Walk this way:

Spatial grounding for city exploration

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1. Aim

To create a dialogue system that helps users **navigate** in and **explore** the city. The system knows the user's GPS position and can thus give help sensitive to the spatial context.

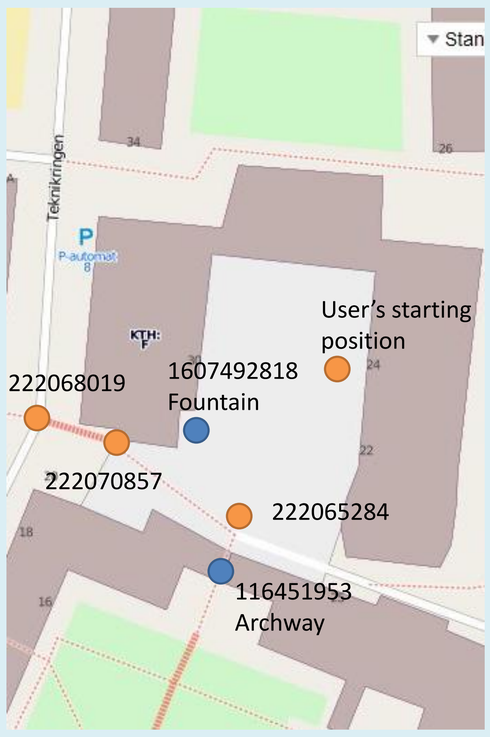
This is tricky because:

• **Data is sparse** (geographic databases are quite good but the visual scene is much more complex).

• We don't know the **user's position** exactly, nor his **orientation**.

• It is not always clear **what the user can see**.

2. Spatial grounding



– Do you know how to go to the KTH library?

– No, I don't.

– There is a fountain about 35 metres from here. Can you see it?

– Yes.

– Good. I want you to pass the fountain. It should be on your right when you pass it.

(*user walks*)

– Please turn right and walk to the top of the stairs.

– What?

– There is a flight of stairs leading down about 25 metres from here. Can you see it?

Main points:

• System plans a route to the goal , and checks if the first waypoint **has a good description**.

• If not, system checks for **visible** objects with good descriptions.

• Of these, the fountain 1607492818 is considered most salient.

• System checks that the **user can see** the fountain, and then describes the route relative to it.

• Relative instructions ("turn right") can be given when the user is moving.

3. Giving instructions

Instructions can be verbalised in various ways:

Relative: Turn slightly left.

By name: Now cross Valhalla street.

By landmark: Pass the 7-Eleven.

Various hybrids: Walk across the green area to Östermalm street on your right.

Salience measures used by the system include:

• **visibility**

• **name –** can the object be named?

• **direction** – is the object roughly in the direction the user should go?

• **distance** – to the user, and to the next waypoint

• **rarity** – rare prominent objects such as fountains are more salient

• **uniqueness**

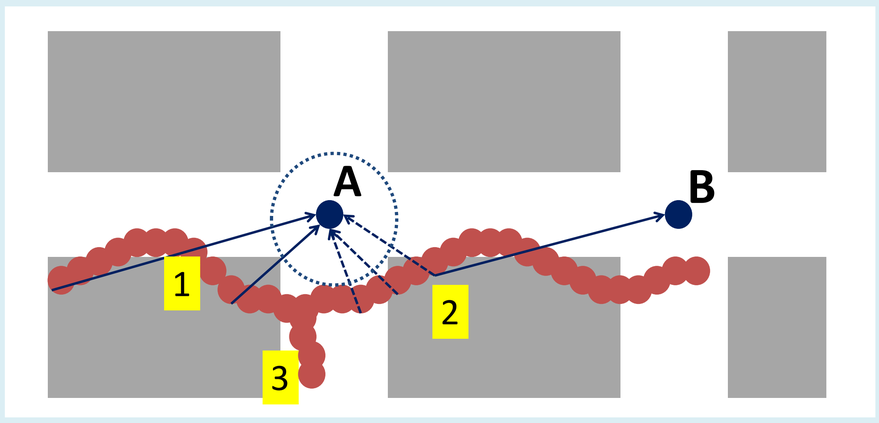
• **familiarity** – places previously visited are more salient

4. Uncertainty and replanning

• The system monitors the movement of the user by GPS. When the user is within 20 metres of the next waypoint, the system can issue the next instruction in the planned route.

• If the user is going the **wrong way**, the system should **replan** the route. But how can we know the user is going the wrong way?

• **GPS is uncertain**: Sometimes the system fails to detect that the user is at a certain node (A), since the GPS reading is wrong.



Method adopted:

• In situation 1 the user is getting closer to the next waypoint A.

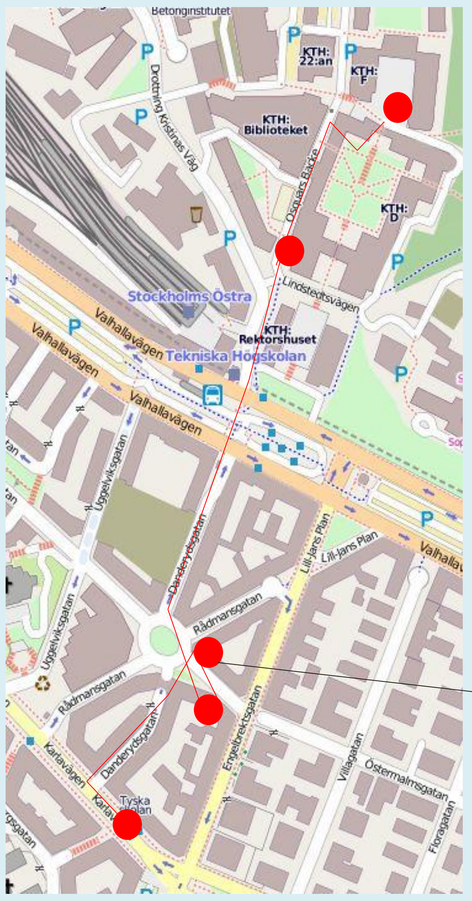
• The GPS is inaccurate and misses the 20-metre zone around A.

• In 2, the user is **moving away from A** but **getting closer to the next-next waypoint B**. After 10 seconds in this state, **assume that the user has already been at A**.

• In 3, the user is moving away from both A and B. After 10 seconds in this state, **issue replanning**.

5. Experiment

12 users were given the task of finding 4 target objects in the city environment. Rough measures of success are: (**I) number of instructions** from the system, and **(R) number of replans** made by the system. Some sample users:



I	Time (mins)	R
48	24.9	0
49	28.2	3
59	34.6	10
60	27.7	4
82	35.6	14

One of the targets

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