Manage the Data from Indoor Spaces: Models, Indexes & Query Processing

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Overview

1. Outlines
2. Indoor Space Models & Applications
3. Indoor Data Cleansing
4. Indoor Movement Analysis
5. Appendix

Aims

- To give a brief review introduction to *indoor data management techniques*.
- To review a series of works in this field, including their proposed *models*, *indexes* and *algorithms*.
- To discuss how to bring those advanced theoretical contents into practice.

About This Work...

Scalable Continuous Range Monitoring of Moving Objects in Symbolic Indoor Space. [3]
B. Yang, H. Lu, and C. S. Jensen.

- Published in *CIKM' 2009*.
- Application: continuously monitor indoor moving objects for space use analysis or security purposes.
- An incremental, query-aware continuous range query processing technique for objects moving in indoor space.
- Use maxmum-speed constraint on object movement to refine the uncertain results.

Motivation

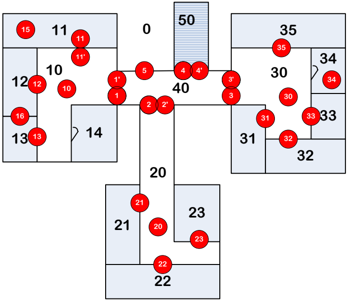
- People spend much time in indoor spaces.
- Indoor spaces are becoming increasingly larger and complex.
  - E.g., London Underground, 268 stations, 408 kilometers of network, +4 million daily passegers.
- Indoor monitoring of people can help support.
  - space use analysis
  - security purposes

Preliminaries: Indoors vs. Outdoors

- Modeling of indoor spaces do not assume
  - Euclidean space. (since obstacles render movement more constrained)
  - Spatial network. (since indoor movement is less constrained than movements in polylines)
- Instead indoor spaces are characterized by entities.
  - Doors, rooms, hallways, staircase, etc.
- **Symbolic models** are more suitable.
- *GPS* and *cellular tracking* do not work indoors.
- Sensing devices are used to detect objects within their activation range, e.g., RFID readers or Bluetooth hotspots.

Positioning Devices Deployment Graph

- Two types of positioning devices
  - Partitioning Device – *undirected* (**UP**), e.g., d_{21} – *directed* (**DP**), e.g., d_{11} and $d_{11'}$
  - Presence Device – (**PR**)
- Note an indoor space is partitioned into *activation ranges* and *cells*



Deployment Graph

- $G = \{C, E, \Sigma_{devices}, l_E\}$
- C: the set of cells
- E: the set of edges, $\{c_i, c_j\}$ where $c_i, c_j \in C$
- $\Sigma_{devices}$: a mapping from $deviceID$ to activation range and type
- l_E maps an edge to a set of positioning devices, i.e., $E \rightarrow 2^{\Sigma_{devices}}$

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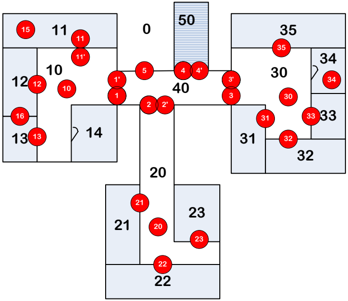

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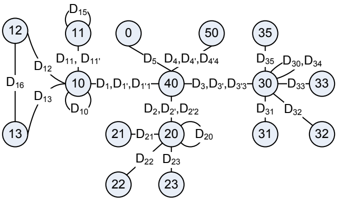

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The End. Thanks :)