1 Introduction

In our design, tourists were selected as the target user group. Therefore, information about transportation, restaurants, places of interest (including libraries, famous universities, churches, museums and department stores) were considered and consequently displayed on the map. To aid with helping tourists find their intended destination, several layers were utilised to display this data. User interactions to display specific features of the map maximises the data-ink ratio by erasing redundant data-ink on a click by click basis.

2 Design Summary

A circle was selected for points on the map as although squares are more accurate in reading, circles offer less overlap, and curvature allows for better boundary detection (Slocum et al., 2004). In addition, hue is ideal for categorical data and can assist in pre-attentive processing by allowing a user to locate the colour of the data point amongst distractors (the map) and assists in breaking the camouflage of the grey and desaturated surrounding map (Brewer & Pickle, 2002). It also assists in establishing the visual hierarchy where the categorical data has emphasis placed upon it in contrast to the base map (Larkin & Simon, 1987) and its hue assists in boundary detection.

Additionally, in terms of intellectual hierarchy, the size of the typeface, for example in the navigation box, reflects upon the importance of the navigation with respect to other text, for example, street labels. Furthermore, the typeface Roboto Condensed was chosen because it can provide a more natural reading rhythm.

The high contrast grey colours with different lightness were selected to make map elements more visible to individuals with colour deficiencies, especially protanopia/deuteranopia and protanomaly/deuteranomaly (red/green colourblindness) (Ware, 2004).

Moreover, the gestalt principle of similarity, for example in the stars, was used to make it easier for the users to distinguish between Yelp! API (2020) retrieved ratings for each specific venue and to assist the user in making a decision with regards to their next destination.

2.1 Restaurant

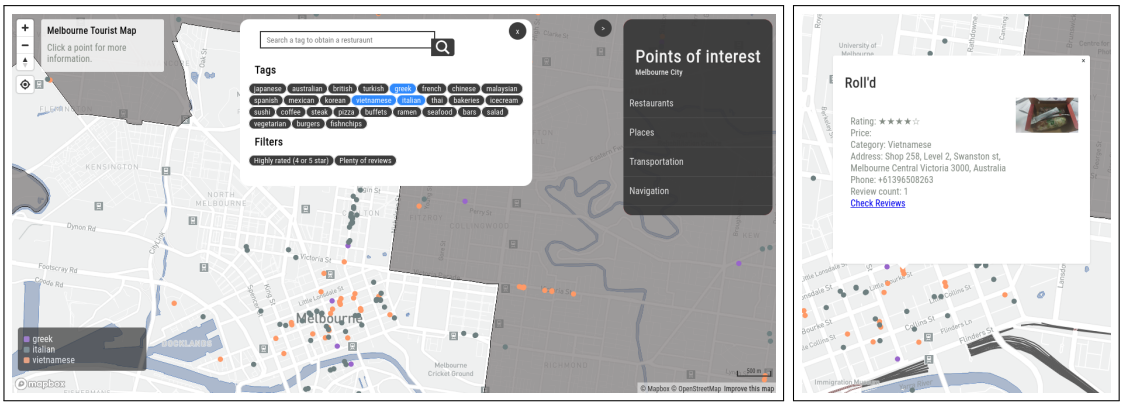

Figure 1: The functionality of the restaurants, highlighting three cuisine styles and their appearance on the map, alongside the contents of the pop-up box which is displayed when clicked.

By clicking on the Restaurants entry on the sidebar (see Figure 1), the user is presented with information about the restaurants. Functionality is built around using static Yelp fusion data to make live requests if the user clicks on a restaurant. By doing so, users are presented with information about the restaurants including their category, rating and any comments made by other customers. Secondly, we used tags, filters and a search box to guide the tourists to their targeted restaurants, then we provide clear directions aiding in easier decision making. Finally, we present our data in a familiar interaction style allowing the user to click on points and makers on the map, features commonly

found in other interfaces. This design choice allows users to be presented quickly with the most relevant information to make a decision.

There are three functionality elements that tourists can use:

Search by tag: We list more than 20 tags for the tourists, which once interacted with, displays the corresponding restaurants' detailed information and location on the map. Also, the user can see the nearby restaurants by clicking certain tags and relocating his or her position using the tool on the top-left of the map.

Filtering by rating and number of comments: The users can filter the restaurants by their ratings (such as 4 or more stars) and the number of comments. This allows a user to be shown popular restaurants and those favoured by reviewers.

Searching Keyword: If the user knows some keywords about a particular restaurant, they can use the search tool's input box which matches their input with the Yelp API (2020), and narrows down the available restaurants.

2.2 Places

Much like the restaurant functionality, we categorise the themes of places (City of Melbourne, 2020b) into several tags. When the user chooses a tag, those with the related theme will display in the map and be added to the legend in the bottom left area. Then, users can click the points which brings up information such as name, opening times and phone number.

2.3 Transportation

In transportation, we primarily focus on the city tram network (City of Melbourne, 2020a) as it's the main form of transport throughout the city centre. Tram and train layers are coloured red and black respectively, both with high contrast to distinguish them from the base-map. The user can click the tags in the transportation pop-up to load the city tram stops by suburb and on clicking the stop, they can check its name and ticket zone. The transportation layers only show when the user zooms in the map as to reduce data ink at times when the detail is unnecessary.

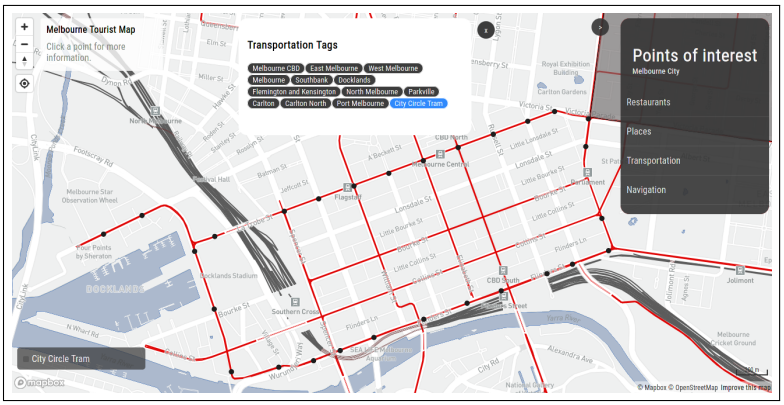

Figure 2: A representation of the transportation layers including the stops for the free tourist city circle tram.

2.4 Navigation

A box with dark grey will pop up at the bottom left when the user clicks the navigation button displaying navigation information. Then, the user can click any point at the map to set as the start and choose another point as the destination. This information relates to the walking directions and distances between the two points.

3 Pattern Summary

3.1 Density analysis

The greatest density of restaurants were located around the Melbourne city as supported by the heatmap in Figure 3. Subsequently, to confirm these findings, clustering was also implemented.

Figure 3: A heatmap of restaurants in inner Melbourne. Dark green highlights areas of great restaurant density, whereas the lighter areas indicate low restaurant density.

Three total layers were used, one layer to display the circular clusters, another layer to display the point counts upon those layers and finally a zoomed in, unclustered dot plot view which is colour coded based upon the rating of restaurants.

It reconfirmed the Melbourne city as the area of the highest density, indicating 1400 restaurants located within that area. Upon subsequent zoom levels, other clusters were detected near Windsor and near St Kilda West (alongside the clusters perceived within the city). Within the city, the greatest clustering was observed along Elizabeth Street in between Lonsdale and Bourke Streets. Additionally, another major cluster was observed at the intersection of Russell Street and Bourke Street. However, within each observed cluster, there did not appear to be many five star rated restaurants. As shown in Figure 4, 5 star restaurants are uncommon whereas low rated restaurants are much more frequent.

Figure 4: The lighter orange the dot is, the higher it is rated. Low rated restaurants are darker. Ratings are a continous measure from 0 to 5.

3.2 Interesting Patterns

Melbourne is one of the most livable cities in the world for the past 20 years, according to the Global Liveability Index offered by EIU. In this section of the report, we are going to use our developed tool in an attempt to discover

the hidden beauty and secret spots in Melbourne. And will present some interesting patterns and use cases to help tourists having a more enjoyable journey. The tool is structured around four key types of Points of Interest that we identified as the most relevant for Tourists: Restaurants, Places, Transportation and Navigation.

It's a matter of fact that humans can capture, relate and recall information way better and more comfortable using the visual/perception system than raw numbers or text assuming the data is adequately visualised. So, after developing and using our tourist guidance tool, the following patterns became apparent.

We will start by exploring the restaurants section: Melbourne is a "foodie heaven", it's a place where you can enjoy the best of all international cuisines in one place. Before digging into details, here are the top 5 cuisines, ordered by the number of available places in Melbourne city; Chinese, Japanese, and Italian Restaurants, Coffee shops, and Sushi Bars. If you are looking for a spot where you can literally find all options within a few walking steps, there is no better spot than the intersection of *Little Bourke St* with *Russell St* and *Lonsdale St*. In a broader sense, if you secured an accommodation within the "City Circle Tram" catchment area, you will be in the heart of the hottest foodie heaven.

We have noticed that there is a high level of correlation between the distribution of the following cuisines: Chinese, Japanese, Thai, Vietnamese & Korean. This correlation might be due to the following reasons. Firstly, there might be some similarities or overlap between what is offered in these cuisines, so for instance, the Chinese tourist may have a higher tendency to try the other Asian cuisines than the American or European. Secondly, the population distribution might be the root cause for such correlation.

Regarding the Transportation section, It is always more convenient to stay in a spot close to the public transport network, in order to move freely and with less cost. Our tool can help in planning a tourist day based on her/his preference for the places to visit and the preferred type of commuting. We will present some use cases to exploit the power of our tool.

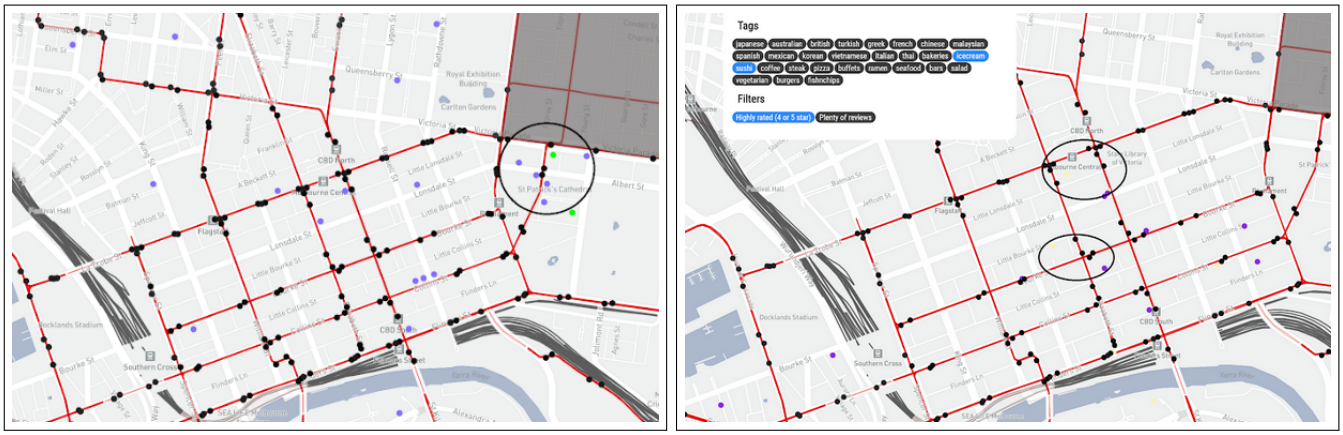

Figure 5: Two maps identifying the scenario results 1 (left) and 2 (right).

Scenario 1: Alex is a British, 73-years old, gentleman, he is suffering from some health issues, so he was wondering if there is any spot satisfies the following requirement(s); close to some health service point(s), close to the public transport network, and close to a place of worship. With the help of the tool we have successfully identified a spot that meets all the requirements, it's in East Melbourne the intersection of Albert St with Gisborne St.

Scenario 2: Jessica is a sushi and ice cream lover. She was wondering if there is any spot satisfies the following requirement(s); she is close to a highly rated sushi restaurant, close to a highly rated ice cream shop, and close to the public transport network. We set the appropriate filters in our tool, So we have successfully identified two spots that meet all the requirements. The first cluster is next to Melbourne central, and the second one is at the intersection of Elizabeth St with Bourke St.

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