Exploring Pedestrian Activity and Park Utilisation in Casey Suburbs

By: Yehezkiel Efraim Darmadi
Student ID: 34078215
Teaching Associate: Deep Mendha
Applied 04

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Introduction

The purpose of this report is to explore pedestrian activity and park utilisation within the City of Casey suburbs. Through the analysis of pedestrian count data collected via IoT sensors, the findings aim to uncover peak pedestrian times, differences in activity between weekdays and weekends, and patterns of park usage throughout various seasons. The goal is to highlight areas with high or low foot traffic, identify opportunities for infrastructure improvements, and provide actionable insights to enhance the public space experience for residents.

The narrative visualisation is designed to convey key insights related to urban planning and public space management. It seeks to emphasise the relationship between pedestrian activity and the accessibility of parks and reserves. By understanding when and where people are most active, city planners can target high-traffic areas for improvements such as better lighting, additional crosswalks, and enhanced amenities. Conversely, areas with low usage may require interventions to address accessibility issues or encourage community engagement (Koohsari et al., 2014).

Alternatively, the visualisation is trying to answer this three research questions:

1. What are the peak times for pedestrian activity in various parts of the City of Casey suburbs?
2. How does pedestrian activity differ from weekdays and weekends?
3. How do pedestrians utilise parks and reserves in the City of Casey, and are the significant trends in park usage across different seasons?

The intended audience for this report is the public sector, including urban planners, policymakers, and local government officials responsible for managing public spaces in rapidly urbanising areas like the City of Casey. These roles are central to ensuring safe, accessible, and well-maintained public spaces that support community well-being. Additionally, the report may be of interest to community stakeholders who seek to improve public safety and accessibility in their neighbourhoods. By presenting data-driven insights, this report aims to support informed decision-making for creating more liveable, safe, and vibrant urban environments.

Design Process

5 Design Sheet

The Five Design-Sheet (FdS) methodology is a structured approach to help developers and designers sketch and iterate their ideas for information visualisation tools. Fds methodology helps designers explore and refine visualisation ideas through five structured stages: brainstorming, developing three main designs, and finalising one for implementation. It fosters divergent thinking and incorporates client feedback to ensure the final solution aligns with user needs (Roberts et al., 2016).

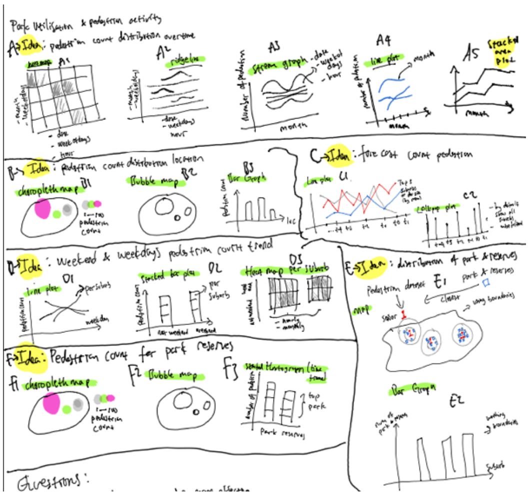


Figure 1. Brainstroming Fds

The initial step in applying the FdS methodology involves brainstorming which is illustrated by figure 1. To generate ideas, I focused on visualisations that could address the research questions outlined in the Introduction. These questions primarily explore pedestrian counts in relation to location, time, and their connection to parks and reserves. After generating ideas, I filtered and merged them, resulting in visualisations cantered around pedestrian count trends over time, pedestrian count by location, pedestrian counts for parks and reserves, and the distribution of parks and reserves.

The 3 design sheets are based on the needs of the target audience. The project's target audiences are considered as people who do not have time, but also need quick, clear, and actionable insights. These individuals, such as urban planners, policymakers, and local government officials, require visualisations that allow them to make informed decisions with minimal effort (Harris County Public Library, 2024). Therefore, the design sheets focus on simplicity, clarity, and interactivity, enabling the users to explore data without being overwhelmed by unnecessary details. Each visualisation is crafted to present key metrics and trends in a visually engaging yet straightforward manner, ensuring that critical information is easily accessible immediately.

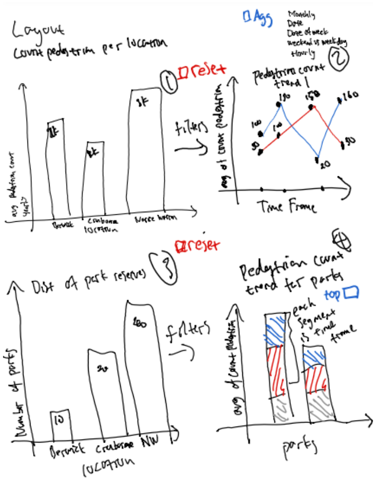


Figure 4. Fds sheet 2

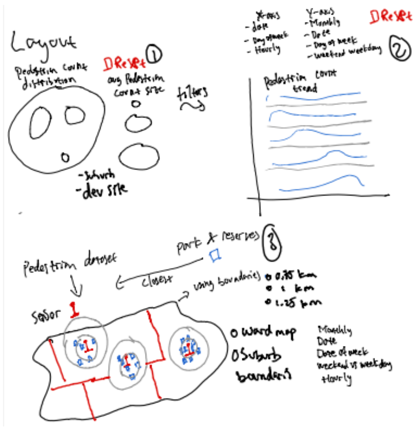


Figure 4. Fds sheet 3

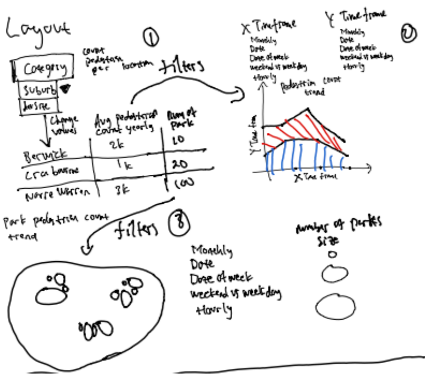


Figure 4. Fds Sheet 4

The first design prioritises clarity which is illustrated by figure 2, using bar and line graphs with hover interactions. However, it suffers from an overload of plots and filters, and lacks visual appeal. The second design which is illustrated by figure 3 focuses on simplicity, featuring maps and ridge line plots to show trends, but is hindered by too many filters and hard-to-interpret plots with missing details. The third design which illustrated by figure 4 emphasises interactivity, allowing table filtering that updates other plots, though excessive interactions compromise the simplicity.

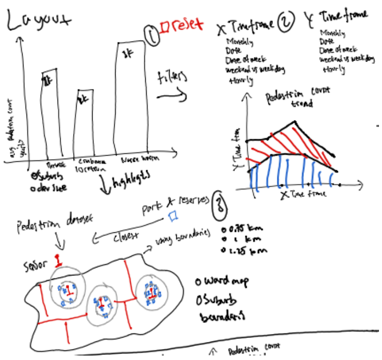


Figure 5. Final design

To create the final design, which is illustrated by figure 5, I combined the strengths of each approach. It incorporates interactive filtering for engagement, trend lines and colour cues to maintain simplicity, and hover interactions to display detailed information, ensuring clarity.

Visualisation Justification

Application of Munzner's What-Why-How Framework

Munzner's What-Why-How framework provides a structured approach to designing visualisations by considering the data being visualised (What), the purpose of the visualisation (Why), and the techniques used (How) (Munzner, 2014). In this project, the framework played a critical role in aligning the visualisations with the goals of urban planners and local government officials, who are responsible for public space management in the City of Casey. The data, which included pedestrian activity counts collected through IoT sensors along with spatial information on parks and suburb boundaries, was analysed to uncover patterns of pedestrian movement and park utilisation. The main tasks involved identifying peak pedestrian activity times, comparing weekday and weekend trends, and understanding seasonal variations in park usage. To support these tasks, various visualisation techniques were employed. Stacked bar graphs and area graphs helped illustrate trends over time, while interactive maps with sensor and park locations provided spatial context. Hover interactions and dynamic filters further enhanced exploration by allowing users to focus on specific locations or time periods. By following Munzner's framework, the visualisations effectively combined clarity with interactivity, ensuring that decision-makers could easily extract actionable insights to guide infrastructure improvements and public safety measures.

Stacked Bar Graph Justification

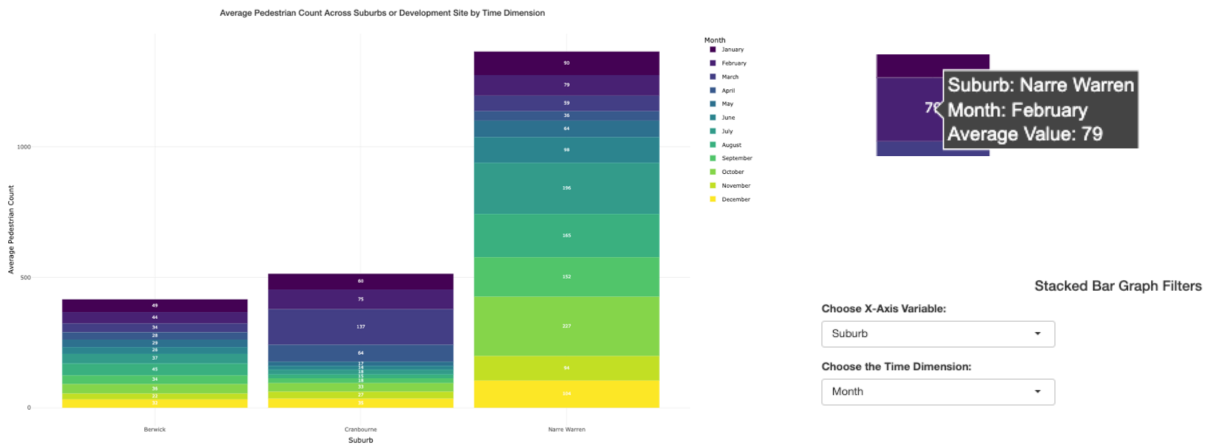


Figure 6. Stacked Bar Graph

As illustrated in figure 6, a stacked bar graph shows the total value of a category while depicting the proportions of subcategories stacked for comparison (Indratmo et al., 2018). The goal of this visualisation is to demonstrate to the audience how each location (suburb and development site) corresponds to peak times (shown as sections of the bar graph) alongside the average pedestrian count. It's also crucial for the audience to observe trends across various time dimensions (month, day of the week, and weekends vs. weekdays). This plot provides an overarching view of pedestrian count trends by location and time dimension, helping to answer the first question.

Figure 6 demonstrate the final design implementation from figure 5. The visualisation effectively conveys pedestrian activity across suburbs and development sites by utilising various visual elements. The vertical position and size of the bars represent pedestrian counts, facilitating easy location comparisons. The horizontal layout maintains clarity, highlighting count differences without distractions. Colour hues differentiate between time dimensions, enhancing the understanding of temporal trends. Consistent colour values and saturation ensure that each month is clearly distinguishable, while the absence of unnecessary textures or patterns keeps the design clean and focused.

Figure 6 highlights the possible interactions with the bar graph, allowing users to choose location precision (suburb or development site) and explore trends across various time dimensions. Users can also hover over each section for pop-up details alongside labels, encouraging deeper engagement and exploration of different location and time combinations.

Stacked Area Graph Justification

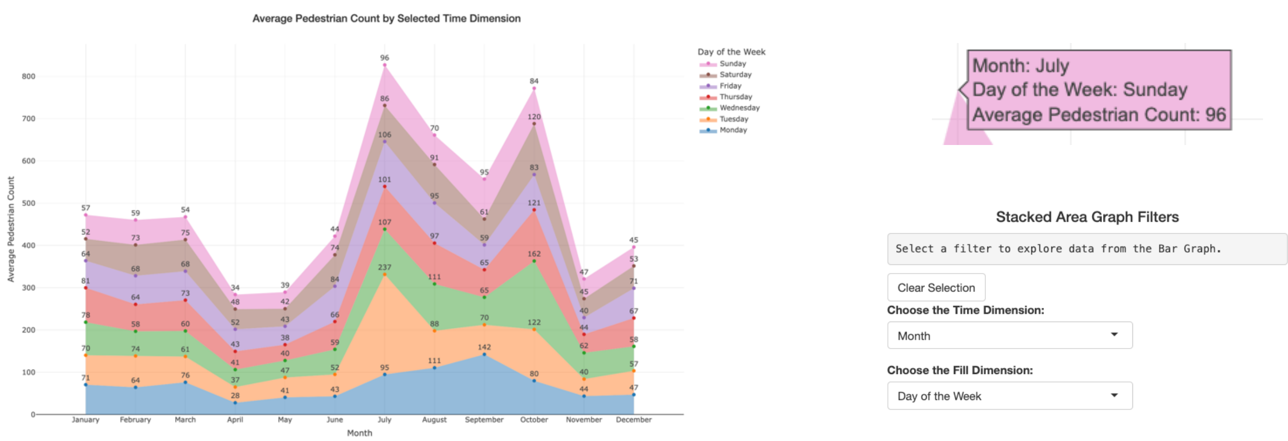


Figure 7. Stacked Area Graph

A stacked area graph displays multiple time series by stacking data layers, allowing the audience to see both individual contributions and overall trends over time (Wu et al., 2016). This plot aims to help the target audience explore pedestrian count patterns across different time dimensions, such as months and weekdays vs. weekends. By providing insights into these trends, the audience can better understand how pedestrian activity varies, offering valuable interpretations of the data in relation to daily, monthly, or seasonal patterns. Ultimately, this plot addresses research question 2.

Figure 7 demonstrate the final design implementation from figure 5. This stacked area graph visualises data over time, segmented by a chosen category. The position and size of the areas represent the values for each segment, with larger areas indicating higher quantities. Colour hue differentiates each segment, making it easy to track trends over time. The consistent colour value and saturation maintain clarity without distractions, while the absence of texture keeps the design simple and focused.

Figure 7 shows the interactive filter, it allows users to select both time and category dimensions, offering flexibility to explore different data views. Additionally, the hover effect provides detailed information, such as specific counts and selected dimensions, when interacting with the graph. This feature enhances usability by giving users precise insights, making the graph more informative and engaging. These interactive elements benefit the target audience by offering a deeper understanding of the data, making it useful for exploring trends and patterns tailored to specific needs.

Map Graph Justification

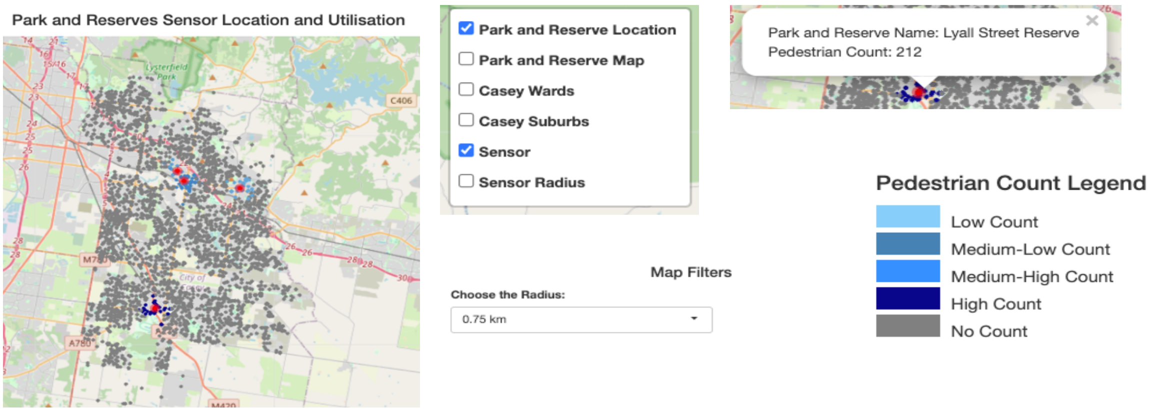


Figure 8. Map visualisation

The map illustrates as illustrated by figure 8, shows the distribution of parks and reserves across sensor, ward, and suburb areas, helping users assess whether these areas have sufficient park coverage for trend analysis based on the first two plots. Additionally, it enables users to explore trends by location, such as proximity to the CBD, providing a justification for patterns observed. This map answers research question number 3.

This interactive map overlays multiple layers, including parks, reserves, suburbs, wards, and pedestrian sensor locations, allowing for comprehensive spatial analysis as shown by figure 8. The position of each marker accurately reflects geographic locations, while the size and shape of markers remain uniform for clarity. Colour hue is used to distinguish different layers, such as parks and sensors, enhancing usability. The chosen map type includes texture/patterns such as roads, providing additional context for users to interpret spatial relationships between locations and road networks.

For convenience, the map is centred around the City of Casey, making it easier to navigate. Users can toggle between layers using interactive filters and explore details through hover effects, which provide information such as park names and pedestrian counts. These features help users gain insights into park utilisation and sensor coverage while understanding how different areas are connected and utilised.

The map is designed to highlight the intended narrative visually, even without requiring users to read any accompanying text. This is achieved by pre-selecting the initial layers rendered in Leaflet, ensuring the most relevant data, such as park locations and sensors, are immediately visible, guiding users through the story the visualisation tells.

Layout and Typography

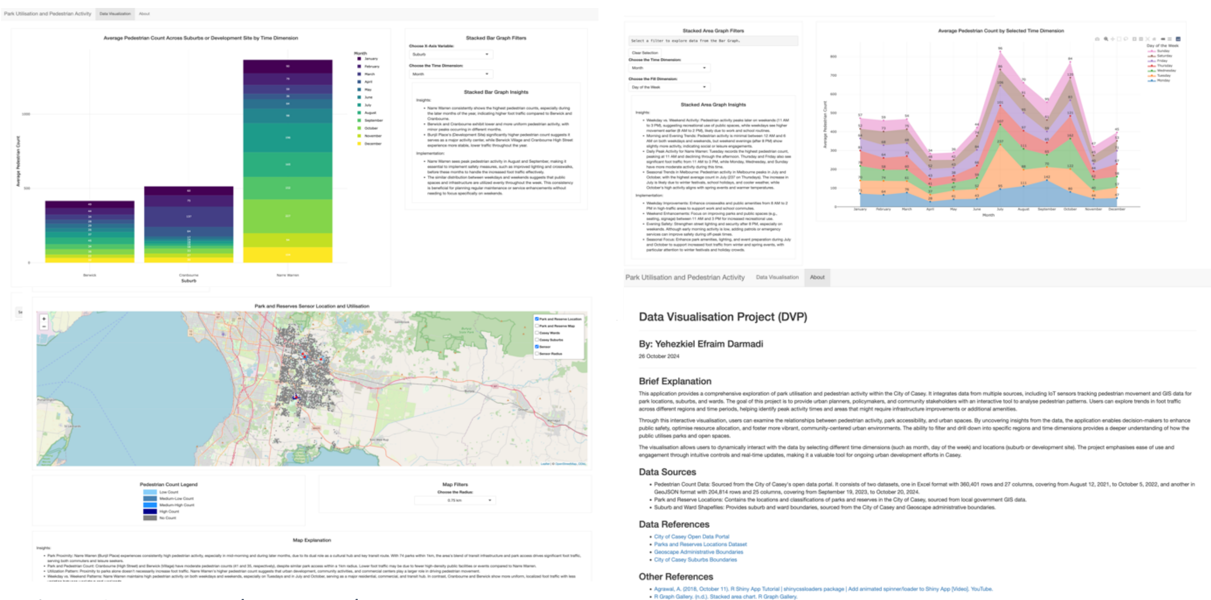


Figure 9. Layout and Typography

In this visualisation project, both layout and typography are carefully designed to enhance clarity, engagement, and quick comprehension. The viewing path is structured from top-left to bottom-right, with the title placed at the top-left to align with the natural reading direction, guiding users to the most important information first (Jenny, 2024a). The visual centre principle is applied by positioning the main visual content slightly above the geometric centre, ensuring the data is perceived as significant without overwhelming the viewer (Jenny, 2024a).

Sightlines are minimised by aligning elements along invisible lines, reducing disjointedness and creating a clean, organised flow that facilitates easy navigation (Jenny, 2024a). To achieve balance, the visual elements are symmetrically arranged, with the map in the centre and supporting charts on either side, distributing visual weight evenly (Jenny, 2024a).

White space is employed to separate elements, preventing clutter and making the visualisation more accessible and easier to interpret (Jenny, 2024a). For typography, a sans-serif typeface ensures legibility, making textual elements like labels and annotations clear (Jenny, 2024b). A strong visual hierarchy is created by varying font size and weight, with the title set in a bold font and secondary details in smaller fonts, helping guide the viewer's focus to the key data (Jenny, 2024b).

Finally, colour contrast is used effectively to enhance readability, ensuring that all text is clear and accessible across different devices and lighting conditions (Jenny, 2024b).

Narrative

The annotated chart narrative style was chosen for this visualisation to effectively meet the needs of the target audience, which includes urban planners, policymakers, and local government officials. These individuals rely on clear, actionable insights from data to inform decisions regarding public spaces. Annotated charts allow critical information to be highlighted directly, helping them quickly grasp patterns such as peak pedestrian activity, weekday vs. weekend comparisons, and seasonal trends.

Annotations placed beside the visualisations ensure that users can interact freely with the data without obstruction, enhancing the experience. This balance between guiding users to important findings and maintaining interactivity is essential for policymakers who need both clarity and flexibility to explore various scenarios. As highlighted in research, effective visual storytelling helps policymakers by emphasising key trends without overwhelming users (Koohsari et al., 2014).

The annotations also directly address the research questions by emphasising the most relevant insights, such as high and low traffic areas or key seasonal changes. This clear messaging supports data-driven decision-making for improving infrastructure and public space management, ensuring that the visualisation is not just informative but also actionable. In this way, the annotated chart style meets the dual objectives of guiding exploration while enabling deeper engagement with the data.

Additional Features

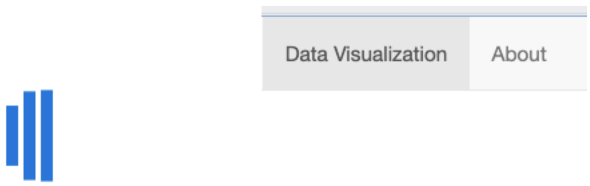


Figure 10. Animation and References

To enhance user engagement, I incorporated three key animations into the visualisation which is shown by figure 10. The first is a loading animation, reassuring users that the visualisation is processing correctly. The second feature is an additional tab providing an overview of the project and data sources. Lastly, the stacked area plot includes subtle transitions for a smoother user experience. I chose a white background to make the visualisation stand out and direct the user's focus to the content.

Implementation

Technical Implementation

Dataset

Here are the datasets used for the project:

- The Pedestrian Count (Hourly) dataset records hourly counts from IoT sensors in the City of Casey and is split into two files:
  - The first file is in Excel format with 360,401 rows and 27 columns, covering the period from August 12, 2021, to October 5, 2022.
  - The second file is in GeoJSON format, containing 204,814 rows and 25 columns, covering the period from September 19, 2023, to October 20, 2024. It is imported using the sf library.
  - Data source: https://data.casey.vic.gov.au/explore/dataset/pedestrian/export/?disjunctive.location_suburb&disjunctive.dev_site&disjunctive.location_desc&disjunctive.sub_location&disjunctive.devicename&sort=date

- Parks and Reserves Location: contains the locations and classifications of parks and reserves in the City of Casey. It consists of 3,237 rows and 16 columns, including spatial attributes, covering parks and reserves across 30 suburbs. The dataset is in SHP format and is imported using the sf library
    - Data source: https://discover.data.vic.gov.au/dataset/parks-and-reserves-locations
- Geoscape Administrative Boundaries: Provides local government and ward boundaries in SHP format.
    - Local government boundary: consists of 92 rows and 7 columns.
    - Ward area boundary: consists of 313 rows and 7 columns.
    - Data source: https://data.gov.au/dataset/ds-dga-bdcf5b09-89bc-47ec-9281-6b8e9ee147aa/details?q=
- City of Casey Suburbs Boundaries: SHP formatted dataset with 29 rows and 10 columns, providing suburb boundaries for the City of Casey.
    - Data source: https://data.casey.vic.gov.au/explore/dataset/suburbs-w-postcodes/export/?disjunctive.suburb&disjunctive.postcode

The addition of the Geoscape administrative boundaries and City of Casey suburb boundaries enhances the DVP project by aiding urban planners and officials in analysing parks, reserves, and pedestrian count distributions.

Data Wrangling

The dataset wrangling in R utilised key libraries like tidyverse, lubridate, readxl, and sf for data import, manipulation, and reformatting. The process consisted of two phases:

- Pedestrian Dataset Wrangling: The goal was to combine two pedestrian count datasets for analysis. To standardise them, I converted the GeoJSON into a DataFrame using st_drop_geometry, selected relevant columns, used regression to impute missing time series data, and formatted the dates. This resulted in a unified dataset.
- Shapefile Wrangling: This phase was more complex due to the handling of spatial data. I imported multiple shapefiles using the sf library, filtered the ward boundaries to match the City of Casey (from the Local Government shapefile), and performed a spatial join with st_join to integrate the park and reserve dataset to get the count of each park and reserves of each area. The result was exported as two shapefiles: suburb boundaries and ward boundaries.

In total, three files were exported for visualisation. Additionally, I retained the parks and reserves shapefile for mapping, as none of the other shapefiles accurately captured the park locations. Each shapefile serves a distinct purpose, so combining them wasn't necessary.

DVP Project

For the DVP project, I chose to use R Shiny as it's the framework I am most familiar with. Below are the libraries that are used in the assignment (for the server and UI code):

- shiny: Builds the app's UI and manages reactivity for inputs, outputs, and events.
- ggplot2: Generates static plots, later converted to interactive ones with Plotly.
- tidyverse: Manages data manipulation (e.g., grouping, summarising) using dplyr.
- plotly: Converts ggplot2 plots into interactive charts with hover and click features.
- rlang: Handles dynamic column referencing in dplyr operations.
- leaflet: Creates interactive maps with shapefiles and sensor data, supporting tooltips and spatial operations.
- sf: Reads, transforms, and processes spatial data for map-based visualisations.
- shinycssloaders: perform loading animation to visualisations.

The project required advanced spatial operations, such as mapping sensor data to parks and reserves based on proximity. This involved calculating nearest neighbours between parks and sensors, as well as handling cases where no sensor was within a specified buffer radius. For these parks, they were tagged with "No nearby Sensor" and assigned a pedestrian count of "0". Additionally, spatial data processing involved transforming coordinate reference systems (CRS) to ensure accurate visualisation of proximity-based insights.

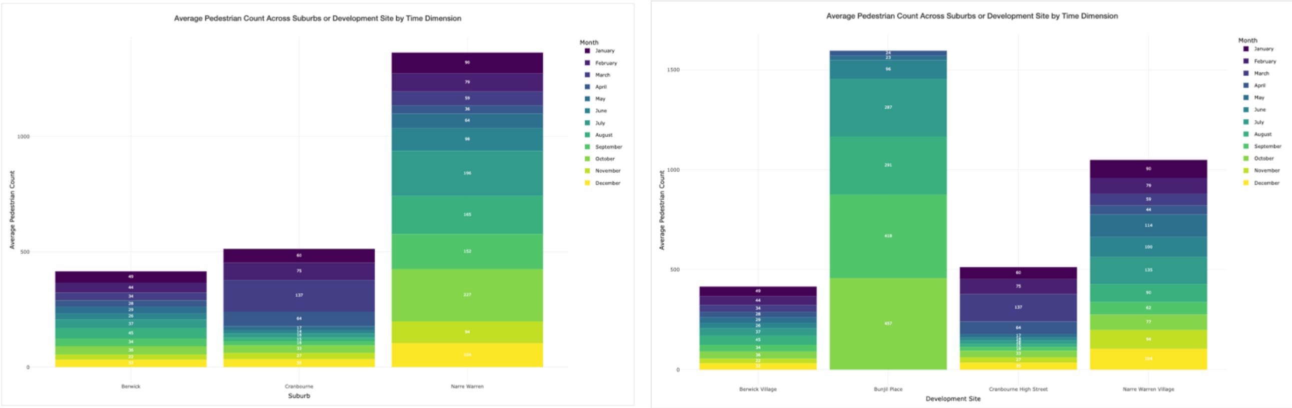
To improve the user experience, the application incorporated animations to address loading delays in R Shiny. The use of withSpinner() for visualisations like the stacked area graph and interactive bar plots provided immediate feedback during data processing, enhancing perceived performance and keeping users engaged. The final design focused on interactivity, allowing dynamic selection of time dimensions, geographic variables, and buffer sizes. This shift from a simpler design enabled real-time data exploration and filtering, making the application more responsive and user-friendly.

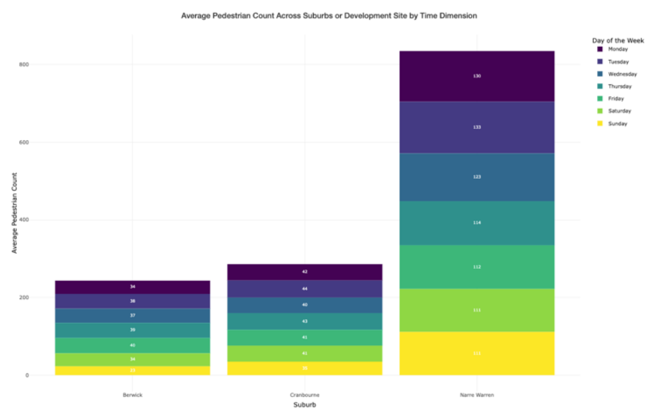
One challenge was adding overall labels to the bar graph. ggplot didn't support using two geom_text() layers on stacked bar charts, making it hard to display both individual and total values. I decided to label only the bar sections, as the target audience could easily assess bar heights, and the focus was on showing pedestrian count trends across time dimensions.

Moreover, the streamgraph was replaced with a stacked area graph due to the limitations of the ggstream library, which struggled with hover and click interactions, often causing crashes. This change ensured stability and interactivity for the user.

Additionally, the Leaflet map was enhanced by adding boundary areas for better clarity and removing the colour hue to avoid conflicts with displaying a colour legend over map layers. A separate colour legend was introduced to clearly indicate pedestrian counts, improving the map's readability and overall user experience. These adjustments contributed to a more robust and user-friendly application, aligning with the project's objectives.

Interactive Narrative Visualisation Implementation





Stacked Bar Graph Insights

Insights:

- Narre Warren consistently shows the highest pedestrian counts, especially during the later months of the year, indicating higher foot traffic compared to Berwick and Cranbourne.
- Berwick and Cranbourne exhibit lower and more uniform pedestrian activity, with minor peaks occurring in different months.
- Bunjil Place's (Development Site) significantly higher pedestrian count suggests it serves as a major activity center, while Berwick Village and Cranbourne High Street experience more stable, lower traffic throughout the year.

Implementation:

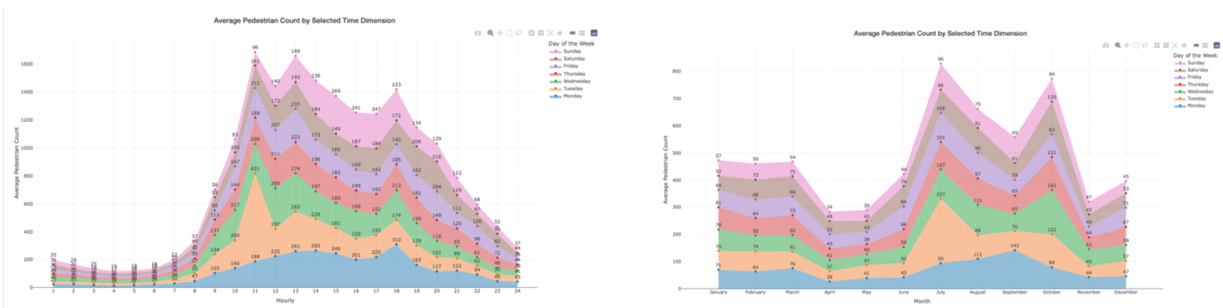
- Narre Warren sees peak pedestrian activity in August and September, making it essential to implement safety measures, such as improved lighting and crosswalks, before these months to handle the increased foot traffic effectively.
- The similar distribution between weekdays and weekends suggests that public spaces and infrastructure are utilized evenly throughout the week. This consistency is beneficial for planning regular maintenance or service enhancements without needing to focus specifically on weekends.

Figure 11. First Visualisation

The final implementation effectively communicates key insights about pedestrian activity and park utilisation in the City of Casey. The visualisations, primarily stacked bar graphs as shown in the figure 11, are designed to help the target audience quickly understand patterns such as peak pedestrian times, differences between weekday and weekend activity, and seasonal trends across categorised locations. The use of an annotated chart style ensures that important findings are highlighted and easily accessible for decision-makers, while the interactive nature of the charts encourages deeper exploration and analysis.

Key insights, such as Narre Warren's consistently higher pedestrian activity in later months and the more uniform counts in Berwick and Cranbourne, point to areas that may benefit from targeted infrastructure improvements. These could include better lighting, more crosswalks, and additional public amenities in high-traffic areas, as well as efforts to improve accessibility and community engagement in lower-traffic zones. The visualisations also highlight differences between weekday and weekend activity, with some areas showing more stable foot traffic compared to others with significant fluctuations.

Overall, the implementation provides data-driven insights that are both informative and actionable. Clear annotations and an intuitive design allow the target audience to easily identify trends, assess infrastructure needs, and make informed decisions for improving public space management in the City of Casey. The balance between narrative guidance and interactivity makes these visualisations a valuable tool for enhancing pedestrian safety, accessibility, and community engagement in rapidly urbanising areas. Ultimately, the visualisation answers the first research question.



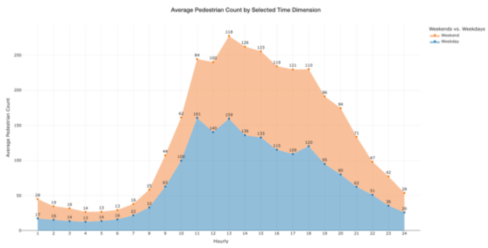


Figure 12. Second Visualisation

Stacked Area Graph Insights

Insights:

- Weekday vs. Weekend Activity: Pedestrian activity peaks later on weekends (11 AM to 3 PM), suggesting recreational use of public spaces, while weekdays see higher movement earlier (8 AM to 2 PM), likely due to work and school routines.
- Morning and Evening Trends: Pedestrian activity is minimal between 12 AM and 6 AM on both weekdays and weekends, but weekend evenings (after 8 PM) show slightly more activity, indicating social or leisure engagements.
- Daily Peak Activity for Narre Warren: Tuesday records the highest pedestrian count, peaking at 11 AM and declining through the afternoon. Thursday and Friday also see significant foot traffic from 11 AM to 3 PM, while Monday, Wednesday, and Sunday have more moderate activity during this time.
- Seasonal Trends in Melbourne: Pedestrian activity in Melbourne peaks in July and October, with the highest average count in July (237 on Thursdays). The increase in July is likely due to winter festivals, school holidays, and cooler weather, while October's high activity aligns with spring events and warmer temperatures.

Implementation:

- Weekday Improvements: Enhance crosswalks and public amenities from 8 AM to 2 PM in high-traffic areas to support work and school commutes.
- Weekend Enhancements: Focus on improving parks and public spaces (e.g., seating, signage) between 11 AM and 3 PM for increased recreational use.
- Evening Safety: Strengthen street lighting and security after 8 PM, especially on weekends. Although early morning activity is low, adding patrols or emergency services can improve safety during off-peak times.
- Seasonal Focus: Enhance park amenities, lighting, and event preparation during July and October to support increased foot traffic from winter and spring events, with particular attention to winter festivals and holiday crowds.

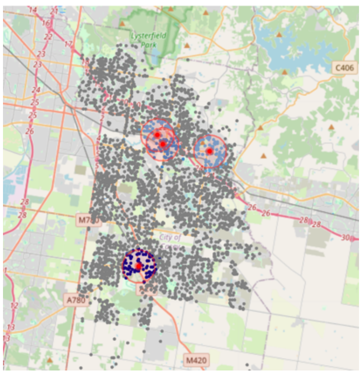
The final implementation uses stacked area graphs to communicate key insights into pedestrian activity within the City of Casey, focusing on weekday vs. weekend activity, daily trends, and seasonal patterns as shown by figure 12. Designed for urban planners and policymakers, the visualisations highlight key findings with clear annotations while allowing for deeper exploration. The insights show that weekend activity peaks later (11 AM to 3 PM), reflecting recreational use, while weekday activity is higher earlier (8 AM to 2 PM), likely due to work and school routines. Weekends also show slightly more evening activity after 8 PM, suggesting social or leisure events. Narre Warren sees the highest activity on Tuesdays, while July and October see seasonal peaks, likely tied to holidays and cooler weather.

This directly answers Research Question 2, comparing weekday vs. weekend pedestrian activity. The data reveals distinct behavioural differences, with weekdays associated with commuting and weekends with leisure, providing a clear comparison of pedestrian trends across the week.

Recommendations include enhancing weekday infrastructure between 8 AM and 2 PM, weekend improvements in parks during 11 AM to 3 PM, and increased evening safety measures after 8 PM, especially on weekends. Additionally, during high-traffic months like July and October, preparations should be made for increased pedestrian flow.

Overall, these insights provide actionable recommendations for improving pedestrian safety and public space management, offering a practical tool for urban planning.

Park and Reserves Sensor Location and Utilisation



Pedestrian Count Legend

- Low Count
- Medium-Low Count
- Medium-High Count
- High Count
- No Count

Map Filters

Choose the Radius:

1.25 km

Map Explanation

Insights:

- Park Proximity: Narre Warren (Bunjil Place) experiences consistently high pedestrian activity, especially in mid-morning and during later months, due to its dual role as a cultural hub and key transit route. With 74 parks within 1km, the area's blend of transit infrastructure and park access drives significant foot traffic, serving both commuters and leisure seekers.
- Park and Pedestrian Count: Cranbourne (High Street) and Berwick (Village) have moderate pedestrian counts (41 and 35, respectively), despite similar park access within a 1km radius. Lower foot traffic may be due to fewer high-density public facilities or events compared to Narre Warren.
- Utilization Pattern: Proximity to parks alone doesn't necessarily increase foot traffic. Narre Warren's higher pedestrian count suggests that urban development, community activities, and commercial centers play a larger role in driving pedestrian movement.
- Weekday vs. Weekend Patterns: Narre Warren maintains high pedestrian activity on both weekdays and weekends, especially on Tuesdays and in July and October, serving as a major residential, commercial, and transit hub. In contrast, Cranbourne and Berwick show more uniform, localized foot traffic with less variation between weekdays and weekends.

Improvements:

- Narre Warren: City planners should focus on enhancing park amenities, improving walkways, safety, and event support around high-traffic zones like Bunjil Place to sustain pedestrian activity and keep the area attractive.
- Cranbourne and Berwick: To increase pedestrian engagement, planners should host community events and improve park accessibility with better lighting, signage, and transportation links to encourage foot traffic to local parks.
- Lower Traffic Areas: In areas like Berwick and Cranbourne with lower pedestrian counts, developing community hubs or commercial spaces near parks and organizing events can stimulate park use and attract more foot traffic.

Figure 13. Third Visualisation

The final implementation features an interactive map that visualises park and reserve sensor locations in the City of Casey, along with pedestrian counts, enabling users to explore park utilisation patterns as shown by figure 13. Narre Warren (Bunjil Place) consistently shows high pedestrian activity, particularly in mid-mornings and later months, due to its role as a cultural hub and transit point. With 74 parks within a 1km radius, it sees significant foot traffic from both commuters and leisure seekers. In contrast, Cranbourne and Berwick exhibit moderate pedestrian counts, despite similar proximity to parks, likely due to fewer events or less dense infrastructure.

The map demonstrates that proximity alone doesn't necessarily increase foot traffic, as Narre Warren's higher counts are likely driven by commercial and residential development. Weekday vs. weekend trends reveal that Narre Warren maintains high pedestrian activity on both, peaking on Tuesdays and during July and October, while Cranbourne and Berwick show more consistent and localised traffic patterns.

Recommendations for Narre Warren include improving park amenities, walkways, and safety around high traffic sones, while Cranbourne and Berwick could benefit from hosting community events and improving accessibility with better lighting and transport. In lower-traffic areas, creating community hubs and organising events could increase park use.

When combined with stacked area graphs and bar charts, the map offers a comprehensive analysis of park utilisation and pedestrian activity, answering Research Question 3 by showing both spatial and seasonal trends. The map identifies areas with concentrated or sparse foot traffic, while other visualisations reveal peaks in activity during specific days and months. This integration of temporal and spatial data helps urban planners understand when and where people are most active, guiding targeted interventions like adding amenities during peak times or addressing underutilised areas. Together, these insights provide a detailed understanding of pedestrian behaviour across the City of Casey.

Using the Implementation

This section offers comprehensive instructions for effectively running, viewing, and interacting with "Park Utilisation and Pedestrian Activity" visualisation. To ensure a smooth experience and to fully leverage the interactive features that illuminate pedestrian behaviours and park usage, please follow the steps outlined below. These guidelines will help you set up the environment correctly and maximise your exploration of the data.

Guidelines on how to run the visualisation:

1. Installed the required libraries: shiny, ggplot2, tidyverse, plotly, rlang, leaflet, sf, shinycssloaders
2. Ensure that all the following files are in the same folder:
   a. server.R and ui.R
   b. casey_ward: shapefiles for suburb and ward boundaries.
   c. park-and-reserves1: shapfiles for parks and reserves.
   d. Pd_df_clean.csv: pedestrian count dataset.
3. Open the server.R and ui.R in the RStudio and directly run either of them.

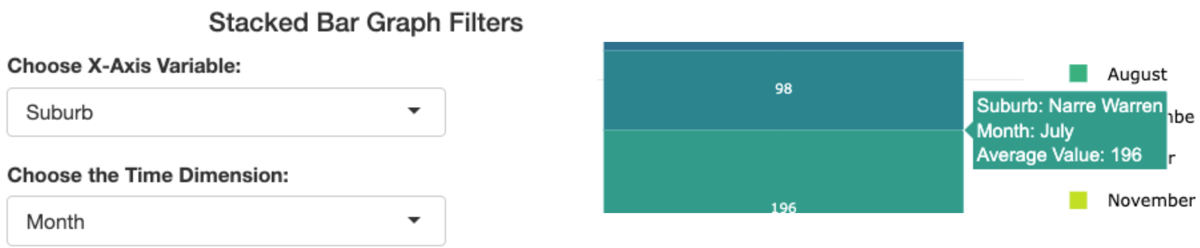


Figure 14. Stacked Bar Graph Interactions

In the bar chart section, you can select the X-axis variable (either 'Suburb' or 'Development Site') and a time dimension (e.g., 'Month,' 'Day of the Week') as shown by figure 14. The chart updates dynamically based on your selections, and hovering over the bars displays tooltips with details such as the average pedestrian count.

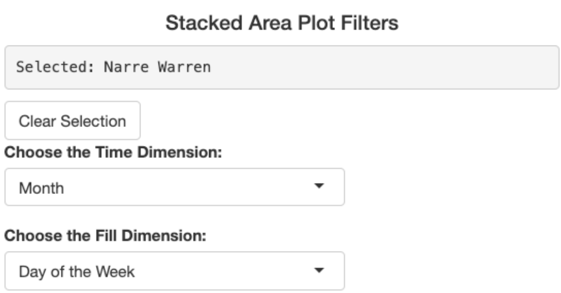


Figure 15. Stacked Area Graph Interactions

You can also click on a bar to select a suburb or development site. Multiple selections are possible, and you can clear them with the 'Clear Selection' button. This filter will be used to filter the stacked area graph as shown by figure 15.

The stacked area chart allows you to explore pedestrian activity over time by selecting both a time dimension and a fill dimension (such as 'Day of the Week') as shown by figure 15. Hovering over the stacked areas reveals detailed information, such as the time period and the average count for each category. The chart is fully interactive, and the data updates dynamically based on your selected filters. Same as the stacked bar graph, the stacked area graph also displays tooltips.

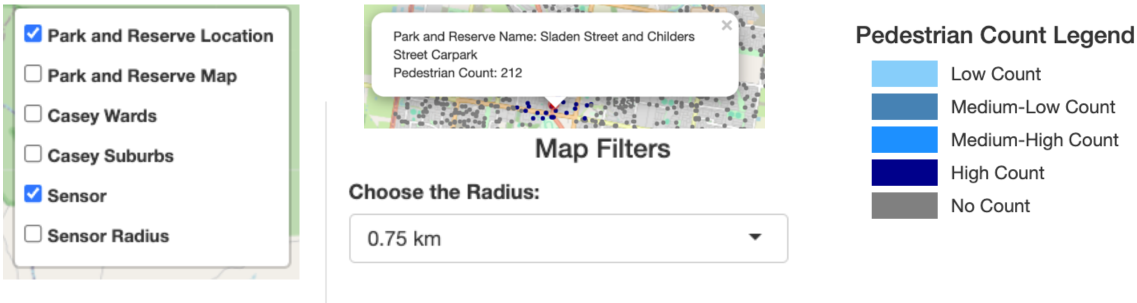


Figure 16. Map Graph Interactions

The interactive map offers multiple layers, including park locations, sensor points, and Casey wards, which can be toggled on or off. Circle markers indicate sensors and are coloured by pedestrian activity, with darker colours representing higher counts. You can hover over the markers to see more details about each park or sensor. The map also features a radius filter that lets you adjust the buffer zone (0.75 km, 1 km, or 1.25 km) around each sensor, updating the number of parks within the selected range. A colour legend explains the gradient used to represent pedestrian activity levels. All of this interactions are shown by figure 16.

These features are designed for deep exploration. You can interact with the charts and maps to gain insights into park usage and pedestrian movement patterns across different time periods and regions. Hidden interactions, such as multi-selection in the bar chart, allow for more in-depth analysis.

Conclusion

In conclusion, the narrative visualisation project successfully achieved its primary goal of exploring pedestrian activity and park utilisation in the City of Casey suburbs. By utilising a combination of interactive bar charts, area graphs, and maps, the visualisation provides a comprehensive understanding of pedestrian behaviour, highlighting key insights such as peak activity times, differences between weekday and weekend trends, and the spatial distribution of foot traffic in relation to parks and reserves.

The project revealed distinct patterns of pedestrian movement, with findings such as higher activity in suburban hubs like Narre Warren and more consistent foot traffic in areas like Cranbourne and Berwick. These insights are crucial for urban planners and policymakers to make informed decisions regarding infrastructure improvements, such as enhancing lighting, increasing crosswalks, and providing amenities in high-traffic zones. Additionally, the analysis of park usage highlighted opportunities to increase engagement in underutilised areas through community events and better accessibility.

Reflecting on the project, a key learning was the importance of balancing interactivity with clarity. Initially, the design incorporated too many filters, which overwhelmed the user experience. Simplifying the final design and focusing on essential interactive elements greatly improved usability and engagement. Moreover, incorporating visual elements like hover effects for detailed data exploration proved valuable in guiding users through the narrative.

In hindsight, one improvement would be refining the integration of temporal and spatial data even further, particularly by including more granular time dimensions or additional contextual layers in the map visualisation. This would allow for deeper analysis of how pedestrian activity fluctuates over shorter timeframes or in response to specific events. Additionally, incorporating more complex machine learning models to predict future pedestrian trends could enhance the decision-making process for public space management.

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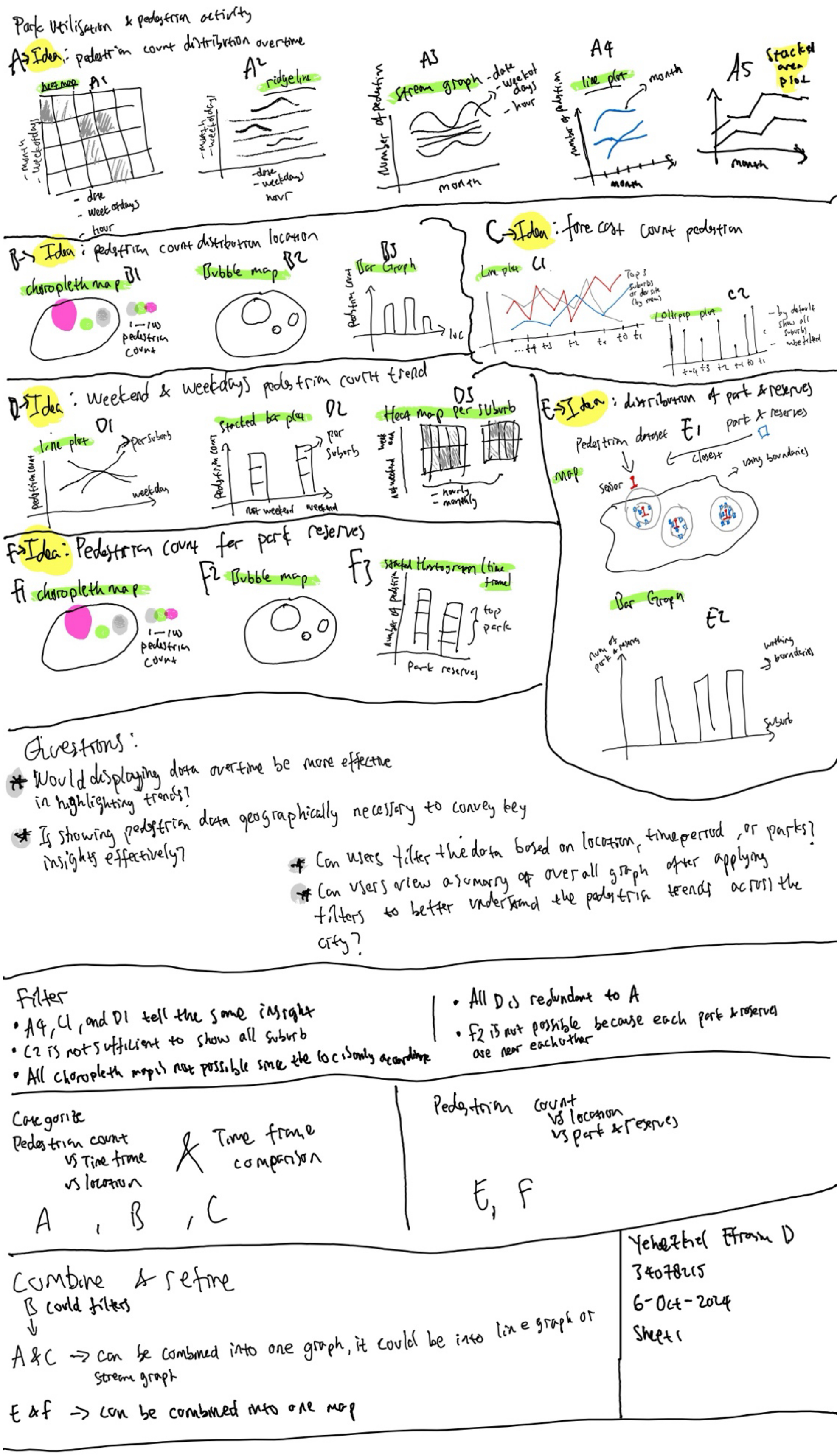
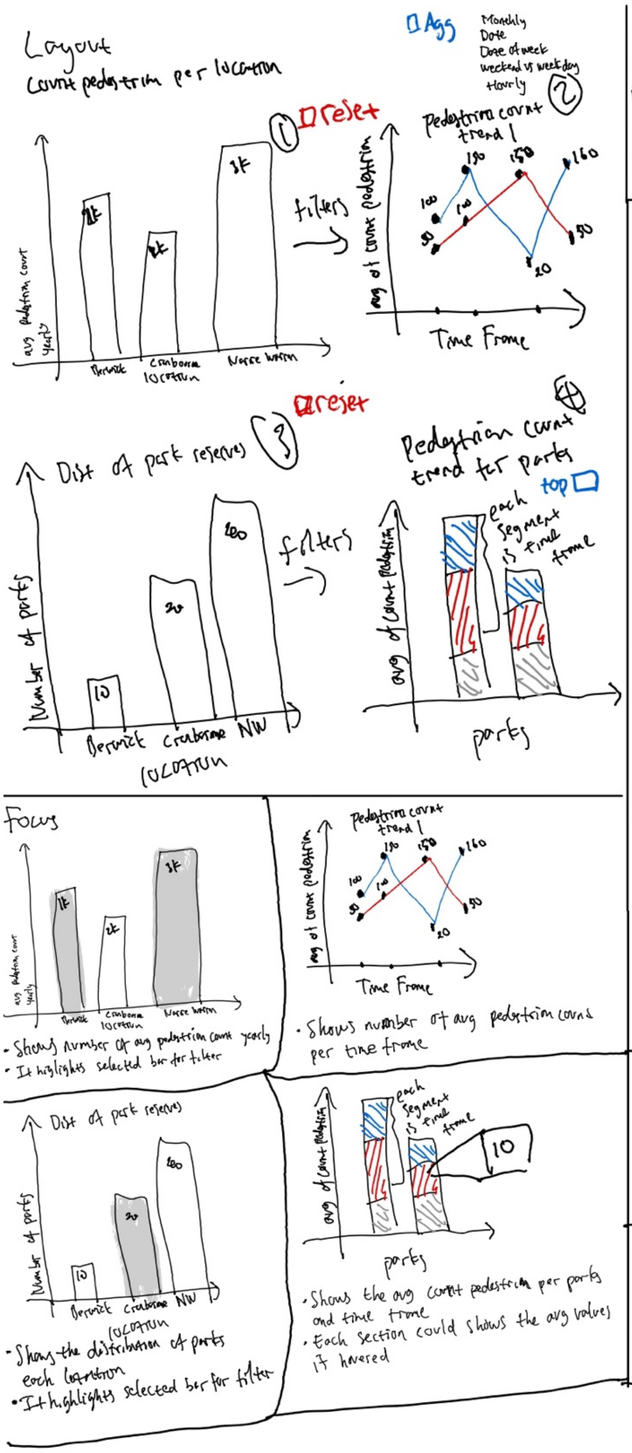

Park Utilisation & pedestrian activity
A> Idea: pedestrian count distribution overtime
heat map A1
- month - weekofdays
- date - week of days - hour
A2 ridgeline
- month - weekofdays
- date - weekdays hour
A3 Stream graph - date - weekof days - hour
Number of pedestrian
month
A4 line plot
month
number of pedestrian
month
A5 Stacked area plot
month
B> Idea: pedestrian count distribution location
choropleth map B1
1—100 pedestrian count
Bubble map B2
B3 Bar Graph
pedestrian count
loc
C> Idea: forecast count pedestrian
Line plot C1
Top 3 suburbs or decide (by mean)
... t-4 t-3 t-2 t-1 t0 t1
C2 Lollipop plot
- by default show all suburbs
- selected
t-4 t-3 t-2 t-1 t0 t1
D> Idea: weekend & weekdays pedestrian count trend
line plot D1
per suburb
pedestrian count
weekday
Stacked bar plot D2
per suburb
not weekend weekend
Heat map per suburb D3
- hourly - monthly
E> Idea: distribution of park & reserves
E1
pedestrian dataset
park & reserves
closest
using boundaries
map
sensor
Bar Graph
E2
num of park & reserves
within boundaries
suburb
F> Idea: Pedestrian count for park reserves
F1 choropleth map
1—100 pedestrian count
F2 Bubble map
F3 Stacked Histogram (time frame)
number of pedestrian
top park
Park reserves
Questions:
* Would displaying data overtime be more effective in highlighting trends?
* Is showing pedestrian data geographically necessary to convey key insights effectively?
* Can users filter the data based on location, time period, or parks?
* Can users view a summary of overall graph after applying filters to better understand the pedestrian trends across the city?
Filter
• A4, C1, and D1 tell the same insight
• C2 is not sufficient to show all suburb
• All choropleth maps is not possible since the loc is only accordinate
• All D is redundant to A
• F2 is not possible because each park & reserves are near each other
Categorize
Pedestrian count vs Time frame vs location
& Time frame comparison
A, B, C
Pedestrian count vs location vs park & reserves
E, F
Yehezkiel Efraim D
34078215
6-Oct-2024
Sheet 1
Combine & refine
B could filters
A & C -> can be combined into one graph, it could be into line graph or stream graph
E & F -> can be combined into one map



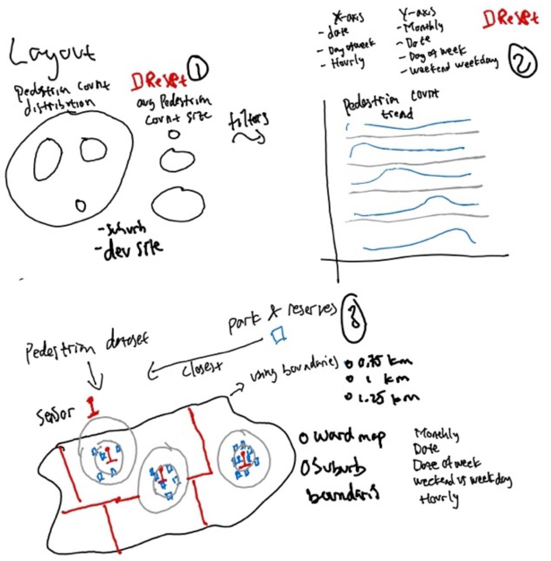
Info
Author: Yehezkiel Efraim D
Date: 6-10-2024
Sheet: 2
Task: Detailed centered dashboard

Operations
- clicking or hovering over each bar in plot 1 & 3, it will filters plot 2 & 4.
- Aggregate option in plot 2 is to combine the line chart as one line to see the overall trend line
- Reset option to clear filters
- It is possible to select 2 bars for plot 1, 3
- plot 4 could select how many top-n parks to show, up until 10.
- Time frame availability (filters 2, 4)
  - Monthly
  - Date
  - Date of week
  - weekend vs weekday
  - Hourly
- Hovering over to each subsection in plot 4, reveal its value

Advantages
- Graphs are simple & easy to understands
- Figures are layed out more clearly

Disadvantages
- Too many plots
- Too many filter options

Layout



Info

Author : Yehezkiel Efraim D

Date : 6-10-2024

Sheet : 3

Task : Vizual centered dashboard

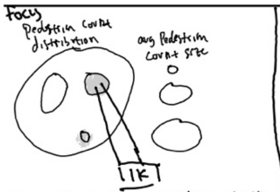
Operations

- Clicking & hovering circle in plot 1 could filter plot 2.
- Plot 1 could change location granularity
- could choose several circles in plot 1 to filter plot 2
- Hovering circle in plot 1 could show avg count pedestrim yearly
- Plot 2 axis granularity could be change:

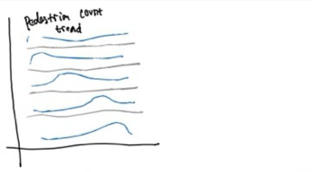
X-axis	Y-axis
- date	- Monthly
- Day of week	- Date
- Hourly	- Day of week
	- weekend weekday

- Hovering each dist graph could show central statistics.
- Hovering each park in plot 3 shows the avg pedestrian count and the park code
- Hovering each sensor shows the number of parks
- Could choose the radius of circle for plot 3.
- Reset button for reset the filter
- Plot 3 uses to filter timeframes
  - Monthly
  - Date
  - Date of week
  - weekend vs weekday
  - Hourly

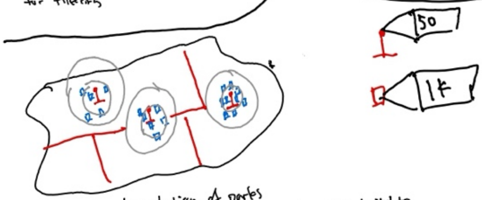
Focus



- Shows the distribution of pedestrim count
- Hovering shows real values
- It highlights circles that is used for filtering



- Shows the distribution count trend timeframe vs. time frame



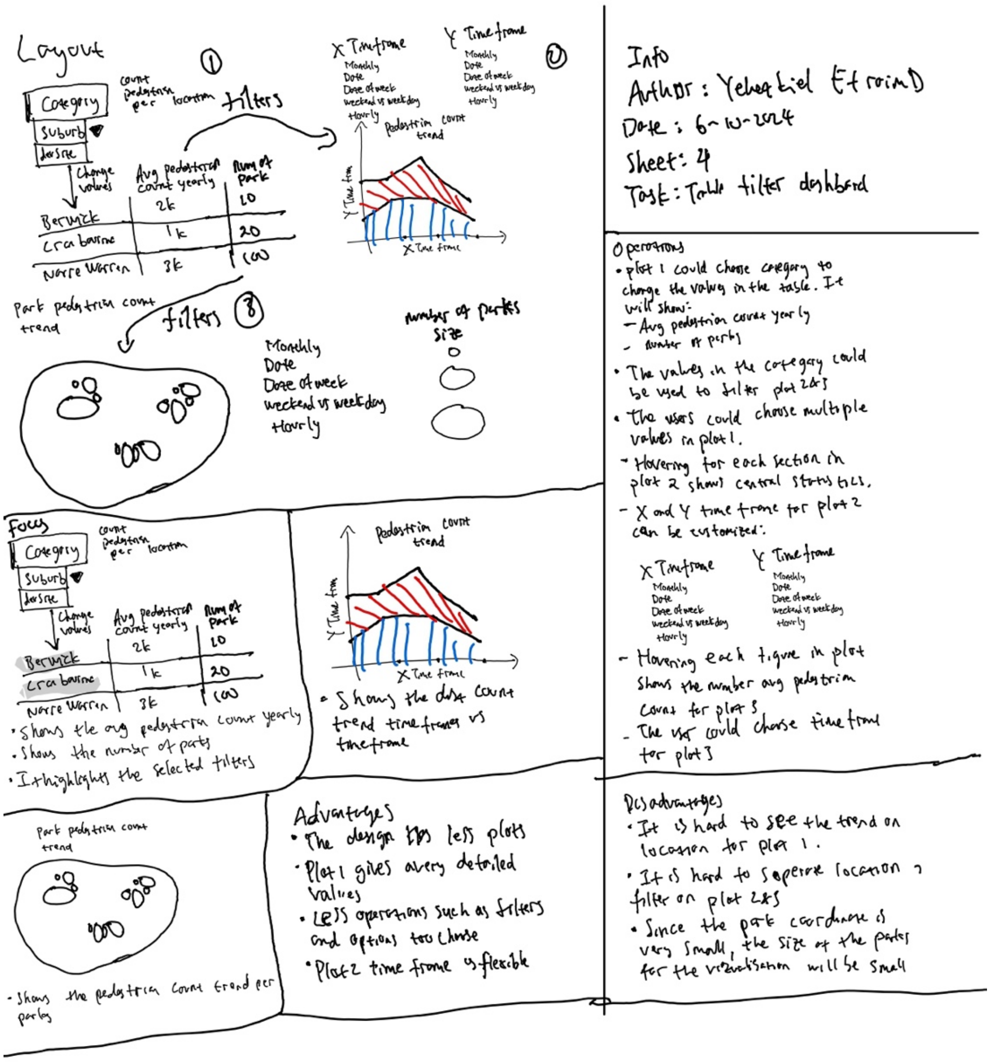
- Shows the distribution of parks
- Each parks has color using color hue (tab limited to colors)
- Hovering shows the detailed values of each sensor and parks, also the park codes

Advantages:

- More flexibility to the users
- Users could visually see the distribution in the map
- The usage of the size in plot 1, intuitively easier for the user.
- The diffrent shape in plot 3 gives a nice visualization
- The color hue in the plot 3 makes it easier for the user to identify the trend
- Plot 2 intuitively shows the trend very clearly

disadvantages

- Too many filtering options
- Some plots are more difficult to understand
- Some detailed values (plot 2) isn't mentioned
- The shapes & circles in plot (1&3) could be overlapping and it will make it harder to hovering
- Y-axis filter values depend on X-axis filter values, which could make user confuse

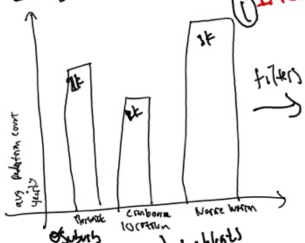

Layout
1
Category
count pedestrian per location
Suburb
Location
filters
Change values
Avg pedestrian count yearly
Num of Park
Berwick
2k
10
Cranbourne
1k
20
Narre Warren
3k
100
X Timeframe
Monthly
Date
Date of week
weekend vs weekday
Hourly
Y Time frame
Monthly
Date
Date of week
weekend vs weekday
Hourly
2
Pedestrian count trend
Y Time frame
X Time frame
Park pedestrian count trend
filters
3
Monthly
Date
Date of week
weekend vs weekday
Hourly
number of parks
size
Info
Author : Yehezkiel Efraim
Date : 6-10-2024
Sheet: 4
Task: Table filter dashbord
Operations
• plot 1 could chose category to change the values in the table. It will show:
– Avg pedestrian count yearly
– number of parks
• The values in the category could be used to filter plot 2&3
• the users could choose multiple values in plot 1.
- Hovering for each section in plot 2 shows central statistics.
- X and Y time frame for plot 2 can be customized:
X Timeframe
Monthly
Date
Date of week
weekend vs weekday
Hourly
Y Time frame
Monthly
Date
Date of week
weekend vs weekday
Hourly
- Hovering each figure in plot shows the number avg pedestrian count for plot 3
- The user could chose time frame for plot 3
Focus
Category
count pedestrian per location
Suburb
Location
Change values
Avg pedestrian count yearly
Num of Park
Berwick
2k
10
Cranbourne
1k
20
Narre Warren
3k
100
• Shows the avg pedestrian count yearly
• Shows the number of parks
• It highlights the selected filters
Pedestrian count trend
Y Time frame
X Time frame
• Shows the data count trend time frames vs timeframe
Park pedestrian count trend
• Shows the pedestrian count trend per parks
Advantages
• The design has less plots
• Plot 1 gives a very detailed values
• Less operations such as filters and options too chose
• Plot 2 time frame is flexible
Disadvantages
• It is hard to see the trend on location for plot 1.
• It is hard to seperate location ↗ filter on plot 2&3
• Since the park coordinate is very small, the size of the parks for the visualisation will be small

Layout

① □ reset

X Timeframe ② Y Timeframe

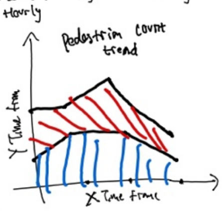
X Timeframe	Y Timeframe
Monthly	Monthly
Date	Date
Date of week	Date of week
weekend vs weekday	weekend vs weekday
Hourly	Hourly



○ Suburbs
○ dev site

filters →

↓ highlights



pedestrian dataset

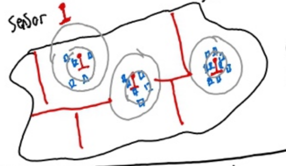
park & reserves ③

closest

using boundaries

○ 0.75 km
○ 1 km
○ 1.25 km

sensor



○ Ward map
○ Suburb boundaries

Info

Author : Yehezkiel Efraim D

Date : 6-10-2024

Sheet : 5

Task : Final Dashboard

Operations

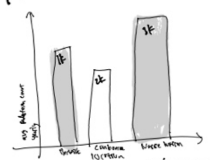
- clicking and hovering plot 1 will filter plot 2 and highlights the area in plot 3
- the user could change the location from suburb to development site
- The users could choose multiple bar on plot 1 to be used for filter
- Hovering for each section in plot 2 shows central statistics

X and Y time frame for plot 2 can be customized:

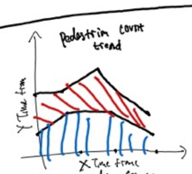
X Timeframe	Y Timeframe
Monthly	Monthly
Date	Date
Date of week	Date of week
weekend vs weekday	weekend vs weekday
Hourly	Hourly

- Hovering each park in plot 3 shows the avg pedestrian count and the park code
- Hovering each sensor shows the number of parks
- Could choose the radius of circle for plot 3.
- Reset button for reset the filter
- Plot 3 could have the option to select type of area boundaries
  - Ward map
  - Suburb boundaries

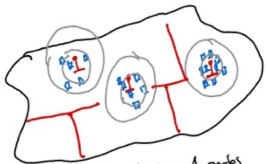
Focus

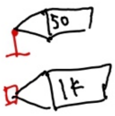


- Shows number of avg pedestrian count yearly
- It highlights selected bar for filter



- Shows the data count trend timeframe vs timeframe
- Trend changes according to plot 1





- Shows the distribution of parks
- Each parks has color using color hue (tab limited to colors)
- Hovering shows the detailed values of each sensor and parks, also the park codes

Details

Dependencies

- R Shiny
- Wrangling R

Estimate (cost)

- No cost

Estimates (time)

- 1 day for plot 1
- 1 day for plot 2
- 2 days for plot 3
- 1 day to connect the plots
- 1 day buffer