Location Based Services – GIScience in the Mobile Information Era

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Applications

- From navigation systems and mobile city guide
- To more diverse applications

- Become more “ubiquitous”
Research Foci

- **Design of human-centered LBS**
  - Mobile guides, navigation systems

- **Modelling of people’s spatial behaviors and experiences**
  - (using LBS and location/activity-sensing technology)
  - Crowdsourcing urban emotion
  - Mobile crowdsensing

- **Impact of LBS on our mobile lives**
  - Privacy
  - Ethics
Research theme 1

Human-centred LBS
Theme 1: Human-Centered LBS (1)

- Mobile pedestrian navigation systems
  - Modelling of pedestrian/wheelchair networks (geometry and road attributes)\(^1,2\)
  - **Route planning**: computing a suitable route from A to B [project: EmoRoute\(^3\)]
  - **Route communication**: with maps, augmented reality, and verbal languages [projects: SemWay\(^4\), ways2navigate\(^5\), “Watch your steps”\(^6\)]

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\(^6\)Huang, H et al. (submitted): Watch Your Steps - Pedestrian Navigation via Smartwatch. Submitted to Cartography and GIScience

- Walk straight, pass the WC, turn left, and cross the lobby.
Theme 1: Human-Centered LBS (2)

• Mobile city guides
  – Context-aware location recommendations\textsuperscript{6,7}
  – “In similar context, other people similar to you often went to ...”


Theme 1: Human-Centered LBS (3)

• **Previous and on-going MSc projects**
  – Indoor spatial modelling to support indoor navigation (UZH)
  – Multimodal route planning with carpooling and public transportation (UZH)
  – Automatic Generation of Landmark-based Route Instructions for Indoor Navigation (TU Wien)
  – Smart watch based pedestrian navigation (TU Wien)
  – “Route-free” navigation guidance (compared to “turn-by-turn”) (UZH)

• **Open MSc topics** (Skills: interface design and empirical studies)
  – Multi-device user interface and interaction (e.g., navigation with a smartphone and a smartwatch)
  – LBS to support collaborative task (e.g., a group of users navigating in an unfamiliar city with a single or multiple smartphones)
  – Mobile maps for supporting mixed indoor/outdoor navigation
  – Standardizing the service interfaces of indoor positioning solutions
Research theme 2

Modelling of people’s spatial behaviors and experiences
(Analysis of location based big data)
Theme 2: Location-Based Big Data (1)

• Using LBS and location/activity-sensing technology to model people’s spatial experiences and behaviour
  – e.g., emotions towards environments, mobility within a city, ...

• **Mapping Urban Emotions**\(^1,2\)

• **Healthy aging** – analysis of elderly’s daily mobility, activity, and social interactions
  – Project: Can smartphone sensors replace traditional clinical equipment?

• **Crowdsensing free on-street parking spots** (via GPS + accelerometer) \(\rightarrow\) real-time availability of parking spots
  – With startup company Parkbob

• **Analysis of (big) location-based tracking and social media data**
  – Place modelling (location, locale, sense of place)\(^3,4\): in contrast to space
  – Traffic modelling with app. in insurance and healthcare: new EU H2020 project

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Geo-social layer

- City is a living organism defined in large by how people perceive, experience, and behave.
- A social layer on top of the physical layer.

Urban planning and sustainable development, transportation, quality of life, cultural and social analysis, ... “Enabling Smarter Cities”
Theme 2: Location-Based Big Data (3)

• **Previous and on-going MSc projects**
  – Do Taxi drivers take the shortest routes in Vienna?
  – Transport mode detection using Cellular Signaling Data
  – Analyzing Mobility Patterns in New York City Using a Big Multi-Source Dataset
  – Predicting public train delays using a network based approach

• **Open MSc topics** (R/Python Programming, big data processing)
  – Comparison of mobility indicators derived from GPS data and mobile phone network data for health applications
  – Analysis of taxi drivers’ route choice behaviors in San Francisco
  – Classification of indoor shopping behaviors
  – Parking Event Detection Using Smartphone Sense Data
  – Prediction of parking availability from crowdsensed data
Crowdsensing free on-street parking spots

- Cooperation with start-up

- Helping people to early find a parking spot in cities

Detection of parking events based on smartphone sensor data

250K active users in Vienna (Austria)

Predicting the lifespan of a free parking spot

“How long will this parking spot be available?”
Research theme 3
Impact of LBS
Introduction

• LBS enter into general public’s daily life.
• People more and more rely on LBS to facilitate their activities and decision-making in space.

• Impact of LBS in daily life
  – How do LBS (e.g., navigation systems) influence people’s spatial ability\(^1\)?
  – How do LBS influence/change our understanding of privacy, as well as our responses toward privacy?

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Navigation systems and spatial cognition

• “Side effect” of mobile navigation systems
  – Project Ways2navigate (2010-2012): Spatial knowledge acquisition during navigation is poorly supported.
  – “Technologies change how we think, often by reducing our ability to reason effectively without the technology”

Theme 3: Impact of LBS (3)

- **Open MSc topics**
  - The impact of selfish routing (e.g., shortest routes)
  - How do LBS influence/change our understanding of privacy, as well as our responses toward privacy?
  - Impact of LBS on spatial abilities
Improvement of Spatial Awareness during the Use of LBS

- “Technologies change how we think, often by reducing our ability to reason effectively without the technology”
  - Navigation systems lead to poor spatial awareness.

- How do environment, user, and LBS interact with each other?

- → Enhancing spatial awareness

- Environment: reality through the eyes
  - LBS: representation of reality (visual or verbal)

- Mental Map (perception/cognition of reality) and Preferences
  - On-going PhD project: “Applications of mobile eye-tracking in LBS research”
• Design of human-centered LBS (in contrast to technology-centered)

• Modelling of people’s spatial behaviors and experiences
(Analysis of location-based big data)

• Impact of LBS on our mobile lives

• Interests? Or having your own ideas? Talk to me.

• Want to know more about LBS? Join Geo 884 in the Spring semester
  – Mobile programming, research in LBS, self-driving cars, social and ethical issues, ...