An Investigation into the Potential of Bluetooth Beacons to Monitor the Movement of People on Public Transport: A Preliminary Case Study of the Norwich Bus Network.

Daniel Stockdale[1], Guy Lansley[1] and Ben Calnan[2]
[1]University College London, [2]Movement Strategies

Project Background

There are currently a limited number of methods to derive important movement data of passengers on most public transport systems, beside expensive roadside surveys. Without this data it is not possible to produce crucial origin destination matrices or dwell times for transport planners. Bluetooth Beacon technology offers a possible alternative to traditional methods due to technological development, increased user engagement as well as a unique, persistent and anonymous ID making it suitable for tracking movement. This paper assessed the potential that Bluetooth data has in providing passenger movement data at a higher spatial and temporal granularity and at a much lower cost than has previously been available.

Data and Methods

The data supplied for this paper was provided by a proximity advertising company that have installed Bluetooth beacons on buses in Norwich. As the primary purpose of the data is for providing hyper-contextual adverts and not for to estimate the movement of patrons across a public transport network, a significant amount of pre-processing is required on the raw data. This processing was essential to identify outliers and erroneous data.

The raw dataset contained 236,827 interactions between devices and Bluetooth beacons over a 358 day study period between December 2014 and November 2015. Post data processing, 708 unique journeys were observed from 220 distinct users over 91 buses.

Key Findings

The exploratory analysis yielded temporal movement patterns that are in line with results from relevant literature. Across the week Sunday has the lowest count of passengers presumably due to a reduced commuter flow, as well as shorter retail hours. Over a daily period, the Bluetooth data also highlighted the morning and afternoon rush hour peaks in the week with the peak number of trips taken later at the weekend.

Assigning the origin and destination of each journey to the nearest bus stop allowed the journey flows to be mapped spatially. Figure 1, highlights a polycentric pattern with the majority of the flows occurring to and from Norwich City Centre. A large proportion of the flows occur on the East side of the city and its surrounding suburbs. It was also possible to aggregate the bus stops to specific routes to estimate the strain on the bus networks. The combination of these results allows transport planners to improve the operational robustness of the location of buses, drivers and routes to meet future demand.

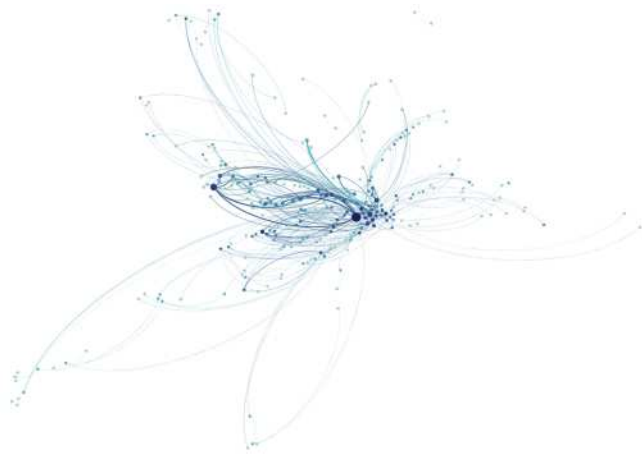

Figure 1. A network graph showing the origin and destination flows at bus stop level

Value of the Research

The lack of volume of data post-processing limited the insights that could be drawn on passenger movements specifically to Norwich. However, the results obtained from the beacon deployment highlight the potential that Bluetooth technology has to capture the movement of individuals in a network. The temporal patterns observed are promising and a sound methodology was developed to assign to bus stops and line colour. This means that data analysis can be carried out across larger public transport networks around the world to provide more meaningful insight to transport planners. Rolling this methodology out on larger networks would have the added advantage of using smart card systems as a ground truth value that would allow for further validation and the penetration rate to be established.