Self-Organized Software Platform(SOSp)-based Mobile chronic disease management

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Abstract. In modem society, aging and chronic disease is becoming increasingly common due to the increasing numbers of elderly patients. To best treat this growing segment of the population, medical care should be based on constant vital sign monitoring. In this study, we propose a mobile vital sign measurement and data collection system for chronic disease management, and we propose medical services with a self-organized software platform.

Keywords :L7, CDA,U-Health, Self-organization, Chronic Disease, Mobile Vital Signs, Context-aware, Opportunistic Computing

1 Introduction

In modern society there is an increasing number of people with bad eating habits who do little physical activity. These people have been experiencing an increase in life-style-related disease. Also, there is a growing number of elderly people with chronic disease as well. Despite the development of medical technology, successful treatment rates of chronic disease are significantly low. The failure of the management of chronic disease causes complications that lower the quality of life, increase the economic burden, and create social problems.

Most chronic diseases can only be cured by active self-management based on a doctor's guiding advice. But if a hospital's medical services can take a more active role in long-term management of chronic disease, it would be possible to maximize therapeutic effects. In order to do that, a patient's biological signals must be measured at all times and instantly transmitted to medical personnel [6].

To implement this type of comprehensive patient monitoring system would be a joint effort between companies and public agencies. They would have to work together with hospitals to provide equipment and home facilities. The raw biometric data from the patient must be identified and filtered before being sent to the medical institution. Creating personal devices to gather patient information is not really a problem

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in this scenario. The problem comes from many users using many devices at the same time, and the huge flow of information that would represent.

There is also the consideration of the quality of data collected outside the hospital. Some devices now do not create data that conforms to international medical standards, and so medical workers cannot take full advantage of it. In that case, medical workers find it difficult to give feedback to the patient.

In this study, we propose a mobile chronic disease management system using a self-organized software platform (SOSP) and implementing international standards to ensure the interoperability of a comprehensive and convenient health information architecture.

2 Backgrounds

2.1 HL7

HL7 refers to an application protocol for electronic data exchange in healthcare environments. It is based on the XML-based message format, and standardization is already ongoing in Korea. It is part of the Electronic Medical Records (EMR) standard, which is increasingly being recognized **[1].**

2.2 Self-Organization

Self-organization is a process in which structure and functionality (pattern) at the global level of a system emerge solely from numerous interactions among the lower-level components of a system without any external or centralized control. The system's components interact in a local context either by means of direct communication of environmental observations without reference to the global pattern [4].

2.3 Self-Organized Software Platform

Development of a SOSP is a national project at Kyungpook National University in South Korea. This project goal is specifically the development of a SOSP that connects disparate health monitoring devices. Also it aims for the development of a reference platform based on SOSP. A description of the SOSP concept is given below.

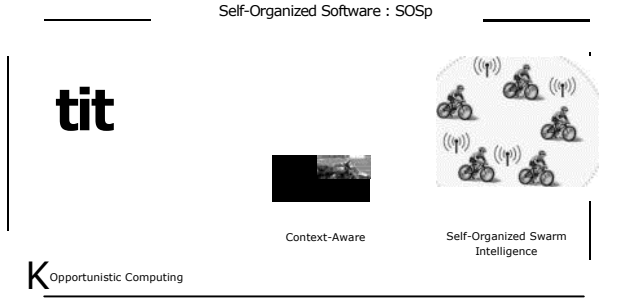

Fig. 1. Concept of self-organized software platform.

SOSPs have three essential features, which are named Opportunistic Computing, Context-awareness, and Self-Organized Swarm Intelligence.

SOSP clients attempt to connect to other SOSP devices within a reachable distance. This also makes it possible for a device to capture both a user's biometric and information on the surrounding environment [3].

In this study we focus on a device that can measure vital signs and also perform as part of a SOSP, in order to carry out effective chronic disease management.

3 Self-Organized Software Platform-based Mobile Chronic Disease Management

3.1 Existing chronic disease management U-Health System

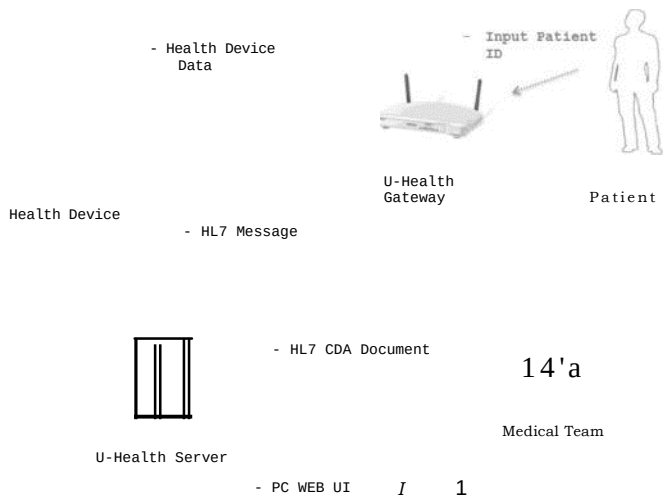

Fig. 2. Existing chronic disease management U-Health system

Existing chronic disease management U-Health Systems need patient authentication before collecting a patient's vital signs (Fig. 2). This is a very cumbersome and the cause of confusion in an environment that uses a lot of patient authentication. Also if the patient don't authenticate, the measured data does not get not transferred to the medical worker, which makes diagnosis more difficult. This will lower healthcare service quality [7].

3.2 Mobile Chronic Disease Management Architecture based on Self-Organized Software Platform

Unlike existing U-health systems, the SOSP client authenticates for the patient automatically, reducing hassles. All the measured data is recorded on the server. This

means that medical workers always have the necessary data for diagnosis, which means that they can provide higher quality healthcare services.

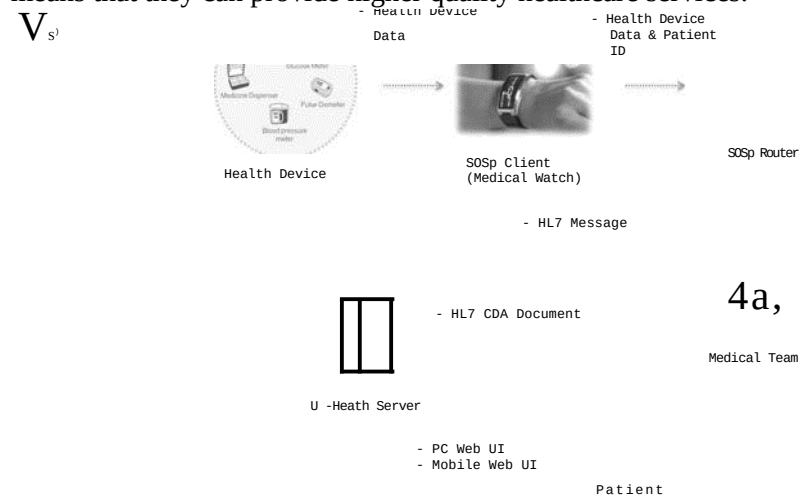

Fig. 3. SOSP-based mobile chronic disease management.

3.3 SOSP-based Mobile Chronic Disease Management Structure

3.3.1 Measuring Vital Signs with SOSP Client

Many vital sign measurement devices do not observe international standards for medical data in many cases, and also often do not include patient information. This hampers the interoperability of said devices. We designed the necessary structure to transform patient information and vital signs into the HL7 V2.5 international standard message format in order to maximize interoperability [1, 2, 5, 7].

The data that is captured through devices is transmitted to the SOSP client and integrated with the rest of the patient's information. Then it is transmitted to the SOSP router. If there is no SOSP router or SOSP client that is connected with an SOSP router, the measurement information is stored until one can be found using the self-organizing network (Fig. 3).

3.3.2 SOSP Router

An SOSP router receives integrated data from an SOSP client, converts the data to an HL7 2.5 message, and transfers that message to a u-health message server. PCD-01 according to the received data is converted into an ORO RO1 message, which is then transmitted. The transmission uses any wired or wireless network [1, 2].

3.3.3 U-Health Message Server

The SOSP server extracts the medical data from the HL7 V2.5 message. The server compares the extracted data with the stored data. They must match in patient ID and other data before being committed, to make sure that the data is something that the medical workers can use [1].

3.3.4 Use of U-Health Data

Data stored on the server must be available through the Internet. Confirmation that patient records have been measured at any time and general access is possible using a PC or smartphone. Medical workers will check the document that matches up with the HL7 Clinical Document Architecture to diagnose a patient [1].

4 Medical Records System with Integrated Utilization

In order for SOSP to combine chronic disease management, hospital and personal health management, several changes must occur.

4.1 SOSP-based Improved Prescription and Payment Services

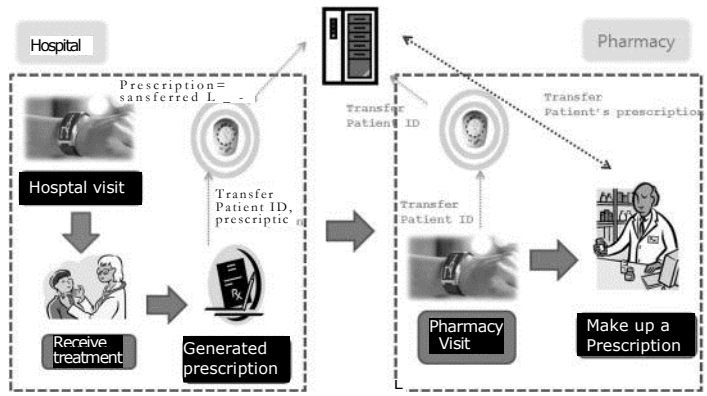

Fig. 4. SOSP-based improved prescription and payment services.

When patients visit a hospital, they normally get care in the order in which they arrived. Even if patients have an appointment they often have to wait before getting treated. After they receive a medical examination, patients must pay the bill and often receive a prescription. Patients must often go to the pharmacy in order to pick up the medication that they need, which requires further payment.

This procedure can be greatly simplified with SOSP. If the patient has an SOSP client, they would not have to wait to register for treatment. Medical treatment can automatically be scheduled. Their on-file billing information can be used to automatically take care of payment for the treatment and the medication both. The only thing a patient would have to do is travel to the hospital and then the pharmacy. When the patient enters the pharmacy, their identifying information can be transferred to a server. The pharmacist can receive all the information he requires and help the patient immediately (Fig.4).

4.2 SOSP Service - Chronic Disease Management

Vital signs and user activity can be measured and recorded in an SOSP environment. If a patient exercises, the SOSP client can collect data about the user and the envi-

ronment in which the user is exercising like current temperature, exercise time, heart rate, and blood pressure (Fig. 5). Based on the data collected, patients will be able to receive high-quality feedback from the SOSP client and excellent advice from health professionals [3].

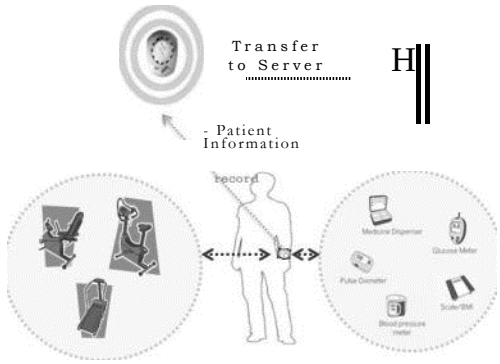

Fig. 5. Chronic disease management related directly with the SOSP service

4.3 Chronic Disease Management Services with Mobile SOSP

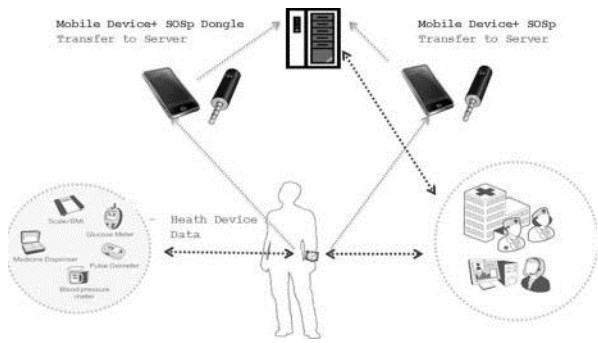

Fig. 6. A diagram of the envisioned chronic disease management service with an SOSP client.

Even if you don't have a router, you can build an SOSP environment with a wireless Internet device and an SOSP router dongle. Just by installing the routing software from the dongle (Fig.6), you can establish a low-cost SOSP environment, and the leverage of the total network will be increased [3, 6].

Personal users can build an SOSP environment using an SOSP dongle. Patients who visit health care services can record vital signs information with the SOSP smartphone environment.

5 Conclusion

In this study, we designed a mobile SOSP-based chronic disease management architecture based on the existing chronic disease u-health system. In particular, the approach was to improve on limitations of the current u-health system.

In the existing u-health system, users must authenticate before measuring vital signs, and that bothers patients a lot. But if they don't authenticate the measurement data cannot be used. This problem is solved by the SOSP environment. Also, the data can be accessed by mobile web UI services, which greatly improves the ability to utilize information.

SOSP combines existing systems. It connects local devices and the natural environment. It is context-aware, fully decentralized, and autonomous. It consists of three elements. This technology has become an autonomous community software platform combining existing systems, which makes a big difference.

In the past, a patient's biometric information was limited due to security problems, and there was a lot of difficulty in providing medical guidance. However, in this new u-health and SOSP age, communication between devices, medical professionals, and patients can be greatly sped up to give more accurate and comfortable treatment of chronic disease.

The SOSP client is always aware of its environment and the person it is monitoring. The doctor is always able to determine the current status and location of the patient, and the hospital can always respond appropriately in emergency situations.

SOSP is a fully-decentralized and autonomous community that can preserve and transmit data without any losses. Based on the data thus obtained, accurate treatment of chronic diseases can be done, and patients can live longer.

It is still not implemented yet, because there are still many requirements to create a functional SOSP situation. In the future, though, the necessary infrastructure will be constructed, such as chronic disease management services, mobile SOSP services that can be used in this situation, and other medical services can be adjusted to account for SOSP abilities. The medical community should be fully prepared for this type of environment.

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