



SOLO: Unmanned Sewer Inspection Robot

Thames Water Lane Rental Scheme Industry Publication

Introduction

A large number of surveys are carried out on London's extensive sewer network every year in order to evaluate its condition. These include cleaning surveys, blockage hotspot surveys and high-risk asset surveys.

All activities that take place on the highway have the potential to cause congestion on the road network. It is therefore essential that utilities look to work in ways which minimise highway occupation and reduce the impact, particularly with planned work.

Current CCTV systems use a remote controlled camera mounted to a wheeled or tracked platform, with a tether to relay the data back to the deployment vehicle in which the operator is based for analysis. This often requires the base vehicle to be parked in the highway for the duration of the survey and traffic management to be put in place. Typically, these systems survey an average distance of 300m per day.





The Trial

The project trialled an autonomous sewer inspection robot that is manufactured by Red Zone Robotics, US, to establish if a greater distance could be surveyed in a single day, while minimising disruption on the network. The system, commonly referred to as SOLO, differs from conventional systems used as the robots autonomously survey to the next manhole and then return to the deployment manhole, thus removing the necessity to park a vehicle at the location for the duration of the survey. Up to four robots can be deployed simultaneously, potentially surveying up to 1000m, with the data stored on the robot itself and subsequently analysed off-site. The SOLO system has the following features: operates in sewers 200- 300mm in diameter, lightweight (11kg), on-board intelligence for autonomous operation, 360-degree spherical video capture, GPS co-ordinate capture of manhole locations, rubber track drive system, automatic transfer of data

Ten localities were selected to ensure a complete representation of London, six in the north and four in the south. Each site survey was designed to be carried out on one day, with pre-site survey maps produced detailing the location, sewer length between manholes and alternative locations should access not be available at the chosen deployment site.

The site surveys were executed by certified engineers and a representative from the US manufacturer of the technology, Red Zone Robotics, who was responsible for the analytical and coding work. The following storyboard outlines the survey process and the subsequent table provides an indication of typical timings for each element of the survey:

It is worth noting that in certain circumstances explosive gases can be produced due to the decomposition of organic material sometimes found in sewer systems. For the trial the robots were filled with nitrogen to reduce the risk of ignition and the manholes assessed for elevated concentrations of hydrogen sulphide before the robots were deployed.

Results

The average distance travelled per day during the trial was 983 metres, which was marginally short of the 1000 meter target. There were some issues encountered with the surveys that impacted on the ability to cover increased distances. These included seized, buried, heavyweight or obstructed manhole covers, downtime to service robots, together with heavy traffic encountered on route to survey localities.

There were also some aborted deployments due to debris/grease, encrustation, tree root penetration, or defective pipework (e.g. holes/voids or displaced joints).

Activity Type	Duration
Identify Manhole and assess accessibility arrangements	10 mins
Set-up traffic management (TM); open manhole cover; deploy robot; replace cover and remove TM	5-10 mins
Launch and retrieve robot - unhindered	25-35 mins
Launch and retrieve robot – encountering obstructions (debris); or inability to locate the downstream manhole	45-60 mins



Conclusion/Recommendations

The SOLO robots do not currently have UK certification to ensure they are intrinsically safe and suitable for use in conditions where explosive gases may be present. It is therefore recommended that UK certification or a safe system of working is developed to mitigate the dangers posed by explosive gases.

There are a number of improvements based on the findings of the trial to increase productivity, including, night time working, specifically equipped vehicles and additional resource to name but a few. The SOLO system can currently only be used in 200mm-300mm diameter pipes. A smaller version to survey pipes between 100mm and 200mm would increase the benefits that can be realised from this technology.

As a feasibility project the SOLO robot CCTV system would significantly improve the UKs conventional sewer survey techniques as it has shown to be successful in surveying three times the expected distance of conventional CCTV systems, it is less disruptive to road users, and is likely to reduce the risk to operators due to the shorter duration of road space occupation. Before the system can be used as a business-as-usual tool there are a few issues that need to be resolved regarding the intrinsically safe certification of the product, and to ensure that contractors are willing to provide this as a commercial service in the UK.

TfL Lane Rental Scheme

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