Los Angeles Bike Share System Visualization

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Abstract— Bike-sharing is growing demand as a new option or solution to urban transport. Bike-sharing can provide an alternative to traditional modes of transport, or more likely an additional service to address the "last mile problem" when traveling from your transfer point to your destination. to the end. What's more, bike sharing systems can help minimize auto congestion and reduce pollution, although very little research has been done to assess their real impact in these areas. Visualizing and analyzing current operations can help to better understand system performance. In this paper, data visualization method is used to identify key factors related to bicycle sharing systems. I analyzed the bike sharing system so that I could group bike rental trends, locate the most crowded local stations, and flexible or monthly number of passengers. Levels of time detail vary. I mine data from Metro Bike Share, Los Angeles and discuss the data set findings. Using this public data, I ran a number of tests that combine data filtering and visualization, capable of analyzing the sustainability of a bike sharing system. For this milestone, I extended the progress from milestone there. One of the main tasks is to do a review by showing the images to others outside of the visual domain and getting their feedback. The results of the evaluation and analysis will be discussed in more detail in the evaluation section.

1 Introduction

The increment of population in urban has boosted the need of using personal vehicles. In high density population area like Los Angeles, traveling using cars are costly due to high parking fee and ineffective due to high traffic. The bike share system or public bike share (PBS) is an essential solution. Bikes have a lot of benefits such as effective short distance travel, low price, environment friendly, reduce traffic jam in urban. Therefore, visualizations about bicycle-sharing system data can help highlight and help us get a more insight of the system.

In addition to envisioning the bicycle-sharing system as a new means of public transport, such community-sharing programs provide a fresh insight into the dynamics of movements in the city and in general. It provides digital traces of people's activity in the city over time and space and helps them analyze. Various problems motivate the study of such a system. Some questions about vehicle use relate to social or economic studies of transport, while others are about the system itself: services. Is it working correctly? Can it be optimized? Can one adjust the bike's availability? Some studies related to this system are the description and data mining to better understand the activities.

Data visualization and analysis of current operations can help to gain a better understanding of system performance. Data visualization, defined as the attempt to put data in a visual context, can help to better understand problems. When I have many data points, it becomes difficult to visualize the data. The purpose of this study is to analyze the bike sharing system by applying filters such as rental trends. I mine data from Metro Bike Share, Los Angeles and discuss the data set findings. I tested the bike sharing system for different quarters of the year, so I can analyze the sustainability of the bike sharing system. This study also helps us to better understand the urban mobility of Los Angeles residents. Visually, the project does not develop a new visualization, but uses common data visualization methods to try and find trends for a given behavior from this data set. I analyzed different types of images and gathered some ideas to form an interactive and easy to use interface that systematically navigates through bike sharing data. Order more. Choose visual images that match design practices to create effective ones, while also reviewing a number of design techniques that further enhance the user experience.

The visualization goals:

- A visualization of Los Angeles map to understand the stations popularity.
- A visualization to analyze the bike rent trends in specific times.

The following progress has been added in this milestone:

- **Evaluation**: I did visual assessment over a period of time with a group of people. Currently, I have received results from these users and analyzed the results in the reviews.

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2 Background

My visualizations will use data from Bike Share website to reveal some prevalent trends of the public bike sharing system (PBS). The data is labeled with simple fields such as rental time, using time, using stations. There are two types of users: regular customers and subscribers, who buy PBS passes. The data is in CSV files and labels by simple words so users do not need much effort to understand.

2.1 Related Work

There are related project from of Zamir, Shafahi, Haghani(2017) [10] which delves into the understanding and visualization of the same kind of data from bike sharing systems in the district of Columbia. Another similar project is from Heinz(2017) [4],research on Bay area bike share data, Patterson(2017) [9] ,research on reveal the trends and patterns of bike share system.

3 Research Plan

The visualization the data of bike share systems in specific area can help us find many trends in the way this service is being used by the general public. This project focuses on mapping the data to find patterns and trends that can help us analyze the effect of the bike share system. By creating visualizations that map bike share data with quarters, city congestion, I can reveal the efficient the location of bike stations and the viable of this service. In each milestone, no new visualizations or libraries have been planned and this is subject to change and further development into the project might bring about some new visualization as well. In an effort to develop data visualizations for the bike-share systems, I aim to create 2 or 3 visualizations, each handling a separate analysis of the data. Referencing Section , I can see the list of visualizations which I will be working on. For the geographical visualizations, I plan on overlaying the data of each visualization category to the same geographical map with the user having a UI interface to switch between the various types of visualizations. Each category begs its own analysis, hence multiples topics/issues will be covered along the way of this project.

3.1 Data

The data is collected from bikeshare.com . The dataset was named *bikeshare Data*. This data is from 2018 to 2019. Data is divided by quarters and contains the following fields:

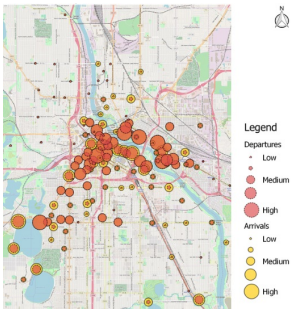

Fig. 1. Extracted from a similar project which shows the user heatmap categorized by arrivals and departures.

- trip_id - Unique ID of each rental time - integer
- duration - Duration of the rental - integer - minutes
- start_time - Start time of the rental - mm/dd/yyyy hh:mm
- end_time - End time of the rental - mm/dd/yyyy hh:mm
- start_lon - Longitude start point - float
- start_lat - Latitude Longitude start point- float
- start_station - The station ID beginning rental - integer
- end_station - The station ID returning rental - integer
- end_lon - Longitude end point - float
- end_lat - Latitude start point - float
- bike_id - Unique ID of each bike - integer
- plan_duration - Duration of the customer's plan - integer
- passholder_type - Type of user's pass - "One Day Pass"/"Monthly Pass"/"Walk-up"/"Flex Pass"
- trip_route_category - Type of users' trip - "Round Trip"/"One Way"

In the first milestone, I understood the needs of the bike sharing system and identified relevant data from Metro Bike shares that I could work with to define assignments. In my second milestone, I did some new designs with a lot of discussion to generate a lot of concepts and then turn them into good ideas to better visualize the division system. Share and perfect the bike based on a unique visual design that I decided to partner with. This design combines many different images in a single, layered interactive frame. These prototypes have been built to process and visualize real and conventional datasets, as more prototypes are built, more design requirements or ideas can be discovered and discovered. , highlighting the repetitive nature of the visual design. Another aspect of out-of-design creativity is the use of development and software engineering techniques to write code and programs to build visual images to meet user needs. I am using JavaScript together with D3.js and Leaflet to build and create interactive visualizations. In the final milestone, I have the final design activity within the visualization framework, i.e. implementation, with the motivation to build the visualization system and put it to work in context. real world to support goals. The overall visual artifact of this activity is a usable visual system. This activity is the ultimate goal of a problem-oriented visualization design as it supports real-world users in their own work environments.

I applied Shneiderman's quest type to learn more about the quests I needed to do. Under this classification, I first have an overview of the data I have with us. Based on this, I focus on the number of clients and bicycle rental locations. I zoom in on the tasks I have interested in to analyze which locations have the maximum number of businesses per day and to see how the business is growing over time. I filter out uninteresting data that is not used to build images (like bike station IDs). I can get more details as required by scrolling and zooming in on specific geographic locations in the map, then hovering over map data items to display tooltips to display information specific about a location or trip. During this process, I am able to retrieve the necessary data for my analysis. By following the classification so far, I can classify my goals into the following:

- **Goal 1**: Get a general picture of the business by location: It would be very helpful to analyze the viability of bicycle sharing systems if I can visualize the geographical locations most businesses tend to focus on. If there is a clear comparison between different locations, it will be easy to understand where the focus of the business is, even more if I can find some connections between the big numbers. For rent at those locations, the same model can be deployed in other locations with similar potential. The business idea can be explained by the number of people arriving and renting from a particular station. Usually a station has a high number of tenants, leading to more business. For ease of visualization, I map the number of tenants from each station, thereby giving a good measure of business activity and occupancy in a particular location. First, I must identify all stations from their latitude and longitude in the city of Los Angeles. This will give us insight into how all rental stations are scattered throughout the city. And furthermore, if there is dense station density in certain locations, then I can analyze the performance of individual stations in that dense cluster and can make a decision about the number of stations. Can be relocated to some other location where the station is not. relatively low density.
- **Goal 2**: How has the rental volume changed over time: I visualize how customer volumes change over time, thereby providing us with clear information about when people are more likely to choose this form of transportation than any other form. It helps to understand what forces them to stay away from bicycles for other years and what steps can be taken to alleviate their discomfort. This visualization adds a dynamic element to the previous static visualization. I map the number of cyclists that rents a day, every month, over a significant period of time. The data is represented in a geographic plane and can be filtered by selecting different time ranges in the timeline. This way, I can analyze data from almost 2.5 years, giving us a better understanding of the growth / decline of the business model over time.

3.2 Evaluation

The dataset used in this project is completely based on the Los Angeles city data. The visualization may point to certain trends, it is also possible that other factors are not taken into account which may affect adversely if the same model is implemented for other cities. Such as, the city of New York has a robust public transport system, which may have an adverse impact on the number of customers if the same business model as used in Los Angeles. So, given time it is possible to collect similar data from other cities for evaluation purpose which can give deeper insights into this matter.

3.3 Technology

This project will be developed on HTML/CSS/Javascript as the primary programming languages. In terms of libraries, I will be using d3js. Most of the visualizations will be geographical maps and bar charts of varying types so D3 should be enough to handle. For user experience, the visualizations will provide users with seamless navigation and scrolling between various visualizations. Different data from different visualizations will be overlayed on top of a geographical map of Los Angeles. Users will be able to switch between various visualizations easily. D3js and JS will be able to handle this functionality hence serving the users pretty well. Since the concept of this project and the visualizations used on it have been worked on previously, several

libraries such as TopoJSON, GeoJSON and Open Street API do exist. Many visualization reseachs use libraries such as topoJSON, geoJSON, therefore, I might use them as extra resources for data parsing part. As the project advances, more idea about previous work on this topic will be gained which in turn will make us make this decision in a more refined manner than now.

3.4 Implementation

The technologies I used in this project are as follows:

- **Programming language**: JavaScript and Python. Javascript has been the primary language for web development efforts. While HTML and CSS are used for external framing and interface design, Javascript is the brain behind visualization. In addition, Python is also used in the script creation and initial data cleaning phase.

  With the main data in raw CSV format, I have to parse and clean it up to make it more logical and structured for further processing. This CSV format data has been converted to GeoJSON to be imported for mapping and then into a Javascript array to manipulate the extra data.

- **Libraries**: D3 is a JavaScript library for displaying data in HTML, SVG, and CSS. D3 is the main library for supporting visualization designs. D3 makes data visualization incredibly easy and simple. Timeline and geographic map created with D3 along with the interaction between these two visualizations. Flyer is an open source JavaScript library widely used for building web mapping applications. This library is used to create basic geographic maps of the city of Los Angeles. I chose this library over the other options because it is lightweight, supporting a large amount of interaction and rich documentation on the web. Pan and zoom is an interactive feature of the Leaflets library.

- **Platforms**: I have not used a standalone platform for rendering yet but all visual inspection and debugging was done using Google Chrome. Chrome makes debugging easier for developers and a very easy program execution.

3.5 Visualization

The visualization currently have these interactions.The following interactions are included in the visualization:

- **Zooming and draggin**: Users can drag the map in every direction to move and locate different data points of the city. The zooming function allows users to get a closer to street-level view to see each separate bike station or get further to see general look of bike stations points. The zoom function is semantic zoom. This interaction follows the Shneiderman's mantra of having an overview and zoom in for filtering data.

- **Popup Effect**: Each data point has a mouse over function. When users mouse over a data point circle, the color of the circle changes to red with a thicker stroke. This makes the data point more visible and allows it to stand out, this is based on the Shneiderman's Detail-on-Demand task taxonomy.

- **Tooltip**: This tooltip function allow user to see the number of bike rental in each specific location

- **Histogram**: The histogram time frame is at the bottom of the visualization window with the number of bikes rental of each month based on the number of trips and passes.

- **Mouse click**: The mouse click function on the histogram allows users to choose data in the map based on the time-frame selection.The map visualization will change it data based on which month users click on.

3.6 Design choices

Using visualization principle learned in the data visualization class help finalized a the type of visualization on this project. I reduced and aggregated the data at hand to indicate total number of the bikes rented. I have the interactions to change the view of data over time, which partition the data using mouse on function so that a specific month can be selected.

- **Geographical Map**: I choose the geographical map of Los Angeles because location has a high density population and high number bike stations. The X-axis represents the longitude and Y-axis represents the latitude data. Users can use the map with multiple interaction such as drag, zoom, or rotate to change the viewpoint.

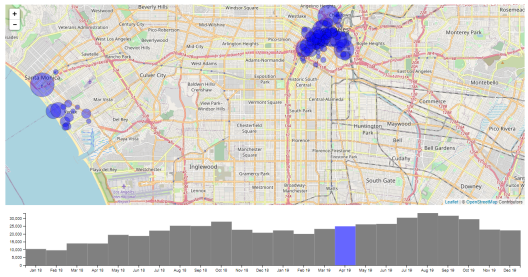

Fig. 2. High level overview of visualization

- **Points and circles**: The map uses circles that vary in size to encode differences in value — the larger the area, the greater the value. Each circle represents a station and their sizes with the number of bikes rented at each station.

- **Selecting**: Users can use mouse click to specific month on histogram to view new data on the geographical map. Between selecting circle on the geographical map and select a bar from histogram, I choose the histogram since it is more practical. The clicked frame on the histogram represents the query and is applied to the geographical map.

- **Hovering on circles**: Between mouse click and mouse over the circles, I choose mouse over because users can miss click due to multiple overlap circle at some points. Based on Munzner's information, mouse click is a complicated interaction while mouse over is much more simple for users.

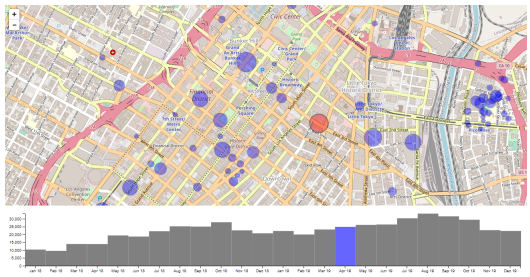

Fig. 3. Tooltip for individual data points

- **Histogram**: The studies on (Cleveland and McGill, Heer and Bostock) showed participants are more accurate in estimating the ratio between two bars when they are next to each other. Keeping this one and along with the application of Gestalt principles in the minds, I choose histogram to represent the bike rental frequency because it is easier to compare and analyze between bars.

- **Color** : I chose warm low opacity colors to saturate the data points. I adjust the color to make sure there are some contrast between background and data points. The result of color choice stand out from these various colors and the chosen colors are able to stand out in the map whilst not being overly saturated.

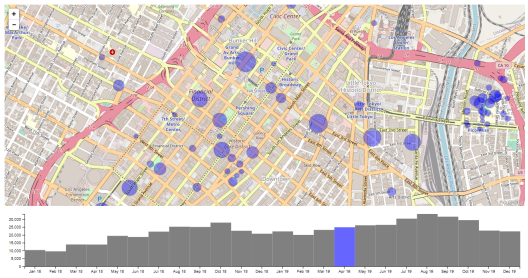

Fig. 4. Interaction support and tooltip for Histogram

3.7 Design relates to data

- Finding the trends - Users can locate the busiest stations in Los Angeles by the number of bikes available in a particular station indicated by the circle size in the map. The same encoding number of bike rents was used in the histogram but here it was plotted against time. The goal of findings trends of the most busiest bike rental location is met.

- Rental Histogram - User can to find the total number of bikes rented each month based on the number of trips indicated by the histogram. The goal which is finding the trend time of year that bike rental users and their trending can be reveal in this visualization.

- Size of the circles on the map with mouse click selection - This indicates the number of bikes available at that particular station in the selected time-frame. The goal is to reveal how the volume of the rentals changes over time by filtering the data.

4 IMPACTS

The bike share system began in 1965 in Amsterdam city , Netherlands and became popular in high density population cities in the USA such as Chicago, New York, San Francisco. The system so far only has a few visualizations such as presenting the number of people using in some cities while its data is enormous and potential for revealing trends for further improvement. The main focus is to understand user trends from different times of a year, and understand potential paths to improve the system. This might also give us some hidden things that can help other fields such as user age range trend, their health based on time using a bike, and how regular they use. To understand more, I might need to conduct further research and expand more datasets that will be used for visualization.

4.1 Process from Milestone 1 To Milestone 3

In this milestone, I have finished creating the geographical map and bar chart of the number of the uses of the PBS which gives a framework of the PBS in Los Angeles. I converted raw data from the beginning of 2018 to the end of 2019 to create a dataset of the PBS system in 2 years to create a geographical map visualization and a histogram chart associated with those numbers on the map. Choosing specific a month on the histogram will change the map visualization based on that month.

4.2 What went more smoothly?

The data processing is difficult and takes a long time. Instead of using javascript, I use python which significantly reduces time. All the visualizations are not difficult to create due to multiple available online sources.

4.3 What went not smoothly?

I have difficulties in processing raw data to information. The data of Chicago PBS in quarter four in 2019 is unreadable which I have to change to the city data from Chicago Los Angeles. Since I want to focus on the trending and the performance of PBS in Los Angeles, I choose data from 2018 to 2019. All data from quarter one to three 2020 are excluded because the lockdown of covid-19 period can lead to incorrect trending. Beside data processing, I tried to make multiple selection view on histogram but it did not work as expect so I took them off.

4.4 Process from Milestone 3 To Milestone 4

I presented the visualization on December 1st 2020 to the class and received no significant feedback. I performed evaluations of the visualization over a period of time with a group of different people. Subsequently, I received results from these users and analyzed the results in the evaluation section. The visualization code did no change anything significant

5 TIMELINE

Milestone 1 (Oct 1) This should include any tasks and data abstraction needed to aid project design whether it's a user research design, a new visual image design, or a new library design. . Initial designs should be included in the discussion of design assistance rationale. Data that supports all of these findings in terms of basic work or newly collected data (e.g. interviews, observations) should be cited or discussed. All related works should be updated with a documented review.

Milestone 2 (Oct 15) This should include the result of the first piece of work that needs to be done. In most projects, this will involve an active data reader and at least an active visualization, gallery feature, or research question type. Milestones should include photos of these features and discuss what they do. Demonstration must run with minimal effort, and the code must be put into the repository. All discussions of project progress as well as any revision to the data, technology options and scope must be included.

Milestone 3 (Oct 29) This should include a complete working prototype of the main project artifact, such as a visualization tool, a visualization library, or a study that works with test subjects and stimuli. complete. Demonstration must run with minimal effort, and the code must be put into the repository. All discussions of project progress as well as any revision to the data, technology options and scope must be included. The special audit plan must be updated to show the milestone plans and any preliminary work in the evaluation design.

Milestone 4 (Dec 8) This should include an initial work evaluation from milestone 3 of the project and recommendations for improvement. It will also include a class presentation scheduled for several weeks before the report is due. Artifacts created (eg, pre-observation plan, observation notes, data from studies) during this evaluation should be included in an archive. A full report on the entire project should be included in this.

6 EVALUATION

The project can be put under the category of an application based visualization project. I used open-source data to create visualizations that help users identify trends and patterns in the way bike-share systems are being used in the city of Los Angeles. Keeping this in mind, I had planned the evaluation process to be primarily aimed at user test surveys. The volunteers for user surveys can be one among the following:

1 Mechanical Turks

2 A group of people who can be considered as laymen in the field of data visualization

3 A group of people with a considerable amount of idea and experience in the field of visualization design.

The evaluation approach included the last two groups of people from the list above. I decided not to move forward with performing evaluations on mechanical Turks because i felt that for a project of the scale, being moderately complex and not too detailed, using the last two groups of people would suffice to come to a strong evaluation result. I explain each form of evaluation through the following sub-sections.

Age	Gender	Occupation	Viz experience
20	M	student	low
21	M	student	low
27	M	soft developer	high
21	M	student	low
24	M	web developer	medium
24	F	student	low

Fig. 5. Overview of Surveyor Demographic.

6.1 Survey Users Questions and Answers

This evaluation was based on asking the test users a number of questions with varying level of depth and accessing their answers in a qualitative and quantitative measure.

6.1.1 Design

As mentioned above, a user's question and answer is mainly based on giving the user a visual visual test, forcing them to study the details and then follow up with a number. question. First of all, I have to choose the test users for the survey. Since this question and answer section is intended for people in the visual field, I have selected friends who are not familiar with this topic to survey.

Then I decided on the survey method. Each user is assigned to view and navigate through the visualization for 2 minutes. After this time, the pictures are removed and they are assigned a sheet of paper with a list of questionnaires. I want to see if the visual design is reminiscent of it, and by forcing the user to answer the question by deleting the image first, I can test that to some extent. The main questions are of two types: open-ended and closed-ended.

Open-ended questions involved volunteers answering what they deduced from the overall visualization. This provided us with high-level feedback on whether my image selection met the original goal. The closing questions will be more detailed and see if the user can pull the data and trends from the visualization. The reason behind choosing these questions is to evaluate my design from both top-level scenario and detailed sample search scenario, which is the ultimate goal of the design. Below are some of the questions asked for each type of questionnaire. You can find a complete list of all questions in the Evaluation section.

1 Open-Ended Questions

- What can you infer from the visualization at a first glance?
- What do you think this visualization is trying to achieve?
- Does the visualization look appealing to you when you first see it?

2 Close-Ended Questions

- Which area of LA has more bike stations?
- How are the bike rents distributed across a certain area of bike stations?
- What overall trend can be inferred from the bike rent data?

In the end, I asked each test they liked. I chose comprehensive questions instead of multiple possible answers asking the subject to respond from a list of 5 options from 'Strongly agree' to 'Strongly disagree'. I decided this because in addition to receiving a positive / negative feedback, I also wanted feedback that could help us improve the design and complement future work. A simple multiple choice question will only provide us with a discrete set of results for generalization. For each user, the questionnaire session was completed in 5 minutes, after which responses were collected and analyzed. Feedback from all test subjects was broadly collated and classified into two groups: positive and negative. Details from the feedback have been recorded to better serve the study and work in the future.

6.1.2 Results

The overall results from the user's Question and Answer session were positive. This section will discuss the observations and responses received for the visualization design.

Almost all open-ended questions received a positive response. It can be concluded that the high-level goal has been met by the intuitive design. Out of the 6 participants, 5 responded positively to questions such as "What do you think this visualization is trying to achieve?". This gives us an 83.3 % success rate. However, the responses are a bit mixed to the original appeal of the image. Only 3 out of 6 subjects responded positively to the appeal and original design. This accounts for 50 % of the topic population.

Some design considerations have shifted to the layout and look of the timeline. I received feedback to make it visually more appealing, and one theme mentioned that common flaws in the design were negative while the other wasn't. in the question and answer section. As for the near-ending questions, they are answered with relative ease. Tasks like finding the busiest bike stations and distribution stations are done quickly, and virtually all test subjects are able to pinpoint bike rental trends. All subjects successfully followed bicycle rental trends over time, with 100 % accuracy. I also tested the mnemonic idea to check how many parts of the image they still remember and got positive results because 5 out of 6 subjects agreed to remember every detail of the visual image (83 , 3 %). As mentioned before, all questionnaire responses can be viewed in the Evaluation directory.

6.2 Visualization Comparison

This evaluation method is closely linked with the first evaluation method because it is done at the same time.

6.2.1 Design

In addition to finding out how the visual design works (in terms of accomplishing its main goals), I also want to see how it compares to other visuals that perform porcelain par is similar to the design. Comparing two similar implementations if not the same tasks is always a good way to test effectiveness and efficiency. This experiment will expand the scope of review in such a way that I can get more ideas and feedback on possible changes / additions to the design.

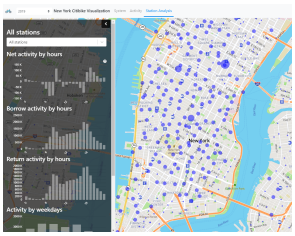

Fig. 6. New York CitiBike Visualization

Following on from the first evaluation technique, I present test objects with a different visual design. I have selected a Bicycle visualization site that contains bike sharing imagery for a large number of locations. This design performs more interactions than I envisioned and is much more complex than the system. So for the sake of comparative equality, I decided to check this out for the same tasks as did on the image. I chose New York Citibike Visualization, where I asked users to test the same questions as before after allowing them to view and interact with the visualization for 2 minutes. In this case, I focus more on closed questions because I want to compare trending search tasks and find the position between two visual images.

6.2.2 Results

Results from the visual comparison given are somewhat expected. Citibike's New York image is more feature-rich and interactive, making it more desirable than imagined. 5 out of 6 test subjects leaned toward this visual approach (83.3%). Open-ended questions showed similar

results, both in terms of response type and response time. These visualizations were developed by a team of experts experienced in the field of data visualization and therefore the design choices they make are justified and precise. This makes the image look appealing and achieves the overall goal. All 6 out of 6 people liked the initial appeal of the 100% success rate image. The same precision has been achieved for the questions such as "What do you think this visualization is trying to achieve?".

Similarly, the ending questions are not much different from the responses of the visualization. The only noticeable difference is in response speed. The test subjects seem to take less time to find trends and locate items / locations on the map than they are visually. This may be due to the faster data processing and smoother filtering by CitiBike's image in New York compared to design. In terms of the ability to memorize charts, users don't seem to remember exactly all the details. Although they have defined the map, they cannot interpret the different bar charts on the left side of the visual image. Overall, visual comparisons made test subjects prefer to visualize CitiBike in New York over visual design.

6.3 Overall Results

The answers to the questionnaires I have analyzed and the following conclusions are drawn for each question:

1. For the first question, all five reviewers accurately described the project's goals including the problem the project is trying to solve and its importance. Responses in line with the project goal of visualizing the LA bike sharing system. In terms of the magnitude of the problem, the responses varied, from helping users see trends in bike sharing to planning bike distribution from a commercial standpoint. All of these responses are of the importance of the problem

2. The intuition received some positive reviews of strengths. What is interesting is how the reactions between the five reviewers differ. This shows the advantage of using visual experts for evaluation. Here are some of the strengths of the image as mentioned in the review:

    - Good source of data with more possibilities for future design additions
    - Smooth interaction in images
    - The trend is clearly displayed and the method is noticed first
    - Low learning curve for intuitive sense to visualize
    - Detailed data and abstraction of the task
    - Well-designed and specialized
    - Detailed evaluation plan, especially the visual comparison part

    These reviews have supported the positive feedback received from the previous two evaluation methods.

3. Along with these strengths, several areas for improvement are mentioned. These points were noted on the reviews but were also discussed in the Q & A section after the presentation. Some areas that need improvement in the future are listed below:

    - As they contract, the circles get bigger and eventually overlap and squeeze together. A better representation, maybe a Voronoi diagram would help.
    - The opacity of the circles is not low enough not to obscure the background, so reducing the blur can be helpful in that.
    - Adding titles and labels to your chart will be very helpful.
    - Adding a 'Play button' animation that automatically spins every month at intervals to render images would be a good design addition.
    - Display the destination when the source is clicked.
    - Adding a button to reset the map view and centering it to its original position will be helpful for the viewer to start over.
    - Since this is a large project with good data sources, using additional attributes such as destination and trip route information to further display trends adds to the current progress.
    - Displaying information for all months at once using different color scales for each month can help compare data between months.
    - Data can be processed with time frames longer than the current two-year frame

    The above ideas and recommendations about future improvements of the project match some of the future plans I already have.

6.4 Discussion

In this part, I talk about results from assessments and how it envisions current and future directions. In short, the visualization project is conceived in a very positive way about the problem it is trying to solve and the execution method to solve it, but it lags behind in functionality and design. Other figures perform a similar task.

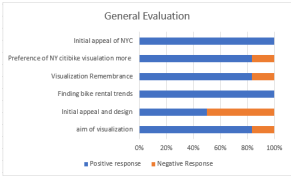

Fig. 7. Overview of Surveyor Demographic.

Starting from the strong points, the review results show that both the general audience as well as the experienced reviewers love the implementation of visual design. Using circles of different radius to show different bike stations on a map of the area may not be the best design option but serve the purpose in a complete and reasonable manner. The following color / opacity marks are also welcome. Most of the test subjects were capable of responding to a high degree of open-ended questions, and the trending questions also concluded that the selected design was well suited to the task. performances. In addition to design, the abstract approach and data evaluation and mission have been adopted by peer critics, leading to well-defined design choices. Looking forward, visualization seems to have more room for improvement and more possibilities for future work. This is evident in the visual comparison and more in-depth assessment received from the presentation. The project idea I worked on and the problem I was trying to solve was greatly reduced. The main goal of this project was to design a visual layout to solve the problem of finding motorcycle sharing trends and how that trend has changed over time. There are several areas where the design can be improved for better presentation of information. Some of the more pressing improvements seem to be adding titles and labels to inform users of what is being visualized, and modifying how the data is mapped when zoomed so that the circles don't overlap.

Also, I have my own improvements, part of a milestone that cannot be reached in time. These include fixing some data mapping errors and implementing a timeline chart to select multiple months at once. The results from the visual comparison show that data processing and processing can be improved to speed up display and engagement. One way to do this is to upload the data to a server and read through it instead of reading the data locally. This will also provide scalability options, which is another area of improvement. The CitiBike visualization in New York shows us that there are several properties that can be mapped into the visual image to show more trends and make the analysis richer. Improvements include making interactions smoother and more user-friendly by adding automatic animations and map view reset buttons.

These are great ideas that can be added to the display to improve the user experience.

In a nutshell, the results from the reviews show that the visualization project performs the intended task with great accuracy but at the same time needs to improve its design along with integrating other attributes for expansion. data and trend analysis of bike sharing system.

6.5 Limitations

Although the assessment approach produces acceptable results, consistent with results from peer assessment, there are some limitations to the approach. First, the exam questions have no detailed answers. The questions focus more on whether someone understands the problem and the task is performed in visual form, and whether the user can easily perform the aforementioned task. While these questions are very important to properly appreciate the effectiveness of visual design, questions similar to those asked in peer evaluation will help us to better understand this issue. . over there. can be improved from a lay point of view. While design recommendations from a visual expert will always be more detailed, it would be beneficial to get recommendations from these test subjects. This is because they form a subset of the demographics, who, although mostly residents of the visualization sector, will be the largest percentage of those using live images. continued. concerned. this. Even if their recommendations may fall under the scope of simple improvement, they'll be geared towards improving user experience. As a result, user questions about possible design and demonstration proposals will help guide future project efforts better.

Another limitation is inefficient implementation of quantitative assessment. During the initial evaluation phase, I timed the users while they were answering trending search questions and data localization. The aim is to compare each user's execution time and get a general sense of the time they need to deal with these tasks. . The method for the test objects to first go through visualization and then answer a question individually posing a matter of timing. This is because the amount of time a user takes to answer questions now also depends on how well they remember the image itself. I want the time to be independent of the event and only on how effective the visualization is. Thought that some of the first ratings were timed, then I dismissed this approach based on the general perception of how long people responded to the questions.

One way to add quantitative reviews to a betting method is to ask users to solve some task or find some data while they navigate visually. In this way, the time data obtained will be a factor in evaluating the effectiveness of the visualization design. I think this will lead to more accurate data and thus get better evaluation results.

Likewise, the assessment method itself can be improved and streamlined by conducting an online evaluation session. In a way, the live review session didn't seem to be going well enough and the test subject had to reread the responses while I found them cumbersome.

Ultimately, the visual choice to compare with the project may not be the best source for comparison. While I was mapping the Metro Bike Share stations in LA, it is possible that other motorcycle sharing providers have installed stations at other locations in the city. CitiBike in New York, on the other hand, maps all terminals in the city depending on carrier. This is why the stations are scattered throughout the city. This information needs to be kept in mind before making any assumptions about the launch of a bike-sharing service in LA.

7 Results

In the process of developing this visual image and analyzing data for visualization, I learned a few notable things:

1. The most important lesson I learned in designing visual images is deciding what the visualization project will look and look like in the first place. I had to do a lot of researches and decide to pick one early in time.

2. Focus on identifying and understanding the problem you will solve. It is impossible to solve all problems in a course project project. So choosing the one that best suits and matters most to the user who is viewing the visual image and focuses on solving it effectively is better for the project than trying to solve it all. at the same time can only lead to trivial solutions for each problem.

3. A user centric design approach can lead to an intuitive interface that, in turn, can open up new possibilities. As I envision, the niche user interface can open up new possibilities by providing a big picture of activity and information in the metro bike sharing system.

4. It's important to focus and invest time in the task summary and baseline data before getting started with visual design. Identify the right problem and the repetitive tasks to solve it along with design choices where the best help in the end task helps to create the most intuitive visual effect on solving. resolved the problem stated

5. The visualization provides a customized, graphic display of bike rental trends in the Los Angleles region. They can also quickly identify correlations and illustrate trends. All of these features combine to help make more informed decisions about the sustainability of a motorcycle sharing system.

6. The most important practice to follow when designing visual images is to find out what information the consumer is aiming for in order to make the right design decisions.

7. The visual image must contain title and label fields that clearly define the contents of the visual image and the information it visualizes. A person without any prior information about the visual image will be able to visually know the visual image and what it is mapping.

8. It is beneficial if interactive elements perform more than one function and allow interactive elements to be interactive (click / hover) for more information. Clicking on a bar in his chart, for example, could further display the current bike rental. When deciding on appropriate interactions, care should be taken to choose the type of interaction that best conveys the information displayed

9. When designing a geographic map visualization, allowing the user to return to the specified starting position is always helpful in case they go astray. A common example of this is being able to go back to the current GPS location on Google Maps.

10. Data may be missing, incomplete, inaccurate, duplicate, or using different standards. I need to correctly clean and preprocess the data before I start visualizing it so that it can be easily imported.

11. To take into account the capacity of larger data sources, scalability can be achieved by storing the data on a server basis instead of importing the data locally, which not only makes the rendering slow. . but also reduces portability. Reading online data through a database will be faster, scalable, secure and portable.

12. Engage the right people to evaluate, as I need a lot of perspectives and experience to jointly discover problems and come up with solutions

8 Summary

I summarize the entire project, describe the tasks I have performed in the development of this project, and the contributions presented in this milestone and in the previous work.

8.1 Ideas

Bike-sharing is gaining popularity as an alternative or complementary to urban transport. Bike sharing can act as an additional service to tackle the "last mile problem" going from your transfer point to your final destination. The whole project could shed light on the effectiveness of bike sharing in the LA metropolitan area. To do this, the project focuses on visualizing bike sharing rents on different bike stations and filtering this data over time to find trends in using the bike sharing system.

8.2 Implementation

I started with the data provided by bikeshare and eventually moved on to open source data from Metro Bike Share. This data has no richer attributes and contains information for larger time frames. The original structure of the data is in CSV format, from then on after purifying the main data with python I converted it to GeoJson format. I have broken down the missions in the Shneiderman Missions category, which are also in line with the project goal. After synthesizing the detailed data and the exercise, I used lean design to create the image. The job is to create a geographic map that guides all stations according to their longitude and latitude; along with the rental amount from each of those stations. I used the Flyer library to create a geographic map that supports many sub categories. I then map the rental (receive) of the bike through this map and encode the rental frequency for each station. Using circle markers and circle radii as codes for rental frequency, the visualization depicts busier stations with larger circles. In addition, I added some interactivity like tool tips when hovering over these data points. I've also added progress for each month from July 2016 to September 2018, which is used to filter rental data in the map for that particular time frame. In addition to the visual design, for this project I also did a detailed evaluation study of visual images, which helped us determine the effectiveness of visual images and also gave us suggestions. about improvement and future direction.

8.3 Current Milestone Contributions

In this milestone, the main focus is on image evaluation. So for this purpose I submitted the visualization to six people with some open and closed questions for evaluation. I have also compared the visual image with other visuals with similar goals. In the end, I made a class presentation that completely included people from visual backgrounds. I intend to receive responses from their questions, but I still have not received any questions yet. This feedback also serves as another form of assessment for the project.

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