



MR(Mixed Reality) Underground Utility Maintenance
(Remote Collaboration) System

Development Background and Purpose

5G & MR Real-time Remote Collaboration System for Underground Utility

5G

(Hyper Speed & Connectivity)

- Enhanced On-site Response
- Multiple Connection Process
- Real-time Interaction
- High-speed Data Process
- High-capacity Data Transmit

Energy Management & Safety Prevention

- Real-time visualization of various underground util. info
- One-stop process for on-site accident prevention

Improvement of inspection & mgmt. process w/ tech.

- Real-time interaction technology coupled with 5G
- Enhanced inspection & management process

Test Bed & Infrastructure

- Smart-city verification project infrastructure
- Collaboration with spatial data business operator

MR

(Real Space + Augmentation + Virtual Info)

- Voice & Video Call
- Visualized Info
- 3D Object Tracking
- Substitution of Real Space Info
- Data Calculation

Daegu Suseong Alpha City

Project Scope



Visualization of Information

- Information data base design & reconstruction
- Real-time 3D modeling algorithm design of management info
- Contents for visualization and display of data
- Application for mixed reality service

NFC Tagging

- NFC based info tagging and transmit system for underground util. management
- Acquisition of indicator coordinates management info and spatial mapping

Mixed Reality

- Application of mixed reality based "Air-tab" technology for remoted collaboration
- Three-dimensional spatial recognition and camera tracking technology for underground utility maintenance
- Voice & Video call service through HMD

MR Underground Utility Maintenance System Flow



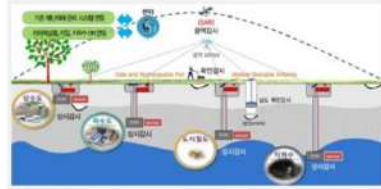
Current Services in Related Area

Korea

ICT total-management-system with mixed reality technology applied to smart city development



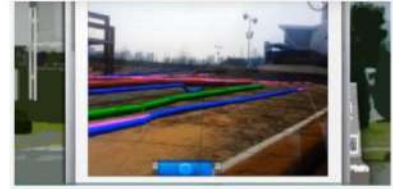
〈 IoT Based Monitoring & Mgmt. 〉



〈 Virtual 3D Spatial Info for Underground Facility 〉



〈 Augmented Spatial Info for Underground Facility 〉



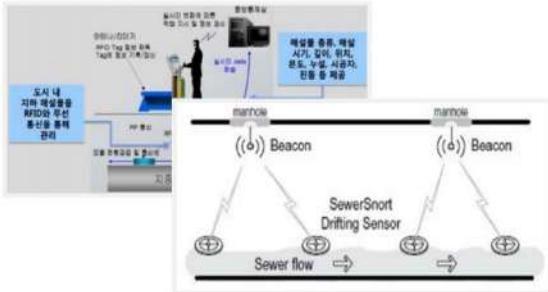
〈 Work Orders through HoloLens 〉

〈 Improve tracking error due to GPS through smart NFC converged with real-time 3D object rendering technology 〉

- Implementation of mixed reality based mobile application for underground utility can be difficult due to low-performing GPS
- Interactive voice & video call technology by fully utilizing 5G communication

Global

Underground pipe total-management-system with tunnel structure and monitoring sensors





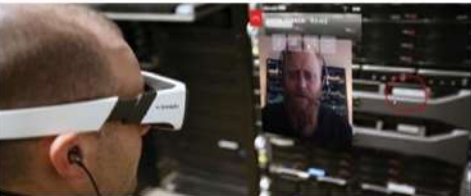

〈 Preexisting Underground Utility Management System Flow 〉



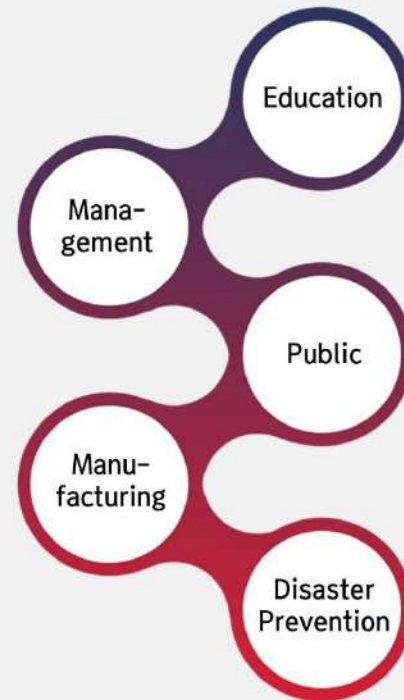
〈 Enhanced Underground Utility Management System Flow 〉



Current Services in Related Area (Continued)

Applied Field	Possible Applications	Other Possible Areas
Maintenance		<ul style="list-style-type: none"> • Ship engine repair • Plant maintenance • Elevator maintenance
Assembly Guide		<ul style="list-style-type: none"> • Automobile parts assembly • Airplane wiring and parts assembly • Powertrain assembly
Remote Assistance		<ul style="list-style-type: none"> • Remote assistance with smart glass • Electric wiring and maintenance • Quality inspection
Automation		<ul style="list-style-type: none"> • Real-time remote control • Production line • Augmentation of factory data

〈 MR(Mixed Reality) Remote Assistance System〉



Technology Development Summary



Functions specialized in underground utility maintenance

Buried pipeline monitoring service infrastructure w/ MR



Augmented contents & HMD-linked platform

5G based hyper-speed 3D object data transmission & output



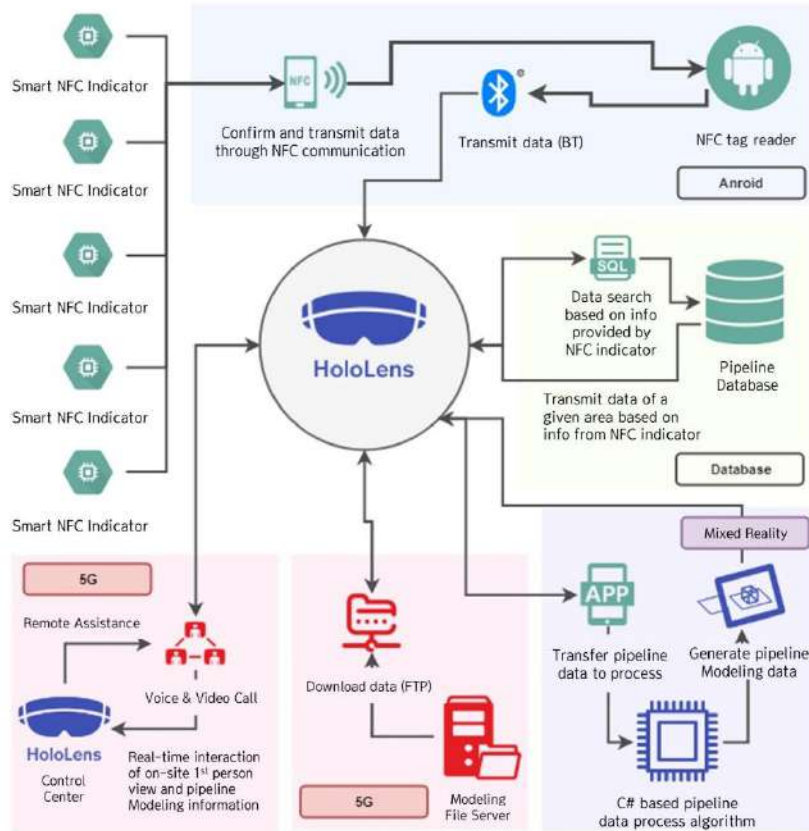
MR based underground utility monitoring system

Smart mgmt. system w/ visualized info and remote assistance

System Flow

Cat.	No.	Functions	Cat.	No.	Functions
An-droid	01	Obtain smart NFC based underground utility indicator info through NFC communication using an android device	MR	07	Confirm database of an area centered by the tagged NFC → 3D positioning of underground utility info within the given area using latitude and longitude value
	02	Transmit underground utility info between android based device and HoloLens using bluetooth		08	Underground utility info dimensionalizing algorithm → transmit targeted modeling data using managed code → real-time processing of data into 3D modeling
Holo Lens	03	Extract database sequence value from information obtained through HoloLens application		09	Display on to HMD : dimensionalized underground utility modeling objects based on tagged NFC coordinates
	04	Confirm data by accessing underground utility database server with HoloLens application	5G	10	WebRTC based voice & video call with designated control center within the area
	05	Obtain full data within a given area from underground utility Database server using RestAPI		11	Information transmission of HMD user's 1 st person view and generated 3D modeling data of underground utility between the user and control center
5G	06	Access modeling data file server through 5G network and download targeted modeling data to HoloLens application		12	Remote assistance from control center

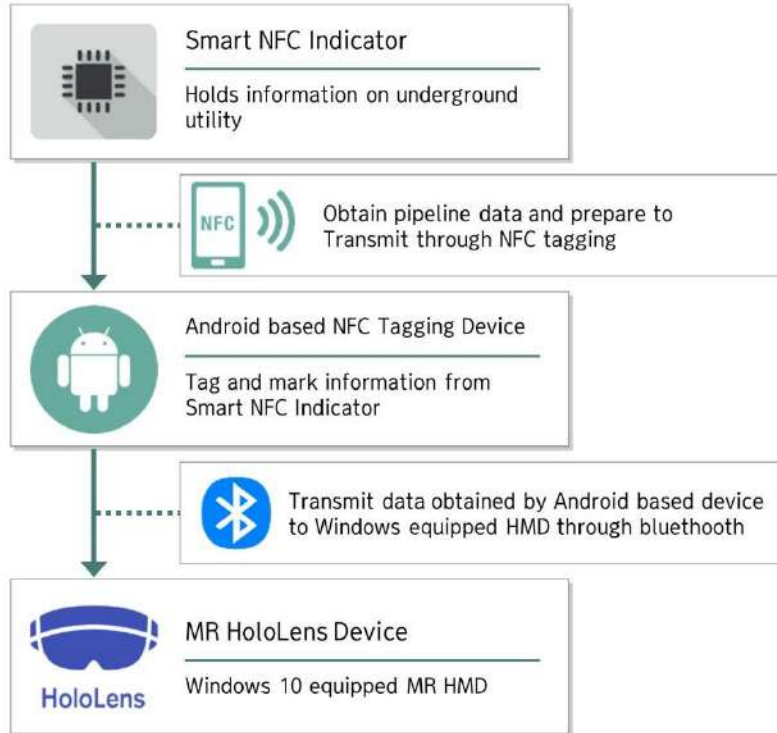
System Outline



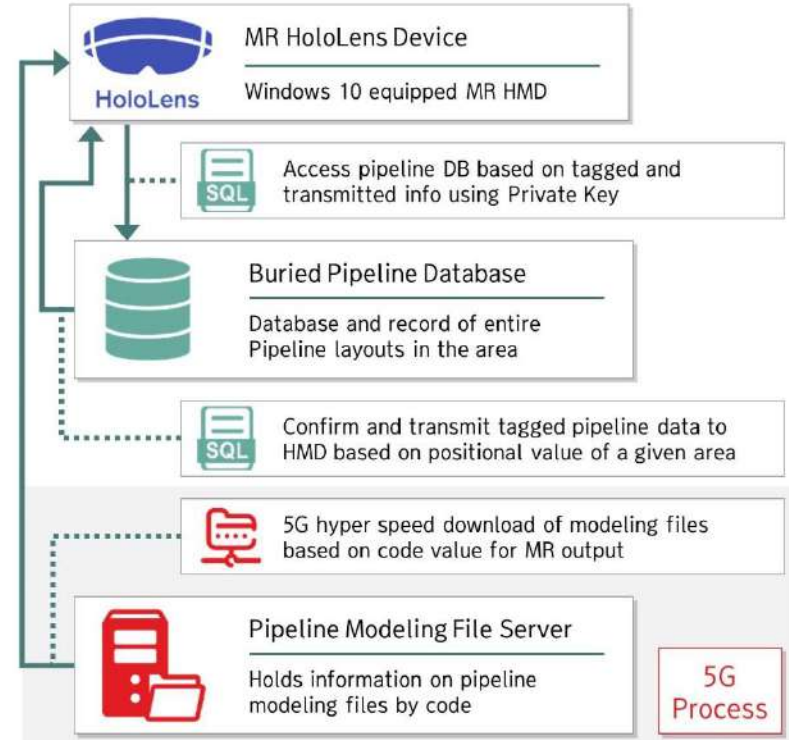
AS-IS	TO-BE
Buried pipeline work & inspection safety issue	Accident prevention through real-time information exchange
Work delay due to pipeline location confirmation lead-time	Directly check with 3D objects
Complex communication between control center and on-site worker	Real-time on-site info exchange
Expert consultation : Issue with time and efficiency	Expert consultation : Real-time remote assistance
Observe pipeline data one by one	Confirm data after calculation process
Inefficient process of 2D blueprint use	Visualized data through NFC tagging
Absence of Smart Water Grid	Smart Water Grid Application possible

System Functions

Smart NFC Based Underground Utility Mgmt. Info Tagging System

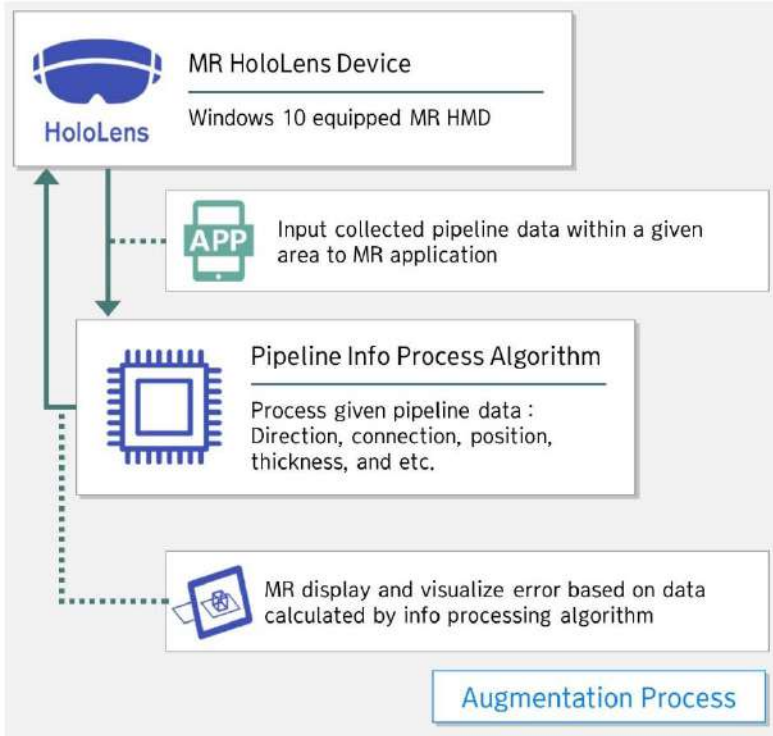


Smart NFC Based Underground Utility Mgmt. Info Tagging System

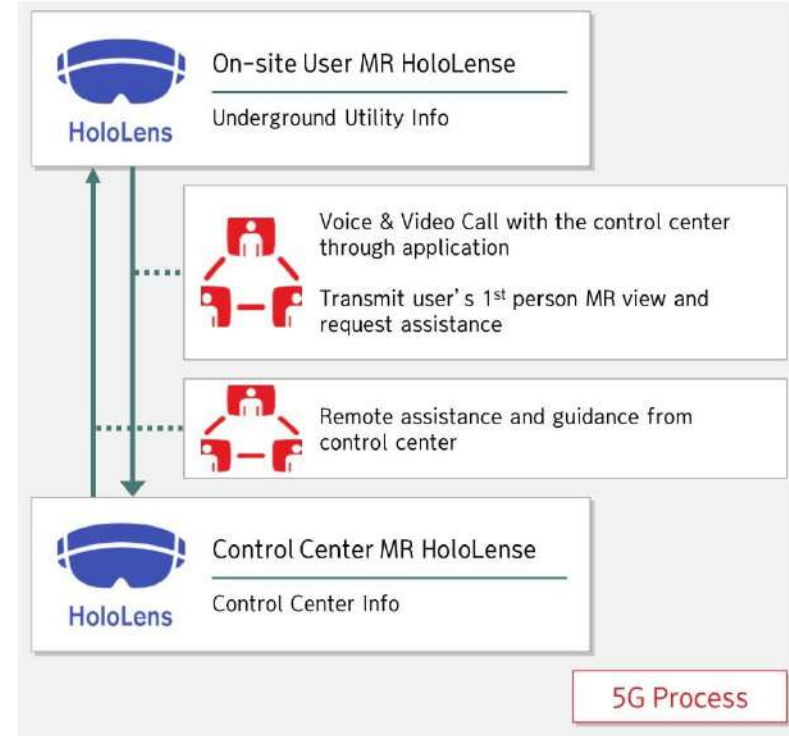


System Functions (Continued)

Dimensionalization and Real-time 3D Modeling of Underground Utility Management Information

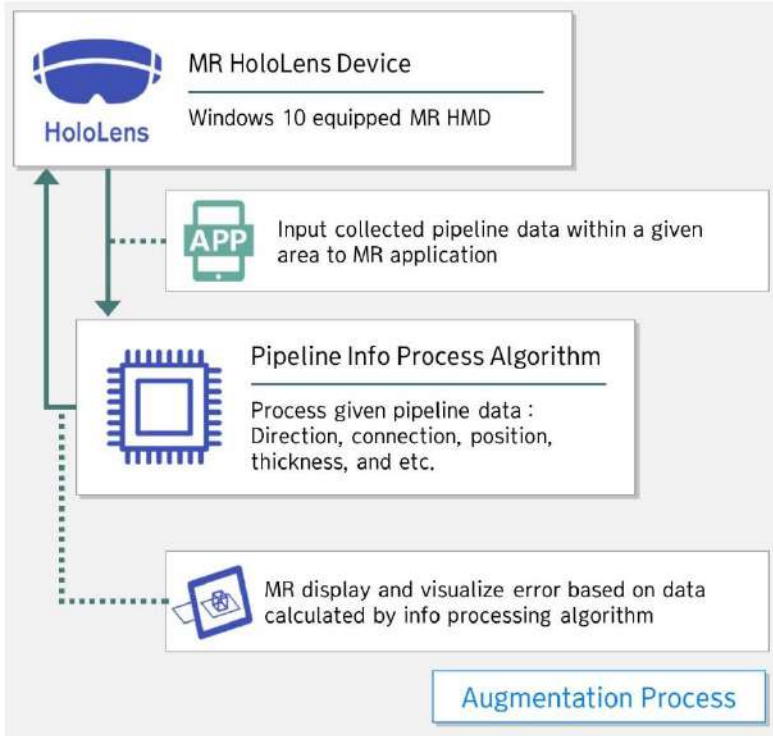


WebRTC Based Voice & Video Call Service



System Functions (Continued)

Dimensionalization and Real-time 3D Modeling of Underground Utility Management Information



WebRTC Based Voice & Video Call Service

