Collaborative Interaction and Integrated Spatial Information and Services in Disaster Management

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Abstract

This application demonstrates the use of a multiuser, multitouch application for enhancing collaboration in a disaster management context. Dynamic and static information is retrieved from different services using open standards to support the roles of different actors in the disaster response at the control center (e.g. police, fire brigade, military). This information is made available in an application based on the .NET framework 3.5 allowing advanced user interaction.

1. Introduction

A collaborative integrated spatial information system is being developed to enhance the communication between different stakeholders (e.g. police, fire department and health sector) during a disaster management response process. This application is able to integrate information from different sources that is relevant to the different users. Since the different users have different information needs, the application is implemented in an interaction device that is able to differentiate between the users, the DiamondTouch [1] and supply them with the different information. Special attention has been paid to user interaction in a disaster management situation.

The application is developed for GDI4DM, a project funded by the Dutch government which aims to to implement an integrated infrastructure for disaster management [2].

2. Disaster management

Disaster management is a cyclic process that can be divided into four phases [3]: 1) Prevention and mitigation phase; 2) Preparation phase; 3) Response phase; and 4) Recovery phase. The application here presented focuses in improving tasks from the “3) response phase” of a disaster. During this phase two factors are important: *Time &stress* and *Collaboration & communication.*

Time is the main factor to be considered during disaster response. Involved organisations need to take decisions rapidly and under *stress* conditions. To make appropriate decision, the decision makers need to have access to the appropriate (and up to date) information in very short time. Furthermore, they need an easy to use interface to the information. In the GDI4DM application this requirements were implemented by using an infrastructure to obtain all relevant information from the proper sources using standards and an intuitive user interface taking full advantage of the multitouch capabilities of the device.

The second factor is the *collaboration & communication* between the services involved in disaster management, such as police, fire brigade, paramedics and civil protection. The multitouch multiuser system allows for improved collaboration and cooperation in a multi-disciplinary team.

3. Information integration

In order to integrate data from different sources a (geo)spatial data infrastructure (SDI) is implemented. A SDI is an infrastructure for searching, obtaining and viewing spatial information. Most recent SDI’s are implemented as a service oriented architecture (SOA) using services based on open standards defined by the OpenGeoSpatial (OGC). Central in most SDI’s is a catalogue service (or CSW) which allows for searching datasets and in this case services based on their spatial and non-spatial metadata. The GDI4DM tabletop application uses different kind of (standard) web services to retrieve information, like mapping services (WMS) to obtain maps from different governmental organisations, web feature services (WFS) to retrieve vector based data and location services to get location information, such as the location of people and vehicles in the field. Data retrieved from the different services can be operational information (e.g. location of gas

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clouds and maps of routes around gas clouds) that support the disaster management professionals in their decisions.

During a disaster it is difficult to get the right information from the abundant data sources; therefore the GDI4DM project investigates the usage of ontology in disaster management [4]. On the tabletop interface, a user can request information through a simple request to an ontology service. This request will have a different meaning depending on the user and on the kind of disaster; therefore the information provision is context dependent.

4. User interaction and collaboration

The interface of the application consists mainly of a full screen map. This map is always oriented to the bottom of the tabletop. All other screens can be oriented to the different users. The main map allows for standard map operations, such as zooming (see Figure 1) and panning to be performed via multitouch.

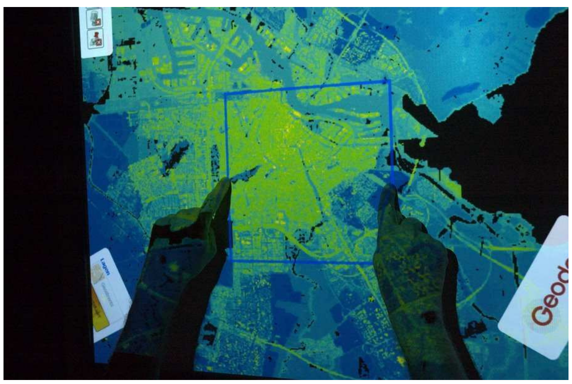

Figure 1. Intuitive Zooming by creating a bounding box using multiple input points.

Different kinds of spatial information can be selected and displayed on the map (see above). In order to select the information to be presented on the tabletop, a user can 'scroll' through previews of the layers. The initial selection and thumbnails are retrieved from the catalogue service.

Additional information of the spatial objects can be requested by clicking on the appropriate object. This information can be dependent on the user and on the type of disaster. For example if a fire brigade officer clicks on an elderly home it might show information necessary for extinguishing the fire, while if a police officer selects the same building object, it could show the number of people that are unable to evacuate the building by themselves.

The positions of different kind of vehicles (e.g. fire trucks and police cars) are displayed as icons on the map in real time. In order for the different stakeholders to keep a track of certain (important) vehicles, a user can select one or more of these vehicles and track them in a mini-map, showing the selected vehicle.

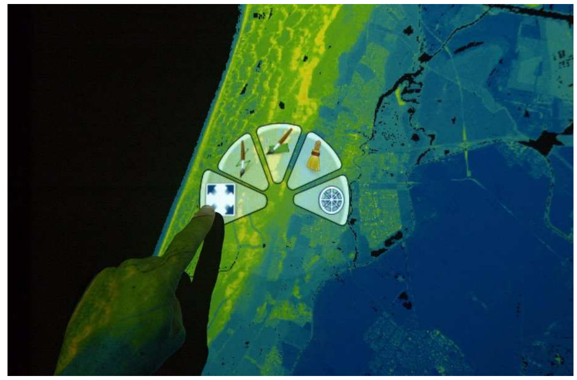

Figure 2. Advanced User interaction menu (pops up only by request). From left to right: unlock screen to allow pan/zoom; draw line; draw polygon; eraser; position the sectors circle.

Apart from retrieving and viewing information a user can interact on the tabletop to perform certain operations (see Figure 2). However due to the multi-disciplinary aspect of the processes, the user actions of a user (e.g. police officer) can be mutually supporting or conflicting with other users. The application can function as a moderator in these cases. For example the tabletop interface can be used to obtain information about an area to be evacuated (e.g. how many people live there) or to propose roadblocks. Because officers from different sectors are cooperating around the tabletop (which is displaying a map with all relevant information) they can collaborate about the decisions to be taken in order to prevent conflicts. Naturally, if one user is selecting or drawing on the interface the application automatically locks the map extent to prevent another user to pan or zoom to another area. The map can be easily unlocked once the user finished the one particular extent task.

5. Implementation

The application is developed on the Circle 12 DiamondTouch Table using the latest Microsoft interaction techniques (e.g. .NET Framework 3.5, WPF and XAML). The usage of these techniques allows for advanced user interaction which can be modelled by a user interaction expert at the same time developers are implementing the application. The open source library SharpMap is used for map interaction.

6. References

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