Geo Mindstorms

Investigating a sensor information framework for disaster management processes

Steven Fruijtier
Geodan S&R
Content

> Sensors in disaster management
  - Use of sensors
  - Problems encountered as system integrators

> Lego Mindstorms
  - What is it?
  - How do we use it?

> Testing sensor framework with Mindstorms
  - How does it solve our problems

> Conclusions
Sensors in disaster management

- Meteorological data
  - Wind direction
  - Wind speed
  - Precipitation
  - Temperature
  - Humidity

- Traffic
  - Flow
  - Density

- River
  - Depth
  - Velocity
  - Direction

- Gas concentrations

- Number of persons at reception centre
- Location of injured/dead people
- Heartbeat, blood pressure of first responder
Example of integrating sensors with the spatial data infrastructure (SDI) in a disaster management process

- Determine Initial Gas cloud
- Measure
- Calculate Gas cloud
- Evacuate area
- Meteorological information
- SDI population
- SDI roads
- SDI vulnerable objects
- SDI processing
- SDI operation data
- Traffic information
Sensors in disaster management

Clients
- Field Officer
- Operator
- Command Center

SDI
- Sensor Observation Service
- Fixed Sensors
- Mobile Sensors
- Wearable systems
- Unmanned aerial vehicles

WFS

WMS

WPS

Service chaining

Water levels

Traffic sensors

Gas measurements

Unmanned aerial vehicles

www.geodan.nl
Problems encountered as system integrators

Sensors are important for disaster management, but

> Access to sensors is limited for developers & system integrators
  - Sensor networks not (yet) deployed
  - No access to existing sensors

> Need to use (simulated) sensor data for testing of sensor information based services

> Want experience with new mobile sensor systems being developed and deployed for disaster management, like
  - Wearable systems
  - Autonomous vehicles
What is Lego Mindstorms?

Sensors
• Sound
• Ultrasonic
• Light
• Compass
• Accelerometer
• Temperature
• RFID
• And a lot more…

Brick
• Programmable computer

Servomotors
Programming environments

> Lego Mindstorms IDE
> Third party environments, e.g.
  – Microsoft Robotics Studio
    • Development
    • Simulation
> (Partly) controlled from Java or .NET OSS environment using Bluetooth communication.
  – More possibilities
  – Easier integration with e.g. location services and webcam
  – UMPC build in Mindstorms robot
Location determination

- Difficult to obtain location from environment, using e.g. compass, distances, etc.

- Using in/outdoor real-time location service **Movida**, supporting different location techniques e.g.
  - RFID
  - GPS
  - Telecom providers
  - WiFi
  - Ultrawideband
Prototype - Tripod

Prototype for collecting data

Accelerometer  Compass  GPS  Cam  UMPC
Prototype - Tripod

> Content determination of photos using metadata of a picture
Lego Mindstorms as testing framework

How is Lego Mindstorms useful to us?

> Lego Mindstorms provides sensor information for
  
  – Incorporating sensor information in disaster management processes
  – Using and implementing OGC SWE standards
  – Testing sensor information based services (SOS, WMS, WFS, processing services, etc)
Lego Mindstorms as testing framework

Other benefits of using Lego Mindstorms

> Prototyping
  – Mobile sensors
  – Autonomous vehicles

> Demonstrating different aspects of sensors in disaster management to customers and stakeholders, e.g.
  – static and mobile sensors
  – command & control
  – autonomous vehicles.
Lego Mindstorms as testing framework

- CSW
- WFS
- BPEL
- WMS
- SOS

Location

UMPC

Sensors

Movida
Conclusions

> Lego Mindstorms offers excellent possibilities for a testing sensor information framework

> Last but not least:
  - Low-cost (ca. 300 euro)
  - Easy (even a child can do it…)
  - Open (numerous resources)
  - Motivating
Geodan S&R
President Kennedylaan 1
1079 MB Amsterdam (NL)
Tel: +31 (0)20 – 5711 311
Fax: +31 (0)20 – 5711 333
E-mail: info@geodan.nl
Web: www.geodan.nl

Copyright © Geodan 2008

This document is provided for information purposes only and the information herein is subject to change without notice. Geodan does not provide any warranties covering and specifically disclaiming any liability in connection with this document. Geodan is a registered trademark. All other company and product names mentioned are used for identification only and may be trademarks of their respective owners. All pictures and illustrations are provided for information only and do not necessarily represent a realistic visualization of the services described in this document.