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**【論文の内容の要旨】**

The aging of society has received considerable attention as a social problem. Provide monitoring and health support services for the elderly is very important to ensure the Quality of Life (QoL) of the elderly, Provide monitoring and health support services for the elderly. In the context of the ever-expanding demand for nursing services, we should pay attention to a severe shortage of professional caregivers. The research and development of smart home can greatly reduce the workload of caregivers. Internet of Everything (IoE) including Internet of things (IoT) known as an advanced paradigm to connect physical and virtual things for enhanced services, has been introduced to provide significant improvements in remote elderly monitoring.

Nowadays, various research and developments on smart home and IoT monitoring systems have been done, but we must solve practical problems on implementation and operation in the smart home. In general, the initial implementation and operating costs of smart home often become high. Furthermore, it is difficult for elderly people to customize the selection and layout of the devices, to update the parameters of smart home, and to choose the suitable healthcare service. Therefore, to solve the above problems, I put forward the concept of Healthcare as a Service (HaaS) for smart home. First, I propose a low-cost, easy-to-use, and human-centric care platform based on HaaS

and Informationally Structured Space (ISS). The proposed smart home platform can freely manage three main compatible components of measurement layer, analysis layer, and service layer. To maintain compatibility, we propose a general preprocessing scheme to meet the needs of behavior measurement with environmental sensor data. Furthermore, I design an initial set-up method based on human behavior analysis without direct human customization and re-learning in a variety of different scenarios to realize the easy implementation. Next, I develop a HaaS-based service integration system to realize human-friendly operations. Finally, I discuss the effectiveness of the proposed system through various types of experiments on healthcare services.
The thesis consists of six chapters.

Chapter 1 discusses the background and related research. The research purposes and goals are also clearly explained in this chapter.

Chapter 2 presents the survey of current smart home research. Through the analysis of core concepts such as IoE, HaaS, and ISS, which are inseparable from smart home, we clarify the research and development goals of this thesis. To solve the practical problems discussed in chapter 1, I propose the smart home platform based on HaaS. To clarify the design guidelines, I discuss the healthcare system platform defined by three layers: the measurement layer, the analysis layer, and the service layer. Next, I define the function and structure of each layer. The measurement layer is used for obtaining sensor data and perform basic processing; the analysis layer is used for user behavior analysis, and the service layer is used for providing services through service robots and smart devices.

Chapter 3 explains the physical structure of the human-centric IoT system from the perspective of sensor selection and measurement. First, we discuss a selection method of sensors based on the actual needs of users. Furthermore, we explain the problems and challenges faced by non-contact environmental sensor systems. Next, given the characteristics of human activities and the integration of multiple sensors, I propose human behavior estimation by using a spiking neural network, which could effectively process sensor data from multiple different information sources, and accurately distinguish human activities from indoor non-human-activity noise. The experimental results show that the proposed method can measure human activities using different kinds of sensors.

Chapter 4 designs an easy implementation method according to the user's personalized information without extra cost such as customization and re-learning by a human operator. From the viewpoint of ISS, I first develop a monitoring system that includes servers, sensors, and smart devices for users to enter their personalized

information in advance. Next, I design a fuzzy inference-based spiking neural network, by using the user's personalized information and the pre-designed knowledge-based system. Experimental results show the system can adapt to changing use environments and maintain high accuracy without additional learning.

Chapter 5 explains a human-centric operation layer to provide personalized services. From the viewpoint of HaaS, I design an in-home healthcare system that includes cloud servers. First, I explain the data structure and information flow in the overall system including sensors and service robots. Next, I clarify the functions and characteristics of a service robot in human-centric healthcare. Furthermore, I develop a scenario editor to realize the easy design of healthcare service that can integrate three stages of healthcare services according to (1) the types of sensors connected to the network in the middleware level, (2) measurement results of environmental states and human activities in the information level, and (3) interactive scenarios with a service robot in the knowledge level. I set up a HaaS-based smart home that includes multiple sensors, multiple network protocols, and multiple robots. Experiments prove that when some sensors are disconnected, the system shows stability and can provide personalized healthcare services correctly.

Chapter 6 concludes the thesis and explains the future research directions. The thesis discusses the methodology for constructing a HaaS smart home platform from different points of view to show the efficiency of the proposed human behavior monitoring method.