AVALON – Advanced Mixed Reality Technology at Your Fingertips

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The AVALON system is a high-performance Mixed Reality (MR) framework which utilize a unique flow-driven programming paradigm for application development. The MR system provides a comprehensive set of features to support classic Virtual Reality (VR) and advanced Augmented Reality (AR) equally well. It has been developed in close cooperation with the industry and supports various ISO/ECMA standards. It includes the latest research results in the fields of high realistic rendering, 3D user interaction and total-immersive display technology. The AVALON system includes the following features and benefits:

Application Modelling
The framework supports a novel data flow graph which allows the developer to create applications by modeling and not just programming. Any AVALON application consists of a number of graphs which are defined by components and relations between those components. Each component includes state parameter and a processing unit which controls the behavior of the component. The component complexity can scale from a single boolean operation to a complete application including geometry and simulation subparts. The processing unit of each component can be declared by a hidden subgraph, a script or a set of native compiled class.

The resulting architecture is extremely flexible and allows the developer to create complex applications by a simple drag and drop interface. The final application graph can be deployed in any supported runtime environment from a single PDA to a multi-screen/multi-node cluster unit.

Efficiency
The behavior modeling approach allows the developer to prototype and to develop new applications very efficiently without programming. The runtime environment analyzes and executes the component graphs by using a wider number of automatic online and offline optimization methods which allow the system to process large and complex component graphs (consisting of thousands of components and relations) and to

German Abstract

Das VR-System AVALON stellt ein plattform- und applikationsunabhängiges VR-System dar. Dabei orientiert sich die Semantik des VR-Systems an Standards in der 3-D-Computergraphik (z.B. X3D Standard). AVALON organisiert den Szenegraphen, kontrolliert VR-spezifische Ein- und Ausgabegeräte, unterstützt verschiedene Echtzeitsimulationen und PC-Cluster.

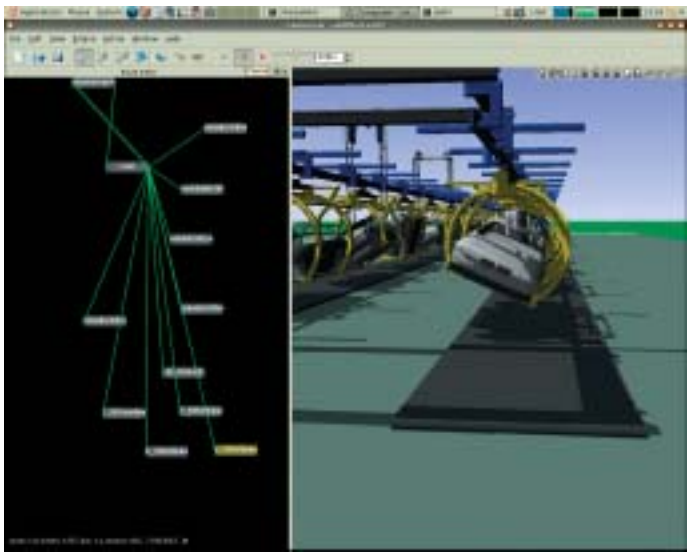

Figure 1: Controlling the AVALON application graph using »AVALON composer«.

visualize large datasets of polygons, points, NURBS and volumes efficiently. It utilizes the latest GPU hardware features to perform advanced real-time shading techniques, including real-time shadows.

Scalability
The framework includes various optimization methods to exploit all available hardware resources to reach global application specific runtime goals:

- Auto-Parallel/Multithread: The system analyzes the structure of the application graph in real time and uses a patented method to detect independent subgraphs and to execute them in parallel.
- Cluster: Different sort-first/sort-last algorithms balance the rendering load for every cluster node in real time. The method scales almost linear and is not fixed to the number of CPUs. The algorithm allows the increase in the overall cluster performance by increasing the number of render nodes.
- Multi-Resolution Datasets: The framework can create and manage multi-resolution datasets for points, meshes and volume datasets. This allows the system to control the overall render performance to reach global application goals like a minimal frame rate.

Interoperability
The middleware components of the framework provide system-specific synchronic and asynchronic high performance network interfaces to incorporate application data at runtime, for example from simulator packages. In addition, SOAP and HTTP interfaces provide very open and flexible ways to control and manipulate the running application, for example by building advanced user interfaces.

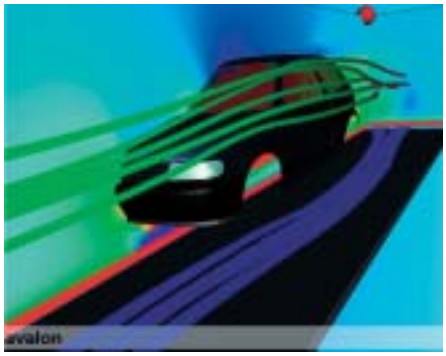

Figure 2: Real-time flow field with AVALON.

Figure 3: AVALON is used within the Virtual Human project for avatar simulation.

IO-Device Independence
A data stream-based IO declaration pyramid provides various levels of abstraction to control all device and data IO aspects of the application. The system provides sensor abstraction to access the low-level data streams directly, as well as high level device and device-class independent components to define very abstract interaction styles on parts of the application graph.

Computer Vision-based Tracker
The IO subsystem includes advanced image-processing functions which are utilized to provide marker and markerless tracking. These trackers represent the latest research results in the field of computer vision-based tracking for AR applications.

Completeness
The Framework provides a complete set of tools and plugins to ease the application development and deployment:

- Integration: Plugins for the most common DCC tools (like maya, 3DMax) enable the application developer to integrate 3D data very efficiently. Data importer for the framework can directly read and process the most common CAD data formats (JTOpen, Catia5, Catia4, Step and STL)
- Composing: Special runtime environments allow the developer to integrate and compose the data from different sources. The system includes various plugins to enable the developer to create any type of application logic and behavior by defining components, component relations and component processing units. A nifty event and script debugger eases the development process.
- Deployment: Various server and middleware systems can be utilized to deploy the final applications on a wide number of hardware platforms. The server and services communicate using standard ZeroConf mechanisms to ease the installation and service process.

Standard Conformance
The system design includes various industry standards to simplify the development and application service process:

- OpenGL 2.0 (Khronos Group)
- GLSL (Khronos Group)
- CG (Nvidia cooperation)
- X3D (ISO/IEC 19775:2004)
- ECMAScript (ISO/IEC 16262:2002)
- JAVA (Sun cooperation)
- SOAP (W3D SOAP V1.2)
- ZEROCONF (IETF Zeroconf Working Group)

Platform independence
All system components are available on a wide number of hardware and software platforms (Windows32, WindowsCE, Linux32, Linux64, OSX, IRIX, SunOS).

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