Where am I? Where should I go?

Effects of map granularity on positioning performance and satisfaction

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Abstract

In this thesis I performed an experiment to get more concrete advise on how to design a map for pedestrian indoor use. I also used this experiment to gain more knowledge of possible objects to be included in the design of maps.

It appears that adding more elements to the map does increase task performance and satisfaction. This does not mean that you should put as much elements on it as possible. Especially on changing environments you should take caution.

Contents

1 Introduction

For years man used maps to plan their car trips. Eventually computers were able to calculate a route from address to address. Later, when the Global Positioning System (GPS) came publicly available (Lloyd, 1992) car navigation applications were developed that could give precise and correctly timed directions.

But roads are not the only place were people need to know where to go. People spend up to 90% of their time indoors of which almost 25% is not at home (Leech et al., 1987). This is far more time then they spend travelling. Although people often come to the same places (work for example), there are a lot of indoor places people do not know inside out.

However, it is not obvious that navigation/positioning interfaces developed for car navigation are suitable for indoor navigation. Earlier studies have shown there are differences between the navigational clues a user should get for use outdoors and indoors (Corona and Winter 2001).

In this research further insights in proper map design are sought. Some concepts of related research are further explored and tested in a new experiment to find a way to optimise positioning performance.

Positioning in the context of this paper is considered the ability to find a given point in an area by comparing the details on a map with the surroundings. In a simplified way, this can be compared to finding the treasure buried underneath the X. Instead of mentioning the number of steps to take when passing the tree, one should be able to use the surroundings to estimate the precise position.

Figure 1: Like pirates on a treasure hunt

We will see that there have been some studies about this subject, but that they lack a concrete advice on how to design a map. This study will explore what objects help to improve positioning performance and satisfaction of the task and help finding a balance between including useful objects and over-cluttering the map.

This dissertation explores the effects that map design has on three topics: task performance, user satisfaction and mentioned objects. The research questions contribute to the big question on how to design better maps.

Research questions

- **How does granularity affect positioning performance and satisfaction**

  1. *How does the granularity affect positioning performance*
     Does adding more objects to the map increase the speed and accuracy in which subjects can position themselves in an area.
  2. *How does the granularity affect satisfaction*
     Does adding more objects to the map increase the satisfaction of the map.
  3. *What elements of a map tend to be used the most*
     Which of the elements are mentioned as being useful or non useful objects.

1.1 Background and aims

Advanced mobile devices recently have gained a lot in popularity and functionality. Features that used to require separate devices (computer, camera, flashlight, navigation) are now all supported by a so-called smart phone (Zheng and Ni, 2006). While GPS does not work very well indoors (because the signals get blocked and reflected by buildings) new and more accurate indoor positioning systems are being developed (for surveys, see Roxin et al. 2008, Liu et al. 2007).

As mentioned earlier, Corona and Winter (2001) did a comparison of the information need for navigating drivers and pedestrians. They show that a significant difference is the granularity of displayed objects (pedestrians usually travel at lower speed and over less distance so a greater scale and more details is preferred) and possible actions (cars usually drive on one-dimensional roads whereas users can also cross two dimensional places like town squares). They, however, do not give a clear prescriptive advice how this granularity should be different. They talk about 'more kinds of . . . '.

Satisfying a user with your product is very important in the smart phone market. There is heavy competition between developers of applications and operating systems for these devices (Bilton, 2010). Providing a better and more satisfying product might just give you the advantage over the competition.

1.2 Related work

Puikkonen et al. (2009) found in their research that maps should not be too detailed. Instead the landmarks on it should stand out. This prevents users from focusing on the map and ignoring other clues. They also indicate that hints should be given relative to their current location (*go one floor up* versus *go to the fourth floor*). These findings are similar to results in earlier research focused on outdoor navigation (May et al., 2003). This, however, might be subject to cultural differences.

As Corona and Winter (2001) mention, pedestrians can cross areas instead of being limited to a certain road. Indoors this can mean rooms and halls. These rooms and halls are usually filled with some furniture or machinery. Also, this furniture is static enough to make it worthwhile to include (and update) the positions of objects in the map.

When indoor positioning techniques develop and start being used for navigation, it will also be possible to use data of people for navigation. Depening on how many information people are willing to share, there is a wealth of interesting information that could be used for navigation. A system that knows where you parked you car could tell someone to take a left turn at the yellow Ford. If the system knows where you are walking and that you are wearing a red coat, the system can navigate other people using this distinctly coloured coat.

2 Experiment

In short, subjects received a map of the building that was annotated with markers. The test subjects task was to stand on or point at the markers as precisely as possible. The distance between the actual point and the point indicated by the subjects and the time to find a marker were measured and stand for the performance of the task. Satisfaction and interesting objects were asking using a questionnaire.

The experiments haven been held at the Huygens building of the Radboud University. This building is conveniently available and familiar to the researcher. This building is quite large and has a variety of spaces like a long hall-way, a big cafeteria square, and smaller rooms. We used the ground and first floor.

2.1 Task

The subjects received a map of the building (for example figure 6c), with certain positions marked. On the maps, the type of elements available were manipulated. There were three different manipulations of the map as described in section 2.2. The subjects were asked to find the exact location of these markings and fill out a short questionnaire.

2.2 Maps

2.2.1 Map design

To determine effects on different granularities, three levels of granularity were defined. These are based on aforementioned literature and will be defined as following:

1. **Simple map**: As a starting point a simple map is considered, only representing information about the building structure. Information about walls and doors can be compared to roads and junctions in car navigation. This will be regarded as the control-experiment.

2. **Including landmarks**: This will form the second level of the experiment. On top of the simple map certain landmarks were placed like toilets and staircases. This should be things that are easy to spot like church towers and sign boards are for car drivers. (Puikkonen et al., 2009)

3. **Including furniture**: To help the user navigate in open spaces (Corona and Winter, 2001) in third level some furniture is added to the map. Because some rearrangements of furniture can be expected, the furniture is limited to tables and decorative features because, for example, the position of chairs is less static than the position of chairs.

The University Real Estate Management (Universitair Vastgoed Bedrijf) had provided a detailed map of the building, though it still needed some manipulation for it to be usable. The maps are designed to represent a familiar map design, namely the design of the commonly known maps application by Google Maps [1]. The design of the maps is included in Appendix A.

2.2.2 Markers

In this experiment 16 markers were defined throughout the first two floors of the building. The markers formed a route through the entire first two floors. Pictures, map layouts and some interesting features of the these markers are described in Appendix B.

2.2.3 Presentation

For showing the map there where two options. Implement an application or print it on paper. Since this research originates from the idea of using navigation on a smart phone, implementing the application resembles common uses a lot better. There are some frameworks/api's available that provideds some very useful functionality like zooming and panning. This allows the subject to have an overview (zoomed out) or see details (zoomed it) without having to carry even more paper.

Figure 2: The map on a smart phone

The map was implemented using the Google Maps v3 javascript api [2]. Although the native application is much more stable, the code is proprietary and it is not possible to

[1] http://maps.google.com

[2] http://code.google.com/apis/maps/documentation/javascript/

develop a custom map for it. For the web application a custom map-type was developed that, instead of fetching images of the world from Google, uses the tiles generated from the map.

To create these the freeware application MapTiler [3] was used. This application automatically slices an image into tiles suitable for use on a Google Maps application. It even generates a implementation of the map. This sample was not immediately suitable (it showed to custom map as an overlay on the world), but with some adjustments it was very usable. To handle the different floors of the building and granularity levels, a very simple php-script that could select the correct map was used as a portal web page.

There still were some minor issues; the zoom-buttons were tiny for anything but children's fingers; no wifi-network had complete coverage in the entire building and the web application did not support pinching [4] which some subjects seem to expect. These issues were, however, no show-stoppers and could easily be overcome with some help of the researcher.

2.3 Subject selection

Navigation is usually used when you dont́ know the environment. Due to the nature of this research, subjects unfamiliar with the location are preferred. This forces the subjects to closely inspect the map for navigational clues. This does mean that students of exact sciences were excluded from participation in the research since this building is their home turf.

Out of convenience, the subjects were recruited within acquaintances and semi-acquaintances of the researcher. This increased the chance of partaking (since no compensation was available while the experiment takes about an hour) and allowed to select people that have not been to the Huygens building before. There were nine participants in total, of which five males. All subjects were students between 18 and 25 years old.

2.4 Measuring performance

The navigation tasks mentions finding the exact location of the given markings, Hence, the main quantity of performance was the distance between the marking and the location the subject thought it marked. The time it took to find the next marking was also

[3] http://www.maptiler.org/

[4] Pinching is used for zooming by sliding two fingers away from or towards each other.

measured.

Time Measure the time between starting to look for a marker and actually finding it. More time indicates less performance.

Errors Measure the distance between the marking and where the subject thought the marking was. A greater distance indicate the subject had a harder time of finding the precise location and thus less performance.

Measuring time is very straightforward with the use of, for example, a stopwatch. We took a picture every time the subject indicated they had found a marking. These pictures were analysed to measure the distances between the marker and the subject. Structural elements of the building proved useful to estimate the distances. For example the grid of the tiles on the floor.

Figure 3: Marker A as indicated by me (left) and by one of the subjects (right).

2.5 Measuring satisfaction and exploring further possibilities

On every marking they filled in the questionnaire in appendix C. It consists of questions about the objects on the map and actual objects in the building that were useful (or not) for completing the task. These questions help determine whether the used objects were suitable and complete and might be used to create better maps in further studies. A large number of objects that *could have been useful* and *were not useful* indicate room for improvement and thus a lower satisfaction with the map.

Additionally, satisfaction is measured using a dis-conformation scale (Danaher and Haddrell, 1996; Yüksel and Rimmington, 1998) where the subject indicates how easy it was to find the marker in relation to how hard they thought it would be. They used earlier markers as a reference.

3 Results

Although the experiments took quite long (about an hour), many of the participants stated that it had been a fun experiment. Having fun was not a topic in this research but it was a nice extra result. All subjects were motivated to perform well.

This section describes some of the results by first showing some overall statistics and then going into detail. These include information about performance (time, distance), satisfaction (easy to find, usefulness of objects) and then some more details about mentioned objects. Some of the tables here have been truncated for clarity. More tables are included in appendix D.

Without further ado, here are some of the most general statistics.

	Map 1	**Map 2**	**Map 3**
Easy to find (-3 ... 3)	-0,65	0,23	0,56
Time (sec)	40,35	45,35	48,72
Distance (cm)	118,00	66,78	69,78
Objects mentioned	186	290	172
Unique objects mentioned	20	28	26

Table 1: Averages for the analysed data

3.1 Distances

The distance between the point's real position and the position as found by the participant were analysed by comparing the photos taken of the real point and the participant at the position he considered that specific point to be. The averages per map are shown in table 2.

The average to marker F could not be determined since this was an inaccessible marker location. At marker O, the map appeared to be very unclear. Even the researcher was unable to find the location using the map, this marker was skipped after the first day of the experi-

Marker	**Map 1**	**Map 2**	**Map 3**	*Total*
A	53,33	50,00	56,67	53,33
B	160,00	120,00	76,67	118,89
C	30,00	36,67	16,67	27,78
D	300,00	120,00	303,33	241,11
E	140,00	173,33	40,00	117,78
G	80,00	86,67	60,00	75,56
H	30,00	83,33	106,67	73,33
I	450,00	0,00	300,00	250,00
J	46,67	75,00	0,00	36,25
K	206,67	50,00	13,33	90,00
L	133,33	86,67	23,33	81,11
M	120,00	96,67	26,67	81,11
N	10,00	6,67	6,67	7,78
P	3,33	16,67	16,67	12,22
Q	6,67	0,00	0,00	2,22
Average	118,00	66,59	69,78	84,93

Table 2: Distance to a marker, in cm

ment and excluded from analysis. Marker J was in a part of the restaurant that closed early on an afternoon in the exam period, so this was inaccessible once. Although it was expected that the furniture at markers H, I and K would change, the arrangement at markers H and I especially changed more then once a day.

The markers with the biggest average distances (D and I) were placed in between two floors. Very few subjects went to the correct floor. One subject mentioned a 'dotted line' not being useful, he however failed to understand what it stands for (the plateau between floors) and therefor positioned himself on the wrong floor. On marker D only 2 subjects went to the correct floor, and one subject asked about the floor after initially positioning herself wrong.

Because vertical distance was also included, these markers contribute a lot to the average distance. Even though both subjects on maps 2 and 3 had an icons of the stairs, mostly subjects from map 2 picked the right floor. If we were to remove these markers from the data, the average distances show a bit of a different picture.

Markers between floors	**Map 1**	**Map 2**	**Map 3**	**Total**
With	118,00	66,59	69,78	84,93
Without	82,50	66,29	33,61	75,23

Table 3: Distances per map with and without the markers between floors

3.2 Time

Time was measured between points starting at the moment the subject was ready to navigate to the next marker and stopping when the subject indicated he had found the marker. Time spent with technical difficulties or other non-experiment related time are subtracted.

On the first day of the experiments, there were some technical issues that prevented a correct collection of time of the first two subjects. The averages of maps 1 and 2 are therefore based on 2 subjects instead of 3. During the other experiments there a few technical

Marker	**Map 1**	**Map 2**	**Map 3**	*Average*
A	20,50	29,00	52,67	36,71
B	33,50	29,00	81,00	52,57
C	39,00	56,50	45,67	46,86
D	17,50	36,00	28,67	27,57
E	37,50	36,50	48,67	42,00
F	19,00	46,00	28,33	30,71
G	30,50	36,00	27,33	30,71
H	71,00	65,00	70,33	69,00
K	62,00	56,00	56,67	58,00
L	75,50	82,50	79,00	79,00
M	46,50	41,00	32,00	38,71
N	36,00	36,00	40,00	37,71
P	36,00	40,00	43,00	40,14
Average	40,35	45,35	48,72	45,36

Table 4: Time to find a marker, in seconds

issues, but because time between different markers cannot be compared with each other [5] I decided to exclude these from the analysis.

3.3 Easiness to find

Subjects indicated how easy it was to find a certain marker, in relation to how easy they thought it would be. This expectation was based on earlier markings, starting at the 'demo' marker in the beginning. The results of these expectations can be found in table 5.

Marker	**Map 1**	**Map 2**	**Map 3**	
A	0,00	0,67	0,00	0,22
B	-1,00	1,00	0,33	0,11
C	-0,33	0,33	0,67	0,22
D	-0,33	0,67	0,00	0,11
E	-1,00	-0,33	0,00	-0,44
F	-0,33	-0,67	0,67	-0,11
G	0,00	0,67	0,67	0,44
H	-0,33	-0,67	-0,67	-0,56
I	-1,33	0,67	1,67	0,33
J	-0,33	1,00	1,00	0,50
K	-0,67	-0,33	0,00	-0,33
L	-1,00	-0,67	0,67	-0,33
M	-0,67	0,00	0,33	-0,11
N	-0,67	1,33	1,67	0,78
P	-0,67	0,33	1,33	0,33
Q	-1,67	0,00	0,67	-0,33
Average	-0,65	0,23	0,56	0,04

Table 5: Easiness to find a marker in relation to expectation; on a scale from -3 (*harder then i thought*) to 0 (*about as hard as i expected*) to 3 (*easier then i thought*)

[5] Time to find a marker is a combination of distance and looking for the marker. Since precise information on distance between markers is not available this cannot be normalised to, for example, time per meter.

3.4 Objects mentioned

Subjects were asked what objects were useful, which were not and which objects would have been useful. This rendered a total of 648 mentions (on average 40.5 per marker, 72 per subject and 4.5 per subject per marker).

How the mentions are distributed over the markers is shown in table 6a. It shows the number of mentions mentioned for each marker, but also how many unique objects were mentioned for this marker. Unique mentions per marker are added in table 8. In table 6b, we see how many objects (non-unique) per usefulness.

Mentions					
A	45	9	I	35	9
B	55	8	J	35	10
C	59	13	K	41	12
D	26	4	L	41	12
E	58	13	M	41	8
F	35	7	N	32	13
G	32	8	P	28	7
H	49	11	Q	36	13

(a) Number of object mentions, total and unique, per marker

Map type	**Useful**	Global	Precise	Total	
Map 1	Yes	76	43	119	64.0 %
	No	6	5	11	5,9 %
	Could	29	27	56	30 %
	Total	111	75	186	
Map 2	Yes	106	61	167	57,6 %
	No	37	32	69	23.8 %
	Could	34	20	54	18.3 %
	Total	177	113	290	
Map 3	Yes	47	27	74	43,0 %
	No	33	16	49	28.5 %
	Could	23	26	49	28.5 %
	Total	103	69	172	

(b) Number of object mentions per map and usefulness.

Table 6: Object mentions

Table 7 shows what objects were mentioned the most for each map and usefulness. This table has been truncated to only include the top three. In table 9 is a complete list for the total number of mentions.

Usefulness	Map 1		Map 2		Map 3		Total	
Yes	doors	29	stairs	40	stairs	19	stairs	84
	stairs	25	colours	27	doors	9	doors	53
	pillars	24	pillars	21	tables	8	pillars	48
No	doors	5	doors	27	tables	7	doors	34
	colours	2	pillars	8	rooms	6	colours	12
	stairs	2	toilets	6	colours	5	pillars	10
Could have	tables	15	furniture	12	stairs	7	tables	24
	hallway	9	colours	12	doors	6	colours	20
	chairs	4	tables	5	tables	4	stairs	12

Table 7: Top number of mentions of objects per usefulness, for each map type

4 Conclusion

Some evidence was found for earlier statements that for indoor navigation it is best to use relative directions (May et al., 2003) [6]. For example, some of the subjects were looking for hallways between marker A and B. There are two hallways (on each side of the building two) but one of them leads to another wing and is behind doors and the other is small and only surrounds a classroom (figure 4). Subjects were looking for the second hallway and walked way too far.

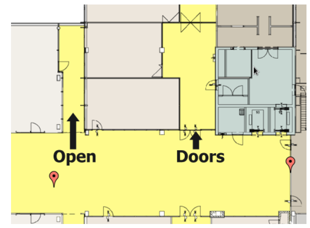

Figure 4: Hallway behind doors

The data also confirms the findings of Puikkonen et al. (2009) that people tend to lose focus one a single element. This happened with the hallways behind the doors, but the result that the more detailed maps took more time then the less detailed is also an indication for this (table 1).

Based on these observations I would recommend limiting the map to a single room. When a subject can only see the contents and surroundings of the current room it limits the number of elements he can focus on (or, get distracted by). This would be benifical for the time in which subjects find their marker, and maybe for the percieved easiness.

On maps 1 and 2, tables (and other furniture) were the most mentioned objects that could have been useful. When they were added in map 3 they ended up as the third most useful object, but also as the most not useful object (table 7). This is largely caused by tables being moved. The third place for 'could have been useful' is also related to this ("it could have been useful if the tables were on the right position").

Still visible in figure 4 is a transition of colours. This is an indication of where the entrance hall ends, and the hallway starts. There is however, not a clear separation of the two areas. The map is more explicit in this. The map also includes a sliding wall, that I, after studying in this building for 5 years, have yet to see pulled out. This was very confusing for some subjects since they were looking for the doors in this wall.

Looking for things that do not exist did not always happen. None of the subjects noticed that the icon of the elevator at Marker E was at the wrong place while they did use the doors that were incorrectly marked as an elevator and the icon of the toilets on the otherside of the hall.

Adding more elements to the maps greatly improves the accuracy of the positioning (when we exclude the difficulties between floors, table 3) and improves the perceived

[6] For example, "go one floor up instead" versus "go to the third floor"

easiness to find the object. It however also increased the number of objects that are considered not useful. This holds especially for markers where the environment had changed (table 6b). The markers where this was an issue actually had some of the lowest scores on perceived easiness. It takes just a little bit more time to find such a marker.

If it was not a lot of work I would recommend including tables and other furniture. The improvement of accuracy is a lot higher than the increase in time. Because of the effort it takes and the variability of furniture arrangement you should however take care in what objects to include. For example by not being to detailed in areas that change a lot, or only at points where you actually need positioning within half a meter.

Most subjects hardly used the zoom feature. When the next marker was not close to the current one, subjects took a long time finding the next marker on the map. Even after a mentioning this functionality the participants seldom used it. When they did, however, they immediatly had an idea of where the next marker was supposed to be and walked straight at it. Since this was usually after searching without zooming, there is no evidence of this in the data.

How do we interpret these findings as answers to our research questions? Adding more elements has a positive effect on performance. It increases the accuracy of positioning by a lot and the time it takes by a little. The satisfaction increases only if the map precisely resembles the world, if it does not the satisfaction drops to the level of a map without any furniture. The most mentioned useful objects are structural objects, even for the map with furniture on it.

5 Discussion

During this experiment I did get some results I cannot explain and more questions have risen. To provides some leads for further research i will discuss them briefly.

This research was performed with nine subjects. There were some results that I cannot explain and that might have been caused by individual differences of the subjects. For example why all subjects of map 2 went to the correct floor. Only one other subject did this (on map 3, with the same visual clues). It would be interesting to see if this difference still exists with a larger set of subjects.

With more subjects it also becomes interesting to see if you can generalise some of the properties of subjects and see whether this has an effect. For instance, cultural differences, educational differences (level or area) and gender. Although I did have both male and female subjects, they were not evenly distributed over the map types which makes it hard to compare. I found no evidence for the popular believe that women turn the map to match their walking direction, I saw both man and women do this.

The subjects in this research were asked to look for the markers. The entire task was focused on finding the markers. However, in a real-life situation this is usually not the case. Then is finding a certain position only a means. It is only part of the task someone is interested in. This is a different approach which might be interesting to explore.

The Huygens building was very familiar for me. Walking the route took only a few minutes for me, whereas subjects took about an hour (they of course also had to fill out a questionnaire). It is possible that I missed some obvious things or took things for granted when designing the map or defining the markers. The stairs at marker I is an example of this. I knew very well there was a flight stairs at the plateau, but subjects only saw it when I walked them back to the ground floor.

The biggest error subjects made was standing on the wrong floor. These markers were actually a bit mean because they were between floors and it was not explained. Some subjects mentioned that there should be an arrow to indicate heights. This can also mean stairs direction and might lead to some other confusion. Maybe we can learn something from computer games with a minimap. An example can be found in the game Grand Theft Auto where a goal is marked with a square, or a triangle when its on another level. A triangle pointing upwards means the goal is above you.

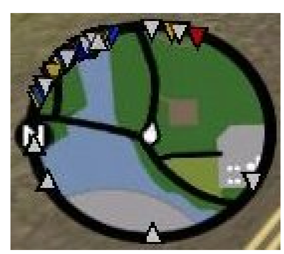

Figure 5: Minimap from the game GTA

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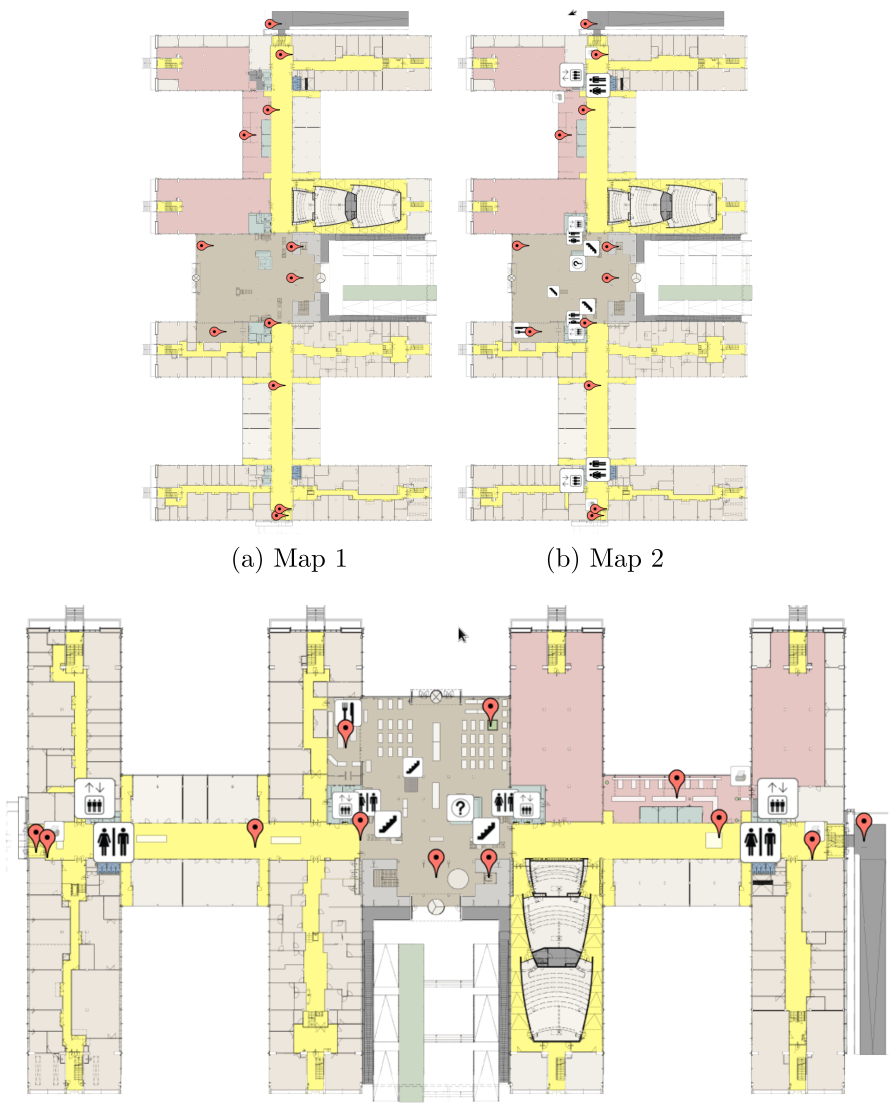
Figure 1 by `http://www.caufields.com/`
Figure 5 by `http://www.rockstargames.com/`

A Maps

In these screen shots, the annotated markers look really big compared to the map. These markers however do not scale when zooming in, so their relative size is a lot smaller.

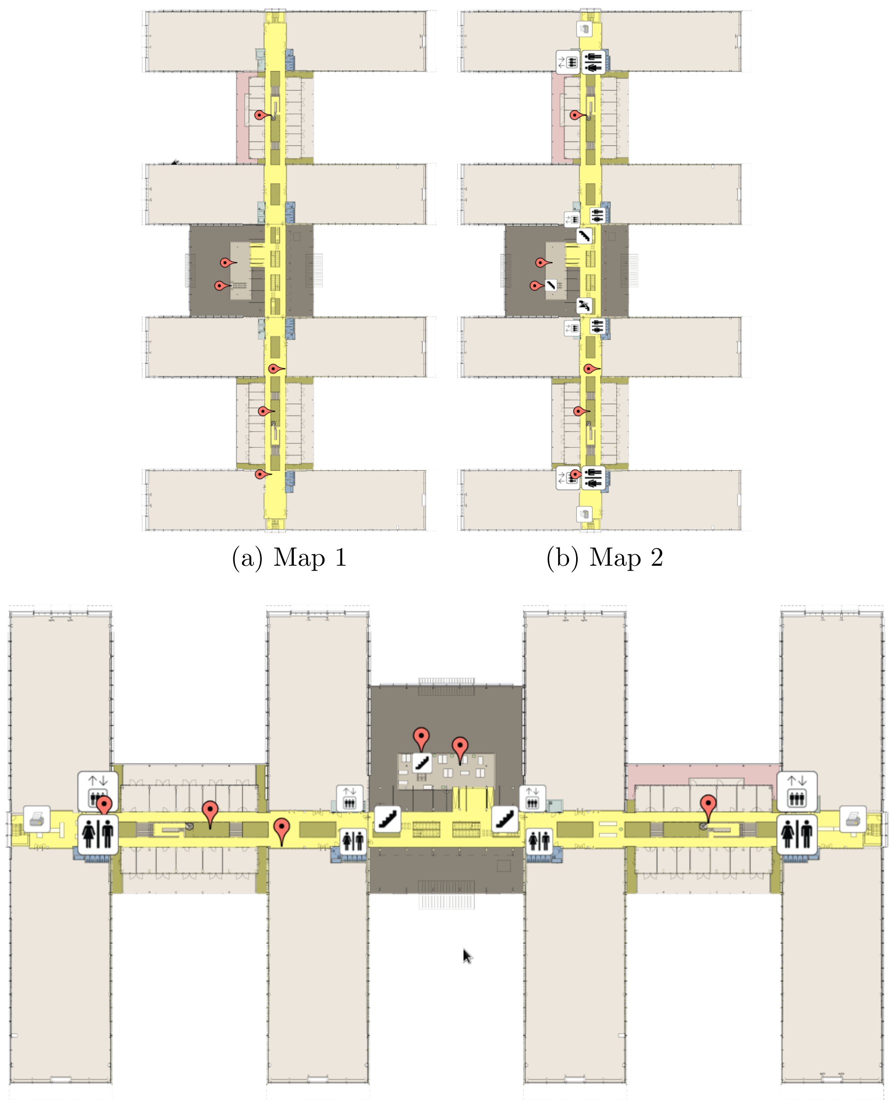


(a) Map 1

(b) Map 2

(c) Map 3

Figure 6: Ground floor of the Huygens building, with different levels of navigation clues



(a) Map 1 (b) Map 2

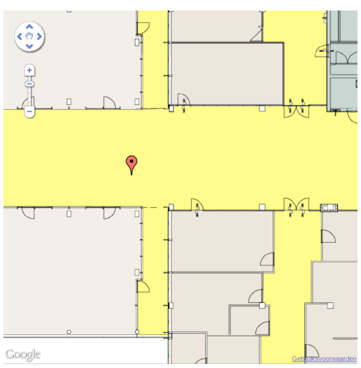
(c) Map 3

Figure 7: First floor of the Huygens building, with different levels of navigation clues

B Markers

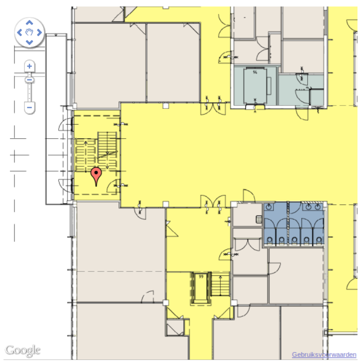
Start Used as a starting point and to let the subject get acquainted with the map and device.

A Precisely halfway between the two walls and on the line that divides the entrance hall from the hallway.



B One third between the walls. In the middle of the width of a window.

C In the corner, about 1 meter from both walls



D In the middle of a plateau between floors. The staircase has two entrances, the previous marker was on the opposite side of where the stairs start.

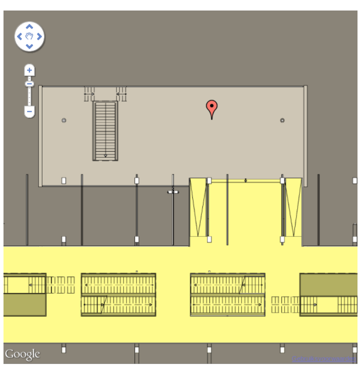
Going to the first floor. In the following image the dark-yellow color indicates were you can see through the floor and see the hallway of the floor underneath.

E On a table that is positioned against the handrail. There is an elevator near, but the icon in map 2 and 3 is actually on the wrong position.

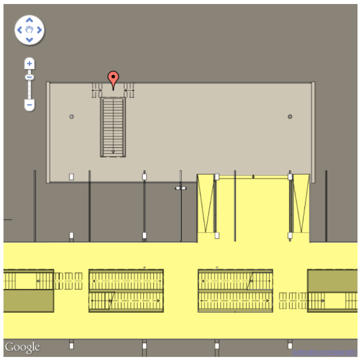
F Marker is inaccessible, since it is either floating or on the floor underneath

G Aligned on the window frames on the wall

The light-gray area is a floating plateau in the cafeteria. Unfortunately, especially in this part, the layout of the furniture changes more than daily.



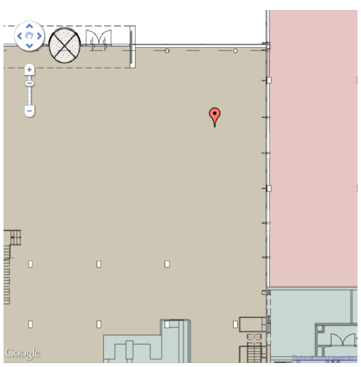
H Aligned on two pillars



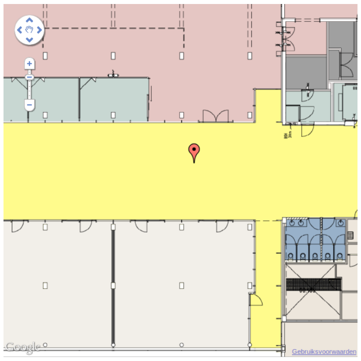
I Down the stairs, on a small plateau

Back to the ground floor

J In the restaurant, aligned on two counters

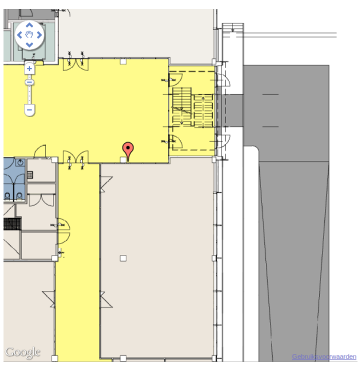


K On the edge of the planter

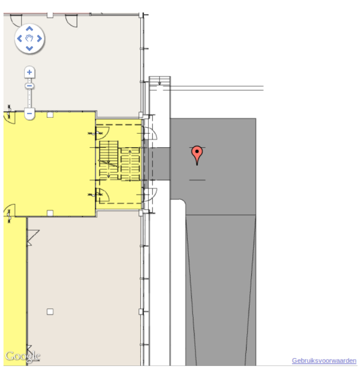


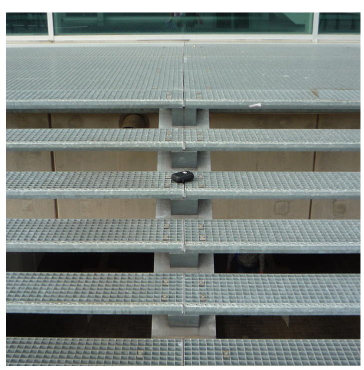
L On the computer stand, which is about one-third on the edge of the stand

M At the information desk



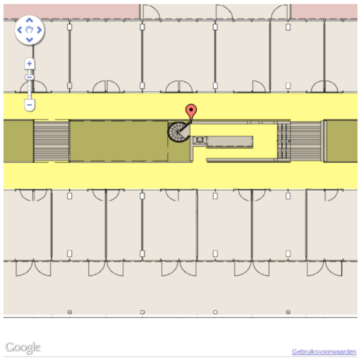
N As far as possible in the corner





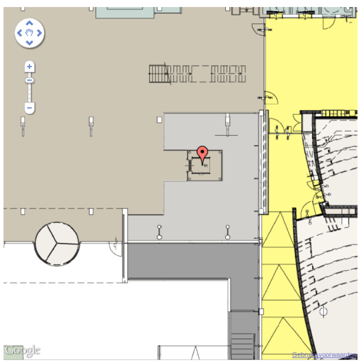
O Outside, on a little stairs

Up to first floor.



P On a low wall, very close to the winding staircase

Back down



Q In the elevator

C Questionnaire

Plek . . .

De volgende vragen hebben betrekking op de onderdelen van de kaart die je al dan niet heb gebruikt om globaal naar het gezochte punt te lopen, en de precieze plek aan te wijzen. [7]

- Welke onderdelen waren *nuttig* om hier te komen?

  . . . . [8]

- Welke onderdelen waren *niet nuttig* om hier te komen?

  . . . .

- Welke onderdelen waren *nuttig geweest* om hier te komen?

  . . . .

- Welke onderdelen waren *nuttig* om de precieze plek te vinden?

  . . . .

- Welke onderdelen waren *niet nuttig* om de precieze plek te vinden?

  . . . .

- Welke onderdelen waren *nuttig geweest* om de precieze plek te vinden?

  . . . .

- Hoe goed kon je de plek vinden, ten opzichte van wat je verwacht had?

Slechter			Ongeveer zo			Beter
○	○	○	○	○	○	○

[7] Since all of the subjects were Dutch, it made little sense to make an English version.
[8] Subjects actually had a bit more space to write their comment then a single line

D Tables

Marker	Yes		No		Could have		Total	
A	25	7	10	4	10	5	45	9
B	25	7	13	5	17	5	55	8
C	34	11	14	8	11	7	59	13
D	16	2	6	3	4	2	26	4
E	29	9	9	5	20	9	58	13
F	20	5	9	6	6	3	35	7
G	19	7	7	5	6	3	32	8
H	26	8	9	6	14	5	49	11
I	16	4	8	5	11	6	35	9
J	22	9	6	4	7	4	35	10
K	19	6	5	5	17	7	41	12
L	21	8	4	3	16	6	41	12
M	27	7	7	3	7	3	41	8
N	23	9	6	6	3	3	32	13
P	20	6	5	5	3	3	28	7
Q	18	7	11	11	7	6	36	13

Table 8: Number of mentions (total and unique) for each marker

Useful		Not useful		Could have	
stairs	84	doors	34	tables	24
doors	53	colors	12	colors	20
pilars	48	pilars	10	stairs	12
colors	43	hallway	9	couches	12
hallway	23	tables	8	furniture	12
walls	19	stairs	7	hallway	11
elevator	14	rooms	6	doors	9
toilets	13	toilets	6	plants	9
tables	13	walls	5	computer island	8
rooms	10	printer	4	rooms	6
furniture	5	plants	4	tree	5
cabinet	4	couches	3	cabinet	4
printer	4	cabinet	3	chairs	4
plants	4	elevator	2	pc	3
couches	4	icon	2	railing	3
tree	3	furniture	2	elevator	2
railing	3	chairs	2	toilets	2
pc	2	railing	2	icon	2
window frame	2	kitchen	2	arrow	2
restaurant	2	computer island	1	walls	2
icon	2	arrow	1	fire hose	1
kitchen	1	fire hose	1	kitchen	1
reception desk	1	window frame	1	trash cans	1
copier	1	copier	1	roomnumber	1
computer island	1	windows	1	scale	1
wardrobe	1			copier	1
				printer	1

Table 9: Total number of mentions for each object