

Context based personalized health monitoring system in a smart home environment

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Abstract—In these days, researchers have been studied about health monitoring with wearable sensors in a smart home environment. However, most work is focused on general medical service with telemedicine. We indicate the personalized health monitoring system with the context awareness technology combining the feature of user centric context modeling, analysis and delivery. This system is characterized by the personalized physiological context analysis, user controlled information management, and daily preventive medicine application.

Index Terms— health monitoring system, context awareness, oriental medical science

I. INTRODUCTION

RECENTLY the study of wearable health monitoring system has been popped with the rapid development of wireless sensing technology, long lasted wearable sensors, and high performance mobile processors such as UMPC, PDA[1]. Wearable health monitoring applications, utilizing data from wearable or portable physiological sensors, can be very helpful for personalized resident health status management based on the various kinds of context information.

However, most of the previous works have been studied about health application with a view point of telemedicine [2][3]. The telemedicine application is reliable to the portable and wearable sensing technology. For this reason, it is hard to guarantee the analysis results as long as the signal is obtained from the high cost medical equipment. In addition, previous health monitoring systems did not consider about the patient or user itself. The health monitoring results are just readable and interpretable only by medical doctor and the medical application is far from the ordinary people in daily life. The individual may be actively willing to know his/ her current status and feedback regarding his or her wellness or disease caregiver. Finally, the previous system did not concern about the user characteristics when it analyze the user's status. Personalized decision, analysis in medical service and treatment are necessary to treat the disease with more reliable manner.

In this work, we proposed the context based personalized health monitoring system for a smart home environment with user centric context modeling, user adaptive health decision

algorithm and disclose control for providing the information in proper situation. Basically, this system supports the real-time long term monitoring, personalized decision and analysis. It is also necessary to display the health information with user centric manner and also consider about the user centric disclosure control of personal information. Because many people utilizing health monitoring systems are quite conscious about the privacy of their medical reports and don't want to share them with anyone except their family doctors. Finally, it serves to recommend the proper alternative medical treatment method for ordinary people such as food, exercise in daily life.

II. PERSONALIZED HEALTH MONITORING SYSTEM

A. Issues and challenges

Generally, u-Health care system is largely categorized into three issues which are health monitoring with real time diagnosis at distance, and maintenance of health records with wearable sensor or personal station. Ultimately, this system enhances the health status of general user under the proper treatment or recommendation. In this work, we take into account to real-time health monitoring with wearable sensors with respect to the monitoring. Real time diagnostics at a distance with interactive technologies will be supported by the system. In this regards, we should guarantee the sensing information with the interoperable and flexible context framework between heterogeneous systems and sensors. Secondly, health management with wearable computers can be a strong point when we record and manage the long term health monitoring data. For that purpose, wearable personal station without involving the entire environment should be considered with proper contextual information management method. In application, we recommend the proper treatment method with alternative medicine which combines the concept of medical application and daily activity such as food, exercise or meditation for reducing the stress level.

B. System architecture and its components

We develop the personalized health monitoring system with the concept of prevent medicine and alternative medicine. The wearable or portable sensor unit, wearable personal device including main processor for signal or context analysis, control and management is required.

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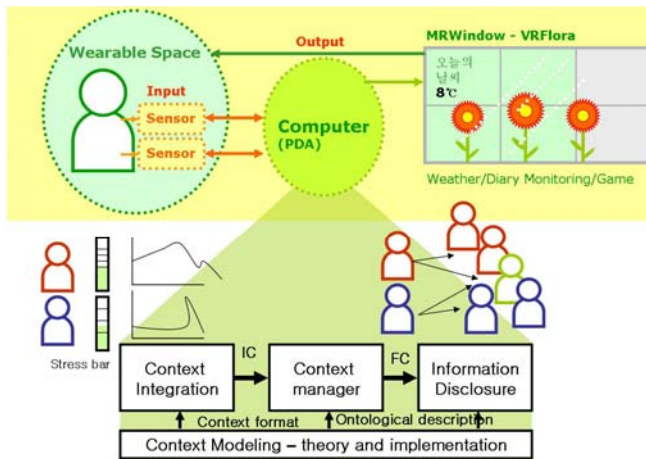


Figure 1. Context based health monitoring system architecture

1) *Context modeling*: Context modeling is a step for formatting the context as a form of SWIH. It enables the intelligent system to be understood about environmental context, user context. Context model provides the context format and supports ontological description.

2) *Context integration*: Basically, the role of context integration is to fill out each contextual element (SWIH) by using the preliminary context obtained from various sensors. Namely, it creates the integrated context from the preliminary contexts which have several blanks in contextual elements because a sensor cannot fill out all contextual elements. In this Section, we focus on 'how' and 'why' contextual elements to integrate the preliminary context from physiological sensors, which delivers body conditions of a user such as heart rate, temperature and skin humidity. The 'why' contextual element gives information about higher level context of user's internal states (intention, attention, emotion, etc) by inferring, interpreting and analyzing other contextual elements (who, when, how and what).

3) *Context management and information disclosure* [4]:

Context information is delivered in the final step; which is context management and information disclosure. In this step, final context includes the different level of contexts and health related information such as stress level, heart rate variations and other physiological signal indicators. In the information disclosure step, disclosure module manage the relationship between the user and the requestors like intelligent services around user, health caregiver or other home services such as ubiTV, MRWindow, ARTable[6,7]. According to the request, the appropriate context information will be distributed.

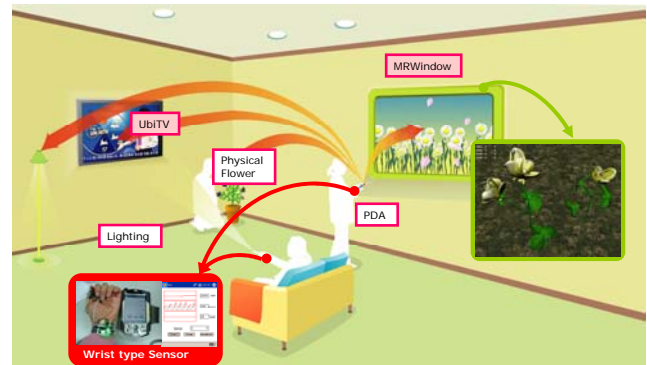


Figure 2. Whole Scenario in UbiHome testbed

III. APPLICATIONS

To validate the mechanism, we have conducted experiment with wrist type physiological sensors that monitor the user's physiological states. The platform of this project consists of an ambient display, wearable personal station for processing and managing the information, and a wrist type multi-physiological sensor including PPG sensor, GSR sensor and SKT sensor that had been developed in previous work [5]. This system is demonstrated in ubiHome, which is the testbed for a future smart home environment in U-VR Lab [6][7]. The health monitoring context can be delivered to the virtual flower in ambient display for showing the family members' condition with intuitive and seamless manner [8]. Virtual flower has a role to illustrate the family member's current body status entirely. If some request from family doctor or expert is transferred, the main personal device will determine whether the information should be disclosed or not. We expect that this system will allow patients to monitor their health and to deliver that information reliably without concerning the privacy problem in real time.

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