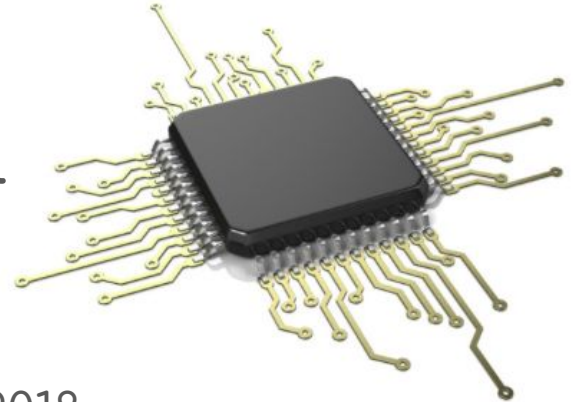


Odd Even Sorting Algorithm - Comparison

Students:

Keli Tauana Prass Ruppenthal

Victor Dallagnol Bento

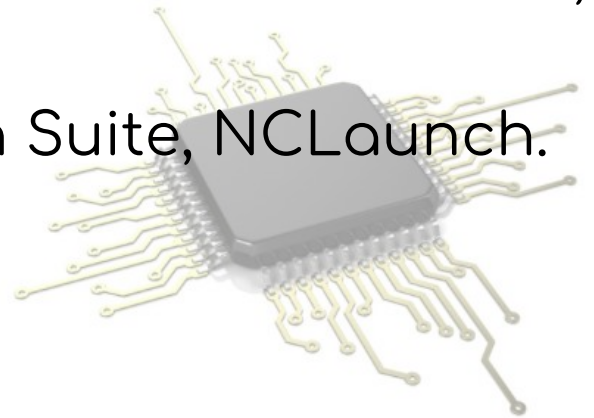


Santa Maria/ December, 2018

Presentation

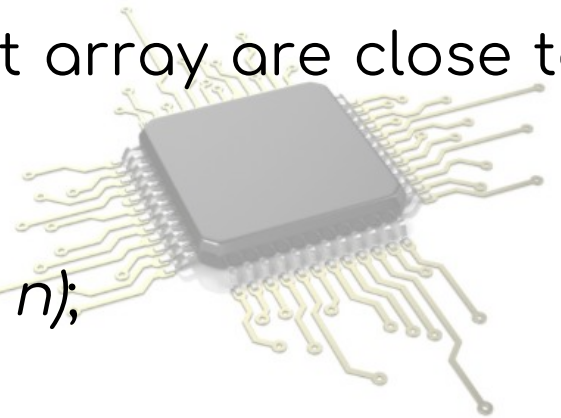
Objectives:

- Area: $50 \text{ } \mu\text{m}^2$;
- Power: 10 mW;
- Performance: Best case $\rightarrow 18 \text{ ns}$, Worst case $\rightarrow 180 \text{ ns}$;
- Tools: *draw.io*, *Logisim*, ISE Design Suite, NCLaunch.



Motivation

- Sorting algorithm fairly simple;
- Variation of *BubbleSort*;
- Explore parallelism by running some comparison efficiently at the same time;
- Fast when all elements in the input array are close to their sorted indexes;
- Complexity in best case: $O(n)$;
- Complexity in average case: $O(\log^2 n)$;
- Complexity in worst case: $O(\log^2 n)$.



Odd Even Sort Algorithm

Keli Tauana Prass Ruppenthal
Victor Dallagnol Bento

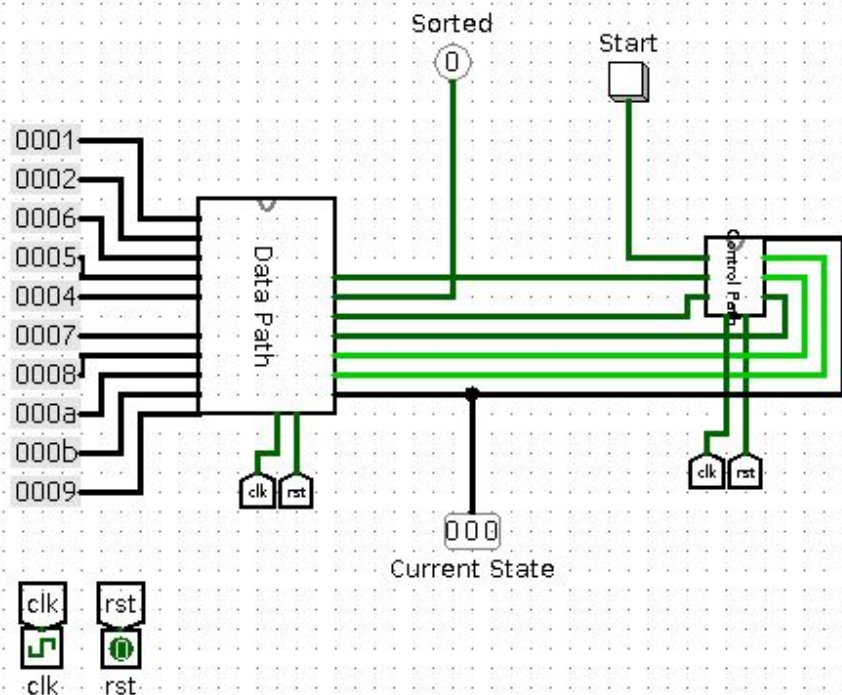
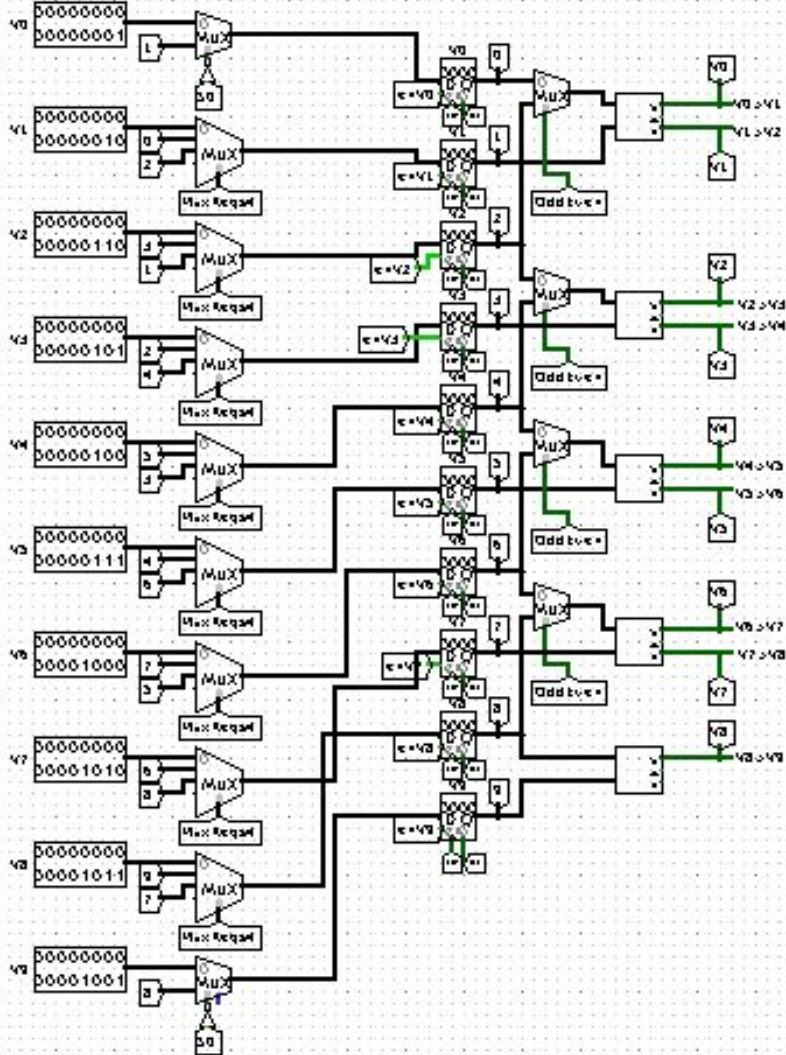


Figure 1: Data Path - main.



8 mux 4:1 (16 bits)
 6 mux 2:1 (16 bits)
 10 registers (16 bits)
 5 comparators (16 bits)

Figure 2: Data Path - Input vector and registers.

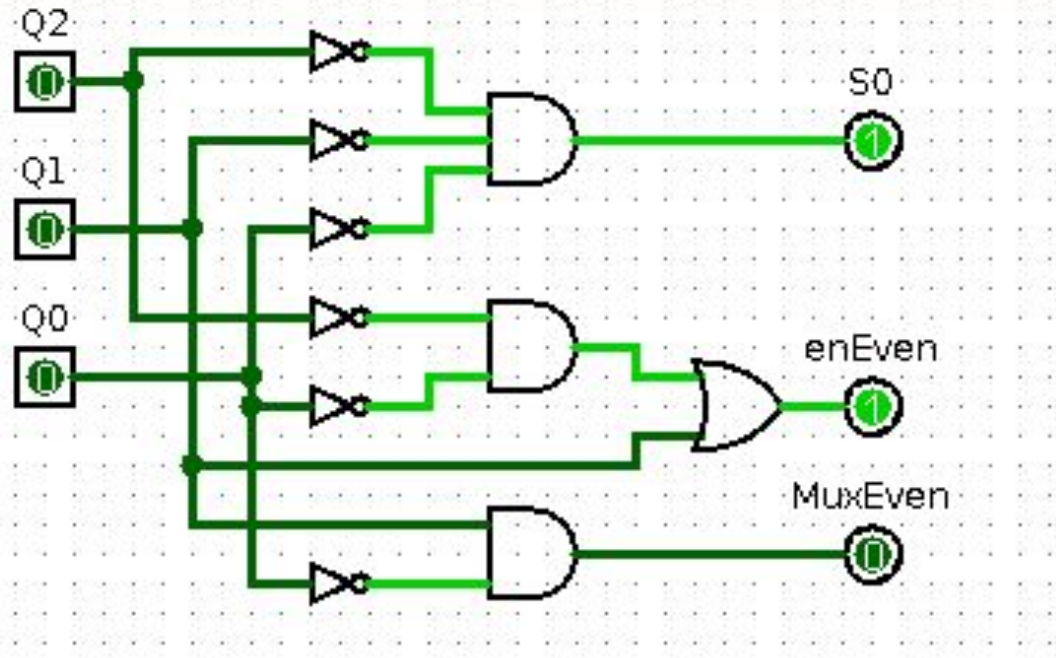


Figure 3: Control Path -
Output logic.

1 mux 2:1 (1 bit)
 1 mux 2:1 (2 bits)
 1 register (1 bit)
 1 adder (2 bits)

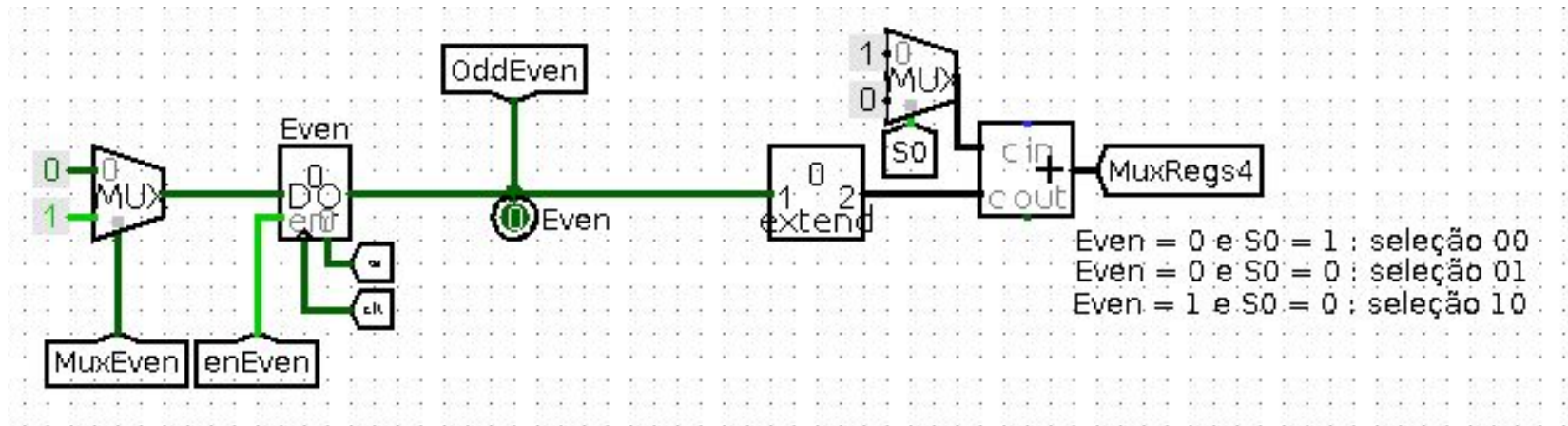


Figure 5: Data Path - Phase manipulation.

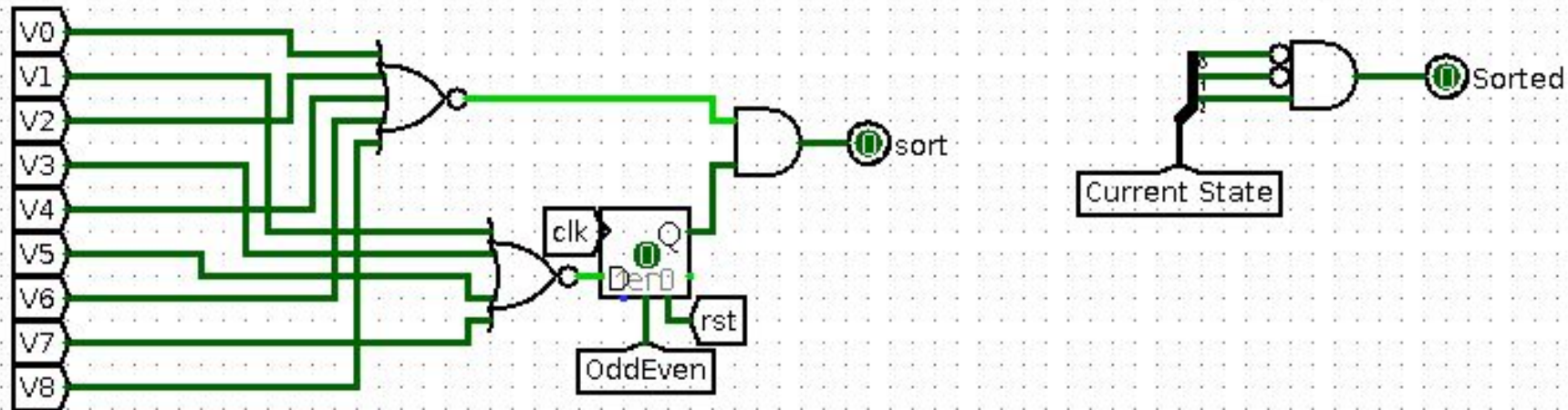


Figure 6: Data Path - Ordering completed and sorted output.

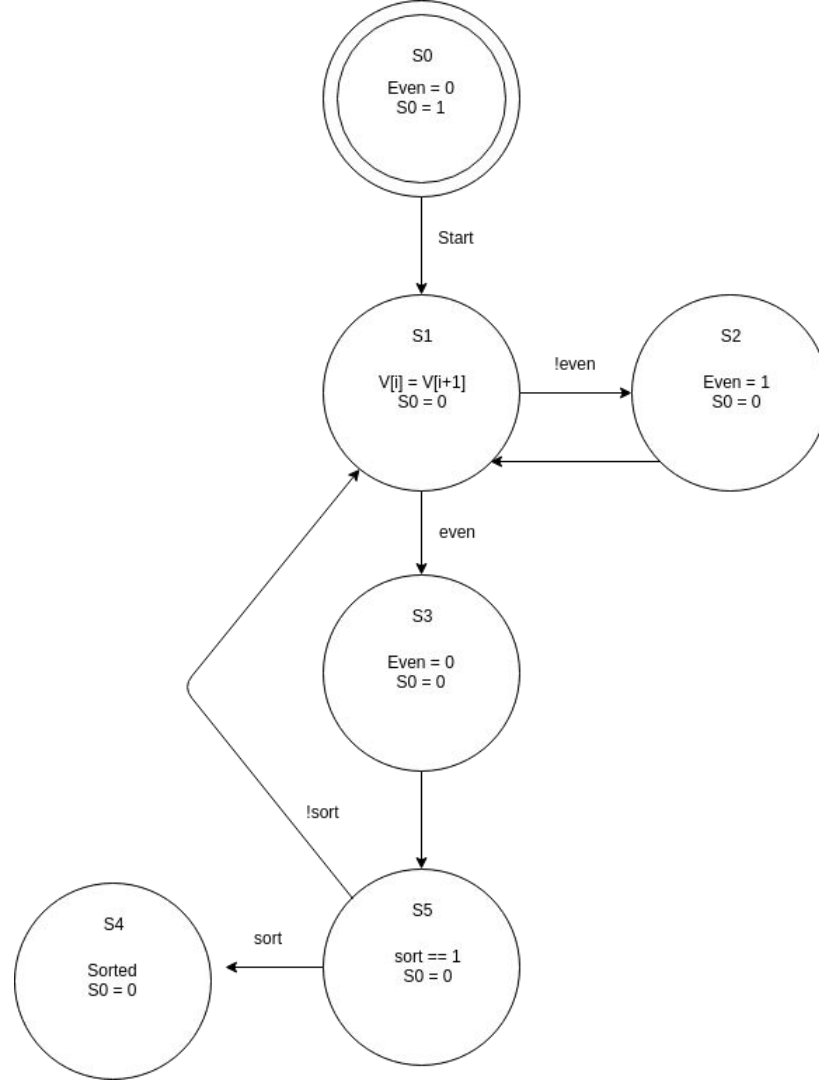
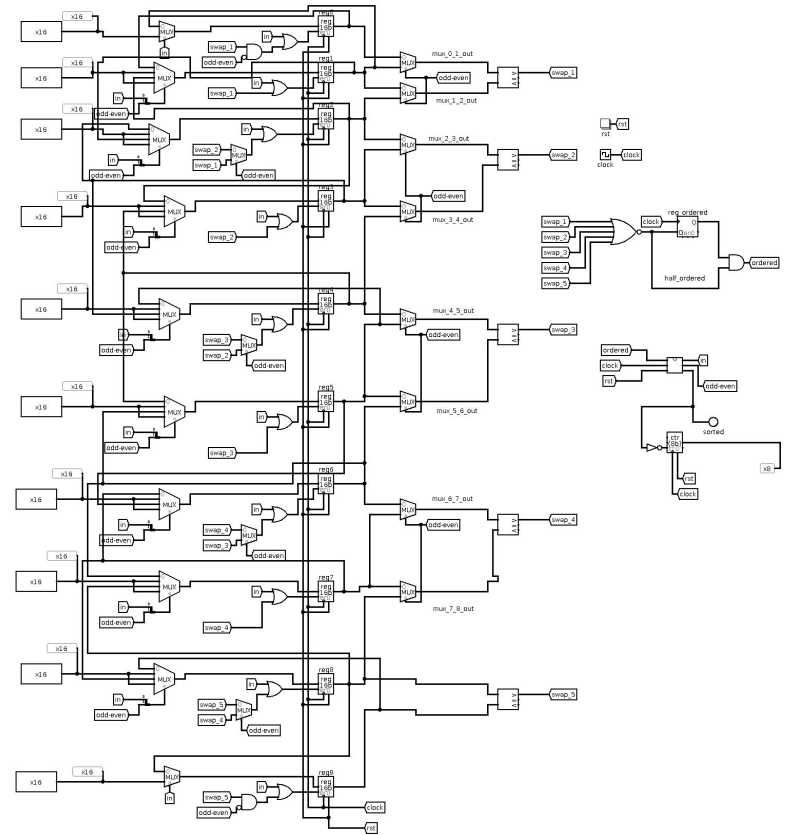
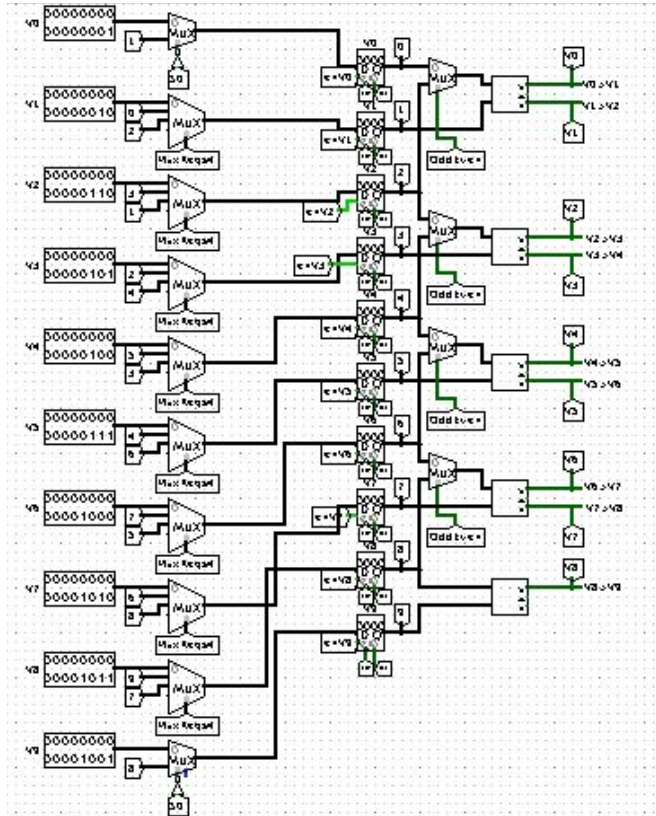
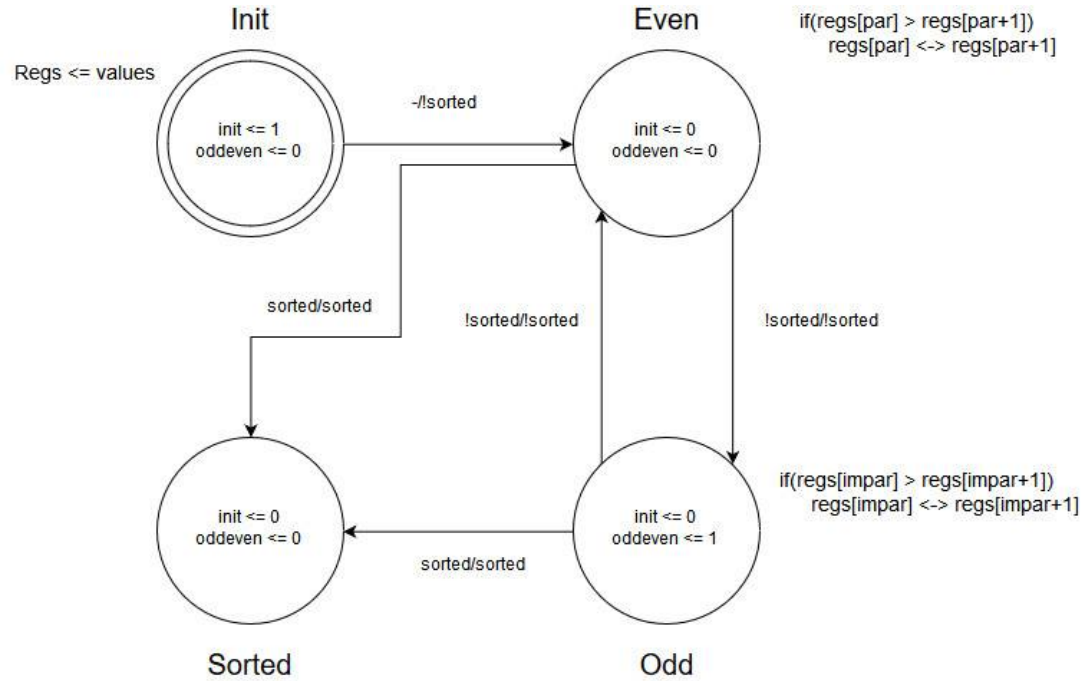
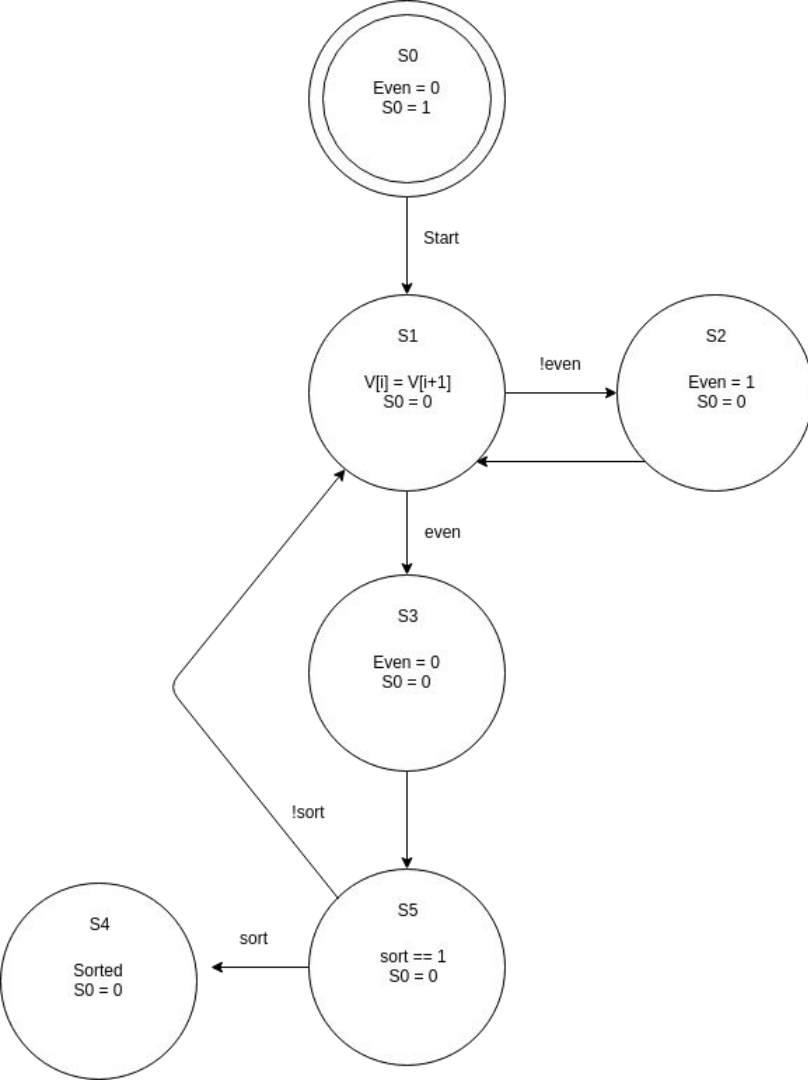


Figure 7: FSM.

Comparisons

Group 1:



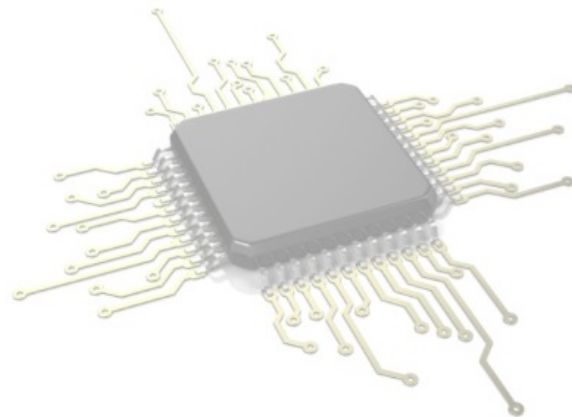


NON-OPTIMIZED SYNTHESIS AND SLOW CELLS

	Group 1 - Structural B.C.	Ours- Structural B.C.	Difference	Group 1 - Structural W.C.	Ours- Structural W.C.	Difference
Area (um^2)	55,492	56,080	↑ 1,04%	55,492	56,080	↑ 1,04%
Power (mW)	14.235	9.64	↓ 47,6%	14.235	9.64	↓ 47,6%
Critical Path (ps)	6.1	8.8	↑ 30,68%	6.1	8.8	↑ 30,68%
Frequency (MHz)	166.67	113	↓ 47,49%	166.67	113	↓ 47,49%
Energy (J)	1.71E-10	4.24E-10	↑ 60%	1.02E-09	2.12E-9	↑ 51,2%
Runtime (ns)	12	44	↑ 72,7%	72	220	↑ 67,27%

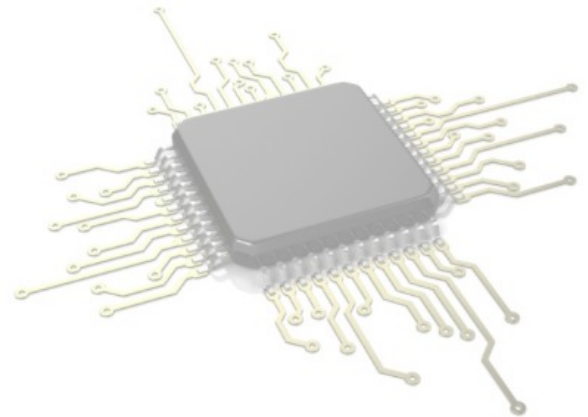
Similarities between Ours and Group 1

- Algorithm;
- Area.

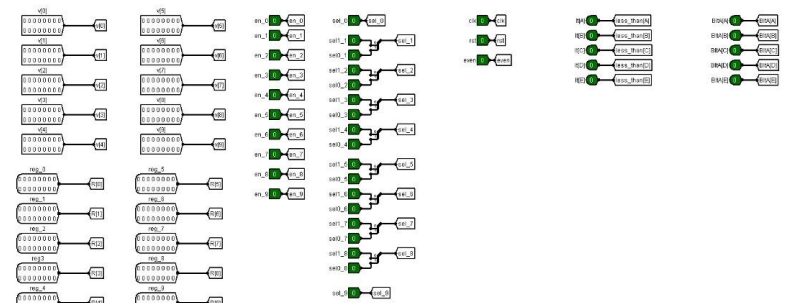
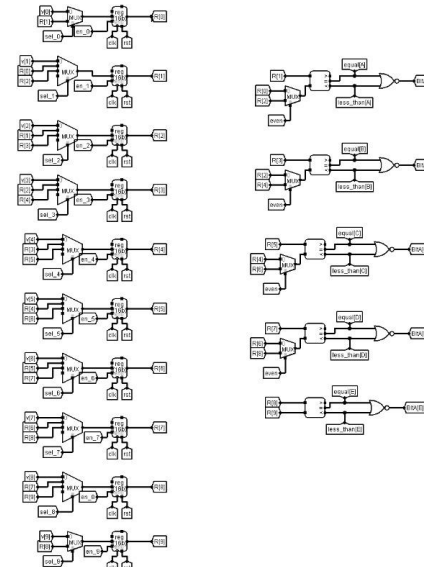
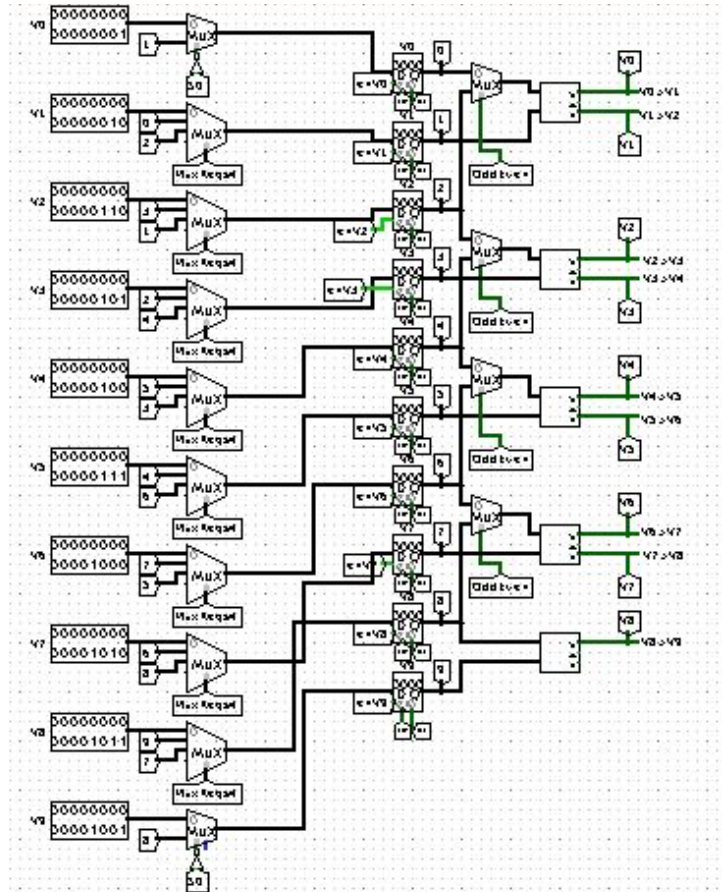


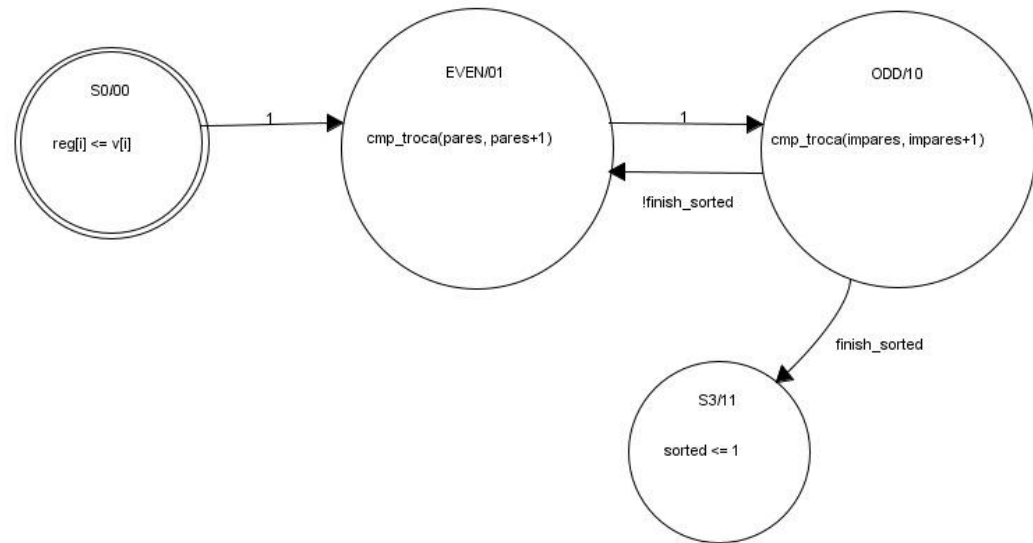
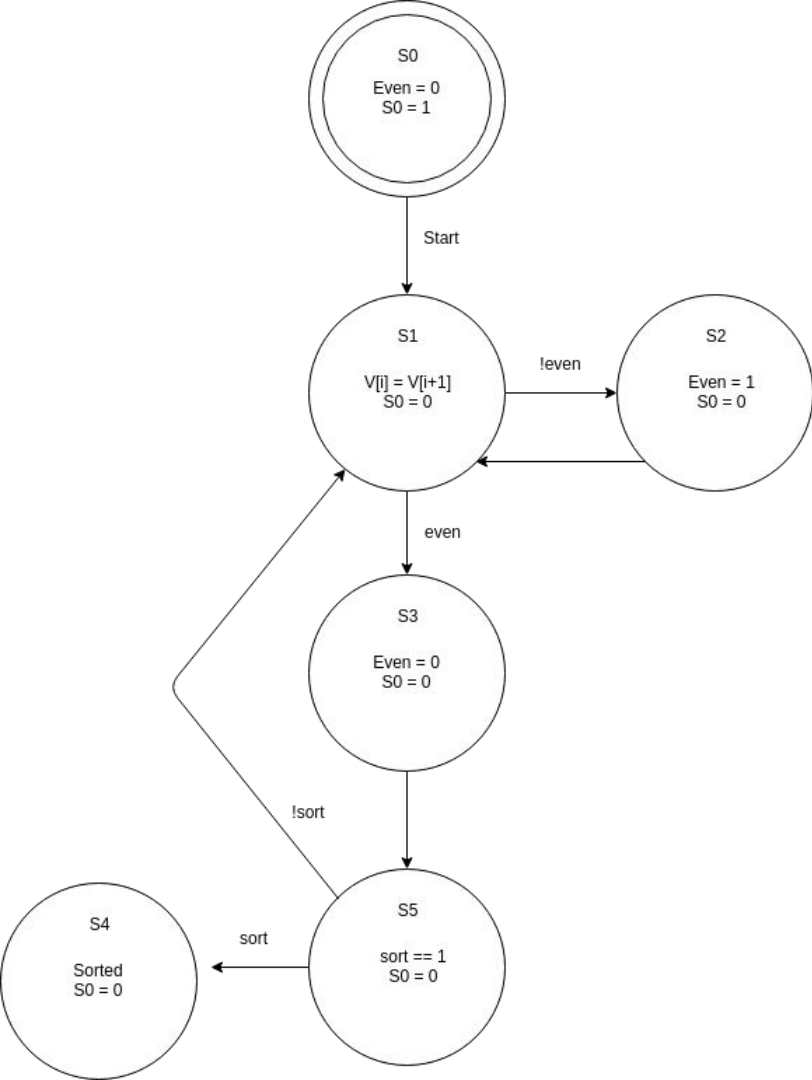
Differences between Ours and Group 1

- Critical Path -> Frequency -> Power;
- Number of states -> Runtime.



Group 2:



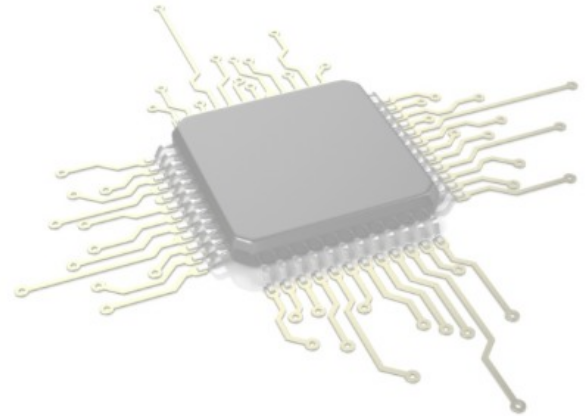


NON-OPTIMIZED SYNTHESIS AND SLOW CELLS

	Group 2 - Structural B.C.	Ours- Structural B.C.	Difference	Group 2 - Structural W.C.	Ours- Structural W.C.	Difference
Area (um^2)	49,639	56,080	↑11,5%	49,639	56,080	↑11,5%
Power (mW)	8,91	9.64	↑7,57%	8,91	9.64	↑7,57%
Critical Path (ps)	-	8.8	-	-	8.8	-
Frequency (MHz)	117,6	113	↓4%	117,6	113	↓4%
Energy (J)	1.52E-10	4.24E-10	↑64%	9.09E-10	2.12E-9	↑57%
Runtime (ns)	17,10	44	↑61,13%	102,10	220	↑53,6%

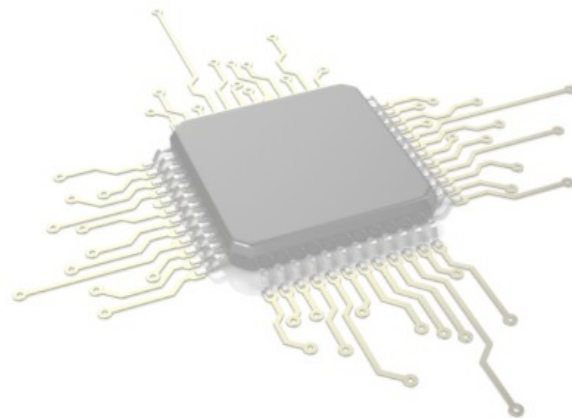
Similarities between Ours and Group 2

- Algorithm.



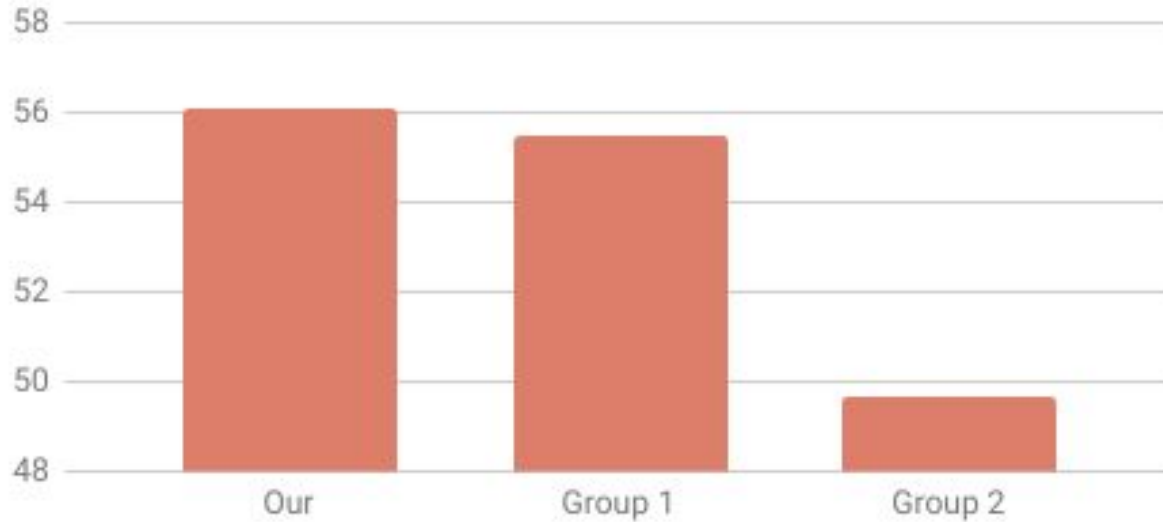
Differences between Ours and Group 2

- Group 2 got all the requirements;
- Frequency \rightarrow Power;
- Number of states \rightarrow Runtime.

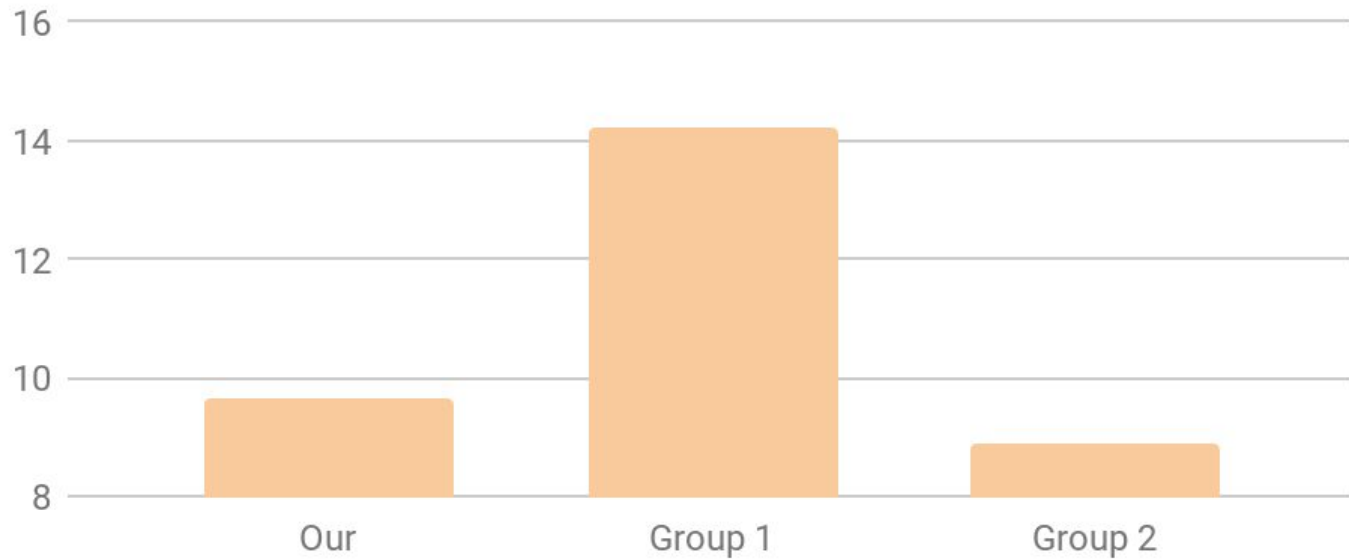


Quantitative Comparative Analysis

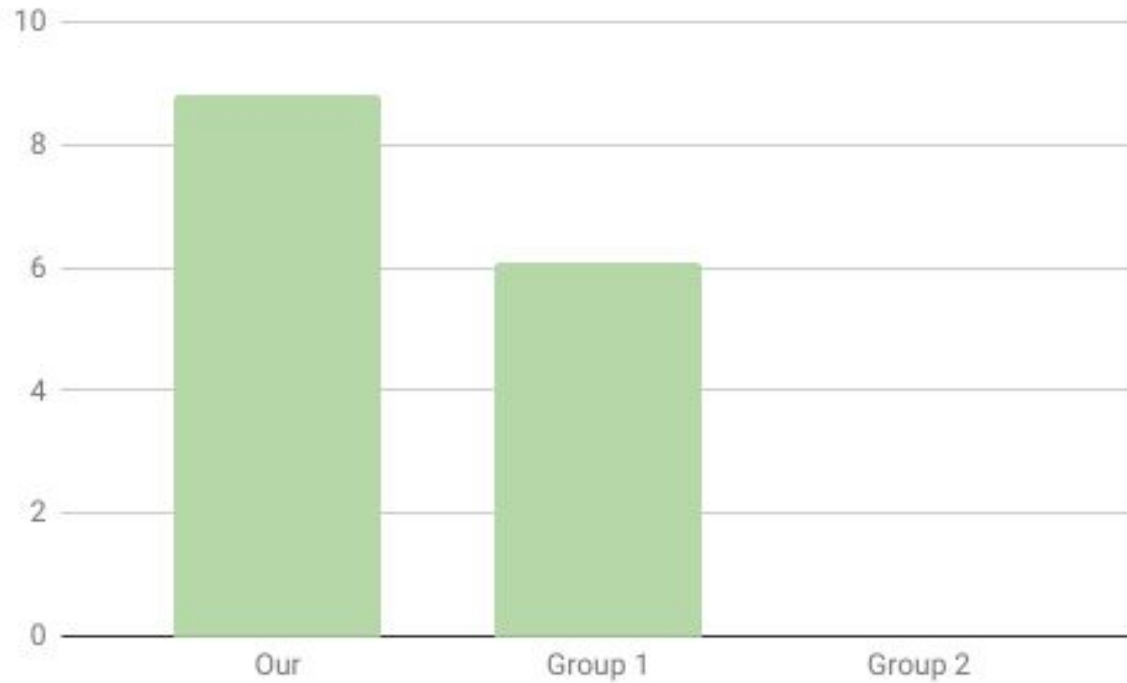
Area:



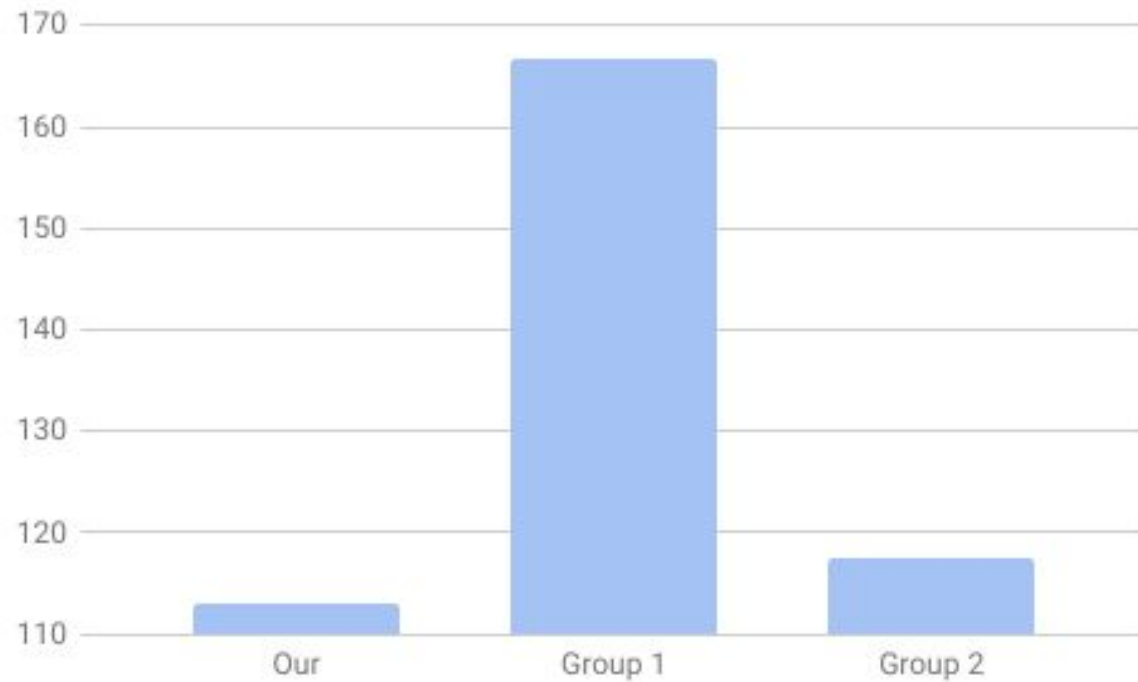
Power:



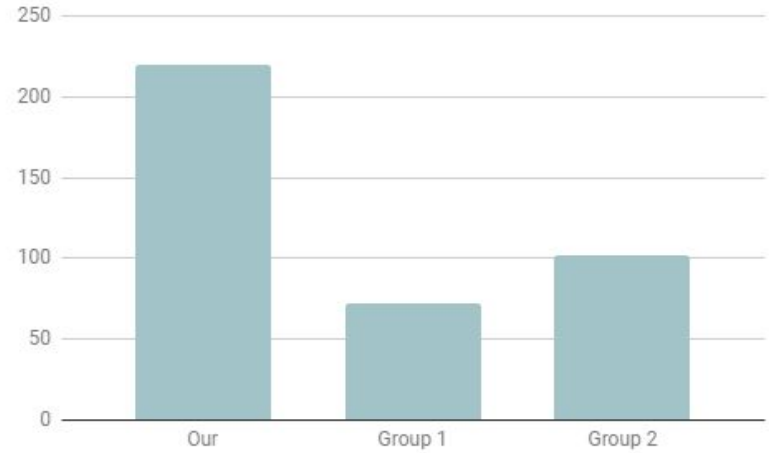
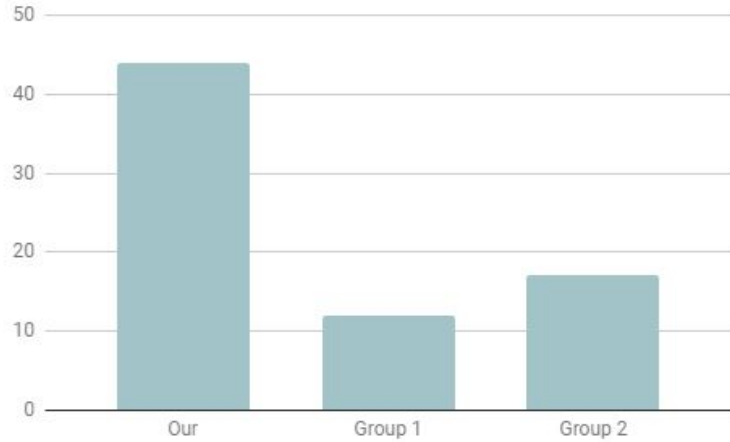
Critical Path:



Frequency:

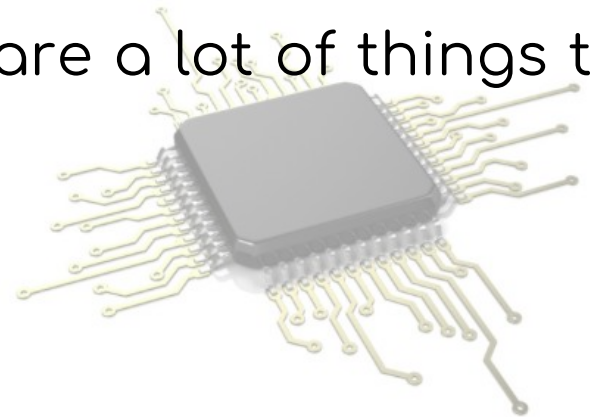


Time Best and Worst Case:



Conclusions...

- Number of states -> Runtime;
- Power ✅;
- Area, W.C. Runtime and B.C. Runtime ❌ ;
- Embedded systems II: new visions about how to design and build circuits... there are a lot of things to be worry about! 😬



Thank you!

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