Methods & Tools

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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?

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

Understanding

Empowerment

Population Trends

Motivations
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
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