Intelligent Cloud System for Wastewater Management

—— Taoyuan City

The AR view of underground sewer pipe ©Taoyuan City Government

City Profile

Country: Taiwan
Area: 1,220.95 km² (471.41 sq mi)
Population: 2,116,988

Urban Challenges

Water treatment is always a crucial challenge to cities in Taiwan. With the development of sewer and water recycling center construction in Taoyuan City, the connection rate of pipelines to sewage treatment has increased significantly and is on track to expand in the future. In early 2018, the sewerage system was about 115 kilometers long. It is expected that the connection rate will reach 13% by the end of 2018 and could reach 60% within eight years. Additionally, the construction progress for the storm sewerage system is anticipated to reach 373.39 km in length and a 78.2% connection rate by the end of 2021.

Consequently, pipeline data management is vital. Proper facilities management for the completed sewerage system and sewage treatment plant are crucial to ensure quality operations.

Cloud System for Wastewater Management

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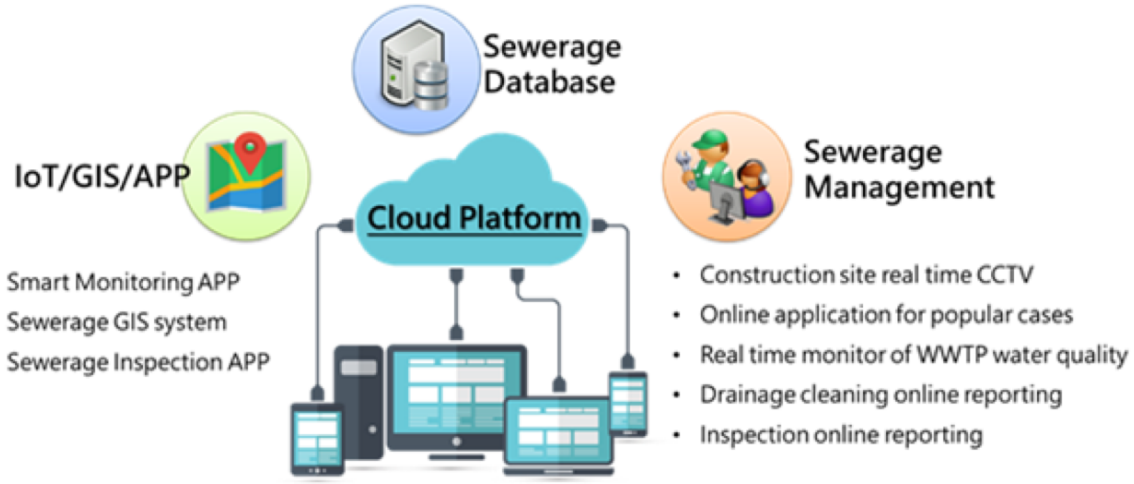
Linking SDGs

"Combining with advanced technologies today including IoT, AR and GIS, Taoyuan City Sewerage Cloud Management System could enhance the efficiency of sewage facilities management." (Quote from Department of Water Resources, Taoyuan)

Taoyuan City 'Intelligent Cloud System for Wastewater Management' integrates Internet of Things (IoT), augmented reality (AR) and geographic information systems (GIS) technologies to monitor the condition of the sewerage system in real time. The operation application modules help carry out routine maintenance more effectively and improve efficiency in administrative work. The system converts all sewerage construction data into a unique attribute format and uses GIS to document and manage information. Additionally, this information can be viewed in a web application accessible to the public.

The project is hosted by the Taoyuan City Government in partnership with Stantec Consulting Services Inc., Taiwan Branch. The following figure provides a systematic overview of this project.



Operational Diagram of the Intelligent Cloud System ©Taoyuan City Government

Results & Reflections

Currently, the cloud system manages over 7,500 manholes/pipes of sewerage, 7,700 manholes/pipes of storm sewerage and six water recycling centers. The system is designed for sustainable sewerage management, and it has achieved targets including the following:

1	Unified the sewerage attributes format of Taoyuan City
2	Built a complete database by integrating and importing the existing drawing information and data of sewer systems
3	Upgraded service to the public by establishing an online viewing application
4	Defined IoT infrastructure and created an app as sewerage management tool
5	Created a real-time water quality monitor app for six water recycling centers to achieve instant management
6	Reduced reaction time after receiving a sewer facility repair request by APP
7	Displayed the GIS map layers by connecting to the Taoyuan GIS data warehouse
8	Built an online form to intake public help requests and expedite repairs [i1]

One year after implementation, the cloud system has succeeded in gaining widespread usage, including the following:

- Digitized more than 7,500 manholes/pipes of sewerage
- Digitized more than 7,700 manholes/pipes of storm sewer
- Obtained real-time data and online documentation of six water recycling centers
- Monitored 121 ongoing construction sites in real time via the system
- Monitored 33 subcontractors with 1456 car rips for water fertilizer station
- Dredged a 28.8 km length of storm sewerage
- Enabled eight cable TV companies to attach 196 km length wires in the storm sewer
- Received reports of 226 damage issues from the public

Import the existing drawings of sewer system/©Taoyuan City Government

Real time data and on-line documents of 6 water recycling centers and sewer AR view/©Taoyuan City Government

The first step of "Wastewater Management" involved integrating the project database, GIS and building a business communication platform and application modules for storm and sewerage operation.

In the future, we envision expanding the content. Potential next steps might be to integrate the rain and sewerage facilities data collection, auto-register operating information systems combined with IoT, use CCTV to conduct longitudinal inspections and evaluate structural performance, add real-time information management of the pipeline, and assess the plant site's energy performance.

Based on the potential strategies above, we have divided the project timeline into four phases, including (1) Solid Foundation, (2) Real-time Monitoring, (3) Assessment Review, and (4) Sustainable Development.

The aforementioned improvements will contribute to a more sustainable development strategy and management of risks, budget, performance, demonstration and assets.

Furthermore, collecting all maintenance data such as water quality, repair and event logs, and an intelligent system could suggest an appropriate maintenance frequency of each sewer facility.

Review Comments

1. With the increasing population, water management will be a critical issue in the future. This project shows how the intelligent use of IT can enhance understanding of sewage management systems and the various techniques which can be employed.
2. Overflow of sewage has been a major problem in many developed and underdeveloped cities as well. Therefore, it is benefit to use IoT, AR, GIS to enhance the efficiency of sewage facilities management. The system should be designed to be comprised of sensors to sense the wastewater level, command controllers, communication networks to register complaints regarding blockage and the continuous increase in the level of sewage. The level sensors should be efficiently used and system should be designed in a socially relevant way, to create an impact on hygiene and cleanliness by simply avoiding the problem of sewers and also to ensure compulsory cleaning of blockages which cause increases in the sewage level by registering repeated complaints to relevant departments unless action is taken.
3. While it is certainly interesting to be able to monitor the functionality of a sewer system in real time, the main benefit of this project for the city and its residents remains unclear. For example, one benefit named includes 196 km of cable inserted into the city's sewer system by local companies. This does not in itself constitute a benefit for the city and the wider public but resembles a mere subsidy for the local economy through public tenders. The question remains whether the new system provides enough of a benefit for the actual operation of the sewer system and in the form of a public service to justify the creation of an expansive digital overlay onto the city's infrastructure.
4. This is one of the more useful and highly applicable case studies. I would further suggest testimonials from the maintenance and operations personnel; for example, has this system actually reduced their workload? Has it improved their efficiency? Would they recommend other cities use it? What kind of savings does it achieve?