"Ghent 3D, in 4th Dimension", Startup for a Holistic Multi-D City Model, using Augmented Virtuality

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1 ABSTRACT

"Ghent 3D, in 4th dimension" was funded (2009-2014) by the EFRD (European Fund for Regional Development). The project had a holistic scope. 3D-data gathering was not the only focus of the project. Different applications for using a digital 3D-city model, as a digital art-engine for designing, discussing, developing and managing a city, were developed. Attention for all kinds of spatial creativity was the goal. "Ghent in 3D" is now the start up for a holistic Multi-Dynamic city model.

2 THE HISTORY OF "GHENT IN 3D"

Fig. 1: 3D-vector model of part of the in city in 1999, Fig 2: 3D-scan of part of the city in 2013

At the end of the eighties the City of Ghent started with CAD and GIS. Since the 90s 3D-CAD and VR (Virtual Reality) were used in city planning and communication, followed by the first 3D-GIS exercises in 2003. Some parts of the city were built digital in 3D, depending on which urban planner was the leader of an urban project. Some planners had digital inspiration, but most of the planners and designers didn't use 3D-technology… But communicators and citizens asked more and more 3D-models. The preparation of using BIM (Building Information Management) as a kind of 3D-GIS for buildings started in 2013. Since 2009 (start of the EFRD-project) the first municipal 3D-coordinator and 3D-team in Belgium take care of a holistic and structured 3D-environment.

3 3D

3.1 From 3D-scanning to vectorised city model

During the EFRD-project the whole city was airborne lidar-scanned. Also mobile scanning was used to get more details. Ghent was the first city using a terrestrial 3D-scanner in a fulltime job since 2010.
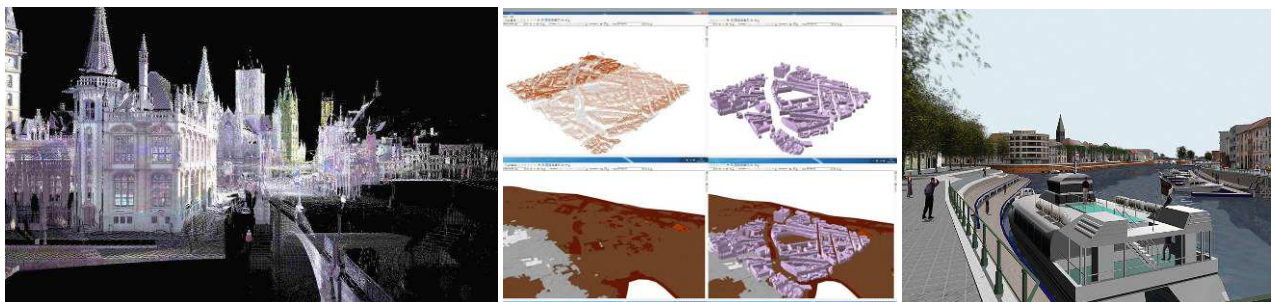

Fig. 3: terrestrial scan of the city center, Fig. 4: process of vectorisation, Fig. 5: Level Of Detail 3 model (LOD3)

Even parts of the underground (infrastructure and archeological sites) were scanned in 3D.

Fig. 6: Infrastructure in the underground, Fig. 7 en 8: Archeological site in 3D

4   4D

4.1 Crowd Sourcing and co-creation with citizens

One of the co-creating projects of the 3D-cityteam was the initiative to involve citizens to draw together. We started with a free initiation "Sketch up" course for citizens. After one hour instructions they reconstructed beautiful old demolished buildings in a 4D-timescale, in collaboration with the city museum and city archive. This crowd sourcing project with happy people, reconstructs different disappeared townscapes in 4D.

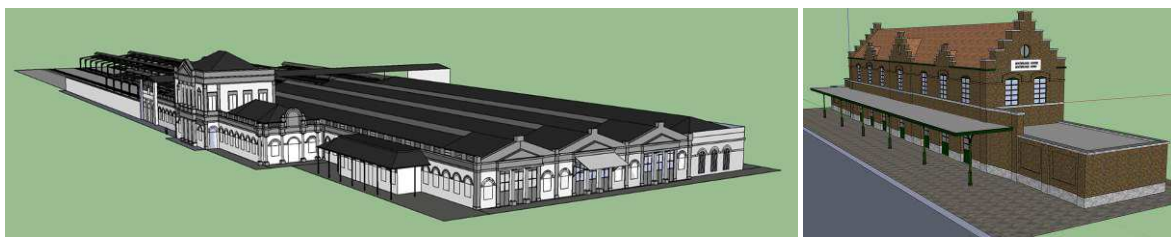Fig. 9: Time scale of the city center in 4D, Fig. 10: citizens drawing in 4D the history of the city

Fig. 11: Reconstruction of the old main station Ghent South, by citizens, Fig. 12: Reconstruction of an old station in a district

4.2 New facades for buildings using light-technology

The results of a competition for citizens to re-design the facades of the old "Castle of the Graves" in the city centre, were shown during the light-festival of the city January 2012. The combination of the 3D-scans of the entire old interiors, with the existing big castle wall, and future dreams for new facades for this castle, was a real-time 4D time-scale evocation.

Fig. 13: Castle of the Graves: 3D-scanning of the interior, Fig 14 and 15: competition for citizens, designing new castle facades

This is city-art-entertainment, using games and 3D-technology, in collaboration with citizens to augment data-actualisation, not only as it was, as it is built, but also as it is dreamed.

4.3 Guideline for architects

In december 2011, a guideline for exchanging architectural 3D-CAD data and 3D-GIS data of the city, was born, as a pioneer in Belgium. The next version of the guideline will be related to BIM and City-GML. In the 4D-scale, the integration of new drawings of buildings and designs for urban public space in 3D, shows the future of the city. Architects can also use the 3D-C.A.V.E. (see 7.1) to discuss their design research.
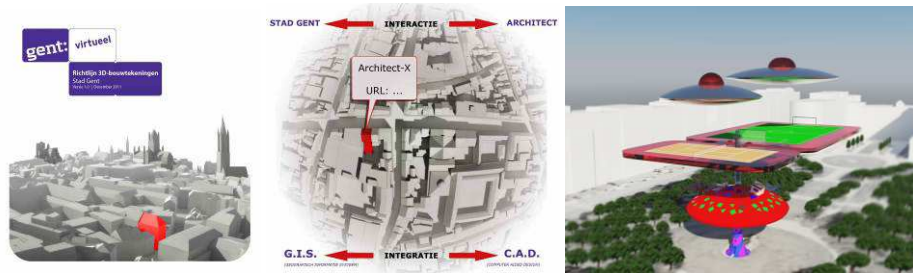
Fig. 16: Guideline for architects   Fig. 17: Integration of 3D-drawingsl   Fig. 18: competition for children, "My house, my dream"

5 MULTI-D

5.1 Augmented Virtuality

"Augmented Virtuality" is the opposite of Augmented Reality. When you upload parts of the reality in the digital city model, you can talk about Augmented Virtuality. We connect videos of the real world IN the city model, even in real-time. For example the traffic situation on the roads can be managed or studied in the 3D-model combined with visual real-time information.
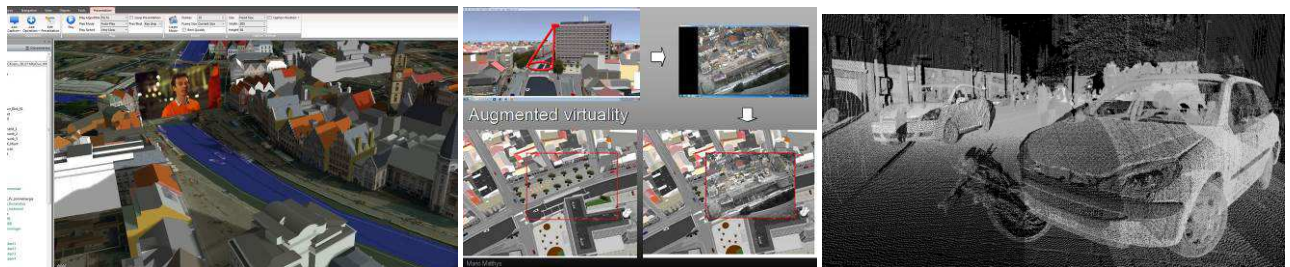

Fig. 19: Integration of video's from citizens, Fig.20: time lapse video, Fig.21: 3D-scanning of an accident

5.2 Noise, accidents, crime, actions, environmental conditions, the weather…

In collaboration with the Crime Unit of the federal police, we integrate 3D-scanning of crime scenes. With the local police we discussed the use of our terrestrial 3D-scanner to register car-accidents. The results of scanning can be combined with the environment of the 3D-model, even the results of accidents are printed in 3D. It is also possible to optimize the city model with real-time noise if we connect sources to the model. In the 3D-C.A.V.E. (see 7.1) we use stereo sounds of cars, talking people … for a multi-D experience.

6 ANALYSES

6.1 Spatial analysis preparing structure and destination maps

The 3D-GIS model uses attributes in spatial databases to analyse the environment in 3D. Dynamic and interactive real-time visibility research is done. When Multi-Data of the whole city is connected it's evident you will design also all your urban structure and destination plans in 3D.

Fig. 22: 3D-GIS attributes with information of volumes, Fig. 23: visibility research, Fig. 24: Spatial structure and destination maps

6.2 Eye tracking on 3D-models to augment spatial quality

In collaboration with Ugent we started Eye-tracking research, using Eye-tracking instruments in combination with 3D-data. The analysis of eye-movements and the focus on city objects will tell us more about spatial attraction and design quality.
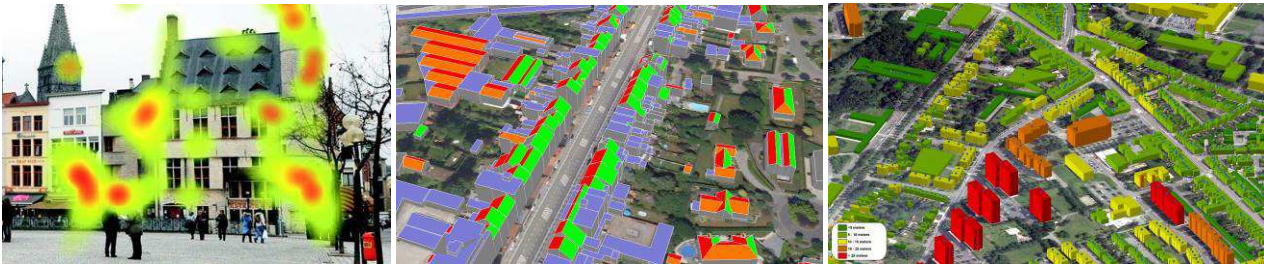
Fig. 25: 3D-EYE-tracking research, Fig. 26: Sun potential of roofs in 3D-model, Fig. 27: Population Density in 3D

6.3 Solar potential in 3D

Ghent is the first Belgian city that is showing solar potention of roofs in a 3D-portal on the internet. This was done in partnership with the European MUSIC project in 2014.

7 INTERACTIVE OUTPUT: EVALUATION AND COMMUNICATION

7.1 3D-C.A.V.E.

Since more than 10 years, the City of Ghent uses a 3D-C.A.V.E. It's a virtual room where you can navigate with a joy-stick or hands-free tracking motion, while flying and walking through the whole city. Architects and other city designers use this interface for urban analysis and spatial designing. Decision makers and citizens use the 3D-C.A.V.E. for evaluation and communication. It's also a promotional instrument of the city.

Fig. 28 and 29: 3D-C.A.V.E. (Computer Aided Virtual Environment)

7.2 Dynamic city model using Game-engines

A game engine is a fantastic instrument to analyse the movements of objects in the city. The high-quality visualisations and the hyper-realistic flying birds or splashing water are the most beautiful environments in evaluation and communication. Game engines can also be used in all kinds of visual analysis.

Fig. 30: Dynamic 3D-city model in a Game Engine, Fig. 31: the movements of a tram in the 3D-city-model

7.3 3D-printing

Gent in 3D uses two little 3D-printers for demonstrations and to print physical models. The results of 3D-printing are in the city-museum, even used in architectural competitions and in communication actions.
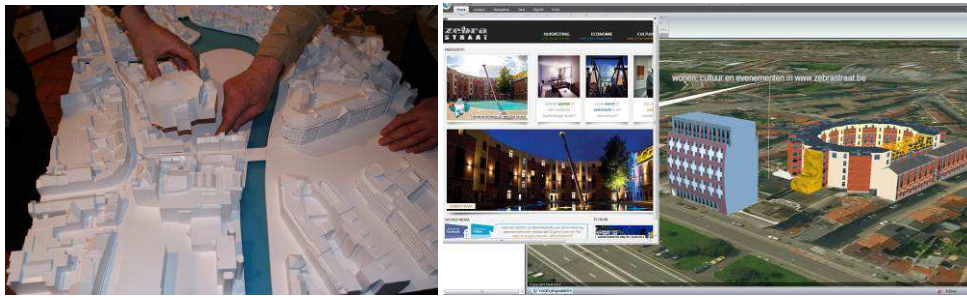
Fig. 32: 3D-printing, Fig. 33: 3D-portal with url-links to website of owners

7.4 3D-portal

In 2014 the first 3D-portal of an entire Belgian City was online www.gent.be In future this will be an online big-data environment including big parts of open 3D-data. It's an interactive design and communication tool.

7.5 3D Mobile and QR-codes

An other output interface is the transformation of an old bus into a 3D-mobile. With the Multi-mobile we drive to the inhabitants to show them IN their street how the street will be redesigned. They can even use laptops in the bus to draw there own ideas of the environmental design. There is a little 3D-CAVE on board. So decision makers can discuss with people (using interactive 3D-infrastructure) even if those people are not able to use 3D-interfaces on a homecomputer. The 3D- mobile can also be used for those citizens who are less mobile.

Fig. 34: 3D-mobile, Fig. 35: 3D-models in combination with QR-codes

The integration of QR-codes in the city model offers an interactive link to extra information of city objects.

All those output instruments are used to optimize the use of the Multi-D model.

8   FUTURE

A city is a little universe. This work is only the start of a growing Multi-D city model. There is no way back.

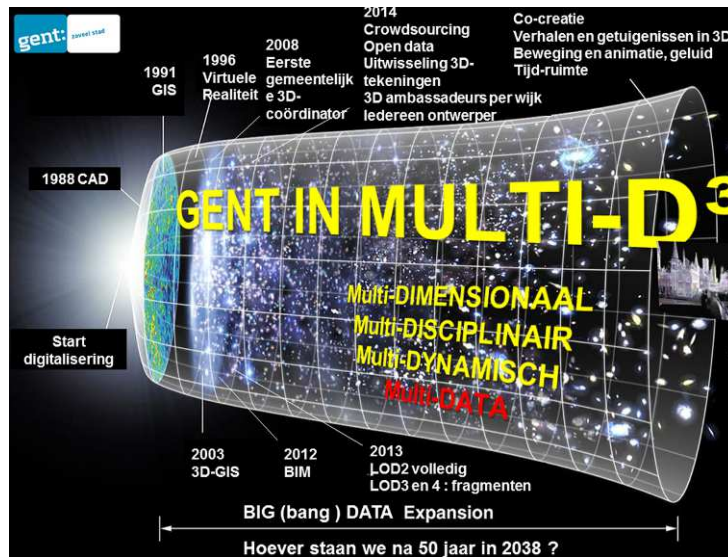Multi-Dimensional + Multi-Disciplinar + Multi-Dynamic = Multi-D³.

Fig. 36: BIG-DATA in a Multi-D3 world

9 CONCLUSION

The bigger the data, in a holistic Multi-D city model, the more money you need to actualise. But there is no budget for the actualisation of the whole 3D-model in extra dimensions. So we motivate everyone in the city to co-create. Even with competitions we ask people to help with the updating and completion, with the use of mobile devices. „Gent in Multi-D" is a digital instrument not only for, but also from, the citizens.

This is the foundation of a never ending big-data process in a Multi-D environment. When we think of the first digital drawings of the city about 30 years ago, realise what can we expect the next 30 years ? I predict an exciting future for Augmented Virtuality and a real time actualisation-process with mobile devices.

The virtual sky does not have a limit…A parallel digital world will be a copy of the real world, augmented with all kinds of dreams of citizens and city-designers that only will exist in a digital world, and not in real world. But, if you can dream it…

10 REFERENCES

Matthys Mario: Mijn gemeente in meerdere dimensies… Inspiratie uit het EFRO-project 'Gent 3D, in 4de dimensie'. Gent, 2014.