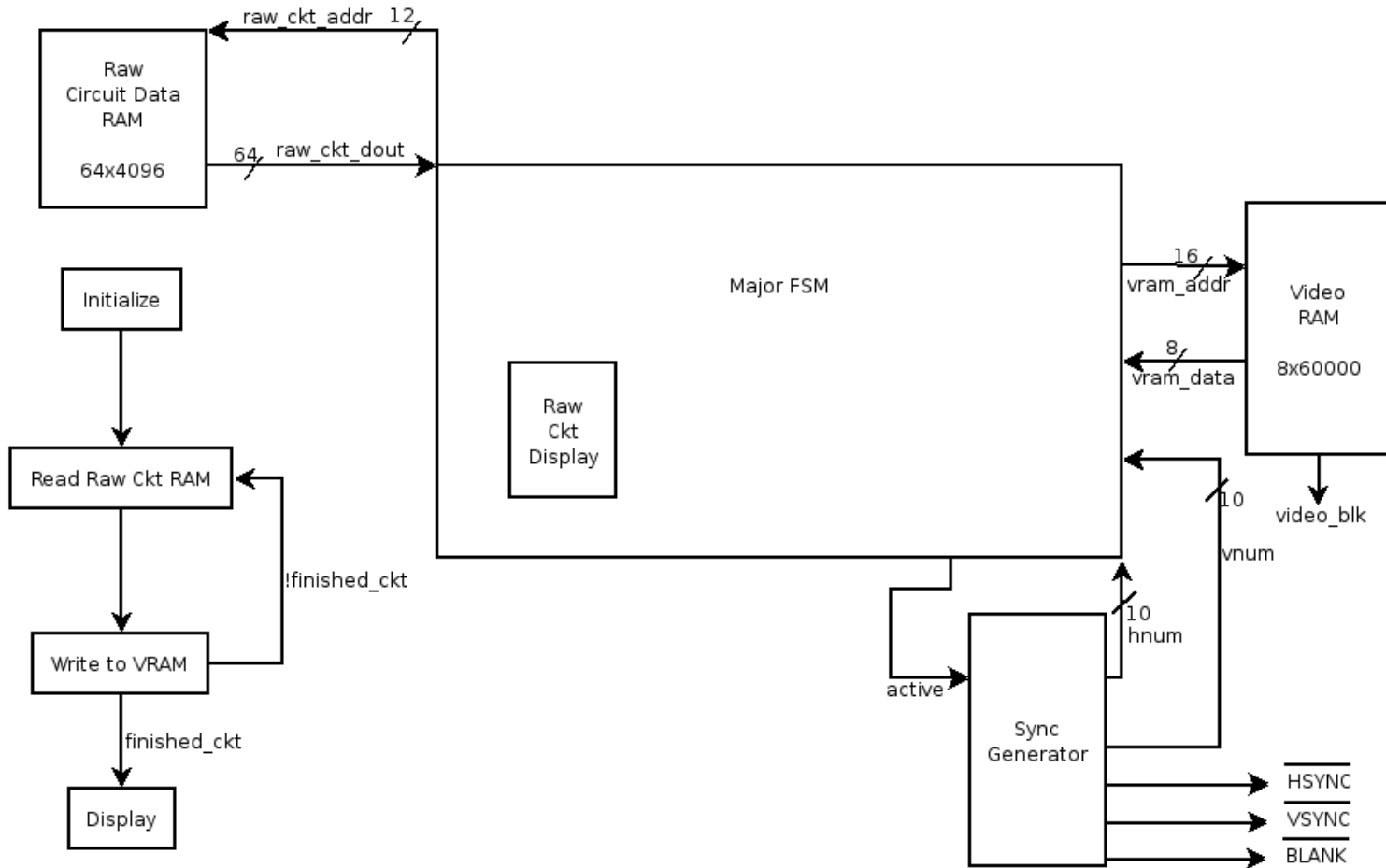
- More pads will be added to allow the user greater freedom in writing

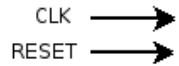# Video Block Diagram

Raw Circuit Display

Global Inputs

CLK →

RESET →

raw_ckt_addr 12

Raw
Circuit Data
RAM

64x4096

64 raw_ckt_dout

Initialize

Read Raw Ckt RAM

!finished_ckt

Write to VRAM

finished_ckt

Display

Major FSM

Raw
Ckt
Display

16
vram_addr

8
vram_data

Video
RAM

8x60000

video_blk

10
vnum

10
hnum

active

Sync
Generator

HSYNC
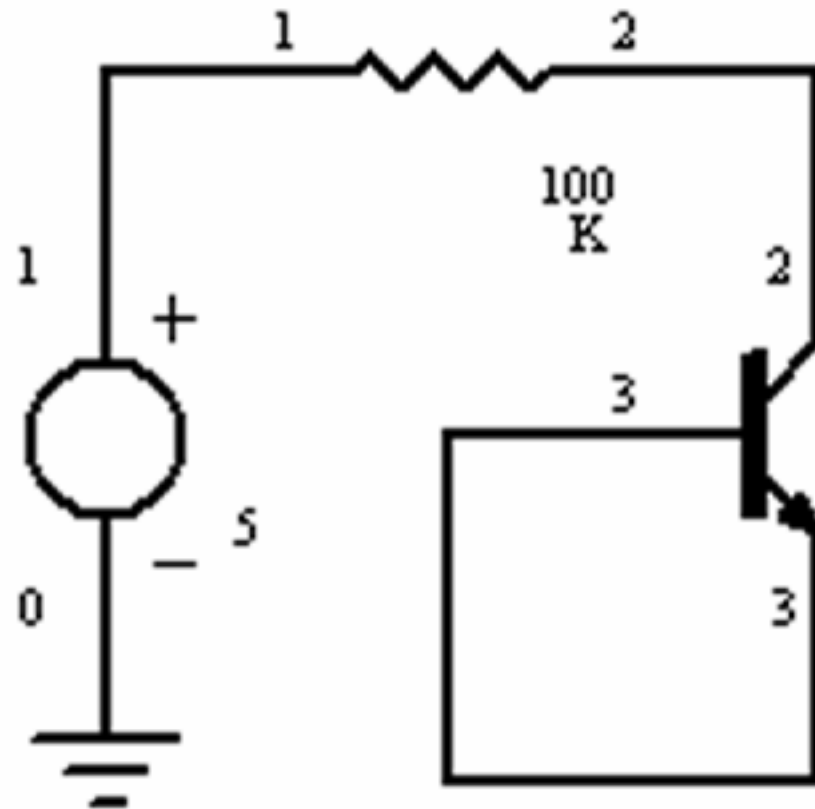
VSYNC

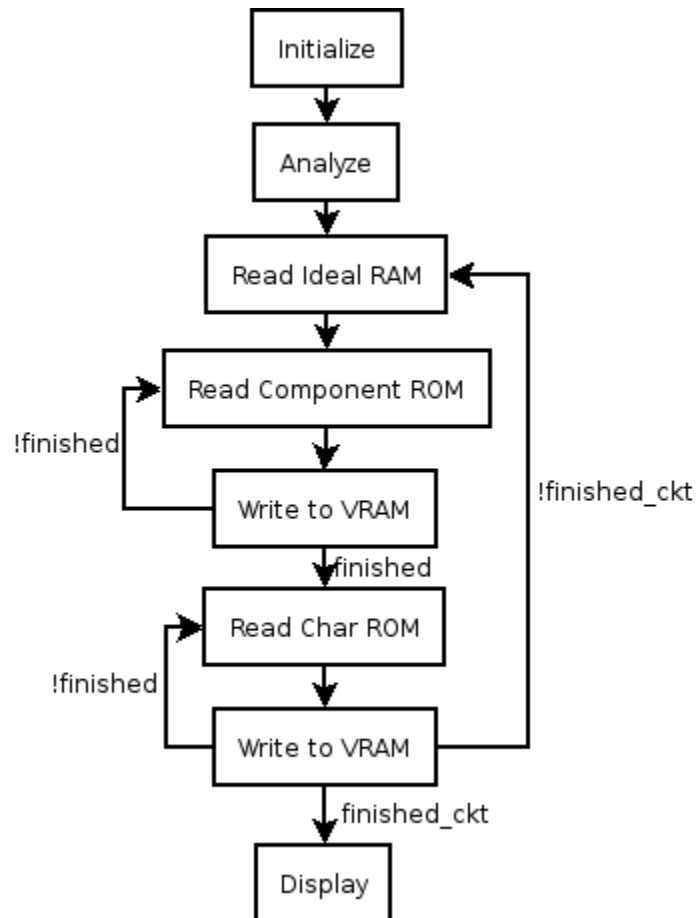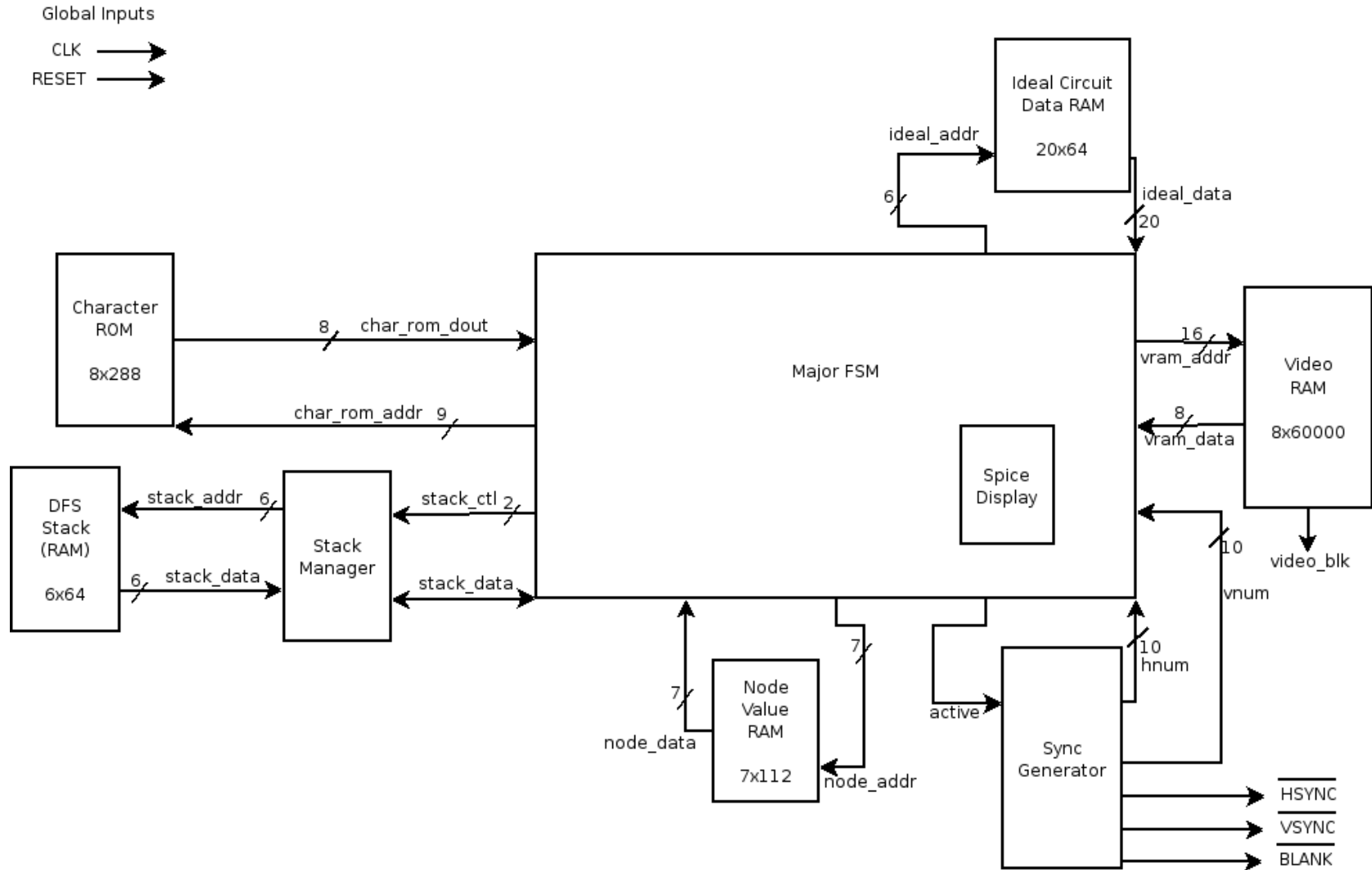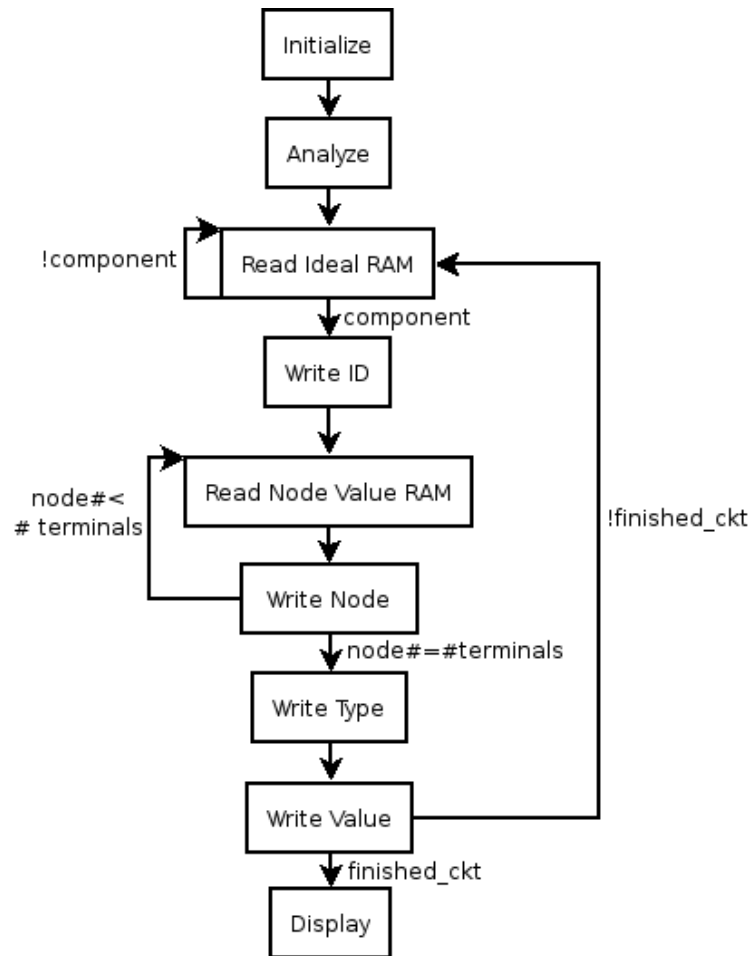BLANK

Ideal Circuit Block Diagram
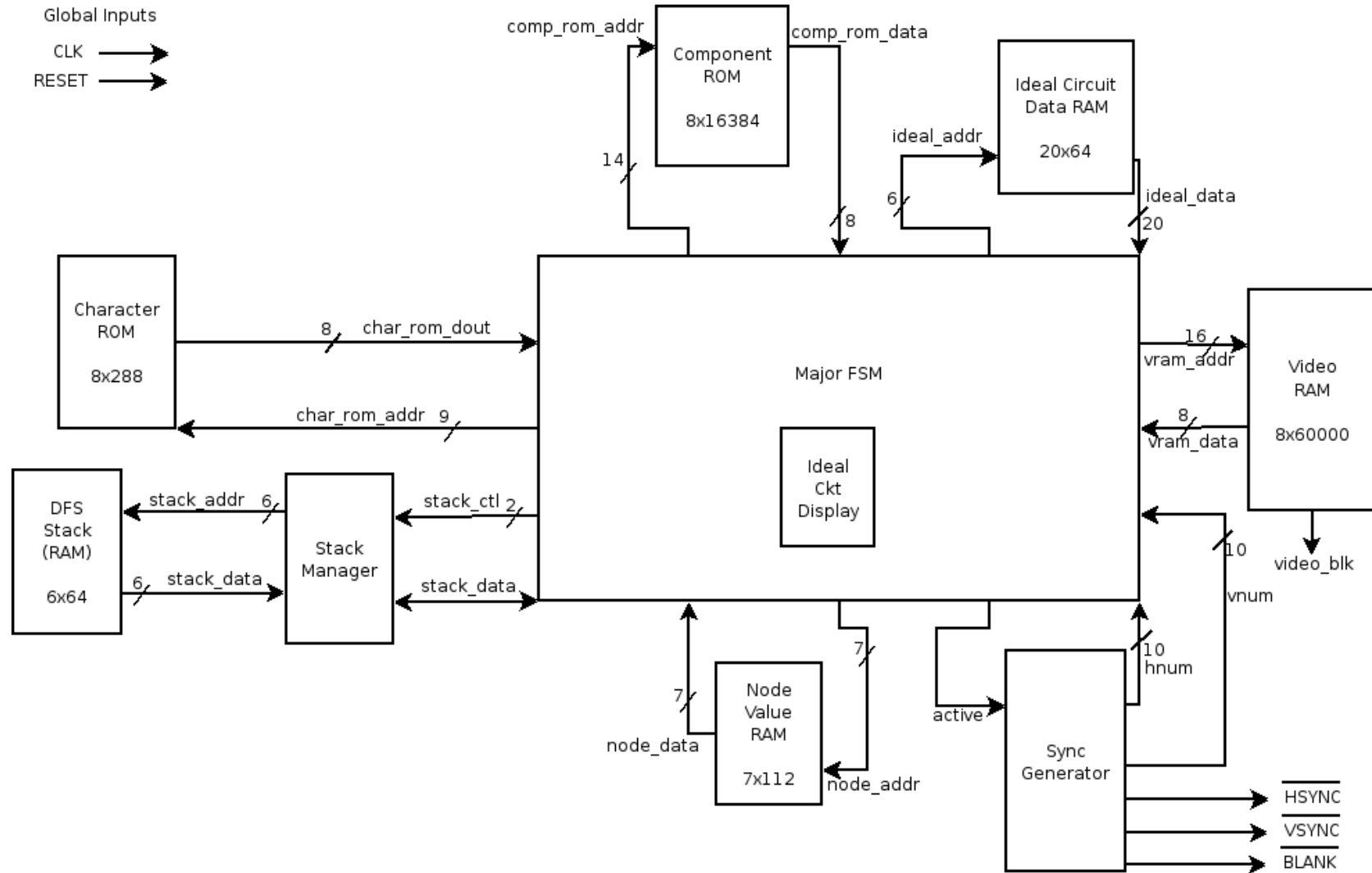
Ideal Circuit State Transition Diagram and Example Output

Spice Display Block Diagram
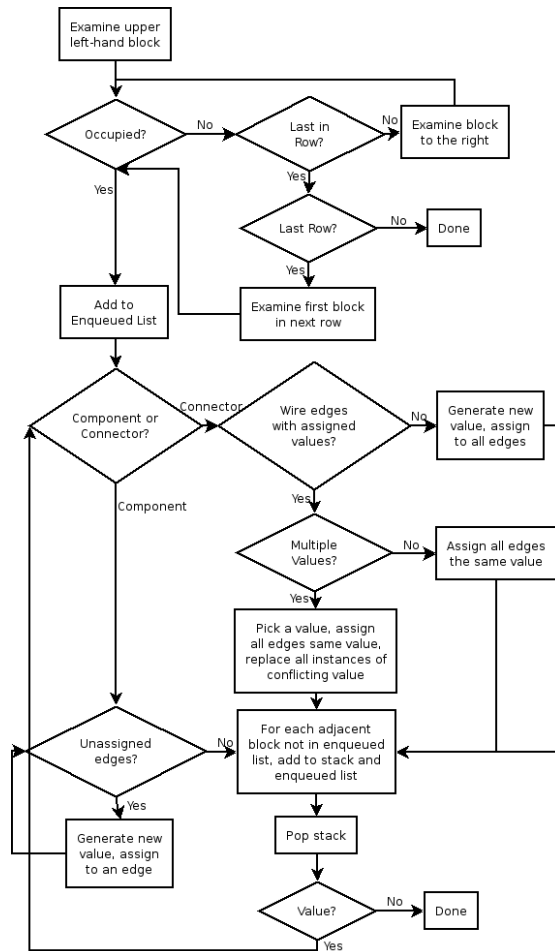
Spice Display State Transition Diagram and Example Output


```
V0  0  1     DC 5

R0  1  2          100k

Q0  2  3  3 NPN
```

Analysis Flowchart

Examine upper left-hand block

Occupied?

No — Last in Row?

No — Examine block to the right

Yes

Yes

Last Row?

No — Done

Yes

Add to Enqueued List

Examine first block in next row

Component or Connector?

Connector — Wire edges with assigned values?

No — Generate new value, assign to all edges

Component

Yes

Multiple Values?

No — Assign all edges the same value

Yes

Pick a value, assign all edges same value, replace all instances of conflicting value

Unassigned edges?

No — For each adjacent block not in enqueued list, add to stack and enqueued list

Yes

Generate new value, assign to an edge

Pop stack

Value?

No — Done

Yes

- Depth-First Search with Enqueued List

- Enqueued List is 64-bit register

- Stack module abstraction

- Node RAM holds values for all possible nodes

Timeline

- Current Status: Partial component recognition, raw circuit display

- April 22: Component recognition, ideal ckt display without nodes

- April 26: Basic serial communication, ideal ckt display with nodes

- May 2: Load circuit bitmaps over serial line, Spice Display

- May 9: Save spice files over serial line