TrailMap: Facilitating Information Seeking in a Multi-Scale Digital Map via Implicit Bookmarking

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Travel to Paris: Love or Hate?

👍 Explore cultural neighborhoods
👍 Taste local delicious
👍 Visit various places of attractions
👍 …

👎 Need a lot of searching
👎 Demand careful planning
👎 Process and compare large amount of information
👎 Browse unfamiliar geographical regions
👎 …
Dining out in Paris

1. Le Jules Verne
   Category: French
   ★★★★★ 63 reviews

2. Verjus
   Categories: Wine Bars, Modern European
   ★★★★★ 26 reviews

3. Le Basilic
   Category: French
   ★★★★★ 18 reviews

4. Restaurant Guy Savoy
   Categories: Modern European, French
   ★★★★★ 33 reviews

5. L'Arpège
   Category: French
   ★★★★★ 19 reviews

6. Pain Vin Fromages
   Categories: French, Fondue
   ★★★★★ 26 reviews

Search “restaurant” on Yelp
Revisitations in Multi-Scale Maps

- Explicit bookmarking: *disadvantages*
  - Additional cognitive burden
  - Interrupt the interaction flow
  - Require users to anticipate the revisitation

- Implicit bookmarking: *challenges*
  - Continuous information space
  - Heterogeneous interactions in a multi-scale 2D navigation
  - Dynamic meta-information content

Develop an implicit bookmark generation *algorithm* and a web app prototype called *TrailMap* for multi-scale digital map navigation
Welcome to Toronto: Demo
User Interaction Model

Time

- Search
- Zoom
- Pan
- Pause
User Interaction Model

Time

- Search
- Zoom
- Pan
- Pause

Search Block
Implicit Bookmark Generation

Searches
Implicit Bookmark Generation

Long Distance Pans or Zooms
Implicit Bookmark Generation

Long Time Dwells
Implicit Bookmark Generation

- Search
- Zoom
- Pan
- Pause

Search Block
Algorithm Diagram

Interaction type?

Zoom

Zoom-start

Yes

Longer zoom-
zoom / pan-zoom
dwell?

No

Zoom-end

Longer zoom?

Yes

Event?

Search

Pan-end

Yes

Longer pan?

Yes

Pan-start

Longer pan-
pan / zoom-
pan dwell?

No

Generate a bookmark

Remove nearby bookmarks

End?

Yes

No

No
Evaluation

○ Participants
  • 4 females and 7 males: aged 20-31, from different academic backgrounds
  • Use of existing online map applications: 6-10 times/week and 5-10 minutes/session

○ Apparatus
  • Personal desktops/laptops via IE, Chrome, Firefox, Safari
  • A Windows IIS server for hosting TrailMap

○ Procedure and Design
  • Pre-study tutorial
  • One week deployment study
  • Post-study questionnaires and interviews
Quantitative Results

Frequency

Frequency

Participant

Time (min)

Search
Pan
Zoom
Implicit Bookmark
Select Bookmark
Select Circular Pin
## Qualitative Results

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Overall I was satisfied with the design of this application.</td>
<td>7.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Q2. The interface of visiting and manipulating bookmarks was easy to use and intuitive.</td>
<td>8.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Q3. The interface of exploring search results (e.g. fading-out labels) on the map was helpful.</td>
<td>8.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Q4. The automatically generated bookmarks were helpful in map exploration and search tasks.</td>
<td>8.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Q5. The functions of logically revisiting multiple bookmarks were helpful.</td>
<td>8.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Q6. I’d like to have a plugin of auto-bookmarking functions with the existing online map applications.</td>
<td>8.9</td>
<td>1.3</td>
</tr>
</tbody>
</table>

1-10 Likert Scale (Strongly-disagree to Strongly-agree)
Future Work

- Develop smarter bookmark generation algorithms using machine learning and natural language processing
- Support importing, exporting, and sharing of implicit bookmarks
- Extend to other devices including mobile phones and tablets
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