휴대형 u-Health 모니터링 시스템 개발
Development of Portable u-Health Monitoring System

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요약

본 연구는 무구속·무자각 지향의 센싱 기술을 통해 취득된 환자 데이터를 지능적으로 처리하고 판단하여 개인 맞춤형 의료 서비스를 제공해주는 모바일 기반 휴대형 u-Health 모니터링 시스템을 개발하고자 한다. 이를 위해 USN 기반의 휴대형 모니터링 unit을 구성하였다. 환자의 몸에 부착하여 생체정보를 검출하는 생체계측센서, 그 센서로부터 정보를 수신하고 모니터서버로 정보를 전송하는 휴대용 무선단말기, 그리고 무선 통신망을 통해 전달받은 데이터를 해석하고 처리하기 위한 모니터서버가 그것이다. 또한, 당뇨 및 심혈관 질환 관련 무구속·무자각 지향의 센싱 기술을 개발하고자 한다.

■ 중심어 : | 휴대형 u-Health 모니터링 시스템 | 생체계측센서 | 무구속·무자각 지향 |

Abstract

This study aims to develop a mobile-based portable u-Health Monitoring System which provides a personal medical service on demand by processing patients' data intellectually achieved through sensing technique of non-restriction/non-consciousness oriented and deciding. To do this, we composed a USN-based portable monitoring unit. It is the one, that contains a somatometry sensor which is attached to patient's body and detects bio information, a portable wireless terminal which receives information from the sensor and transmits it to monitor server, and a monitor server which interprets received data through wireless network and processes. Also, it tries to develop a non-restriction /non-consciousness oriented sensing technique which is related to glycosuria and cardiovascular diseases.

■ keyword : | Portable u-Health Monitoring System | Somatometry Sensor | Non-Restriction/non-Consciousness Oriented |

I. 서론

Most enterprises for u-Healthcare are small and medium enterprises and not easy to present a united solution to be commercialized because of no confirmation of source technique and standardization. Medical information service operated in Japan and the US can be referred to, but still they are not very suitable for domestic medical environment. For instance, domestic hospitals do not prefer the medical service of Japan/US that provides information of treatment/prescription to patients[1][2]. Like this,

domestic health care is too different from foreign one and need and characteristics of Korean patients are also different from those of foreign ones, so there should be a Korean-style of u-Health service that suits domestic medical law and process urgently. It is very important for u-Health system which is constructed based on ubiquitous environment to utilize tools like mobile phones that heighten customer accessibility. The study of U-health field so far, however, is mostly about home remote service which is limited to blood pressure, pulse, and body fat. There was a method that contacted the doctor by using SMS (Short Message Service of mobile phone) to get service when symptoms happens, but it failed to commercialize u-Health service by portable mobile terminal[3]. Mobiles which most of economically productive population possesses and PDA which is spread to persons and enterprise market will be able to be the optimal channel of u-Health monitoring for patient management[4]. So, this study with the consideration of this problem aims to develop a mobile-based portable u-Health Monitoring System which provides a personal medical service on demand by processing patients' data intellectually achieved through sensing technique of non-restriction/non-consciousness oriented and deciding.

II. 기존 연구

U-Health (ubiquitous Health) System can be explained health care and medical service which is able to be used "anytime, anywhere" by utilizing wired/wireless networking technique by combining IT with health care service. After it measures bio signals and heath information and transmits data to medical institution through wired/wireless communication, it analyzes it and feeds back, By doing that, it enables remote management of patient's disease and health maintenance and improve service of public. It is a new medical paradigm based on IT, BT, and NT that have changed rapidly and it seems to reflect the trend that existing service which was limited to one time treatment or management in medical institutions is provided not only to hospitals, but to home and all parts of real life for the entire life and spread to time and space[6][7].

The US government got ahead the most in the field of medical information that promotes national level of medical information policy and puts more investments every year. In the case of the US that is leading Health market, it already established ATA (American Telemedicine Association), a special remote medical institution, in 1993 and is ready for legal basis to foster u-Health industry by passing important bills related to u-Health till 2003. Main Japanese advanced enterprises started to prepare a graying society before 2000 and have created synergy by entering into welfare and health care business. Golden Plan has been executed since 1989, and it has developed and been operating home service and health care system by erecting a 10-year plan for the aged welfare as a part of the Plan and at present 'Japan Health 21' as a third health improvement business are being operated successfully. Since April, 2006, MHLW (Ministry of Health, Labor, and Welfare) has been operating a Healthcare system using home-network for small sized multi-function houses, elderly group homes for dementia, and exclusive small-sized Healthcare facilities. Our country is at the beginning stage to form a u-Health market and it still about home remote treatment service which is limited to blood pressure, pulse, blood glucose, body fat, and so on. U-Health service in domestic is mostly done among middle-class families while exhibition service of u-Health service in foreign countries is done for

elderly welfare and among mostly chronic disease patients[8]. As a part of government fostering policy, the Ministry of Information and Communication, the Ministry of Commerce, Industry and Energy, the Ministry of Health and Welfare, etc., promote home-network business with Healthcare business upbringing and medical information[9]. Domestic medical service measures bio information like blood glucose, blood pressure, body fat, body heat, body weight, and electrocardiogram with terminal and provides remote treatment service, however, there is a limit that it only enables to measure and to be gotten service in certain places.

III. 시스템 구조

1. Composition of Portable u-Health monitoring System

The goal of this study is to develop a portable u-Health Monitoring System that constructs an intelligent DB related to the glycosuria and cardiovascular disease by taking non-restriction /non-consciousness bio signals as input through portable terminal without limits of time and space so as to manage the glycosuria and cardiovascular diseased patient's state and provides the optimal service which the patient wants at the optimal timing. [그림 1] is the whole composition of Portable u-Health Monitoring System for management of the glycosuria and cardiovascular diseased patient proposed by this study. This system is the system that lets the patient carry a light portable monitoring system to be provided a personal disease control or healthcare without restriction of time and space. For this, it is composed of a sensor that detects patient's bio information, a portable wireless terminal that receives information from the sensor, and a monitor

server that analyzes bio information and provides suitable contents by applying personalized analyzing technique. It also develops a sensing technique related to non-restriction /non-consciousness related to the glycosuria and cardiovascular disease. It develops a non-restriction bioinstrumentation system that draws out blood glucose and non-invasive blood pressure which are the main index for the glycosuria and cardiovascular disease with no effect on patient's daily life and a non-consciousness sensor measuring technique that makes continuous monitoring possible with no awareness of measuring. Through this, it tries to present a tailored wellbeing management service that provides health mobile contents according to patient's character and health condition based on patient's data and disease control service for the glycosuria and cardiovascular diseased patient like emergency call service and mobile blood glucose management service.
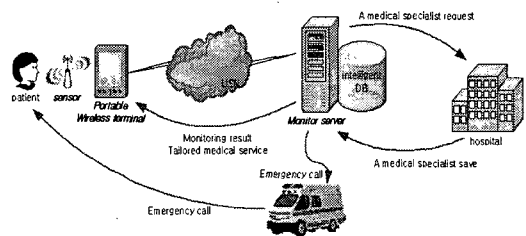

그림 1. Portable u-Health Monitoring System

2. USN based Portable u-Health Monitoring unit

The portable u-Health Monitoring System proposed in this paper is composed of a sensor that is attached to patient's body and detects bio information, a portable wireless terminal that receives information from the sensor and transmits it to monitor server, and a monitor server that analyzes the data received through the wireless network and processes.

Monitor server sends an emergency message when it recognizes an emergency among analyzed data and informs the name of hospital nearby the portable terminal exists or does an emergency call. [그림 2] shows the system structure unit proposed by this paper and detailed role of each unit is as follows.

○ Bioinstrumentation Sensor

It uses sensors such as blood glucose, blood pressure, electrocardiogram, pulse, skin conductance, acceleration. and environment information that are needed to check patients' health states related to the glycosuria and cardiovascular disease. Used bio signal detection sensor devices are ECG, EEG, SpO2, CO, EtCO2, IBP, NIBP, Respiratory Mechanics, Peripheral Nerve Simulator, Multi Gas Analysis, and so on.

○ Portable Wireless Terminal

Input information through transmitting/receiving part from the bioinstrumentation sensor is analyzed by using simple standard. It is a process of judging stage whether it transmits measured data or not, the effect of the system can be heightened by filtering the value measured wrongly or meaningless. It also includes a judging part of measured value that gives the first warning in the case that values of pulse or blood glucose are out of the certain range or leave from the body and there will be alarm warning secondly in the case of no confirmation of user. State data analyzed first through wireless terminal is transmitted to monitor server through Internet.

○ Monitor Server

It plays a role that diagnoses patient's health states which are happened on the portable wireless terminal by being delivered in realtime through Internet and transmits the suitable reaction to the portable wireless terminal. Monitor server is composed of

transmitting/receiving part that receives state date from the portable wireless terminal and transmitting the health measurement result to the portable wireless terminal, management part that analyzes data of each patient and provides tailored medical service connecting to intelligent DB, and control part that controls and manages all the connected processes. Data analysis in the monitor server is used for the judgement health state, emergency state, and environment state and for location based service. For the tailored service, there must be a connection to intelligent DB, so it uses personalized analyzing technique by thesaurus based reasoning to enables to provide a tailored service according to the analysis of patient's type of using contents.
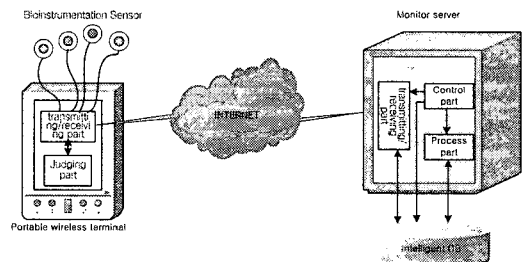

그림 2. Monitoring System Structure Unit

IV. 개인 맞춤 의료 서비스

1. Non-restriction/Non-Consciousness oriented Sensing for the glycosuria and cardiovascular diseased patient

For the user's convenience and to reduce infection, there have been some studies to change the method of measurement from existing invasive measuring method to non-invasive method or non-restriction/non-consciousness measuring method. Non-restriction bioinstrumentation is a technique that measures with no effect on patient's daily life and

non-consciousness measuring is a measuring method that helps measure without patient's awareness of measuring for the continuos monitoring. However, existing non-restricted/non-conscious measuring devices are not spread a lot, there are almost no products to be replaced as the newest measuring devices in the conservative medical market. It needs the minimum of blood sample and time for measuring to develop non-restriction/non-consciousness oriented sensing unit and it also need to develop a sensor that enables to measure continuously for long for the development of biosensor to measure biochemistry which is necessary to measure a lot of physiology variables. Thus, I in this draw out blood glucose, non-invasive blood pressure, non-restriction electrocardiogram, and index of PPG in order to secure non-restriction /non-consciousness oriented sensing technique for the glycosuria and cardiovascular diseased patients.

○ Blood glucose
- Index 1: measuring blood glucose below 0.2uL of sample blood
- Index 2: measuring range is 20~900 mg/dL
- Index 3: measuring time : within 10 seconds

○ Non-Invasive Blood Pressure
- Index 1: According to AAMI SP-10, the average of instrumental measurement values should be within 5mmHg and a standard deviation should be less than 8mmHg.
- Index 2: The range of blood pressure measurement is that it enables to measure adults, children, and infants and the range of blood pressure measurement has to meet the satisfactory that Sybolic is 60~250mmHg, Mean is 45~235mmHg, Diastolic is 40~200 mmHg, for adults and children, and Systolic is 40~

120mmHg, Mean is 30~100mmHg, Diastolic is 20~90mmHg for infants.
- Index 3: The pulse used to measure blood pressure is the signal that is showed up by synchronizing of heart beat and to measure accurately there should be a range of heart rate. the range of heart rate measurement. it should measure 40~200bpm for adults and 40~240bpm for infants.
- Index 4 : The time of blood pressure measurement is the time from starting pressurization to calculate final blood pressure, users often feel uneasy because of pressure of cuff and the change of blood pressure happens when the measuring time gets longer. So it is better to measure as soon as possible. in the case of normal user, the measurement should be done withing 40 seconds.
- Index 5: The detection function takes long to measure because there is a high possibility for user to move, so it is possible to measure accurately when the movement is got rid of.

○ Non-Restriction Electrocardiogram and PPG
- Index 1: Heart rate and HGV monitoring
- Index 2: Non-restriction measurement with no use of Ag/AgCl electrode
- Index 3: Within 5% of measurement error

2. Tailored Wellbeing Management Service

Tailored wellbeing service is the service that it provides information as a schedule with a tailored menu and a health prescription for the person if there is an input such as personal body information, current state, disease history, and desired goal. Advanced countries were interested in health management from early have various related service programs, the character of medical system is very different from

other countries. the difference affects the type of personal daily health management directly/indirectly. In the point of domestic medical system view which is under strong control of national health insurance, simple management of promotion of health which an individual manages does not guarantee continuos health, so individuals are to get a whole, systematic, and personal service with professional's help.

Therefore, this study composes a variety of service group that includes medical professional, health coordinator, special helper, etc., who can help a tailored health management for each individual and provides a personal tailored wellbeing management service. In the long term, health management by united health management system will be generalized. Now personal health management is done in a lot of places like home, workplace, fitness club, clinics, nursing home. If an establishment controls and manages this health management, people will get more consistent and systematic management service. Under this united system, as related organizations share the health records of persons, more effective health management and treatment will be possible through the communication of each. This study that provides intelligent DB and united data environment has a view that it plays a big role to embody this tailored health management service and actualize.

[표 1] describes the contents of personal tailored wellbeing management service. When a user asks for a health information service using mobile, intelligent DB asks a question of professional using user's personal data and medical history and provides the result to the user. It also provides personal health history management as a statistics and graph and various contents related to health if a user wants to confirm one's own health information through mobile and gets information to improve one's health. [그림 3] shows the concept of tailored wellbeing

management service.

표 1. Contents of Tailored Wellbeing Management Service

| Main Functions	Detailed functions	Contents
Tailored Wellbeing Management	store function of Measured data	Sort and store data connected to intelligent DB
	Reference function of professional's opinion	Reference function of bio information, health information, medical examination information
	statistics function of personal data	Function of health history management, statistics comparative analysis, data print out
	reference function of personal health information	Function of homepage registration, secession, modifying information
	Management function of Medical history	Indication function in graph of medical history, health history confirmation
	Management function of Medication history	Medication history management function
	Management function of health life	Function of grasp of bio information trend by period and presentation of opinion
	Management function of eating habit	Management function of specialist's advice on eating habit and execution
	Offer function of Contents	Function of providing various contents using Web and mobile
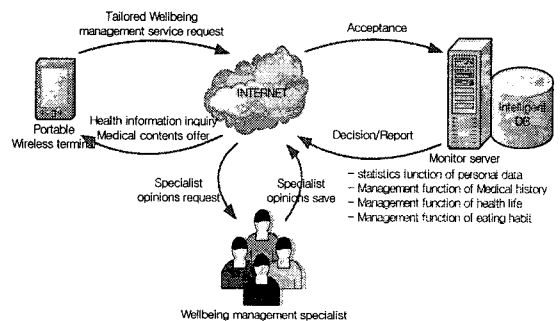
그림 3. Concept of Tailored Wellbeing Management Service

V. 결론

This study is to develop a portable u-Health Monitoring System that constructs an intelligent DB related to the glycosuria and cardiovascular disease by taking non-restriction/non-consciousness bio signals as input through portable terminal without limits of time and space so as to manage the glycosuria and cardiovascular diseased patient's state and provides the optimal service which the patient wants at the optimal timing. The purpose of portable u-Health Monitoring System proposed by this study is not to treat every patient the same but distinguish patients and propose tailored medical service for each patient. As we arrange an scientific environment based on information technology, it is important to use DW to understand patients group in the viewpoint of attribute of medical service, population statistics information, and profit and to plan individual service strategy for patients group. To do so, it must be acknowledged which stage it is in; the sensing unit, united control unit, or server. It manages data applied to personalization analysis technique and needs to provide tailored contents. SMS service to call the doctor in charge simply so far, mobile technique which is spread to all of industries cannot be an exception and distinguished mobile service of each patient will improve patients' satisfactions and enlarge the sales of the hospitals. Also under the Healthcare service compared to one in advanced country and for the request to open medical service we face in real, medical information fusion service platform which connects medical organizations to individuals and to Healthcare system is expected to develop both Home-network and u-Healthcare industry through synergy effect in between.

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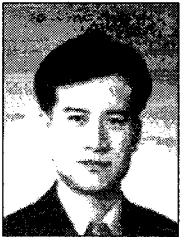
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