

What's up that street? Exploring streets using a **Haptic GeoWand**

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What is Haptics?

is a tactile feedback technology

takes advantage of our **'sense of touch'**

by applying forces, vibrations, and/or motions to the user through a device.



Why Haptics?

“ ... navigate without having to hold and look at a display.
... thus allowing the user the freedom to **attend to whatever is most important** at that time.”

— L.R. Elliott and J.B.F. Van Erp (2010)

“ ... tactile wayfinder **freed the participant's attention** but could not keep up with the navigation system in terms of navigation performance.”

— M. Pielot (2010)



What is a **GeoWand**?

“**GeoWands** - smart geographic pointers that allow users to identify nearby objects by pointing towards them.”

— M.J. Egenhofer (1999)

“Point to Discover: a system and application development framework for **orientation-aware** location based mobile services”

— R. Simon (2007)



Research Question

Can we develop an efficient means of integrating haptics into pedestrian navigation/querying applications on mobile devices thereby:

(1) allowing users to make navigation decisions more quickly
and

(2) not requiring users to constantly look/interact with the device along their journey?



whichHaptics
Haptic
GeoWand
whereHaptics

is a **pointing/scanning gesture based** querying system.

reduces the query region/space from the usual 'find around-me' circular query.

visual and **haptic feedback** for quick decision making.

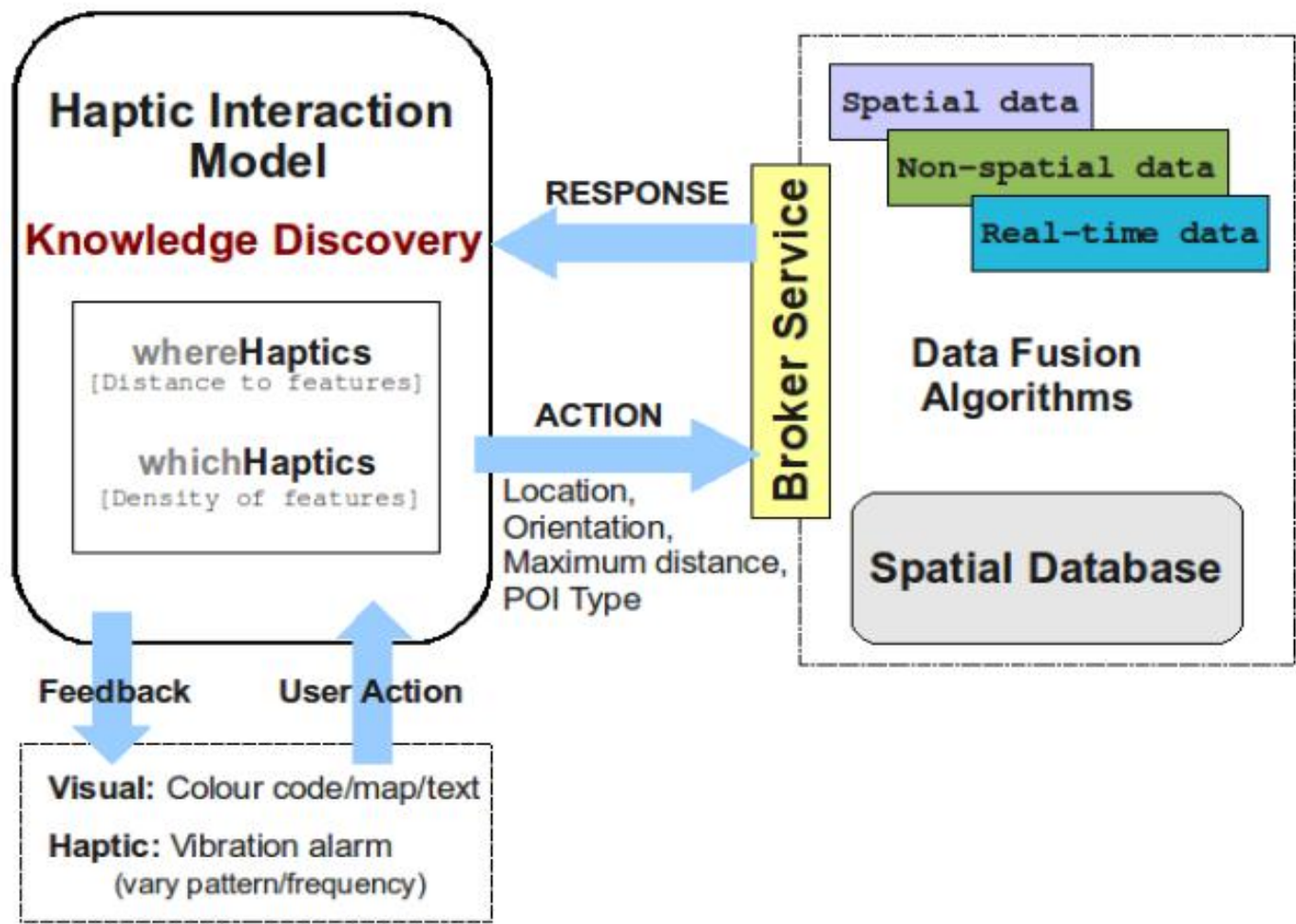
Queries/Tasks:

Where is the **nearest?**

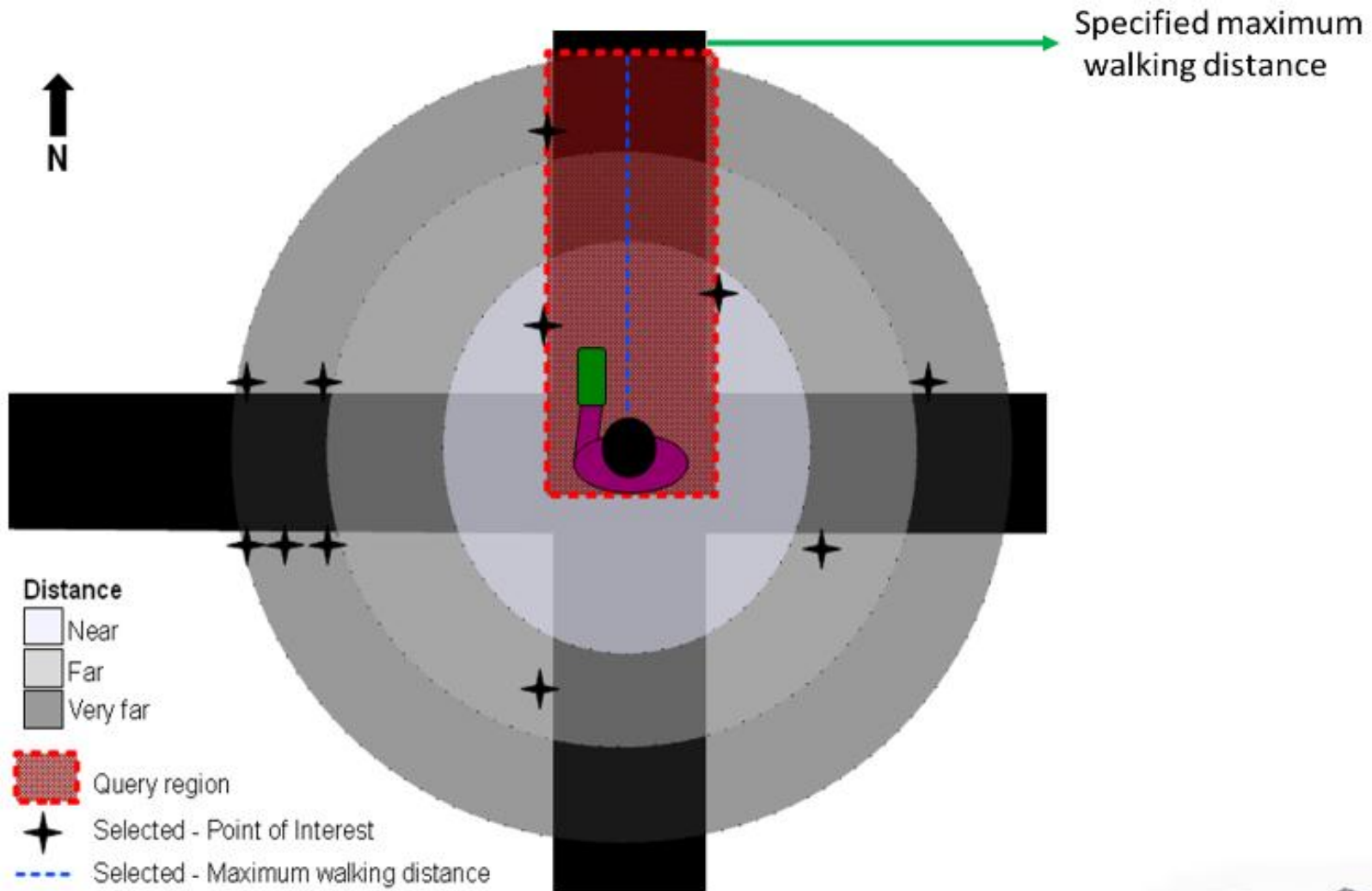
Which path has **higher density of POIs?**



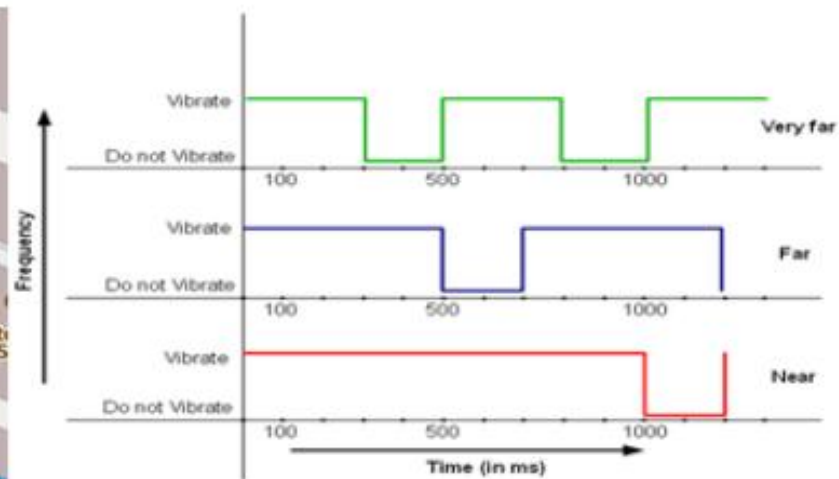
HapticGeoWand System Interaction Model



HapticGeoWand: How does the query work?



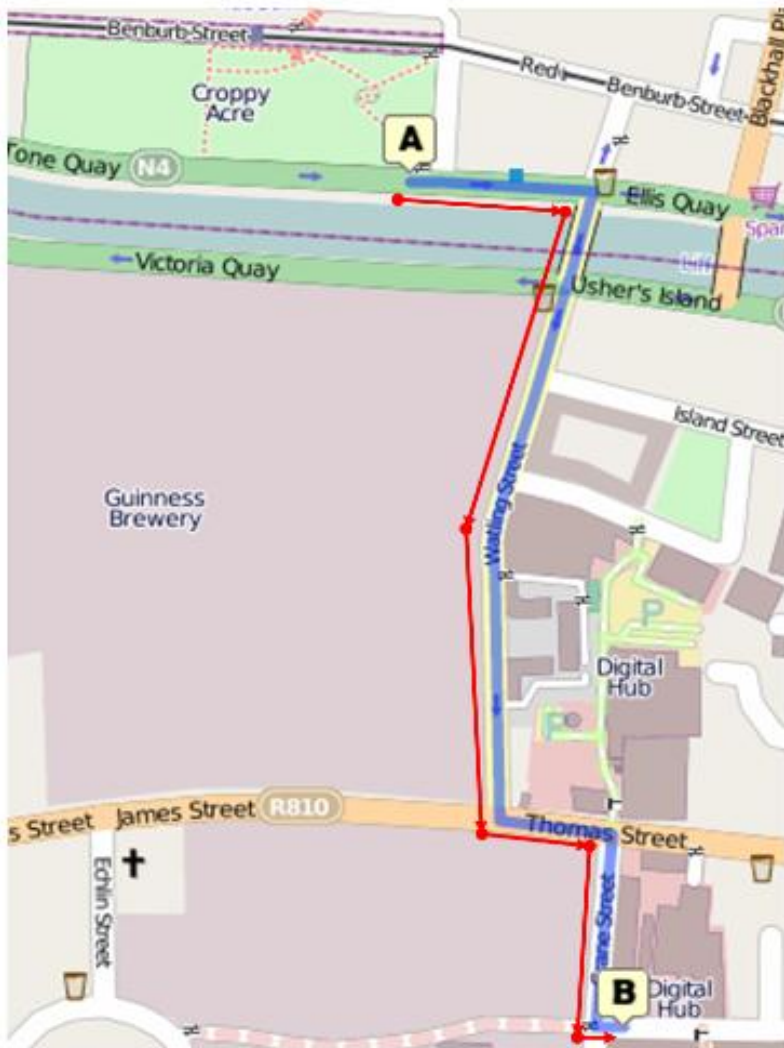
whereHaptics - Where is the nearest?



which Haptics - Which path has higher density of POIs?



Trip 1: Simple Route



Distance (m)		Time Taken (min)	
Routing Service	Using Haptics	Routing Service	Using Haptics
660	660	8	7

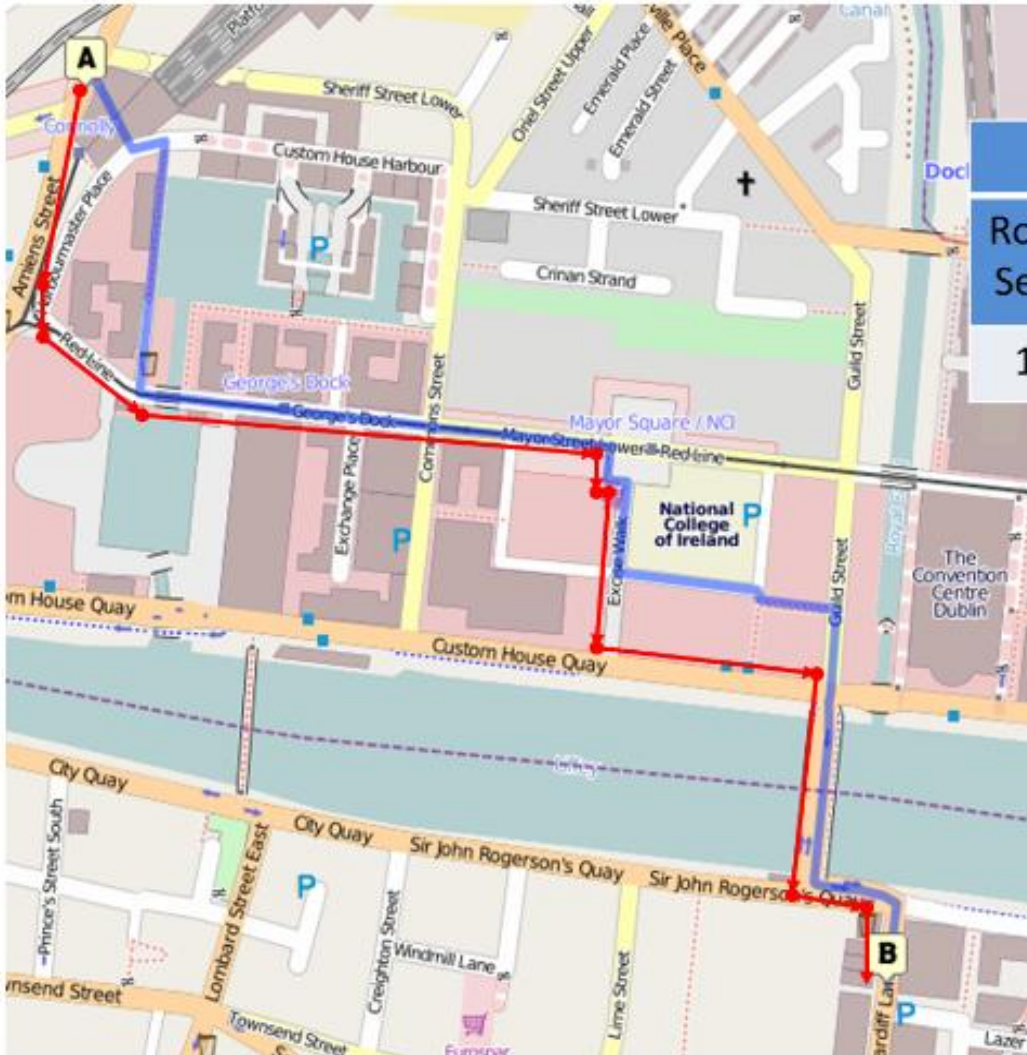
- Shortest Path
- User trail

Route type

Simple route. Very little change in general direction.



Trip 2: Moderate Route



Distance (m)		Time Taken (min)	
Routing Service	Using Haptics	Routing Service	Using Haptics
1200	1220	15	13

- Shortest Path
- User trail

Route type

Moderate route. Mix of long straights and changes in direction in between.



Trip 3: Complex Route



Distance (m)		Time Taken (min)	
Routing Service	Using Haptics	Routing Service	Using Haptics
860	890	10	12

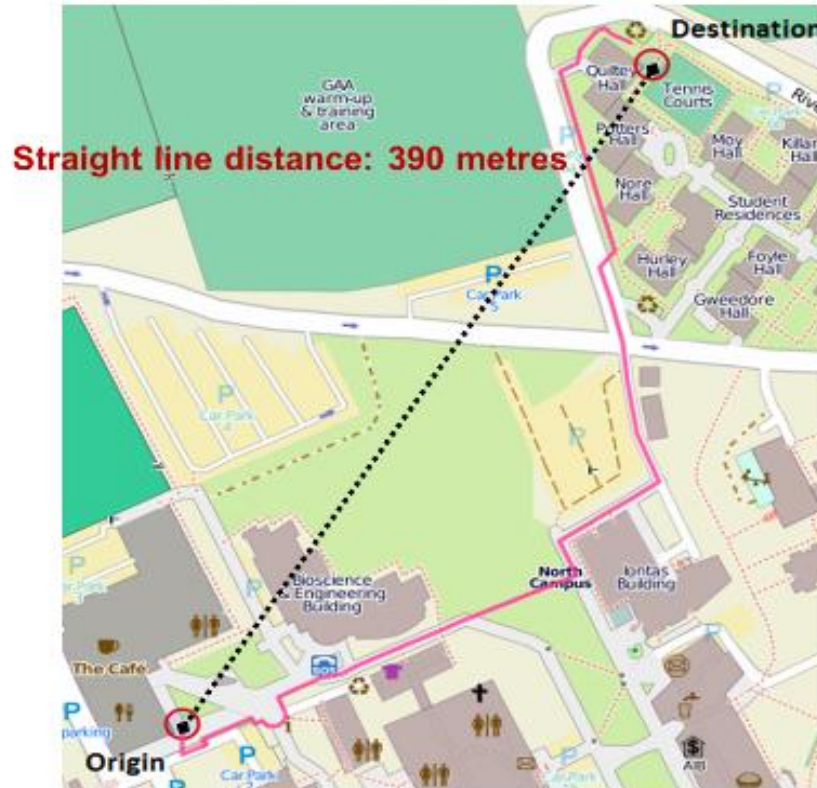
-  Shortest Path
-  User trail

Route type
 Complex route. City Centre – Dense Urban Environment



User Trials: Can you navigate using haptic feedback?

Cloudmade Routing Service



Distance: 536 metres
Time taken: 6.5 minutes

User who was quickest to finished the task



Distance: 652.57 metres
Time taken: 9 minutes



User Trials: Can you navigate using haptic feedback?



User Trials: Can you navigate using haptic feedback?



Many different characteristics

All users successfully reached the destination.

Users

- walked over open areas and paved paths.
- took different routes.
- travelled more distance.
- took more time to complete.
- were over all satisfied with the task.
- liked the subtle feedback.
- did not have to look into the device even once for guidance.



User Trials: Can you navigate using haptic feedback?

User	Distance Traveled (in metres)	Time Taken (in secs)	Comments
2	652.57	540	Finished task in the quickest time.
1	856.16	3	Took the longest time to finish the task.
2	652.57	540	Finished task in the quickest time.
3	938.84	1192	Took the longest time to finish the task.
4	812.68	960	Was taking more time at certain points.
5	784.32	7	Walked the longest distance. Poor with orientation.
6	845.12	940	Walked the longest distance. Poor with orientation.
7	949.89	940	Walked the longest distance. Poor with orientation.
8	758.22	748	Took time to re-orient at certain points
9	833.86	850	Used mostly paved ways. Paused more often.
10	912.31	975	Was finding it difficult to re-orient near the buildings.
11	885.43	12	Felt feedback was very subtle and good
12	781.32	843	Felt feedback was very subtle and good
13	692.54	689	Walked across car parks and beside buildings.
14	688.76	735	Took the path between the buildings.
15	711.87	759	Walked across open grass fields.



HapticGeoWand: The Interface.



Select maximum walking distance

Select POI

Click to query

Display response (Name and Distance)



Limitations of the haptics model

Users must **"get used to"** using the non-visual interaction techniques

Conveying complex spatial information in vibration patterns

Limitations of the data/environment

GPS accuracy is problematic

A **POI Rich database** of the urban environment (good currently for most cities and large towns in Europe)

These **databases must be updated** very frequently and be reliable



Haptics helps increase the **real-world interactions!**

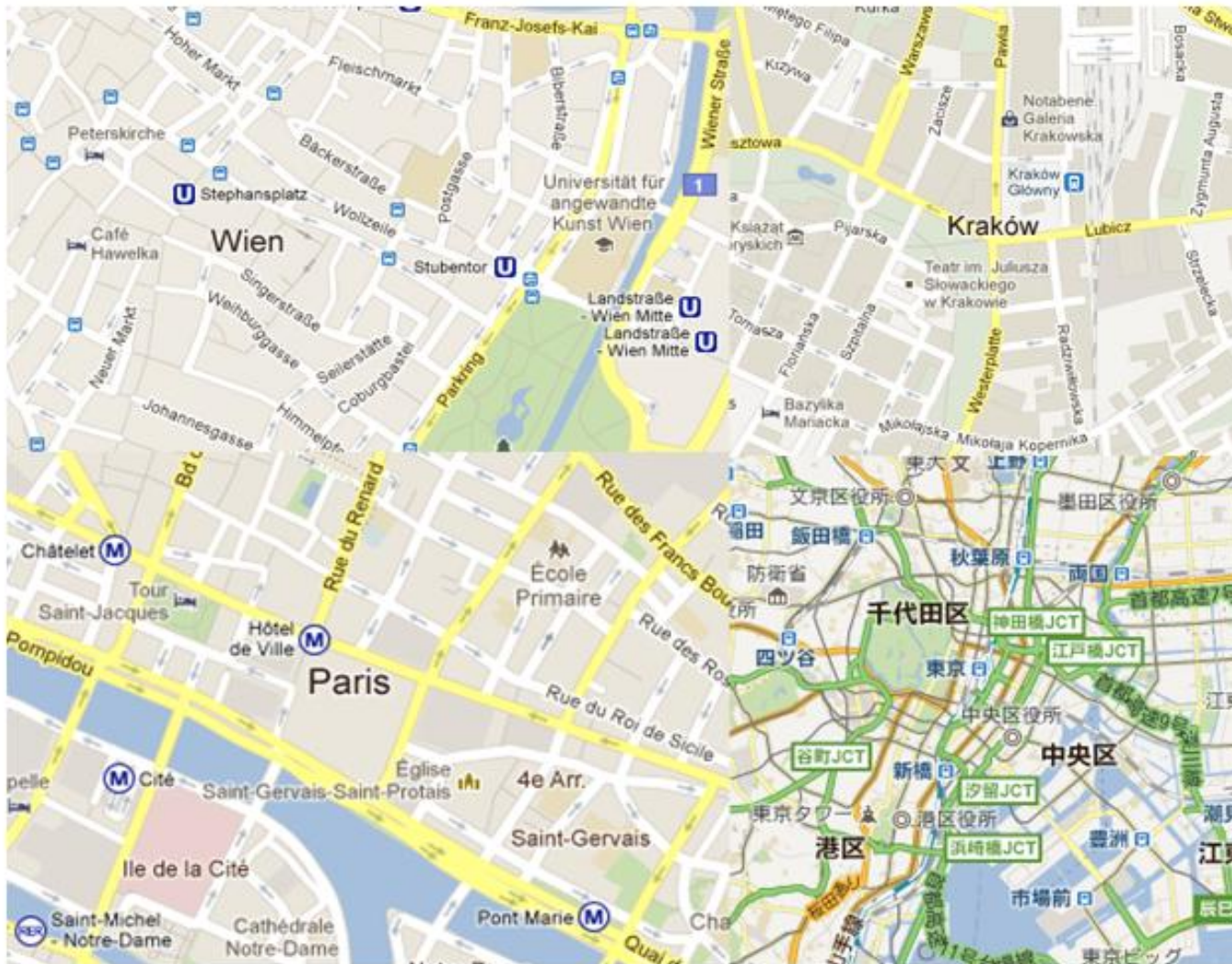
Although I hate it when socially awkward people abuse this privilege.



The Oatmeal <http://theoatmeal.com>



With Haptics, there is **No** language barrier!



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Concluding Remarks

In our user trials - we found that **users make decisions quicker** along the route, especially at intersections/junctions

Users were **able to navigate**, using haptic feedback, with comparable success to that of non-haptic methods

Haptics has great potential as an interface modality - particularly in **cases where purely visual interfaces are not suitable**



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So what next?

Spatial Cognition and Spatial Ability- currently **carrying out controlled experiments** with Dept of Psychology, NUIM to quantify the effects of haptics on people's spatial cognition and route following.

Explore a large model for haptics in Mobile LBS - integration of location, distance, density, orientation and real-time information.



Thanks for your time.

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