PlaceCrafter: Curating Urban Functional Regions through Platial Clustering of OpenStreetMap Points of Interest

James Williams[1,*], and Gary Priestnall[2]

[1] Newman Interdisciplinary Research Centre, Birmingham Newman University, Birmingham, UK; JWilliams@Staff.Newman.ac.uk
[2] School of Geography, University of Nottingham, Nottingham, UK; Gary.Priestnall@Nottingham.ac.uk

* Author to whom correspondence should be addressed.
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The world is not just made of streets, buildings, and zones; it is shaped by how people engage and interact with places in their everyday lives. This manuscript presents a web-based geospatial tool that enables the mapping of these lived places and locales named PlaceCrafter. PlaceCrafter supports researchers in identifying platial regions: functional, human-centred areas that cross administrative and formal boundaries. The framework is built on OpenStreetMap, combining (near) real-time clustering, analysis, and statistical validation of these platial regions. PlaceCrafter is an initial demonstration for exploring the subjective experiences of place through existing datasets and city structures.

Contemporary urban analysis requires tools and analytical software that can not only capture the physical structure of the city, but also the dynamic and human-centred places that can emerge from everyday interactions. While these technologies, such as existing OpenStreetMap (OSM) [1] views and Geographic Information Systems (GIS) [2] are effective for spatial tasks, these abstractions fail to understand the notions of place when compared to space [3]. Recent work [4, 5] has sought to shift the focus towards platial information systems, tools which situate the human experience, subjective knowledge, and fuzzy representation as a comparison to existing spatial systems. These fuzzy, subjective, and personal representations attempt to model 'place' as a contrast to space.

PlaceCrafter responds to this challenge by integrating a spatial-platial [6] approach to identifying regions that are functionally cohesive, representing dense and meaningful concentrations of specific points of interest (POI). The POIs are traditional representations of space within GIS [3], such as cafes, museums, and places of worship. Rather than relying on the top-down designation of locations, PlaceCrafter supports researchers in curating clusters that represent how space is used as opposed to administratively divided. Aligning with recent calls in GIScience to shift from 'space' to 'place' in smart city analysis [7] and building on work which has operationalised the sense of place in urban contexts [8].

PlaceCrafter is designed not just to analyse space, but to make its platial structure visible, explorable, and comprehensible to analysts, researchers, and planners. While

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PlaceCrafter captures place through functional coherence of POIs, it does not yet capture temporal or subjective meanings that also shape lived experiences. Figure 1 presents the web-based application, developed in TypeScript using React, Vite, Leaflet, Turf.js, and D3.js. The software uses the Overpass API [9] to retrieve (near, depending on number of POIs loaded) real-time user-filtered POI data. The datasets are organised into categories based upon the existing OSM semantic structures [10]; these filters can be customised depending on the analytical task. This functionality supports the purpose of the framework, which is to enable researchers to understand city form and structure through a platial lens.

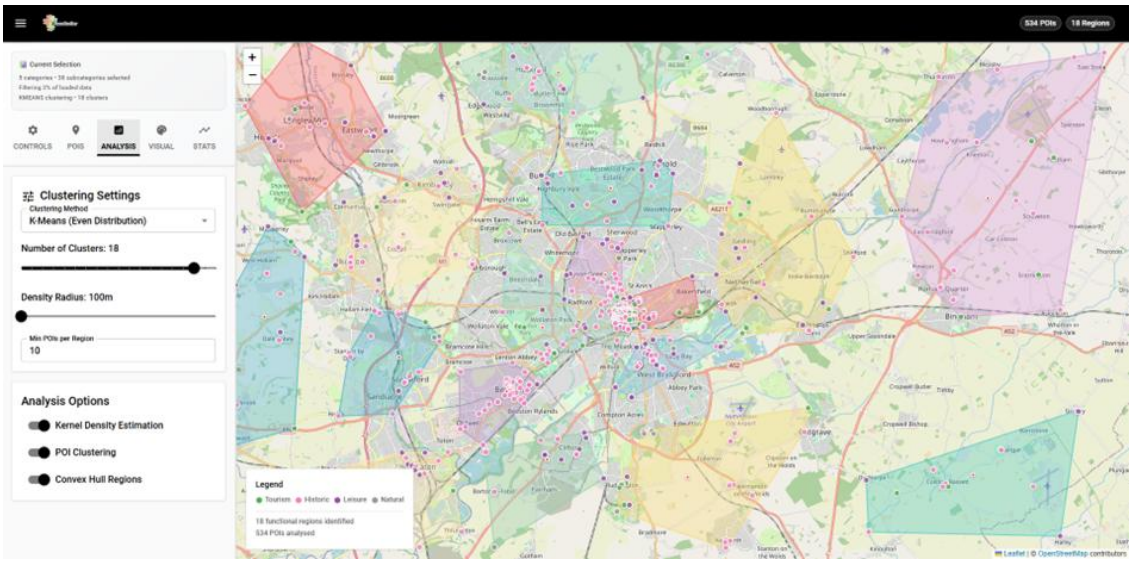

Figure 1. Screenshot of PlaceCrafter set around the Nottingham city centre, clustering places based on tourism, historical, leisure, and natural categories within the city.

PlaceCrafter is structured around four phases guided by the OSM filtering approach: the initial phase (1) focuses on filtering and selection of relevant OSM categories [10], building upon existing work, such as POI Pulse [11] which classifies regions using semantic signatures, and user behaviour to generate profiles of locations in the Los Angeles area and ClusterRadar [12] which supports comparative spatial clustering and parameter tuning through interactive visualisation to examine how clusters change temporally; the second phase (2) is where the fuzzy clustering approaches are applied interactively to the selected category grouping and includes user-selectable K-Means [13] for compact formations, DBSCAN [14] for spatial structures, and hierarchical clustering for multi-level structures. These methods are applied to the grouped and filtered POI data to reveal dynamic regions.

The penultimate phase (3) focuses on statistical validation, where each clustered region is evaluated using established spatial metrics. These evaluations include the nearest neighbour index to assess spatial clustering, silhouette scores [15] for understanding cluster coherence, and spatial autocorrelation is measured using a simplified Moran's I statistic for insights into category-based dependency [16]; The final phase is (4) visualisation, which explores the concept of platial readability, where each region is presented not just spatially but semantically, with data supported by POI type, diversity score, and density metrics. Additionally, the platial visualisation techniques used support the emerging approaches to conveying ambiguity, overlap, and functional gradients [3, 17]. The visualisation subsystem is modular for end-user requirements, supporting fuzzy spray can visualisation and region

influence grids, convex hulls, kernel density heatmaps, and region quality indicators.

Figure 1 presents a case study using PlaceCrafter to analyse Nottingham, United Kingdom and the surrounding areas. The POI filtering focused on tourism, historical, leisure, and natural categories. A total of 534 POIs were clustered into 18 functional regions using K-Means. There were 344 historical POIs and 111 leisure POIs as the largest categories from the filtering. The spatial pattern reflects the diverse landscape of Nottingham, with dense clusters in the city centre based around historical POIs, with suburban and rural areas having a more diffuse pattern of historic and leisure clustering. The statistical validation showed strong autocorrelation using Moran's I (0.68) and a high internal cohesion Silhouette score (0.83), confirming the utility of platial clustering in capturing real-world functional structures.

PlaceCrafter offers a powerful and emerging way to engage with spatial data, but its outputs are shaped by the characteristics of OSM. The crowd-sourced nature of this data means that those tied to commerce or tourism are more visible than the informal or everyday categories related to subjective personal experiences. However, previous research has shown that OSM data is generally reliable for urban-area analysis, despite some noise [18]. The clustering algorithms respond to spatial density and POI tag semantics, which do not explicitly capture human-perceived understandings of place boundaries, indicating a need for inclusion of social media data such as those used in POI Pulse [11] or the subjective experiences captured from linked walking narratives in WalkGIS [19].

The software and framework is being developed to be an open-source software which enables broader use, adaptation, and academic contributions in platial information systems. Planned expansions include supporting historical analysis to track the evolution of platial regions and their changes over time. We intend to further expand the platform to incorporate multi-comparative views of platial functional regions, enabling cities, timeframes, and thematic domains to be compared in real-time. We also intend to conduct a qualitative study investigating how users, analysts, and researchers interpret and engage with PlaceCrafter's outputs in practice. These improvements will help the validation of the tool's interpretability and role as a flexible analytical environment for platial analysis.

As cities continue to change, we hope to explore how PlaceCrafter can be used to understand engagement as increasingly layered and complex. Recognising that cities are more than their administrative boundaries, while valuing the role of spatial data, PlaceCrafter helps uncover the functional geography of place by clustering OSM POIs into meaningful regions that reflect how place is used, shared, and shaped through the spatial logic embedded in mapped data. The practical implications of this work include informing the design of walking routes or geo-narratives in more dynamic and context-sensitive ways.

The PlaceCrafter source code is available as open-source software on GitHub at https://github.com/jwilliamsresearch/PlaceCrafter. All point of interest data is sourced from OpenStreetMap (https://openstreetmap.org) and accessed via the Overpass API (https://overpass-api.de) under the Open Database License.

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