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Smart Device and Internet of Things (IoT) Convergence Technology Trends

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Abstract: Recently, with the rapid spread of smart devices including smartphones, the paradigm of the mobile communication industry is shifting from 'voice call' to 'application', and consumers' perception of information is a process of "development, sharing, participation, and diffusion" I started to pay a lot of attention to the use for personalization and lifestyle change through In particular, due to the recent rise of the Internet of Things (IoT), through interworking with IoT (Internet of Things) and smart devices, we are providing an individual-centered, life-friendly sensor app service that directly processes or controls information collected from nearby sensors. Various attempts are being made to provide it. In this paper, we will look at domestic and international trends in convergence technology with IoT, along with examples of interworking and application of sensors in smart devices.

I. INTRODUCTION

At the same time as the launch of the Ministry of Science, ICT and Future Planning in early 2013, interest in sensor devices was once again amplified. Recently, the Ministry of Science, ICT and Future Planning mentioned IoT and sensor technology as one of the key research areas for the future, and emphasized the importance of network and communication technology that can weave these sensors [1]. The sensor network technology, commonly referred to as USN (Ubiquitous Sensor Network), has already been studied from various angles at various domestic research institutes, so domestic researchers have secured many technologies [2][3]. Sensor network technology, which plays a large part in the Internet of Things (IoT), uses low-power and ultra-small sensors to collect and manage environment variables from a macroscopic point of view that we have not encountered before.

In the past decade with sensor network technology, we have experienced an unprecedented smart device revolution. Through this revolution, smart devices that were previously thought of as PCs and notebook computers were diversified and released, and important parts of daily life were introduced. became occupied Examples of such smart devices include smart home appliances, such as smart phones, which are commonly encountered, and smart TVs, which are rapidly spreading in recent years. Recently, smart devices provide the ability and framework to create new application services using their own built-in sensors, and the values of the built-in sensors can be utilized according to the convenience of users and developers. Built-in sensors include an accelerometer, GPS, proximity sensor, and camera, enabling the development of various sensor-based application services.

However, due to the size, price, and limited space of the smartphone sensor, it is not possible to embed all of the various sensors, so there is a limit to satisfying the needs of various users. For this reason, as shown in Figure 1, recently, information is collected by using various sensors located outside through interworking with the Internet of Things, or data is collected from smart devices. Smart device applications can provide various services by utilizing external sensor information in addition to the existing internal sensors.

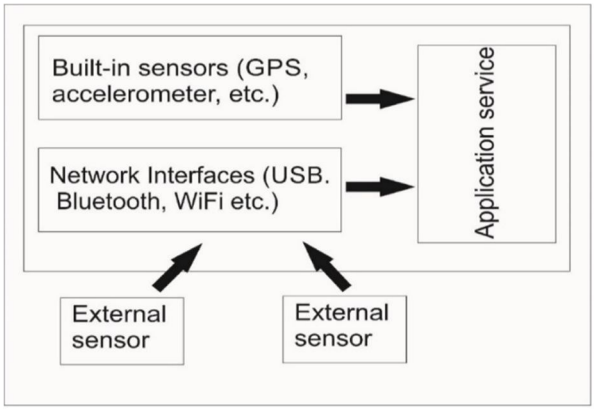


Figure 1: Convergence between smart devices and external sensors

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There is a lot of interest in and discussion on the development of technology that can be controlled at a high rate. For example, mobile smart devices (for example, by collecting information from various fixed environment and weather sensors scattered around the smartphone can utilize various environmental information including real-time temperature and humidity of the current location.
In particular, the trend of applying sensor network technology to domestic home appliances is gradually increasing. According to the service operation status by domestic USN field, it is rapidly increasing from 9. 4% in 2007 to 21. 4% in 2012. Convergence between smart devices and IoT Technological trends are noteworthy.

II. APPLICATION EXAMPLES

Efforts to develop new applications by applying external sensors to smart devices are being actively carried out at home and abroad.

A. Healthcare Sector

Among the fields where the most diverse types of sensors are actively developed in the field of healthcare, sensors using networks such as USB, Bluetooth, WiFi, and NFC are being developed. These sensors include a sensor that acquires a patient's biometric information and a sensor that measures an individual's exercise amount or body characteristics. Recently, Samsung Electronics introduced the S-Health service for the realization of telemedicine service [4]. This service is an application that allows patient-related biometric information, such as weight, blood sugar, and blood pressure, to be transmitted directly to a smartphone via Bluetooth or USB and easily recorded. Through this convergence service, patients can receive faster health care services, and medical staff can proceed with patient care using more accurate information.
Similarly, Qualcomm of the US recently announced '2net', a machine-to-machine (M2M)-based data platform service that stores health-related information. If various health care applications using smartphones are released in the future, it is expected that the number of medical equipment that checks not only body information such as weight and blood pressure, but also sleep and electrocardiogram will increase. The increase in such equipment is expected to provide services that can be easily approached to users by interworking with smart devices [4].

B. Public Welfare and Construction

While healthcare-related services are services that help manage personal information efficiently, sensors managed from a national or urban point of view can be used for individual needs through the convergence of sensor nodes and smart devices. It is also possible to create applications.
For example, the US city of San Francisco recently announced plans to provide intelligent parking services using smart devices and wireless sensor networks. Called SFPark, the system an application service that installs about 6,000 sensors in 20,000 parking spaces in the San Francisco area and helps to identify the parking space using a free map for smartphones [5]. In addition, in places where parking fees have to be paid, payment using a smartphone is possible. As such, applications using smart devices and external sensors not only increase user convenience, but also enable the city to pursue resource conservation in the short term and environmental conservation in the long term by increasing fuel efficiency of individual vehicles. As another example, Valarm, a US company, recently combined a building sensor with a smart phone, allowing users to connect various sensors to a smart phone using USB, so that the information collection process can be performed from a variety of angles. By analyzing living environments such as illumination, an application system that makes building energy management efficient was commercialized and presented [6].

III. BASED TECHNOLOGY TREND

There are various ways to build a system for convergence of smart devices and external sensors. In this paper, the contents of the two most widely used and researched methods are introduced, and how the collected sensor information can be managed in smart devices and their methods will be examined.

A. Internet-Based Convergence

According to the recent sensor network research trend, it breaks away from the existing independent network management method and creates an environment where IP addresses are allocated for efficient information sharing with other objects on the Internet and direct communication with other network objects is possible. It is in focus [7]. In particular, IPv6 (Internet Protocol version 6) note for independent IP (Internet Protocol) address assignment to multiple sensor devices. Smart devices and sensor devices are all connected to the Internet to share information.

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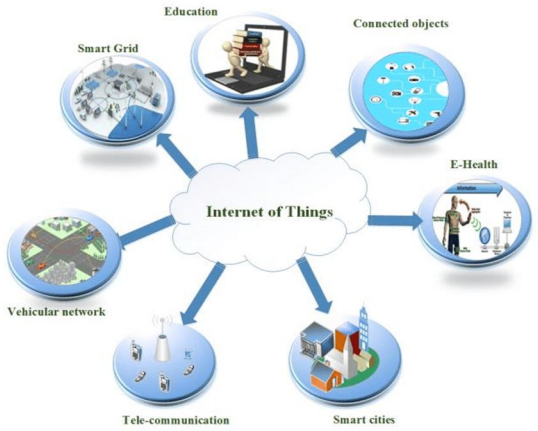


Figure 2: Internet connection-based sensor/smart device convergence technology structure

IETF (Internet Engineering Task Force) standardized various protocols using the sub-system. These protocols allow each sensor device to be recognized as an Internet object, organize the address system (8), and provide a routing environment using RPL (IPv6 Routing Protocol for Low-power and Lossy Net works) protocol 9, application It defines the transmission method of the layer [10]. This provides an environment where sensor devices connected to the Internet can easily collect information. While this easy access to information is an advantage, there are disadvantages such as a security problem for information and a lack of smooth service when Internet access is not smooth. As a result, Internet-based information fusion has a centralized network structure as shown in Figure 2, in which smart devices collect information on the web or cloud and sensors upload information.
However, since it provides an efficient communication method in an environment with an Internet connection, many smart device applications are currently receiving external sensor information in the same way as above.

B. Direct Fusion Between Devices

Unlike the method in which both sensors and smart devices exchange information based on internet connection, it is a method that enables direct communication between the two types using the network interface built into the smart device and the sensor. As the communication method, technologies such as wired USB, wireless Bluetooth, IEEE 802. 15. 4 (Zigbee), RFID (Radio Frequency Identification)/NFC (Near Field Communication), WiFi, etc. can be utilized. It has the advantage of being able to build an independent, personalized and stable network that is not bound by enhanced security functions or other network conditions while avoiding Internet access for communication. As can be seen from Figure 3, various smart devices already in our lives are by supporting various networking methods, this direct small-scale networking method is possible.

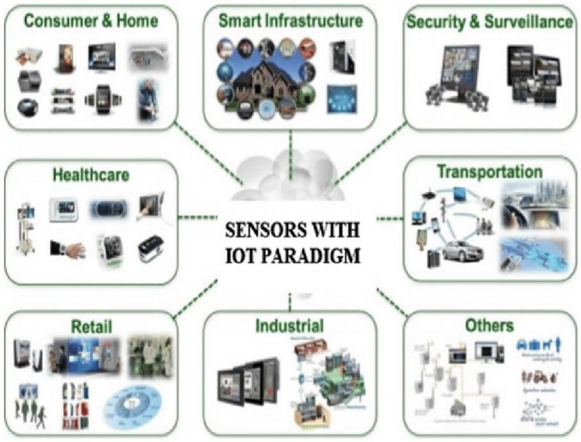


Figure 3: Sensors and applications using direct connection between external sensor equipment and smart devices

Examples of systems and sensors that use this communication method include personalized health care sensors such as Nike's Nike Plus [11] and Zephyr Bioharness Remote Physiological Data Monitoring Sensor [12], as shown in Figure 3.

C. Sensor Information Management

By using the above two methods, the Information can be gathered from smart devices, but the next technical question is how to process this information. Research to provide such a sensor data processing framework is still in its infancy, but it is actively progressing. One example is the ODK sensor framework announced by the University of Washington researchers. ODK is an abbreviation for Open Data Kit. The proposed ODK sensor framework has a sensor managing layer to store and manage sensor information coming from outside. It is a framework that does [14]. As shown in Figure 4, it collects and manages information from external sensors to efficiently deliver it to the application layer, and unlike the existing information management middleware, it abstracts the networking layer to make it easier to develop application services for smart devices. It can increase the performance and reduce the probability of software errors.

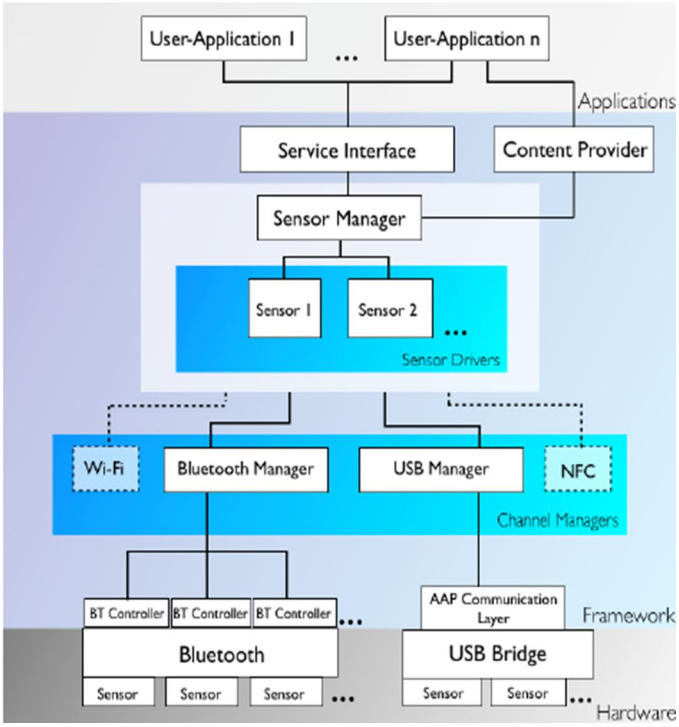


Figure 4: Structural diagram of ODK sensor framework

The advantage of middleware such as ODK sensor framework is that it provides a more efficient resource management environment by allowing multiple application services to jointly utilize information received from one external sensor. It also manages resources by allowing you to manage the security of sensor information in one place efficiency can also be increased.

This effort goes beyond the effort of simply physically connecting the information of an individual's surrounding sensors with the smart device, and analyzes individual characteristics using the smart device's built-in sensor, and then sends and receives sensor information between users with similar data characteristics. It leads to the development of a framework that provides an enabling software environment. An example is Community Similarity Networks (CSN) published by Dartmouth College [15]. CSN analyzes users' behavior and finds similarity between various smart device users. Based on this similarity, CSN analyzes the user community and provides an environment in which to derive application services that provide personalized sensor information services at lower prices using crowdsourcing-based methods.

As mentioned above, ETRI has also developed an SVM (Sensor Virtualization Machine) that can directly collect or control various sensor information located outside through interworking with an external sensor network to virtualize the information collected from the sensor. We are developing a common platform for smart device-based sensor terminal support software that can easily develop or apply various sensor-based application services and sensor apps. SVM, which is being developed by ETRI, stores and manages information provided by existing software. In addition to the purpose of Lee, it enables the creation of new virtual sensors through fusion and mashup between sensors through abstraction work [16]. Newly developed applications can avoid the hassle of modifying the networking layer every time by using SVM, and have the advantage of helping the application development process for smart devices more easily by using and manufacturing various types of sensors. have.

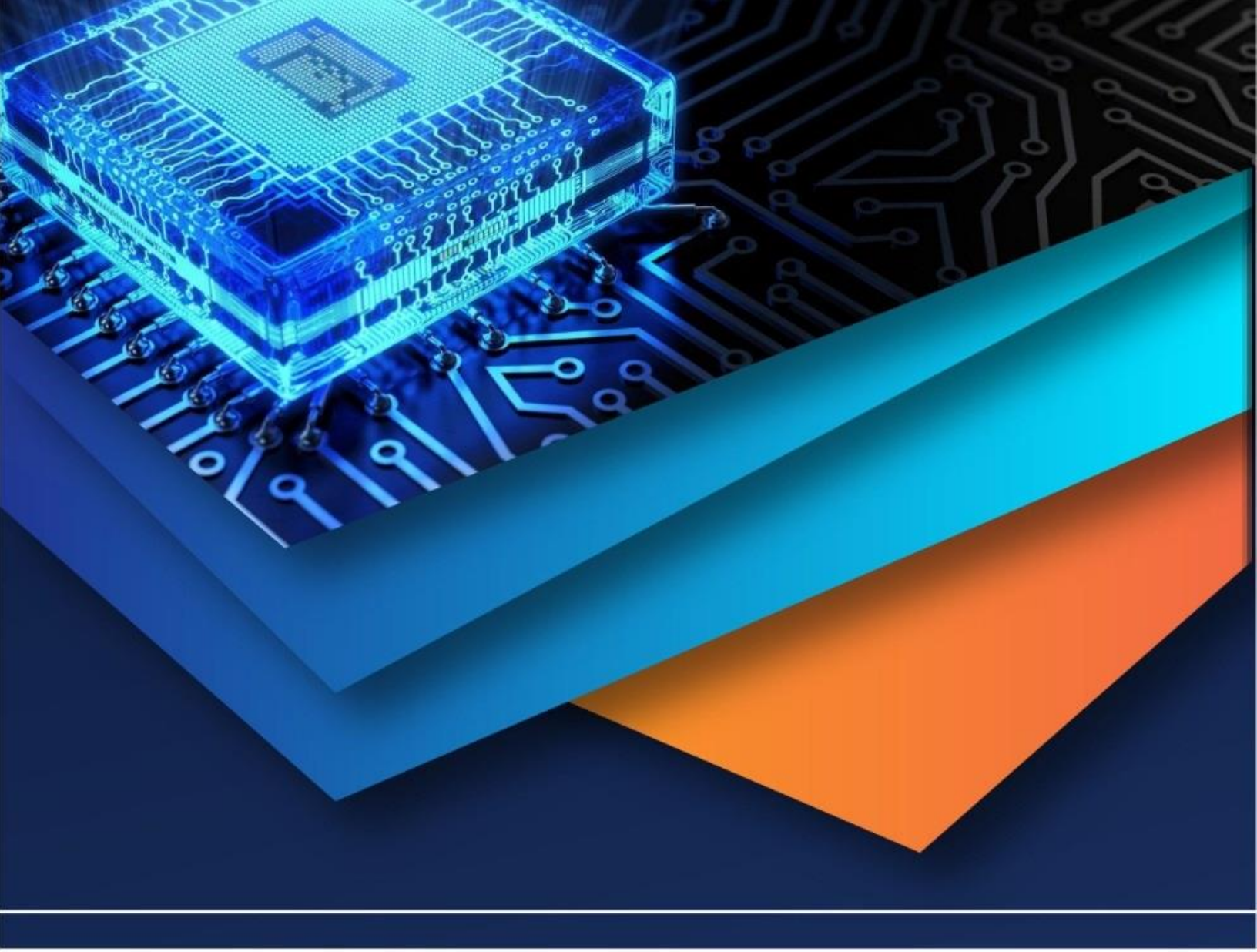
IV. CONCLUSION

In this paper, IoT convergence that can provide a new personal-centered life-related service through the opening, sharing, distribution, and participation of sensing information through linking with smart devices through sensor network information that has been used separately and closed until now Technological trends were examined. To keep pace with the growing needs of users, various smart devices such as smartphones and smart TVs move away from existing methods and applications that utilize built-in sensors, and through convergence with IoT, external sensors are It is predicted that various research and development will be carried out to realize this, along with the change to a new paradigm that is utilized and controlled to communicate with humans. The convergence of smart devices and IoT is expected to play a leading role in creating a new ICT convergence industry that unites the real world and the virtual world. However, such research is only a basic technology that can study new applications and services. In the future, based on the various software frameworks introduced above, it is a time when research on new application systems is required through convergence with more diverse research fields.

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