



Road Condition Surveys Using Artificial Intelligence

Enfield Lane Rental Industry Publication



TRANSPORT
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Introduction

The London Borough of Enfield (LBE) covers an area of 31.7 square miles, comprising of 585km of road with varying classification.

The Highways Act 1980 places a duty on the Highway Authority to maintain the road network, which is achieved through highways maintenance programmes and determined through road condition surveys (RCSs).

Historically, these have been undertaken by officers, who walk every road to determine the overall surface condition, identifying any defects. This process is labour intensive, has an associated risk to staff (particularly near those with high-speeds) and can lead to variances associated to interpretation.

To improve the consistency, accuracy and safety of RCSs, the LBE proposed a trial of an alternative survey technique from Vaisala which uses artificial intelligence (AI) to provide a condition rating without any human intervention.

Already trialled within the rural setting of North Yorkshire, the Vaisala system analysed nearly 5,000km of road and was found to be 93% accurate when matched with human identified defects. This trial set out to determine if a similar accuracy could be achieved in the urban environment of London.

The Trial

Over a 12 month duration, the mobile data collection system used a simple application on a smart device, mounted on a vehicle windscreen. High-definition video was then collected from the vehicle while travelling on the road network, automatically transferring the data to the cloud. Analysis was carried out using artificial intelligence, which identified, road condition, line markings and assets, gaining intelligence over time through machine learning.

Road Condition	Line Markings	Assets
Cracking	Condition	Guard rail
Potholes	Average (all)	Road Signs
Edge defects	Centre average	
Fretting	Width	
Bleeding		
Settlement/subsidence		
Sealing/Patching		
High friction surfacing		

The data was then viewed later through a colour coded mapping user interface and condition verified by an officer to determine accuracy.





Study

Three roads were chosen for comparison between AI and UKPMS, Bullsmoor Lane, Bycullah Road and High Street, in Southgate. These roads provided a complete representation of the urban street environment where vehicles were parked on both sides of the road. Approximately 3km in total length, all had areas of carriageway showing signs of deterioration during the selection process for comparison.

Both the UKMPS compliant survey and AI data were collected within the same week in early November 2020 in order to enable a close comparable inspection data.

The gathered data was then compared by Metis Consultants with a full report being issued of the findings.

Outcomes

The savings in time and cost were considerable, with RCS carried out through AI, four times faster than conventional methods, due to vehicle driving speeds (mostly 20mph), allowing for greater lengths of carriageway to be surveyed.

An unexpected outcome was the flexibility for undertaking RCSs given the changes to working hours since the pandemic, while still enabling other areas of the authority the ability to obtain the latest data. This was in addition to the improvement in health and safety risks associated to walking the routes.

It was found that to enable the whole borough to be inspected, while still allowing downtime for inspectors, the devices were attached to the borough refuse vehicles that travel every road during an eight-week cycle. This meant RCSs were far less onerous on officer time and due to the nature of the refuse vehicles, the camera was located much closer to the road when filming, giving a sharper image.



Lessons Learnt

Several learnings were identified during the project;

- Condition data could be used to develop maintenance plans/ immediate works.
- Signage data not only recorded the position of the sign, but also its relevant diagram number, reducing officer time.
- Missing or damaged signs could be easily identified, with increased speed of orders being placed
- Camera must be mounted correctly to avoid reflection from the dashboard to ensure video quality. This is in addition to clement weather to identify defects as accurately as possible.
- Vaisala uses high quality continuous video footage with hundreds of gigabytes transferred. A stable Wi-Fi connection is required for the efficient download.

Industry feedback: Use of AI surveying tools

London Highways Engineering Group (LoHEG) are in favour of using AI as a tool for undertaking road condition surveys because it is relatively inexpensive and can provide objective results when compared to conventional detailed visual inspection (DVI) surveys. However, it is noted the accuracy can be affected by weather and lighting conditions so caution should be taken when reviewing the results. Additional AI surveys may be required to be conducted if weather conditions were not suitable on the day, which would be more cost-effective compared with a physical re-inspection by highway inspectors if DVI's are found to be inaccurate.

It is also understood the Department for Transport is building a universal data comparison model to accommodate all kinds of available and developing technologies including DVI, course visual inspections (CVI), UKPMS and AI data, and the model will undergo testing later in 2022 and will become the standard later in 2023.

Other suppliers of AI road condition survey technology are detailed on the following three pages:



VAISALA

AI System Comparison (1/3)

- The Vaisala system uses continuous video footage and AI software to establish the visual condition assessment.
- Limited human intervention
- Requires clement weather and visibility conditions to increase feature detection



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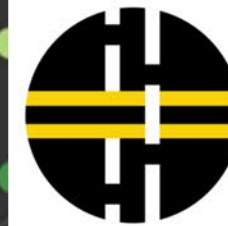
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AI System Comparison (2/3)

- The Gaist system uses high-definition data capture surveys and connected vehicle technology to carry out condition assessment, providing complete roads scape coverage
- Highly skilled personnel at Gaist analyse footage, rather than using AI to automatically carry this out
- Also requires clement weather and visibility conditions to increase feature detection



RoadBotics
by **Michelin**

AI System Comparison (3/3)

- The Roadbotics system uses high quality imagery every 3 metres of carriageway to identify and assess defects, enabling them to form a visual condition survey.
- It is understood that Roadbotics AI is not compatible with UKPMS survey results at present as the software is more suitable for US roads
- Again, requires clement weather and visibility conditions to increase feature detection

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Conclusion/ Recommendation

AI was found to have the potential of becoming a valuable tool for asset management within an urban environment, as it provided the ability for objective analysis and offered information not previously reported via officer, public or councillor enquiries. However, for maximum benefit to be achieved, the technology requires clement weather conditions.

Comparable to that of conventional methods, data is available within 24 hours of collection, reducing cost and improving efficiency. The study has provided LBE with the evidence needed for future integration of AI into highway asset management processes, based on real-time information and ability for verification of video imagery. This will ensure that the available budgets are spent where they are needed the most.

TfL Lane Rental Scheme

Optimising customer journeys through the delivery of safer, innovative and sustainable roadworks



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