Navigating Users Based on Estimation of Interest Vectors with Utility Function

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Contents

1. Introduction
   • Connections in large-scale trade shows
   • Research purpose
2. Personal navigation system
3. Utility-based booth recommendation
4. Implementation
5. Conclusion
Introduction

• **Large-scale trade shows**
  – Booths are set up and an attendee visits them if their contents are interesting for him.
  – Example: International CES 2007
    140,000 attendees and 1,200 booths

• **two kinds of connections dependent on each attendee’s interest.**
  – Connection between an attendee and a booth
  – Connection between booth and other booths

[1] [http://www.flickr.com/photos/21045961@N03/2050069557/in/set-72157603247489302/](http://www.flickr.com/photos/21045961@N03/2050069557/in/set-72157603247489302/)
  (uploaded by International CES, 2007)
Connections between an attendee and a booth

- **Connection**: visiting each interesting booth
- **Required for establishment**: knowing which booths are interesting
- Each attendee cannot get the information of all booths (large number of booths, vast show floors). → **Not always established**

Interested in mobile devices

Booth A

Mobile phone
Connection between a booth and other booths

- **Connection**: visiting other booths of research fields relevant to an interesting booth
- **Requirement for establishment**: knowing similarity of research fields of booths’ contents
- Each attendee cannot get the information of all booths. → Not always established

I want to see other booths about mobile technologies…

Booth A
- Mobile phone

Booth B
- PDA

Booth C
- Mobile application

Similar research fields of contents

→ Not always established
Our purpose

• **Problem:** large-scaleness prevents establishment of the connections

• **Requirement:** provide the information of booths to each attendee according to his interest

• **Proposition:** A personal navigation system in large-scale trade shows through an RFID system
Contents

1. Introduction
   • Connections in large-scale trade shows
   • Objective of our research

2. Personal navigation system

3. Utility-based booth recommendation

4. Implementation

5. Conclusion
Characteristic vector

- **Characteristic vector:** represents the degree of association for each research field of a booth’s content
  - Example: a mobile phone with a screen by the organic electroluminescence technology

```
[software development  organic electroluminescence  ubiquitous computers] = [0.1, 0.9, 0.5]
```
Satisfaction level

• It is possible that an attendee is not satisfied with the content of a booth even if he visit it.

• **Satisfaction level**: represents the degree of satisfaction for each booth’s content.
System overview

- RFID tag
- Booth A
- Booth B
- Booth C
- History of visited booths
- Characteristic vectors
- Satisfaction levels
- Mobile device with RFID reader
System overview

- The attendee visits a booth if it is interesting.
- After he watched its content,
  - read the RFID tag, and
  - input the satisfaction level to his mobile device.
System overview

- The attendee visits a booth if it is interesting.
- After he watched its content,
  - read the RFID tag, and
  - input the satisfaction level to his mobile device.

![Diagram showing booth visits and RFID tags](image)

- History of visited booths
- Characteristic vectors
- Satisfaction levels
- Mobile device with RFID reader
System overview

- The mobile device
  - Estimates his interest,
  - Chooses a certain number of booths from unvisited ones according to his interest, and
  - Recommends the chosen booths with a map and predicted satisfaction levels.
Features

– Estimates user interest from the history of visiting booths
– Recommends unvisited interesting booths with a quantitative bases
– Allows each user to select a recommended booth at choice (location vs. quantitative bases)
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5. Conclusion
Utility function

- Utility function
  - Represents user interest: satisfaction level for each booth
  - mapping from scalars to satisfaction levels
    - Easy data processing
    - Requires reduction from characteristic vectors to scalars
- Finding a utility function enables prediction of the satisfaction level of any unvisited booths with known characteristic vectors.

Characteristic vectors → scalars corresponding to characteristic vectors → Satisfaction levels
booth recommendation overview

History of visited booths

Booth D:
Characteristic vector = [1.0, 0.4, 0.8]
Satisfaction level = 5

Booth B:
Characteristic vector = [0.2, 0.0, 0.6]
Satisfaction level = 2

Reduced history

Booth D:
Score = 2.0
Satisfaction level = 5

Booth B:
Score = 4.1
Satisfaction level = 2

History reduction by PCA

Estimation of a utility function

Recommendation ranking

1. Booth X
Satisfaction level = 4.5

2. Booth Y
Satisfaction level = 3.0

3. Booth P
Satisfaction level = 2.9

Utility function

 Ranking booths & recommendation

score
History reduction by PCA

• Reduction by Principle Component Analysis (PCA)
  – A useful tool to represent multivariate data as single-variable
data with few loss of information
• Each characteristic vector are reduced into its principle component score (called score).

![Diagram](image-url)
Estimation of utility function

• Identify a utility function
  – Example 1: curve fitting by the regression analysis
    • Degree n polynomial
  – Example 2: curve fitting by the curve interpolation
    • Bezier curve

<table>
<thead>
<tr>
<th>Reduced history</th>
<th>Utility function</th>
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<tr>
<td><strong>Booth D:</strong></td>
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<tr>
<td>Scalar = 2.0</td>
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<td><strong>Booth B:</strong></td>
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<tr>
<td>Scalar = 4.1</td>
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<tr>
<td>Satisfaction level = 2</td>
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Ranking unvisited booths

- Calculate each unvisited booth’s score and its satisfaction level
- Rank unvisited booths in decreasing order of satisfaction levels
- Recommend a certain number of booths with the highest satisfaction levels

![Utility function and recommendation ranking]

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Recommended
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1. Introduction
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3. Utility-based booth recommendation
4. Implementation
5. Conclusion & future work
Implementation

- HP IPAQ hx2490b
- C# application on Microsoft Windows Mobile 5.0

- 5 satisfaction levels by a questionnaire
- Utility function: curve fitting of degree 2 polynomial
Implementation

Screen of the mobile device

Questionnaire for inputting satisfaction levels

Booth recommendation
experiment

- Newspaper articles instead of booths
  - 10-dimensional characteristic vectors
- 5 satisfaction levels by a questionnaire
- Utility function: curve fitting of degree 2 polynomial
experiment
Conclusion

• A map-based personal navigation system for large-scale trade shows
  – Estimates an attendee’s interest based on utility function
  – Recommends booths with a map and predicted satisfaction level

• Future work
  – Complete implementation
  – Evaluation through experiments