AWARD CATEGORIES: Public Sector – Smart Cities Award

YOUR NOMINEE: Hancom Intelligence Inc.

REASONS FOR NOMINATION: Hancom Intelligence Inc. has developed an innovative remote water meter reading system (HY·CHECK) through AI and IoT technology to create a smart city ecosystem and improve city asset management (reducing water loss and cost) and customer service.

Hancom Intelligence Inc. has worked with Seoul Metropolitan Government to successfully promote smart city projects and has expanded the results to overseas cities for better lives of global citizens.

With US$ 1,738K of annual cost saving in a city, HY·CHECK should be regarded as one of the best success cases in smart city program and its technical functions and dynamism shows the future of smart cities.

SUPPORTING INFORMATION:

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  2) About the solution (HY·CHECK)
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I. About the company (HANCOM Intelligence Inc.)

As a leading AI and IoT service in the 4th Industrial Revolution era, Hancom Intelligence continues to innovate and develop the domestic and global AIoT industry ecosystem for a convenient and connected world. As a member of Hancom Group, Hancom Intelligence enhances customer value by generating business synergies with other Hancom affiliates.

In addition, Hancom Intelligence creates a future Smart City ecosystem by using technologies that implement Smart Cities. As a consortium between the Seoul Metropolitan Government and ICT companies, it has been formed to build up and customize Seoul's Smart City models to meet the requirements of overseas cities. As a chairman of the consortium, Hancom Group plays a role to develop client cities into sustainable cities.
We thrive on stable business based on our well-established management. Hancom Intelligence consists of businesses with a solid basis in software technology, a core element of the future ICT industry. There are 3 main businesses.

[3 main businesses of Hancom Intelligence]

Below are the key features of the main business.

- **CONNECTIVITY Business**
  | Intelligent IoT Platform Business

  - Convergence with Machine Learning, Big Data Analytics and Security Technologies
  - IoT management and control based on bidirectional communication (OTA included)
  - Digital twin & Smart cities
  - Compliance with international key management standards and integrated HSM-based encryption key management
  - Device/Electronic document authentication, sensitive information management
- **ARTIFICIAL INTELLIGENCE Business**
  | Smart Business AI Platform Business
  - Providing AI translation service that automatically translates video contents into multiple languages (e.g. live broadcasting, movies, lectures etc)
  - Providing Vision AI Solution that can be used in various business environments
  - Voice/Text Interpretation, Face/Object Recognition, Audio/Video synthesis

- **ENGINEERING Business**
  | Development Quality and Productivity Improvement Platform Business
  - Providing Engineering solutions and consulting for each development stage based on international standards
  - Improving Security and Quality of SW Development
  - Providing Elemental Technologies

## II. About the solution (HY·CHECK)

- **Definition**

  HY·CHECK is a smart water metering solution using AI and IoT for smart city to enhance the RWR* (Revenue Water Ratio) and water supply chain, to make transparent water usage and billing, to reduce the management cost, and to improve underserved communities.

  *The ‘Revenue Water Ratio (RWR)’ is defined as the ratio of the volume of water paid by the customers to that supplied. The higher RWR means water loss in supply system is minimized. The water system with higher RWR can increase the managerial efficiency as the water demand and supply can be controlled precisely.*

- **Overview**

  The resource of water is one of the most important resources in operating a city. In the past, water inspectors made a meter inspection in person to check and manage water usage, but there were various problems such as lack of accuracy and transparency. At the same time, compared to other major countries in the world, Korea has the lowest tap water price, but the water consumption per person is the highest. This resulted in huge loss of tax revenues.
In the past, tap water was previously focused only on supply, but now it is changed to focus on the management of efficiency, demand forecasting, and the management of vulnerable groups to revitalize the economy. To this end, the government is strengthening the management of tap water for each local government. Especially, tap water usage management and billing is the most important part of water management policy.

To solve this situation, since the IoT telemetry system without the inspector's intervention can replace the way of meter inspector's work of visiting each household in person and handling manually, it is expected to further enhance the safety of water use by improving the existing poor working environment and preventing water leakage in advance with high accuracy.

Recently, Korean government has been expanding investment across smart grid technology including smart metering, as part of the digital twin-based and smart grid business. With the Ministry of Environment's budget allocated to 70 billion KRW in 2020, 420 billion KRW in 2021 and 450 billion KRW in 2022, the smart metering platform project in the water sector using the IoT platform is actively underway. As a result, 50% of the entire country is expected to be converted into a remote metering system by 2022. By this, water leakage will be checked real-time to make an immediate action, which will lead to water leakage protection.

With the purpose of making city smarter, the government is also investing heavily in the application of improved ICT technologies such as AI and IoT in the areas of water usage management. Hancom Intelligence, as a subsidiary of Hancom Group with an extensive expertise in imbedded such areas as AI, IoT, etc., has been involved in the IoT industry since 2015, and has developed various services like NeoIDM, IoT Device management platform.
Based on its many years of successful business experiences in conducting stable interactive IoT services targeted at Japan, Hancom Intelligence is carrying out various activities including Seoul Metropolitan Government project related to Smart City. And it currently provided the government with a new product line of NeoIDM, HY·CHECK. HY·CHECK, a remote water meter reading solution using AI and IoT technology, makes it easy to collect the water metering data remotely to help realize the smart cities in an easy way and to reduce the cost considerably. This is why the deployment of HY·CHECK is spreading fast throughout Korea.

- **Function**

[How HY·CHECK works]
HY·CHECK is a smart metering solution that supports various local government operation policies to improve RWR by utilizing the advanced ICT technologies such as IoT and AI and by analyzing the water usage data.

However, there were several problems with smart metering solutions that had previously been carried forward. First of all, digital meters introduced in the early days for remote meter reading have become a major problem due to their low durability. Eventually, Hancom Intelligence has developed smart metering implemented with AI technology in the extensive use of analog meters that are already widely installed and durable.

Other problem is it needs a variety of operational functions such as remote setting and change of communication terminal (modern) and shooting cycle adjustment. For example, digital metering with one-way communication is no use for the inspection, so IoT platform with two-way interlocking among the multiple devices spread across the wide area is required.

HY·CHECK allows users to check meter reading data at a remote location to prevent complaints caused by various errors due to existing inaccurate manual measurement and provides an Internet of Things-based system with optimal efficiency. Since it uses the broadband LTE network, the radio shadow area can be covered without missing to gather the relevant data.

HY·CHECK operates on a NeoIDM, IoT platform developed by Hancom Intelligence. NeoIDM supports interactive two-way IoT environment that enables millions of metering devices to link together simultaneously for data acquisition. Also, it provides updates to the latest version of software remotely or selectively using its own developed OTA(OverTheAir) technology.
Unlike the other smart metering solutions generally in use, HY·CHECK can be installed on an existing meter, and there is no need to cutoff the local water supply. Here is a process of an innovative technology of HY·CHECK with AI and IoT technologies applied. Firstly, its camera will procure the readings of the meter at regular intervals, and the LTE modem will transmit the meter readings to the central HY·CHECK server. Then, HY·CHECK collects and analyzes all the water usage data via deep learning within AI. This enables to read the meter remotely without a meter man and removes the need to visit each meter individually. Accordingly, monitoring the entire city/area in real time now became possible.
Features

First, HY-CHECK can be implemented in a way that minimizes additional services and saves cost. Since digital meters are vulnerable to humidity/temperature change/vibration to broke easily, Hancom Intelligence has developed HY-CHECK, a smart remote meter reading system without replacing the existing devices, and it can be used as it is.

Second, HY-CHECK was developed to analyze the image data through AI deep learning with the actual meter reading data. Previously, OCR was mostly used in a lot of attempts to read the meter reading image; however, there was lower quality of reading when used with OCR technology. From here, HY-CHECK can help to overcome this vulnerability of the existing devices.

In other words, HY-CHECK provides an image reading method, so that it can be continuously used only by installing remote metering module without replacing the existing water meter devices.
And by using this remote meter reading module, it can be applied to the water meter of all calibers, making it easy to build.

Lastly, HY-CHECK fundamentally prevents physical manipulation, as only the images from the meter can be used. That means it ensures the transparency in the measurement of the amount of water usage.

The real-life water usage data mostly obtained through HY-CHECK is utilized to build a regional and hourly database. As various database is collected from IoT devices in everyday life, Hancom Intelligence can not only see the trends in water usage by region/population/period, but also simulate them in conjunction with digital twins. This will bring Digital Twin to fruition.

- Advantages

Currently, water use inspection is operated through the meter men, but there are problems with objectivity of water use, such as filling out the false water usage information through behind-the-scenes transactions and false assumption in the estimate by the misinformation of meter location. For these reasons, residents don't trust the water usage bills charged from local governments, and the local governments are always faced with a large deficit in the water supply systems.

To resolve these problems, local governments, including the government, deals with RWR as a very important operational indicator and are making various efforts to improve RWR. Based on Korea, RWR 1% is equivalent to the amount of eight dams, which is equivalent to $50M (KRW 50 billion) annually in taxes. If RWR can be improved through advanced ICT technology, it enables various government policy operations by securing tax revenues, preserving the environment, and predicting demand for tap water to population ratio.

As the IoT(Internet of Things) technology spreads, it is changing everyday life, and in the IoT era, the remote water meter reading system is also seeping into our everyday life through our daily life. As single-person households and small families are increasing, the number of water meters that need for a measurement is also increasing. There are 8.2 million (except for apartment town, ‘19.12.) water meters devices, and 348 water inspectors visit 95.5% of the total meters to perform an average of 3,000 meter-reading tasks per month. However, the problem is inspectors are in dangerous and vulnerable situations, where they happen to have accidents such as traffic accidents, falls and crimes frequently. That is why the need for smart water meters continues to rise for the safe environment for inspectors.

The advantages that HY-CHECK offers are as follows; First, HY-CHECK helps to construct a social safety net through connection with public welfare services. ICT can be used to accumulate and analyze the data to take care of the underprivileged and the vulnerable as well as to manage the illegal facilities. The data gathered from IoT can be provided to protect the elderly living alone and the vulnerable based on water consumption.

Since, water is one of the most essential basic resources in life, HY-CHECK monitors the amount of water used every day and check if each of them in the vulnerable groups are leading a steady
life without any accidents such as lonely death. It can be also utilized to identify whether commercial facilities are doing business illegally outside business hours allowed by monitoring the amount of water usage.

Another advantage of HY-CHECK is its scalability to extend its application to various fields. With the recent rapid development of communication technology, there is a need for remote meter reading technology, which can remotely detect various types of resource consumption such as water, gas and electricity used in every home, factory, plant, etc. away from the past analog-type meter reading-based poor environment. Above all, from the smart city aspect, Hancom Intelligence with its rich experiences in implementing stable interactive IoT services is ready to utilize HY-CHECK to various fields of analog metering such as gas usage reading, electricity usage reading, etc.

As already mentioned above, legacy water inspection system had included lots of problems and issues. Other advantage of HY-CHECK is it can help to enhance the social trust by the clear measurement of water usage and transparent billing system implementation.
In the past in Korea, water inspectors visited every home monthly to check each household's water meters and recorded them by hand. However, deteriorated equipment caused incorrect water measurement, resulting in excessive water charges and many civil complaints. Hancom Intelligence’s HY-CHECK, which allows users to check meter reading data at a remote location, prevents complaints caused by various errors due to existing inaccurate manual measurement and provides an Internet of Things-based system with optimal efficiency. This contributes greatly to the transparency of water charges imposed in connection with the billing system based on clear measurement of water usage, resulting in largely reduced costs of social trust.

Lastly, HY-CHECK is not only available for on-premise deployment, but also for SaaS services that can be used in the form of monthly billing without system construction. This allows real-time monitoring of the nation's water conditions collected from various water meter readers with the data analysis using machine learning technology. From this, the real-time data provided from this by population/period/region makes it available to analyze, predict and contrast distinguish the water consumption. And this can be beneficial when utilized to establish the government's water resource policy.

- Benefits

Digital Twin is a technology that can predict and diagnose future results by building the same virtual environment as the real world on a computer and by running computer simulation that may occur in the real world. This digital twin technology can minimize time and cost because it can respond to problems by monitoring the situation in real time, and it is a highly promising field in the future as it can be applied in various ways depending on the purpose of each area.

In July 2021, Hancom Intelligence signed an agreement with LX, Korea land and geospatial informatix corporation, to build a data sharing-based platform to provide digital twin services using data collected through 'NeoIDM'. Both of organizations are expecting to create results of the Korean version of New Deal and make more efforts to help people enjoy safer and more convenient digital twin services by combining various data and technologies accumulated based on real-time monitoring.

The Revenue Water Ratio (RWR) Improvement Project Under Smart City Implementation Plan has begun with the start of the special organization focused on drinking water, i.e., Seoul Water Authority, in 1998. Although there were projects to increase the system efficiency before, it can
be said that the real plans and projects to improve RWR have been carried out by Seoul Water Authority since 1998.

There are several benefits we can expect from the introduction of HY·CHECK. First, it helps to improve the RWR, which will lead to streamline the management in water business by securing tax revenue and keeping operation costs down. The table shows the expected result with powerful effects after deployment of HY·CHECK as follows;
- The cost of meter reading per household will be decreased by 50% from $1/mth to $0.5/mth.
- Avg. RWR will be increased by 20% from 82% to 99%.
- Avg. cost of loss per month based on RWR will be decreased largely by 94.5% from $131K to $7.2K.
- The cost of monthly Management per 50K households will be decreased by 95.7% from $495K to $21K.
- The cost of annual water meter reading per 50K households will be decreased by 57% from $595K to $255K.

<table>
<thead>
<tr>
<th>Description</th>
<th>Before</th>
<th>After</th>
<th>Expected effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of meter reading per household</td>
<td>$1/mth</td>
<td>$0.5/mth</td>
<td>50% of cost saving</td>
</tr>
<tr>
<td>Avg. RWR</td>
<td>82%</td>
<td>99%</td>
<td>20% of improvement</td>
</tr>
<tr>
<td>Avg. water use per household</td>
<td>18.8t</td>
<td>18.8t</td>
<td>-</td>
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<tr>
<td>Avg. Tap water price (t)</td>
<td>$0.80</td>
<td>$0.80</td>
<td>-</td>
</tr>
<tr>
<td>Avg. Cost of loss per month based on RWR</td>
<td>$131K</td>
<td>$7.2K</td>
<td>94.5% of cost saving</td>
</tr>
<tr>
<td>Monthly Management cost per 50K households</td>
<td>$495K</td>
<td>$21K</td>
<td>95.7% of cost saving</td>
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<tr>
<td>Annual water meter reading cost per 50K households</td>
<td>$595K</td>
<td>$255K</td>
<td>57% cost saving</td>
</tr>
<tr>
<td>Annual Saving</td>
<td>-</td>
<td>$1,738K</td>
<td>-</td>
</tr>
</tbody>
</table>

[How much cost saved after taking HY·CHECK in a city]

To sum up, the annual cost reduction will be amount to $1,738K with improved RWR (flow rate), tax revenues, and even to the efficient management of the vulnerable. In particular, it will contribute to strengthening the water supply management system by replacing water meters, improving waterway facilities, and using them in water policies when developing new cities by combining with digital twins that are actively promoted worldwide in the field of smart cities.

Besides those benefits of securing taxes revenues and reducing operating cost, HY·CHECK is can provide another huge benefit. HY·CHECK have made a concerted effort to use that data to improve the lives of the alienated classes with socially beneficial advantages. All of data gathered though HY·CHECK can be utilized to construct a social safety net in cooperation with the public welfare services to protect the elderly living alone and the vulnerable based on water consumption. If the monthly water usage is below the standard by monitoring the usage of vulnerable classes, then the alarming notification is automatically sent to an associated organization for social welfare, and a social worker visit to check for abnormalities.
Cities are beginning to, and will continue to, integrate technological dynamism into municipal operations, from transportation to infrastructure repair and more. As the integration of smart cities technologies becomes more visible in our everyday lives, we could begin to see large scale changes in our cities. In line with this trend of smart city integration, many companies are jumping into this market; however, majority of them comes to an end without any meaningful results.

Smart city initiatives involve three components: information and communication technologies (ICTs) that generate and aggregate data; analytical tools which convert that data into usable information; and organizational structures that encourage collaboration, innovation, and the application of that information to solve public problems. All of those are supported by our product, HY-CHECK, based on NeoIDM, IoT Device management platform, with advanced AI technology. Transparency in the management of the water resources is the most necessary elements for better life in the smart city. With the recent rapid development of communication technology, there is a pressing need for remote meter reading technology, which can remotely detect various types of resource consumption such as water, gas and electricity used in every home, away from the past analog-type meter reading-based poor environment.
Other than privacy issues for small and single-person households, there's a growing number of accidents for single-person households dying alone and abandoned. HY·CHECK can help to resolve this problem by providing real-time monitoring of the water usage of each socially isolated household and sending an alert to social workers if there is no change in the amount of water consumed for a certain period of time. Through this, hazardous situations can be indirectly detected in advance so that the possibility of suicide can be prevented by the strengthening care for vulnerable peoples.

Since Hancom Intelligence and LX, Korea land and geospatial informative corporation, has signed an agreement recently to build a data sharing-based platform using 'NeoIDM' for digital twin services, both organizations have been making enormous efforts to secure qualified data through real-time monitoring using IoT and AI technology. This will facilitate to secure tax revenues and manage city in new and more effective ways. Furthermore, the data is expected to be utilized for government policy implementation. That's why both parties are expecting to provide safer and more convenient digital twin services beyond Korean New Deal realization.

Hancom Intelligence’s HY·CHECK has a responsibility to protect the environment and to make it real. The near future to come with smart city sooner and better, is not far away, with HY·CHECK.

- The End