Move Right - Technical Documentation

1 Context:

This document outlines the contextual, technical and front-end decision-making that informs the development of **Move Right** (hosted at: http://samcomber.co.uk/), an interactive geo-visualisation dashboard intended to project neighbourhood data to home-buyers in the metropolitan area of Liverpool. Move Right is an explorative device constructed using open data and dynamic maps to allows users to discover the most attractive locations to live relative to their personal preferences and financial opportunity. By simpling dragging the cursor over a neighbourhood demarcation, lower super output area (LSOA) boundaries can be explored in depth, providing a rich social observatory from which home-buyers, or other interested parties, can come to decisions regarding the attractiveness of a neighbourhood. An overview of Move Right is shown in Figure 1.

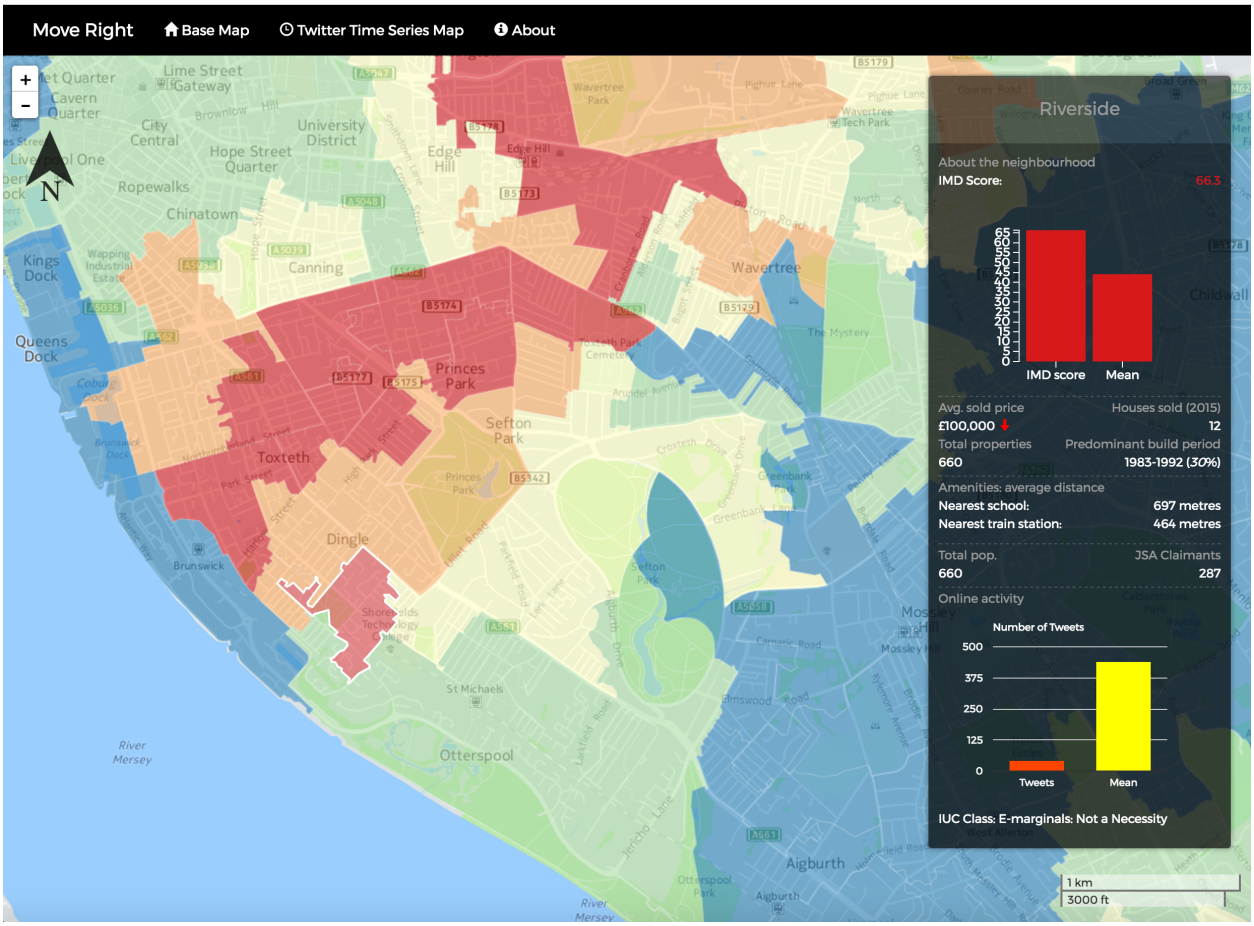

Figure 1: Baseline dashboard for Move Right.

2 Technical strategy:

As opposed to using the Carto Builder UI, we opt for the `carto.js` API to allow more flexibility to build advanced features into the dashboard. To begin with demonstrating IMD score, we use the `d3.js` library to

define a scalable vector graphic (SVG) to contain a per-LSOA comparison of the IMD score to the mean score across Liverpool[1]. In a sense, the `d3` plot removes the need for a legend because hex colours are used to colour the bars of the plot according to the break points of the quantiles defined in the Carto Builder editor (see below).

```
switch (true) {
    case d >= 61.1:
        var col = "#d7191c"
        break;
    case d >= 49.9:
        var col = "#fdae61";
        break;
    case d >= 34.9:
        var col = "#ffffbf";
        break;
    case d >= 20.5:
        var col = "#abdda4";
        break;
    case d >= 3:
        var col = "#2b83ba";
        break;
}

// after switch statement, assignment appropriate colour
document.getElementById("col").style.color = col;
```

Ultimately, the IMD dataset embodies the master dataframe to which we join our other sources of data (LSOA code becomes the primary key for join operations). In addition to showing IMD score, we compile LSOA-level data on the local housing market, distance-based measures to desirable local amenities, local population data, and finally online activity data from a multitude of open data sources. For example, we derive property market data from the CDRC archive of the annual median transaction value for all property types at the Land Registry and frequency of sales per year; and Valuation Office Agency (VOA) data for total homes and the most frequent property build period at LSOA geographies. Regarding our distance measures, we use the following PostGIS spatial queries to identify nearest amenities:[2]

```
-- distance to railway stations
SELECT   imd_2.cartodb_id,
         Round(Min(St_distance_sphere(imd_2.the_geom, railway.the_geom))::numeric, 0)
         AS railway_dist
FROM     imd_2,
         railway
GROUP BY imd_2.cartodb_id

-- distance to schools
SELECT c.cartodb_id,
       round(st_distance_sphere( c.the_geom,
       (
                SELECT   the_geom
                FROM     schools
```

[1]Originally, this generated a MIME type error which was reported to Carto's issues stream on Github (see: http://gis.stackexchange.com/questions/232159/mime-type-not-executable-error-in-cartodb).

[2]School and railway station shapefiles from the CDRC's Liverpool geodata pack are loaded into Carto to calculate nearest distances.

```
                ORDER BY the_geom <-> c.the_geom limit 1) )::numeric, 0) AS school_dist
FROM    imd_2 c
```

In our case, we use `ST_distance_sphere` to return the minimum distance between two geometries in metres. The output of these queries are left joined to the master dataframe to become usable in the Move Right dashboard.

To obtain local population data, we use CDRC 2013 mid-year total population estimates to extract the variable for total population per neighbourhood. Moreover, to approximate unemployment rates, we query the ONS's Nomis service for Jobseeker's Allowance claimants at LSOA-level. A comparison of total population and JSA claimants provides an indication of the labour market activity of the LSOA under the user's cursor - a higher proportion of JSA claimants to residential population is implicit of high unemployment rates.

Our final section, online activity, is intended to give the end user a sense of Liverpool's online activity. One might, for example, take Twitter usage and internet user classifications (IUC) as a proxy for community engagement and participation (Matthews, 2015). For the former, we use Carto's temporal mapping library extension, `Torque.js`, to generate a layercube format - a JSON representation of data with geospatial coordinates - for displaying the temporal activity of Tweets across a 24-hour period (shown in Figure 2). As for the IUCs, we derive LSOA-level geodemographic classifications of digital consumers from the CDRC ckan repository, before joining them to the master dataframe.

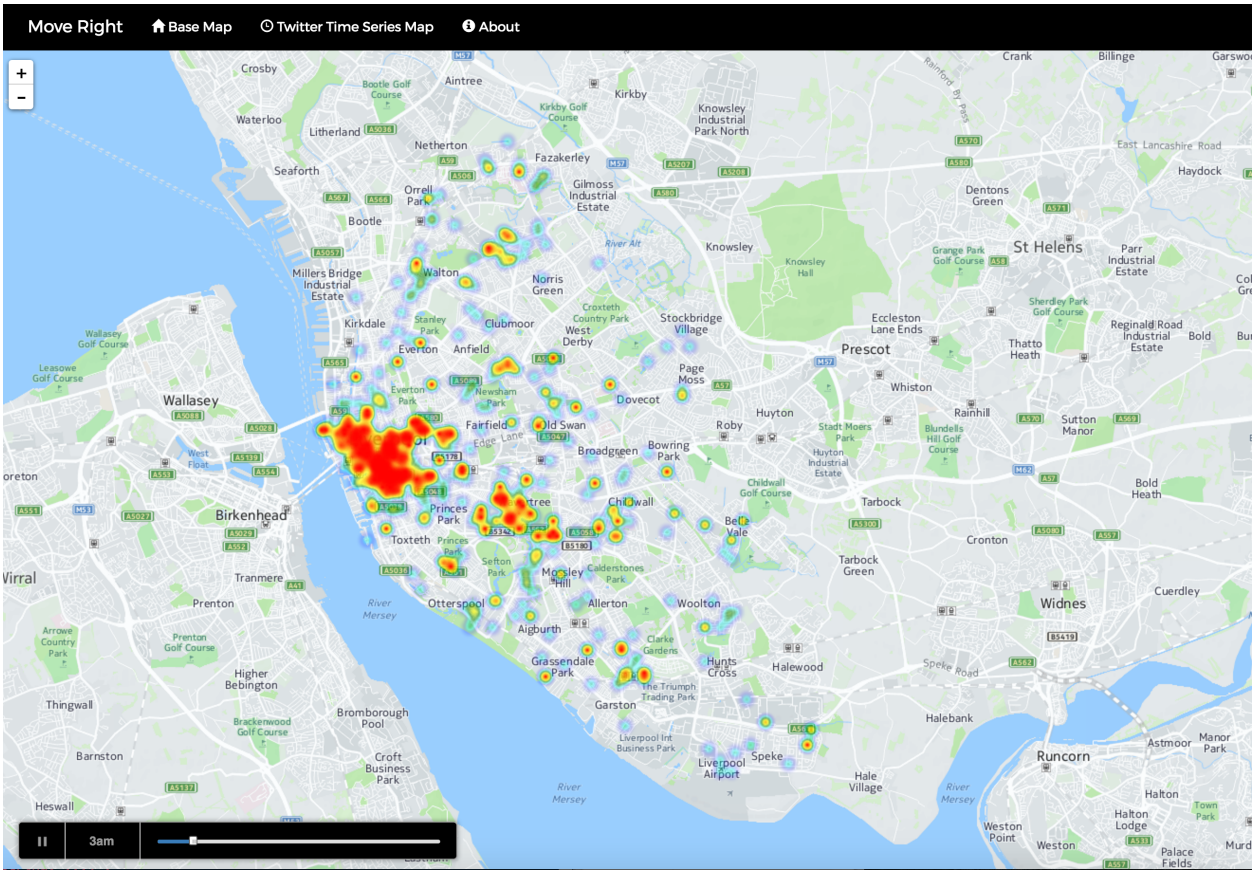

Figure 2: Twitter time series plot using Torque.js.

3 Front-end strategy:

Several stylistic factors contribute to the aesthetical properties of the dashboard. Firstly, we code the functionality to allow LSOA polygons to be highlighted on hover. This is achieved by creating a `featureOver` event that makes an AJAX call to the Carto SQL API for selecting the geometry of the polygon currently under the cursor. From here, we parse the data as GeoJSON and apply custom styling before adding the feature to the map. We then set the `currentHover` variable to the Carto ID of the polygon whilst the cursor remains inside that polygon to prevent additional AJAX calls. On `featureOut`, we clear layers to remove the custom styling.

Next, the `Bootstrap` library allows us to work within a responsive web framework that is suitable for mobile technologies. Moreover, `Bootstrap` provides glyphicons which we use to illustrate the price fluctuations between the median housing prices from 2014 to 2015. Here, we conditionally apply classes to the `<span id="updown">` tag in the DOM for each LSOA based on whether the previous median property sale price was higher than the current (see below).

```
// parse carto outputs to float
var t2014 = parseFloat("{{md_2014}}");
var t2015 = parseFloat("{{md_2015}}");

// if 2015 year of median sales is greater than 2014,
// set classname via javascript for up arrow, else down
if (t2015 > t2014) {
    document.getElementById("updown").className = "glyphicon glyphicon-arrow-up"
} else {
    document.getElementById("updown").className = "glyphicon glyphicon-arrow-down"
}
```

To access an attractive font-family, we specify an external script linking to the `Google Font` CDN to access the `Montserrat` font - we apply this to all HTML elements in the DOM. Next, as opposed to LSOA codes which are meaningless to the end user, we use the ONS best-fit lookup table between 2011 LSOA and 2015 electoral wards to project on hover place names. Finally, we apply auxiliary cartographic elements such as a north arrow - installed using the `l.control.rose` package via node package manager - for displaying cardinal directions and scale bar by extending leaflet's interactive control interface.

4 Discussion and conclusion:

From the **Move Right** dashboard, we can observe several interesting features. For housing values, we note the highest average sold price along the belt of LSOAs which runs from Grassendale Park to Childwall. Unsurprisingly, this belt is constituted of neighbourhoods with low IMD scores and a low number of JSA claimants as a proportion of the total population. Considering the metropolitan area of a whole, we observe a gradient of increasing housing values North to South up to the neighbourhood of Speke-Garston, which may reflect the disamenity of aviation activity surrounding John Lennon Airport, or the longer distance from the city centre. Regarding building age period, we observe the latest housing developments in the city centre. Around Albert Dock, for example, we observe 79% of housing as constructed between 2000-2009, which aligns with the council's regeneration narrative for Liverpool's docklands. For Twitter activity, we observe the spatio-temporal spread of tweets across 24 hours. We observe, for example, a distinctive cluster of activity along Smithdown Road, which presumably reflects the student population of the area and higher propensity of students to engage with social media.

In summation, **Move Right** seeks to illustrate neighbourhood data using an accessible interface for the end user. Yet, several improvements may be sought had Move Right been taken from a staging environment to a production server. For instance, to achieve a real-time streaming application, one might wish to set syncing

intervals in which the master dataframe is updated from its various data sources. This would significantly expand the shelf-time of the application beyond the next few years. Finally, one might seek finer granularity in the detail of the data currently visualised. For example, school and railway station names could be introduced into the output of the spatial queries, which could then be utilised to extract Ofted scores and available station facilities at the nearest local amenity.

5 Bibliography

- Matthews, P. (2015) Neighbourhood Belonging, Social Class and Social Media - Providing Ladders tot he Cloud. *Housing Studies*, Vol.30 (1), p.22-39.