GEOM90007 Assignment 3 Report

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1 Design Summary

1.1 Working of the interface

The **Header** component of our application provides users with intuitive navigation and theme customisation options. Positioned at the top of the interface, the header displays the application title "Melbourne Tours," followed by a series of tabs representing different functionalities: Attractions, Transit, Stays, and Climate. Users can effortlessly switch between these main sections by clicking on the corresponding tabs, which are designed with clear labels and distinctive icons for quick recognition. On the right side of the header, a theme selector allows users to customise the visual appearance of the application by choosing between different themes, such as "Zinc" and "Violet." This feature enhances user experience by providing options for personalising the interface according to individual preferences. The header remains consistent across all pages, ensuring seamless navigation and a cohesive look throughout the application.

The **Attraction** tab providing users with comprehensive information on Melbourne's landmarks and pedestrian flow through three main sections. The first section is based on a heatmap of pedestrian traffic over the past year. Users can use the time slider in the top left corner of the map to accurately view foot traffic density at different times, helping them choose ideal visiting times and locations. The second section displays a landmark distribution map, where green density points contrast sharply with red-gold pedestrian heatmaps. Landmark ratings are shown by color intensity, and users can multi-select landmarks on the map and filter categories of interest using the filter in the top right corner. The third section includes three types of analysis charts: a 24-hour foot traffic trend chart for selected sensor areas, an annual search popularity trend from Google Trends for selected landmarks, and a rating treemap that comprehensively presents both popularity and rating information for landmarks. Data is sourced via Python's pytrends library, Google Maps API, and open data from Melbourne City Council, optimized to enhance performance.

In the ***Transit*** interface, the map is used to show the free tram zones in Melbourne city center, the routes of each tram stop, the locations of train stations and airports, as well as the density of pedestrian traffic. The layout of the interface focuses the user's eye first on the green free zones in the center, and then naturally shifts to the selection panel in the top right corner. The selection box in the upper right corner of the interface allows the user to filter data points based on specific tram routes and time periods. Additionally, users can further explore downtown transportation information on their own by using the Google Navigation feature to view paths between selected locations. Finally, the green square in the free zone serves as the core visual area to attract users, while avoiding the harsh effect of overly attracting the eye, which is suitable for the needs of tourism information display. The overall interface uses the primary colors of red, green and blue with a white background to ensure visual simplicity and readability.

The **Stays** interface is a meticulously crafted platform that assists users in exploring accommodation options within the City of Melbourne. The interface is divided into two main sections: an interactive map and a dynamic information panel. The map features custom-designed markers for various hotels, enriched with pricing labels, allowing users to visualise the geographical distribution of accommodations. Users can click on these markers to view pop-up summaries or select hotels from a list to access detailed information, including descriptions, amenities, and booking links. The information panel adapts based on user interaction, displaying either a list of hotels or comprehensive details for a selected hotel. To enhance the user interface, The extensively used custom UI based on HTML and CSS allowed for a more refined and visually striking presentation. Additionally, users can obtain directions from their current location to the hotel via Google Maps integration, enhancing their trip planning process.

The ***microclimate*** tab is divided vertically into 3 sections. The first one at the top is a control row where filters, function buttons and time sliders resides. The measure drop-down lists provides the user with the option to select their microclimate measure of interest including Wind, Air Temperature, Humidity, Air Pressure, Air Quality, and Noise. A play button plays the evolution of micro-climate measure over time by incrementally selecting data after a time interval. An individual window will pop up after the "show latest data" button is pressed. Under the hood, we uses API to retrieve latest data from City of Melbourne Open Data and transforms that into various innovative visualizations.

1.2 Features creditable

The ***Header*** and ***Theme*** components incorporate several notable design features. The header employs a clean and responsive layout that adjusts seamlessly to different screen sizes, enhancing usability across various devices. The use of intuitive icons alongside text labels in the navigation tabs aids in quick identification of each section, improving overall user experience. The theme selector offers real-time theme switching without requiring page reloads, achieved through dynamic CSS loading based on user selection. This functionality demonstrates advanced client-side scripting and efficient state management within the application. The themes themselves are carefully designed with contrasting colour palettes to ensure readability and visual appeal, catering to diverse user preferences and enhancing accessibility.

The **Attraction** interface tab combines external data integration with user-centric visualization features to offer a seamless decision-making experience. By leveraging `pytrends` and Google Maps API, the interface retrieves up-to-date search popularity and rating information, enabling users to view landmark trends and quality evaluations directly. The time slider allows real-time control over Melbourne's foot traffic density heatmap, helping users select ideal visit times and locations. Green density points on the landmark distribution map contrast with the red-gold foot traffic heatmap, while color variations indicate ratings, allowing users to easily distinguish landmarks. Three analysis charts—a foot traffic trend chart, Google Trends search popularity trend, and a rating treemap—provide a multi-dimensional view of landmark popularity, utilizing data from multiple sources and ensuring optimized performance and responsiveness.

Transit Interface:

- **Color coding and symbols**: Cartoonish icons are used to mark fixed transportation facilities, such as airports and train stations, so that users can quickly distinguish between transportation facilities and data points. Green is used for the square boundaries of free tram zones, blue marks data points such as tram stops and pedestrian monitoring points, while pedestrian traffic density changes gradually from dark green to red depending on the value.
- **Attention guidance**: The user's vision first focuses on the free area, then naturally transitions to the filtering panel in the upper right corner, where different data presentation options are explored by selecting tram routes and time periods.
- **Visual hierarchy and differentiation**: Free tram areas, train stations and airports use skeletonised cartoonish icons contrasted with blue data points to enhance the hierarchy of the interface. Traffic density, on the other hand, is marked with different colors to help users quickly understand the traffic distribution.

The ***Stays*** interface incorporates several notable design features. It integrates an interactive map with clustering of hotel markers to handle dense areas effectively, improving usability on various zoom levels. The use of custom icons and pop-up windows provides immediate visual feedback and essential information without overwhelming the user. The detailed information panel offers rich content, including images, ratings, and booking links, presented in a clean and organized layout. The ability for users to get directions from their current location to the selected hotel via geolocation enhances user engagement and provides practical utility.

Micro-climate tab:

- Animation is used to show the past trend of micro-climate measures in an engaging way.
- A pop-up window shows the latest data retrieved using API from the sensors to give the users most up-to-date information. Creative plot types such as wind compass and speedometer-like gauge is used to arouse the interest of the uses.

Additionally, the application's dynamic header with navigational tabs allows users to switch between different sections seamlessly, while the theme selector offers personalisation options, enhancing accessibility and user engagement across the entire interface.

1.3 Justification of design decisions

In designing the ***Header*** and ***Theme*** components, we prioritised user accessibility and personalisation. The decision to include a fixed header with prominent navigation tabs was driven by the need for

users to quickly access different sections of the application without confusion. The use of universally recognisable icons alongside text labels enhances usability, particularly for international users who may rely on visual cues. The theme selector was implemented to provide users with control over the visual aesthetics of the interface, acknowledging that colour preferences can significantly impact user comfort and engagement. By allowing real-time theme changes, we ensure that users can immediately see the effects of their choices, enhancing the interactive experience. The themes were designed with attention to colour contrast and harmony, ensuring that the interface remains visually coherent and accessible regardless of the selected theme.

The design of the Attraction interface labels centers on user experience and information visualization, with all design elements carefully considered to enhance users' intuitive understanding and ease of operation. First, the time slider provides fine control over different time periods in the past year, allowing users to view changes in foot traffic at weekly and hourly levels. This interaction method replaces traditional filters, making it more convenient for operations when dealing with a wide range of timeframes and better aligning with users' habits when interacting with dynamic spatiotemporal data.The landmark distribution map uses green density points to ensure clear visibility of landmarks against the heatmap background. The green color contrasts sharply with the red-gold tones of the foot traffic heatmap, enabling users to instantly distinguish between landmarks and high-traffic areas at first glance. Additionally, by varying shades of green for landmarks, users can quickly grasp basic information about landmark ratings without needing extra clicks or further searches.Three types of analysis charts respectively present trends in foot traffic, search popularity, and rating distribution. These combine different dimensions of landmark and foot traffic data to meet diverse user needs. The 24-hour foot traffic trend chart helps users plan their visit times; Google Trends' search popularity chart reveals annual interest in each landmark; while a rating tree diagram offers a multi-dimensional view of landmark ratings—allowing users to easily find popular or highly-rated landmarks within a busy map interface.To maintain high performance and ensure fast data loading speeds, backend data has been cleaned multiple times and merged where necessary while optimizing unnecessary columns—simplifying both the interface itself as well as improving response speed. In summary, the design philosophy behind Attraction's interface labels aims at efficiently presenting complex information so that users can quickly access clear multi-dimensional insights needed for personalized decision-making.

In terms of ***Transit*** interface's color choices, green is usually used to indicate free or discounted, and is therefore suitable for displaying the boundaries of free tram zones; blue is used to indicate static location data such as tram stops and pedestrian monitoring points, distinguishing them from dynamic information, while the eye-catching effect of red is suitable for marking high-density pedestrian traffic areas. In terms of attention flow, the visual path starts from the free zone in the center and then naturally shifts to the filter box area in the upper right corner; after the user selects it, the line of sight will return to the navigation bar area at the top again, forming a triangular attention path that helps the user to flow within the main information area. Visual area control guides users' attention to the core information area through the layout design of the free area in the middle and the screening box in the upper-right corner, avoiding the interface information from being too scattered, thus enhancing the user experience.

In designing the ***Stays*** interface, emphasis was placed on user experience, accessibility, and the richness of information provided. The decision to use customised HTML and CSS was driven by the need for a highly tailored interface that could offer superior aesthetics and allows for precise control over interactive elements, animations, and responsiveness. The choice to obtain detailed hotel information through web scraping from Booking.com was made to provide users with the most up-to-date and comprehensive data, including pricing, availability, and score reviews etc.. This approach ensures that users have access to a wide range of accommodations with detailed descriptions, enhancing their ability to make informed decisions. The integration of geolocation for navigation caters to tourists unfamiliar with the area, simplifying the process of finding accommodations. Overall, the design decisions aim to create an intuitive and informative platform that meets the needs of travellers seeking accommodations in Melbourne.

For the ***microclimate*** tab, depends on the measure chosen, the map in the middle of the dashboard displays different symbolic markers. For wind, a triangle points from the direction of the wind and its length shows how strong the wind is. For temperature, 3 layers of circle with different transparency is stacked onto each other to mimic a diffusing effect for a more appealing appearance. Red and blue is used as an intuitive representation of the hotter and colder end of the temperature spectrum. The

number of water droplets represents the humidity. For example, a 65% humidity will have 6 droplets on the map. In the latest data popup window, a wind compass is used to represent the direction of the wind with its strength shown as text number in the middle of the compass. A speedometer-like gauge measures the relative temperature over the span of the last 24 hours. Each measure are displayed in there own gadget in a nicely formatted 3 by 2 grid.

2 Findings and information

2.1 Interesting/useful patterns and Information

Through the ***Attraction*** interface tab, users can discover interesting correlations between foot traffic, landmark ratings, and search popularity in Melbourne's city area. For example, users may observe that certain landmarks experience a significant increase in foot traffic during specific periods (such as weekends or holidays), which could be related to local events or seasonal factors. By combining heat maps of foot traffic with landmark ratings, users can find highly rated but relatively less crowded attractions, avoiding crowds and enhancing their travel experience. The Google Trends chart on search popularity reveals trends in attention toward landmarks throughout the year, helping users choose the best time to visit. Additionally, the tree map of landmarks displays their popularity and quality evaluation through rating counts and median scores, allowing users to identify which attractions are highly praised or controversial.

For ***Transit*** interface, pedestrian traffic density distribution is marked by a gradient of colors from dark green to red, enabling users to quickly identify areas of heavy pedestrian traffic and relatively empty areas, providing effective reference information for travel planning. The free tram zones are marked with green squares, clearly demonstrating the range of free rides and helping visitors optimize their travel costs. Meanwhile, train stations and airports are marked with cartoonish icons, while tram stops and pedestrian monitoring points are marked with solid blue markers, allowing users to quickly locate these key nodes and helping to plan their travels. Through the judicious use of colors and icons, the interface effectively helps users to quickly extract key information. The colour coding of pedestrian traffic and the display of free zones enhance the aesthetics of the interface, and its practicality. The contrast between the cartoonish traffic facility icons and the blue static data points avoids information overload and ensures the visual freshness and overall coordination of the interface.

Using the ***Stays*** interface, users can discover patterns in hotel distribution, pricing, and amenities within Melbourne. For instance, users may observe that hotels closer to the city (CBD) or popular attractions tend to have higher prices or are more densely clustered. The detailed information allows users to compare hotels based on various criteria such as price, ratings, and description. The interface enables users to identify accommodations that balance proximity to points of interest with price considerations. Additionally, the integration of ratings helps users discern quality differences among hotels in similar locations, aiding in making informed decisions based on both location and user satisfaction. The ability to visualise this information on an interactive map, combined with detailed listings, enhances the user's ability to plan their stay effectively.

The geographic distribution of the ***microclimate*** sensors within the CBD area is not very even with most of the 11 sensors located on the south side of the free-tram zone along the South Yarra river. This hinders the usability of data to represent a holistic picture of the micro climate structure in Melbourne. We suggest to set up more sensors in north city or the Carlton area as well as in Southbank. There has also been redundancy in the location of the sensors. For example, ICTMicroclimate-10 and 11 are almost right next to each other with distance less than 100 metres. Another finding is the relative high delay between the time measurement happens and the time it is uploaded into the database so that it's retrievable by the end user. Based on our experience there is usually an 11-hour delay which again hinders the usability of this data, especially in real-time scenarios.

Table 1: Group Member Contribution Table

Name	Contribution to Project (max 50 words)	Percentage Contribution
Yan Yang	I developed the Attraction tab, consisting of Pedestrian heatmap & Landmark Map in the city of Melbourne, also including Google Trends plot of landmark and Tree map contains data from Google Map Ratings.	25%
Ximing Wan	I developed the Transit tab, highlighting Melbourne's free tram zone, plotting tram stops, and showing pedestrian density along tram routes. I wrote this part of the report, and also shot the aim video section of the project.	25%
Jiarui Ni	I contributed to the project by designing the header, theme components along with their report sections, integrating the Shiny modules of other tabs into app.R, and developing the "Stays" page along with its corresponding report section.	25%
Shengyang Sun	I developed the "Climate" tab, visualising microclimate data with interactive maps and dashboards for wind, temperature, and humidity. I also wrote the corresponding report section for this part of the project.	25%

3 Contribution

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