A Time-Location-Based Itinerary Visualization

Florian Haag¹, Thomas Schlegel², Thomas Ertl¹

¹Institute for Visualization and Interactive Systems, University of Stuttgart
{Florian.Haag, Thomas.Ertl}@vis.uni-stuttgart.de

²Junior Professorship Software Engineering of Ubiquitous Systems,
Technische Universität Dresden
Thomas.Schlegel@tu-dresden.de

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Motivation

Itinerary Search

- System can provide some information
- Travelers have their own information
  - may know places
  - may access different data sources
  - ...

...
Motivation

Required knowledge:
Where are the stopovers?
How much time is available at each of them?
Motivation

Required knowledge:

- Where are the stopovers?
- How much time is available at each of them?
Motivation

Which are the mutual stopovers?
How much overlapping time is available there?
Motivation

Same location, but do the stopovers actually overlap?

Required knowledge:
- Which are the mutual stopovers?
- How much overlapping time is available there?
## Current Approaches

### Tabular

<table>
<thead>
<tr>
<th>Itinerary 1</th>
<th>Arrival</th>
<th>Departure</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>09:24</td>
<td></td>
<td>Central Station</td>
</tr>
<tr>
<td></td>
<td>U27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>09:31</td>
<td>09:36</td>
<td>Alice Street</td>
</tr>
<tr>
<td></td>
<td>U44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>09:48</td>
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<td>Charles Corner</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Itinerary 2</th>
<th>Arrival</th>
<th>Departure</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
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<td>09:29</td>
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<td>Central Station</td>
</tr>
<tr>
<td></td>
<td>U12</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>09:34</td>
<td>09:40</td>
<td>Bob Alley</td>
</tr>
<tr>
<td></td>
<td>U09</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>09:57</td>
<td></td>
<td>Charles Corner</td>
</tr>
</tbody>
</table>

- complete information
- requires much space
- no direct visual comparison
Current Approaches

Timelines

- clear temporal information
- only implicit information about routes
- no visual comparison of matching stopovers
Current Approaches

Route Graph

- different routes are obvious (are they?)
- additional information (stopover durations) can be indicated
- issues:
  - same route, different times?
  - same stopover, overlapping, but slightly different times?
- map overlay possible (but then even less space for temporal information)
Current Approaches

Matrix View (Keller et al., 2011)

- used/unused types of transportation
- total walking distance
- accessibility
- number of changes
- departure time
- etc.

one itinerary
Current Approaches

Spatiotemporal Concepts

Space-Time-Chart

Separate spatial and temporal displays

Space-Time-Cube
Time-Location-Based Approach

Goals

Create an itinerary visualization that allows to ... 
- ... be aware of stopover locations 
- ... be aware of stopover durations 
- ... compare stopover locations across itineraries 
- ... compare arrival and departure times across itineraries 
- ... display various itineraries in a space-efficient manner 

Additional information about transportation lines and walking distances is desirable!
Basic Layout

Logical Locations

<table>
<thead>
<tr>
<th>Itineraries</th>
</tr>
</thead>
<tbody>
<tr>
<td>itinerary 1</td>
</tr>
<tr>
<td>location 1</td>
</tr>
<tr>
<td>location 2</td>
</tr>
<tr>
<td>location 3</td>
</tr>
<tr>
<td>...</td>
</tr>
</tbody>
</table>
Cell Layout

Only applies to “relevant” (with a stopover) cells!

order of stopover in itinerary

time axis

09:18
arrival

09:34
departure

color for first transportation line

color for second transportation line
Cell Layout

Only applies to “relevant” (with a stopover) cells!

order of stopover in itinerary

walking time

arrival

departure

walking distance

90m

- color for first transportation line
- color for second transportation line
Time-Location-Based Approach

Complete View

10:02
10:19
10:32
10:54
12:02
12:24
Time-Location-Based Approach

Exemplary Itineraries

<table>
<thead>
<tr>
<th>Itinerary 1</th>
<th>Itinerary 2</th>
<th>Itinerary 3</th>
<th>Itinerary 4</th>
<th>Itinerary 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hedelfingen</td>
<td>09:44</td>
<td>10:14</td>
<td>10:44</td>
<td>11:14</td>
</tr>
<tr>
<td>Central Station</td>
<td>10:19</td>
<td>10:45</td>
<td>11:19</td>
<td>11:45</td>
</tr>
<tr>
<td>Bietigheim-Bissingen</td>
<td>11:08</td>
<td>12:02</td>
<td>12:08</td>
<td></td>
</tr>
<tr>
<td>Ellental</td>
<td>10:37</td>
<td>11:10</td>
<td>11:40</td>
<td>12:10</td>
</tr>
</tbody>
</table>

University of Stuttgart
Germany
Time-Location-Based Approach

Order of Locations

- Workplace: Itinerary 1: 16:12, Itinerary 2: 16:20
- Bookstore: Itinerary 1: 16:58, Itinerary 2: 17:18
- Electronics Store: Itinerary 1: 17:08, Itinerary 2: 17:03, 16:30
Evaluation

- 11 participants
  - frequent users of public transportation in Dresden
- 4 tasks
  - comparison with timeline visualization (Öffi): departure, arrival, number of routes, etc.
  - available time and walking distance
  - identify order
  - find meeting opportunity

The study used real data from the transportation network of Stuttgart.
## Evaluation

### Results

- correctness of answers varied
- origin/destination not obvious
- number of routes can be recognized
- walking time/distance redundant?
- reordering liked; connection lines “necessary, but confusing”

<table>
<thead>
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<td>0</td>
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<td></td>
<td></td>
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<td>13</td>
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</tr>
<tr>
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<td>1</td>
<td>1</td>
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<tr>
<td></td>
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<tr>
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<td>2</td>
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<td>3</td>
<td>3</td>
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<td></td>
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<td>33</td>
<td>12</td>
<td>5</td>
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<td>12</td>
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<td>9</td>
<td>4</td>
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<td>10</td>
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<tr>
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<td>tl</td>
<td>33</td>
<td>5</td>
<td>4</td>
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<td>33</td>
<td>6</td>
<td>3</td>
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<td>meeting</td>
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<td>1</td>
<td>1</td>
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</tbody>
</table>
Conclusions and Future Work

- Current itinerary visualizations are problematic for planning stopovers.
- We propose a time-location-based itinerary visualization.
- Small user study suggests that some visual elements need to be clarified.
- Visualization might be useful for other event-related information.

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Order of Locations II

![Diagram of travel connections between locations]

- **Hedelfingen, Stuttgart**:
  - Verbindung 1: 09:44, 09:44
  - Verbindung 2: 10:14, 10:14
  - Verbindung 3: 10:44, 11:44
  - Verbindung 4: 11:14, 11:14
  - Verbindung 5: 11:44

- **Hauptbahnhof**:
  - 10:02
  - 10:19
  - 10:32
  - 10:45
  - 11:19
  - 11:32
  - 12:02
  - 12:19

- **Bietigheim-Bissingen**:
  - 11:02
  - 11:08
  - 12:02
  - 12:08

- **Ellental**:
  - 10:37
  - 10:38
  - 11:10
  - 11:11
  - 11:40
  - 11:41
  - 12:10
  - 12:11
  - 12:37
  - 12:38

110m
Order of Locations III