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The Use of Visual landmarks in a Wayfinding System for Elderly with Beginning Dementia

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Abstract: This paper presents an experiment carried out to study the design options of a GPS-based navigation aid for elderly with beginning dementia. Results suggest that landmark-based instructions may yield higher performance of the system than left/right instructions.

Introduction

One of the main symptoms of dementia is a gradual decline in memory. This can result in topographical disorientation and the loss of one’s way during unaccompanied outdoor walks. GPS-based navigational aids have been proposed to assist the users in case of disorientation. An import issue is the interface for such a system. Since we want the interface to be as simple as possible, and we want users to have their visual attention on the surroundings, we chose audio feedback as the sole modality.

Current pedestrian navigation systems predominantly use distance-to-turn information and directional information to enable a user to navigate. However, [1] showed that dementia patients performed better on recognition of landmarks compared with recognition and recall of spatial layout. Studies have been carried out on the quality of landmarks [2,3]. Here we focus on the performance of such a navigational system for elderly and defined the following research question:

“Does the use of landmarks in route instructions lead to better performance and a better acceptance of the elderly patient with beginning dementia?”

In this paper we present an experiment which is carried out to compare landmark-based navigational instructions with navigational instructions based only on left/right turn information.

Method

Since we did not have a working prototype with sufficient high accuracy of the GPS system we carried out the experiments in a ‘Wizard of Oz’ (WOZ)
setting. In a WOZ experiment the human interacts with a (computer) system of which one thinks that it operates autonomously, but is partly operated by a human. The concept is shown in fig. 1.

System
The system consists of a PDA which sends the audio information via Bluetooth to the patient. The receiver is a small wireless mobile phone headset which is connected to the patient’s earphone. Playing the audio files is triggered by the Wizard, following the patient. A second researcher is observing the behavior. The patient was told that the navigation system consisted only of the small receiver and earphone.

Conditions and routes
We compare the following conditions:
1. Navigation information is given as directional (left/right/straight) instructions on decision points
2. Navigation information is given as directional instructions augmented with landmark information.
We have set out two routes in the vicinity of the day care centre, each approximately 750 meters long. Each route had 13 decision points at which navigational information had to be given. Both routes are as similar as possible with respect to difficulty and the number of instructions. Both contain a shopping area, residential area and a park-like area. In the first route we used only directional information. In the second route we used directional information augmented with landmark based instructions.

Instructions
The instructions were as short as possible, and spoken by a male voice. The instructions are ‘pre-recorded speech’, and not computer generated. The use
of a landmark is always an addition to the directional information, where the landmark was always used at the end of the sentence [4], e.g. ‘Turn left at the IKEA’. Given the limited number of participants it was not possible to use elderly patients to find the best names for the landmarks, as was suggested by [3].

**Participants and design**
We used participants with beginning dementia from a day care centre, 4 males and 2 females. Each walked both routes in a random order.

**Performance measure**
We compared the two conditions on the navigation performance and on the attitude of the users. During the walk we registered at each decision point whether an error was made, and whether the participant was sure about its direction or hesitated. A navigation error is counted if the participant takes the wrong direction and has to be corrected by the wizard. He does this by giving an audio instruction ‘Please try to turn around’. When the participant sees that he or she is going wrong before the correction instruction is given, this is not counted as error. We also measured the hesitation of the participant by observation (0 points for no hesitation, 1 for a little and 2 for much hesitation). At the end of each route we also measured the acceptance and participant’s attitude toward the navigational system. We used a small questionnaire with 10 questions with a 7-points Likert scale. The questionnaire was taken after the first part of the tour, and again after the second part.

**Results**
Table 1 summarizes the results for the conditions. The landmark condition resulted in a lower number of errors then the left/right condition. The
Table 1. Results for the 6 participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Left/right</th>
<th>Left/right</th>
<th>Left/right</th>
<th>Left/right</th>
<th>Left/right</th>
<th>Left/right</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>67</td>
<td>69</td>
</tr>
<tr>
<td>P2</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>48</td>
<td>58</td>
</tr>
<tr>
<td>P3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>68</td>
<td>68</td>
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<td>0</td>
<td>1</td>
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<td>67</td>
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<tr>
<td>P5</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>P6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>65</td>
<td>62</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
<td><strong>4</strong></td>
<td><strong>11</strong></td>
<td><strong>6</strong></td>
<td><strong>64</strong></td>
<td><strong>65.5</strong></td>
</tr>
</tbody>
</table>

amount of hesitation was lower for the landmark condition than for the left/right condition. The attitude of the participants toward the system was only slightly more positive for the landmark condition. Under both conditions an overall high positive evaluation of the system was given.

Discussion and conclusions

A further analysis of the data learned that the 4 errors in the landmark condition were made at the same decision point, where the route instruction was not optimal. The instruction was to turn left at the landmark, while the landmark itself was placed after the decision point. For landmark based navigation, a careful formulation of the instructions is needed. In the final discussion with the participants the overall consensus was that the system is very helpful indeed. Even the use of earphones was not considered as a problem.

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References