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A Robust Low Power Field Programmable Threshold Logic Gate Array

Existing complementary metal-oxide-semiconductor (CMOS) technologies are becoming obsolete because we have nearly reached the maximum capability of further miniaturizing computer chips built from modern, state-of-the-art materials. The semiconductor industry association predicts that further scaling is not sustainable and new technologies that can replace current materials will be needed in the next 10 to 15 years. Research is being conducted to determine the most beneficial options for the future. Currently, many nanotechnologies are being explored to determine their potential. Threshold logic, which compares input and output voltages against a threshold voltage, will be needed in these new technologies. Therefore, there has been renewed interest in developing practical implementations of threshold logic.

Researchers at Arizona State University have developed a threshold logic circuit that improves the performance of logic circuits by performing calculations faster and consuming less power. In the past, process variations have been an obstacle for developing effective threshold logic because it alters the set of threshold functions that are implementable by each cell. This innovation exploits these variations through a process aware logic synthesis approach. The results provides a 5X improvement in dynamic power, a 2X improvement in leakage due to elimination of the need for static random-access memory (SRAMs), and close to 3X improvement in transistor count per computing elements. This innovation can be used with existing technology, but also paves the way for future nanotechnologies.

Potential Applications

- Medical imagery
- Computer vision
- Speech recognition
- Bioinformatics

Benefits and Advantages

- Lower Costs – Allows for fewer transistor components
- More Power – Operates with improved efficiency
- Smaller – Allows for development of nanotechnologies that provide greater miniaturization potential
- Retrofit – Works with existing technologies

For more information about the inventor(s) and their research, please see Dr. Sarma Vrudhula's directory webpage