

## Mobile 3D Maps

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## 3D Maps

- Direct visual representations of the environment
- Ptolemy AD150: *Chorography* requires artistic skill, to reproduce “even the most minute details” (geography = world cartography)
- Facilitate realism and details instead of abstraction
- Map data and its renderings are separate (“data” in artist’s mind)
- 3D ≠ 2D perspective (“2.5D”)



Detail from *Arahem, Theater of Cities*, 1654, Joan Blaeu

## 3D Maps - art

- Artistic 3D maps often emphasize the 3D characteristics – true realism not necessary
- Often used as a show case, not intended for on site navigation



H.C.Berann's 'panoramic maps'

## 3D Maps – scale models

- Navigation use on site: local orientation
- Special case: blind people can ‘feel’ the environment



Cambridge, U.K.

## Mobile 3D Maps – assumptions

### Hypothesis:

- Realistic more intuitive than abstract
- Interaction leads to better usefulness

### Potential:

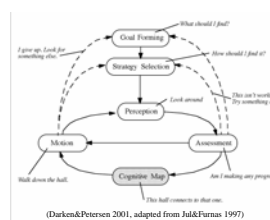
- A digital replica of the world
- Bidirectional gateway to content
- Near real time updated map data and content - life
- Piloting (navigation based on visual cues)
- Visual pinpointing of objects and positions

### Challenges:

- Pocketable - must function on mobile devices
- Runs on batteries
- Very limited resources



## Possible uses I: Pedestrian Navigation



- Navigation is not just route following (orientation, maneuvering, progress assessment, orientation assertion, cue extraction...)
  - Demanding for UI design
  - Controls of mobile devices limited

## Possible uses II: Gateway and Life



- 3D background for location based content
- Associate content to meaningful entities – not just (3D) coordinates
- Content can be anything – labels, messages, social, sensor based data
- Near real time updated content via cell networks

## 3D Maps – state-of-the-art



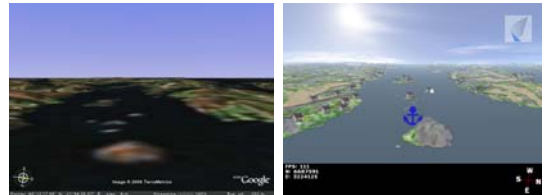
- Feature-rich but technically limited
  - Navitime: limited urban areas with low resolution details
  - Google Earth Mobile: only aerial photos (no 3D buildings)
  - NaviGenie: generic surfaces (not based on actual facades)
- User interfaces suited for route following – touch screens aid navigation
- Location based content still essentially 2D

## 3D Maps – open issues



- Which environments and users should a 3D map support?
- Is realism and accuracy possible on mobile devices?
- How accurate is enough?
- Is 3D intuitive and useful?

## Case 1: Archipelago, Navigation (Google Earth vs TKK)



- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• 10fps on old hw accelerated laptop</li> <li>• 320MB memory</li> <li>• inaccurate but real aerial photos</li> </ul> | <ul style="list-style-type: none"> <li>• 60fps on an old hw accelerated laptop</li> <li>• 32MB memory</li> <li>• quite accurate but generic details</li> </ul> |
|---|--|
- Ability to go up and down helps a lot! (still not directly in Google Earth)
  - 3D easier for new users than traditional sea charts
  - Keyboard+Mouse superior to simple buttons (desktop vs mobile)

Project TellMaris, EU IST FPS

## Case 2: Urban Environment, Navigation

### Performance

- 6-12fps on non-hw mobile platforms
- >30fps on hw platforms (Nokia N93, N95)
- Details from real buildings
- Detail scale 10-20cm
- Can view dozens of textured buildings
- Model download progressive, on-the-fly



### Results

- Not instantly intuitive, 3D maneuvering challenging!
- Navigation speed better on traditional maps (not tested with GPS)
- Piloting possible, traditional maps rely on annotation (street names)
- Accuracy situation dependent: users can move closer for better look
- Inconsistencies in near realistic 3D models not acceptable

Project m-LOMA, EU InterregIIIA

## Case 3: Indoor cleaning robot management

- Remote state observation and robot swarm management
- Requirement: Dynamic state updates
- Accurate details (<2cm)
- Performance: >30fps on 3D mobile devices
- Critical problem: indoor positioning insufficient – WLAN tracking fails (~2-5m error visually not tolerable)
- No navigation tests – verbal feedback “wow”

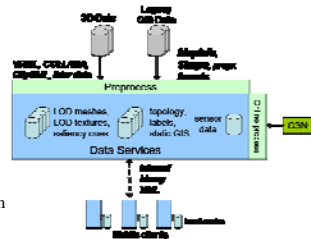


Project Roboswarm, EU IST FPS

## Lessons learned – mobile howto

### Optimize data and processing

- Static data pre-processed and placed to databases
- In 3D rendering, show only visible surfaces, with suitable level-of-detail
- Store and transmit geometry and textures in compact, hw compatible form
- External streamed data processed online and forwarded immediately in binary form
- Avoid inefficiency (Java, web, XML...)
- Don't trust on future miracles (mobile fusion reactors)



## Lessons learned

- Technically mobile 3D maps are reality
- Efficient implementation (C or C++, OpenGL ES) can exploit characteristics of the environment
- 3G Cell networks sufficient for both model download and content updates (near real time tracking)
- 3D navigation still cumbersome, hopes in touch screens and gesture sensor technologies
- Direct navigation speed comparison between 2D/3D too simplistic for measuring 'goodness'
- High veridicality needed, but minimum detail accuracy still uncertain (10cm quite ok) – emphasis on cues more important
- Lot of practical problems: 3D models, data models, data formats, content...
- Are 3D maps any good? Yes, but need more trials...!

## Work continues...

Hydrosys (EU)

<http://www.hydrosysonline.eu>

3D WIKI (SA)

<http://foto.hut.fi/instituutti/projektit/3dwiki>



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