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

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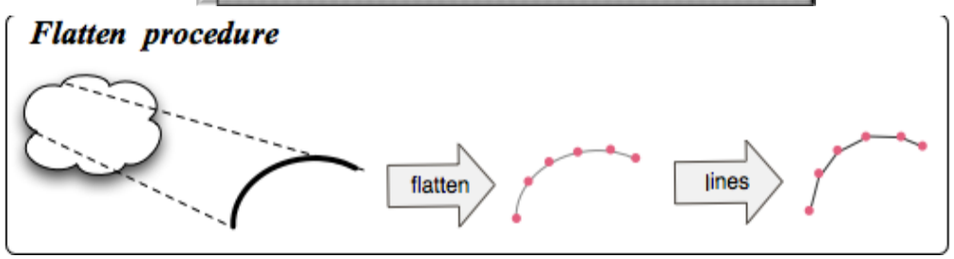
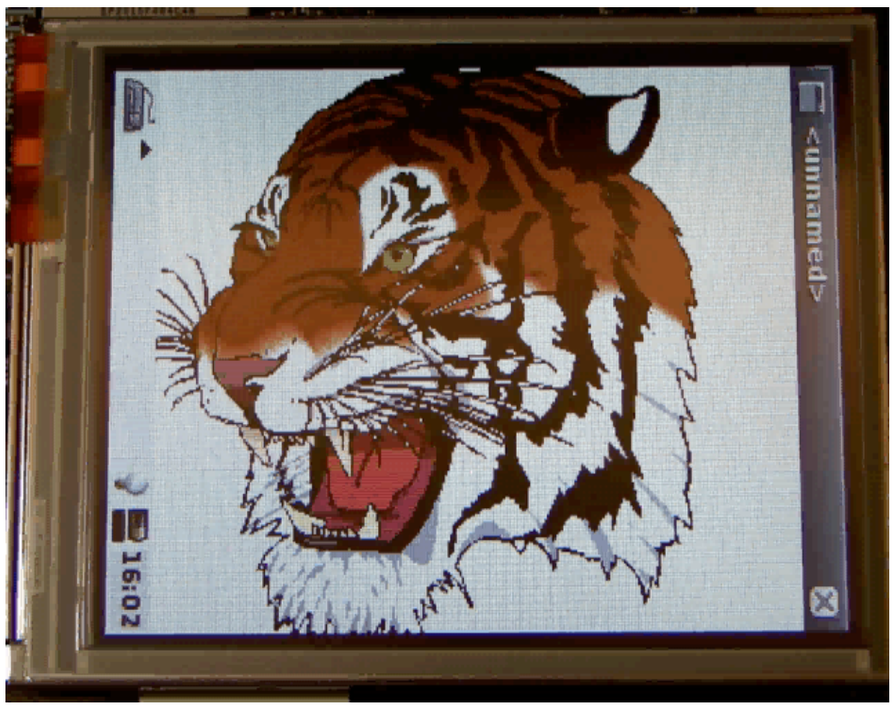
Background

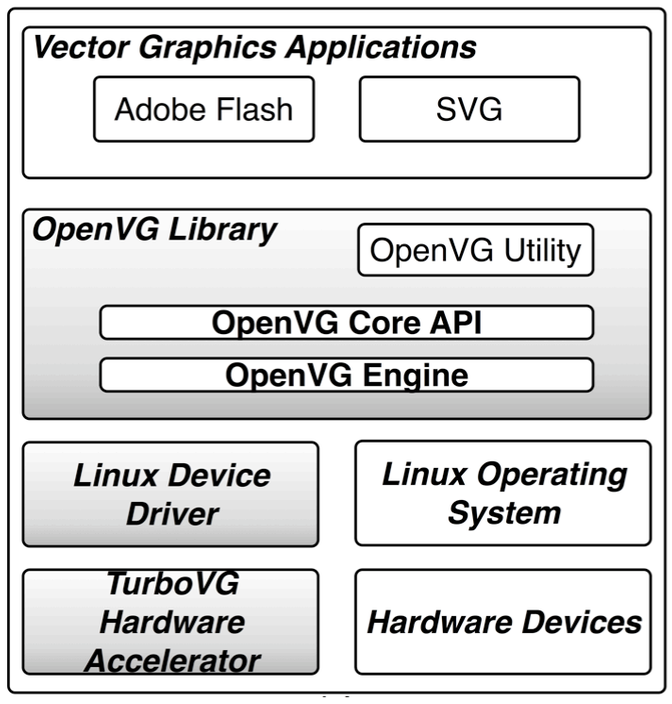
- **Vector graphic requires extremely high computation resources, which make it impossible to run on embedded system.**
- **Use HW/SW co-design methodology to design a high-performance multi-core accelerating system with low power consumption.**
- **Find an efficient way to develop a both-HW&SW-optimized system.**

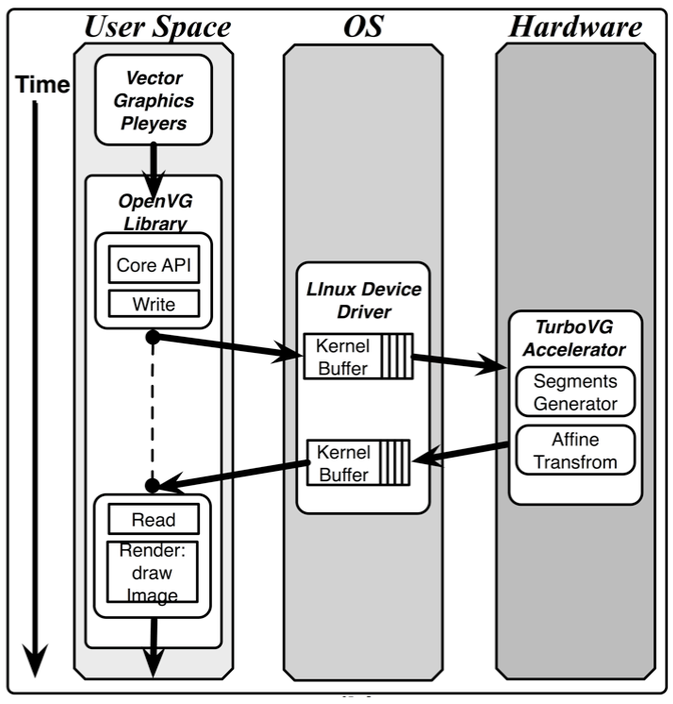


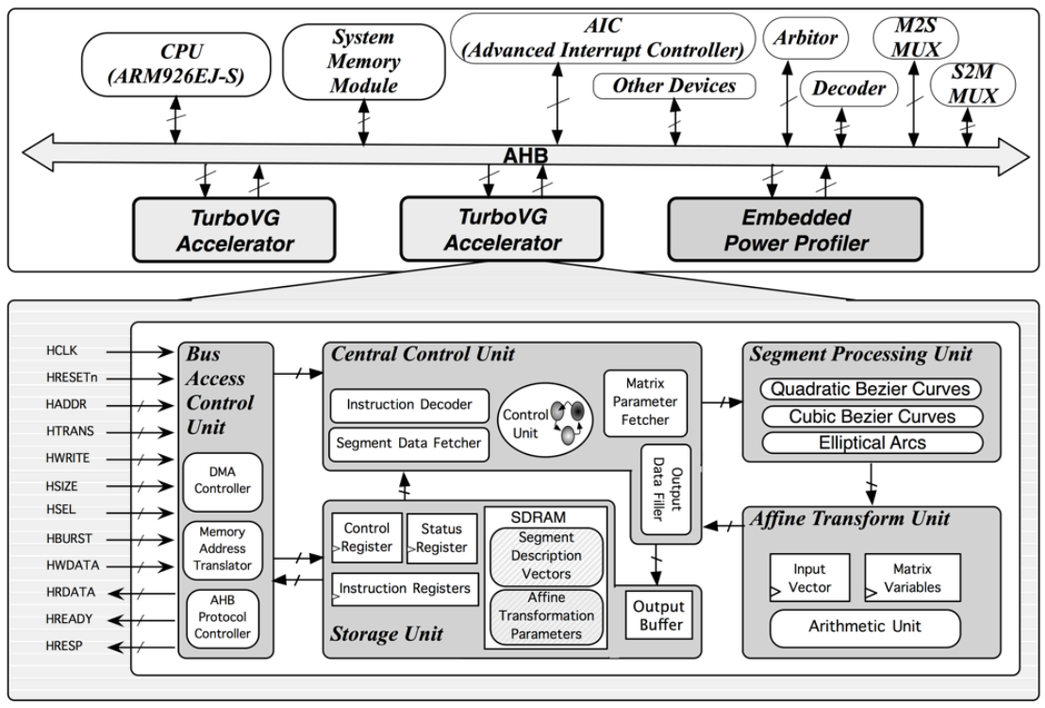


Hardware/Software Components

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



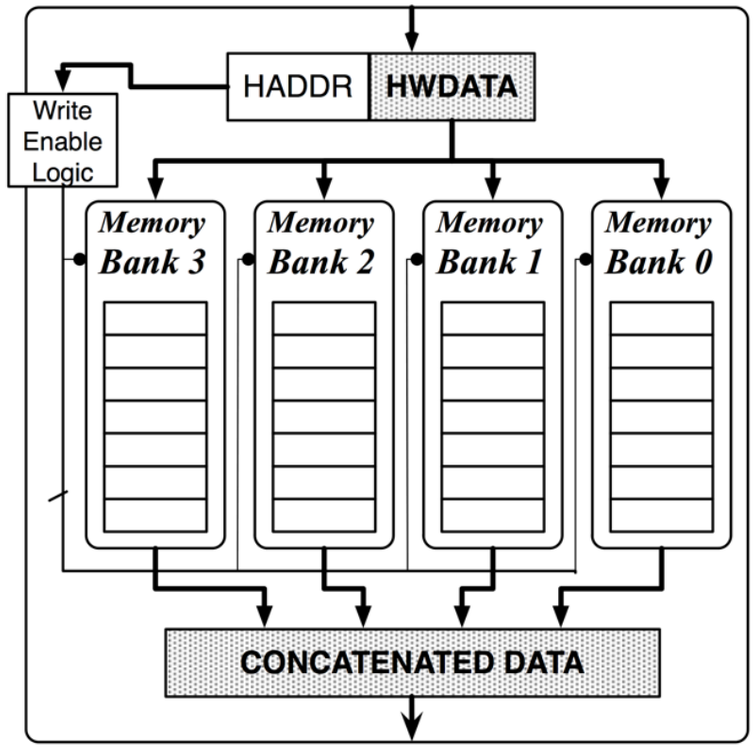


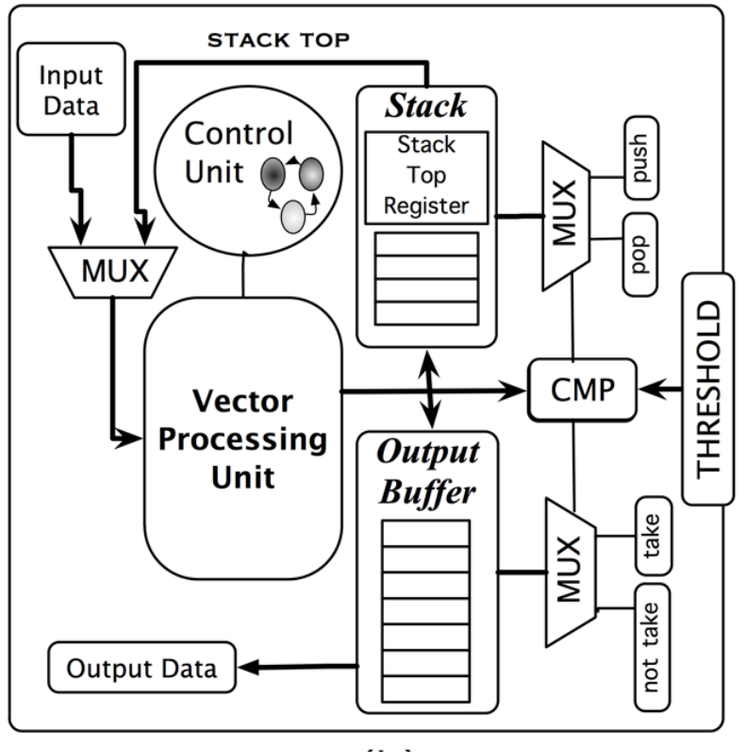


Hardware/Software integration is a big challenge because of the data transportation!!

Design Features to Overcome the Performance Degradation

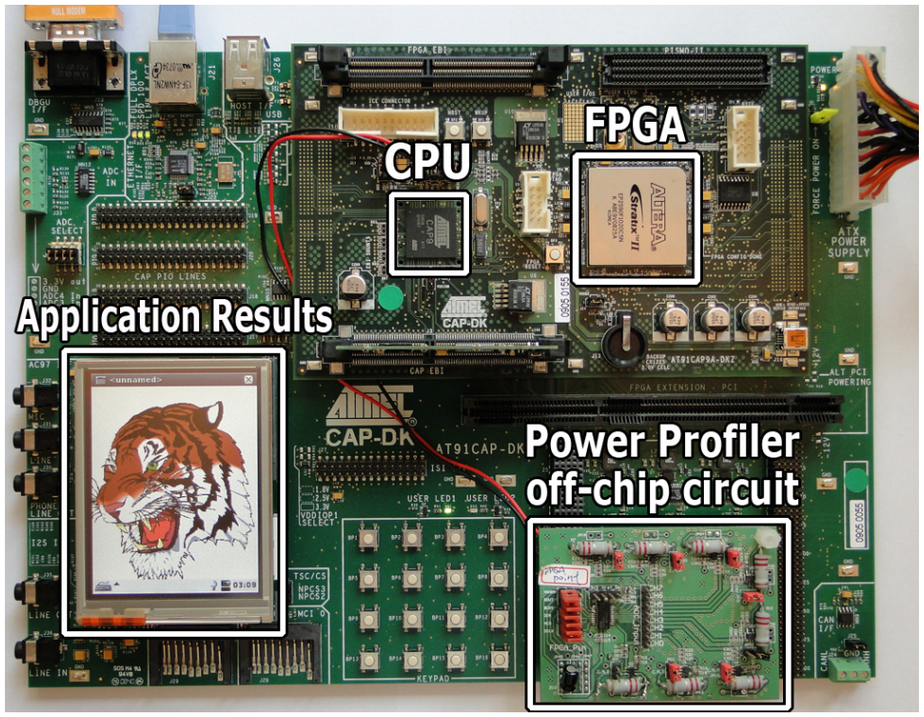
- **Multi-banked memory with write enable**
  - Efficient serial-to-parallel conversion
  - Support software I/O optimization
- **Stack-simulated recursion**
  - Adaptively generating points near high-curvature curves
- **Multi-core architecture**
  - Speedup single application
  - Increase multi-application throughput
- **Embedded power profiler**
  - Monitor system components
  - Software API allows dynamic power profiling and management

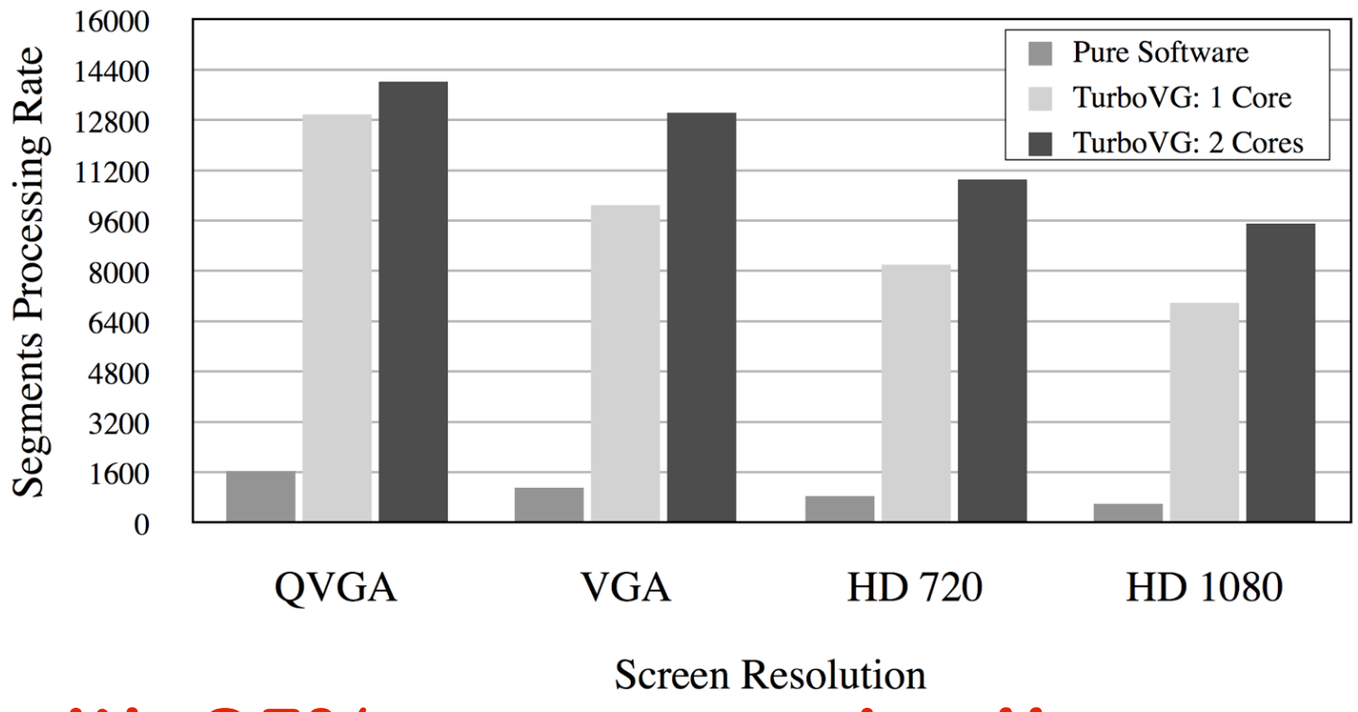




Experimental Results

- **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)**