An Open-Source Web Architecture for Adaptive Location-Based Services

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Outline

1. Motivations
2. Background
3. Approach
4. Prototype
5. Future Work
Motivations

Information Overload is a common problem in many domains

- News saturation
- Too many Google search results
- Media advertising saturation
- Too many research papers to read
- Too many points of interest on a map

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Motivations

Reduce Geospatial Information Overload

All hotels in Paris

Personalised set of hotels in Paris
• **Implicitly** monitor interactions with the map interface and combine this with context information to build a reliable user profile.

• Update the profile **dynamically** as user interests alter.

• **Personalise** and **adapt** map content depending on the user profile and current context.
Background

User Interactions
• Record User Actions Implicitly
  – Interaction Interest Indicators:
    ➢ Mouse Clicks
    ➢ Mouse Movements
    ➢ Zooming
    ➢ Panning
    ➢ Tool Usage
    ➢ Direction

User Context
Record User Context Implicitly
• Monitor user position
• User Context
  ➢ Time
  ➢ Location (GPS)
  ➢ Device
  ➢ Speed
Background

- **RecoMap**
  - Stand-alone desktop application
  - Based on OpenMap™ framework (by BBN Technologies)
  - User friendly, stable & tested

![OpenMap™](image)

- **Limitations**
  - Difficult to run it on mobile devices
  - Mature technology
  - Not true LBS

Solution: Personalisation on Mobile Devices
How? : Web Platform
Background

Advances in Mobile technologies

- Faster processors
- Larger screens
- Sensors now common
- 3G network connectivity
- Wi-Fi connectivity

Web Enabled

Benefits of Web-based Approach

- Cross platform
- Independent Component Architecture
- Interoperability issues removed
- Wide adoption of W3C standards
- AJAX/Javascript
- Complex Web interfaces
Approach

Client/Server architecture
- Client: query and display maps
- Server: compute complex algorithms
- Enable load balancing

Open-source Spatial Technologies
- Increasing quality of software
- Often maintained and supported by companies
- Active online communities
Architecture

Client Tier
- Handles user interaction with system
- Monitors user interactions
  - Mouse clicks
  - Mouse movement
- Non-map content
- Visualises the web pages
  - Maps
  - Any web browser
  - Multiple devices
Architecture

**Middle Tier**
- Provides the functionality of the system
  - Hosts the web server pages
- Contains the personalisation service
  - Tracks sessions
  - Logs interactions/location
- Generates & Maintains user profiles
- Renders the map
  - According to configuration files
- Utilises map servers
  - Standard format for spatial info.
Architecture

Data Sources

- Provides spatial information
  - DBMS
  - Vector maps
  - User data (profiles)
  - External datasets
- Provides access to 3rd party services
  - Routing
  - Geo-coding
Web-Based Prototype Interface
Web-Based Prototype Interface

Recording User Interaction And Behaviour

• Mouse Movements
• Mouse Clicks
• On and Off Map
Mobile Prototype Interface

iPhone Look and Feel
Mobile Prototype Interface

iPhone Look and Feel
Mobile Prototype Interface
Mobile Prototype Interface

14th International Symposium on Spatial Data Handling
Hong Kong - May 2010
Mobile Prototype Interface

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Ongoing and Future Work

- New interaction paradigms
  - Touch screen devices
  - Mouse no longer rests on the screen
- Map Logger / mobile connectivity slow and intermittent
  - Client-side Caching strategy
  - Heuristics to minimise client/server communication
- Improve analysis of Spatial Implicit Feedback
  - Include other interest indicators (mouse movements, map actions, etc)
  - Incorporation of Visual analysis for identification of behavioural patterns.
- Evaluation: large study on different devices
Thank You!

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Architecture

Personalisation Algorithm

- Assign a score for individual map objects

\[
\text{ObjectScore} = \text{ObjectScore} + (\text{InteractionScore} \cdot \text{InteractionRatio}) + (\text{ProximityScore} \cdot \text{ProximityRatio})
\]