Visualizing the Residents of Engagement Ohio

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Abstract—The VAST challenge in 2022 had competitors determine how best to spend an urban planning grant awarded to the city of Engagement Ohio. To do this participants were provided with data on the demographics and daily routines of 1000 city residents as well as some information about the businesses within the city. Using this dataset and Plotly Dash we created a dashboard to visually explore the demographics of these citizens, businesses, and how people move throughout the city over time.

1 Introduction

The annual IEEE Visual Analytics Science and Technology (VAST) Challenge seeks to push the field of visual analytics by providing both industry and academia the ability to test their tools on realistic tasks and datasets. The VAST challenge in 2022 [2] focused on the urban development of Engagement Ohio. As per the challenge, the city of Engagement Ohio had received a large city renewal grant. To best utilize this funding, the city collected data on the daily activities of its citizens to locate the best areas for investment. Specifically, the city sought to understand 3 aspects of the city:

1. The demographics and relationships of its residents
2. The daily routines of its residents
3. The financial health of the city

In this work, we focus solely on the first two topics. Using Plotly Dash [1] we visualize the provided data to explore the demographics of both Engament's citizens as well as its buildings and businesses. We also use the animation functionality of Dash to display participants' movements throughout the city for a selected day.

2 The Dataset

As mentioned above, the dataset used in this project comes from the VAST 2022 challenge [2]. The dataset contains a year's worth of information from 1000 residents of Engagement, OH gathered from March 1, 2022 to May 31, 2023 in five-minute increments. Some of the information in the dataset is synthetic to provide competitors with more data to work with. This data was collected by an app that tracked each participant's location, spending, and items purchased. The dataset consists of activity logs, journals, and attributes. The activity logs track participant locations and spending, the journals track various participant features and check their status in the project and the attributes track various demographics of the city and individuals. Within our first challenge of exploring the city and resident demographics, we used the various attribute datasets included, including jobs, restaurants & pubs, available apartments, and participant details. For our second challenge, we used the participant activity logs to analyze the participant movement across the city.

3 Our Visualizations

For our first research question, we focused on the attribute datasets, analyzing and visualizing these to understand the attributes of the city and population. Firstly looking at the demographics of the population, within the datasets we can analyze participant age, education level, household size, and whether the participant has kids or not. To start analyzing this dataset we built simple histograms and pie charts, shown in Figure 1 to analyze the population-level attributes. We then dug deeper into these datasets looking into the interaction between various participant attributes. Primarily we looked at the participant attributes within the ages of the participants. Building various comparative bar graphs to investigate how education level, household size, and kids are spread across the various age categories in Engagement Ohio. After investigating the population demographics of the city of Engagement, we looked into the city attributes specifically, the apartments, restaurants, and jobs. When looking at the apartments we looked at the price of apartments compared to the available rooms in the apartment also incorporating the max capacity of apartments. After looking at the housing within the city we looked towards the restaurants and pubs in the city to determine how expensive it is and how much a night out will cost. Finally looking toward employment opportunities we looked at the level of education required and earning opportunities available at various jobs throughout the city.

To explore the daily routines of participants, we generated three visualizations. Each visual maps participants' locations onto an image of the city at various points throughout the day and across different days. For the initial mapping, we use the location information provided in the dataset. Participant locations are represented as a string containing the x and y coordinate of the participant relative to the provided city map. To graph these positions, we first needed to convert the provided strings into an actual (x, y) coordinate pair. Once converted we are able to plot the participants on a scatter plot and overlay the plot on top of the provided map. For the temporal aspect, we restrict each visualization to a single day. Due to the size of the dataset, it is prohibitively slow to load and render all the data at once. However, the data is spread across multiple status logs, each containing about 5.5 days of data. As such we only load a single file at a time and as needed to minimize the overhead of loading the data and share the cleaned data across all three visuals to avoid duplicate loads and filtering. Similarly, we filter the data to a single day to improve the rendering time of each visual.

The first visual, shown in Figure 2, provides an animation of participants' movements throughout the city during the selected day. This not only allows the viewer to see each participant's routine individually but also gain insights into commonalities across participants such as the busiest times of the day to travel, where participants are employed, where they go for food and/or recreation, as well as information on the city structure itself such as where the residential districts are compared to commercial zones. Participants can further be color-coded based on their Hunger, Financial, Sleep, and Location statuses to see how they change throughout the day. The second visualization is very similar but only provides a mapping of the participants' locations and statuses at a specific time during the day. This static mapping allows the viewer to more easily view the data at specific times than scrubbing through the animation. Similarly, this second mapping can also be color coded to the same statuses and is displayed next to the animation. This allows the viewer to easily explore points of interest within the animation across the other statuses without needing to change and rerun the animation. The final visual provides a density heat map of participants within the city. This heat map provides insight into the most used/traversed portions of the city throughout the day and can be altered to provide either broader or more fine-grained sectioning of the city.

4 Our Findings

4.1 Population and City Demographics

Engagement OH is a unique area with a young population and a diverse education level. The majority of individuals have completed some college or a bachelor's degree, with fewer individuals having graduate

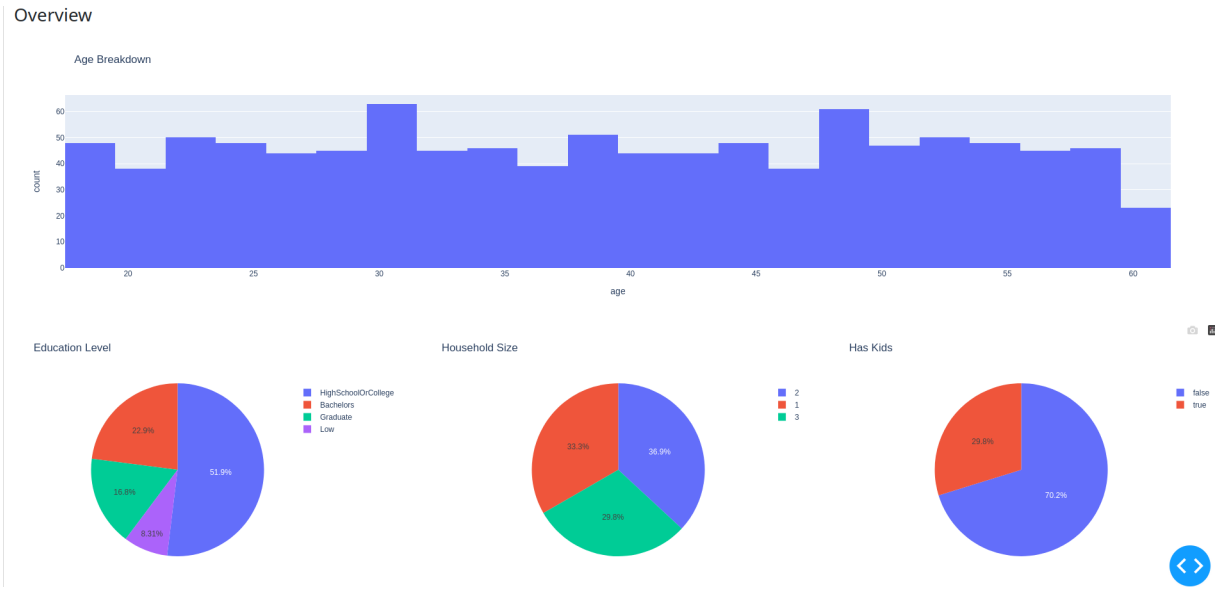

Fig. 1: Visualization of resident demographics

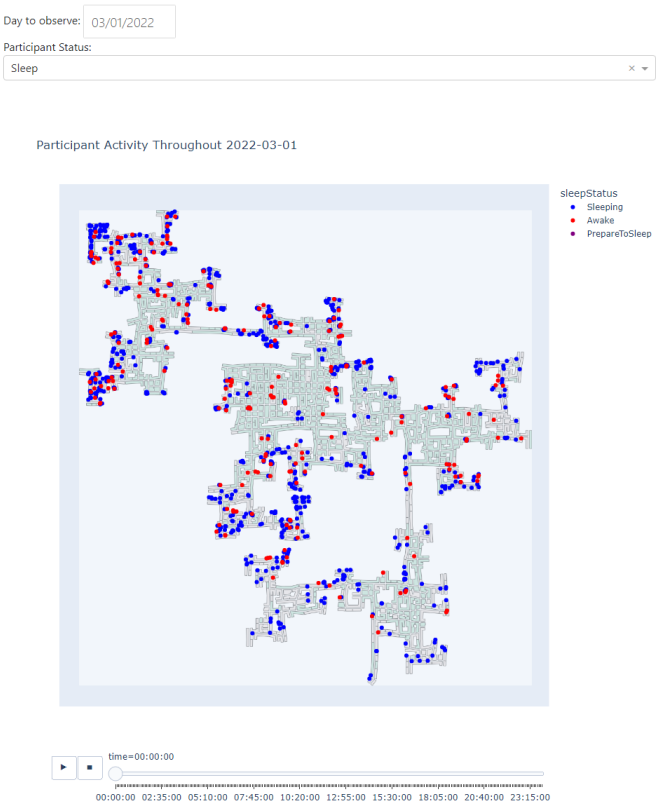

Fig. 2: Animation of participant activity throughout the day

or professional degrees. Most households consist of 1-2 people, and the majority of residents do not have children.

Our analysis of education levels across age categories found that younger residents (20-29 years old) have a higher percentage of individuals with some college education, while older residents (30-39 years old) have a higher percentage of individuals with a bachelor's degree. This highlights the importance of education in Engagement, OH, as individuals with higher education levels tend to have smaller households and higher-paying jobs.

4.2 Residents' Daily Routines

Our findings suggest that most individuals tend to stay within the same general area of Engagement, OH, and visit grocery stores, restaurants, and their workplaces most frequently. It is interesting to note that grocery store visits are more common during the weekdays, while restaurant visits are more common on weekends. Additionally, we found that residents who frequent more expensive restaurants tend to have higher grocery bills and incomes.

Finally, our analysis of job levels and income in Engagement, OH shows that individuals in higher education-level jobs tend to earn more on average. This highlights the importance of education and job skills in achieving financial success in this area. Overall, these findings provide insight into the unique demographics and daily routines of residents in Engagement, OH.

5 Conclusion

In conclusion, through our analysis of the attribute datasets and participant activity logs, we were able to gain insights into the demographics of the city and its residents, as well as their daily routines and behaviors. Our findings suggest that the city should focus its resources on improving infrastructure and amenities in the areas where residents spend the most time, such as grocery stores, restaurants, and workplaces, while also providing incentives for businesses to open in these areas. Additionally, the city should prioritize the development of affordable housing options for smaller households, particularly for younger residents with some college education facing job opportunities that require a higher level of education and offer higher earning potential. By leveraging these insights, the city of Engagement can make informed decisions and effectively allocate its resources to improve the lives of its residents and promote economic growth.

References

[1] Dash overview. 1
[2] Vast challenge 2022. 1