Presentation of “Next generation navigation: the importance of context and quality”

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Additional Information:

- This is a copy of a presentation given at Transport Location and Route Guidance Seminar, Coventry 2002.

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Next generation navigation: the importance of context and quality

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The REGIONAL Project

- UK government funding
- LINK IST Programme
- 1999 – 2002
- Vehicle navigation
- Incorporating landmarks
- Database and HMI
Why should systems include landmarks?

- Landmarks are commonly used in current way-finding strategies

- Vehicle Navigation systems that utilise landmarks have been shown to improve:
  - safety
  - acceptability
  - effectiveness
Research rationale

Choose

- i.e. What landmarks to use

Use

- i.e. When to use them

Present

- i.e. How to display them

Advice to industry
Industry Requirements

For database development
• strong business case
• multiple potential uses
• available, accessible, accurate, easily maintainable data
• avoid field visits

For navigation system software
• ‘rules’ for use of landmarks
• ‘proof’ that any approach is the optimum.
• landmarks considered within the ‘big picture’
Study 1 – Context of use

• 36 subjects wrote directions to navigate 3 routes
  – Video of route
  – Cognitive map

• Written directions coded

• Sources of navigation information identified

• Context of use identified
Use of general navigation information

The chart illustrates the frequency counts of different general information categories used by subjects in a navigation task. The categories include:

- Direction sign (nav)
- Direction sign (object)
- Distance
- Environment
- Junction description
- Junction name/number
- Landmark
- Lane change
- Node geometry
- Path geometry
- Road marking
- Road type
- Street name/number
- Time

The frequency counts are represented by bars, with different colors indicating different sources of information:

- All subs (red)
- Cognitive map (blue)
- Video (yellow)

The x-axis represents the general info category, while the y-axis indicates the frequency counts.
Use within the navigation task

![Graph showing frequency counts for various general information categories.]

- Frequency counts are displayed for different categories such as Direction sign, Distance, Environment, Junction description, Junction name/number, Landmark, Lane change, Node geometry, Path geometry, Road marking, Road type, Street name/number, and Time.
- The graph indicates the number of occurrences for each category, with categories like Direction sign (nav) and Direction sign (object) having significant frequency counts.
Information: main or secondary

Frequency counts

General info category

- Direction sign (nav)
- Direction sign (object)
- Distance
- Environment
- Junction description
- Junction name/number
- Landmark
- Lane change
- Node geometry
- Path geometry
- Road marking
- Road type
- Street name/number
- Time

Legend:
- all information
- main
- secondary
Information used at Manoeuvre 1
Information used at Manoeuvre 9

Frequency counts

General info category

- Direction sign (nav)
- Direction sign (object)
- Distance
- Environment
- Junction description
- Junction name/number
- Landmark
- Lane change
- Node geometry
- Path geometry
- Road marking
- Road type
- Street name/number
- Time

Categories:
- all subs
- cognitive map
- video
Information used at Manoeuvre 26

![Frequency counts chart](image)

- **General info category**
  - Direction sign (nav)
  - Direction sign (object)
  - Distance
  - Environment
  - Junction description
  - Junction name/number
  - Landmark
  - Lane change
  - Node geometry
  - Path geometry
  - Road marking
  - Road type
  - Street name/number
  - Time

- **Frequency counts**
  - All subs
  - Cognitive map
  - Video
Predicting Landmark Value (V)

\[ V = (0.340) \text{DEGOFINT} + (0.255) \text{USEOFLOC} + (0.134) \text{VISCAR} \]

Where:
- DEGOFINT = Degree of Interaction
- USEOFLOC = Usefulness of Location
- VISCAR = Visual Characteristics

OTHER POTENTIAL FACTORS
- Visual Effort for Scanning*
- Pre-Warning*
- Familiarity
- Ease of Naming
- Influence of Surroundings*
- Similarity of Appearance
- Level of Task Demand*
Study 2 – Effect of Landmark Value

- 48 subjects (3 x 16)
- Good vs Poor vs No Landmarks (verbally)
- Left turn…

[before the pedestrian lights]  [before the phone box]

V=79  V=50

TTEC
Number of glances to display

<table>
<thead>
<tr>
<th>Landmark category</th>
<th>Mean no. of glances - all target manoeuvres</th>
</tr>
</thead>
<tbody>
<tr>
<td>good</td>
<td>5.2</td>
</tr>
<tr>
<td>poor</td>
<td>4.5</td>
</tr>
<tr>
<td>none</td>
<td>8.8</td>
</tr>
</tbody>
</table>
Number of glances

Estimated Marginal Means

Landmark category
- good
- poor
- none

Manoeuvre number
2  4  7  8  9  15  19  22  33  37
0  2  4  6  8  10  12  14
TTEC
Percentage moving time

![Bar chart showing mean percentage moving time for different landmark categories: good (10.5), poor (9.0), and none (16.6).]
Percentage moving time

Estimated Marginal Means

Manoeuvre number

Landmark category
- good
- poor
- none
Approach confidence

Mean approach confidence

1 = low;  2 = medium;  3 = high
Approach confidence

1 = low; 2 = medium; 3 = high
Confidence changes

1 = low; 2 = medium; 3 = high
Driving errors

1 = minor;  5 = serious;  10 = dangerous
Navigation errors

i.e. 25% for poor/none; 10% for good
<table>
<thead>
<tr>
<th></th>
<th>Good landmarks</th>
<th>Poor landmarks</th>
<th>No landmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of glances</td>
<td>**</td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>Glance duration</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% time looking at display</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>Workload</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Driving errors</td>
<td>***</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Navigation errors</td>
<td>***</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Approach confidence</td>
<td>**</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Confidence at Preview 1</td>
<td>**</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Confidence at Preview 2</td>
<td>**</td>
<td>*</td>
<td>***</td>
</tr>
<tr>
<td>Confidence at Final</td>
<td>***</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Confidence post-manoeuvre</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Study 3 - effect of incorrect information

- 18 participants drove three routes
- 10 traffic lights (control - all correct)
- 10 pubs (no. 7 - wrong name)
- 10 petrol stations (no. 7 - wrong name)
- Driver confidence at each manoeuvre (1=low, 2=medium, 3=high)
Change in confidence levels

Line graph to show the overall confidence levels for the 3 routes

- Overall Confidence levels for Petrol Station route
- Overall Confidence levels for Pub route
- Overall Confidence levels for Traffic light route

1 = low; 2 = medium; 3 = high
Main effects on confidence

- Prior to vs post error
  - Traffic lights  2.83
  - Petrol Stations  2.85 to 2.63  (down 0.22)
  - Pubs  2.79 to 2.29  (down 0.50)

- Pre-error confidence range = 2.5 – 3.0
- Manoeuvre at which the error occurred:
  - 2.0 for petrol stations
  - 1.5 for pubs

- Post error, 3 manoeuvres to regain confidence
Did drivers notice (n=16)?

Graph to show how many people noticed the incorrect naming of the landmark

Number of people

Petrol Station  Pub

Type of landmark
Explanation of findings

• Petrol stations
  – designed to be easily spotted by drivers
  – very different to surrounding objects
  – likely to occur singly

• Pubs
  – pubs are often clustered together
  – there may be other potential manoeuvres nearby
  – difficult to pick out from the surroundings
Future Plans

• Application of results to other areas
  – Pedestrian navigation
  – Location based services

• Information reliability – does the effect differ?

• Context specific information

• Adapting to the user