3D City Data Management, Integration and Exploitation - the iSCOPE Project Experience

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Type of proposed presentation: Research contribution

Summary of the presentation

Smart City services are core elements for urban evolution, digitization and computerization. In order to provide these services to a wide geographical target, it is required an infrastructure that allows the integration of heterogeneous geographical information and sensor networks into a common technological ground. This work describes an innovative Services Oriented Architecture software platform aimed at providing smart cities services on top of 3D urban models. This treaty will address all the steps involved in the data-related chain: data collection, harmonization, ingestion, processing and generation of the CityGML standardized data model and format are the firsts. The storing and management of the 3D city model in CityGML format, the integration of the same with data coming from heterogeneous sources and the streaming of the resulting data-compound represent the second part of the chain.

i-SCOPE (interoperable Smart City services through an Open Platform for urban Ecosystems) project aims at delivering an open platform, based on interoperable 3D CityGML UIM (Urban Information Model), on top of which it possible to deploy various 'smart city' services. CityGML (Open-GIS 2008) represents a very attractive solution that combines 3D information and semantic information in a single data model. Additionally, according to the i-SCOPE perspective, CityGML is the appropriate instrument to become the container on which a series of smart city services will be provided.
Cities are 'systems of systems', and this could stand as the simplest definition for the term. The management of these complex objects requires a platform for integrating city information from different resources. However, most of the current city and urban developments are based on vertical ICT solutions leading to an unsustainable sea of systems and market islands. The emerging trend is going towards a unified urban-scale ICT platform transforming a City into an open innovation platform called Smart-City.
This applies in particular to digital cities, where networks of data and computers represent networks of people and buildings.
To fully develop this Smart City concept at a wide geographical scope, an infrastructure that allows the integration of heterogeneous and geographically disperses information and sensor networks into a common technological ground is required.
3D city models are the basis of many applications and can became the platform for integrating city information within the Smart-Cites context. Real world we live is in 3D and it is natural for the human brain to interpret 3D scenes and in consequence 3D city models are becoming a hotter topic in both academia and industry.

The objectives of i-SCOPE are to:

-Develop an open toolkit based on 3D UIMs according to the principles of service-oriented architecture using open standards (OGC). This includes even services capable to create CityGML models starting from data available at city level such as surface models (e.g. LIDAR), terrain models and building floor plans.
-Develop smart services to improve decision-making in planning processes and policy design at city-regions management levels, with regard to issues related to energy efficiency and noise levels, based on urban pattern and its morphology.
-Develop smart services to promote inclusion and mobility of differently-abled people and elderly users through technology that help them overcome barriers at city level and that support them during their daily urban trips.
-Develop smart services that can involve citizens at wider scale by collecting real-time location-based information at urban scale.
Test smart services within a variety of network ecosystems ranging from city-wide sensor networks, to large scale regional optic fibre networks (in the case of Trento and Lazio Region, Italy), to mobile location based services.
-Develop trustable, secure privacy schemes to ensure the highest level of protection of users' information. This is necessary since such a set of real-time, location-based mobility services poses significant security and privacy issues (due to traceability of people's location, actions, travel plans etc).

The i-SCOPE Project focus to match three main questions:

-How to improve the life conditions for those citizens who are diversely able by removing in alternative way all the barriers that commonly exist in our towns?

-Will a citywide system able to visualise how the concentration of human activities can vary during the day and how the pollution (more specifically noise pollution) can be directly related to the presence of people on urban scale be available ?
-Can it be possible to know over urban areas to get information and immediate visualise data about the energy dispersion? These information can be also formalised in a series of tools or better in a platform out of which administrators, city planners and citizens to interact and use them aiming at improving life conditions and economies.

The main activities performed within the first 18 months of the project are related to the setting-up and the deployment of the smart city services toolkit, in particular:

-Setting-up and deploy the i-SCOPE 3D platform to provide access to the cityGML information.
-Implementation of disabled people routing algorithm, including development of the dialog interface between routing and semantic description.
-Definition and implementation of the solar potential services, including all components starting from the solar irradiation calculation to the graphical web interface.
-Definition of the crowd source noise mapping services.
-Development of web-based and mobile client.
-Starting of services integration.

At present, the demand of making the surrounding environment more intelligent, especially in the metropolitan area, is really huge. Technologies have become mature and Smart City is not just a concept anymore but a realistic opportunity too. The municipalities involved are committed to use such technologies in order to improve citizens' day-life and respond to their demand of more participative services with the public administration. In this context, i-SCOPE project is creating services for Smart Cities, thus it is important to do crowdsourcing, not just to get more information at a lower cost and faster, but also to make the project known to the public and to be able to involve inhabitants. On that regard the consortium developed Architectural Barriers Survey APP. Architectural Barriers Survey is an application for mobile devices that allows citizens to create a database of all the architectural barriers in a city by uploading pictures and comments. Architectural Barriers Survey aims to improve inclusion and mobility of visually impaired and disabled citizens within our cities.

Currently**, 1,039,411** are the amount of citizens that live in the urban areas in which the CityGML models have been created by means the i-SCOPE project so far, and more will come. In particular, the areas of Lazio, Trento and Cles, Indjija, Zadar, Zagreb, and Wien.

This scenario has rapidly brought to a profound paradigm shift whereby i-SCOPE users are getting used to access a variety of digital information from within a 3D or an Augmented Reality environment, regardless whether they are operating a computer, a tablet, a smartphone. An example of this is the use of software exploited within i-SCOPE services such as NASA World Wind, by means of which we are creating new ways of experiencing and sharing heterogeneous digital information according to their spatial reference in the real world. This is only an example of a multifaceted paradigm shift, which is having a large impact at a professional as well as societal level. In fact, the rising role of smart cities is clearly transforming the way users discover, access, and interact with data, and it is bringing to a brand new generation of commercial and community services both for professional and personal use.

RAFFAELE DE AMICIS SHORT CV

Dr Raffaele De Amicis is Director of Fondazione Graphitech, he holds a MEng in Mechanical Engineering, a Ph.D. on Surface Modelling in Virtual Environments. He has been research fellow at the Industrial Applications Department of Fraunhofer Institute, Darmstadt and senior researcher at the Interactive Graphics Systems Group, University of Darmstadt. He has been involved in several EU and Industrial projects. His research interests are in CAD, virtual reality, computer supported cooperative work in engineering.

Affiliation and official address: Fondazione Graphitech - Center for Advanced Computer Graphics Technologies, Via Alla Cascata 56C, Povo (TN) 38123- Italy

Nationality: ITALIAN

Education (*degrees , universities, dates)*

- Doctorate in Design and Methods of Industrial Engineering, Faculty of Engineering University of Bologna, , Italy, 2001
- Laurea in Mechanical Engineering, specialised on Mechanics of Materials, Faculty of Engineering University of Calabria, Italy, 1996

Career/Employment (*employers, positions and dates)*

- 2006- : INI-GraphicsNet Foundation, Darmstadt, Germany, Chairman of the Steering Committee
- 2004-06: INI-GraphicsNet Foundation, Darmstadt, Germany, Vice-Chairman of the Steering Committee
- 2004- : INI-GraphicsNet Foundation, Darmstadt, Germany, Members of the Board of Trustees
- 2003- : Foundation Graphitech - Center for Advanced Computer Graphics Technologies, Trento, Italy, Director
- 2003- : Department of Information and Communication Technology, University of Trento, Italy, Consulting Professor
- 2000-02: Interactive Graphics Systems Group, Department of Computer Science University of Darmstadt, Germany, Senior Researcher
- 1999-00: Fraunhofer Institute for Computer Graphics, Darmstadt, Germany, Researcher
- 1997-99: Mechanical Engineering Dept., Faculty of Engineering, University of Calabria, Researcher
- 1996-99: Molecular Biology Dept., Faculty of Science, University of Calabria, Research Assistant, Researcher
- 1994-96: Mathematics Dept., Faculty of Science, University of Calabria, Research Assistant, Researcher Assistant

Specialization

i. **main field:** Design and Methods of Industrial Engineering, Computer Graphics**,** Technology Transfer, Science and Technology Policy,

ii. **other fields:** Computer Aided Design, Geometrical Modelling, Interactive Graphics Systems, Human Computer Interaction, CAD-CAE process integration, Virtual/Augmented and Mixed Reality, CAD/VR Interfaces Virtual Product Development Process, Simulation-Optimisation and Interactive Visualisation, Computer Supported Co-operative Work, Management Control in Non Profit Organizations

iii. **current research interest:** Advanced 3D Interaction Techniques, Shape Semantics, Visual Analytics, Augmented Engineering, Real-time Visualization of Geo-referenced Data,

Multimedia Content Engineering, Collaborative Architectural Design, Virtual Reconstruction Assessment and Restoration, Scientific Management, Innovation Management

Honours, Awards, Fellowships, Membership of Professional Societies

1. Coordinator of BRISEIDE project – Bridging services, information and data for Europe (www.briseide.eu)
2. Director of NATO-ARW on NATO-ARW on Geographical Information Processing and Visual Analytics for Environmental Security, Trento (Italy) 13-17 Oct. 2008.
3. Invited Talks
    a. NATO Ecoter Final Project Meeting Development of a Prototype System for Sharing Information related to Acts of Terrorism to the Environment, Agriculture and Water systems (Ecoterrorism) - Venice, 2007,
    b. Workshop on Collaboration@Work by the European Commission New Working Environment Unit. Brussels, 2006, Workshop – From CAD to Virtual Reality, University of Naples Federico II, Napoli 2006 ,
    c. Workshop COMSON - Coupled Multiscale Simulation and Optimisation in Nanoelectronics, Cosenza, 2006, Workshop Topics in Automatic 3D Modelling and Processing, Verona, 2006.,
    d. Workshop on the Virtual Reality in the Vehicle Engineering – Virtual Reality Laboratory - FIREMA Trasporti S.p.A. - Caserta, 2005,
    e. Workshop “ECOTER”, development of a prototype system for sharing information related to acts of terrorism to the environment, agriculture and water systems NATO Headquarter, Brussels, 2005,
    f. Conference "Mathematics , Arts and Industry, Cetraro, 2005.
4. Computer Graphics Best Paper Award 2003, “Spacedesign: A Mixed Reality Workspace for Aesthetic Industrial Design”.
5. EC Culture 2000 programme, Net-Connect: Connecting European Culture through New Technology, grant holder 2006-2009
6. EU FP6-STREP, IMPROVE: Improving Display and Rendering Technology for Virtual Environments, grant holder 2004-2007
7. EU FP6-Craft , AMI-SME: Analysis of Marketing Information for Small- and Medium sized Enterprises, grant holder 2004-2007
8. Autonomous Province of Trent, MoSeS: Modeling Semantic Shapes, grant holder 2004-2006
9. Autonomous Province of Trent, SpaceDesign Pro: Ubiquitous Shape Design, grant holder 2004-2006
10. Autonomous Province of Trent, InSIDe: Intelligent Styling system for Industrial Design, grant holder 2004-2006
11. Autonomous Province of Trent, SIMI-Pro: Semantic Information Management system for Innovative Product design, grant holder 2004-2006
12. Chaiman of the Eurographics Italian Chapter Conference, Trento 2007
13. Chairman of the group WG2 “System prototype definition ”at the workshop “ECOTER” Development of a prototype system for sharing information related to acts of terrorism to the environment, 2005
14. Scientific Committee member of the: Conference Eurographics Italian Chapter, 2007- Conference Contexts and Ontologies: Theory, Practice and Applications, 2006. Conference Eurographics Italian Chapter, 2006, IEEE International Conference on Image Processing, 2005, AICA 2005, Conference "Matematica, Arte e Industria Arte e Industria, Cetraro, 2005,
15. Member of European Association for Computer Graphics. EuroGraphics, since 2004
16. Member of Italian Charter of Engineers, since 1997

FEDERICO PRANDI SHORT CV

Dr. Federico Prandi has been working in Fondazione Graphitech since 2009. He received a master degree in environmental Engineering, a PhD degree in Politecnico of Milan. He has been involved in several EU and research project in the area of 3D geo-visualization and application and 3D reconstruction and image based modelling.

Education and training

Dates 01/01/2006 - 31/12/2009

Title of qualification awarded PhD in Geodesy and Geomatic

Principal subjects / occupational skills covered Final thesis topic: 3D Object recognition and reconstruction for digital mapping and 3D GIS

Name and type of organisation providing education and training Politecnico di Milano (University) P.zza Leonardo da Vinci 32, 20133 Milan (Italy)

Dates 01/09/1994 - 21/12/2001

Title of qualification awarded Master Degree in Environmental and Land Planning Engineering

Principal subjects / occupational skills covered Energetic and Thermodynamic planning

Name and type of organisation providing education and training Politecnico di Milano (University) P.zza Leonardo da Vinci 32, 20133 Milan (Itlay)

Dates 01/09/1989 - 01/07/1994

Title of qualification awarded High school Degree in electro technic

Name and type of organisation providing education and training Alessandro Volta (ITIS) Lodi (Italy)

PUBBLICATIONS

- F. Prandi, R. de Amicis, G. Conti, S. Piffer, A. Debiasi and M. Calderan. "BRISEIDE a spatio-temporal framework to support environmental analysis and emergency management". In proceeding of EnviroInfo 2011.
- R. de Amicis, F. Prandi, G. Conti, D. Taglioni, S. Piffer, M. Calderan and A. Debiasi. "Landslides and spatio-temporal processing of geographical information". The second world landslide Forum. 2011.
- O. Melnikova, F. Prandi (2011). 3D Buildings Extraction from Aerial Images. In proceedings of High-Resolution Earth Imaging for Geospatial Information ISPRS Workshop. Hannover, Germany June 14 - 17, 2011
- R. de Amicis, G. Conti, S. Piffer and F. Prandi (2011). "Service Oriented Computing For Ambient Intelligence To Support Management Of Transport Infrastructures", Journal of Ambient Intelligence and Humanized Computing, DOI: 10.1007/s12652- 011-0057-z

- M. P. Riggio, F. Prandi, R. de Amicis and M. Piazza (2011). "Use of High Resolution Digital Images and NDT Imaging Techniques for the Characterization of Timber Structural elements". Proceedings of the NDTMS-2011 International Symposium on Non-destructive Testing of Materials and Structures.
- R. de Amicis, F. Prandi, G. Conti, D. Taglioni, S. Piffer, M. Calderan and A. Debiasi (2011). "Landslides and spatio-temporal processing of geographical information". The second world landslide Forum.

MARCO SOAVE SHORT CV

WORK EXPERIENCE

01/02/2012–Present

Computer systems designer and analyst

Fondazione Graphitech
Via Belenzani 12 - Trento - Italy, 38122 Povo (TN) (Italy)
http://www.graphitech.it/

-Research and development within a wide range of ICT application domain.

-Technical management of iSCOPE EU project.

-Design and development of Augmented Reality, Virtual Reality and Geo Visualization solutions.

-Study, design, implementation and testing of natural interaction models and multi-modal interfaces.

-Geographical data management and processing.

Business or sector Center for Advanced Computer Graphics Technologies

EDUCATION AND TRAINING

18/11/2008–02/02/2012

Master of Science in Telecommunications Engineering

Università degli studi di Trento, Trento (Italy)

02/09/2004–18/10/2008

Undergraduate course in Electronics and Telecommunications Engineering

Università degli studi di Trento, Trento (Italy)

ADDITIONAL INFORMATION

Publications

Prandi, F., Soave, M., Devigili, F., Andreolli, M., & De Amicis, R. "SERVICES ORIENTED SMART CITY PLATFORM BASED ON 3D CITY MODEL VISUALIZATION". *ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences*, *1*, 59-64. 2014

Publications

F Prandi, M Soave, F Devigili, R De Amicis, A Astyakopoulos "Collaboratively Collected Geodata to Support Routing Service for Disabled People". Peer Reviewed. In "Proceedings of the 11th International Symposium on Lacation-Based Services", 2014

Publications

E. D'Hont Federico Prandi, R. De Amicis, S. Piffer, M. Soave, S. Cadzow, E. Gonzalez Boix. "USING CITYGML TO DEPLOY SMART-CITY SERVICES FOR URBAN ECOSYSTEMS" .International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences 05/2013, 2013

Publications

U. Di Staso, M. Soave and R. de Amicis. "Engaging Outdoor User Experience Based on High Fidelity 3D Terrain Representation on Mobile Apps". Peer-reviewed. In Proceeding of the COM.Geo 2013. 2013. IEEE

Publications

M.Soave, F.Prandi, R. De Amicis, F. Devigili. "Visualization and Analysis of CityGML Dataset within a Client Sever Infrastructure." Peer-reviewed poster at Web3D2013. 2013. ACM

Publications

M. Soave and R. de Amicis. "Analysis of Human Gestures in the 3D Space to Control Multimedia Interfaces". Peer-reviewed. In Proceeding of the VSMM2012. 2012. IEEE

Presentations

29-30 October 2013, presentation titled "Use of CityGML standard in the context of Smart Cities" during the First International Conference on "Space and Time. Enhancing resilience of communities and territories through smart technologies."

Projects

i-SCOPE: interoperable Smart City services through an Open Platform for urban Ecosystems

http://www.iscopeproject.net

GA number 297284 Call identifier: CIP-ICT-PSP-2011-5

Project start date: January , 2012

I have actively participated in the development of the project in all its phases: the definition of use cases, system architecture and the design and development of individual components.

I have worked the integration of the entire chain of processes involved:

-spatial data management -use of geodata to automatically generate buildings CityGML models - exploitation of the city 3D model to provide services for the citizen such as personal mobility of aging and diversely able citizens, roof solar potentia simulation and assesment and real-time environmental noise mapping.

I have personally developed a method to stream a semantic and geometric city model between client and server, and an algorithm to improve the quality of a digital surface model.

Projects

SUNSHINE: Smart UrbaN ServIces for Higher eNergy Efficiency

http://www.sunshineproject.eu/

GA number 325161 Call identifier: CIP-ICT-PSP-2012-6

Project start date: February , 2013

Project duration: 3 years

Carried outactivities: active partecipation in the the definition of use case and system architecture.

Future planned activities: adaption of the client server infrastructure developed in the iSCOPE project.

Projects

Smart Island:

http://www.smart-islands.eu/

In the context of the Smart Isalnd project I conceived and developed an algortithm to adaptively optimize the terrain mesh according to it's complexity in order to improve the visualization performances on mobile devices.

I developed a routine to automatically generate vectors plots representing the altimetry of paths starting from geographical data.

Moreover I collaborated in the creation of the three-dimensional virtual environment interaction model using multi-touch capable devices.