Autonomous Vehicle Edge Detection Project Plan

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(Team 3)

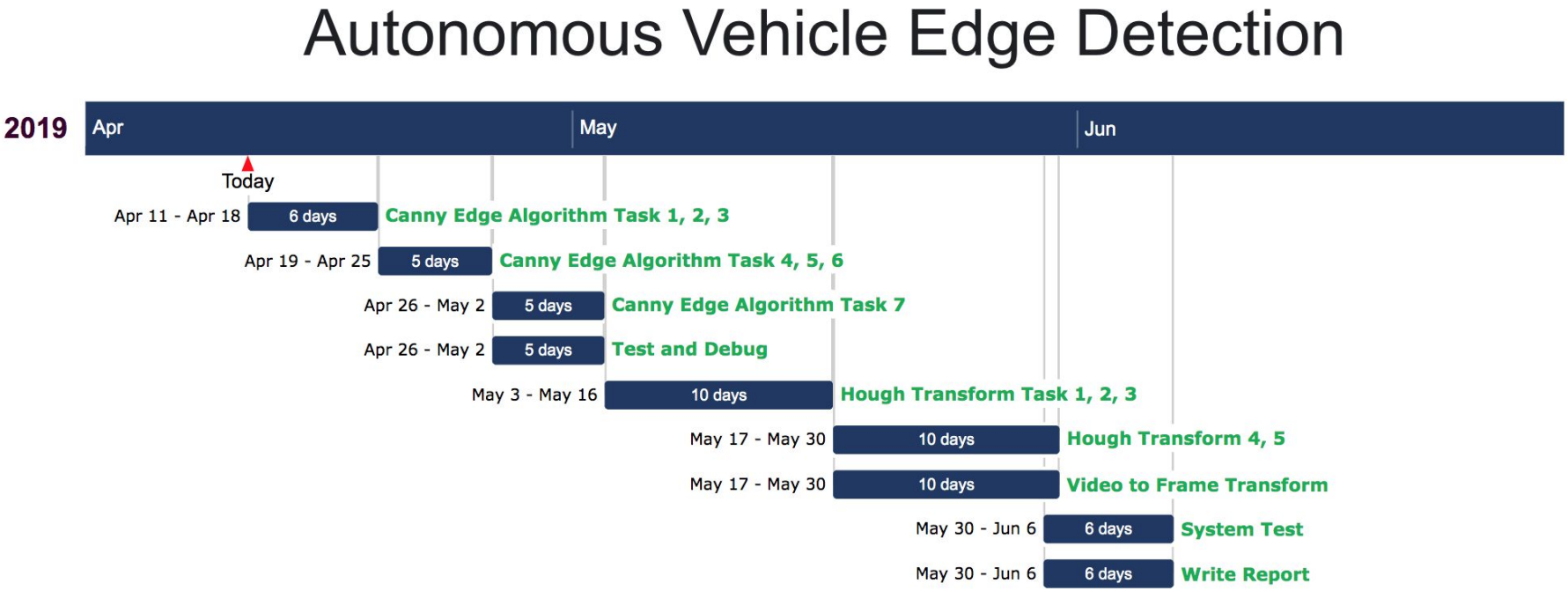
START DEMO

Overview

Canny Edge Algorithm

Hough Transform

Development Plan



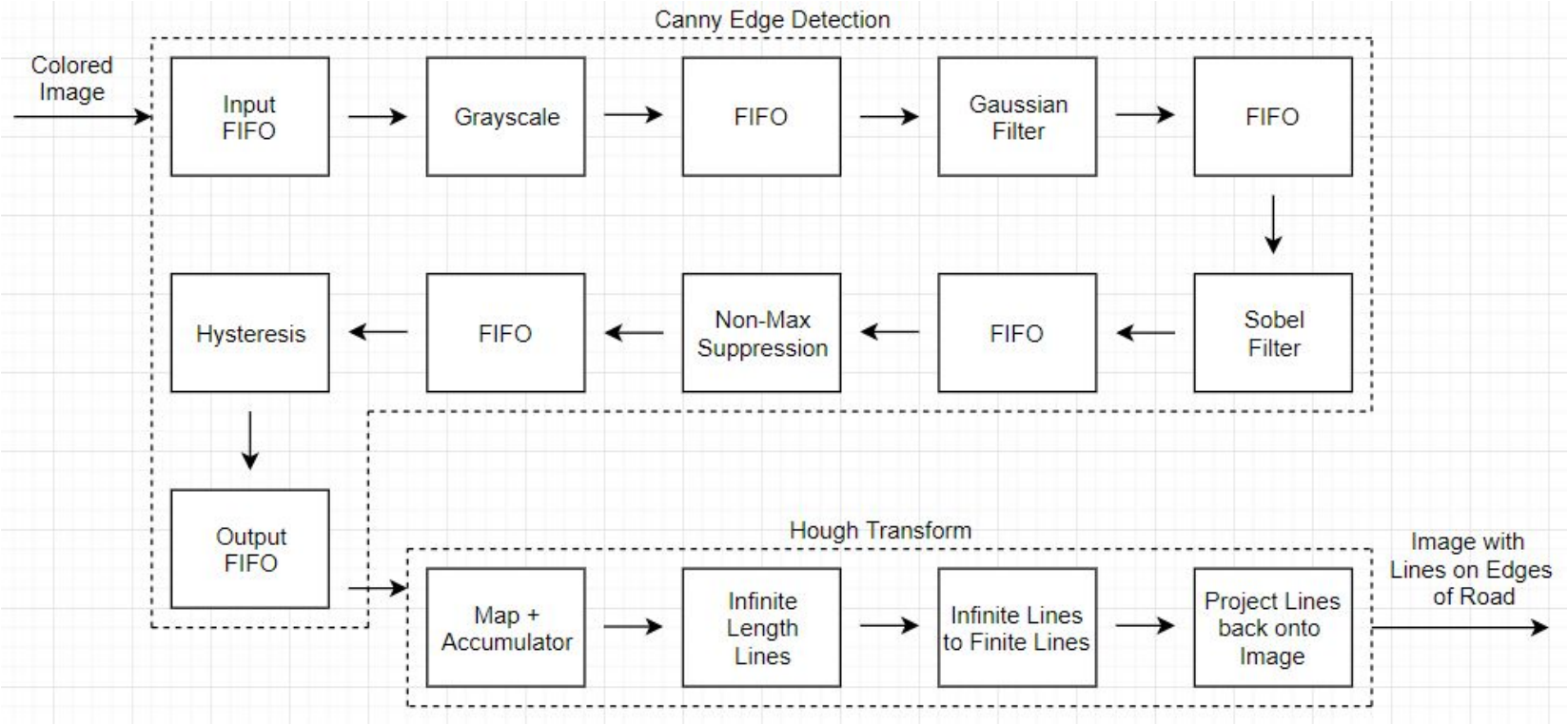
Major Components

1. FIFO: Memory buffer to temporarily store data
2. Grayscale: Convert colored image into grayscale
3. Gaussian: Blurs image using 5x5 matrix
4. Sobel: Calculates gradients using a 3x3 matrix
5. Non-Maximum Suppression: Fixes thick white lines so they aren't as thick
6. Hysteresis: Keeps pixel if pixel exceeds high threshold, or if pixel exceeds low threshold value and there is one adjacent pixel

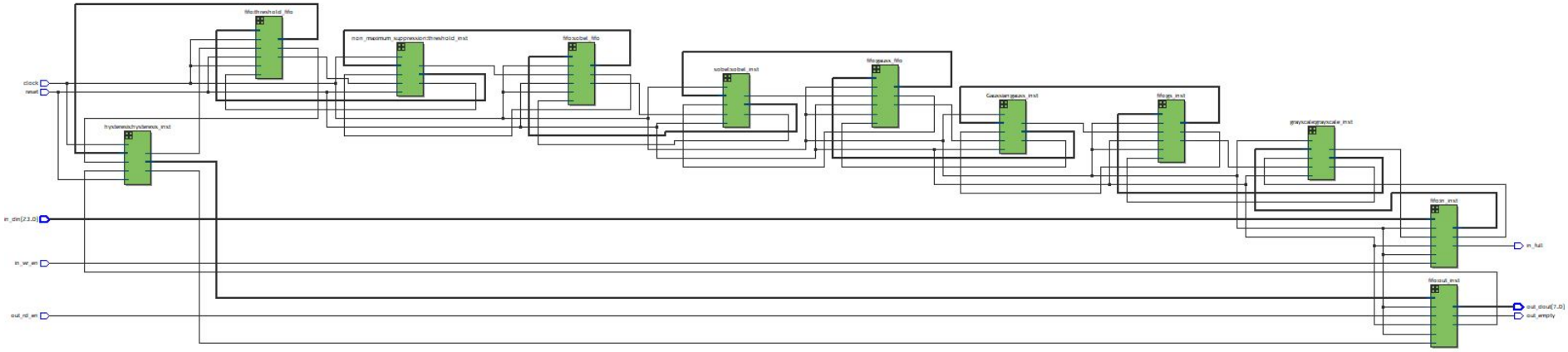
Major I/O (For FIFO streaming architecture)

- Inputs: rd_clk, wr_clk, reset, rd_en, wr_en, din_data
- Outputs: dout_data, full, empty

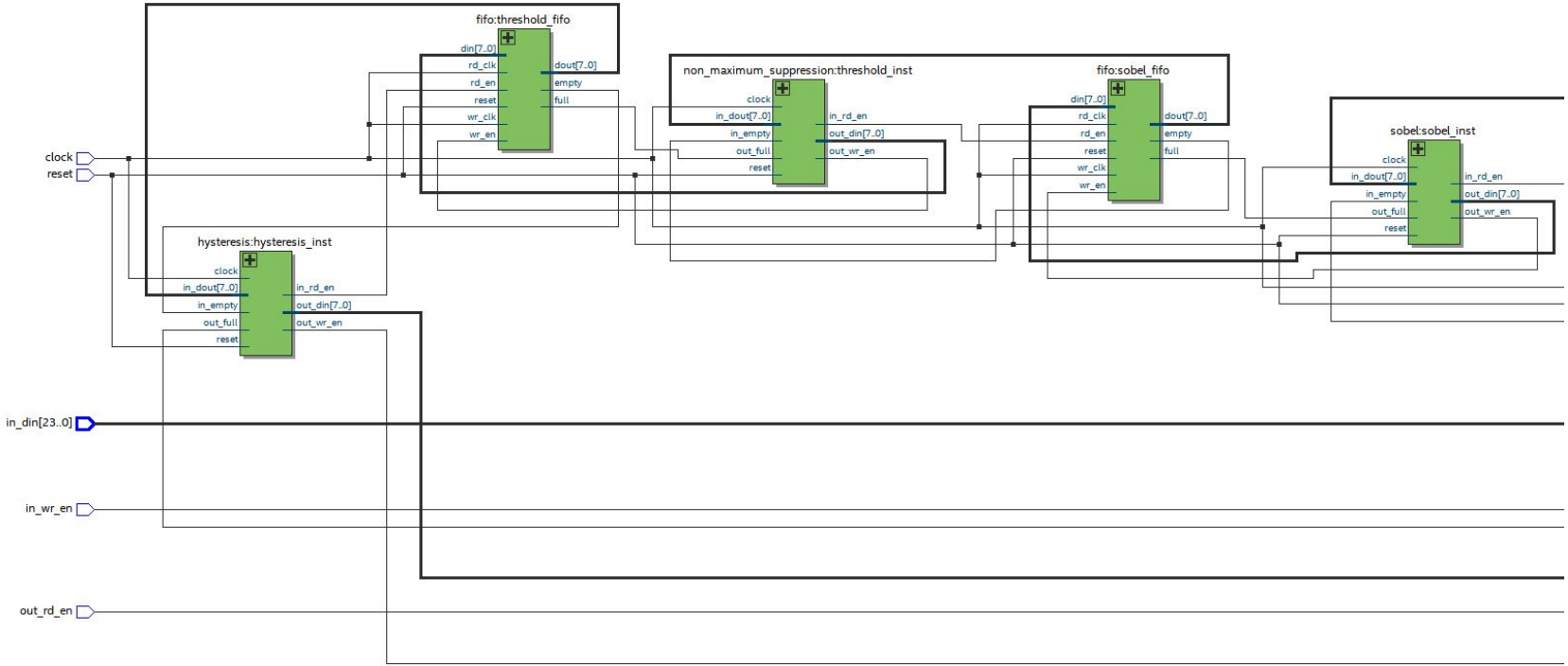
Block Diagram



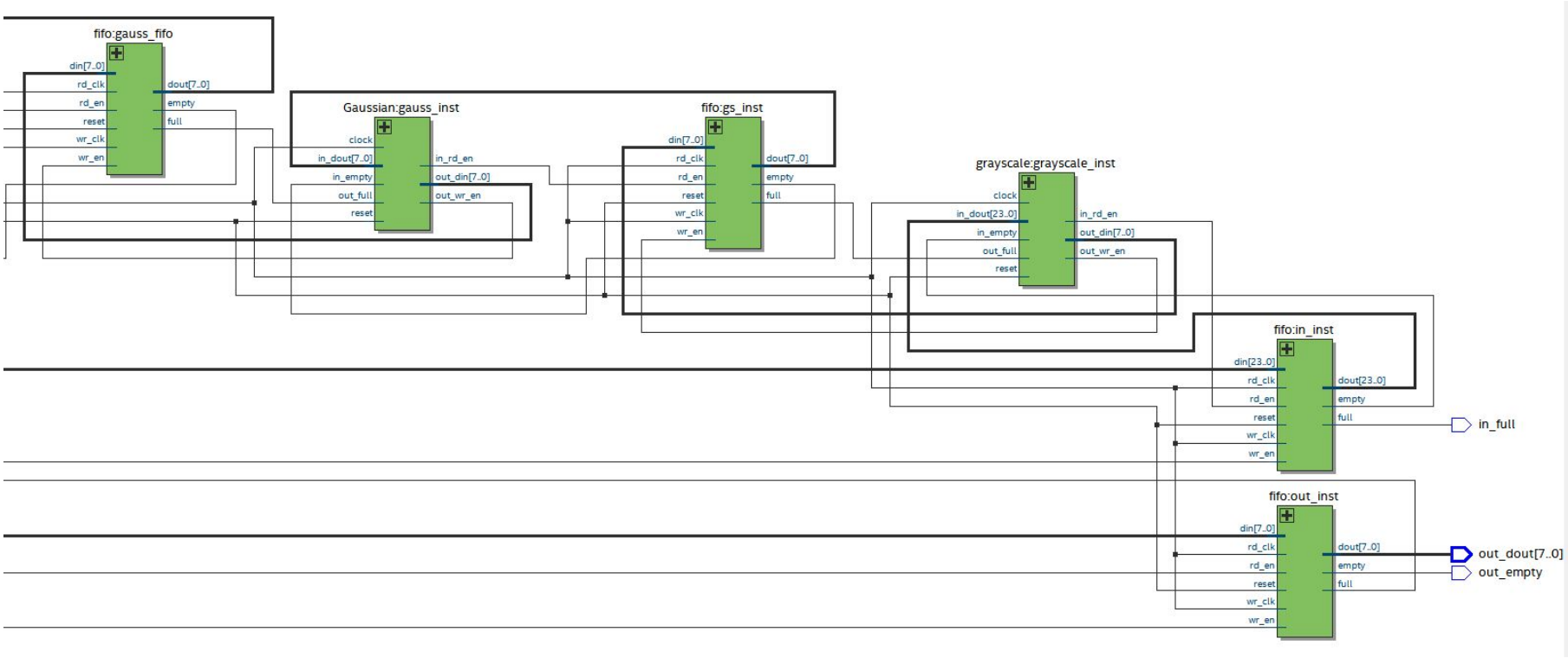
Overall Component Block Diagram



First Half Component Diagram



Second Half Component Diagram



Flow Summary

Flow Summary

<<Filter>>

Flow Status	Successful - Mon Apr 29 21:23:35 2019
Quartus Prime Version	18.1.0 Build 625 09/12/2018 SJ Lite Edition
Revision Name	AVED
Top-level Entity Name	AVED_top
Family	Cyclone IV E
Device	EP4CE115F29I8L
Timing Models	Final
Total logic elements	61,184
Total registers	58242
Total pins	38
Total virtual pins	0
Total memory bits	16,384
Embedded Multiplier 9-bit elements	16
Total PLLs	0

Deliverables

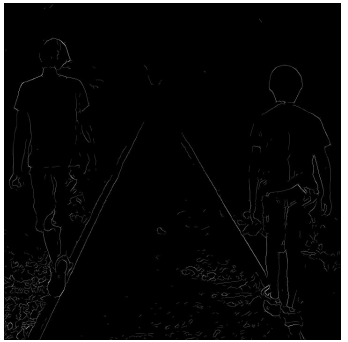
Original Image

Step 1: Grayscale

Step 2: Gaussian Blur

Step 3: Sobel Filter

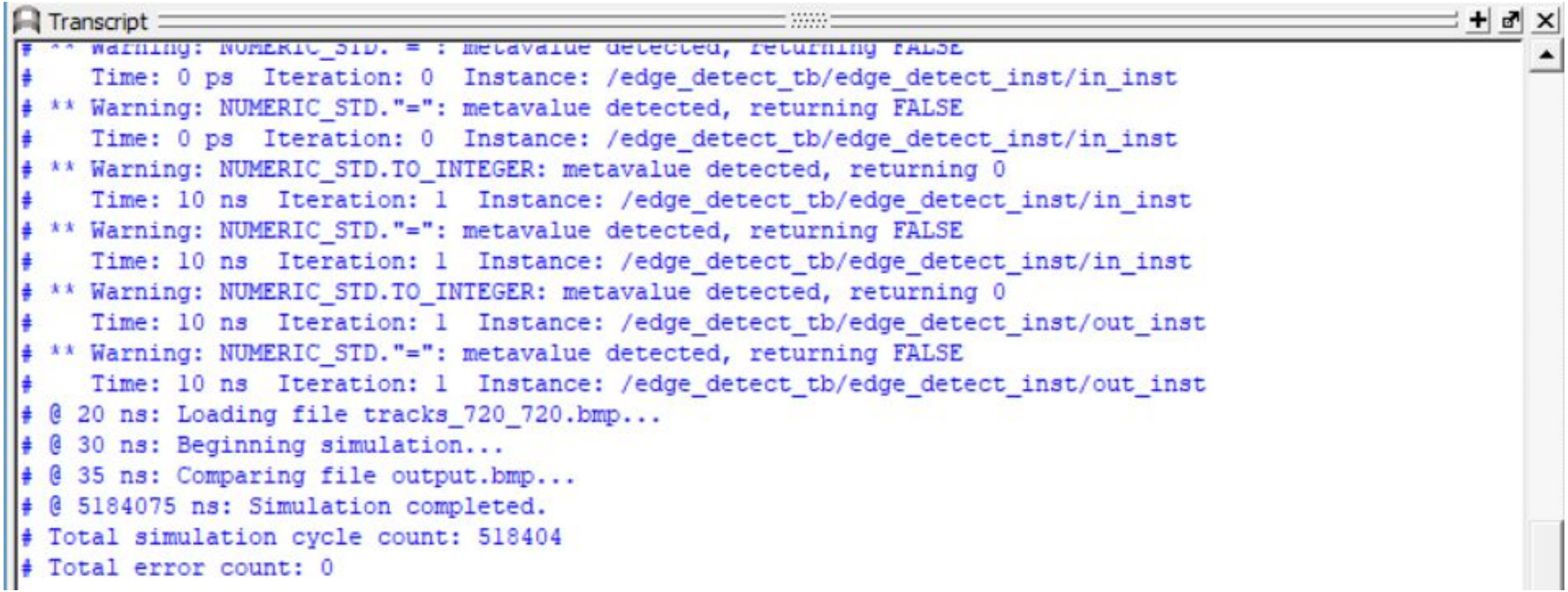
Step 4: Non-maximum suppression



Step 5: Hysteresis

Performance and Testing

Grayscale Sim. Output



Performance and Testing

Gaussian Sim. Output

Transcript

```
# @ 5198465 ns: gaussian_output.bmp(518397): ERROR: 80 != 83 at address 0x0007E8FC.
# @ 5198475 ns: gaussian_output.bmp(518398): ERROR: 80 != 83 at address 0x0007E8FD.
# @ 5198485 ns: gaussian_output.bmp(518399): ERROR: 80 != 83 at address 0x0007E8FE.
# @ 5198495 ns: gaussian_output.bmp(518400): ERROR: 80 != 83 at address 0x0007E8FF.
# @ 5198505 ns: Simulation completed.
# Total simulation cycle count: 519847
# Total error count: 356997
```

Performance and Testing

Sobel Sim. Output

```
# @ 20 ns: Loading file stage1_gaussian.bmp...
# @ 30 ns: Beginning simulation...
# @ 35 ns: Comparing file sobel_output.bmp...
# @ 5191295 ns: Simulation completed.
# Total simulation cycle count: 519126
# Total error count: 0
```

Performance and Testing

Non-Max. Suppression Sim. Output

```
#    Time: 10 ns  Iteration: 1  Instance: /n
# @ 20 ns: Loading file stage2_sobel.bmp...
# @ 30 ns: Beginning simulation...
# @ 35 ns: Comparing file nms_output.bmp...
# @ 5191295 ns: Simulation completed.
# Total simulation cycle count: 519126
# Total error count: 0
```

Performance and Testing

Hysteresis Sim. Output

```
# @ 20 ns: Loading file stage3_nonmax_suppression.bmp...
# @ 30 ns: Beginning simulation...
# @ 35 ns: Comparing file hyst_output.bmp...
# @ 5191295 ns: Simulation completed.
# Total simulation cycle count: 519126
# Total error count: 0
```

Performance and Testing

Top level Canny-Edge Sim. Output

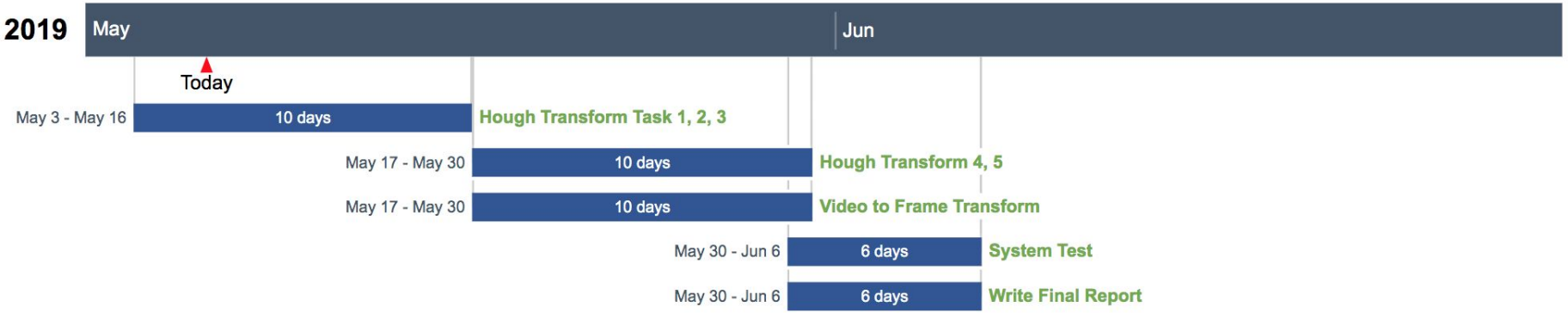
```
# @ 5220235 ns: 518399: 00
# @ 5220245 ns: Simulation completed.
# Total simulation cycle count: 522021
# Total error count: 11725
```

DEMO RESULTS

Challenges

Gaussian Filter

Autonomous Vehicle Edge Detection



Next Steps

Hough Transform