DEVELOPMENT OF A PROTOTYPE WELLNESS SUPPORT SYSTEM FOR ELDERLY PEOPLE

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Abstract: An increasingly aging society and higher prevalence of lifestyle-related diseases are significant problems in advanced countries. There are social requirements of integrated services for medical care, welfare, and healthcare. In this paper, we propose the concept of a Wellness Support System (WSS), which is an integrated information system that can be used to prevent the solitary death of elderly people, provide daily life support services, and improve the health of those at risk for lifestyle-related diseases. The WSS enables ease of use and a helpful information environment using a newly developed type of IP telephone for elderly people. This paper introduces the concept and describes the development of a prototype WSS.

1 INTRODUCTION

There are three main areas in human life support, namely, medical care, welfare and healthcare. Many systems using information and communication technology (ICT) have already been introduced in each area. There are also social requirements for integrated medical care, welfare, and healthcare services to reduce management costs and improve security and serviceability (Sasaki, 2011).

This paper first discusses previous studies on ICT applications in each of the above fields as well as issues to be solved. Then, we propose the concept of a Wellness Support System (WSS) to help solve these issues. We present the architecture and a prototype development of the WSS.

2 PREVIOUS STUDIES

2.1 ICT in the Medical Field

The medical field typically has a consistent budget and can develop new technologies and advanced equipment such as teleradiology, telepathology, electronic medical records, and so on. However, subjected to the effect of an ever-increasing number of elderly people, economic conditions for medical services in Japan will become more strained as a result of the greater need for costly treatments combined with the weak financial position of retired people. Particularly in rural areas, government budgets are too limited to allow optimal management of public hospitals and medical facilities. Recently, network-based medicine (i.e., cooperation in a regional medical group through information sharing) and telemedicine (a medical diagnosis service from a remote site using a network) have become popular since the need for high-cost medical facilities is not strictly necessary.

2.2 ICT in the Welfare Field

There is a social problem of increasing solitary deaths of the elderly. Although many kinds of sensor-type systems are available to monitor the health and activities of elderly people (Talab, 2009) (Eikerling, 2009), these have not been very successful because the intended users see such systems as an invasion of their privacy. Previously, we proposed a self-send-type monitoring system using an L-mode telephone and reported some successful experimental results (Yoneda, 2006). Now, a new self-send-type monitoring system using normal home telephones has been developed and tested in Japan (Sasaki, 2010).

2.3 ICT for Healthcare

Daily healthcare is important to prevent lifestyle-related diseases such as hypertension,

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hyperlipidemia, and diabetes. Although many healthcare-related web sites aimed at the general public are available online, there is no adequate healthcare system for professional users such as healthcare workers and physicians. People with lifestyle-related diseases usually have little motivation to seek good health promotion, nutrition management, and physical exercise, and if their healthcare were to be provided by a medical clinic, the cost would be high.

3 TARGET OF WSS

3.1 Users and Items in a WSS

The approach adopted for improving the health of those with lifestyle-related diseases is shown in Figure 1. The target users of our research are located midway between wellness users and patients. Vital signs, including weight, fat ratio, and blood glucose levels, have to be monitored to improve the health of these users. Patients are surrounded by a variety of therapies, including:

- dietetics, which deals with their intake of food and history of nutritional counseling, among others;
- physical exercise, which deals with calories and their history of exercise counseling; and
- drugs, which deal with their history of medicine.

As one moves from the bottom to the top of the pyramid, health conditions improve and the items dealt with become simpler. As such, the users and items in a healthcare system can be very complex and changeable depending on the individual health condition and situation of the user.

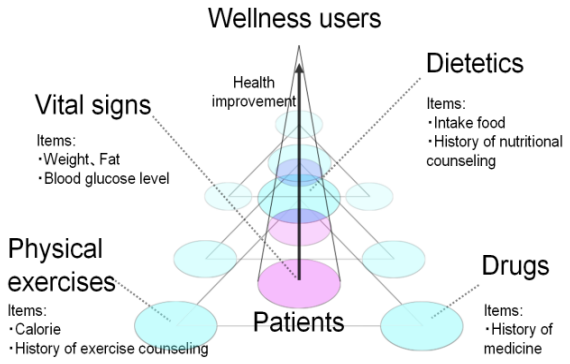

Figure 1: Approach for improving the health of those with lifestyle-related diseases.

3.2 Current Healthcare Support Systems

There are many existing healthcare support systems in Japan, which can be categorized by their services and target users. However, there is no all-encompassing main healthcare system in Japan. If we use multiple systems to cover multiple areas, a conflict of scope and items occurs. For example, when the condition of a wellness user changes to that of a patient, the data must be transferred to a different system, because the different health databases are not integrated.

3.3 Conventional Studies on WSS

Previously, the authors proposed the concept of a Life Support Network (LSN) (Sasaki, 2001). Currently, using standard non-LSN systems, personal data of individuals are managed in each individual field's system, causing many problems with regard to information security, management cost, and serviceability. In the LSN, on the other hand, personal data are managed in a single local database and can be shared with high security to provide optimal service through collaboration in the medical, welfare, and healthcare fields.

The requirements for the next level of healthcare system, or WSS, include:

- construction of an integrated healthcare database;
- effective use of any available part of the current system (to satisfy this requirement, a common platform for different systems is needed—further, administration items should be customized);
- adaptability to a variety of terminals and networks;
- security and user authorization management.

4 WSS PROTOTYPE

We propose a WSS architecture that includes various terminals and networks. In the architecture, single-sign-on can be realized by a core system, and users can control access to their data. The architecture also realizes an integrated healthcare database, which can be used by all users, for example, patients, healthcare administrators, and specialists.

Figure 2 shows the paradigm shift from the current model to a new model by means of the WSS. The server computers are placed at the top level with users and specialists in the bottom and middle levels,

respectively. A characteristic of the new model is to place the core system between the servers and users. In the current model, users have to access servers individually. In the new model, users can use a service without considering individual servers. An aim of our research is to construct a WSS platform and architecture to realize the new healthcare management model.

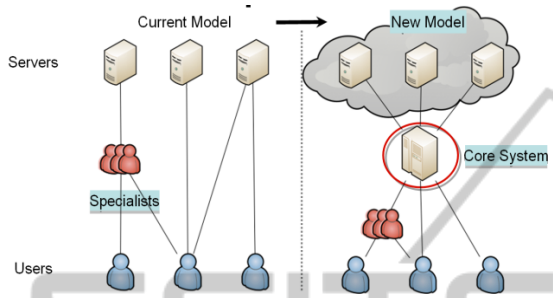

Figure 2: Paradigm shift from current model to new model by means of the WSS.

Figure 3 shows the proposed WSS architecture, which has the following layers.

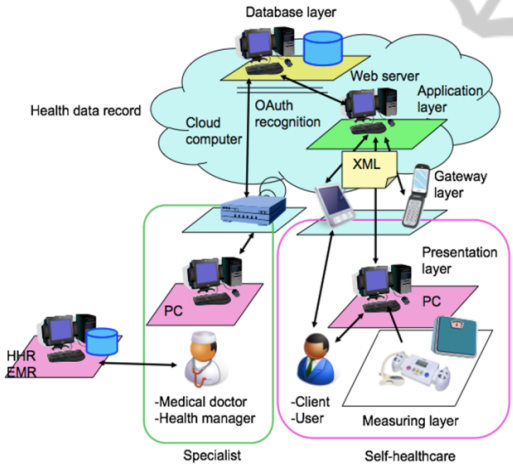

Figure 3: Proposed WSS architecture.

Measuring Layer. This layer has a health data measurement terminal that can be connected to the presentation layer or the gateway layer. Health data measurement terminals have a standard wireless interface such as Bluetooth to connect to the gateway layer. The available standard interface is the ISO/IEEE 11073 proposed by the Continua Health Alliance (Continua, 2010) and is our recommended interface. In consultation with medical doctors, we selected various devices for the daily healthcare of a residential client as shown in Figure 4. All the devices have a standard wireless communication network (ISO/IEEE 11073) and auto-sending function of the measured data to the gateway device. The gateway device has an IP network interface to connect to the server via the Internet.

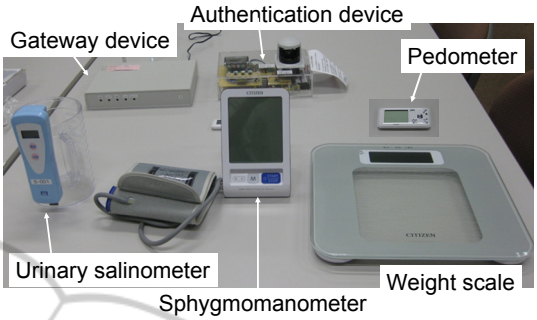

Figure 4: Prototype measurement devices.

Presentation Layer. This layer provides a user-friendly interface for easy input, expression, and editing to enable users to understand the vital health data visualized graphically or using other presentation tools.

Gateway Layer. This layer connects the measuring layer and presentation layer terminals with the IP network (Internet- or Cloud-based). The gateway layer terminal can be used to allow communication among users including physicians and health managers. We are developing a new application that works on the IP telephone shown in Figure 5. The IP telephone has six touch panel buttons, the top three of which (representing, I am “fine”, “not so fine”, “bad”) are used for a self-reporting type safety monitoring system, while the bottom three are to talk to a volunteer, a life supporter, or a healthcare manager. The IP telephone also includes gateway and presentation functions to connect to the Internet and to allow for easy operation by the elderly, respectively.

Figure 5: A new terminal with self-reporting type safety monitoring, gateway, and presentation functionality.

Application Layer. This layer includes many healthcare applications including vital data management, nutritional management, and physical exercise management. Documents exchanged in the WSS are XML format as this is preferable to realize flexible adaptation for many applications and a variety of terminals. Representational State Transfer (REST) (Fielding, 2000) is a useful technology for this layer.

Database Layer. All the data used in the WSS are centralized in the database layer so that the best combination of optimal quality medical, welfare, and healthcare services can be provided to users. The database can be constructed as a virtual database on the Internet or in a Cloud. There are certain required functions such as a recognition (certification) function to access data and data protection and a back-up function to maintain good reliability. We propose adopting Open Authorization (OAuth, 2011) technology for more convenient certification.

5 SUMMARY

In this paper we proposed the concept of a WSS to ensure the daily safety of elderly people and to improve the health conditions of people with lifestyle-related and pre-lifestyle-related diseases. The architecture of the WSS allows easy operation with a flexible information environment supporting a variety of terminals and applications, as well as interface adaptability. The following issues should be considered when constructing an ideal WSS:

- social and system management organization for continual use of the system;
- the economic effects and a business model of the system so as to clarify suitable areas and long-term use; and
- a real-time action system with a decision-making support function.

The major benefit of a WSS is the integration of isolated information systems in the medical, welfare, and healthcare fields on a common platform.

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