An Integrative Method on the Remote Monitoring of Walking Activity Using Ubiquitous Healthcare System

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Abstract: The present concept of u-Healthcare is based on treatment and recuperation and in the future it will become specialized as wellness based on prevention. It is predicted that wellness care among others will develop to become the key field of u-Healthcare. For this reason in this research, ubiquitous technology was grafted to the passometer (P-meter) which is frequently used for monitoring during existing walking exercises. Emerging from the existing method of the P-meter which simply calculates the amount of exercise by counting the number of steps taken, using the GPS incoming data, the distance and speed of the location changes is calculated and the acceleration sensor will reflect the steps and intensity of movement to measure the walking activity amount to realize a smart walker system which will help the maintenance and promotion of modernists health.In this paper, we propose an integrative remote monitoring system for measuring walking activities under ubiquitous healthcare environment considering walking effects in healthcare of human life through the calculation of the distance of location changes and speed using GPS reception data and reflecting the steps and intensity of movement using the acceleration sensor.

Index Terms: Ubiquitous (u)-Healthcare systems, distance healthcare service system, walking activity, electronic space remote monitoring.

1. Introduction

The aged societies have been rapidly increased as the standard of living improved and medical technology developed globally. Korea became an aging society in the year 2000 when its population aged 65 or older became higher than 7% and it is predicted that the Korean society will enter the early stages of the aged society in 2026 when the population aged 65 or older exceeds 20% of the total population.The number of cases of chronic diseases such as diabetes, high blood pressure, high cholesterol, among others, is increasing rapidly due to the course of the aging society and the improved standard of living caused by the changes of life style. For this reason, the need to reduce medical expenses of the government and medical insurance is increasing. Also, thanks to the increase of income and interest in health consumption in the medical area is increasing but the level of satisfaction of medical costs is low and the needs for medical services are increasing[1].

For thisreason the u(ubiquitous)-Healthcare is emerging industry as a new medical service paradigm which uses internet, mobile, among other information communication technology (ICT) in the existing medical system providing medical health information, knowledge, service, and products to the consumers. As a position industry which supports the new industrial product creation which leads the 21st century and the existing products which creates high value, the u-Health Industry is predicted to create new high values linked with information technology, biotechnology, environmental technology, Nano-new material technology, among others. U-Healthcare based on convergence of IT and Healthcare provides information services through

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diffusing information and knowledge related with u-Health such as medical information through portal sites and DB, industry solution, domestic and international industry trends, policy trends, technology trends, and so on. Distance Healthcare Service System also provides telemedicine, distance monitoring, distance medical information services in real time to individuals at home, offices, public institutions, using the internet.

Like this u-Healthcare makes the functions of medical service more concrete in daily life and health information and records can also be used anywhere and anytime without restrictions. It is predicted that this can develop in the form of wellness care which can be used in the treatment and prevention of diseases, health care, and early treatment[2].

This research helps modern men to stay healthy and improve their health by establishing a system which enables the monitoring of the amount of walking exercise activities only by wearing it anytime and anywhere in the u-Healthcare environment through the calculation of the distance of location changes and speed using GPS reception data and reflecting the steps and intensity of movement using the acceleration sensor[15],[16].

2. Related Researches

A. U-Healthcare Outline Paradigm

U-Healthcare is an IT based technique which enables the management of diseases, health, and life anywhere and anytime and also makes a healthy and safe life possible.The ultimate goal of u-Healthcare is “the pursuit of improvement of the quality of life.” And to realize it, future u-Healthcare based on the generalization of IT/infrastructure such as the improvement of ICT and establishment of network, etc. will rapidly change due to the occurrence of new diseases, aging of the population, increase of consumers desires of health, data development of mass processing and storage technology based on broad band network technology, sensor network development such as RFID, business extension of medical solution providers, governmental health promotion policies, etc. Health care in the ubiquitous society is predicted to evolve based on intelligent health care providing medical and health care based on information acquired by sensors [3], [4], [7], [8].

To make the new paradigm called u-Healthcare possible, technology fusion of various areas is needed, especially, by naturally combining living space and medical treatment, minimizing, wearing and making things intelligent. With this the intrinsic nature of technology which makes intelligent health care possible and wearable forms which make mobility easy will be generalized. According to health sensors and modules with various measuring sensor, signal

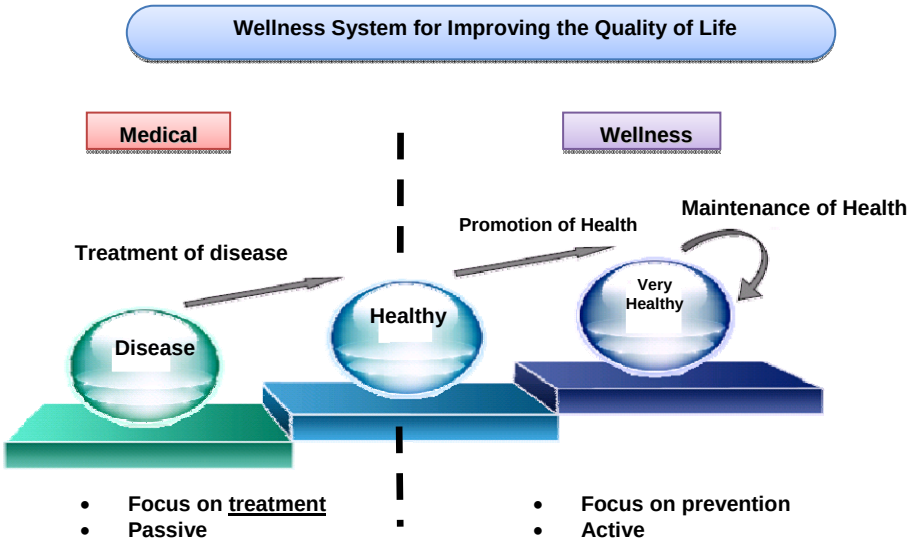


Figure 1. Expansion of Healthcare Steps

process functions, wireless communication functions incorporated, products which make continues and natural monitoring of health possible may be formed[5].

Also, as the modernists desire for checking their health conditions increases, the social trend of u-Healthcare understanding the health conditions of the general consumers is not medical health as in figure 1 and figure 2.

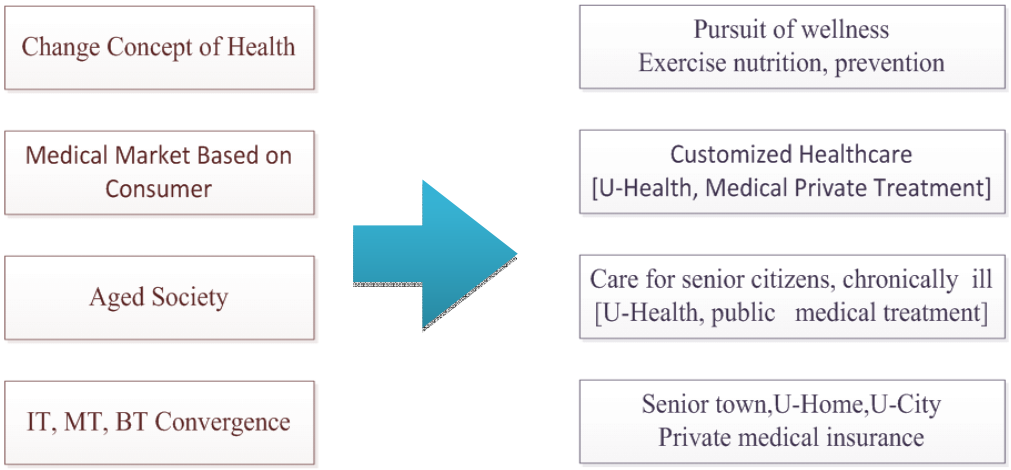


Figure 2. Social Trend of U-Healthcare

It is also predicted to change the form of Wellness-Care which does not only prevent obesity or diabetes, high blood pressure, among other chronic diseases but also analyzes everyday diets, support health promotion activities, among others [6].

B. Wellness-Care and Smart Walking Issues

Walking plays the most importantrole in everyday activities and above all, walking for modern men who easily lack exercise, is more than a meanof transporting himself, it is a form of exercise which maintains and promotes his health. Walking which is a low intensity exercise is favored over jogging, tennis, dance, cycling, skiing which are high intensity sports, because of the time economic application, accessibility and health conditions.

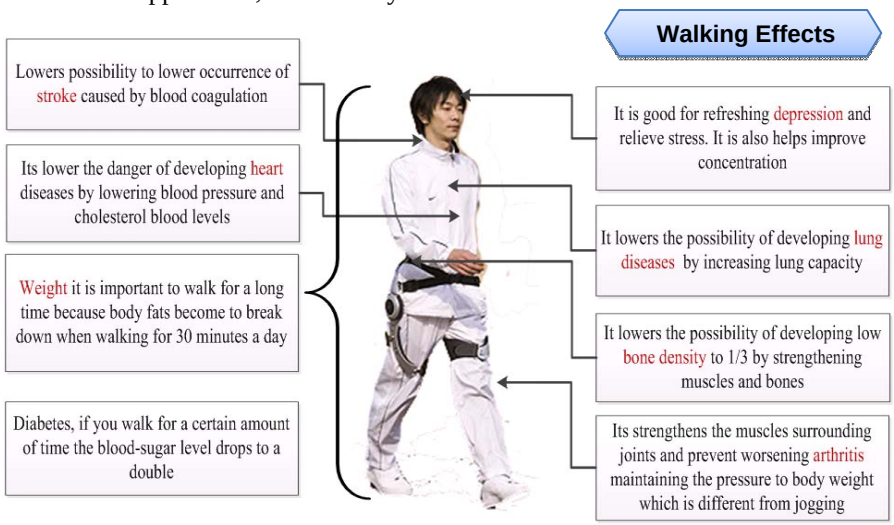


Figure 3. Effects of walking on the healthcare activities neither of modern life style fully activities

Especially,Walking exercise does not need special skills or facilities. It has the advantage of being performed in all ages without the danger of injuries and the effects of walking, as shown in figure 3, includes changes of the body form, improvement of aerobic capacity and the cardiovascular system, flexibility, muscular strength, increases bone density, and so on. It also is known to help improve cognitive skills, depression among other psychological symptoms. However, research on walking is still incomplete and there is a lack of programs and devices which can be objectively recommended to the modernist.

The governmental institutions and each local government are also promoting support policies and various projects related with walking to nationally promote health by establishing ubiquitous walking courses aiming towards wellness to reconsider the quality of life.

3. Walking Activities Amount Measuring System

A. Object of Development

The objective of this research is to actively handle diverse changes in the sports industry and U-Health care area by adding functions which makes monitoring of the amount ofexercise possible during walking, using GPS and gyro sensor, acceleration sensor, and also take measures adequate to the market trends such as the elaboration of trial products and addition of functions to satisfy the user's needs. The overall administration of the systems is explained in figure 4[11], [14].

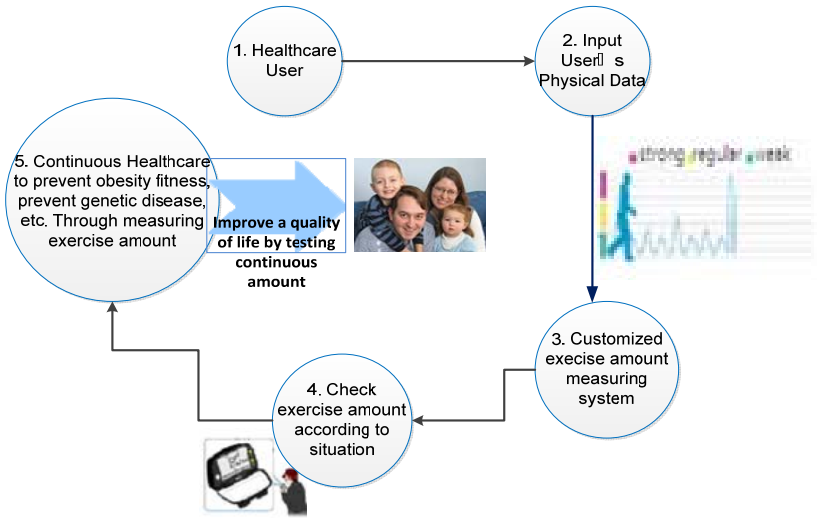


Figure 4. Data Flow Concept Map of the Walking Activities AmountMeasuring System on the Smart Family Life Style

B. Architecture System Design

Although the exercise amount measurement control terminal is frequently used for monitoring during the existing walking exercise, by grafting ubiquitous technology to the existing passometer which simply counts the steps to calculate the amount of exercise, the user's exact amount of exercise can be calculated because the precise amount of exercise is calculate according to walking conditions. Walking conditions means the expression of the user's travel distance, distinguishing walking situations such as irregular steps, walking in crowded areas, exercises which include sudden stopping and squatting, jumping, extreme sports, climbing, going down stairs, going down steep hills, riding cars trains, etc. and calculating the exact calories consumed considering the travel distance and situations[6], [8].

Figure 5 is a terminal block diagram composed of I/O sections for input and output of external data, control section including MCU, memory section for storing data, GPS reception module to receive present location signals, blue tooth communication module for transmitting

signal of location information and MP3 sound source contents, acceleration sensor for measuring speed per unit time, gyro sensor module for measuring directions, and so on [9], [10].

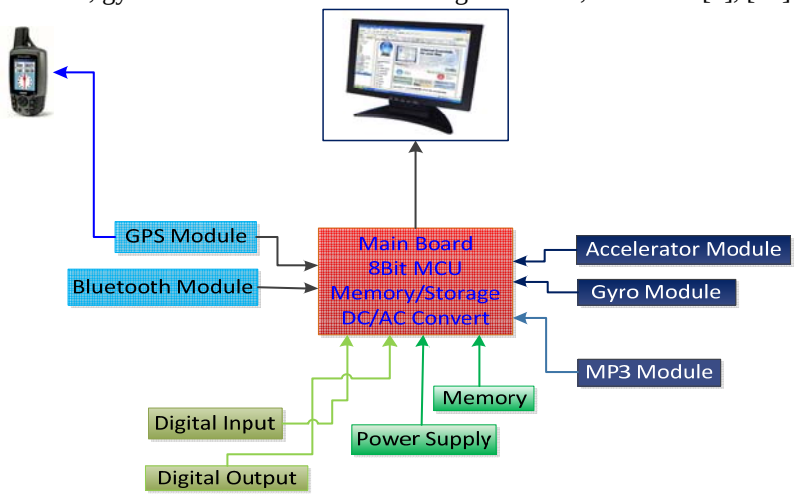


Figure 5. Terminal Function Block Diagram with 8Bit Microcontroller Unit Memory

Also, the terminal application software systems must perform the following functions[17], [19], [20].

First, it must check the state of GPS reception and parsing function. To conduct this GPS drive should be develop to acquire GPS reception data. The GPS reception state should be checked and if the signal is not detected or the signal is weak, the data should be printed through the terminal LED and the essential items (time,coordinate speed, etc) needed to locate the user which have been received by the GPS should be parsed.

Second, detection of situation and control functions to measure the amount of exercise for each situation. Check the state of the gyro-sensor and acceleration sensor using the digital IO and calculation of exercise amount according to each situation should be possible.

Third, calculation functions for each walking condition and exercising condition. The table structure which stores the value configured to calculate exercise according to each walking situation should be designed and using the sensor value, the algorithm for distinguishing the walking situations should be developed.

Fourth, as a memory administration function, to efficiently administrate lacking memory of the embedded operative system, a memory manager must be realized and the basic internal memory pool should be maintained and the memory area allocated to the application program demands should be returned and an external memory device drive should be developed.

Finally, a protocol between each module should be developed to make the design and realization of the internal protocol and data storage protocol between the main modules possible. Then, it should be realized to enable GPS data transmission cycle of the terminal, input of basic data for each user and administration function as a terminal environment configuration function. To support the ubiquitous health care smart walking activities, we conduct to implement a method infrastructure network,well known the scenario of ubiquitous healthcare environment in the smart home own. On the home architecture building, the tools is appliedsupporting ubiquitous healthcare system in the smart walking activities, weeffort to apply a scenario of ubiquitous in a smart house integrated, thus, this device is used to detect the completeness of supporting healthcare facilities, then confirmed the tool is helping from the security side for remote and detection the object as human based on, which is inserted in additional to the RFID mode integrated with online CCTV which is connected to the main server properly.

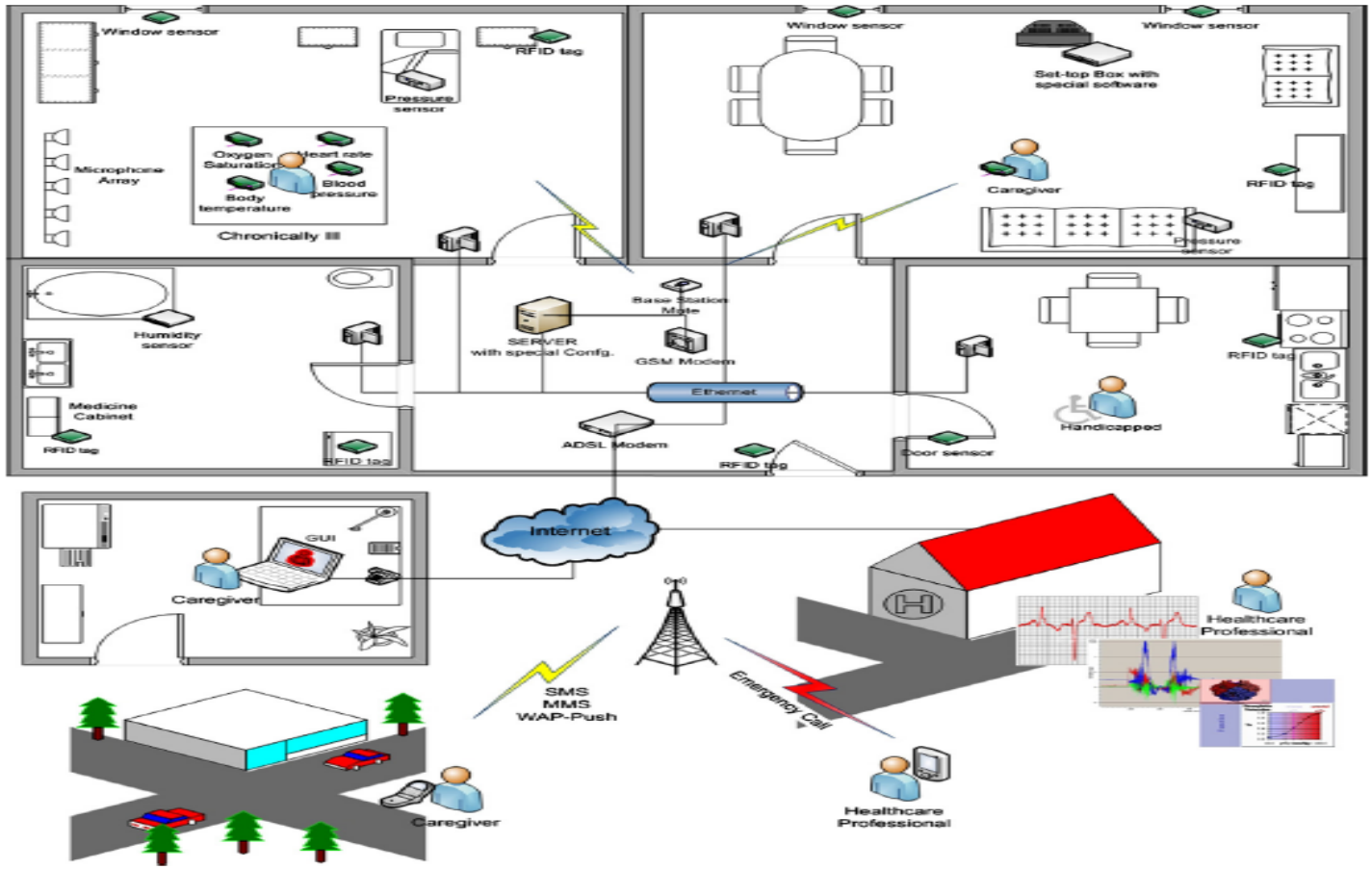
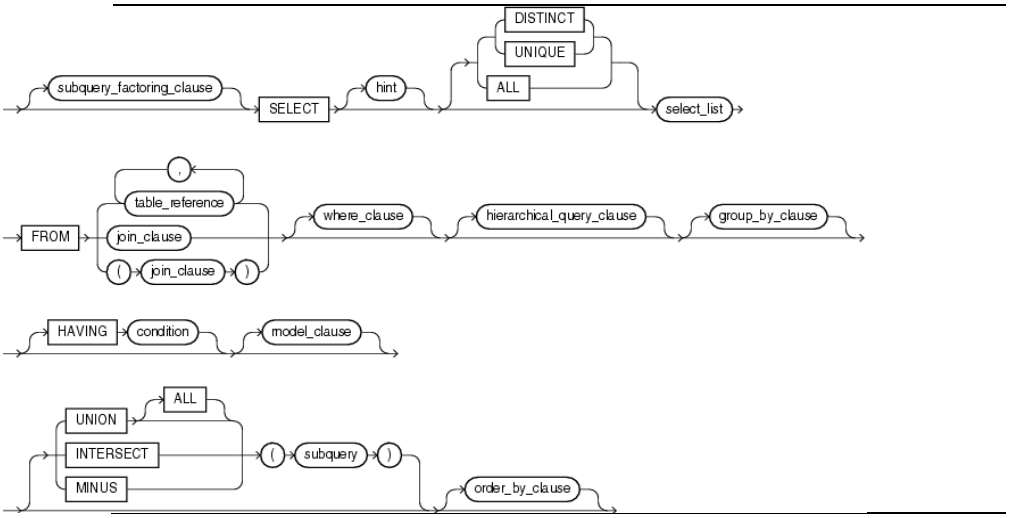


Figure 6. The Scenario of u-Healthcare Environmentwith Remote Monitoring Systems of Walking Activities

Based on several environmentsthe devices such as emergency call, it will beconnected to the healthcare professional staffs and complemented by the SMS / MMS WAP gateway application to a central information system used vehicles. This smart home scenario is connected directly to the healthcare hospital service, so on this occasion that will be a space to report the daily activities through Database (DB) recording system on the web based, as the frame work information system.Even though the tools is configured to the Base Transceiver Station (BTS)as a cell site, the equipment will emit a signal to the cell-phone user directly, when they are accessing the ubiquitous healthcare contents for further healthcare information's,thus, this piece of user equipment and network also will be supported by Radio Base Station(RBS) to transceiver all the node neither node B both of base station terminal,byimplementing a space solutions we apply the searching mechanism on the framework information system as is, searching a specific space to, which is allocated to an entity both of healthcare indicators, it will be accessed by an entity and of a specific type, the command will be interpreted to the structure query language(SQL), on the other hand sub-query to retrieve data from views, tables and spaces which will be performed below[18],[21],[22].



Next step, the implementation for searching methods is established in the command below based on the accessing key index with the type of classifications.

FIND?name_space**allocated_to** devices/collections **accessed_by** devices/collections **OF_TYPE** readspace/writespace/treatmentspace/indicatorspace/medianofsenioragespace/recuperationspace/quarantinespace/incubationspace/diagnosisspace/deseaseindicatorspace/clausespace

To search a rule space monitoring and evaluation a space:

FIND?name_space**monitoring**||**evaluation**?name_space

Thus, to list all the agents that have access to a space, the command will be used is:

LIST_ALL collections/devices **IN**name_space (except personnelspace,activespace)

On the other hand, we will read the tuples from the space as is performed on the table 1 below,

SELECT * **FROM** MEDIANOFSENIORAGESPACE / TREATMENTSPACE / INDICATORSPACE / DIAGNOSISSPACE / ALLOCATEUHEALTH
WHERE (OWL:class_type, its_property,its_value, allocated_number, allocated_percentageofgradehealth)

4. Performance Evaluation

A. Experimental Analysis

The authors provide a performance evaluation data field system for warehousing the classification of median of senior age, treatment, indicator, diagnosis and grade of u-healthcare.

Table 1. Performance Evaluation Data Report Generatingof Smart Walker Based on u-Healthcare System on the Walking Smart Display Healthcare Boards

Id.	Median of Senior age	Treatments	Indicators	Diagnosis	Grade of u-health
1	50-55	Diabetes	Unusual changes in drinking and eating habits	Finger stick blood glucose	78.45%
2	50-55	Diabetes	Sudden Weight Loss	Fasting plasma glucose	97.35%
3	50-55	High Blood Pressure	Blood vessel damage(arteriosclerosis)	Systolic pressure, diastolic pressure	65.95%
4	50-55	High Cholesterol	LDL cholesterol levels > 160	A direct LDL test	92.35%
5	50-55	High Blood Pressure	Heart attack or heart failure	Systolic pressure, diastolic pressure	90.15%
6	50-55	High Blood Pressure	Kidney failure	systolic pressure, diastolic pressure	89.25%
7	50-55	High Cholesterol	HDL cholesterol levels > 60	A fasting cholesterol test	77.35%
8	50-55	High Cholesterol	LDL cholesterol levels > 160	A direct LDL test	81.15%
9	50-55	Diabetes	Excessive urination	Oral glucose tolerance test	80.15%
10	56-60	Diabetes	Fatigue	Glycosylated hemoglobin or hemoglobin A1c	78.35%
11	56-60	High Blood Pressure	Kidney failure	Systolic pressure, diastolic pressure	76.35%
12	56-60	High Blood Pressure	Heart attack or heart failure	systolic pressure, diastolic pressure	75.50%
13	56-60	High Cholesterol	LDL cholesterol levels > 160	A direct LDL test	91.25%
14	56-60	High Cholesterol	HDL cholesterol levels > 60 & Triglycerides	A simple cholesterol test	89.75%
15	56-60	High Blood Pressure	Blood vessel damage(arteriosclerosis)	Systolic pressure, diastolic pressure	90.00%
16	61-70	High Blood Pressure	Kidney failure	Systolic pressure, diastolic pressure	87.35%
17	61-70	High Cholesterol	LDL cholesterol levels > 160	A simple cholesterol test	90.15%
18	61-70	High Cholesterol	HDL cholesterol levels > 60 & Triglycerides	A fasting cholesterol test	86.45%
19	61-70	Diabetes	Eye Problems	Finger stick blood glucose	85.75%
20	61-70	Diabetes	Fatigue	Glycosylated hemoglobin or hemoglobin A1c	92.35%
21	71-80	High Blood Pressure	Heart attack or heart failure	Systolic pressure, diastolic pressure	90.35%
22	71-80	High Blood Pressure	Stroke	Systolic pressure, diastolic pressure	92.35%
23	71-80	High Cholesterol	LDL cholesterol levels > 160	A direct LDL test	97.45%
24	71-80	High Cholesterol	HDL cholesterol levels > 60 & Triglycerides	A simple cholesterol test	93.25%
25	71-80	Diabetes	Excessive urination	Glycosylated hemoglobin or hemoglobin A1c	95.15%

In this experimental analysis, we classify the entire above field in to the table of performance evaluation, hence, we can perform the about the treatment, indicator, diagnosis the index result of grade of u-health for a couple of senior age now days.

The table 1 below is a representative result data from our experimental analysis in performance evaluation of ubiquitous healthcare system for smart walker activities.

Conclusions

The modern society is changing in to a passive wellness environment based on prevention to maintain and promote health in treatment based medical health care based on treatment of diseases,symptoms, etc. and the need for maintenance and promotion system for individual's health in the U-Wellness environment is on the rise.

For this reason, this system grafts ubiquitous technology to the p-meter function which is frequently used in monitoring of existing walking activities. Diverging from the existing p-meter which simply counts the steps to calculate the exact amount of exercise adequate to the situation of walking exercise, it can precisely calculate the user's amount of exercise daily.The system developed through this research can be applied not only to future u-Health, u-Wellness projects but LBS based application services using GPS and it is expected to be used in health promotion through walking exercises and services which help people to stay healthy through collaborative relations with governmental and related organizations.

In this paper, we conduct to implement this research by applying a u-Healthcare environment scenario life style, the main key-concept of this scenario is to establish the result of healthcare environment cases and a study is to build a prototype of network architecture system based on ubiquitous healthcare environment now a days in communication and telecommunication system.

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