

# ECE 6770 – Project Ideas

Following is a list of project ideas. Feel free to pick one of these or select one of your own choosing. A very productive projects ideas is to design a circuit that is related to your graduate research project.

Preferred team size is 2 – 4 students. Smaller or larger teams are allowed based on project definitions and scope. Projects can be combined to make a more comprehensive design. For instance, a low power microcontroller project could be combined with an MPEG decoder project to form a larger and more interesting design.

## Custom Design / Technology Studies

- Simple MIPS/ARM ISA processor with dynamic power management techniques
- Study designs and tradeoffs of different dynamic power management methods for data paths.
- Low power (static and dynamic) cache design (with dynamic or static  $V_t / V_{dd}$  scaling)
- Multi- $V_{dd}$  microcontroller design with voltage converters.
- Dual  $V_t$  DTCMOS microcontroller design for high performance and low leakage power
- microcontroller with dynamic voltage and frequency scaling
- Asynchronous micro controller datapath
- Asynchronous FIFOs for interfacing between clock frequencies
- GALS (Globally Asynchronous Locally Synchronous) SoC or processor
- NoC relay controllers for high bandwidth and low latency
- Adiabatic datapath design
- Current based voltage sensor and control for PLLs
- High speed arithmetic coprocessor or datapath using advanced logic family such as Domino or pass gate logic.
- New clocking schemes (rotary clocks, resonant clocking, etc.)
- Library design issues - low variation, low power, function diversity issues.
- Timing flow and closure issues - Datapaths that detect timing failures

## IP Blocks

- Encryption chip for the Advanced Encryption Standard (Rijndael algorithm) with self-test upon power-up.
- Public key encryption using Montgomery or Galois Field multiplier
- Smart proximity card controller that is secure from attack
- IP Packet Forwarding engine (possibly with encryption and decryption)
- PCI controller for a microcontroller
- Ethernet controller for packet transmission/reception and encapsulation/decapsulation.
- Viterbi decoder
- Game or graphics coprocessor for accelerating graphics rendering
- Arithmetic co-processor implementing complex numerical algorithms
- Low power high throughput FFT design
- MPEG compression / decompression
- JPEG encoder / decoder
- DSP core with multiple MAC units and VLIW instructions
- Application specific processors with ISAs specifically designed for efficient execution of compression or encryption algorithms
- Base band digital signal processing such as JPS, Bluetooth, MIMO

## Analog and Other Designs

- CDMA encoder/decoder
- PLL
- DLL
- Switched capacitor DAC/ADC
- Voltage Controlled Oscillator (VCO)
- Low voltage analog design
- Image sensing array with image processor
- Reconfigurable computing array