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Dietary and Health Information Logging System for Home Health Care Services

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Abstract— **In this paper, we propose a wearable dietary and health information logging system. The system consists of a cellular phone, a sphygmomanometer, a body composition monitor, and a calorie consumption meter, which are crucial for monitoring life-related diseases. We conducted an experiment with a subject and succeeded to get his dietary and health information continuously for two months. We also introduce the blog interface for home health care as one of the applications.**

I. INTRODUCTION

In recent years, increase of lifestyle-related diseases are raised as one of the most significant problems in developed countries. Lifestyle-related diseases are caused by personal lifestyles accumulated for long years and actual symptoms could be high blood pressure, obesity, diabetes, and etc. It is said that an increase of the lifestyle-related diseases is caused by westernized eating habits.

In order to prevent the diseases, monitoring and support by taking account of information in two viewpoints are indispensable. One is a dietary information, which denotes whether people is having healthy eating habits. The other is a health information, which denotes whether people are in good health conditions.

Recently, since lifestyle-related diseases are recognized as social problems, many kinds on health monitoring systems are developed. But these are taking account either dietary or health information. However, as we've mentioned above, the symptom of lifestyle-related diseases has correlation both in dietary habits and health statuses. Also the progress of the diseases will be found by monitoring these information for a long time.

Since the symptoms of lifestyle-related diseases are found by long-term health information, the methods for gathering these information and the analysis of symptoms by using huge health data are key issues for developing the system. Computer technology (i.e. mobile devices, network, database) and computer intelligence are indispensable for developing such data gathering devices and data analysis system.

In this paper, we propose a system, which monitors both dietary and health information continuously for a long time. The system consists of a cellular phone, a sphygmomanometer, a body fat scale, and a calorie consumption meter. We report experimental results with a subject to denote the efficiency of the system. We also introduce the blog interface for home health care as one of the applications.

II. MONITORING AND SUPPORT OF LIFESTYLE-RELATED DISEASES

A. Lifestyle-related Diseases

Lifestyle-related diseases consist of various symptoms such as high blood pressure, obesity, diabetes, and etc. These diseases are developed by the accumulation of the everyday life for a long time. Especially, a dietary habitat and a health status in everyday life affect the development of the diseases. Moreover, the symptoms do not progress rapidly but gradually. Therefore, in order to detect the development of the diseases, it is very important to monitor both of dietary and health information constantly for a long time.

In follows, we'll explain how the dietary habits and the health conditions have correlation to lifestyle-related diseases.

1) High Blood Pressure: High blood pressure is thought as one of the significant factors that cause the apoplexy, myocardial infarction, hypertrophy of the heart.

High blood pressure is caused by lack of physical activity, obesity, excessive intake of salt and sodium, and excessive intake of alcohol. On the other hand, the intake of the potassium calcium is assumed to suppress high blood pressure. However, excessive intake of potassium (under 15,000 mg/day by FDA) will need an attention since it is harmful for the kidney.

2) Obesity: Though the obesity is considered as not so danger, it is one of the factors that cause high blood pressure, the diabetic, the heart disease, the brain disease, the liver complaint, and cancer. The obesity is developed when calorie intake is more than calorie consumption for a long time. Thus, to know the tendency of obesity, the monitoring of calorie intakes and consumption for a long is indispensable.

B. Related Works

Since the monitoring of both the dietary and health information is recognized as very important, in hospitals, patients who are in serious diseases are forced to write those information on papers. Then a doctor records and analyzes them by hand. This kind of conventional methods are very tedious and seemed to be used for general people.

So several systems have developed by using computers. Internet Nutritional Diagnosis developed at Shikoku University [3] provides the home page that enables user to record his dietary information. On the other hand, health measuring instruments are diffused into homes (i.e. diffusion of body fat scales: 33.2%, sphygmomanometer: 35.4%, in Japan, 2004).

Though these instruments are diffused in homes, there are no systems that afford people to record both of dietary and health information for a long time nor to monitor and check their health statuses by taking account of both information.

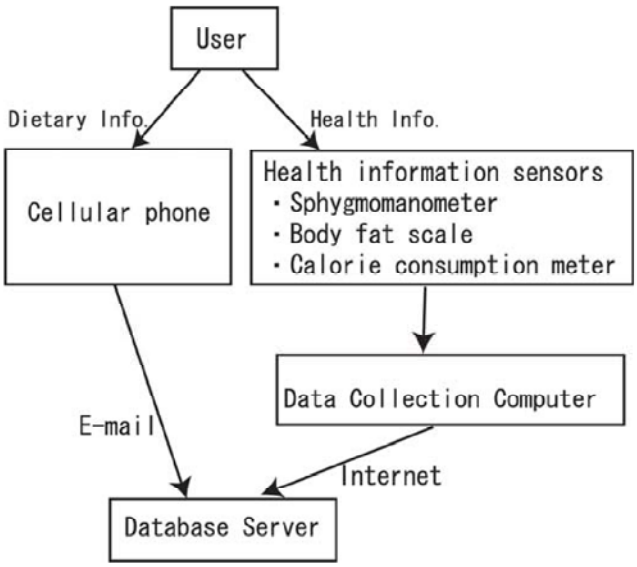

Fig. 1. Configuration of dietary and health information logging system.

III. Dietary and Health Information Logging System

A. System Configuration

In order to record dietary and health information for a long period, we propose a system composed by the following three parts (see figure 1).

1) Dietary Information Input Interface
2) Health Information Input Interface
3) Database Server

For the dietary information input interface, we use cellular phone. The diffusion rate of cellular phones is more than 80% in Japan. Since cellular phones are carried by people all the time, it is suitable device for recording dietary information.

On the other hand, for the health information input interface, we use sphygmomanometer, a body composition monitor, and a calorie consumption meter. These health information are commonly used in hospitals to monitor lifestyle-related diseases patients.

The third component is a database server that accumulates dietary and health information for long in time and analyzes health status by taking account of medical findings. These systems are connected via e-mail systems on cellular phone and via internet. Each user will possess his own cellular phone and one set of health measurement instruments in home and uses one database server commonly available for all users.

B. Dietary Information Input Interface

In order to ease the input of dietary information by cellular phone, we provide the following two input methods.

- Menu Selection Method
- Bar Code Input Method

Menu selection method is used for recording dietary information when a user is eating in restaurants or in home. On the other hand, bar code input method is used for recording dietary information when a user eats foods purchased at supermarkets. In this way, a user can select his easiest input method. These input methods are implemented as a software system on cellular phone.

1) Menu Selection Method: Menu selection method consists of the following steps.

1) User selects the name of meal from menu, which consists of three hierarchies as shown in figure 2.
2) User inputs the amount of meal by number.
3) The cellular phone sends the information to the database sever via e-mail.
4) The database server records the meal information received by e-mail.

An example of the screen shot when a user is selecting from the menu is as shown in figure 3. Then the e-mail as shown in table I will generated and send to the database server.

2) Bar Code Input Method: Bar code input method consists of the following steps.

1) User selects barcode input method in the menu (see figure 2).
2) User takes photo of bar code by using camera attached on phone.
3) The cellular phone sends the information to the database server via e-mail.
4) The database server records the meal information received by e-mail.

An example of the screen shot when a user is selecting from the menu is as shown in figure 4. Then the e-mail as shown in table II will generated and send to the database server.

TABLE I

E-mail composed by menu selection method.

to:	XXX@hri2.iit.tsukuba.ac.jp
subject:	Basic Menu
body	Main Dish curry & rice 1 Salads vegetable dressing 1

C. Health Information Input Interface

For the health information sensors, we've used the following instruments.

- Sphygmomanometer (NT-201 by TANITA, see figure 5)

Fig. 2. Hierarchies of menu at the menu selection method.

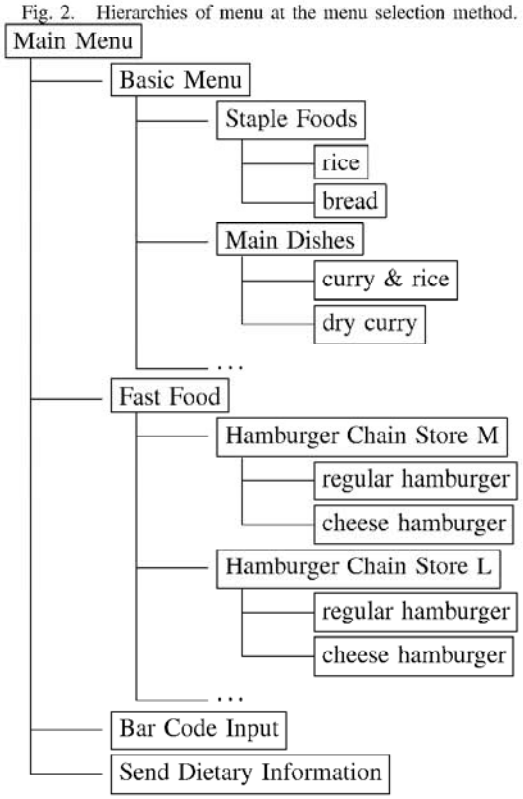

Fig. 3. Screen shot of menu selection method.

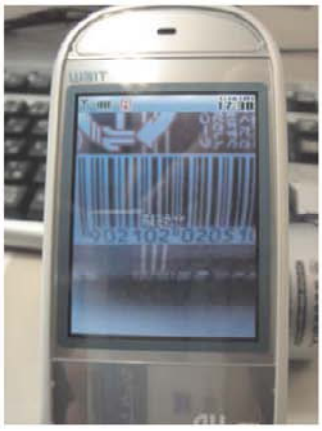

Fig. 4. Screen shot of bar code input method.

TABLE II

E-MAIL COMPOSED BY BAR CODE INPUT METHOD.

to:	XXX@hri2.iit.tsukuba.ac.jp
subject:	Bar Code
body	4902210380797 1 4901005135253 2

- Body fat scale (NT-101 by TANITA, see figure 6)
- Calorie consumption meter (ViM Sports Memory by MicroStone, see figure 8)

Fig. 5. Sphygmomanometer (NT-201).

Fig. 6. Body fat scale (NT-101).

Fig. 7. Wireless receiver (NT-401).

Fig. 8. Calorie consumption meter (ViM Sports Memory).

TABLE III

MEASUREMENT TIME RECOMMENDED TO USER.

Time	Dietary Info.	Blood Pressure	Body Fat	Calorie
After wake up		x		x
After breakfast	x			x
Before lunch		x		x
After lunch	x			x
After dinner	x			x
Before sleep		x	x	x

Calories are continumously measured by watch type device.

For the measurement of sphygmomanometer or body fat scale, the user is recommended to measure at the time specified in table III. This is because these measurement time is recommended in hospitals.

The measured information by sphygmomanometer or body fat scale will be transferred to PC via wireless receiver (NT-401 by TANITA, see figure 7). On the other hand, a user wears a calorie consumption meter on his wrist to measure the user's calorie consumption. The user will put the meter when he sleeps. At that time, the data accumulated in the calorie consumption meter will be transferred to PC via RS-232C serial link (attached on battery charger). These data transmitted to PC will be transferred to the database server via internet.

D. Database Server

1) Food Database: In order to record the nutrients intake, the database server has food database. The food data is prepared for each kinds of food user may take. The food database has the following contents:

- food categoriy name (i.e. staple foods, main dish, etc.) or restaurant name (see figure 2)

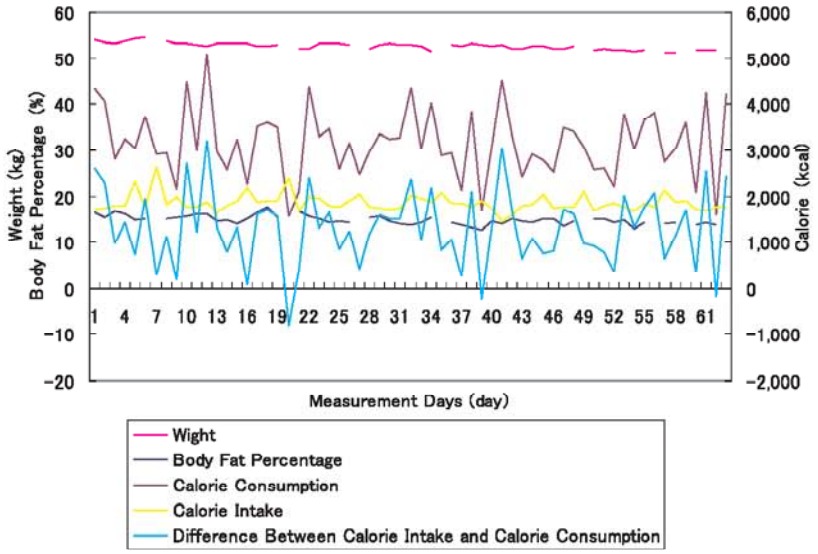

Fig. 9. Relation between consumption calorie , intake calorie and weight and body fat percentage

- food name (i.e. rice, bread, etc.)
- bar code number
- 23 kinds of nutrients with quantities

607 kinds of foods which don't have bar code and 805 kinds of foods which have bar code number are registered in database. We are using the bar code numbers and nutrients information that were provided by local supermarket chain store.

2) Lifelog Recorded in Database Server: The information sent from the dietary information input interface and the health information input interface is recorded by the database server. Since we are using e-mail for data transmission, these data is stored for each user by taking account the sender.

The following contents are recorded as dietary information.

- time (when food has eaten)
- food category name or restaurant name
- food name
- amount of food
- nutrients intake

The nutrients intake is calculated by the product of nutrient in the food database and intakes user had. On the other hand, the following contents are recorded as health information.

Data measured by the sphygmomanometer:

- measurement time
- systolic blood pressure
- diastolic blood pressure
- ventricular rate

Data measured by the body fat scale:

- measurement time
- body fat percentage
- weight

Data measured by the calorie consumption meter:

- measurement time
- consumption calorie of three minutes

IV. Experiments and Discussions

In order to confirm the adequacy of the proposed system, we have conducted an experiment by using a subject. We asked one graduate school student to use our system and measure his dietary and health information for two months.

We've succeeded to measure his dietary and health information for two months. This means that the devices and the system we've developed could be used for logging health statuses for a long time as we aimed. We have got a report from the subject that he sometimes selected similar foods in the menu when he could not find the one he intended. So we will increase the number of subjects more and improve the structure of the dietary information input menu.

Figure 9 shows the relation among consumption calorie, intake calorie, weight, and body fat percentage. With these data, we can analyze how the weight and body fat percentage are affected by calrie consumption and calorie intake.

As we've mentioned in section II-A.2, the weight and body fat percentage will increase when calorie intake is more than calorie consumption for a long time. So we have plotted the difference between calorie intake and calorie consumption in figure 9. Though the plot is scattered, it has tendency of decreasement from day 15th to 60th. Also you can see the weight and body fat percentage are inclined so that they are decreasing.

Figure 10 shows the relation among the amount of the intake sodium, the amount of the intake potassium, the amount of the intake salinity, the blood pressure, and the ventricular rate. As we've mentioned in section II-A.1, high blood pressure is caused by excessive intake of salt and sodium. On the

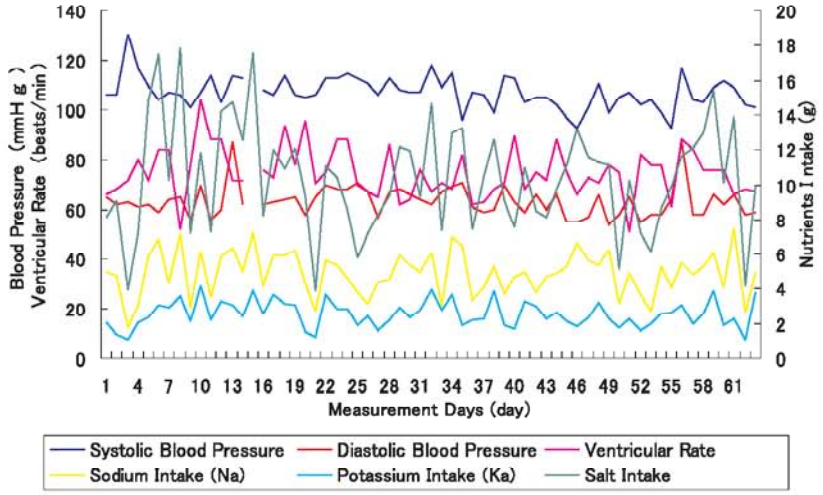

Fig. 10. Relation between amount of intake sodium, amount of intake potassium, amount ofintake salinity, and blood pressure and ventricular rate

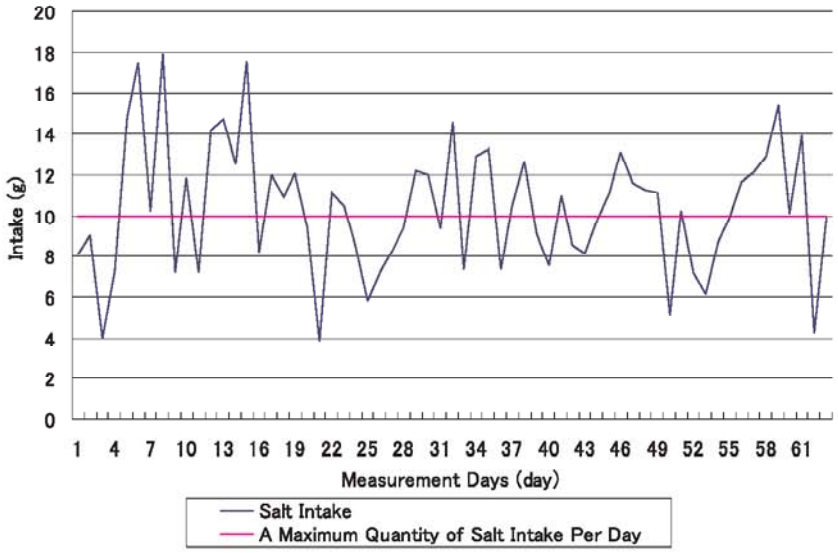

Fig. 11. Comparison between amount of intake salt and a maximum quantity of salt intake

other hand, the intake of the potassium calcium is assumed to suppress high blood pressure. As you could see from the figure, the diastolic blood pressure and intake sodium have correlation especially from day 15th to 40th.

Figure 11 shows the relation between salt intake and a maximum quantity of salt intake per day. This kind of figure could be used to warn a user for the excess intake of salt and guide a user to spend healthier life.

V. Conclusions

In this paper, we proposed a dietary and health information logging system for monitoring and supporting lifestyle-related diseases. We've developed a system by using a cellular phone, a sphygmomanometer, a body fat scale, and a calorie consumption meter. We also have conducted an experiment with a subject and succeeded for logging his dietary and health information continuously for two months.

We are currently developing a blog system, which displays every meal a user had as diary (see figure 12). It also displays

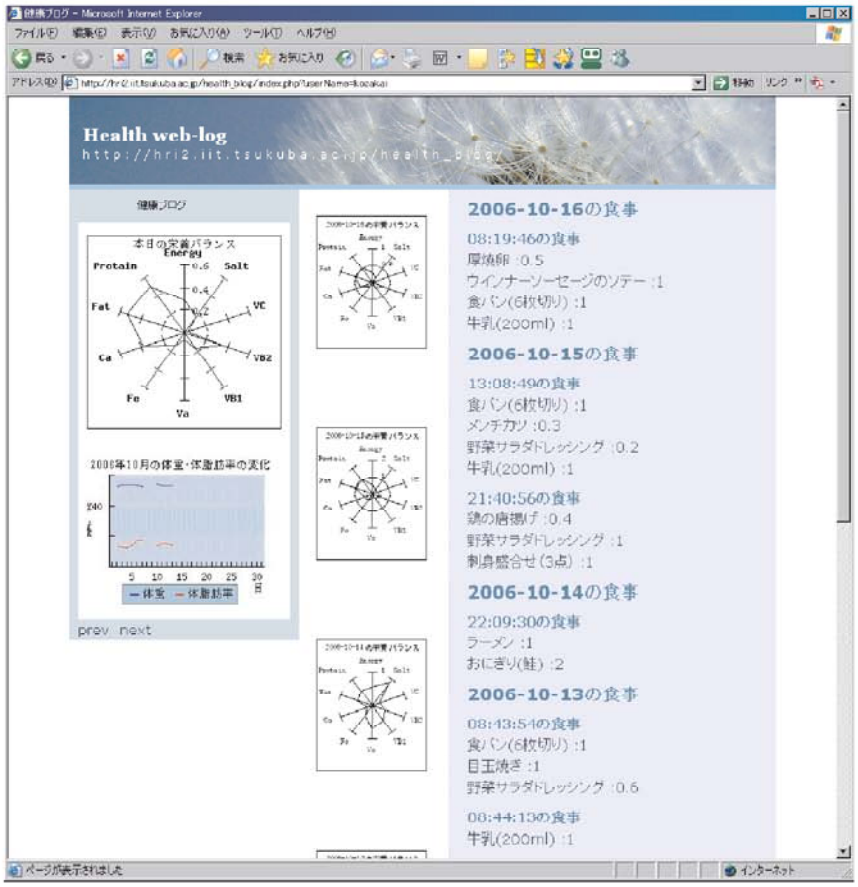

Fig. 12. Blog interface for home health care

how much typical nutritions a user had taken day by day as a rader-graph and a line-chart that denotes the changes in body fat percentage, weights, etc. for a recent month.

The analysis we've mentioned in the previous section were preliminary ones. We'll prepare more devices so that we can conduct experiments with more subjects. With more dietary and health information of many users, we'll analyze the correlation among data which leads them to lifestyle-related diseases much more in detail by using computational intelligence (i.e. data-mining, data clustering, rule-based system). Then, we will integrate such analytic results as a feed back to a user into the above mentioned blog system.

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