Tracking de-sludging vehicles through axle load sensor

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Summary (100 words)
Tamil Nadu is a rapidly urbanising state that has been establishing and scaling up sustainable FSSM, leading the way in innovating technologies and operating models in sanitation. Safe collection, handling, and transport of fecal sludge (FS) is an integral part of a septage management programme. This paper documents the use of load axle sensors with GPS technology in the de-sludging vehicle to understand the movement of the vehicle, de-sludging and disposal locations, travel distance and time, and the time for de-sludging and decanting. These learnings help determine the location of current disposal, service area, and planning of decanting facilities.

Introduction, Methods, Results and Discussions (900 words)

Introduction
De-sludging vehicles collect and transport septage to the designated decanting facilities, eliminating the need for manual emptying and reducing the risk of human contact with fecal sludge (FS). As per the Operative Guidelines for Septage Management issued by the Government of Tamil Nadu, the vehicle owner must install a GPS device to monitor the de-sludging and decanting activities. However, GPS could only track the movement of the vehicle and not locate de-sludging locations and whether operators were safely decanting the FS at the designated spot. This study primarily intended to identify the possibilities of monitoring the de-sludging vehicles using a load sensor with GPS technology.

Methods
There are two types of axle load sensors available in the commercial market: position sensors for leaf spring suspension vehicles and pressure sensors for air suspension vehicles. The position sensor measures the distance between the vehicle frame and axle, whereas the pressure sensor measures the pressure of the compressed air in the suspension circuit.

The stuffy preferred the position axle load sensor to monitor the selected de-sludging vehicle with leaf spring suspension due toits cost-effectiveness and lower accuracy range requirement.

A position axle load sensor with GPS connected to an IoT device was installed in a de-sludging vehicle providing services in an urban area of Tamil Nadu. The operator used the three designated decanting facilities located in the service area of the vehicle for decanting purposes. During the de-sludging and decanting of the FS, the sensor captured the axle load weight data, corresponding to the movement of the spring attached to the body of the vehicle. Server software processes and analyses the received data to generate analytical reports for a selected period of time. Thus, the quantity of FS loaded/ unloaded, duration, latitude, and longitude were recorded, and the corresponding locations were identified as the de-sludging/decanting points. From April 2022 until now, these outputs have been remotely monitored using the mobile software or the customised web application. The capital cost, including the installation of the devices in the vehicle, was around USD 740.

Results and Discussions

De-sludging locations: Once the FS was loaded on the vehicle, it was possible to detect the downward movement of the spring attached to the body of the vehicle. The software then reflected the location data (geo-coordinates) and the corresponding rise in the vehicle load. Therefore, the exact locations of the containment were captured. From a sample data of two months from the date of installation, 175 de-sludging locations were captured.

Decanting locations: The vehicle operator decanted the FS at the three designated decanting facilities in 108 trips out of the 175. One decanting station was visited frequently, as most trips were made to neighbourhoods around the station. The remaining trips were to nearby rural areas outside the urban limits.

Travel distance and travel time: Analysis showed that the average travel time between the de-sludging and decanting locations was 25 minutes. For rural areas, the average distance between the de-sludging and decanting location was 3.42 km, it increased to 7.85 km in the urban limit.

De-sludging and decanting time: A sample data set was taken to identify the time taken for de-sludging the FS from the containment into the vehicle and decanting the same into the decanting facility. The respective time was identified from the graphical representation and the average time for de-sludging, and decanting were around 11 minutes and 5 minutes, respectively.

Challenges

The major challenges of scaling this system are the higher cost, the lower acceptance of de-sludging operators for installation, and the possibility of device tampering.

Conclusion and implications (100 words)

This study intended to identify the possibilities of monitoring the movement as well as the de-sludging and decanting activities (loads, time and distance) of vehicles using axle load sensors. The monitoring helps identify the service area of the vehicle, current disposal locations and planning additional decanting facilities.

Field teams are working on upgrading the system with an ultrasonic load sensor for more accuracy at an affordable cost. Also, the option of incorporating the sensor output with the FSSM application to plan schedule de-sludging, auto deduction of decanting fee and real-time plant utilisation rate, etc., are under progress.

References

1. Operative Guidelines for Septage Management for local bodies in Tamil Nadu, GoTN, 2014,