Technological challenges of Augmented Reality

W. Pasman
Overview

UbiCom: Mobile AR.

Video: Overview of UbiCom problems and solutions

UbiCom rendering QoS management

Video: Statue on Campus illustrating LL rendering

NISHE: mobile AR on PDA
Applications

Delft University Library
Architect: Mecanoo
980,000 Books

Prof. Jansen
Maintenance, assistance

Check min. reservoir level

OK

Low
Video: UbiCom AR
Dynamic Simplification

Dynamic LoD generation in backbone

Maximize perf/cost ratio in headset.
Mathematical model per object

- Estimate link and CPU load, memory usage, lifetime of objects, etc.
- Estimate screenspace error and geometric distortions.

$D = 0.001$

$R = 1m$
Scene Graph

Root

Transform

LOD

Transform

Group

[Diagram showing a scene graph with nodes and connections]
QoS: Scheduling of resources

Usual Goal: maximize benefit within a cost budget.
this problem is NP complete..
- Iterative approx giving in worst case half the maximum possible quality
- Quality only known after iteration
- Only feedback loop with application possible
Accuracy Curves

each node in scene graph is assigned an accuracy curve

- required resources as function of accuracy target
- monotonically increasing.

\( R \rightarrow \# \text{polygons} \)
Measurement of geometric distortion $d$ as function of number of polygons $n$

Accuracy $a = \frac{1}{d}$

Resource usage $r = K a + R_0$

$\Rightarrow$ piecewise linear function

$d \sim C/n$. 
Propagating accuracy curves

Leaf nodes: accuracy curve from (1) mathematical model or (2) measurements

Other nodes: propagate curve upwards through scenegraph
Statue on the campus

- Prototype implementation of all previous
- Very complex, implementation was simplified at several places (caching, prediction, etc)
Statue application

Tracker was not yet working -> tracker stub
NISHE project: AR on PDA
Implementation issues

ARToolkit
- track markers
- Estimate cam position
- make overlay

Backbone/Server
- RLE Decode
- RLE Encode
- MVQ Encode
- MVQ Decode
- RLE Encode
- RLE Decode

Mobile/Client
- Thresh hold
- camera
- display

get image
get transparency
get image
Speed tests

After lot of optimizations ...
800 ms per frame (WLAN)
5s per frame (GPRS)
1s per frame (USB)
Conclusions

Current handhelds no 3D accel
Semi-realtime (eg, architecture apps)
Not good for AR using HMD
3D accelerator needed for HMD AR
Realtime simplification and LL rendering for optical mixed AR (as in UbiCom) and for very complex scenes