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

TTEC
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

![Frequency counts for different general info categories across all subs, cognitive map, and video]
Use within the navigation task

Frequency counts

General information 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:
- preview
- identify
- confirm
Information used at Manoeuvre 1

- 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

Information type

- all subs
- cognitive map
- video

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Information used at Manoeuvre 9
Information used at Manoeuvre 26

![Graph showing frequency counts of various information categories. The categories include Direction sign, Environment, Junction description, Junction name/number, Lane change, Node geometry, Path geometry, Road marking, Road type, Street name/number, and Time. The graph uses different colors to represent frequency counts across different conditions: all subs, cognitive map, and video.]
Predicting Landmark Value (V)

\[ V = (.340) \text{DEGOFINT} + (.255) \text{USEOFLOC} + (.134) \text{VISCAR} \]

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
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
Percentage moving time

![Bar chart showing 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

Estimated marginal means

Landmark category
- red: good
- green: poor
- blue: none

1 = low; 2 = medium; 3 = high

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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

![Graph showing confidence levels for three different routes.

- Blue line: Overall Confidence levels for Petrol Station route
- Pink line: Overall Confidence levels for Pub route
- Yellow line: Overall Confidence levels for Traffic light route

Average Confidence rating

Manouevre Number

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

<table>
<thead>
<tr>
<th>Type of landmark</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol Station</td>
<td>5</td>
</tr>
<tr>
<td>Pub</td>
<td>20</td>
</tr>
</tbody>
</table>
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