Project WASP: Geo Spatial-Temporal analysis of construction trends using building permit info.

Problem Statement: There are no good tools to visualize trends over time and analyze how the construction densities have changed in a city(ex.Chicago).

Heilmeier Questions:

1)

2)

3)

4)

5) If you're successful, what difference and impact will it make, and how do you measure them (e.g., via user studies, experiments, ground truth data, etc.)?  
 - Geo-Spatial visualization will help users gain insights into construction and real estate trends. This tool will help city/authorities make data-driven decisions for infrastructure, sustainable living planning. For, construction companies, this can serve as a great way to visualize how trends have changed over time.  
 The tool adoption can be assessed by measuring the traffic to the web page. This can be automated with tools like Google Analytics. For specific use cases for enterprises, user surveys can be conducted to prove the hypothesis/assumptions about the tool.

6) What are the risks and payoffs?  
 -Risks: Data cleaning can get complex and time consuming.  
 Geo-Spatial visualization using 3rd party libraries can become risky if they don’t support what we are intending to build.  
 Scope of the project might get huge given the amount of time we spend on homeworks.  
 - Payoffs: The ability for retail users to make sound financial decisions.  
 City/Town planning can use this tool for data driven decisions vs anecdotal instincts.

7) How much will it cost?  
 -Resource Cost (10 hrs/person/week) = 50 hrs/wk \* 8 weeks = 400 resource hours  
 -Storage Cost - Tier 2 Data Lake = 1$/month   
 -Computation Cost – 24.7$/Month (using AWS ec2 pricing of 0.0139/hr)  
 - Miscellaneous – 1% of the overall cost.

8) How long will it take?  
 -7 weeks for project to be completed, 1 week for presentation prep.

9) What are the midterm and final "exams" to check for success? How will progress be measured?  
 -Following is the plan of activities and also serves as check-points to track project:

|  |  |  |
| --- | --- | --- |
| Activity | Assigned | Date |
| Data Gathering, Cleanup and Storage | Brian Tran, Aayush Parwal | 03/26/2021 |
| POC for visualization with fixed data | Prashant Kubsad, Wael Sulthan,Scott Bader | 04/09/2021 |
| Time series analysis of data | All | 04/15/2021 |
| Final working tool with complete data and analysis. | All | 04/25/2021 |
| Final Presentation and wrap up | All | 05/01/2021 |

Literature Survey:

Building permits are great information to understand construction trends. A spatio-temporal analysis done in the article[PK-1] provides us, with lots of parallels in our aim to visualize the construction trends over time. Analysis of type of work, value would enrich understanding beyond time and space linked with world events [PK-1]. Lot of work has been done on usage choropleth maps to visualize geo spatial models, like dynamic increase in percievable area[PK-2], boundary neighbour selection [PK-2]. This coupled with Google Maps/API, gives us ability to develop interactive webpages. Reactive time component to geo-spatial models, presents its own challenges. Possible solutions are discussed in EST[PK-3]. We can combine the principles mentioned in EST[PK-3] with web development technologies[PK-4] to provide an easily accessible tool that visualizes trends in construction patterns.

The journal is presenting different ML models like ARIMA and exponential smoothing to enhance transportation system. The paper helped us identify different models and how to use them in predictions. Exploring existing machine learning platform like Google cloud and MS Azure could save us hassle and time[WS-1]. The second paper provides home-seeker an interactive visual system. The variety of visualization included provided us a complete view on different designs and the way of use. The potential challenge is the level of complexity of some graphs yet utilizing third party tools like Tableau and Power BI will solve it [WS-2]. The last paper presents the use of ML algorithms to predict city expansion. The paper integrated two models, the Markov chain and the Cellular Automata. This will help us in forecasting urbanization growth. The availability of satellite images is a challenge. However, we could rely on other relevant public data [WS-3].

1. The Future of Spatial Analysis in the Social Sciences

Main Idea : The study mainly wants to address how advances in geo-spatial analysis is influenced by social sciences and vice versa.

This is useful as construction permits for residential, commercial or public buildings go hand in hand with socio-economic demography of an area.

Given the time, study cites major challenges in being able to read, manipulate and store large amounts of detailed data which is required for any geo-spatial analysis, like maps, roads etc. With today's accessibility of such data from local governments and combining it with flexibility of cloud, makes such limitations go away around gis.

2. Using Building Permits to Monitor Disaster Recovery: A Spatio-Temporal Case Study of Coastal Mississippi Following Hurricane Katrina

Main Idea : of the author here is to identify extent of damage and recovery efforts based on building permits and a spatial scan.

This is directly relevant to us as city planners, specifically in danger areas, can use our website/tool to balance giving out building permits to residential, and also understand disaster recovery clusters and allocate resources accordingly.

Author touches but fails to fully integrate re-population, or not immigration pre and post disaster. For example if people chose to move away from the region permanently.

3. Adaptive clustering algorithm based on kNN and density

Main idea: The author looks to utilize density of population to sample t dynamically adjust k value in the algorithm.

This is particularly useful for us as even within city concentration of building permits needs to be changed for example, city center vs suburbs etc.

Author fails to show how the cluster moves/trends as external factors influence density as against to a cluster behaving in a silo. Our analysis using the building permits will look to perform trend analysis on these clusters

References:

PK-1 : Using Building Permits to Monitor Disaster Recovery: A Spatio-Temporal Case Study of Coastal Mississippi Following Hurricane Katrina - <https://www.tandfonline.com/doi/abs/10.1559/152304010790588052>

PK-2: Dynamic Choropleth Maps – Using Amalgamation to Increase Area Perceivability

<https://ieeexplore.ieee.org/abstract/document/8564174>

PK-3: Exploratory spatio-temporal visualization: an analytical review

Journal of Visual Languages & Computing, Volume 14, Issue 6, December 2003, Pages 503-541

<https://www.sciencedirect.com/science/article/pii/S1045926X03000466>

PK-4: Data Visualization with D3JS and Angular – Christoph Korner

<https://www.google.com/books/edition/Data_Visualization_with_D3_and_AngularJS/FQOzCAAAQBAJ?hl=en&gbpv=1&dq=d3js+with+angular+application&pg=PP1&printsec=frontcover>

WS-1: Smart transportation planning: Data, models, and algorithms

<https://www.sciencedirect.com/science/article/pii/S2666691X20300142>

WS-2: HomeSeeker/ A visual analytics system of real estate data

<https://www.sciencedirect.com/science/article/pii/S1045926X17301246>

WS-3; Spatiotemporal urbanization processes in the megacity of Mumbai, India: A Markov chains-cellular automata urban growth model

<https://www.sciencedirect.com/science/article/pii/S0143622813000362>