PowerVR GPU Accelerated Augmented Reality

February 2012
Company Overview

- **Leading Semiconductor IP Supplier**
  - PowerVR™ graphics, video, display processing
  - Ensigma™ receivers and communications processors
  - Meta™ processors – SoC centric real-time, DSP, Linux
  - Licensees: Leading Semis and OEMs
    - Selection of POWERVR Graphics licensees on the left
  - #3 Silicon Design IP provider

- **Strategic product division: PURE**
  - PURE digital radio, internet connected audio
  - Leading deployment of Flow technology

- **Established technology powerhouse**
  - Founded in 1985
  - On London Stock Exchange since 1994
  - Employees: more than 1000 worldwide
  - >600m devices shipped
Augmented Reality and GPUs

- GPUs combined with Khronos APIs offer hardware acceleration opportunities for Augmented Reality (AR) applications:

  - **3D Rendering using OpenGL ES 1.1/2.0 APIs**
    - High quality 3D graphics rendering
    - Can then be blended into the real world camera capture

  - **Camera Image Texture Streaming using EGL/OpenGL ES**
    - Process camera images as textures
    - Enables seamless 3D & Reality integration with minimal CPU loading

  - **Camera Image Processing using OpenCL Embedded Profile**
    - Parallel compute highly efficient on GPUs
    - Perfect match for majority of AR Video Processing and Tracking Algorithms

- PowerVR SGX S5, SGX S5XT and S6 GPUs enable AR Hardware Acceleration
Video Texture Streaming for AR (1)

- Efficient integration of Camera images into the 3D rendering flow is essential for good performance and efficiency in AR Applications
  - Overlay – Simple combination using Alpha Blending in the Display Controller

- Critical to avoid CPU Copy and/or CPU based colour space conversions
- Overlay access mechanisms and functionality often platform specific
- Limited to basic AR processing – 3D blended on top of Reality
Efficient integration of Camera images into the 3D rendering flow is essential for good performance and efficiency in AR Applications.

- Texture Streaming – Advanced GPU based combination allows Processing & Distortions.

Critical to avoid CPU Copy and/or CPU based colour space conversions.

All PowerVR GPUs support Texture Streaming:
- Platform Specific Implementation exists e.g. Apple iOS
- Vendor Specific Implementations exist e.g. IMG_Texture_Stream Extensions since 2005
- Standardisation in progress e.g. Android EGL_Image_External
AR Video Streaming Examples
iPhone4S with PowerVR SGX543MP2

- String
  - Framed Image based Marker tracking and 3D Positioning
AR Video Streaming Examples
Sony PS Vita with PowerVR SGX543MP4+

- **Reality Fighters**
  - 3D Fighting game in your own living room
  - Complex interactions and distortions of the environment
AR Video Streaming Examples

- **Obvious Engine**
  - Natural Feature Tracking
  - Interaction between Camera Content and 3D Content – e.g. distortions, depth complexity
AR algorithms are highly parallel in nature and thus a perfect fit for the massive parallel compute capabilities of PowerVR GPUs

- Offloads the CPU for other tasks – from 100% down to 1 or 2% loading
- Higher performance for parallel algorithms – near 2x (304MHz GPU vs. 1GHz Dual CPU)
- Offers lower power consumption – almost 1 Watt less power consumed

GPGPU on PowerVR offers significant advantages over CPU based processing
**AR GPGPU Examples**

**Samsung GalaxyS – with PowerVR SGX540**

- **Feature tracking with Chan/Vese Active Contours**
  - Higher performance and lower power consumption than using ARM Cortex A9 CPU
GPU Accelerated AR Resources
Toolkits, Guidelines and Support Resource

- Many AR Toolkits and frameworks available today
  - Most are focussed on Apple iOS and/or Android

- Some useful AR links to check:
  - Obvious Engine - http://obviousengine.com/
  - String - http://www.poweredbystring.com/
  - Metaio - http://www.metaio.com/

- Need help with OpenGL ES for PowerVR enabled devices?
  - Visit www.khronos.org for API Specifications
  - Check www.powervrinsider.com for latest tools and guidelines
  - Contact pvrdevtech@imgtec.com for technical support

- Interested in GPGPU and OpenCL or want to see the demos running?
  - Visit our booth here at MWC - Stand in Hall 1 - 1D45
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