Parking Navigation for Alleviating Congestion in Multilevel Parking Facility

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Background

- Large crowded parking facility
  - Difficult to find a vacant parking space
  - Long waiting time
  - Make customer uncomfortable
  - Opportunity loss for store
- The requirements of parking navigation
  - Shorten parking waiting time
  - Low deployment cost
  - Selfish driver tolerable

Proposal

- Target
  Provide parking route with the shortest waiting time
- Assumption
  - Parking map is available for cars
  - Wireless LAN AP deployed in each zone
  - A central server
  - Some cars equipped with car navigation system and WLAN device
  - Sense car’s position by fingerprinting technology
- System Architecture
  1. Server Part
     - Sense occupancy information and estimate parking probability
     - Announce the information periodically
  2. Vehicle Part
     - Calculate parking route that has the minimum expected waiting time

Evaluation

- Target
  - To confirm the proposed method’s performance on shortening waiting time

Benchmark methods
- Random
  Select target zone randomly
- Billboard
  Go to the zone which is announced to be empty
- Greedy
  50%: Select favor zones one by one
  50%: Select target zone randomly

- Estimate parking probability at server part
  - Parking probability → parked cars/arrived cars in past 30 minutes

- Calculate recommended parking route at vehicle part
  - Moving time → Derived from parking map
  - Every car calculates all paths’ expected waiting time
  - Provide a route from the top 3 results to driver

- In this example, Route length = 4

<table>
<thead>
<tr>
<th>Method</th>
<th>Avg. time(s)</th>
<th>Max. time (s)</th>
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</thead>
<tbody>
<tr>
<td>Random</td>
<td>121.4</td>
<td>1184.0</td>
</tr>
<tr>
<td>Billboard</td>
<td>109.4</td>
<td>997.0</td>
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<tr>
<td>Greedy</td>
<td>244.1</td>
<td>3967.0</td>
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<tr>
<td>Proposal</td>
<td>96.1</td>
<td>219.0</td>
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</tbody>
</table>

Reduced waiting time by 10-70%

- We used parking facility map and trace data of a real shopping mall