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The Development of an E-Participation Platform for Rural Areas in the Study Area of Niedernhall

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1 ABSTRACT

The participation methods changed in recent years with the evolution of communication methods in general. It goes from an analog approach to a more information technology-based concept. This new form of participation is called e-Participation. With this new form of participation, the process opens up for different new technologies.The emergence of 3D Web-visualisation technologies presents themselves as an interesting application in the participation field. Especially regarding planning participation. Different examples introduce this concept in big cities andare based on open 3D city model data.However, there is also a need for this participation concept in a smaller urban area.

This paper shows a way to provide an easy to access 3D model of areas in Baden-Württemberg for participation processes.

In this paper, the system was tested with a trial run in a small village where the parish council was asked to design a public place. The platform provided them with functionalities to design in the 3D environment on the web globe. These functionalities were introduced to the council at an on-site appointment. This proves the technical validity of the project. The usability and acceptance of this method by the council will be determined by a questionnaire at a later stage in the project.

Keywords: e-participation, 3D, city model, rural areas, participation process

2 INTRODUCTION

Recent years have shown that citizens want to participate in major decisions about their communities(Goetz, 2014).One flagship example of that is the Stuttgart 21 debate in Germany. This is also a valuable development for the governing body since it gives them a great input about the state of mind of their citizens. A result which is valuable for citizens and the government because the decisions made by consent of the public will be more widely accepted by everyone.

Public Participation stands as an essential tool for direct democracy. In an environment filled with technical evolution, the evolution of participation processes is inevitable. This leads to a newly coined term of e-Participation which together with e-Democracy forms under the banner of e-Government. These terms describe the governance in combination with the usage of modern technologies.

The participation process for Planning projectis divided into different (levels) parts Information (non-participation), participation (non-interactive) and cooperation (interactive). These different stages require different tools(van den Brink, 2007).The lowest stage of e-participation which only informs people can be done over social media channels or dedicated websites. Most of the times no specific tool is needed to bring the information to the people. In case the governing body wants to let the citizens participate in the decision making itself more advanced tools are needed. Here it has to be explicitlytaken care of any kind of voting. The most interactive format of e-participation, the cooperation, needs another level to it.

This paper focuses on the cooperation between government and citizens. The defined used-case is taking place in a small village of Niedernhall in Baden-Württemberg. The goal for the mayor's office is to let people decide and cooperate on the design of a specific part of the village.

To achieve this goal, different questions have to be answered. The first is how will the information be brought to the people to allow for the most understanding of the environment.

Thisis answered if we look at development in the 3D Web Visualisation Technologies. It has become increasingly simple to display 3D Models using a Web browser without the need for any additional software. According to the fast development of web-based 3D visualization tools in recent years, the 3D interaction application could be developed for the e-Participation platforms which will give many advantages concerning communication, co-operation, and particularly participation(Knapp, Bogdahn, & Coors, 2007).

Moreover, the inclusion of 3D allows especially in regards to planning phases of buildings a more neutral judgment by citizens over images that only show certain aspects of the building(Pantzer, 2018).

What can be done to give people or authorities easy access to a 3D City Model that can be used for planning? In examples such as Smarticipate open data is used to provide an environment for participation.Accordingly, the main focus lies in large urban areas(Stelzle & Noennig, 2017). Some cities provide their building models on their website. However, this is still not a given for all areas. Especially for small cities, it is not feasible to create their own 3D Model due to lack of experience or equipment. That is why a platform providing datasets like this in a ready to use way is necessary.

The German state of Baden-Württemberg can maintain a server which hosts their current 3D models of the buildings in their jurisdiction in the CityGML format. Additionally, a Digital Terrain Model (DTM) is provided by the state. Baden-Württemberg handles this in the form of one of the state agencies, the "Landesamt für Geoinformation und Landentwicklung".To create the e-Participation platform with the mentioned datasources, we study on the methods of data preparation and data delivery in an efficient way. The platform is based on the Cesium web globe with the buildings displayed through 3D Tiles. The architecture contains two individual parts. One server is hosted by the state and contains the 3D model and also the first part of the proposed architecture. Another Server hosts the user management tools and user-created or -uploaded models.

This platform not only displays the 3D Model of Niedernhall but also lets users create or upload their own models. Thisis used for the cooperation process.

The first test run described in this paper focuses on the city council, which is comprised of around 20 members, to cooperate on the design of the area of interest. In addition, some preconstructed 3D Models of city furniture were provided to this group.

3 RELATED WORK

3.1 Public Participation and e-Participation

Participation is a concept that includes many subdivisions. A first subdivision is made by emphasizing the initiator of the participatory process. A "top-down" participation is, as the name suggests, a process initiated by the decision-maker, e.g., the governing body. Is the process initiated by the public respectively the people affected by the decision, it is called "bottom-up"(Paust, 2016).

Another distinction is to make between formal and informal participation. In Germany, the law demands participation processes for processes such as land use planning and spatial planning processes. These then are called formal participation processes, whereas processes not demanded by law are considered informal participation(Paust, 2016). The section this paper is interested in is the "top-down" approach, both formal and informal.

Innes and Booher discuss the usability of the formal participation in the US. They conclude that collaborative participation can help solve complex problems, whereas the standard procedure shows difficulties(Innes & Booher, 2004). A report from the European Commission states that the usage of ICT (information and communications technology) in governing processes is emerging in the majority of the cities from all researched(Misuraca, Reid, & Deakin, 2011). This is especially the case for big cities (500.000 – 1.000.000 citizens), which provides another reason to bring this to more rural areas. This is supported by the work of Stelzle and Noennig which states that more complex processes of participation such as Urban Gaming and Augmented Reality are only restricted in their application to larger cities(Stelzle & Noennig, 2017).

This goes for the example of the "Finding Places" application from 2016 in the city of Hamburg. An application was extended by workshops with around 11 participants per workshop. A weakness that was brought up in this project is that the availability of urban data is limited. Additionally, it discusses the problem with non-expert users not familiar with the data and the visualization. Apart from that, the CityScope Platform was received in a positive light(Noyman, Holtz, Kröger, Noennig, & Larson, 2017).

3.2 CityGML

Nowadays, the 3D web technologies are far developed and better accessible which is the fundamental basis of the "Smart Cities" concept. For example, the 3D plays an essential role in the development of future

navigation network(Prendinger et al., 2013). In addition, one effective 3D technology that represents the urban city in 3D through the web is the CityGML standard(Kolbe, Gröger, & Plümer, 2005).This standard leads to several usages in Smart Cities. For example,it allows for the simulation of heatdemand and other relevant information(Weiler et al., 2018).Also, it can be used for disaster management such as 3D flood information in the city(Schulte & Coors, 2009).

Accordingly, more and more cities in Europe like Monaco, Geneva, Zurich, Leewarden, and cities in Denmark are now using CityGML LoD (Level of Detail) 2 or LoD3 as a standard to represent and exchange the 3D city model data(Gröger, Kolbe, Nagel, & Häfele, 2012).

3.3 3D Globes

The development of 3D Web technologies brought different platforms for geographic data into existence. Amongst the more popular 3D Globes are the NASA WorldWind Globe, Cesium and Google Earth.

	Nasa Web World Wind	Cesium	Google Earth
Producer	NASA	AGI	Google
Programming language	JavaScript	JavaScript	-
3D models	Collada, KML	Collada, glTF, KML, 3D Tiles	KML
Development start	2015	2011	2001
License	Open Source	Open Source & Commercial	Freeware
Typology	Web	Web	Desktop

Table 1: 3D globe comparison (Würstle, 2018)

The main advantage of the Cesium globe lies in the possibility to use the development of the 3D Tiles. This technology supports the usage of large 3D building models in a web environment.

3.4 Database

To store the data for the application, database systems are required. The different types of database systems, such as SQL, no-SQL or NewSQL Databases provide different possibilities of application. These types warrant different advantages and disadvantages (Dambruch, Stein, & Ivanova, 2016). To best store the datasets of the CityGML models, which are used in this paper, the 3D City DB is used. This is a database model for the relational PostgreSQL and Oracle database management systems (Yao et al., 2018).
Additionally to that, the MongoDB as representative of the no-SQL databases is used. As a file-based storage system, it provides a good solution to store singular small 3D models that need to be displayed on the globe.

3.5 UrbanAPI / Smarticipate

TheUrbanAPI project was developedfrom 2011 to 2014. It focuses on the aspects of planning, visualizing and analysis in different cities. It targets the Cities of Vienna, Bologna, and Vitoria-Gasteiz(Soomro, Ludlow, Khan, & Loibl, 2014). The UrbanAPI platform combines 2D and 3D Web technologies. For the 3D part, the WebGL technologyas part of HTML5 is used(Dambruch & Krämer, 2014).

The Smarticipate project is developed by the Fraunhofer Institute.It focuses on the 3D-Web technology that emerged in recent years. It combines it with an open data approach. The open data approach comes with a lot of different challenges mainly caused by the data not being provided uniformly. The proposed solution is to apply semantic web technologies(Dambruch, Stein, & Ivanova, 2016).

4 PROJECT

4.1 Setup

The project “Smart Villages”[1] stands under the banner of “digital@bw” and focuses on attractive places in rural areas. In the bigger picture of “digital@bw”, this falls under the field of action “smart data / smart living”.

[1] http://www.lgl-bw.de/lgl-internet/opencms/de/05_Geoinformation/Digitalisierungsstrategie/Smart_Village/

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The city of Niedernhall is the selected Area for testing the platform. The city has a population of around 4000. Niedernhall is selected because, apart from being interested and open to the project, is of a size that would make it difficult to maintain an own 3D Web application. As a focal point in Niedernhall, a public place near the city center is chosen. The place is redesigned because the surrounding area is renovated and repurposed.

Figure 1: Exemplary design of the Area

The redesigning allows the citizens to give their opinion on how it should look. In the first step, the participants are only the parish council and the mayor of the city. This elective group gives the advantage that the people already know the critical information regarding this space. Additionally, the participants can be guided through the platform in a much more personal way since it is only around 20 people.

In a 45 min on-site appointment, the platform was presented. This is a necessary step since the participants are not familiar with platforms such as this. Especially regarding the navigation around the 3D environment and the uploading of 3D models.

In addition to the platform, the participants were provided with different 3D Models to design the public space. The models are different city furniture, trees, and parking spaces.

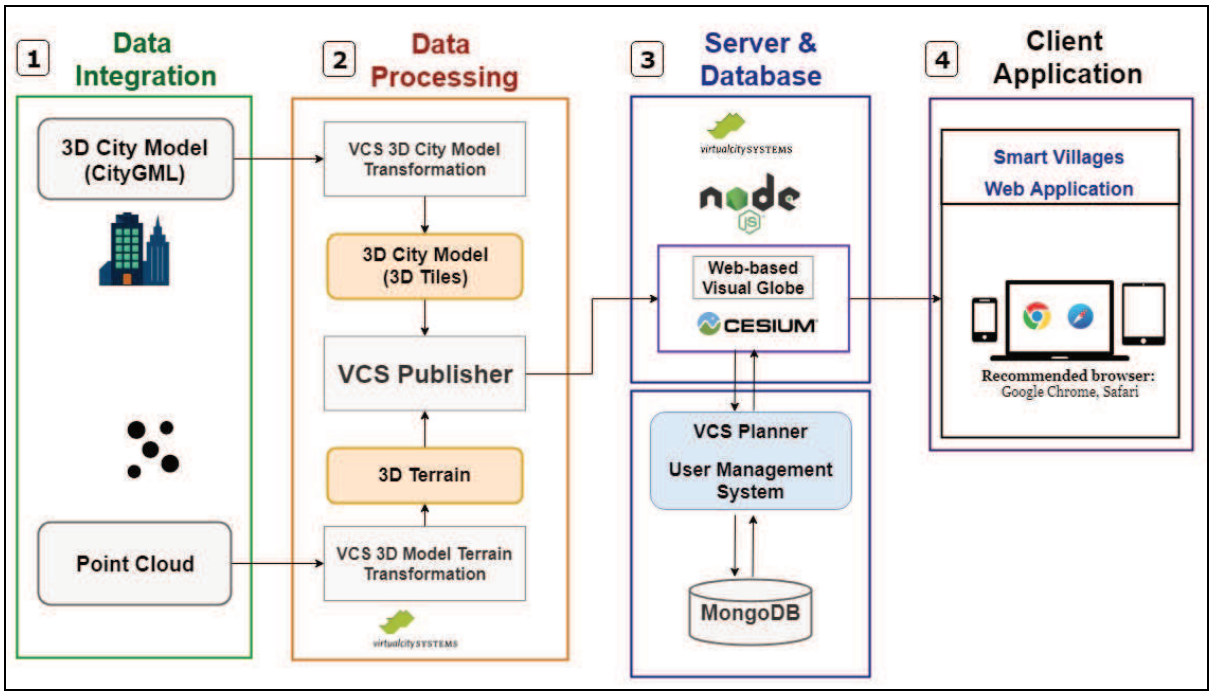

Figure 2: SmartVillage System Architecture

4.2 System Architecture

This section describes anoverview of the Smart Village platform. It contains four main sections including (1) Data Integration, (2) Data Processing, (3) Server & Database, and (4) Client Application as shown in figure 2.

4.2.1 Data integration (①)

This section explains all the data sources we used in Smart Village platform. In total, we have two primary sources which are consisted of a 3D city model in CityGML format and point cloud data in the area ofNiedernhall. These datasets are collected and provided by the LGL. The 3D city model is created through automated and interactive workingsteps by taking the appropriate footprint of the building from the cadaster and areal images(Gültlinger, 2015). The point cloud data is collectedthrough areal flights.

The LGL manually creates the 3D models which are provided to the users of the platform. These include trees and other city furniture.

4.2.2 Data Processing (②)

This section explains how we prepared the data source in order to create a web application project. We processed the data in the Virtual City System platform. This part aims to transform the city model data into 3D Tiles format as it is a format that is capable of visualizing 3D large-scale city scenes(Dambruch & Krämer, 2014). As well as to transform the point cloud data into the terrain model. Then, we created a web application project based on WebGL-based web globe Cesium[2] using the application framework "virtualcityPUBLISHER"[3]. It allowed us to create, configure, and publish the Smart Village application in an efficient way. The 3D city model of the area is stored in a PostgreSQL database with the 3D City DB Schema.

4.2.3 Server and Database (③)

This section explains how we prepared our web application server, database, and user management systems. For the application, we hosted the main Smart Village application project on the Node.js server using the Express framework. The LGL maintains this server as they are also the owner of the displayed data, making this solution the most convenient. This application is developed based on the Cesium web globe library. The main features of this application are described in chapter 3.4.

For the user management system, we used the virtualcityPLANNER[4] platform that associates the data with a MongoDB database system. This part of the system connects to the Publisher part over a specific locator id. It then functions as an Add-on. The Planner exceeds the user management capacity by providing the functionalities for users to include their own 3D Models. These are then stored in the MongoDB.It also provides functionality to draw 3D models in the city model.

4.2.4 Client Application (④)

The Smart Village application[5] is accessible through web-browsers across all different platforms to provide the best possible experience for the users.

One of the main features of the Smart Village application is the visualization of the City of Niedernhall. This part of the application is publicly available to everyone. It allows users to view the provided model in different ways with textures, with different base maps or vegetation. Also, the user is provided with the general possibilities of Cesium like 3D Navigation.

The Planner and Publisher Application are divided into two distinct parts. Both have a backend interface and a frontend interface. Most regular users will only deal with the frontend part. However, the backend allows to set different settings, creating different experiences for the frontend.

[2] https://cesiumjs.org/
[3] http://www.virtualcitysystems.de/en/products/virtualcitypublisher
[4] http://www.virtualcitysystems.de/en/products/virtualcityplanner
[5] http://3dweb.lgl-bw.de/3D/Niedernhall/

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(I)

The Planner Add-on allows the user to create or use their 3D models. For the creation, it provides the user with different drawing tools such as polyline or polygon. These allow for basic designing processes.

(II)

There is also the possibility of uploading external 3D models. These can be designed by the users itself or downloaded from multiple sources online. Also, the LGL provides different models of city furniture and vegetation to the users in the glb format. These models can be uploaded into the existing environment.

(III)

An important functionality of this platform is user management. Only registered users should be able to plan something on the platform. In this project, the users had different roles to fill. The first role is the administrator. This role gives this user permission on the backend to add, alter and delete users, to add, alter and delete groups and roles and on the frontend to create, read and edit all plannings of other users. This role has to exist independent of the project. For this specific project, three roles were created. A role for the mayor of the city which grants him the power to add, edit and delete users and groups. On the frontend, he has the same possibilities as other users of just creatingplannings. Apart from that, there are two more roles.One is for the member of the city council the other for a jury. The city council is only allowed to create and share plannings, and the jury is only allowed to read plannings.

These users are managed by their email address and a created password. The users have not only roles but also groups. The groups allow on the frontend to share the planning with specific people. Thisis used when a user created planning and wants the jury to see it. In this case, he can share it with the group of jury members.

Figure 3: Multi-platform approach

5 CONCLUSION

The first impressions of the participation show some worries regarding the ease of use for the people. Thisis mainly caused by different levels of technical know-how amongst the participants. Some participants are not familiar with information technologies of any kind whereas others already have experience in this specific field. The knowledge gap between the different participants is especially evident in the on-site appointment where the platform has been introduced.

The platform setup of the principle of providing 3D Models through official channels such as the LGL is working. It allows smaller cities to access the 3D Model over the server provided by the LGL as shown at the example of Niedernhall.

A central goal in the near future is reviewing the existing platform through the parish council. For this purpose, a questionnaire has been designed to get the impression on a general acceptance of this kind of tool for participation processes, aswell as how the platform can be improved to make it more user-friendly. Additionally, the platform will be extended by using different data sources apart from the 3D City model and the DTM. These datasets will include Sensor Data in combination with Sensor things and the usage of BIM models.

It is intended that these will give more complete informationon things regarding energy production and a more detailed look into newly planned buildings.

In addition to technical improvements, the goal is also to spread the platform to the public by introducingit to the citizens via local newspapers. A broader audience can then give a better outlook on general acceptance.

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