

Smart-IVC

Cities Becoming Alive

Andrea Vicari

Abstract

Web users have to aggregate different data from various sources whenever they are looking for some information on the Internet. Think about the student who is looking for a rented room near her university: she firstly uses a specific website to find the advertisement of a room for rent, she then looks for the address on another website that provides a map service to see if the house is located where she desires.

No such service exists that provides a unique environment in which the user can both visualize a city and interact with its elements. The only technologies available are either not exhaustive or too complex to use.

This thesis introduces Smart-IVC a web application that provides an intuitive interface and prevents the user from jumping from website to website. Through the form of a 3D-environment, this application provides an interactive visualisation of cities in which the user can directly communicate with the elements, executing queries on them. After having clicked on a building in the map, the user is able to get information (coordinates, address, floors etc.) about that construction and also find out what are the various relations between that specific building and the other entities in the city.

Smart-IVC is an application accessible by everyone and that aims to enhance the city visualisation, getting closer to the user needs.

Advisor
Prof. Michele Lanza
Assistant
Prof. Dr. Andrea Mocci

Advisor's approval (Prof. Michele Lanza):

Date:

1 Introduction

Cities nowadays are in constant evolution. They change their structure overtime through the appearance of new elements and the disappearance of old ones, thus they are very unstable and prone to changes. Important changes, might be considered with regard to the deployment and management of all types of infrastructures within cities.

Moreover, cities have a very large impact on the economic and social development of nations: they represent the real foundation where people live, where companies have their business and in which numerous services are provided. Often, a city overview is not available, so decision may be taken without having a big picture of the surrounding environment. This could lead to choices that might have a negative impact on the current city, reducing the efficiency and the life quality of the citizens.

To control these changes, a visualization, which provides a city overview, is required. Such a visualization is considered to be the first step towards what it is called a Smart City. A Smart City can be defined as a city which uses information and communication technologies so that its critical infrastructure as well as its components and public services provided are more interactive, efficient and so that citizens can be made more aware of them.

1.1 Contributions

Smart-IVC aims to solve the problem generated by the static nature of data regarding cities (as mentioned above) through an Interactive 3D–Visualization model. Therefore, the main contributions that Smart-IVC provides are:

- The visualization of a 3D city model. As a use case for this Bachelor Project, the city of Lugano has been taken into account.
- The interactivity that the user has with the entities inside the city: buildings can be clicked in order to receive information about them and in order to receive information between the selected building itself and the rest of the entities in the city.
- The possibility to have a graphical city overview using a very intuitive system of visual queries which produce results that are immediately visible through the highlighting or colouring of the buildings.

1.2 Structure of the report

- **Chapter 2** is about the state of the art. It talks about already existing tools which allow city visualization in a virtual environment. In particular, it focuses on tools that use the Cesium framework comparing and contrasting the existing features with the ones proposed in Smart-IVC.
- **Chapter 3** is the main chapter of the entire report. It shows how Smart-IVC has been developed step by step. The decisions that have been taken and the technologies adopted will be explained and discussed in detail starting from the parsing of the unique .xml file provided by the Comune of Lugano and ending with the final result (i.e., the 3D–visualization of the entire city).
- **Chapter 4** is about showing some use cases of the application. Examples will be illustrated and explained in detail, in order to show the features proposed by Smart-IVC.
- **Chapter 5** is the conclusion of this report. Here, the current limitations of the application will be presented. Finally, the future work and the different paths that Smart-IVC could take will be discussed and analyzed.

2 State of the Art

The uniqueness of Smart-IVC resides on the fact that it provides, not only a visualization of a city but, above all, it gives the possibility to the user to interact with the city itself through a simple system of visual queries. Before getting into the details with Smart-IVC, the current state of city visualization must be clarified.

Firstly, in this chapter, the Cesium framework will be introduced since it has been used as a basis of Smart-IVC, after this, the work done by the community online that used this powerful framework will be compared.

2.1 Cesiumjs

Cesium is an open-source JavaScript library for world-class 3D globes and maps that is used to create a web-based globe and map for visualizing dynamic data.



Figure 1. Cesium logo



Figure 2. An example showing a 3D visualization of the city of New York. Using Cesium 3D Tiles Tecnology

2.2 Swiss Geospatial Portal Using 3D Tiles



Figure 3. A 3D visualization of the city of Bern in the Swiss Geospatial Portal. Using Cesium 3D Tiles Tecnology

3 Smart-IVC

3.1 Environment and Frameworks

3.2 The first Attempt: Babylon.js

3.3 The final version: Cesium.js

3.4 The Overall Structure

3.5 Server Side

3.5.1 Parser

3.5.2 Cron Jobs

3.6 Client Side

3.6.1 Cesium Framework

4 Use Cases

4.1 Access information

4.2 Visualize the City

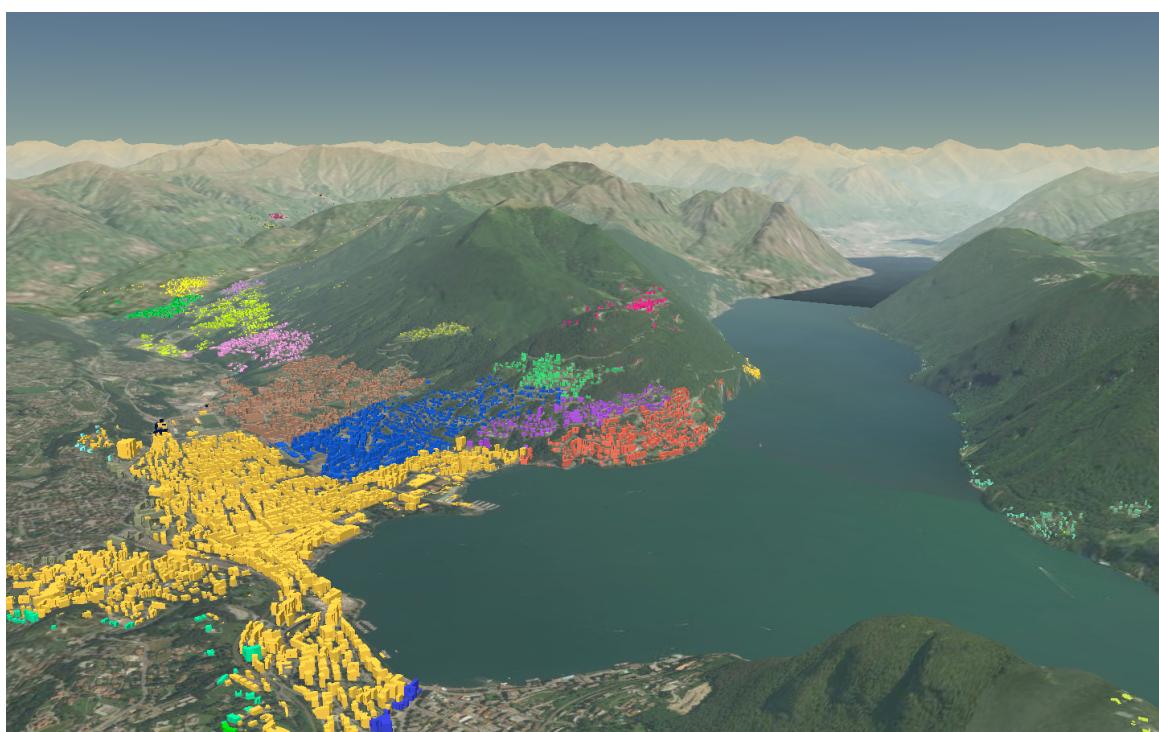


Figure 4. A Visualization of the city of Lugano where every suburb is coloured differently

4.3 The Query System

4.3.1 Building Selection

4.3.2 City Gradient Map

5 Conclusions and future work or possible developments

5.1 Summary

5.2 Future Work

References