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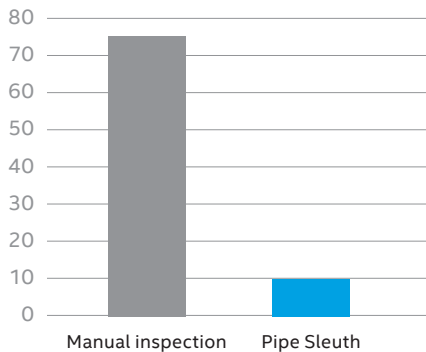
Streamlined Sewer Pipe Inspection Analysis with Intel AI Technologies

Cut costs, optimize maintenance assignments and improve customer service

Number of minutes needed to analyze 60 minutes of sewer pipe inspection video and generate a report

"We are using Pipe Sleuth to inspect our sewer network. It is an innovative solution that dramatically increases inspection productivity and significantly reduces costs while at the same time improving the overall defect detection rate. Having the option to run Pipe Sleuth on our existing Intel-based platforms was an added benefit."

Tom Kuczynski, Vice President, Information Technology, DC Water

Executive Summary

Artificial Intelligence (AI) enables utilities to speed up analysis of sewer pipe inspection videos, while ensuring accuracy. This allows their workforce to focus on making timely maintenance decisions instead of conducting routine inspections. Other benefits include reduced costs, lower rates of error, and fewer disruptions in service.

To help lower the hurdle of deploying AI, utilities can work with solution providers experienced in the challenges that affect this sector. DC Water enlisted the help of Wipro, an IT services provider and member of the Intel® AI Builders program with expertise in the utility industry as well as computer vision, machine learning and related technologies.

Sewer Systems: Miles of Challenges

Sewer pipe maintenance is like a form of insurance against future service disruptions. As part of the cost-benefit analysis, utilities are looking for ways to mitigate sewer pipe faults while lowering the cost of inspection.

This is critical given how many miles of sewer pipe lay hidden beneath cities. For example, more than 1,800 miles of sewer pipe crisscross under Washington, D.C.[1] Its more than 701,000 residents and nearly 20 million annual visitors depend on the District of Columbia Water and Sewer Authority (DC Water) to collect and treat wastewater.[2]

The utility's system dates back to 1810, with pipes built from a variety of materials including brick and concrete, vitrified clay, reinforced concrete, and cast iron.

Infrastructure such as this is typical throughout the United States and other countries. That makes it a full-time job for utilities to ensure their sewer system remains consistent and operational, as wastewater removal is an expectation that customers take for granted.

Standard Inspection is a Cumbersome Process

Regular inspection of underground sewage pipelines enables utilities to prioritize maintenance tasks that can help prevent leakage, breakage, and blockage. Standard inspection consists of difficult, time-consuming manual activities. In one common method, an operator remotely guides a camera-mounted rover to record video of underground sewer pipes. The operator uses the video recording to produce an inspection log and summary report, flagging anomalies or problems along with their locations.

Quality control staff then reviews the video recordings and reports for accuracy. With thousands of miles of pipe and hours of video to view in real time, it's a never-ending process. Fatigue, distraction, and differing opinion as to which maintenance items or repairs should be marked a priority can lead to errors.

Moreover, it's not uncommon for utilities using this method to wait until end-of-day Friday to evaluate a week's worth of reports before issuing work orders for the following week. That can lead to backlogs. Backlogs can lead to delays. Delays can lead to emergency repairs.

This has motivated utility companies to look for ways that increase the efficiency of the pipeline inspection process.

Automating Sewer Pipe Inspection with AI

DC Water sought a solution that would automate and help to accelerate pipeline video inspection while still maintaining accuracy.

The utility's management team met with counterparts from Wipro, a company with experience in automation, AI, analytics, and other technologies. Each organization brought its domain knowledge, and together they worked on developing a solution that would eliminate manual review and classification of sewer pipe video scans.

Their goal: optimize infrastructure maintenance in order to save time, improve efficiency, and lower costs. Automating sewer pipe inspection video analysis and reporting could help achieve this.

DC Water and Wipro Collaborated in their Development of Pipe Sleuth

DC Water applied its deep domain knowledge in qualifying the severity of anomalies to generate comprehensive reports that could seamlessly integrate into its existing workflow.

Wipro combined its strong Digital Signal Processing (DSP) domain skills – in the areas of image and video processing and computer vision – with AI and machine learning technologies in order to solve business problems.

The company's history includes vast IT system integration experience with both public and private entities. This includes government-owned water providers as well as gas and energy companies in the US and around the world. By providing both technological and sector expertise, Wipro helped guide DC Water on its digital transformation journey, turning the utility's capabilities and insight into a practical solution.

Applying Computer Vision to Sewer Inspection

The Pipe Sleuth solution automates the process of identification, annotation, scoring/grading of pipeline condition, and reporting of pipeline defects using standards that meet the Pipeline Assessment Certification Program (PACP). These benchmarks were instituted by the National Association of Sewer Service Companies (NASSCO).

The solution contains a dataset of 26,600 annotated images extracted from documented pipe inspection videos. A machine learning model built from these images was trained using TensorFlow and optimized with the Intel® Distribution of OpenVINO™ toolkit for inference.

This training enables Pipe Sleuth to compare new pipe inspection videos with established anomalies. The solution can rapidly detect quality issues and eliminate the need for manual review and coding of underground sewer pipeline video scans (see Figure 1).
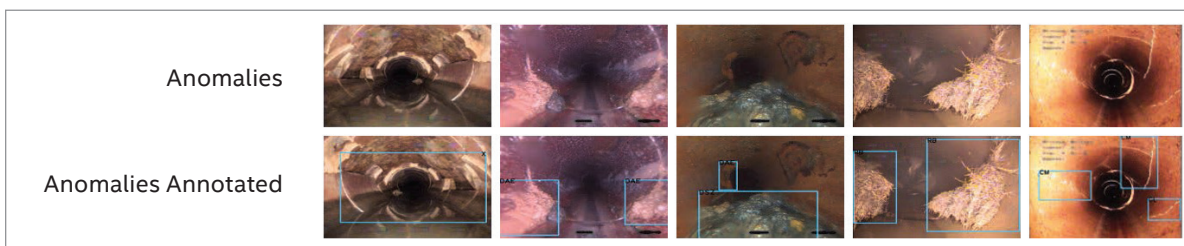

Figure 1. Sample anomalies and annotated images using the Pipe Sleuth solution.

Pipe Sleuth then generates a comprehensive inspection report, which can be integrated with commonly used asset management systems to automate maintenance work orders. Pipe Sleuth can also interface with geographic information software systems, which can map the precise locations where tasks must be performed. The software also makes it simple to retrieve and view specific scenes in pipe inspection videos.

In addition to optimizing the solution to work with the Intel Distribution of OpenVINO toolkit, Wipro also optimized it for Intel® Core™ i5 and Intel® Core™ i7 processors, and Intel® Xeon® Scalable processors. That enabled the solution to deliver gains of 32, 55, and 77 percent respectively.[3]

Inference time was also improved with a reduction of up to 80 percent using Intel Xeon processors with the OpenVINO

toolkit, while not producing significant loss in model precision or accuracy.[4] This optimization was a strong benefit for DC Water, which had already invested in Intel® processor-based servers.

The result: a solution that can perform image inferencing in real time, allowing pipeline inspections to improve in efficiency, consistency, and accuracy.

Furthermore, Pipe Sleuth enhances long-term monitoring by storing pipeline data and metadata. This makes it simple to look back at the history of specific problems and their locations, establish when and what maintenance actions or repairs were performed, and compare previous conditions with their current status.

Pipe Sleuth Benefits

Pipe Sleuth today supports detection of 50 anomalies targeted for waste water utility infrastructure. Wipro plans to support additional anomalies as part of the product roadmap, which will enhance its business value.

Saves Time
Takes 10 minutes to analyze 60 minutes of inspection video and produce a report, which to do manually requires an hour and fifteen minutes.[5]

Reduces Scanning Costs
Saves up to 50 percent of the cost of anomaly detection, allowing utilities to shift spending from maintenance to capital improvement.[6]

Provides High Accuracy
Achieves a 90 percent accuracy rate while eliminating human errors due to fatigue and distraction and improves detection reliability by up to 20 percent.[7]

Increases Availability of Experts
Enables staff to focus on complex problems by using AI to perform routine inspection.

Optimizes Maintenance Decisions
Improves the process, allowing maintenance crews to work where they're needed most.

Reduces Disruptions
Speeds analysis and prioritization so maintenance may occur before repairs must take place.

Improves Customer Service and Safety
Demonstrates commitment to customers by reducing the frequency of repairs and closures and damage to roads, public and private property, and the environment.

Delivers ROI
Utilities can experience up to a 350 percent ROI over a three-year period.[8]

Get Started Today

For more information download the white paper, *Pipe Sleuth with Optimized Inference on Intel® Processors*

Hear a podcast discussion on Pipe Sleuth with Deepak Dinkar, Senior Practice Manager, Wipro, and Emily Hutson, Senior Product Marketing Manager, AI Products Group, Intel Corporation

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To know more about what we do at Wipro, go to wipro.com

And learn more here about the Intel Distribution of OpenVINO toolkit

1. https://www.dcwater.com/sanitary-sewer
2. https://ngicp.org/project/dc-water/
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