OccuV : A Visualizer for Spatial and Temporal Databases

Swagnik Roychoudhury[1], Nada Lahjouji[2], Sharad Mehrotra[2]
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[1] New York University, Courant Institute of Mathematical Sciences

[2] University of California, Irvine, Donald Bren School of Information and Computer Sciences

OBJECTIVE

Our objective is to create a free and open source visualization tool for spatial and temporal databases

INTRODUCTION

Background

- Databases have historically been tailored to storing large amount of tabular data for servers, logs, user info, and other storage use cases. The rarity of storing spatial-temporal data has caused a lack of tools to display such data
- One popular software used in the industry is Tableau, which provides a suite data visualization tools. However, it is an expensive enterprise toolkit and not open-source, making it difficult for many businesses to adopt its usage

Overall Project Goal

- Our tool is designed to allow users to visualize UC Irvine's TIPPERS system. The TIPPERS system is a complex IoT (Internet of Things) system of sensors across the UCI campus that measures occupancy of rooms in buildings.
- The tool should be capable of of displaying the spatio-temporal data using maps, graphs, and list.
- While the tool is demonstrated on the TIPPERS system, it is designed to be compatible with any database that follows a similar database schema

METHODOLOGY

Understanding the data

- Designing the tool requires an understanding of what the data looks like. Database Schema (architecture) files were provided.

Analysis of Tools Available

- Multiple platforms exist on which this tool can be built on, such as Grafana, React JS, and GoDot.

ETL

- Using the Builder application created by UCI graduates as part of the TIPPERS system, spatial data is created of the entire campus. We use sensor data and historical temporal data to populate database with occupancy values over many five-minute intervals.

PROJECT OVERVIEW

Understanding the Data Structure

- The first week was spent analyzing the table structure of the tippers system, which consists of 18 tables

Analysis of Tools Available

- Originally the selected platform was Unity. However, since it is not open source, GoDot was decided to be use. The app is hosted on itch.io, and communicates to the TIPPERS PostgreSQL backend through a REST API

ETL

- Most of the TIPPERS data was destroyed. We obtained blueprints of Donald Bren Hall and the ARC to construct them on the map. The ARC will soon be transpitting live occupancy data

Atomic Units of Visualization

- The UI consists of three views: Map, Graph, and List. Graph and List view. The user is presented with a blank canvas, upon which they can select which view they would like to explore.
- The user can add more views in the canvas in addition to the first. While the views are initially independent of each other, the user can link multiple views togethers to control them at the same time, such as temporally

Fig1. Map View Zoomed out, shows buildings

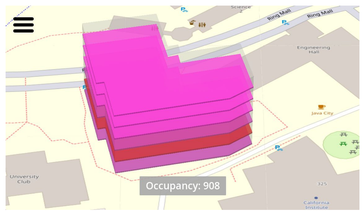

Fig2. Map View Zoomed in, shows floors

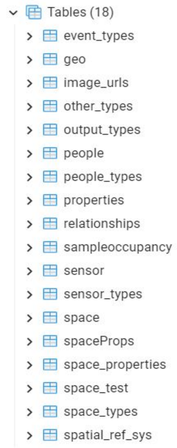

Fig3. Tables in the System

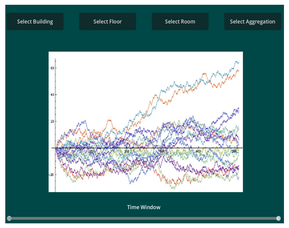

Fig4. Graph View

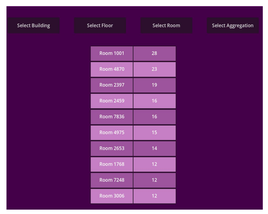

Fig5. List View

REFERENCES

Tableau Software, Data visualization company, *tableau.com*
TIPPERS System, UCI, isg.ics.uci.edu/portfolio/tippers/

APPLICATION LIFECYCLE

Download	Tilemaps encompassing all geographic coordinates are downloaded from the internet
Request	The application requests data from the PSQL server and stores it in a relational data structure
Convert	The buildings' coordinates are translated to pixel space via relative distance of the map
Render	Using mesh rendering algorithms, 3D models of all buildings and floors are generated
Travel	Go back in time via a time slider to view historical data

LIMITATIONS

Open Source

- Since this project is open source, we were limited in the resources we could use

TIPPERS availability

- There is not much data available since TIPPERS is not online everywhere

FUTURE WORK

Expanding TIPPERS

- The TIPPERS team is continuing to bring sensors across the campus online. TIPPERS is also being deployed to buildings affiliated with UCI (i.e. the ARC)

Expanding Visualizations

- Since TIPPERS can collect data about individuals over time, the tool can also be used to track trajectories across spaces. This is very helpful to see where people may have gone in the case of an emergency

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