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Visual Analytics for Emergency Response Using Mobile Devices

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Introduction

The motivation for our work is that mobile devices could be indispensable tools for emergency response if various relevant, selected information (e.g., images, 3D models, and sensor data streams) can be effectively visualized together on devices that have varying capabilities and resolutions. With the advent of high-bandwidth wireless networks and rapidly growing computing capability, the current platform barrier for such visualization is now being removed.

Goal & Scope

The purpose of our work is to develop a mobile visual analytic system for emergency response. In particular, we are interested in processing and displaying sensor network, location, and video data for the first responders to increase situational awareness and enable more effective response.

Scenario

- The Station nightclub fire of West Warwick, Rhode Island, Feb., 2003
- Simulated evacuation of 419 intelligent agents
- Simulated fire data including the level of temperature, HRR (Heat Release Rate), smoke, CO, CO_2

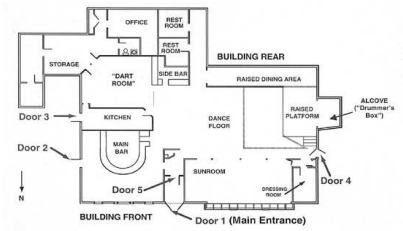


Fig. 1. Floor plan of the Station nightclub
(Image courtesy National Institute of Standards and Technology)

Results

We have focused on visual analytics on client mobile devices basing our system upon server-client architecture. Our tool presents efficient and interactive visual analytic methods for emergency response on mobile devices and provides visualization of various types of data. For visual analytics, our tool provides following functions.

Visual analytics

- Visualize the current health status of agents and the number of agents in each condition (*alive, unconscious, dead*)
- Display the information (agent *ID*, *FED of gas*, *used exit ID*) of the selected agent
- Display areas of exits and the number of evacuated agents at each exit
- Display the rate of evacuation
- Visualize temperature, HRR, smoke, CO, CO_2 distribution
- Analyze and evaluate effectiveness of evacuation results
- Suggest response priorities and plan actions

System organization

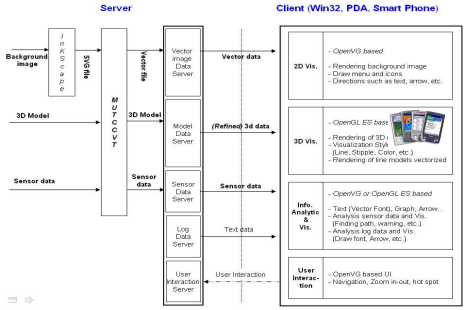
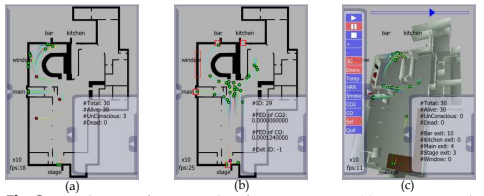


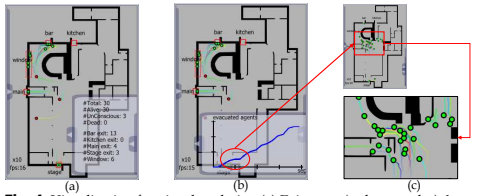
Fig. 2. System structure

Visualization for Client Devices



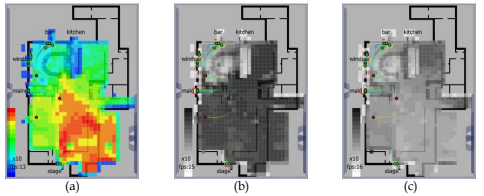
(a) (b) (c)

Fig. 3. Visualization of agents and 2D/3D environment; (a) Movement and health condition (green, read) of each agent, (b) Information of a selected agent (magenta), (c) 3D environment & user interfaces based on OpenVG



(a) (b) (c)

Fig. 4. Visualization for visual analytics; (a) Exit areas (red rectangles) & the number of evacuated agents at each exit, (b) The rate of evacuation that means the total number of evacuated agents per each second, (c) Evaluation of the rate of evacuation



(a) (b) (c)

Fig. 5. Visualization of simulated fire data; (a) Temperature, (b) CO, (c) Smoke

Conclusions & Future Work

- For situations requiring rapid decisions, such as emergency response analysis and services, our system can be used as an efficient testbed and prototype.
- More analytic functions will allow us to understand emergency situations and support rapid decision making. (e.g., information visualization of specific agents selected by a user can improve analysis
- Extension using GPS for a client-centered visualization as well as 3D movement of agents for effective user observation through 3D navigation can provide a more meaningful visualization.

Acknowledgements

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For further information

For more information on this and related projects visit: www.ecn.purdue.edu/purpl

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