A Direction for Promoting IoT/Cloud-based Informatization for the 4th Industrial Revolution

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Abstract

In this paper, a constructing direction of the ICT infrastructure of the e-government for 4th industrial revolution was researched and analyzed. For this process, the ICT technologies, such as IoT, big data, cyber physical system and artificial intelligence, to play an important role in the 4th industrial revolution were examined and analyzed. Author proposed AI based on smart administration technique and data sharing system. Finally, to construct Hubogent(Humanized Robotic Agent) for actualizing the public smart administration and intelligent citizen services to be carried out by the government, the IoT/Cloud-based Hubogent architecture that carries out a convergence among IoT, big data, cyber physical system and artificial intelligence was designed.

Keywords*: Hubogent, e-government, ICT infrastructure, Cyber Physical System, smart administration.*

1. Introduction

In the aspect that the 4th industrial revolution is expected to automate human intelligence through IoT(internet of things), big data, cyber physical system, AI and 3-D printing technology, it is possible to differentiate such 4th industrial revolution from the 1st/2nd/3rd industrial revolutions that automated physical activities of humans. The 4th industrial revolution that emphasizes the hyper-connectivity and hyper-intelligence has been recently recognized as the intelligent information society in Korea. CPS(Cyber Physical System) and AI are two of the various technologies included in the 4th industrial revolution that are considered very important. CPS is a system that decides whether or not to control humans and things in the real world through using big data and AI in the cyber computing world to analyze various sensing data collected from the physical real world. CPS is a system that serves either as a space for real world and cyber world to interact and cooperate or as a space for humans and AI to interact and cooperate. [1]

CPS supports humans to make decisions through adding a function that controls the real world to the preexisting system mainly used for monitoring. CPS autonomously prevents dangerous situations and takes immediate countermeasures against outbreak of accidents.

For example, the sensing data that determine whether or not a bus driver is drowsy through the real-time monitoring of the driver's face/eyes and the sensing date that determine the driving status, such as road departure, can be collected into and analyzed by the remote monitoring system through the IoT technology. Then, provided that the situation is analyzed to be dangerous, preventive information can be delivered to the driver to prevent a full-scale accident in advance.

In this research, it was suggested to expand the use of such technology into all the fields, such as administration, safety, disaster, security and distribution, that require real-time full-cycle management and control.

2. A Direction for Promoting Informatization for the 4th Industrial Revolution

2.1. Promoting IoT (Internet of Things)-based Smart Informatization

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It is necessary for the government and companies to promote the innovative smart informatization based on the sensing data coping with the 4th industrial revolution rather than simply computerizing the preexisting tasks. Namely, it is necessary for the government and companies to promote the informatization that can not only support the persons in charge of tasks, but also support the decision-making for every task process.

Up to the present, all the public institutions and companies have promoted computerization in all administrative fields with a purpose to computerize the electronic government services as well as the tasks. However, because such informatization system is rather a task-supporting system than an essential task system, its utilization is quite low. Moreover, promoting the preexisting informatization does not relate to promoting the intelligent informatization that uses the real-time sensing data and big data of IoT. Accordingly, some employees in charge complain that their tasks tend to increase every time a new information system is developed.

The smart informatization can be signifies as developing and maintaining a system that corrects the errors experienced by the persons in charge of actual tasks, supports their decision-makings and innovatively decreases the processing time. For the case of preexisting informatization, to use the structured data required for a task, the consultants conducted ISP, the SI experts developed a system based on the SI development methodology, and the persons in charge of the task used that system based on the given task process. On the other hand, for the case of smart informatization, research and development activities are conducted to examine how to use the structured and unstructured data, namely, the SNS and IoT sensing data, for applying the smart administration to the actual task, the experts from the companies specializing in development conduct development, and the persons in charge of the task cooperate with Hubogent (AI agent) to support the task process [1].

IoT is capable of assigning a sensor and ID to all things. As shown in Table 1, diverse communication methods can be used to monitor all things to be managed in real time.

Table 1. A Comparison of Wireless Communication Technologies for IoT[Source: National Information Society Agency]

Type	Form	Power consume	Speed	Range	Apply	Cost
RFID	P2P	very Low	400kbs	< 3M	TAG	Low
Bluetooth	Star	Low	700kbs	< 30M	data transfer	Low
Zigbee	Mesh, Star	very Low	250kbs	10-300M	sensing	Medium
Wi-Fi	Star	Low ~ High	11-100Mbs	4-20M	internet	Medium
WirelessHART	Mesh, Star	very Low	250kbs	200M	industrial sensor	Medium
LoRa	Mesh, Star	very low	300kbs	21Km	industrial sensor	Low
Wi-MAX	Mesh	high	11-199Mbs	50Km	broadband	High
3G/4G	Mesh	high	1.8-7.2Mbs	Cell	cellular phone	High

As shown in Table 1, IoT is a technology that uses diverse communication technologies, such as RFID, NFC, WIFI, Bluetooth, ZigBee, LoRa, GSM, 3G, LTE and satellite communication, to connect the things that exist in the physical/virtual spaces through the internet. It is a system that provides real-time services through using diverse sensors to send and receive information. LoRa (Long Range) is the most recently released technology among these technologies. This technology has been attracting the interest since it features a long range transfer. SKT and others have started servicing LoRa technology. It can be used to efficiently monitor and control various things, such as cultural assets located in outer regions, that are exposed to the risks of disaster in real time.

As a result of tracking various incidents such as Meokgeori X-File and Seomun Market fire, it was clarified that it is important to conduct real-time management and full-cycle management. Unless the full cycle of food used in schools is managed under a system where 1) Ministry for Food, Agriculture, Forestry and Fisheries is in charge of source materials, 2) Ministry of Land, Infrastructure and Transport is in charge of distribution, 3) Ministry of Trade, Industry and Energy is in charge of processing, 4) and Ministry of Health and Welfare is in charge of its safety, students will continue to suffer from food poisoning due to the poor quality of meals provided at schools. In addition, it would

be impossible to apply smart informatization just based on the authentication and informatization systems used for discovering causes after accidents happen.

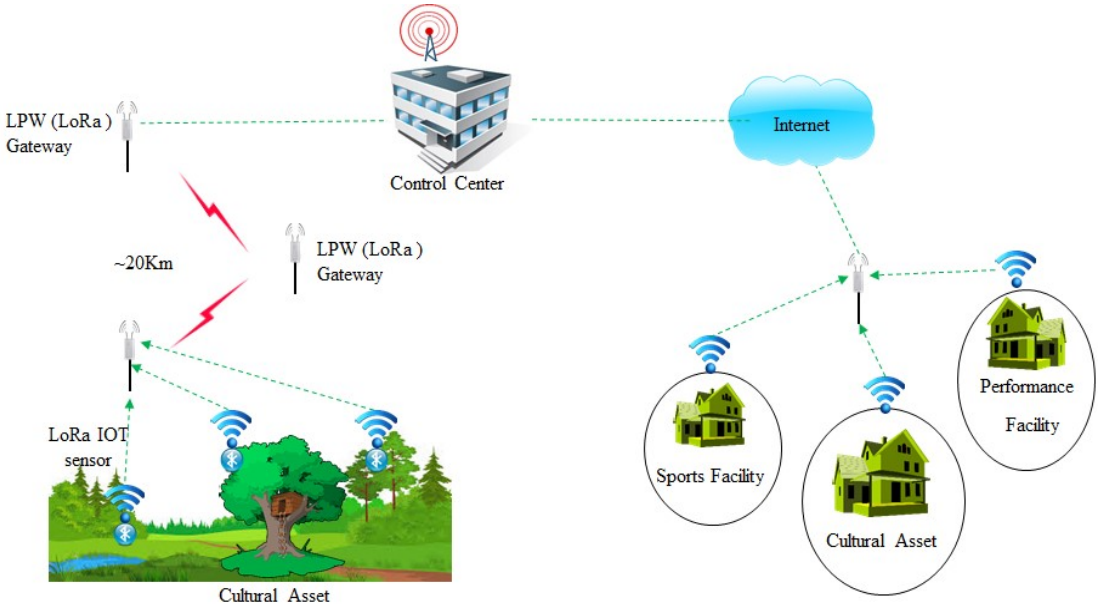

Figure 1. A Concept of Lora-based Real-time Cultural Facility Monitoring System.

The information system that uses IoT is different from the legislation and certification system. Because an IoT sensor can be used to monitor and analyze the full cycle of the case in real time, it makes it possible to carry out the preventive administration before it is too late. Without requiring a person in charge to carry out monitoring for 24 hours, the system autonomously senses and processes the case. Figure 1 shows a LoRa-based real-time network concept that relates to the cultural assets existing in the forest regions, such as national park, and the performance/sports facilities managed by Ministry of Culture, Sports and Tourism. As shown, the smart informatization is different from the preexisting task computerization in that it uses the sensing data to provide support for the actual tasks.

2.2. A Sophistication of AI-based Smart Administration & Citizen Services

Using AI technology and big data analysis is considered one way of sophisticating smart administration and citizen services. Such smart administration can be diversely defined. However, in this research, such smart administration is defined as a method that uses data and AI to processing administration without having to rely on experience or ask for opinions from experts. For example, in a situation where a person in charge has to process administrative tasks or a decision maker has to approve of administrative tasks, without having to rely on their memory to apply the law and regulation or without having to inefficiently search for and apply the legislations, the AI-based smart information system can be used to secure reliability and efficiency through recommending the law article. In many cases, the law and regulation are required to be applied to the administrative tasks carried out by the government. However, because the position assignment frequently changes and the law regulation frequently change, there are limitations in accurately applying the updated law and regulation. If there is an intelligent information system that re-confirms whether or not the task processed by a person based on one's experience and knowledge violates the related legislations, namely, if there is a searching system that lists similarly processed cases to be used as a reference and if there is an AI-based engine that lists suitable law and regulation, a person in charge will be able to carry out smart administration with reliability and efficiency [3,4,5,6].

Figure 2 shows how the smart administrative process system for the forestry task is configured.

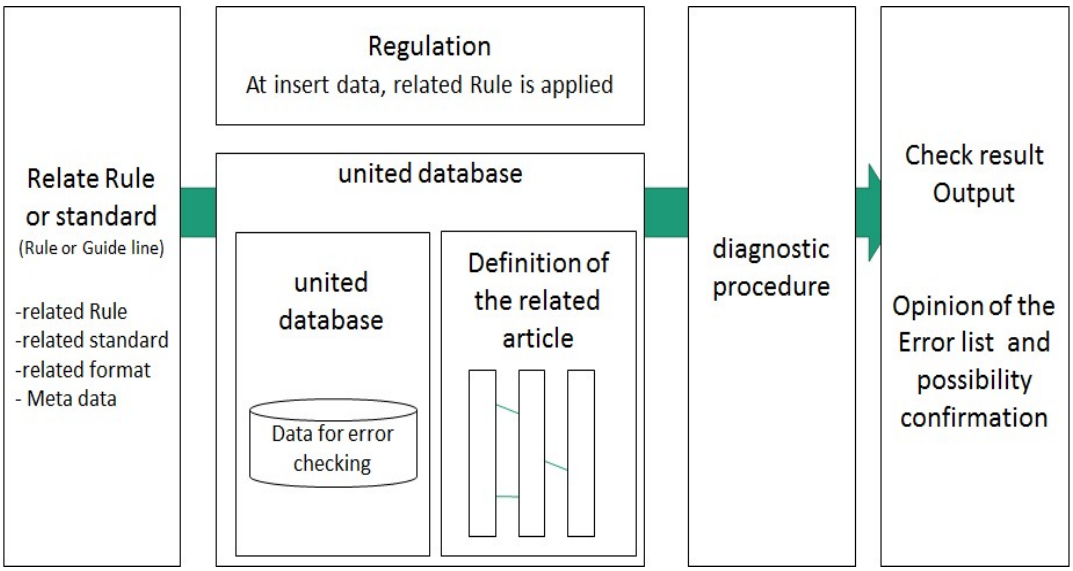

Figure 2. A Configuration of AI-based Law/Regulation Application Support System

Figure 2 shows how the AI-based smart administration is processed. Namely, Figure 2 shows configuration of a system that enhances reliability and efficiency of administration through supporting the law and regulation application process. The scenario of how this system will be used is as follows.

- In the case where a person in charge is required to carry out administrative tasks, related regulations will be automatically matched to print out data of related law and regulation.
- Similar to how the legal case searching is actualized, the searching system will be actualized and used to find similarly processed cases that can be used as a reference.
- In the case where a person in charge of application of laws and regulations or an administrator in charge of decision making is required to carry out tasks through the system, this system can be used through typing in title and information of the task to be processed and clicking on the related law search menu to list results searched based on the written information. Then, titles of law and regulation relating to the task to be processed will be brought up from the regulation database. By clicking on the law relating to the task to be processed, this system will find and propose the article relating to the task to be processed.

2.3. IoT/Cloud-based ICT Infra Architecture for the 4th Industrial Revolution

It has been said that the 4th industrial revolution will appear through a flexible intelligent production system based on the cyber-physical system. The informatization system and automated system in the preexisting 3rd industrial revolution featured monitoring or already-determined control. However, the smart administration system in the 4th industrial revolution that uses AI is significantly different in that it features intelligent control through providing the feedback on the results continuously learned, reasoned and determined to the real world.

Cloud computing (simply known as “Cloud”) is a unit-based system for paying for the cost of the computing resources ranging from app to data requested by the users through the internet. Depending on the computing resources provided in the Cloud service, it can be divided into IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). Initially, IaaS is the Cloud service that is most frequently spoken of. Namely, it is a service that allows the users to use the required hardware resources stored in virtual

environments such as server and storage. For example, KT's U Cloud Server and Hostway's Flex Cloud count as IaaS. Secondly, SaaS is a service that allows the users to use the required softwares and related data through the web or smartphone app. For example, Google Apps, Saleforce and IBM Smartcloud Notes count as SaaS. Lastly, PaaS is a service that provides a platform for development/execution along with IaaS to allow the users to use the service without having to separately construct a platform for executing SaaS. For example, Google API and Naver API count as PaaS.

Figure 3 shows a concept of the CPS-based smart administration system that uses an AI agent known as Hubogent [7,8].

As shown in Figure 3, various Cloud-based AI agents for smart administration, such as dangerous distribution, disaster and safe food, can be serviced as a development platform in the PaaS stratum, and not only the server storage, but the IoT sensor-based IaaS infra can be designed based on the Cloud in which the IoT, big data, cyber physical system and AI are converged. In particular, within the CPS-based cyber world, the big data collected from the physical world can be analyzed to provide support for the decision makings relating to the cultural administration. Moreover, the system itself will be able to smartly prevent disasters and provide cultural services on its own.

2.4. Connecting Data Sharing for the 4th Industrial Revolution

It is necessary for the public institutions and companies to secure a system where the data stored in the application systems owned by the numerous affiliated/subordinate institutions and involved institutions can be connected and collected in order to process the AI-based smart administration. The data sharing through the data connection not only enhances the system efficiency, but also creates new task functions and new task-applicable fields. A while ago, Ministry of Education conducted a complete enumeration survey on long-term absentees from schools. As a result, approximately 2900 students were absent from their schools for more than 3 months. As a result of precisely analyzing the survey, it was found that a lot of these students were deceased. As a result of cooperating with National Police Agency, the murderers were found as well. Accordingly, the most immediate measure to be taken by Ministry of Culture, Sports and Tourism is to establish governance for the data connection, data collection and storage [9,10,11].

In addition, it is necessary to organize an algorithm research group to specialize in analyzing the big data in order to successfully promote the big data. Such big data stood out as an hot issue a few years ago and a number of institutions constructed a big data platform without properly understanding what such big data is. Accordingly, such institutions are unaware of what to do with such big data platform, they lack objectives and are incapable of defining the data to be used. In particular, since they lack algorithms for analysis, it is impossible to practically utilize such platform.

On the other hand, it is necessary for the public institutions to create not only the services for cultural industries and companies but also the citizen services through analyzing the big data. Since the big data is useful for analyzing trends, hidden needs and characteristics per each user, it is necessary to analyze the characteristics of the cultural industrialists and cultural service users to provide the cultural services customized per each user.

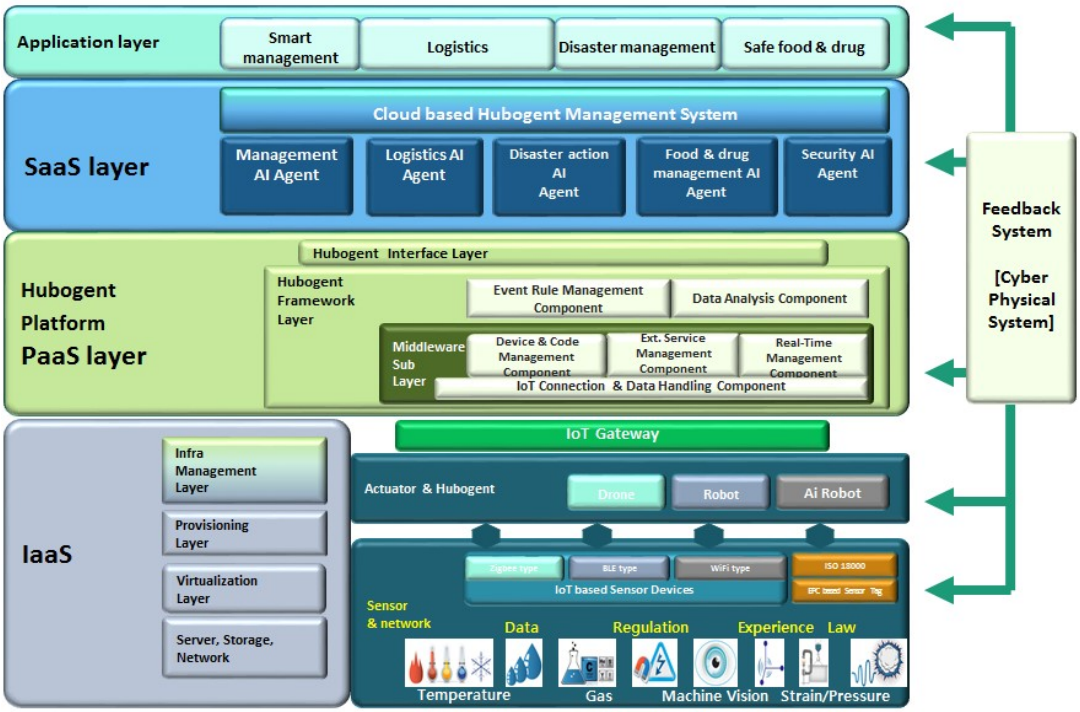

Figure 3. A Concept of CPS-based Smart Administration

3. Conclusion

Korea lagged far behind other nations in the 1st and 2nd industrial revolutions. Fortunately, Korea partially played a leading role in the 3rd industrial revolution. For Korea to play a leading role in the 4th industrial revolution, it is necessary to 1) construct ICT-based infrastructures, 2) expand mind, 3) cultivate personnel, and 4) construct institutional infrastructures.

The author proposed Hubogent Platform, which is used for collecting/analyzing data in real time and intelligently controlling the real world, as the most urgent ICT infrastructure to be constructed to prepare for the 4th industrial revolution. The ICT infrastructure for the proposed Hubogent was designed based on the IoT/Cloud that create a convergence among IoT, big data, cyber physical system and AI. It seems necessary to include the field of smart administration proposed in this thesis into the plan being set up by Ministry of Science, ICT and Future Planning for making a focused investment in R&D of AI and intelligent information technology. The public institutions will be able to use the proposed Hubogent platform to 1) conduct smart administration, 2) monitor and control dangerous goods, 3) predict and respond to disasters, 4) and provide citizenship services such as safe food. In addition, various industries will be able to 1) increase productivity, 2) enhance quality and service, and 3) cultivate new growth engines.

In order to promote the smart informatization proposed in this thesis, there are task to be immediately processed based on the cooperation between the government and ICT experts.

It is necessary to construct the CPS platform based on IoT, Cloud and big data at a government level. It is probable that the involved companies will compete to construct CPS required in the smart factory. However, it is necessary to construct the CPS platform at a government level to secure safety and serve public purposes. The ICT experts are required to develop the applicable sensor and technology as well as the platform technology to be commonly used by various ministries in diverse industrial fields. The ICT experts need to develop AI that can defeat Lee, Sae Dol instead of pointing out that they have been

studying AI for a long time and that big data is not a new concept. In addition, the ICT experts need to stop pointing out that the IoT technology is likely to fail just as the RFID/USN technology did. They need to stop bragging about the experimental product that has been already developed, Instead, the ICT experts need to develop an actual system that is commonly applicable to the CPS platform.

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