TurboVG: A HW/SW Co-Designed Multi-Core OpenVG Accelerator for Vector Graphics Applications with Embedded Power Profiler

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Background

• Vector graphic requires extremely high computation resources, which make it impossible to run on embedded system.

• Use HW/SW co-design methodology to design a high-performance multi-core accelerating system with low power consumption.

• Find an efficient way to develop a both-HW&SW-optimized system.
Hardware/Software Components

TurboVG is designed to be integrated in a complex SoC system with full software stack.

Hardware/Software integration is a big challenge because of the data transportation!!
Design Features to Overcome the Performance Degradation

- **Multi-banked memory with write enable**
  - Efficient serial-to-parallel conversion
  - Support software I/O optimization

- **Stack-simulated recursion**
  - Adaptively generating points near high-curvature curves

- **Multi-core architecture**
  - Speedup single application
  - Increase multi-application throughput

- **Embedded power profiler**
  - Monitor system components
  - Software API allows dynamic power profiling and management
Experimental Results

- **Hardware**
  - CPU: 200 MHz ARM926EJ-S
  - FPGA: 20 MHz Altera Stratix II
  - RAM: 32 KB SRAM
  - Bus: 100 MHz AHB
  - QVGA Touch Screen

- **Software**
  - OS: Linux 2.6.27
  - X11 Window System
  - OpenGL Graphic Library

10 times faster with 25% power saving!!
Concluding Remarks

• **Extreme Performance**
  - 10x performance over pure software
    - Full HD (1920x1080)
      - HW/SW: 7000 seqs/s,
      - Pure SW: 690 seqs/s

• **Power Efficient**
  - 25% power saving
  - 92.5% energy saving

• **High Scalability**
  - Multi-core accelerator can meet requirements of higher resolution screen
    - Duo-core: 951 seqs/s in Full HD (1920x1080),
    - Single core: 1200 seqs/s in VGA (640x480)