Design of a Component-Based Augmented Reality Framework

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Summary

• We think the time has come for augmented reality frameworks
• This will allow software components to be reused between different AR applications
• We have built and tested a first version of such a framework, called DWARF
Outline

• Advantages of an AR framework
• Necessary elements of an AR framework
• DWARF – architecture and components
• Demonstration system
Advantages– Project manager

• Components can be reused in different applications
• Components are “black boxes” for other components
• Distribute development in time and space
• Rapid prototyping of AR applications becomes feasible
Advantages– User

- Software is integrated with hardware in wearable or stationary *modules*
- System is reconfigured by re-plugging modules
Advantages– Application developer

- System consists of layered *services*
- *Application* is modeled by configuring services
Advantages– Module developer

- Modules are hardware with software services
- Services provide basic functionality, e.g. tracking
- Services have *needs* and *abilities*
Elements of an AR framework

• Services providing general functionality
  – General enough to reuse, yet also efficient

• Architecture to fit the services together
  – Generalization of many different AR systems

• Middleware to let services communicate
  – Must allow fast yet flexible communication
DWARF—Main services

- Distributed Wearable Augmented Reality Framework as test of framework concepts
- First DWARF services cover the basic functionalities for AR applications
  - World model, optical tracker, GPS/compass tracker, tracking manager, user interface engine, VRML viewer, HTML viewer, voice recognition, taskflow engine, context router
- Implementation of services uses well-established and third-party technology
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DWARF—Generic architecture

- Information
  - Taskflow Engine
- Application
  - Bootstrapping
  - Initialization
  - Glue Logic
- Services
  - Path Service
  - Context Router
  - Print Service
- User
  - UI Engine
  - Speech
  - VRML Display
- World
  - World Model
  - Tracking Mgr
  - Optical Tracker
  - GPS Tracker
  - Room Tracker
**DWARF—Middleware**

- To find each other spontaneously and communicate with one another, the DWARF services use CORBA-based Middleware
- This is distributed as local Service Managers on each hardware node to provide fault tolerance
Demo system– Navigation scenario

• Indoor and outdoor campus navigation system
• Wireless access to external services
• 2D maps, 3D maps and AR overlays
Demo system– Using the framework

• Nearly entire functionality is handled by the DWARF services
  – Navigation sequence, campus geography, multimodal I/O, printer location, outdoor tracking, indoor tracking, 3D rendering

• Application design is greatly simplified
  – Model campus and navigation in markup languages
  – Bootstrapping, glue logic

• Application implemented in three weeks’ time
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Demo system– Hardware

- Backpack system for demonstration of software
- Two laptops running Windows NT and 98
- Glasstron see-though HMD, FireWire Camera for Optical Tracking, commercial GPS receiver, Bluetooth / WaveLAN wireless communication
- Battery-powered, > 2 hours of operation
Conclusion

- The time has come for AR frameworks
  - Technology is becoming mature
  - Number of AR research groups is increasing
- We have investigated the feasibility of AR frameworks
  - Componentization is workable
  - Performance does not suffer from distribution
  - Rapid application development becomes possible
- We would like to encourage a discussion on framework components and technology.
Thank you

• Any questions?