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Mobile and Ubiquitous Computing

Location System Properties

George Roussos

g.roussos@dcs.bbk.ac.uk

Birkbeck

Overview

- Properties of location systems
- Choosing the right one
- Limitations
- Implications of location data

Location System Properties

- Physical position and symbolic location information
- Absolute versus relative locations
- Localized location computation capability
- Accuracy and Precision
- Scale
- Recognition capability
- Cost
- Limitations

Physical Position and Symbolic Location

- Location information can be
  - Physical (47º39'17'' N by 122 º18'23" W)
  - Symbolic (in the kitchen, next to a mailbox)
- Symbolic location information can be derived by physical position with additional information.
- Using only symbolic location information can yield very coarse-grained physical positions

Absolute vs. Relative

- Absolute location system
  - Shared reference grid for all objects
  - Can be transformed into a relative location
- Relative location system
  - Each object may have own frame of reference
  - Can transform into absolute location from relative location readings
    - Must know absolute position of reference points

Localized Location Computation

- Location computation can happen in:
  - The object being located
    - Ensures privacy
  - The external infrastructure
    - Lower computational and power demands on objects
    - Many more applications possible

Accuracy and Precision

- Accuracy
  - Grain size (e.g. “within 10 meters”)
- Precision
  - Probability of achieving a particular accuracy
- Sensor Fusion
  - Tries to improve accuracy and precision through integration of location systems to form hierarchical and overlapping levels of resolution
- Adaptive Fidelity
  - Ability to adjust precision in response to dynamic events like partial failures.

Scale

- Scale assessed by:
  - Coverage area per unit of infrastructure (e.g “1 base station per 10 square meters”)
  - Number of objects the system can locate per unit of infrastructure per time interval (e.g. “25 computations per room per second”)
- Larger scale achieved by increasing infrastructure

Recognition

- Necessary for applications that take specific actions based on location of object (e.g. airport baggage handling system)
- GUID (Globally Unique ID)
  - Used to provide recognition capability
  - Combined with other contextual information allows for different object interpretations in different settings. (e.g retrieving museum information in a particular language)

Cost

- Time
  - Installation process length
  - System administration needs
- Space
  - Amount of installed infrastructure
  - Hardware size
- Capital
  - Price per mobile unit or infrastructure element
  - Support personnel salaries

Limitations

- Improper functionality in certain environments:
  - Signal strength indoors
  - Exceeding request limits
  - Frequency interference

Two major issues

- System operation is transparent
  - invisible, everywhere computing
  - guarantee the rights of users
- Trust is a non-cognitive process and thus is hard to compute with (trust is different to trustworthiness)
  - overall acceptance of location sensing depends on whether it is perceived as “fair”
    - Use of GSM data for example
  - More usable solutions that employ localised computation

Three decisions

1. Initial entitlement:
   - Allocation of property rights
   - Who should get the initial right to control the information generated by location sensing?
2. Coercion and choice:
   - If you want discount you will get the technology.
3. Societal overrides:
   - When does society, regardless of your preference, get access to the data anyway?

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