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Design and Implementation of Intelligent Healthcare Terminal Interface

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Abstract: As the population ages and the number of people with chronic illness increases, the demand for proactive healthcare services is increasing rapidly and the need for health and health care services accompanying the improvement of people's standard of living is increasing. In particular, the study shows that Korea's aging population is much faster than other advanced countries such as the US and France and the elderly population rate is only 8 years from 14% (aged society) to 20% (super-aged society). As a result, the healthcare industry is being fostered and enhanced by the next generation power industry. As healthcare terminals are emerging from time to time, the Continua Health Alliance International Industry Partnership has been established with Philips in 2006. In this study, it suggests a gateway interface system for Continua authentication which can control each different heterogeneous communication terminals through an intelligent healthcare interface design suited to the international certification of Continua.

Key words: Continua, health care, certification, aged society, illness, Korea

INTRODUCTION

The standardization related to u-Healthcare has a strategic value as a means of securing dominance in the domestic and foreign markets and securing the initiative for technology development in high-tech fields beyond the level of establishing a simple protocol. There are IEEE11073, HL7, ISO/TC 215 and CEN.TC 251 as international health and medical information standardization development agencies. In recent years, ISO/TC 215 has been working with the three organizations to cooperate with each other to establish standard harmonization agreements to accelerate the development of standards. The u-Healthcare business requires standardization to ensure interoperability. In the future, all healthcare products must be able to sell products only if they comply with international standards.

The purpose of this study is to design an integrated gateway for international recognition of Continua that can connect various communication methods such as Bluetooth and Wi-Fi used for data transmission of an increasing number of healthcare terminals in the aging society.

Main subject

u-Healthcare: Figure 1 shows 3 technologies to provide u-Healthcare service with u-Healthcare element technology. The first is biological/life information sensing technology that measures biometric information and living information necessary to provide u-Health care service. Second, it is a bio-information/living information sensing technology that provides biometric information andlife information to bio-/life information analysis technology and the third is u-Health care application service technology including warning, risk situation support, device terminology, network platform, service protocol, information protection, examination and authentication necessary for u-Health care application service, respectively (Kang *et al*., 2007).

There are IEEE11073, HL7, ISO/TC 215 and CEN.TC 251 as the international health and medical information standardization development organizations (Anonymous, 2014). Recently, the standard harmonization agreement with the three organizations cooperating with ISO/TC 215 has accelerated the development of standards.

To enable interoperability between personal and health care devices and services, the Continua Health Alliance an open industry organization formed in January 2006. There are Integrating the Healthcare Enterprise (IHE) which verifies the interoperability of the profiles presented through Connection and adoption/validation of interoperability standards with medical institutions/systems which provides profiles.

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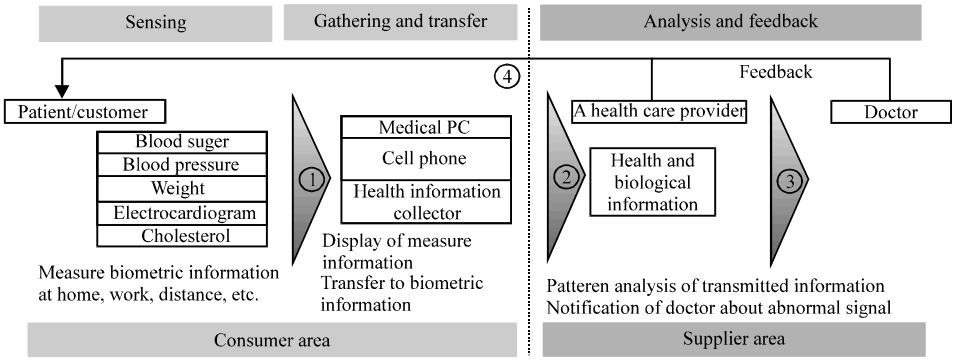

Fig. 1: u-Healthcare element technology

MATERIALS AND METHODS

Continua health alliance: Continua is an international industry partnership that was established in 2006 to help telecommunication, healthcare and fitness companies achieve interoperability through standardization of u-Health sector which is expected to become a next generation new growth engine industry.

It aims to provide consumer-oriented, reliable u-Health service by establishing a certification logo program to adopt and verify various communication standards required for data transmission from personal health devices to medical information servers at home.

Currently, about 30 members of promoter such as Samsung, Intel and Philips and about 225 contributor members including TTA (Telecommunications Technology Association), SK T elecom, ETRI participate and work.

ISO/IEEE 11073 personal health device: Figure 2 shows the general structure of a personal healthcare system used in u-Healthcare and personal healthcare devices such as blood pressure monitors, scales and pedometer collect patient information and transmit information to managers such as cell phones, medical devices and computers. The manager can send data to the remote support service for precise analysis (Anonymous, 2016). Information refers to disease management, medical and health information and physical information. In general, assuming that the communication path between a personal health device and a manager is a logical point-to-point connection, a personal health device communicates with a manager.

Managers can simultaneously communicate with multiple personal health devices using separate point-to-point connections. Figure 3 shows the ISO/IEEE 11073 Personal Health Device (PHD) standard for interoperability of personal health devices which consist of personal health devices and managers (Park *et al*., 2010).

Intelligent healthcare integrated gateway design: The Continua Design Guideline is designed to ensure the interoperability of Continua products by referring to the standards of ISO/IEEE and the standards of each interface. It is designed according to the design guidelines of each interface that Continua has provided to its member companies. PAN (Personal Area Network) interface is a process of measuring user's medical information and transmitting it to AHD (Application Hosting Device) in u-Health medical device which is the starting phase in end-to-end architecture. The following three basic requirements are satisfied in order to provide services through the internet.

The first is the bi-directional sensor control, the second is the exchange of bi-directional sensor information, the third is the proper combination of the PAN device and the application hosting equipment. Continua uses ISO/IEEE Standard 11073-20601 for optimized exchange of information through the PAN interface on the exchange protocol layer (Fig. 4).

The Wide Area Network (WAN) interface measures the PAN interface and delivers the health information data that has reached the AHD such as Gateway, Mobile Phone and PC in the home to one or more other servers.

The WAN interface acts as a WAN Observation Sender Device (Episodic, Batch, Streaming) and a WAN Observation Receiver Device (Fig. 5). The healthcare gateway is built on Embedded Linux for low cost production (Fig. 6). Although, BoA webserver does not have the same performance as Apache, it is a very small server program for providing web service on embedded devices. Therefore in this study, wireless communication environment setting, healthcare device environment

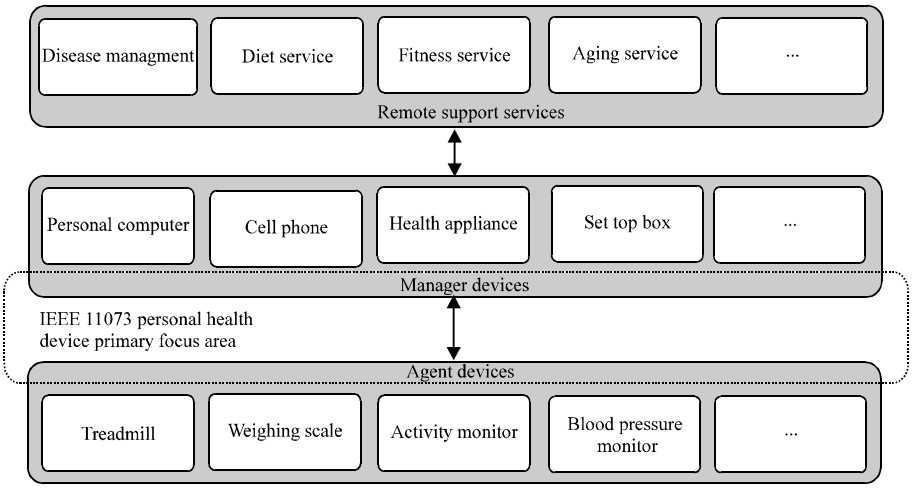

Fig. 2: Structure of a general medical system

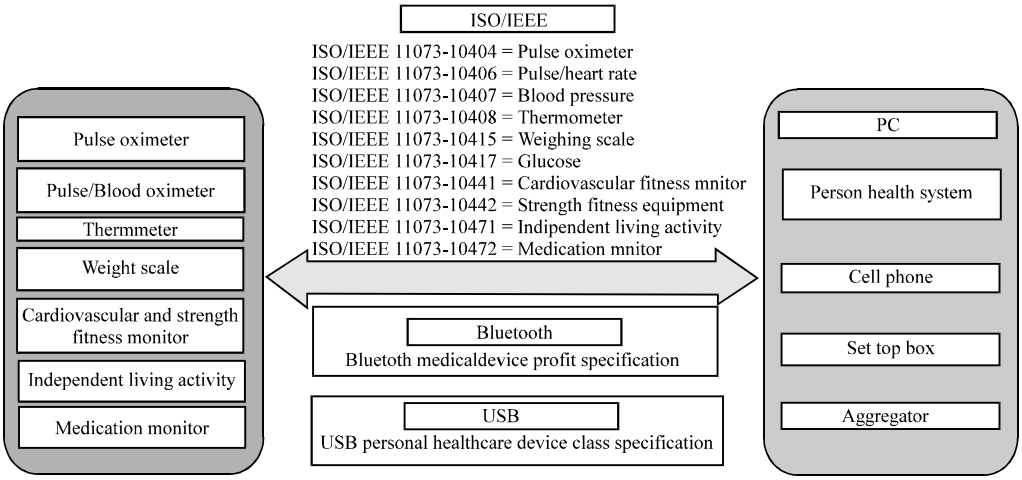

Fig. 3: IEEE 11,073 PHD Standard Model

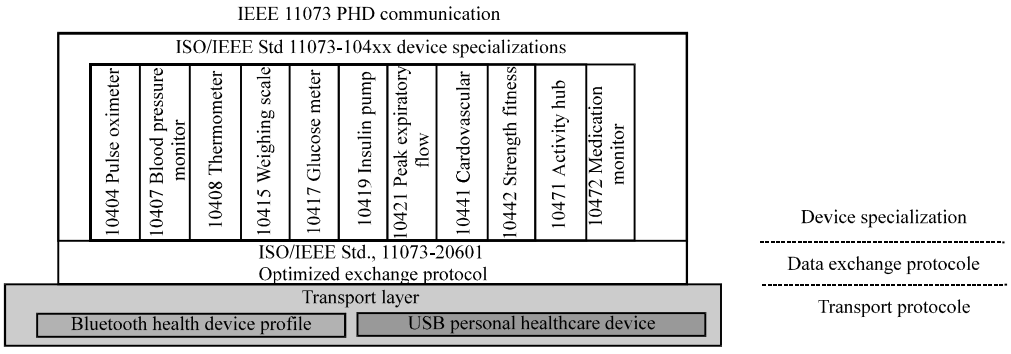

Fig. 4: PAN interface stack structure

setting and control and healthcare access information as appropriate for data processing server were selected (Fig. 7). In the performance requirements, the verification test between the device and the gateway was performed

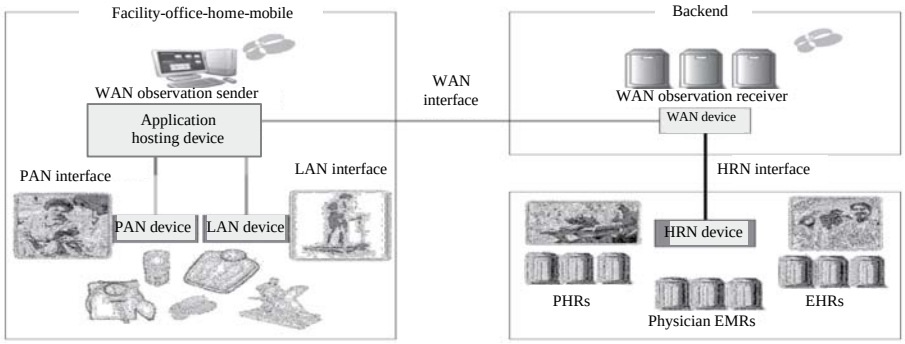

Fig. 5: WAN interface scope

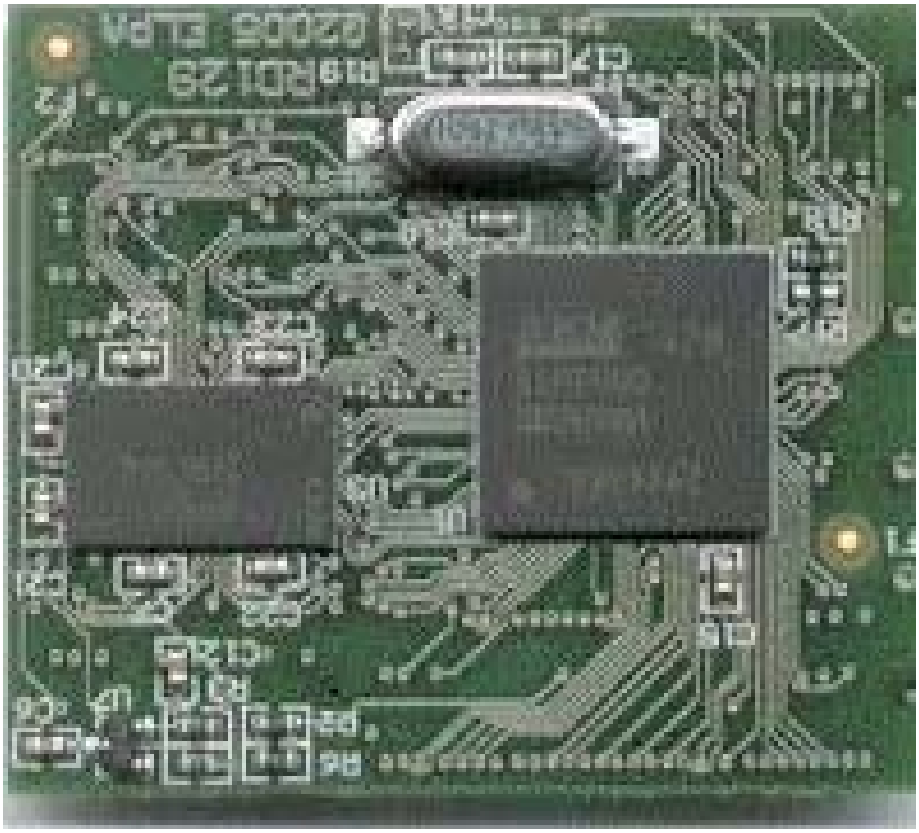

Fig. 6: A small embedded board based ARM9

by the IEEE 11073 PHD communication and the verification test between the gateway and the diagnostic support system was performed by the HL7 CDA communication (Fig. 8).

The HL7 (Health Lever 7) standard is a medical information exchange protocol that corresponds to the application layer in the OSI 7 layer. It is used to manage the patient's business management, general prescription, patient referral, accounting management, patient treatment, medical record/information management and the like in order to standardize all the messages used in the medical field. The messages sent and received in the HL7 Clinical Document Architecture (CDA) are largely composed of Trigger event, query and acknowledgment. When an ADT (Admission, Discharge and Transfer) message occurs due to an event, the HL7 CDA message is transmitted by transmitting a query message and an acknowledgment message between the medical systems (Anonymous, 2005; Kilner, 2002).

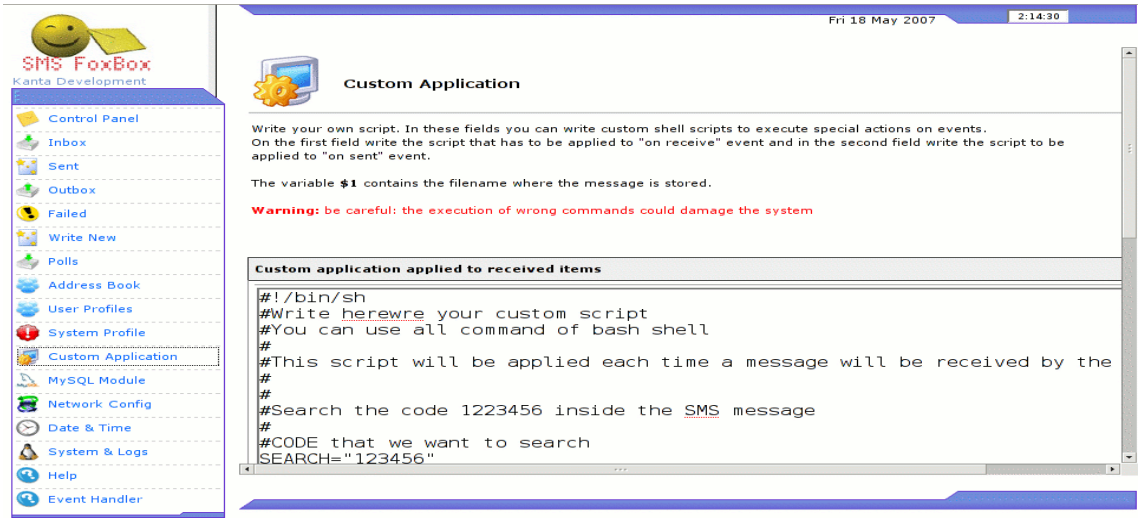

Fig. 7: Boa web server display

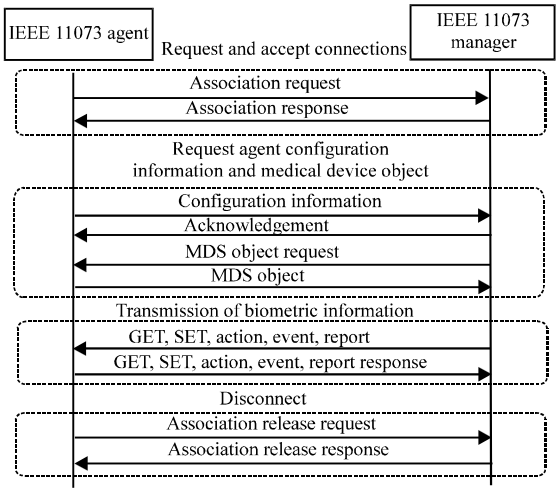

Fig. 8: IEEE 11073 access between a manager and agents and transmission are procedural

RESULTS AND DISCUSSION

Implementation of intelligent healthcare gateway for heterogeneous wireless communication terminal control WiMAX supports high-speed data transmission based on a bandwidth of up to 10 MHz. It combines next generation communication technologies such as Orthogonal Frequency-Division Multiplexing (OFDM), Multiple-Input and Multiple-Output (MIMO) and smart antenna and features high-capacity wireless data transmission which has never been seen before. In healthcare gateways, WiMax wireless communications is focused on optimizing parameters for uploads with the main purpose being to send data to the server (Table 1).

Table 1: Uplink frame-OFDM parameter

UL symbol/Title parameters	Values
No. of bands	24
No. of bins per band	4
No. of tones per bin	9 (8 data+1 pilot tones)
No. of tones per tile	Diversity: 9 (8 data +1 pilots) PUSC: 12 (8 data +1 pilots)
No. of bins per AMC subchannel	6
No. of tiles per diversity and PUSC sub-channels	6

Uplink Control Symbols include Ranging, CQI, MIMO Antenna Weight Feedback, MIMO Mode Feedback and ACK. WiMax wireless communication considered the Wimax Forum official authentication test and the UQ interoperability test specialized for UQ Communications (UQC) in Japan and the general radio characteristic and PHY/MAC characteristic of WiMax product are shown in Japan Ordinance Regulating Radio Equipment Article 49.29/ARIB STD-T94 standard (Fig. 9 and 10).

Figure 11 shows an analysis result of WiMax Signal (Modulation, Spectrum, Flatness, Power) using Agilent Technologie's Mobile WiMax Test Set (E6651A) device and analyzing parameters (Center frequency, receiver attenuation, source amplitude, enabling modulation and RF output) were designed, WiMax Modulation Signal was analyzed.

Bluetooth and Wi-Fi were designed and verified using the Agilent technologies personal area wireless communication test system (Z2239A) which was designed and validated for the continua authentication healthcare gateway. The short-range communication module test equipment specification conforms to IEEE802.15.4, IEEE802.15.1.1, ISO/IEC18000-6 and EPC Global Class1 Generation 2 standard of wireless specification test.

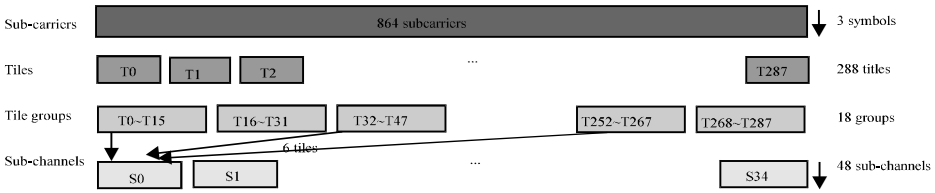

Fig. 9: Uplink frame-diversity sub-channel

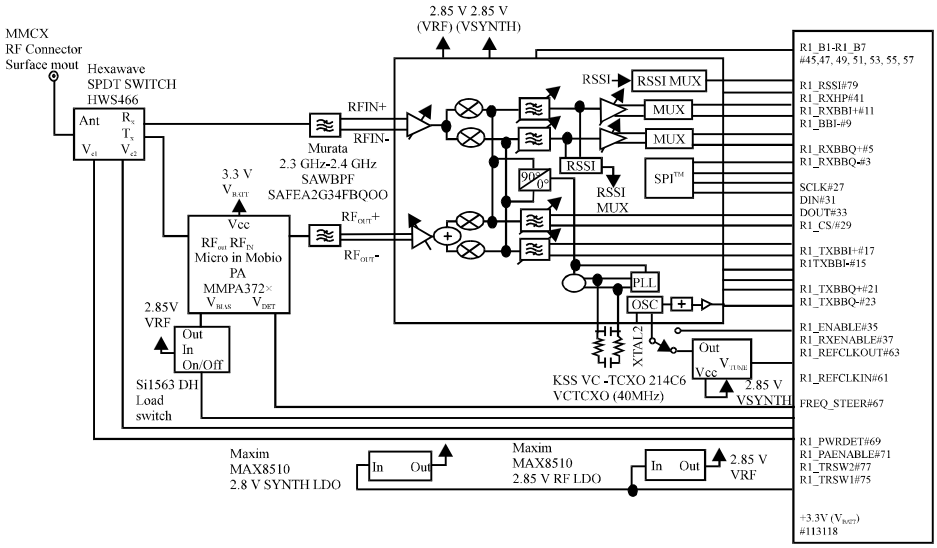

Fig. 10: WiMax wireless communication chipset block diagram

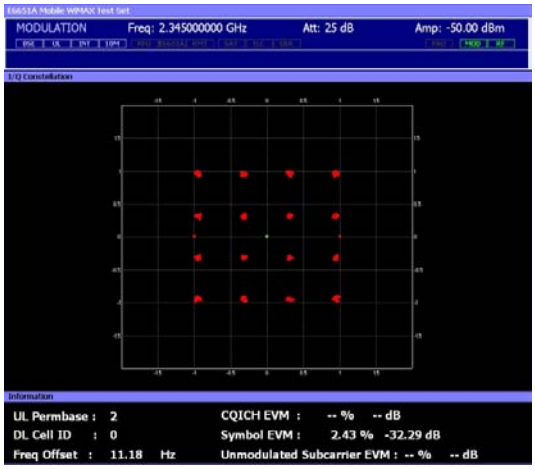

Fig. 11: WiMAX modulation signal analysis screen

Mobile WiMax test equipment specifications include frequency range 50 MHz to 2.7 GHz (E6651A-503), 450 MHz to 5.99 Ghz (E6651A-506) Resolution 1 Hz (<3 GHz), 2 Hz (≥3 GHz), Meas. Range (+27~m-50) dBm (Fig. 12).

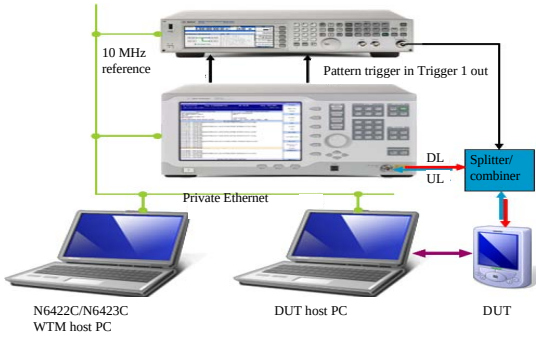

Fig. 12: Simulation environmental formation

CONCLUSION

In this study an international standard-based gateway architecture was designed for gateways for healthcare terminals based on Continua authentication. By designing the ISO/IEEE 11073 standard protocol as the gateway for continuation authentication, the user who develops the healthcare terminal product using the ISO/IEEE 11073 protocol can easily connect with other

terminals. In future research, terminals and gateways for Continua authentication must pay a lot of attention to security due to the processing of user's body information and personal data. So far, this research has been studying the application of security chip dedicated to health care because there is not enough research.

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