Outline

I. Overview on Mobile Analytics
II. Mobile Analytics for Emergency Response
III. A System for Mobile Analytics
   a) Input Data
   b) Visualizations
Mobile Visual Analytics

• Science of analytical reasoning facilitated by interactive visual interfaces
• Extending the process using mobile devices
  • increases effectiveness and interactivity of on-site analysis
  • can be helpful for first responders
→ Rapid and on-site decision making
→ Improve situational awareness

Goals of Mobile Analytics

• Mobile device as valuable tool for emergency response by tracking in-field actions and events
• Visualizing relevant, selected information on devices with varying capabilities and resolutions
Problems

• General visual analytics approaches do not apply because of intense hardware limitations (screen, memory, processing power)
• Time is critical: reduce time for information gathering but focus on response actions
• Need new approaches that enable visual analytics on mobile devices
  • transform data (bitmap graphics to vector graphics)

Mobile Analytics for Emergency Response

1) Provide first responders with all the information they need to make quick and good decisions
e.g. hostage in school:
  • Where are team members?
  • Where are responding personnel?
  • Where are secure, neutral and hot zones of the incident?

2) Allow after-action-reviews (AAR):
  • recap what happened during the incident
  • what could have been done better?
Examples

A System for Mobile Analytics
Input Data

1. Personnel related (simulated)  
   → ID, position, time, …
2. Situational information (simulated)  
   → temperature, water contamination, …
3. Static Scene related information  
   → 2D map or 3D model representing the environment

Visualization of the Data

• Personnel related data:
  • position, path travelled, health/activity level, evacuation status, corresponding video data
• Situational data:
  • sensor data (distribution of temperature, toxic gases)
• Perspective view of 3D environment
Visualization Requirements

- Dynamic (D) vs. Static (S)
  - Moving entities
  - Static scene
- Temporal (🕒) vs. Spatial (지도)
  - Information changed over time
  - Information changed at different places at same time
- Aggregation (집합) vs. Non-Aggregation (개별)
  - Population
  - Individuals

Case Studies (Scenarios)

1. Simulated evacuation after nightclub fire
   - simulated fire (300 sec)
   - simulated evacuation of 419 personnel
   - fire data and evacuation data of 419 personnel
Case Studies (Scenarios)

2. Testing exercise for rescue operation in elementary school
   • in-school shooting accident
   • two teams enter building and try to find the subject
   • real-time agent location, video feeds from stationary and on-agent cameras, agents have sensors providing activity level

Visualization Types

1) Personnel-Related Information
2) Situational-Related Information
3) Static Scene-Related Information
4) Mobile Visual Analytics
5) User Interface
1) Visualization of Personnel-Related Information

- Current position as circle, moving path as line segments
- Color: pre-assigned based on team designation or changed based on health/activity level
- Congestion: how many personnel at same location
- Health/activity: how is the health of an entity (heat exposure, gas concentration), how active is it (moving)?

Congestion visualization:
(A) congestion visualization with personnel
(B) congestion visualization without personnel
2) Visualization of Situational-Related Information

- Temperature, heat release rate (HRR) - colors
- Smoke, CO₂, CO - gray level
- Visualization overlayed on environment
- Mobile and stationary camera data streams: select agent or stat. camera and play corresponding video stream
3) Visualization of Static Scene-Related Information

- 2D background map with orthogonal view
- Additional 3D perspective view

4) Mobile Visual Analytics

- Capturing the event and analyzing it
- Examples
  - effectiveness of evacuation (unused evacuation paths?)
  - building response priorities based on evaluation
4) Mobile Visual Analytics

<table>
<thead>
<tr>
<th>Object</th>
<th>Question for analysis</th>
<th>Visualization</th>
</tr>
</thead>
</table>
| Personnel | 1. Who is the person?  
2. Where is the person?  
3. What is the person’s movement pattern?  
4. How is the person’s health condition?  
5. How does the health condition change?  
6. Was the person successfully evacuated?  
7. How many entities succeed in evacuating? | Personnel info  
Movement path  
Health change  
Personnel’s status  
Emergency status |
4) Mobile Visual Analytics

<table>
<thead>
<tr>
<th>Object</th>
<th>Question for Analysis</th>
<th>Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scene / Environment</td>
<td>1. What is the condition? (temperature, toxic gas, …)</td>
<td>➢ Environmental condition information</td>
</tr>
<tr>
<td></td>
<td>2. How does the condition change?</td>
<td>➢ Change of environmental condition</td>
</tr>
<tr>
<td></td>
<td>3. What is the structure? (map, exits, …)</td>
<td>➢ 2D map/ 3D model</td>
</tr>
</tbody>
</table>
4) Mobile Visual Analytics

- Number of personnel in each health condition
- Number of personnel at each exit
- Evacuation rate over time

Evacuation rate over time

Video feed from stationary camera (top) and video feed from agent camera (bottom)

Information of selected entities
5) User Interface

Video
Embedding in Visual Analytics

Pros and Cons

+ Runs on any device using PocketPC at interactive rates
+ Useful for training such as pre-planning scenarios and site inspection
- Need real-time tracking capability for real emergency situation: seems to be quite challenging
- Why do not do AAR on desktop system?
Future Work

- As a visual analytic tool
  - include more analytic functions to enhance emergency situational awareness
  - e.g. 3D optimal path finding for virtual rescue
- To be used in real emergency situation
  - add real-time tracking
- To be more useful
  - integrate social network data, e.g. family, friends, police, fire station, hospital, etc.

Thanks for Your Attention
More Examples

Visualization of personnel in 2D environment

More Examples

Video playback from stationary cameras and agents