Mobile Augmented Reality

Wouter Pasman

Crash Course:
What is Augmented Reality
Applications

Delft University Library
Architect: Mecanoo
980,000 Books

Prof. Jansen
Maintenance, assistance

Check min. reservoir level

OK

Low
Technical Challenges
Alignment error = Latency * Rotationspeed

For the applications targeted, 0.5° at 50°/s seems acceptable => 10ms.
Application databases

Network resources

Compute station

Base station

simplified scene

UbiCom

TU Delft
Delft University of Technology
Latency Layering

Limited resources on mobile, 250–400 polygons w. textures
Dynamic Simplification
NISHE

Augmented Reality with Large 3D Models on a PDA
Introduction

- AR with large models on PDA
Application area picked: supporting architects
VR is getting more popular for this. But modeling of environment is cumbersome

--> often modeled quickly with large grey blocks
AR is making its way

- hand work: placing building at right location, proper lighting, occlusion, ...
  - still picture

AR on PDA seems useful for such situations.
Architecture

Server
- RLC decode, Track markers, Render virtual objects
- Transparent bitmap of virtual objects
- Decode virtual objects & mask, Overlay with camera image

PDA
- Capture camera image
- Show result

PDAServer
- Transparent bitmap of virtual objects
Hardware:

PDA: iPaq H3800, Camera 640x240, display 240x320

206MHz StrongARM

Server: Dell Latitude, GeForce4 440 Go, 1.8GHz P4

Links tested: WLAN, USB, GPRS
Tracking

ARToolkit
Multimarking tracking: spanning large area with multiple Markers 76cm wide for tracking up to 10m distance

ARToolkit adaptations:
• using low resolution 320x240 bitmap
• bitmap from link, not from camera
• Disable rendering of camera
The Test Scene

Real scenes:
- outdoor parking place with snow, –20°C, bright enhanced with few 76cm markers
- Lobby at entrance of the first floor enhanced with 40cm marker or with smaller markers as needed

Virtual scenes: VRML
- Simple scene (flower) not filling screen
- Itäkeskus building, 60k polygons w. texture 60m wide, 15m high, more than screen filling
Compression Opportunities

1. Compressed B&W bitmap the camera image to the server
2. Video compress the overlay image to the PDA
3. Compressed Transparency mask to the PDA
• B&W bitmap the camera image to the server
• RGB to B/W: 24x compression
• RLE coding: using Elias Gamma code: 5x compression

Cam image size:

Original 320x240 : 230 kbyte
B/W : 9.6 kbyte
RLE coded : 1.9 kbyte
2. Video encode the overlay image to the PDA

Using Motion Vector Quantization (MVQ)
Commercial coder, developed at our VTT group

• Very light decoding:
  using motion vectors and lookup tables,
  not using DCT
  typically 50ms for full 320x240 image on PDA
• Large motion vectors up to 64 pixels,
  suits shaky cam movements and low frame rates
Optimizing MVQ Coding Modes
Optimization for Modem (4kb/frame) and Wavelan (30kb)

“Offline” = Best but 510ms/frame (10.8/15.3dB)
“Online” = Fast 160ms/frame but not so good (9.8/15.2dB)
Optimize for synthetic images with large smooth shaded areas
“Synthetic” = compromise, 200ms/frame (10.1/15.3dB)
3. Compressed Transparency mask to the PDA

- RLE coding: using Elias Gamma code: 
  now 9x compression (less noise than natural imgs)

320x240 mask compresses about 1 kbyte.
Some Performance results

Without optimizations, “offline” MVQ compression, half-screen object, USB1 : 0.28 fps

With optimizations, worst case full screen object using USB1 and “online” : 0.9 fps
using WLAN and “synthetic”: 1.25 fps
using GSM and “synthetic” : 0.2 fps

Much more details in the paper.
Usability

• WLAN 1fps good for architecture. GSM is bit slow but convenient and always ready for demo
• Architects appreciate on-site experience of presence
• Need for markerless tracking
• ARToolkit has some tracking problems with certain marker orientations
• iPaq screen bit dim, especially when sunny
• Our system can be run even on mobile phone now.
Videos

- AR on PDA “digitalo”. (1:30)
- AR “indoors” (1:10)
Conclusions

• AR with video mixing was implemented on PDA/Mobile Phone.

• For mobile AR with optical mixing and for gaming latency is more critical. For such situations the UbiCom approach still seems the way to go.