SPACE, TIME, PLACE, DURATION; THE EVALUATION OF DESIGNED URBAN LANDSCAPE THROUGH PUBLIC SOCIAL MEDIA ACTIVITY

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1 ABSTRACT

Advances in smartphone GPS and the increased use of location-based social media have enabled a shift in analytics from global to large-scale urban trends to the local instances and their immediate spatial context. This paper advances previous methods of using location-based social media to characterize urban space by extracting location based Twitter use within the London Olympic Park and Village Complex during periods surrounding the 2012 Olympic Games from July 21st until August 11th. The analytical scope of the survey encompasses a range of site specific textual, temporal and geo-location data generated from 63,897 instances of Twitter communication by 13,844 unique persons over the period in question. Specific areas of analysis addressed in the paper include geospatial densities, textual sentiment and temporal movement patterns associated with active and passive space, Olympic venue site context, pedestrian circulation and transportation routes, parkways and surrounding urban fabric.

The findings offer exemplary big data analysis methods grounded in current scholarly literature for GIS that correlate life cycle processes with intended use of a large scale designed landscapes. The findings also provide worthwhile methods relevant to landscape architects and landscape architecture education for evaluation of socially mediated urban space defined by place and mobility patterns associated with "momentary life-logging via Twitter."

1.1 Keywords

urban design, social media, geo-location, lexicographic analysis, sentiment analysis

2 INTRODUCTION

An essential part of any design process entails an understanding of the context within which one is working, particularly the social context. Eventually when proposals are made, these too, must be measured to determine their likely impact on the people who will use and live with them. The general objective of this paper is to support these accepted caveats, through a case study of methodologies for the extraction and analysis of intensive social media activity and user transient spatial location. There are many terms given to this type of data collection, for example; “data-mining”, “pervasive computing”, “semantic analysis of online crowd activity,” all of which describe techniques of gathering publicly available digital social interactions in order to form an interpretive narrative.

The majority of current research to date on this subject has been conducted in two key areas of related work: the use of new technologies and data sources for urban studies, and studies of social media to extract “real world” insights, or temporal dynamics. This work suggests that digital social interaction through Twitter often mirrors “real world” experiences and can be used to sense and track large physical events (Fujisaka, 2010). Methods for using data in this regard have been developed in the work of Sakaki et al, demonstrating how social networks can be used as sensors to detect natural disasters (Sakaki, 2010). For example, in “Earthquake Shakes Twitter Users: Real-time Event Detection by Social Sensors” the University of Tokyo data have indicated that when an earthquake occurs, people generate Twitter posts (tweets) relating to the earthquake, which enables a prompt detection of earthquake occurrence simply by observing the tweets (Sakaki, 2010).

As such, as general principles underlying our methodology we assume two principles: (1) each Twitter user can be regarded as a sensor and (2) each tweet can be associated with a time and location in latitude and longitude. As a corollary to these principles, the paper proposes that sensory information such as tweets can be utilized successively as ongoing narratives of specific locations and times within a larger context of the city. Moreover, we suggest that these narratives can then be analyzed for a much greater understanding of human relationship within the urban environment.

3 METHODOLOGY

3.1 Geo-location Analysis

Data was mined through a spatial extraction radius using a Twitter search API over the duration of the 2012 Olympic Games in London from 6:00 on 7/21 to 21:00 on 8/11. The spatial extraction radius was set for 2 kilometers from a center point at latitude 51.542291 and longitude -0.01604. The total number of tweets collected during the study was 688,137 with 63,897 or 9.28% containing latitude and longitude GPS coordinates. These geo-located tweets were then analyzed using ArcGIS and network graphing software, and then displayed to compare spatial trends of the 13,844 unique individuals. Tweets used in the study were from retrieved from mobile phones and are not always located based on the GPS tracking of the phone. The single locations within the Olympic Park with the most frequency of sampled tweets were the main stadium and surrounding venues, which were geocoded by Twitter based on the “@” symbol in the message text.

Figure 1 depicts the location of those places with greater than 500 geo-referenced tweets. For example if an individual writes “Eating some great fish and chips @Olympic Stadium” the message subsequently geo-codes at the center of the Olympic Stadium. While this greatly increases the total number of geo-located tweets relative to those without a spatial location, it decreases the overall accuracy. Tweets that do not rely on the “@” for their location are given a geo-location that reflects the GPS accuracy of their mobile device. The majority of mobile devices were deemed accurate to four decimal degree decimal points (ex. 0.0001) which corresponds to the proximity of 10 meters. Locations with greater than 500 tweets represent 22% of the total geo- located sample. The referenced locations are similar to those used within popular online searches and represent a key feature’s general location rather than the more detailed location in or around this feature.. Within our sample, the majority of these feature locations are associated with stadiums and larger regional names, while the remaining are found to be individual accounts.

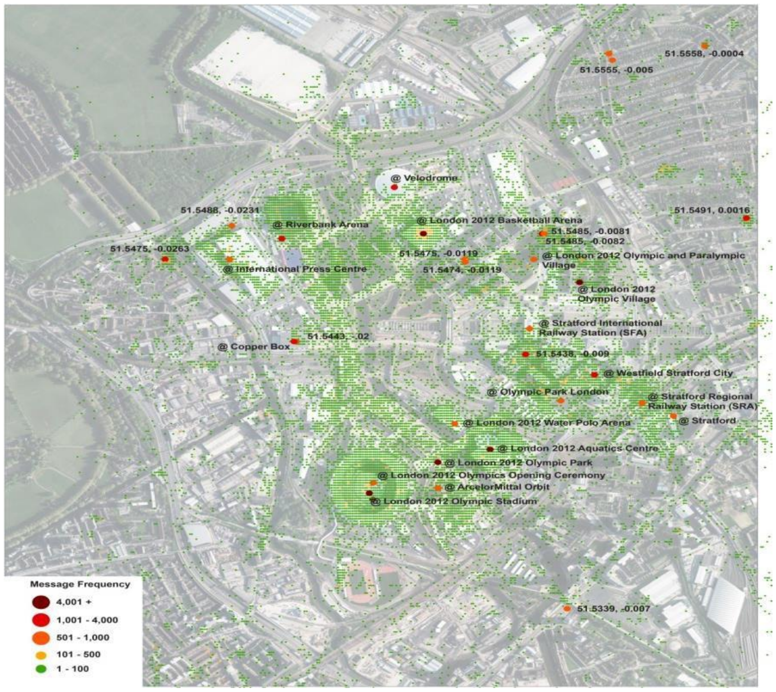

Figure 1. Olympic Venue with greater than 500 geo-referenced tweets

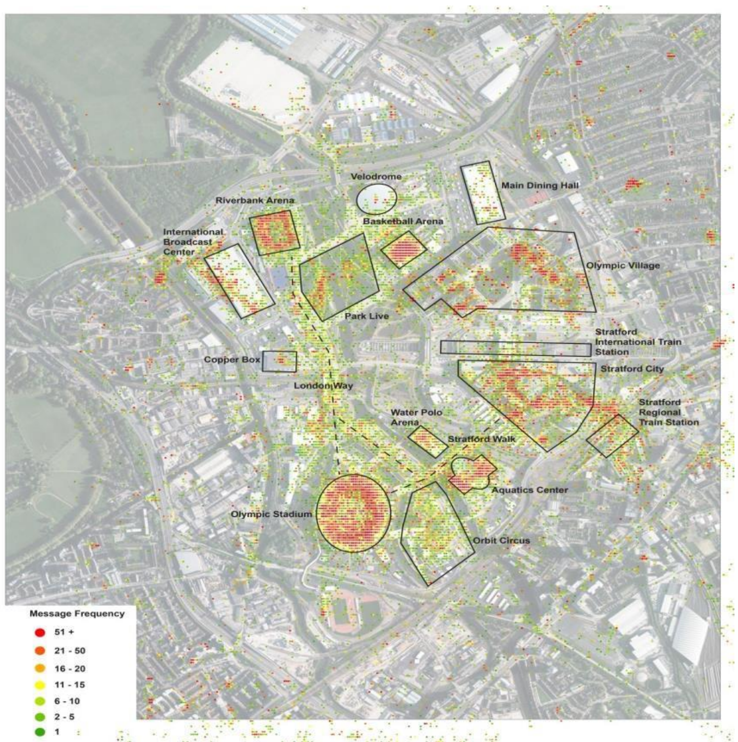

Figure 2. Olympic Venue with highest frequencies and most spatial regularity

While the primary use of this data is to reveal to the observer the location of individuals within the landscape, to successfully depict this information, a frequency count was performed to mitigate overlapping instances of Twitter use. Figure 2 above illustrates the highest frequencies with the most spatial regularity within the surveyed data.

3.2 Sentiment Analysis

Qiu et al. of the Division of Psychology, Nanyang Technological University, Singapore, demonstrated in their in-depth study: *You are what you tweet: Personality expression and perception on Twitter*, that personality traits are associated with linguistic cues in microblogs and can be accurately judged by unknown others. In particular, extraversion was found to be positively correlated with positive emotion words and social process words, agreeableness was found to be negatively correlated with negation words, and openness was found to be negatively correlated with second-person pronouns, assent words, and positive emotion words.

McCullough observes that “Language abounds with bodily metaphors that recall the experience of environment” (McCullough 2004). As such, if one considers digital social interaction related to an individual’s mental and subsequent physical environment, one can perform quality evaluations of their context based on their calculated sentiment and location. A subsequent analysis of keywords in the surveyed Twitter message text provided relative sentiment of each message (see Figure 3). Subsequent following maps below illustrate spatiotemporal data points at the Olympic Venue statistically weighted by the number of keywords, with a positive weight (+1) for each positively scored keyword (see Figure 4) and a negative weight (-1) for each negatively scored keyword (see Figure 5).

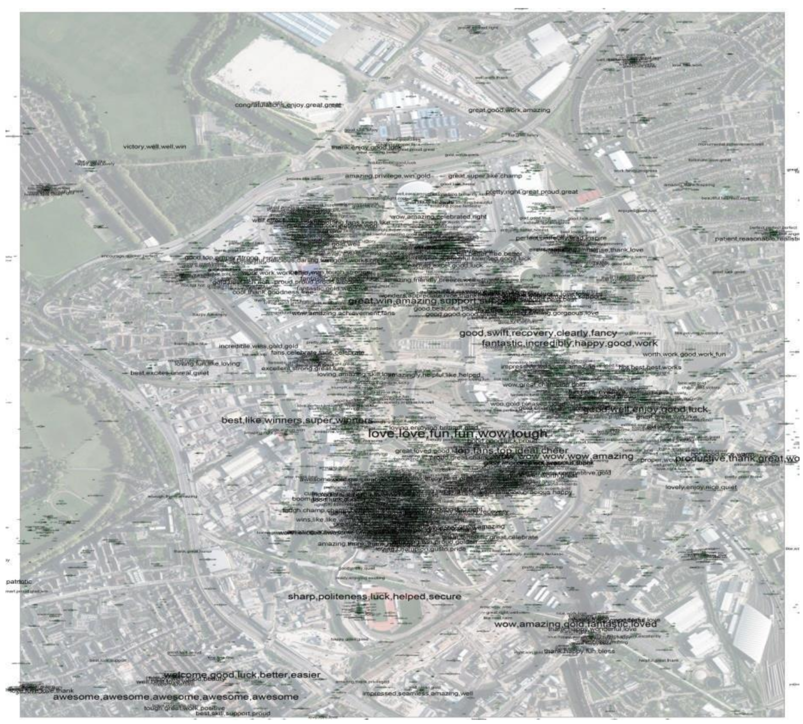

Figure 3. Olympic Venue statistically weighted by the number of keywords

While the graphics for negative and positive maps are similar, they feature unique characteristics bound to the individual locations. The node points are varied in size effectively representing the weight of the sentiment, with a stronger sentiment theoretically having a much larger social radius of influence. As these spheres of influence cross the color deepens and allows the observer to view the clustered sentiment. In the field of landscape architecture, this data can help better understand the unique social sentiment of a certain place at a certain time. (Please see Figure 8 for a word cloud illustration of these positive and negative relationships)

Sentiment analysis on keywords left 70% of the data set with a neutral sentiment (that included words in foreign languages) and these were not used in the above mapping examples (see Figures 5 and 6a). For the duration of the Olympic Games using the 30% of our sample that was weighted, sentiment was found to be 74% positive in nature which corresponds to about 22% of the total sample. In contrast, 26% was negative in nature which corresponds to only 8% of the total sample. For graphs illustrating these percentages see Figures 6b and 7 below.

Figure 4. Olympic Venue statistically weighted by the number of keywords, with a positive weight

Figure 5. Olympic Venue statistically weighted by the number of keywords, with a negative weight

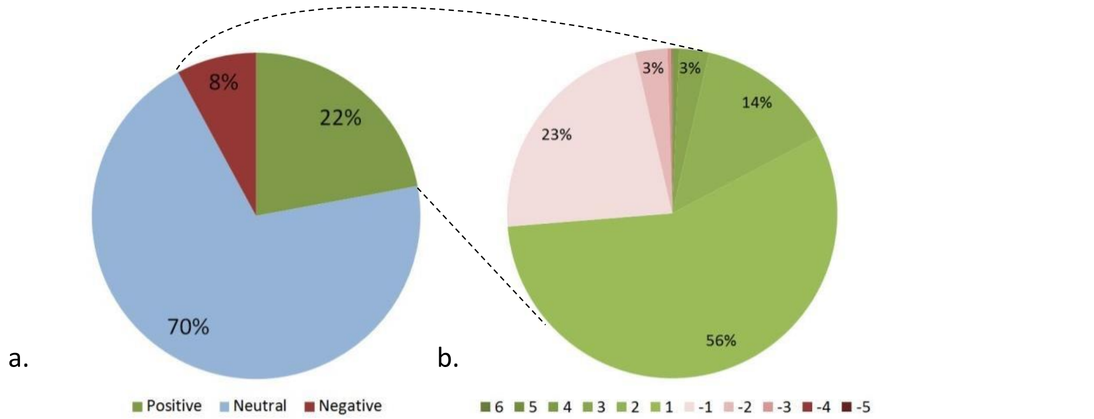

Figure 6. (a) Total sentiment classifications of Olympic Park from July 21st until August 11th, (b) Sentiment of tweets with some positive or negative classification within the Olympic Park from July 21st until August 11th

While sentiment analysis suggests that places within the Olympic park were significantly more positive, those places associated with positive sentiment also exhibited negative sentiment. And while we can assume that the venue activities contributed to the majority of positive and negative reactions to the sporting events, it is important that future work attempt qualitative study of how tweets, positive and negative, reference the context from which they are sent.

Figure 7. Sentiment 'Word Clouds' with a larger word size representing higher frequency use within our sample

3.3 Temporal Analysis

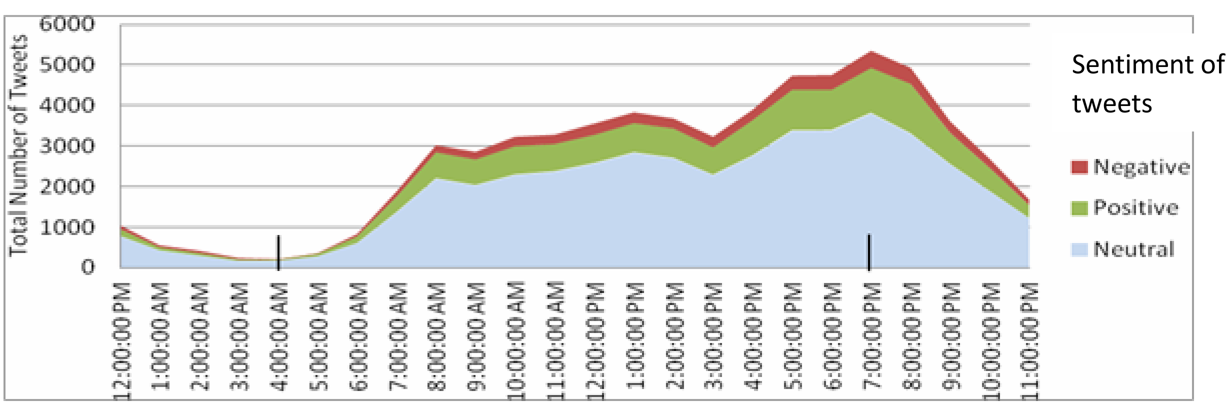

Figure 8. Cumulative georeferenced tweets for the sample duration of the 2012 Olympics depicted by hour and representing the diurnal pattern of the event

Recently, Golder and Macy (2011) have examined temporal variation related to Twitter posts reflecting mood, across different locations, and indicating diurnal (as well as seasonal) mood patterns consistent within many cultures. Naaman, Zhang, Brody, Lotan (2012) further elaborated diurnal urban routines using Twitter, focusing more on city-scale rather than time-zone and country. While Naaman et al concluded that when compared to overall online activity, low number of tweets from GPS-enabled mobile devices are too small and too biased for adequate data-sets, we successfully managed much smaller yet more accurate data sets consisting of only the tweets from GPS-enabled devices. For example, within the two week sample the study combined consecutive days with temporal patterns by hour. Figure 8 illustrates a sample 24 hour period indicating the diurnal pattern of the event.

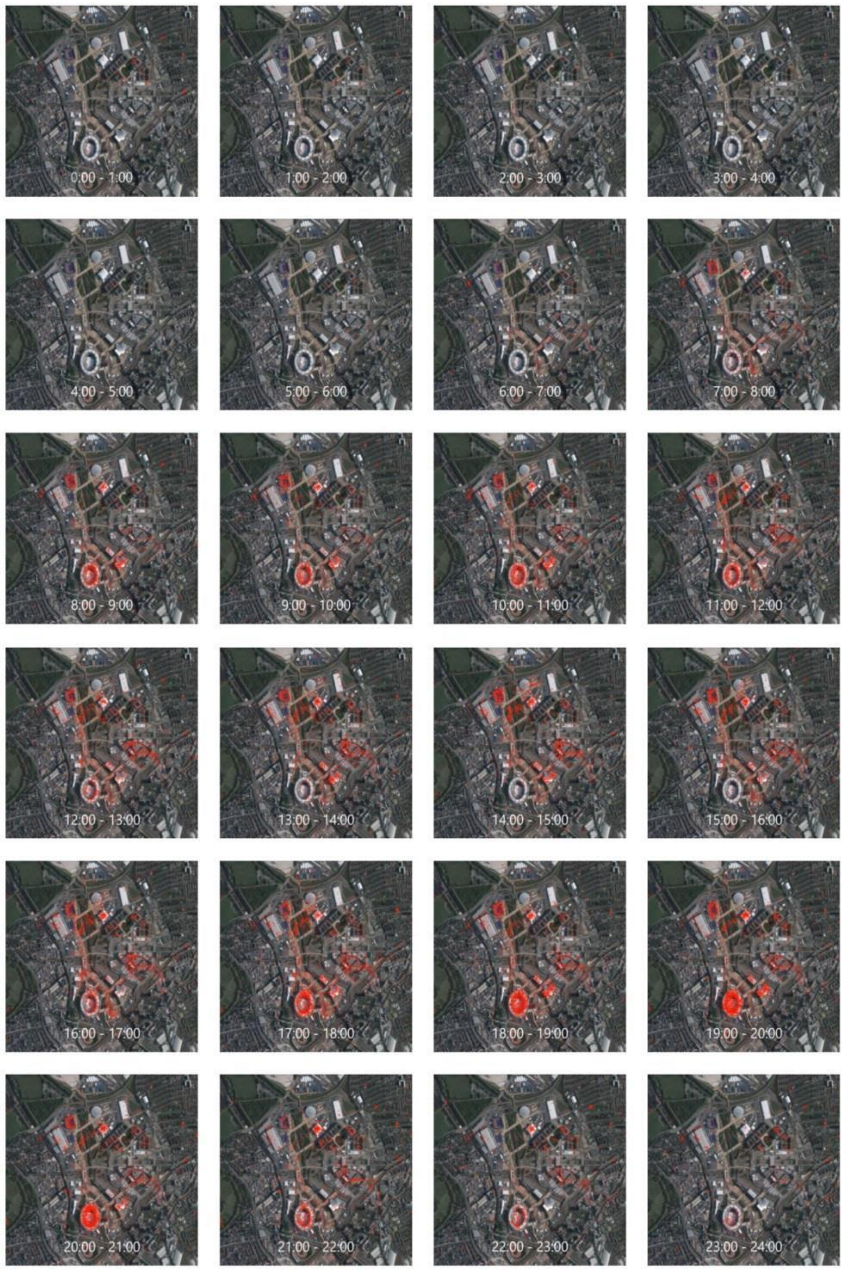

Figure 9. Cumulative georeferenced tweets for the sample duration of the 2012 Olympics depicted by hour

Figure 9 represents the spatial location of tweets during the Olympics by hour. The findings clearly show the entering and exiting of the Olympic stadium as it related to the morning and afternoon schedule with a break in the mid-day for lunch. The consistent use of Park Live and surrounding hardscape throughout the day also stood out.

4 DISCUSSION

The issue of using such data in a real planning situation raises several significant questions: 1) how to determine the extent of limited demographic information, data frequency, and the privacy concerns of Twitter users, 2) accessing and processing increasingly larger data, and 3) assuring a sample's diversity. In response, we believe that the three analysis techniques described above suggests that: 1) Big Data can become a robust tool, 2) Density can be coupled with temporal patterns to reveal dynamic sentiment monitored city wide offering detailed views of social trends.

For issues related to better informed decision making, characterizing urban areas is essential. Through the union of data and location as exemplified in this study, multiple layers of real-time information can be displayed geographically, providing enhanced situational contexts and the deciphering of evolving social narratives. Odendaal (2006) acknowledges this premise, suggesting a growing movement in urban planning to utilize city narratives in the process of understanding place. The paper suggests that public life within digital social networks can tell an exceptionally well documented story.

5 CONCLUSION

The paper points to a number of directions for future work. The advantages of data generated by social media networks in comparison to more traditional data sources such as government data, are found in the areas where the data is currently completely missing or where up-to-date human spatial patterns are an integral part of a project. The theoretical base from which landscape architects, urban planners, and architects operate and the ability to analyze big data within conventional GIS platforms will enable a position of oversight to those trained in computer science now attempting to make sense of urban social theory. The practical application for big data from social media outlets cannot be summarized at this stage in its development by a few keywords namely: public health, emergency response, community safety, resource planning; the true value of applied big data will increasingly reveal itself with more directed research into this new field of urban informatics.

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