Application of Augmented Reality for Mapping and Evaluating Encroachments on Bulk Water Pipeline Systems

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SUMMARY

This study focuses on identifying and evaluating encroachments of bulk water pipelines and servitude areas using Augmented Reality (AR). The study's objectives were to use existing pipeline, servitude, and encroachment data for AR visualisation, quantify the impact of encroachments, and assess the performance of AR positions against baseline reference points established using Trimble R12i GNSS. The pipelines investigated include the L06, J10&J08, S01/S04, and K05, which are located in the City of Ekurhuleni Metropolitan Municipality region with a high number of reported encroachments. Existing data for pipelines affected, servitudes, and encroachment reports was acquired in shapefile format and loaded in ArcGIS for visualisation and processing. 3D pipeline models were created using attribute data for existing pipelines, including description, horizontal and vertical alignment, pipeline diameter, and ground elevations.

Encroachments within a 0-2m radius from the pipeline had higher Encroachment Severity Index (ESI) values due to potential infrastructure damage, maintenance restrictions, and pipeline burst catastrophes. Comparative analysis indicated strong positional correlation between the AR dataset linked to the Leica GG04 receiver and R12i GNSS survey baseline data. The VGIS AR application demonstrated its suitability for mapping and analysing encroachments due to lower RMSE values below 5cm. The information generated from the AR field reports can be used to justify legal actions and as evidence in court.

The AR models can be used to create awareness about the existence of the bulk water pipelines and servitude areas within communities, and highlight the risks associated with encroachments. This study paves the way for AR mapping to be integrated into routine pipeline inspection, mapping and investigation of encroachments.
