Study on the Use of Pervasive Technology to Improve the Emergency Response to Mass Casualty Incidents

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Introduction & Motivation

Cost from transportation attacks in the world - last 10 years:
- 1.125 incidents, 7,037 injuries and 2,333 fatalities 35 thousand deaths; (Prevention of Terrorism Incident Database – RAND Corporation)
- 32% of the attacks to public surface transportation, from 1997 to 2000, were subways, trains and/or train stations. (Mineta Transportation Institute)

“IT is virtually impossible to defend against attack, due to the very nature of their design and operations”

Design and operations:
- Scheduled stops along fixed routes;
- Operations depend on people having quick and easy access to stations and trains;
- The number of access points and volume of ridership make it impractical to subject all rail passengers to the type of screening that airline passengers undergo.

Emergency Response Process

Casualty Sequence Flow
- Rescue/Decontamination
- Sorting (Triage)
- Evacuation
- Definitive Treatment

Key Concepts:
- Triage: sorting victims according to priorities;
- Overtriage: noncritical sorted as high priority;
- Critical Mortality Rate: deaths among critically injured.

Architecture

Agents are divided into the following categories:
- Personal agents: on mobile devices carried by passengers/train master;
- Environmental agents: responsible for managing the train schedule stops, for aggregating, estimating and interpreting data gathered from sensors, etc;
- Emergency service agents: interfaces with the ambulance service center system, hospital systems, etc;

Prototype

- Personal agents: JADE/LEAP, J2ME CDC over IBM’s WEME J9 VM.
- Environmental agents: JADE platform, hosted on a main-container.

Pervasive Metro Emergency Environment

Casual Mortality Rate: 20% within 5 minutes of critical injury.

Accurate estimations may be obtained through the following categories:
- OK: 0% mortality, triage and medical resource consumption.
- GREEN: 3.4% mortality, triage and medical resource consumption.
- YELLOW: 14.5% mortality, triage and medical resource consumption.
- RED: 72.4% mortality, triage and medical resource consumption.

Evaluation & Conclusion

Specification of the necessary parameters for achieving accurate estimations:
- each carriage has 200 passengers;
- passengers carrying mobile devices are distributed uniformly, their number is the sample size;
- after an emergency occurs, a portion of passengers possessing mobile devices may respond, thus defining the response rate;
- each response, representing the victim’s condition, can be one of the categories: OK, GREEN, YELLOW or RED;

Conclusion
- Although the error margin may increase according to the response rate, keeping higher sample sizes shrunken the error margin slide window, and thus increases the overall accuracy.
- If percentages of each category are distributed relatively evenly, the accuracy of our system is compromised. On the other hand, should there be one category with most passengers (e.g. OK), then the accuracy of our system is strengthened.