VELO-CITY 2019: INVESTIGATING THE SERVICE QUALITY OF CYCLE INFRASTRUCTURE USING BIG DATA

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Irene McAleese; See.Sense
See.Sense and AECOM have collaborated over recent years to see if the data collected from See.Sense bicycle lights can be used to generate useful information for use in the planning and maintenance of bicycle networks.
Challenge

Theme 1: Technology, Intelligent Transport Systems and Data Analytics

- Can bicycles become part of the connected world providing useful information for users and planners of networks?
- Is Cycling data any good?
- Is it useful data or is it just more data to fill the Data Lake

This presentation looks at how data collected from a “not so simple” bicycle light can be used to provide useful data that can improve cycling infrastructure in cities.
ABOUT SEE.SENSE

See.Sense technology can accurately detect where and how people are cycling, giving cities the data they need to transform their roads for cyclists. This data is gathered via our sensor and communication technology through:

BIKE SHARE INTEGRATION
Our technology can be embedded into existing bike share / scooter schemes.

INTELLIGENT BIKE LIGHTS
Our smart bike lights are used by 50,000 cyclists every day.

CONNECTED MOBILE APP
Our app allows all cyclists to share both qualitative and quantitative feedback on their journeys.
INTRODUCING
SEE.SENSE ACE

- Most popular bike light ever on Kickstarter
- Finalist Irish Design Awards
- Voted Best Bike Light by The Telegraph
- Contains patented See.Sense tech
ACE REACTS TO ITS ENVIRONMENT, IMPROVING VISIBILITY OF THE CYCLIST

ROAD JUNCTIONS

ROUNDABOUTS

FILTERING IN TRAFFIC

CAR HEADLIGHTS
ACE CONNECTS TO THE FREE SEE.SENSE APP

Use the app to control light settings.

Cyclists can OPT-IN to the See.Sense community to unlock additional features such as crash alert, theft alert, change settings and share aggregated ride insights with their city.

CRASH ALERT
THEFT ALERT
SETTINGS
SHARE RIDE INSIGHTS
RIDE INSIGHTS COLLECTED FROM ACE SHOW

- **MOVEMENT PATTERNS**
- **SPEED AND DWELL TIMES**
- **ROAD ROUGHNESS**
- **COLLISION AND NEAR-MISS EVENTS**
- **CYCLIST FEEDBACK**
- **PROFILE DATA**
HOW OUR RIDE INSIGHTS ARE UNIQUE

LOW COST / HIGH REACH
Our solution is low cost to deploy in bike share schemes, while our light and app are something cyclists want to use on a daily basis as they improve their safety and enhance their riding experience. This leads to lower PR costs to launch and sustained engagement over time.

HIGHLY ACCURATE DATA
Phone apps can take 5-10 readings / second. In contrast, our advanced sensor technology processes data at 800 times / second using edge processing and proprietary algorithms at speeds up to 16 million instructions / second.

MULTIPLE DATA TYPES
The accuracy we achieve means we can provide much deeper information beyond GPS including: road surface condition, collisions, near-miss events and acceleration / deceleration.

REPRESENTATIVE POPULATION
Data from both bike share integrations and our lights make our insights reflective of all types of cyclists. In particular, our lights are used by all rider types and account for the ‘interested in cycling but concerned’ group of cyclists that make up a large % of the population.

MADE IN UK
Our products are designed and manufactured in Northern Ireland (UK). This allows us to ensure high quality and control, and greater protection of IP. We use several factories across NI, so we can scale quickly to meet demand, producing thousands of devices per day.
HOW WE RECRUITED PARTICIPANTS

SEE.SENSE

Create collateral

Lights offered at discounted rate of €20 (RRP is £65)

Over 1,500 applications received

500 selected who met profiled criteria of commuter cyclists

Lights delivered to Smart Dublin & Docklands Authority and cyclists collect.

Onboarding using video on Youtube

Go live in October

Coverage received by media outlets
ENGAGEMENT OF PARTICIPANTS

1,500 cyclists apply
500 cyclists accepted
3 Months of data collection from Sep - Dec
2,027 annoyances recorded

SMART CITIES // MANCHESTER
MANCHESTER CITY TRIAL: THANK YOU!
Thank you once again for your participation in the See Sense Manchester City Trial, run in conjunction with BT and CityVerve.

MONTHLY NEWSLETTER
PUBLIC SHOWCASE
HACKATHON
PARTICIPANT WORKSHOP

6,862 Total number of journeys
33,942 Total distance covered (km)
SEE.SENSE DATA COVERAGE
Useful Data?

Some aspects of the data that AECOM thought worth looking at are available from a few sources:

- Routing
- Speeds
- Delays

While the quality of the above data would vary from product to product the real attraction of the See.Sense product to AECOM was the unique data from the accelerometer within the lights which provides:

- Vibration for road surface condition;
- and
- Collision and Near-Miss Events.
Quality of Service

The National Cycle Manual in Ireland uses Quality of Service ratings as a measure of the degree to which the 5 needs of a cyclists are met. The 5 needs are:

- Road Safety
- Coherence
- Directness
- Attractiveness
- Comfort

Quality of Service rating:

<table>
<thead>
<tr>
<th>Level</th>
<th>Poor</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>A+</td>
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</table>


Why is it important?

Confident Cyclist

Utility/Vulnerable Cyclists
Why is it important?

Eastbound from Rathmines Road to Baggot Street, off peak.
Why is it important?

Volume split of cycle routes between 8-10am

Gender split of each route

Research by Eoin O'Mahony and Matthew Richardson (AECOM/TCD)
Why is it important?

User-type profile for each route

<table>
<thead>
<tr>
<th>Type</th>
<th>Lane (n=1,070)</th>
<th>Track (n=1,505)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sports</td>
<td>76</td>
<td>37</td>
</tr>
<tr>
<td>Commuter</td>
<td>585</td>
<td>685</td>
</tr>
<tr>
<td>Utility</td>
<td>396</td>
<td>756</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>13</td>
<td>27</td>
</tr>
</tbody>
</table>
Quality of Service

The QoS is measured through the following 5 characteristics of infrastructure which can be related back to the 5 Needs of Cyclists:

- Pavement Condition
- Number of adjacent Cyclists
- Number of conflicts per 100m of Routes
- Journey Time Delay
- HGV Influence
QoS Parameters
Pavement Condition

<table>
<thead>
<tr>
<th>Poor</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe undulations, very poor ride quality, cyclists experiences jolts, due to concrete aprons and/or very poorly maintained surface.</td>
<td>High quality, well maintained surface. No manholes, gullies or other iron works</td>
</tr>
</tbody>
</table>

Can the accelerometer be used to provide reliable data to classify road surfaces condition?
QoS Parameters
Number of Adjacent Cyclists

<table>
<thead>
<tr>
<th>Rating</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>A+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>&lt;1.5m</td>
<td>1.5 to 1.8m</td>
<td>1.8 to 2.0m</td>
<td>2 to 2.5m</td>
<td>&gt;2.5m</td>
</tr>
</tbody>
</table>

Mixed traffic without appropriate traffic regime and heavy traffic

Facility with sufficient width to allow side by side cycling and overtaking
# QoS Parameters

## Number of Conflicts

<table>
<thead>
<tr>
<th>Rating</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>A+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conflicts (per 100m)</td>
<td>&gt;10</td>
<td>4-10</td>
<td>2-3</td>
<td>&lt;1</td>
<td></td>
</tr>
</tbody>
</table>
### QoS Parameters

#### Junction Delays

<table>
<thead>
<tr>
<th>Poor</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclists stopped at regular intervals with significant wait times</td>
<td>Cyclist experience little or no delays at junctions, crossings etc.</td>
</tr>
</tbody>
</table>

Can the location data be used to estimate delays at junctions along a route so as junction delay can be estimated?
### QoS Parameters

**HGV Influence**

<table>
<thead>
<tr>
<th>Rating</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>A+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>&gt;10%</td>
<td>6 to 10%</td>
<td>2 to 5%</td>
<td>0 to 1%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

**Poor**

- Poor-quality road conditions

**Good**

- Good-quality road conditions

- Wide lanes

- Smooth traffic flow
Therefore See.Sense bicycle light might be able to provide information on the more challenging, and time consuming, aspects of assessing the QoS for an urban area.

AECOM used available information for Dublin, gathered as part of the Smart Dublin programme to look at the following areas:

- Pavement Condition
- Journey Time Delay
GRAND CANAL QUAY
GRAND CANAL QUAY
Journey Time Delay
Outbound (NS-EW) - All Routes
Summarised Points - Average Speed

- 0 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 50
JUNCTION ANALYSIS

10 Metre Buffer Applied Around Stop Lines
JUNCTION ANALYSIS (Inbound)

Speed Profile at Junctions

Average Speed (km/h)

- Trimmelstown Av
- Strand Rd
- Nutley Ln
- Sandymount Av
- Ballsbridge Park
- Herbert Park
- Landsdowne Rd
- Canal
JUNCTION ANALYSIS

Delay at Junctions (% results with speed <5kph)

<table>
<thead>
<tr>
<th>Junction</th>
<th>Delay (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimelstown Av</td>
<td>68%</td>
</tr>
<tr>
<td>Strand Rd</td>
<td>23%</td>
</tr>
<tr>
<td>Nutley Ln</td>
<td>45%</td>
</tr>
<tr>
<td>Sandymount Av</td>
<td>68%</td>
</tr>
<tr>
<td>Ballsbridge Park</td>
<td>90%</td>
</tr>
<tr>
<td>Herbert Park</td>
<td>90%</td>
</tr>
<tr>
<td>Landsdowne Rd</td>
<td>68%</td>
</tr>
<tr>
<td>Canal</td>
<td>90%</td>
</tr>
</tbody>
</table>
JUNCTION ANALYSIS

Inbound – Average Speed Throughout the Day
Journey Time Delay

Towards City Centre – AM PEAK Hour (KM)

Cyclist - Average Speed KPH
Car - Average Speed KPH

Away From City Centre – PM PEAK Hour (KM)

Cyclist - Average Speed KPH
Car - Average Speed KPH
Routing
Routing
Routing
Routing
Conclusion

Data recorded by the See.Sense bicycle lights can be used to get a better understanding of a cities cycle network in terms of:

- Pavement Condition;
- Junction Delay; and
- Desire Lines.

While not looked at in detail for this paper there is also good quantitative and qualitative information in regard to Conflicts.

The data provided by the lights is a useful tool for planners to develop cycle networks and also identify maintenance priorities. However its usefulness and accuracy will be dependent on the number of lights in use and the demographic of the users.
CYCLISTS CAN OPTIONALLY CREATE PROFILE INFORMATION

Our project participants have a facility in the app to provide information on their profile, allowing data to be disaggregated by:

- Age
- Gender
- Cycling Experience level
- Type of bike
Our partnership aims to help British Cycling’s work to:

- Promote active travel
- Improve cycling infrastructure
- Better advocate for funding based on concrete data
- Transform Britain into a cycling nation

“The more insight we gain on where people ride within our towns and cities the more help we can provide to build safer places to ride bikes. What the See.Sense team are doing is truly amazing.”

Martin Merryweather - Head of Strategy, British Cycling