Methods & Tools

Mike Pennisi

March 22, 2010

Introduction to Ubiquitous Computing

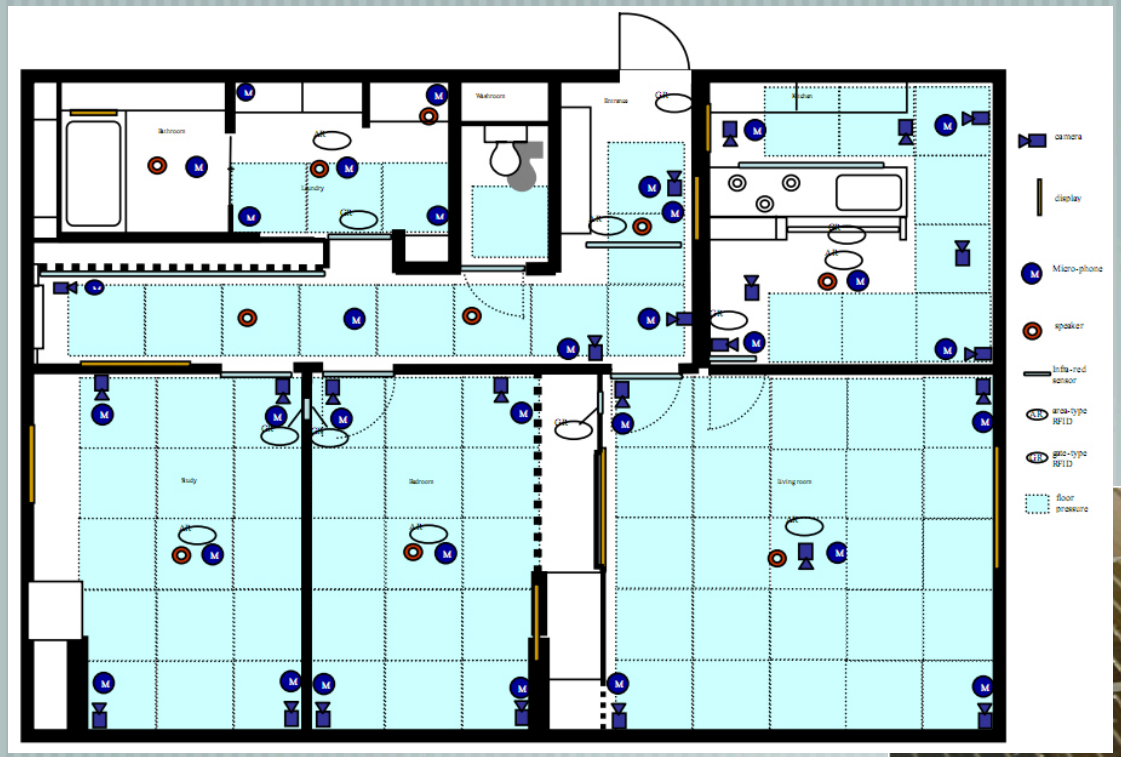
Visions

Challenges

Methods and Tools

Evaluation of Video Summarization for a Large Number of Cameras in Ubiquitous Home

The Ubiquitous Home



TRECVID Benchmarks

Key Frames?

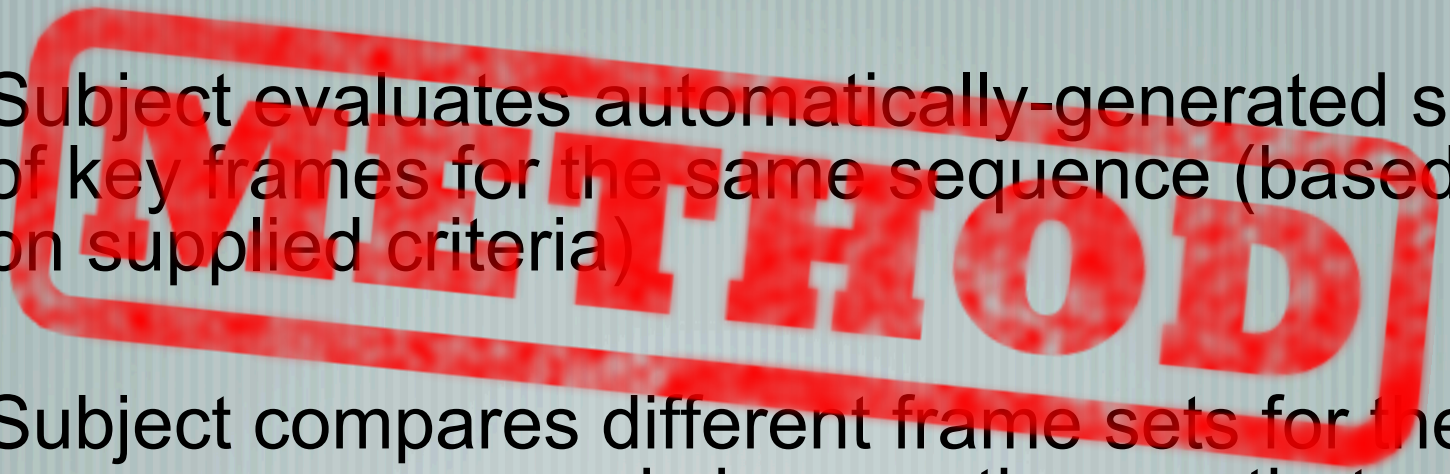
Sampling Algorithm	Conditions
Spatial	At every camera change
Temporal	Once every T seconds
Spatio-temporal	•At every camera change •If T seconds elapsed with no camera change after the previous key frame
Adaptive Spatio-temporal	•At every camera change •If t seconds passed without a camera change where: t = T(1 – n / 20) if 1 <= n <= 10 t = T / 2 if n >= 10

Evaluation

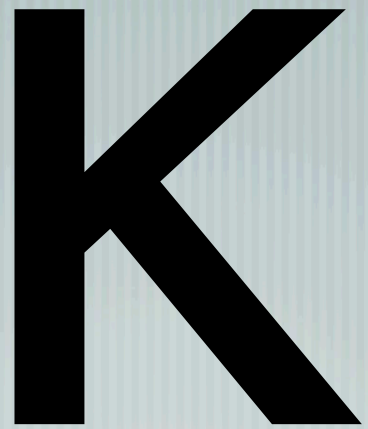
1. Test subject browses sequence, selects key frames to summarize it

2. Subject evaluates automatically-generated sets of key frames for the same sequence (based on supplied criteria)

3. Subject compares different frame sets for the same sequence and chooses the one that summarizes best. Then answer two open-ended questions



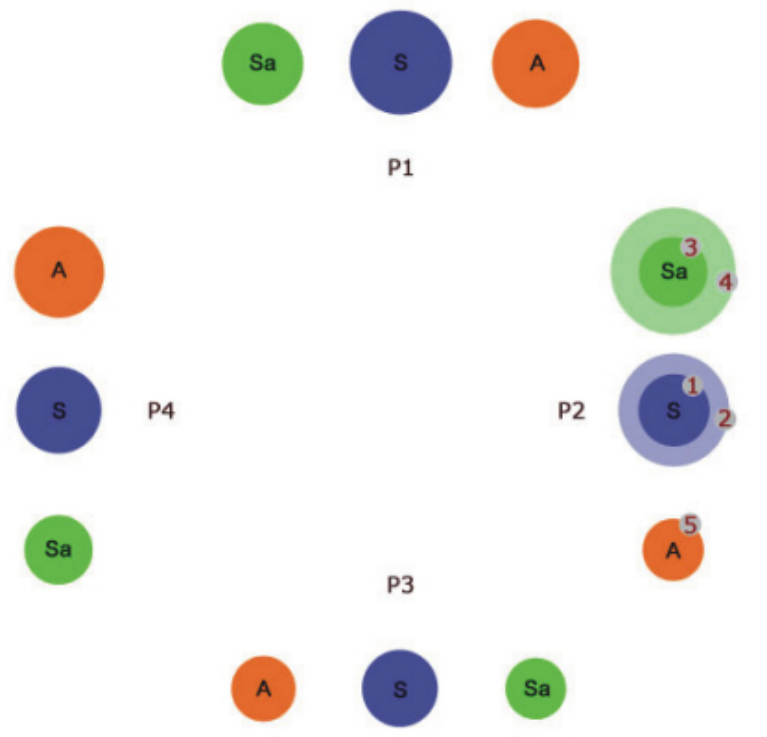
Aside: Evaluation in Machine Learning

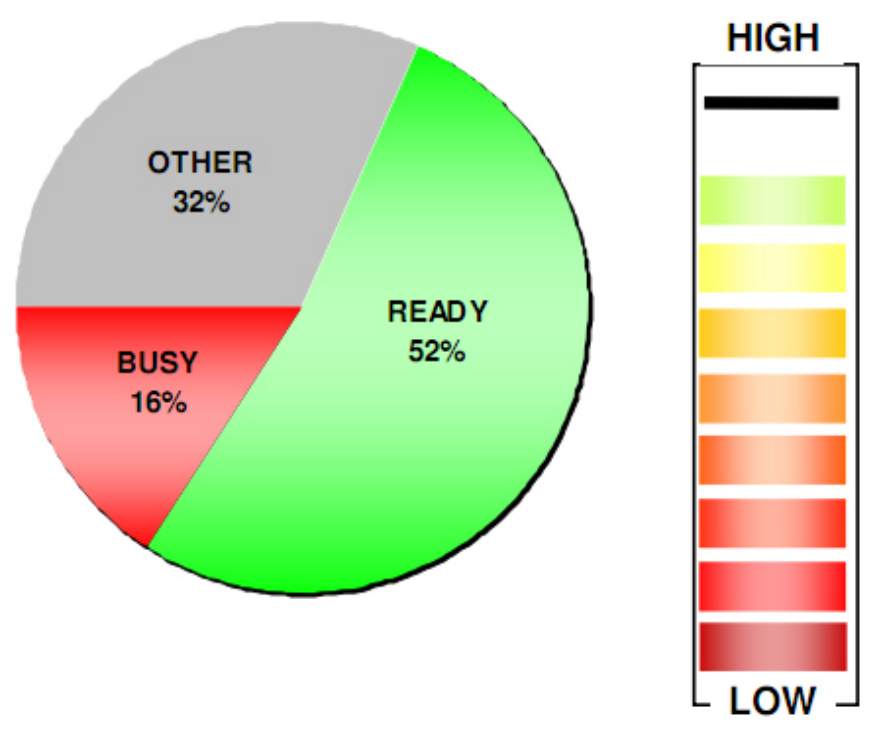


User-Centered Design and Evaluation of Ubiquitous Services

CHIL

Computers in the Human-Interaction Loop





Evaluation Techniques

Summative

vs.

Formative

Finding Meaningful Uses for Context-Aware Technologies: The Humanistic Research Strategy

Humanism

"Humanism believes in human rationality, creativity, and morality, and recognizes that human values have their source in experience and culture."

Humanistic Research Strategy

Relevance

Understanding

Empowerment

Humanistic Research Strategy

Relevance

Population Trends

Motivations

Understanding

Empowerment

Humanistic Research Strategy

Relevance

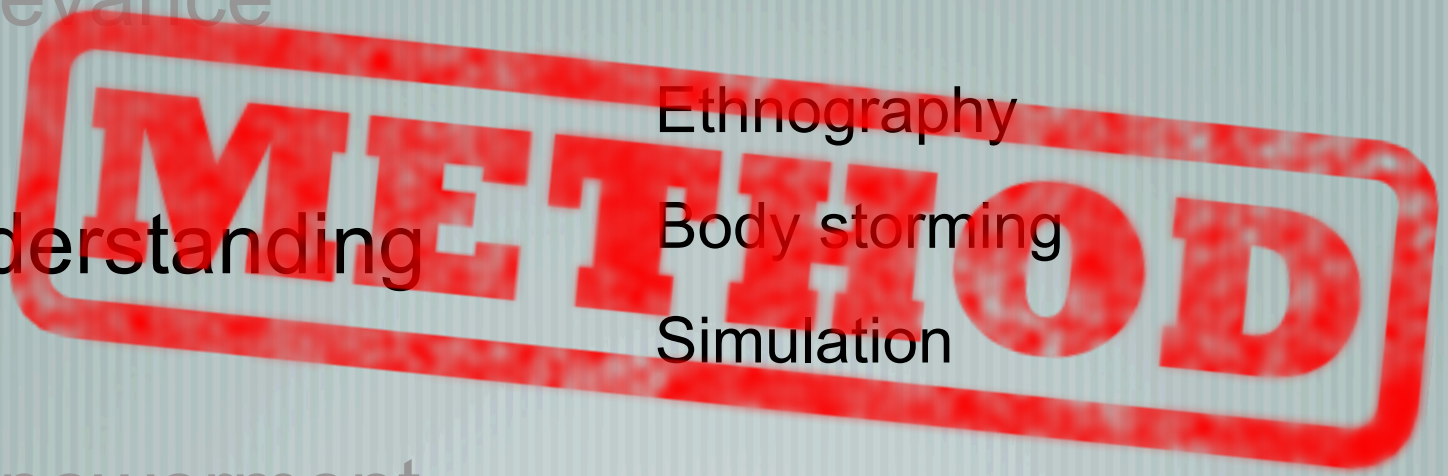
Understanding

Empowerment

Ethnography

Body storming

Simulation



Humanistic Research Strategy

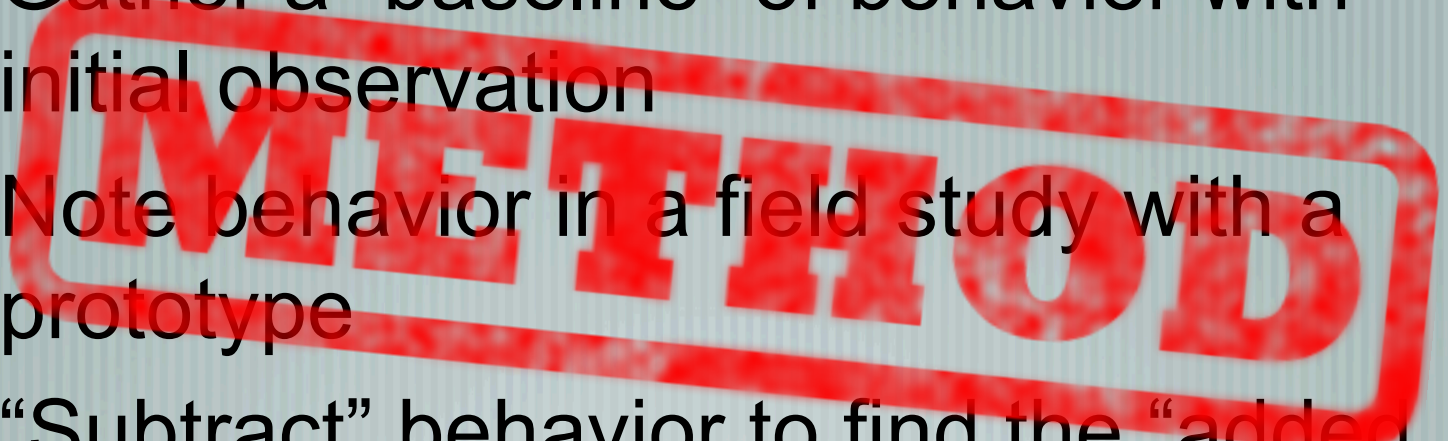
Relevance

Understanding

Empowerment

Subtraction Method

1. Gather a “baseline” of behavior with initial observation
2. Note behavior in a field study with a prototype
3. “Subtract” behavior to find the “added value,” or what is “left-over”



Understanding and Measuring the Urban Pervasive Infrastructure

Urban Pervasive Infrastructure

City as a system

Parameters:

- People
- Space
- Technology

Measurable Characteristics

Mobility

Social Structure

Spatial Structure

Temporal Rhythms

Facts and Figures

Aside: Small World Experiment

Stanley Milgram

Yale University, 1960's

War Driving

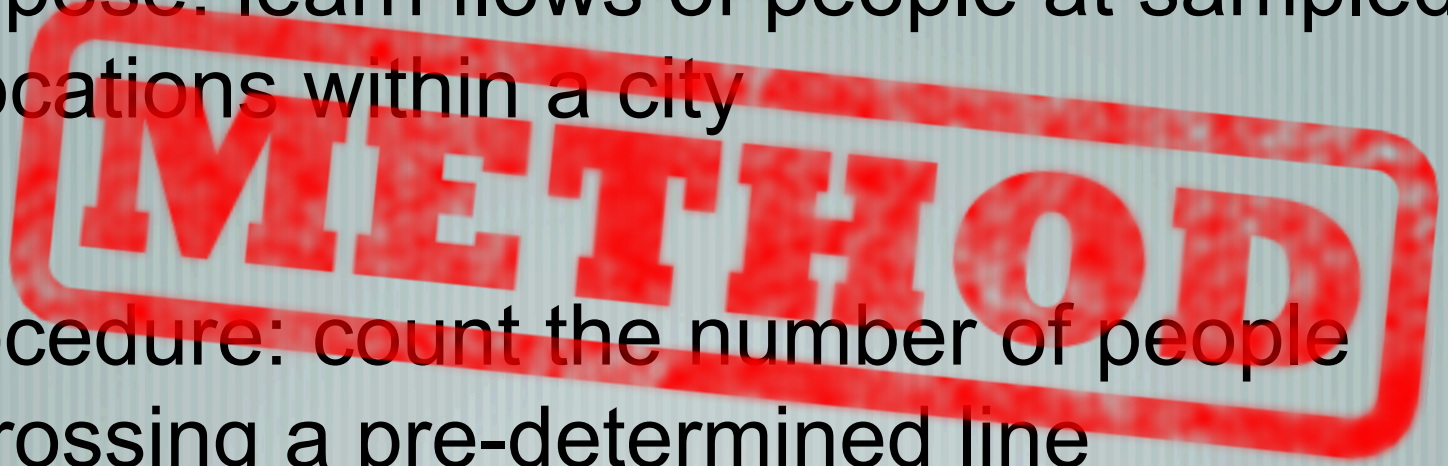
Purpose: gain an understanding of the wireless infrastructure

Procedure: systematically move through city, noting presence of mobile phone towers, use of mobile phones, laptops


WARCART

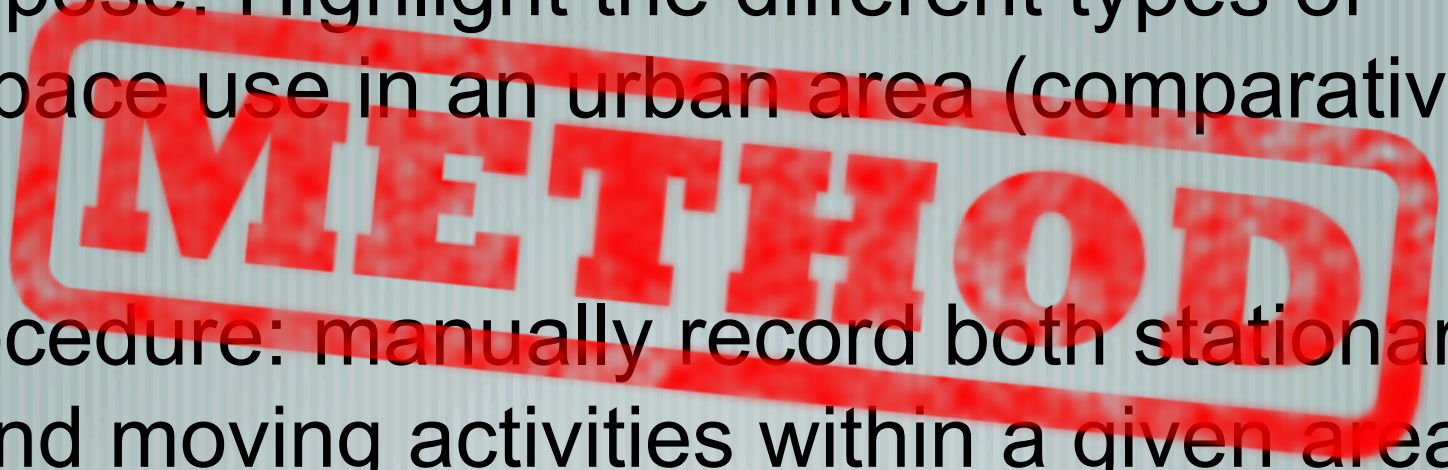
Gatecount

Purpose: learn flows of people at sampled locations within a city



Procedure: count the number of people crossing a pre-determined line

Static Snapshot

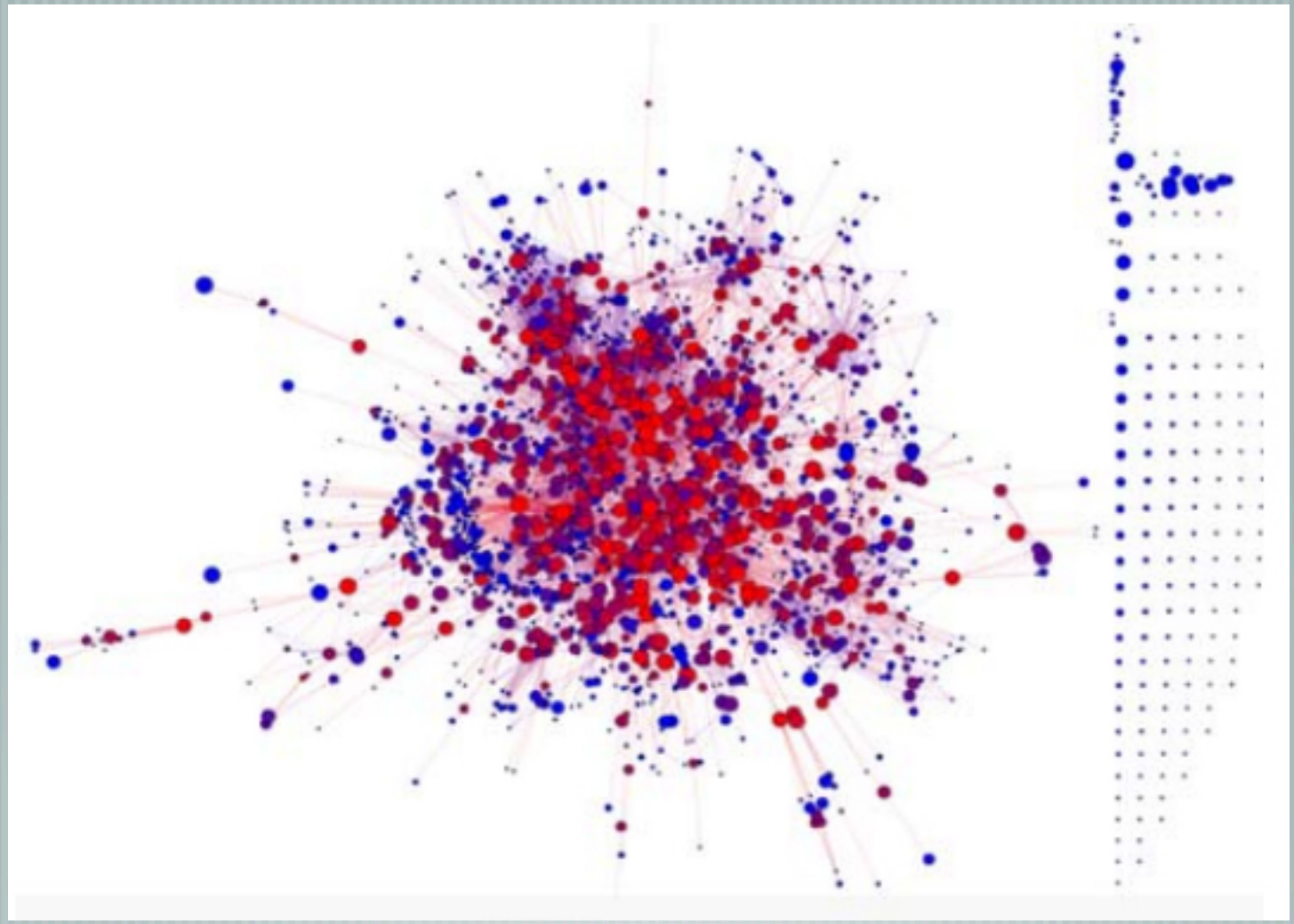


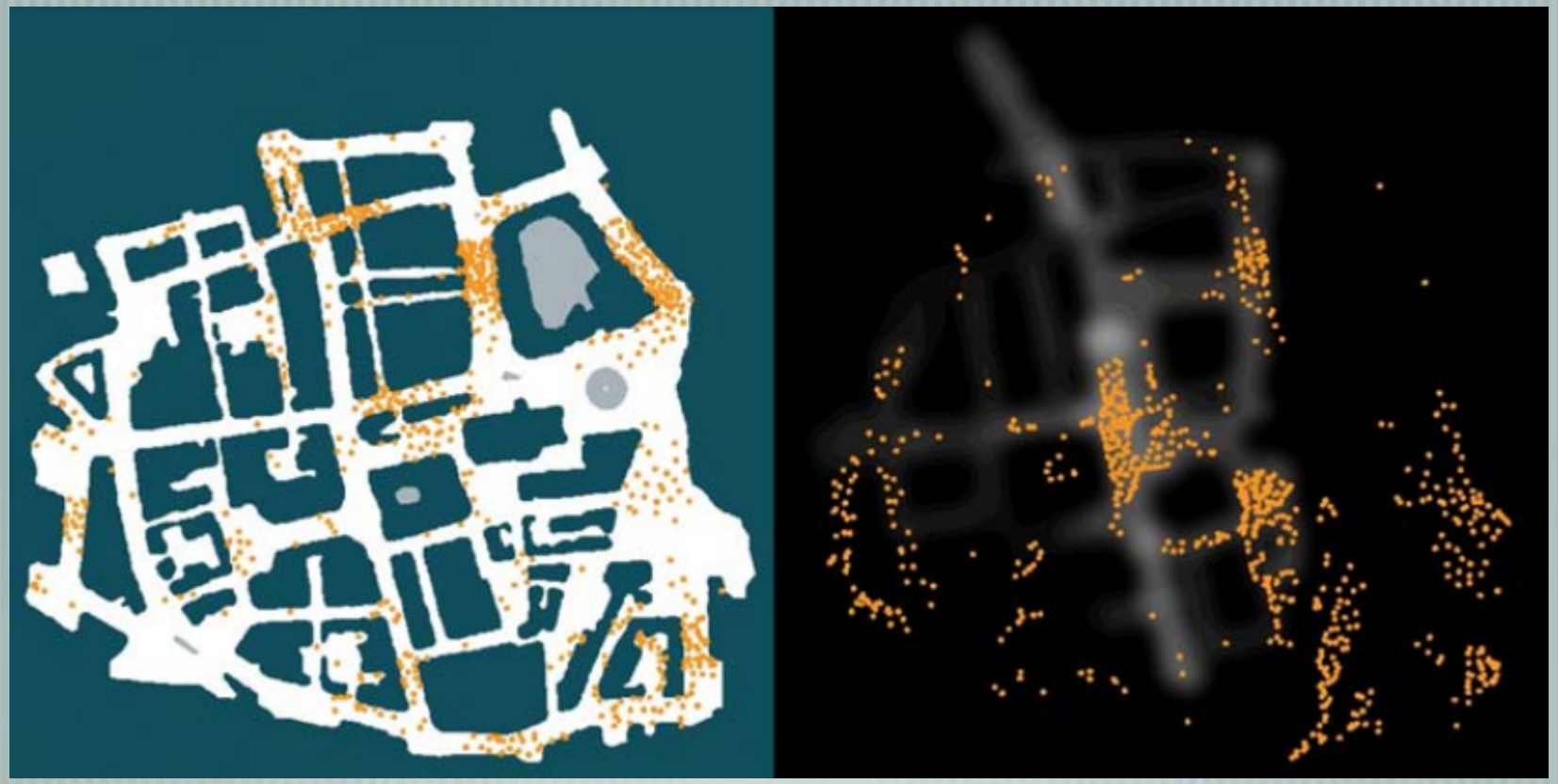
Purpose: Highlight the different types of space use in an urban area (comparative)

Procedure: manually record both stationary and moving activities within a given area

Analysis

- Gatecount datasets
  - Bluetooth device penetration
  - Device brands
- Static snapshots
  - Social network graphs
  - Movement through city
- Device contact patterns
  - Network opportunities that arise in a city





Aside: Familiar Strangers

Originally studied by Stanley Milgram

Research on those people we recognize by face but to whom we've never spoken

More recently studied by CMU's own Eric Paulos

Emulation & Simulation

Emulation

- Explore “what if” situations by tuning parameters
- Initial testbed for novel applications

Simulation

- Evaluate a pervasive application across different cities
- “Plug in” target city parameters and run