Sensor Fusion: A Technique To Improve Location Systems

E-NEXT WG1 TF

Thomas King

University of Mannheim

king@informatik.uni-mannheim.de

UNIVERSITY OF MANNHEIM

Motivation

- Various applications require location information
  - mobile ad-hoc routing: position based routing
  - mobile business: context-aware applications
- various location systems are around
- no highly accurate, easy-to-use indoor location systems is available

Motivation

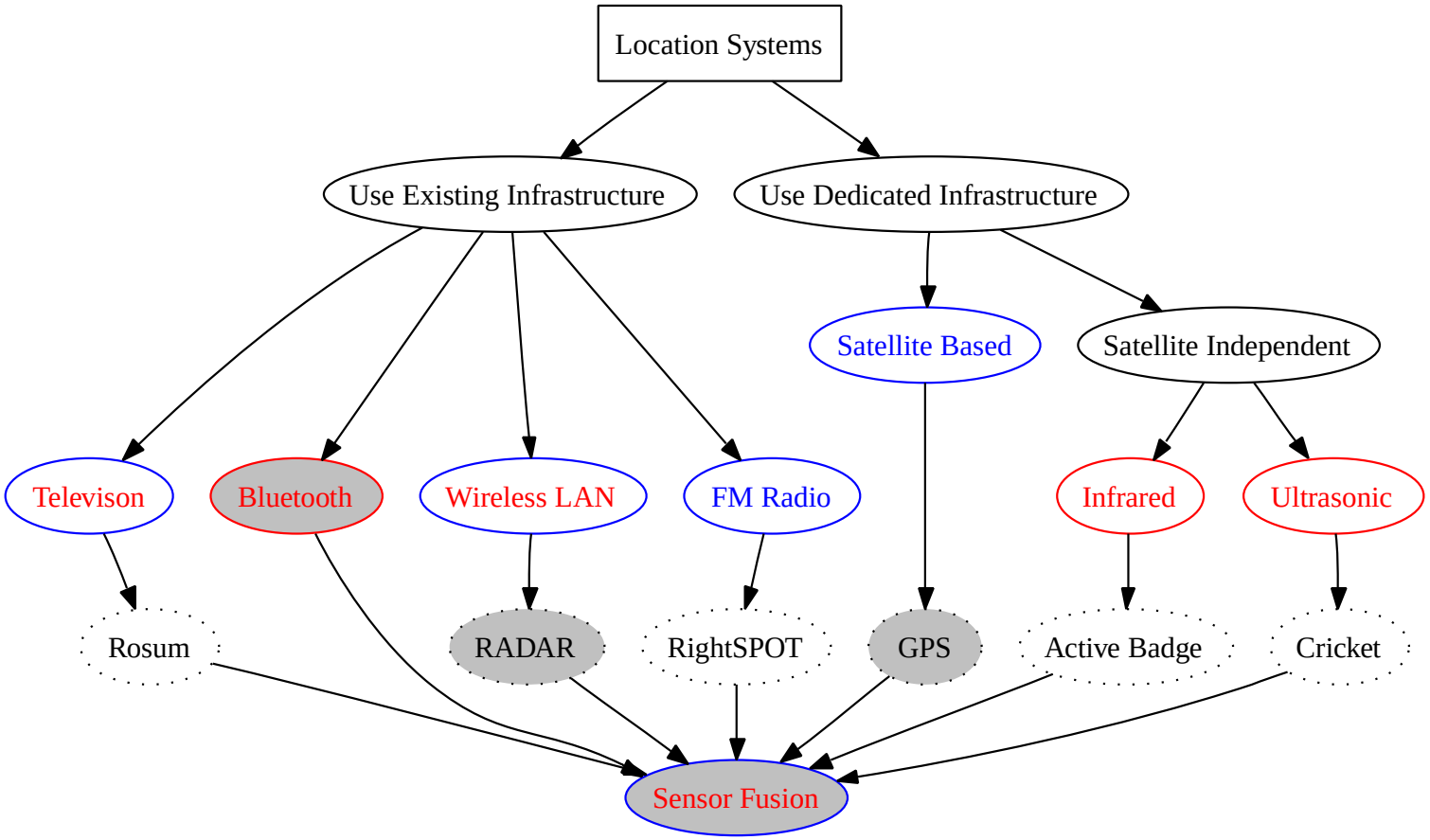
- Various applications require location information
  - mobile ad-hoc routing: position based routing
  - mobile business: context-aware applications
- various location systems are around
- no highly accurate, easy-to-use indoor location systems is available

$\Rightarrow$ we investigate sensor fusion based location systems

Outline

- Categorization
- Existing Work
- Sensor Fusion
- Conclusion

Categorization



Global Positioning System - Overview

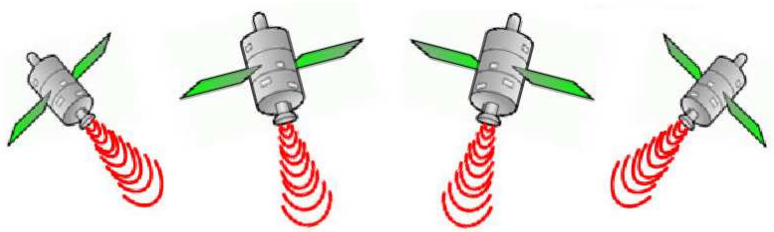
- designed for the U.S. military
- funded and operated by the Department of Defense
- operational since 1995
- 24 satellites orbit the earth at a height of 20.000 km
- provides an accuracy of 5-20 meters in 95 percent of all cases

Global Positioning System - Flaws

- a line of sight to at least 4 satellites is required
- the GPS signals are blocked by obstacles (walls, foilage, ...)

Global Positioning System - Flaws

- a line of sight to at least 4 satellites is required
- the GPS signals are blocked by obstacles (walls, foilage, ...)

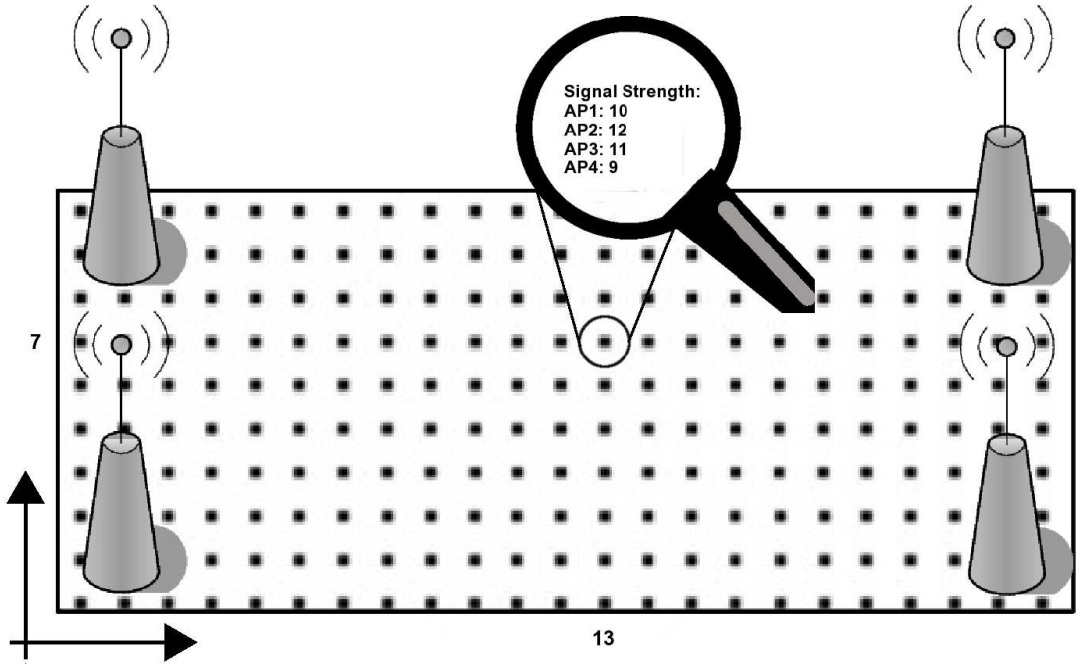


RADAR - Overview

- wireless LAN access points are used to determine the position of mobile devices
- two step approach:
  - trainging phase: a database with signal strength values of the operation area have to be created
  - location phase: uses this database
- median distance error 2.5 meters

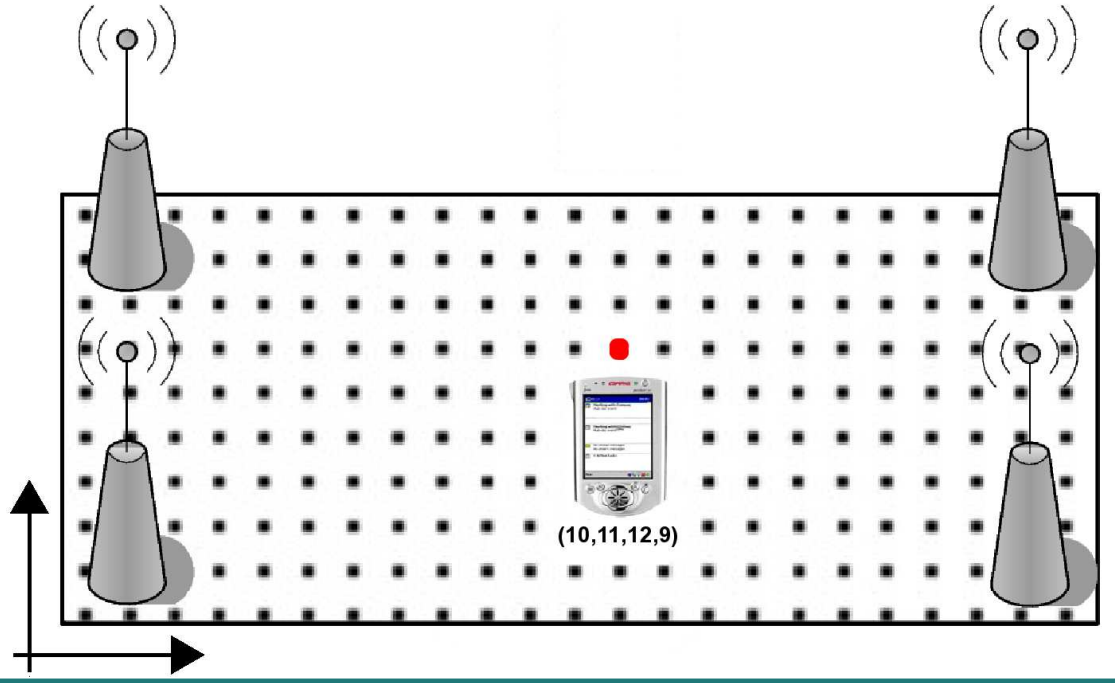
RADAR - Database

- a dense grid of measurement points is required



RADAR - Positioning

- the mobile device measures the signal strength of the access points in communication range
- the mobile device compares this sample with the values stored in the database

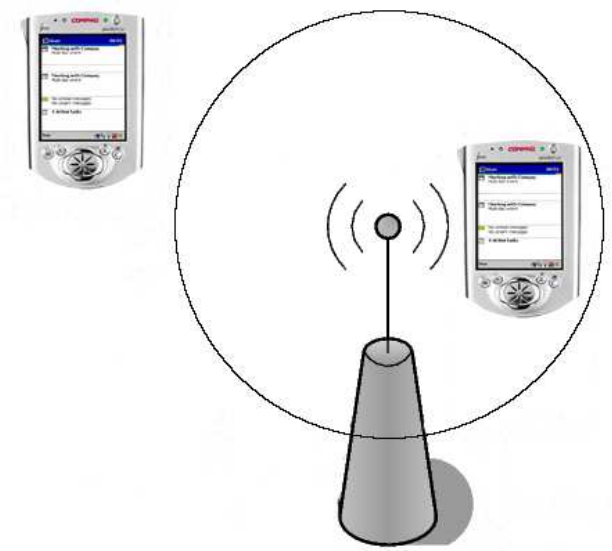


Bluetooth

- invented to replace low-bandwidth cabling e.g. computer peripherals
- communication range up to 10 meters
- proximity based location determination

Bluetooth

- invented to replace low-bandwidth cabling e.g. computer peripherals
- communication range up to 10 meters
- proximity based location determination



Sensor Fusion - Overview

- modern mobile devices contain a multiple of communication and sensor interfaces (e.g. Wireless LAN, Bluetooth, GSM, ...)

Sensor Fusion - Overview

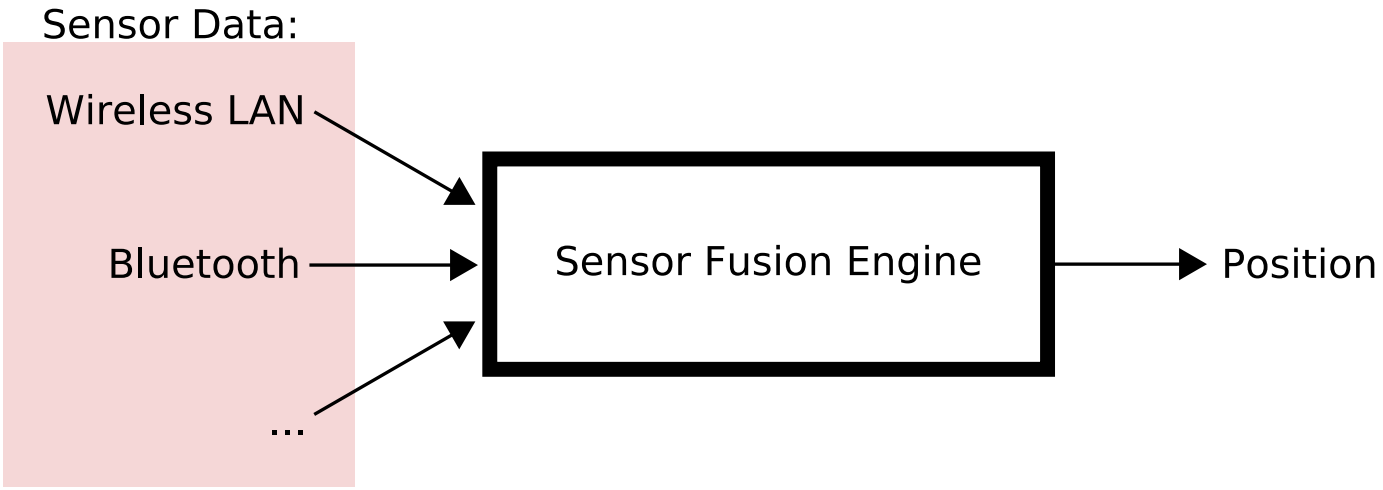
- modern mobile devices contain a multiple of communication and sensor interfaces (e.g. Wireless LAN, Bluetooth, GSM, ...)

$\Rightarrow$ exploit the correlation between sensed parameters to increase the positioning accuracy and availability

Sensor Fusion - Overview

- modern mobile devices contain a multiple of communication and sensor interfaces (e.g. Wireless LAN, Bluetooth, GSM, ...)

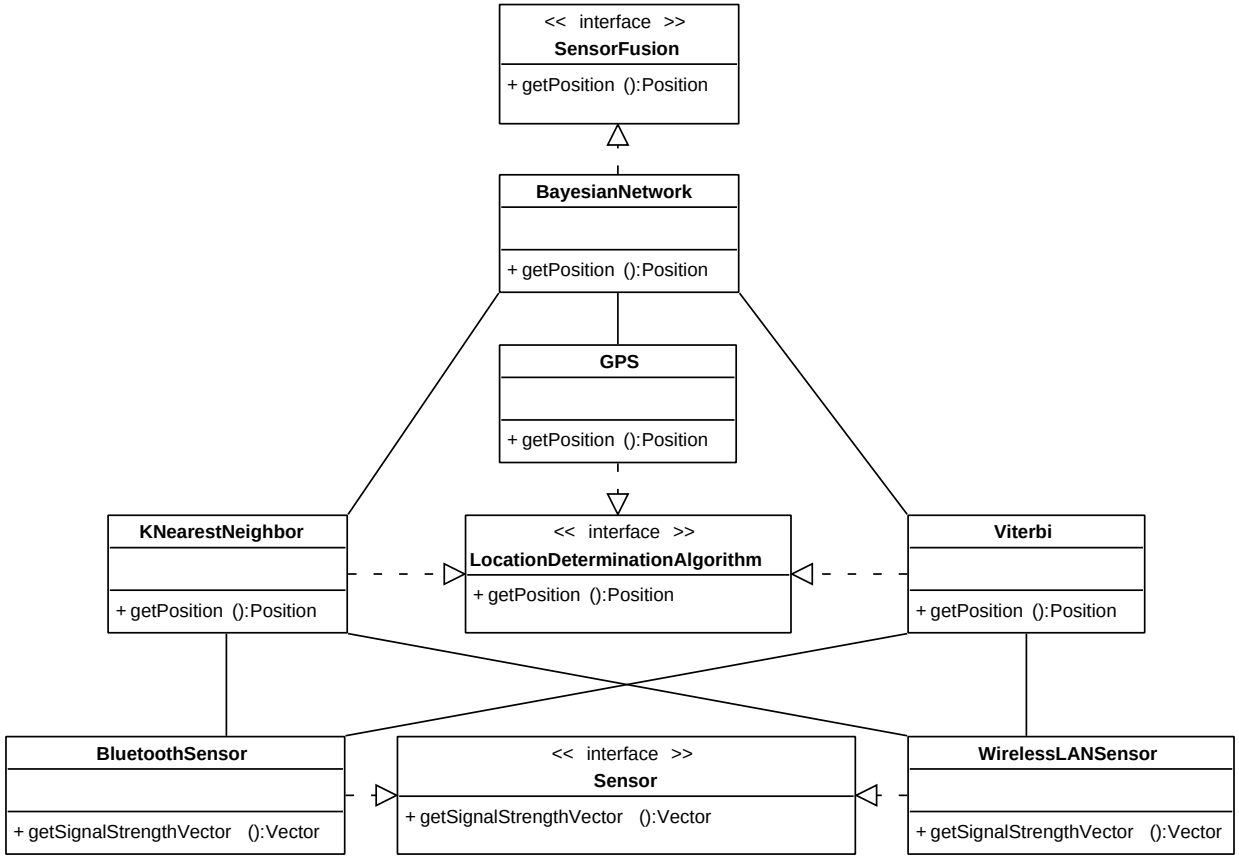
$\Rightarrow$ exploit the correlation between sensed parameters to increase the positioning accuracy and availability



Sensor Fusion - Challenges

- challenges:
  - different sensor types provide different accuracy and precision
  - sensor data is often noisy
  - position estimates from different sensors may conflict with each other

Generic Location System Architecture



Conclusion

- Categorization of location systems
- Existing Work
  - GPS
  - RADAR
  - Bluetooth
- Sensor Fusion