Disaster Management by Working Interactively with Geodata

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Abstract—The work presented here concerns the development of a system that allows people in disaster management to collaboratory work together. The system hereby adapts to the users hardware in display resolution and offers sophisticated interaction technology. The system is highly modular allowing to build role based views on a common operational picture (COP) in a control room of an emergency centre as well as in field work for the operational forces. Because the system is able to process spatial data in accordance with the European INSPIRE directive, it corresponds here to the current regulations in disaster management to be implemented within the EU by 2017 concerning the geodata interface. Basis for the directive are OGC based geodata services as delivered by the German geodata infrastructure. The system is working on mobile devices, work stations, laptops, a Digital Map Table, and the video wall of Fraunhofer IOSBs SmartControlRoom.

Index Terms—Disaster management, human machine interaction, WMS, WFS, SLD,

Introduction

Integration and optimal use of numerous information sources are the basis for the evaluation of a crisis situation and its efficient management. This requires a presentation of the information obtained from different data sources such as current aerial photographs, maps, and various sensors. Geo data and meta data can be stored on a local system or are available via network in individual formats. During a crisis, experts with different roles work together (such as firefighters and rescue personnel). Depending on their roles, the experts need role-specific views. In addition, a wide range of display systems is used -- from handheld computer to multi display teamwork station. However, when getting data from multiple, different sources, today's systems are not always able to depict them uniformly and harmoniously. Main reason is that the nowadays systems often support only certain data types (such as image formats) and do not allow data conversion in an appropriate way.

This use of multiple systems often means time consuming configuration and erroneous operation.

1 Solution

A geographical information system (GIS) with an adaptive human machine-interface was developed at Fraunhofer IOSB to support users in analysis, decision, and leadership depending on the available data and the problem to be solved [1]. The system supports web services based on standards by Open Geospatial Consortium (OGC). OGC is already anchored legally across Europe in the civil sector by the INPIRE directive of the EU Parliament in 2007. There are also open-source data such as OpenStreetMap OSM data, and military standardized STANAG support as well as some proprietary interfaces [2]. They allow an automated fusion and visualization of geodata from different civilian and military sources. Visualization is here adapted to the boundary conditions of the user.

1.1 Geodata Visualization

Generic OGC-styled layer descriptors (SLDs) are used for role- and hardware-specific visualization (Fig.1). SLDs allow to take into account the display resolution as well as the role and task of the user when visualizing the geodata. The implemented GIS architecture generates a high refresh rate of the data for each user. The client-server architecture also allows running calculations on the servers. This helps to release strain from mobile hardware and thereby supports the efficient use of these under-performing devices. With SLDs, it is possible and much easier to update the depiction of the geodata without manipulating the source data itself. With SLD technology the calculation is done on-the-fly as shown in Fig.1 with external raw-data rendered within the own server using SLDs. Within the databases no data is merged, altered, or stored. This is an advantage regarding license regulations, e.g. these from the OSM project. If data within the OSM project has been modified and merged, it has to be returned to the OSM community. Other data sources beside OSM can be OGC based services, as across Europe demanded by the INSPIRE directive. These geodata services may be delivered by the German implementation GDI-DE (Geodata Infrastructure Germany). Additional embedded proprietary services allow to include other systems data.

Fig. 1. External raw data on-the-fly rendered using SLDs.

1.2 Architecture

A suitable architecture (Fig. 2) was designed to make data available to the user. Central element here is the back-end, which holds all geodata for multiple clients. The back-end offers central configuration and a central security concept to allow only authorized users to access the data. Because all data, including their chronological sequence, are stored, it is possible to virtually go back in time and to analyse older data. Input and output adapters are used to feed dynamic data such as GPS tracks into the system or deliver this data. Interaction with the system via novel input methods such as hand gestures, gaze control, and touch are already implemented in the architecture.

Two different suites have been developed for data visualization. The one consists of a viewer based on the ESRI runtime, which can be used on desktop PCs as well as large video walls. The other is a web client, based on various web technologies, and can be used on mobile devices such as smartphones and tablets [3].

Such a system provides comprehensive support for all emergency personnel. The system can be used by staff at the situation centre for crisis management as well as by those working outdoor for situation assessments. The exchange of information helps everybody involved staying up-to-date.

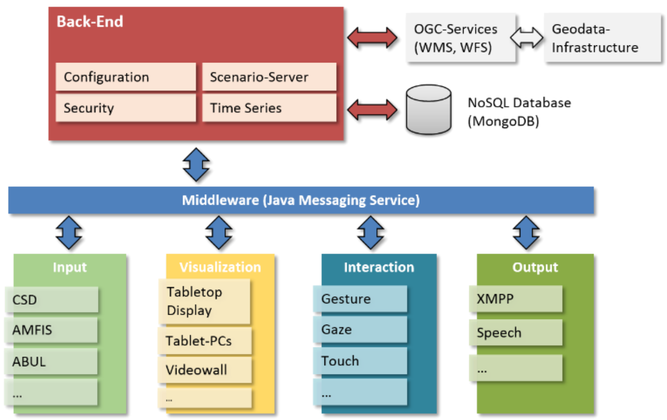

Fig. 2: Architecture.

2 Implementation

Within the disaster management various workspaces indoor and outdoor are equipped with multiple and different hardware. The architecture described above supports most of them. Fat clients are supported by the ESRI-client solution and mobile devices use the web solution. Mobile devices are intended usually for outdoor working. Here the user loads the maps and aerial images before leaving. By this the strain on communication nets is lowered effectively. Sending all additional information as position data, sensor data e.g. temperatures or water level, as well as drawings even radio networks are sufficient. The central database harmonizes data quality for all participants in the theatre. A viewer copying technology allows to force a whole group of devices to visualize the same area for all participants of a ‘geodata conference call’. Everybody participating in this geodata conference call can paint and draw into her device, what is visualized for everybody looking on this area.

The system is running on all devices shown in Fig.3. Tablet and smartphone run the web solution in their browsers. The desktop PC, laptop, Digital Map Table, and video wall visualize their common operational picture (COP) by ESRI viewers.

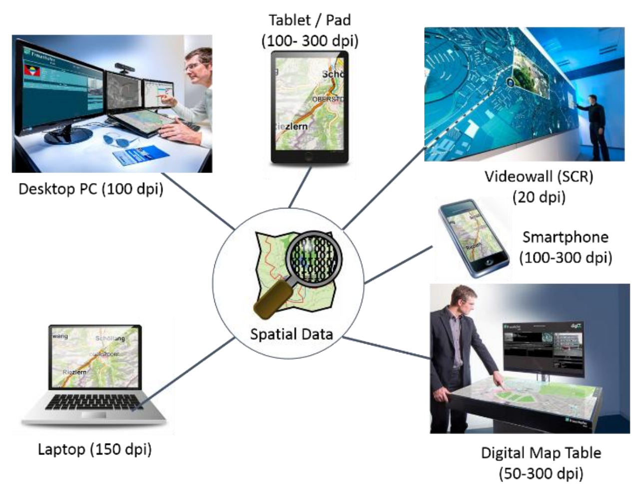

Fig. 3: Geodata tailored for devices and purposes.

The Digital Map Table is an interactive table top showing the geographical overview of terrain or town of concern. This is the basic workspace for the team. Each team member may have an additional tablet-PC or smartphone that can be moved freely over the scene on the table. A patent-registered procedure makes the device always showing the underlying area in higher detail or with different technical details, by this becoming a Fovea-Tablett®. This technology allows specialized analyses of areas of interest without changing the overview.

As an additional information source the Digital Map Table is equipped with a background monitor which presents context information as internet pages, live-streamed videos and images, and object information out of data bases (Fig. 4). All team members are permanently kept on the same information level and by this contribute faster and more precisely their newly gathered information and knowledge to the COP.

Fig. 4: Digital Map Table with meta data display and mobile devices.

3 Conclusion

The software architecture described here and their implementation on multiple hardware allow members of disaster management to access a COP that is adapted to their hardware constraints, their available interaction technology, and their role. Hardware can be technology for in-house use in an emergency operation centre as well as mobile devices for operators as fire brigades or rescue forces operating in the field. Because the system is able to process spatial data in accordance with the European INSPIRE directive, it corresponds here to the current regulations in disaster management to be implemented within the EU by 2017.

From first experiments and demonstrations positive feedback was given from control room side as well as by mobile forces like squad teams of federal and state police.

References

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