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Personal Health Care Management System Developed under ISO/IEEE 11073 with Bluetooth HDP

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Abstract

The standardization and interoperability become central issues among researchers and the business market in Personal Health Monitoring and U-Health support systems. ISO/IEEE11073 gives a good cost efficient standardization medium for that matter. In this paper, we developed a smart phone based health monitoring system under ISO/IEEE11073 and Bluetooth HDP. Here we report the implementation details of HDP Manager that can be used for personal health monitoring with smart phones based on Bluetooth HDP through HDP agent simulator based on ISO/IEEE 11073 PHD. The gateway in our system is based on HL7 converter. The system is designed for applying to all PHDs based on Bluetooth HDP authorized by CHA (Continua Health Alliance). While there has been a great amount of similar efforts to build a health monitoring system under ISO/IEEE 11073, Android smart phone systems allow only after ICS version announced in 2012 thus this effort is to enhance the interoperability between HDP and smart phones.

Keywords: *HDP Manager, Personal Health Device, ISO/IEEE 11073, Android Smart Phone, Bluetooth HDP*

1. Introduction

Recent progresses in mobile healthcare technologies with fast developments of smart equipments and personal health devices (PHD) will make U-healthcare society coming true in the very near future [1]. In typical u-healthcare service architectures, patient health data is measured on a PHD and transferred to external devices. Thus, standardization and interoperability become central issues among researchers and the business market and several system prototypes are proposed [2, 3]. However, the standardization of the cost efficient communication protocol is necessary.

The ISO/IEEE 11073 (or referred as X73) that specifies a set of joint standards addressing complementary organizational and technological aspects [4] becomes more and more important. The interoperability of PHDs made by different vendors, such as weighing scales, blood pressure monitors, and blood glucose monitors are essential to develop a general purpose health monitoring system. The scope of 11073 standards is to provide interoperability between an agent that is any of the PHDs, and a manager or compute engine.

Therefore, the aim of this paper is to develop a smart phone based personal health care monitoring system under ISO/IEEE 11073 as data standard and Bluetooth HDP as the communication standard to increase data reliability and interoperability between HDP and smart phones. Especially, Android smart phone systems allow only after ICS version announced in 2012 as a note. Recently, similar efforts to develop a u-health system under

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ISO/IEEE 11073 [8] and a mobile healthcare gateway design are also reported with different methodologies from ours. In this paper, we will describe our implementation methodology of smart gateway and HDP manager [8].

2. Smart Health Gateway and System Configuration

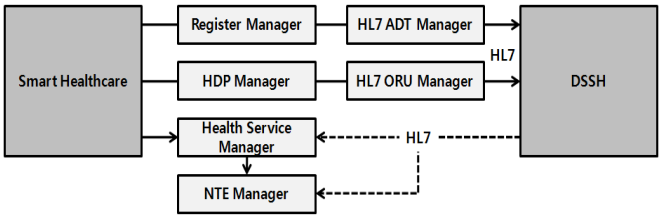

Figure 1. Overall Android Activity Diagrams

As shown in Figure 1, HL7 ADT manager deals with user profile information message production and transfer while HL7 ORU manager produces and transferrs HDP infoemation combined with user profile information. A user can ask his/her archived health information through HSM(Health Service Manager) and NTE Manager from Health Diagnosis Supporting System.

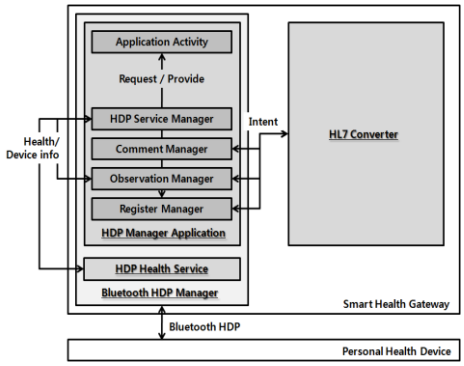

Figure 2. Overall Software Configuration

Figure 2 demonstrates overall software configuration. HL7 converter transforms information between IEEE 11073(Bluetooth HDP) and HL7 through HL7 WorlList Server and HL7 v2.x message from Diagnosis Supporting System. HDP information from PHD combined with user profile will be collected as segment information to produce hL7 message and transferred to HL7 Converter through Android-Intent.

3. HDP Manager Implementation

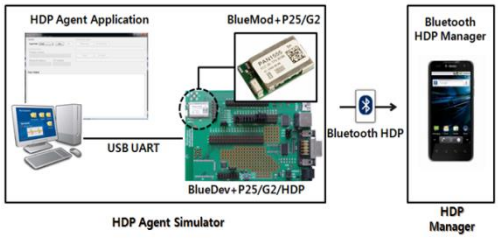

Figure 3. HDP Manager Configuration

Figure 3 shows the overall architecture of our HDP Manager implemented. The HDP manager is designed to provide personal health monitoring based on Bluetooth HDP through HDP agent simulator based on ISO/IEEE 11073 PHD. The system is designed for applying to all PHDs based on Bluetooth HDP authorized by CHA (Continua Health Alliance). The software is developed with BlueDev+P25/G2/HDP development toolkit and tested under Windows 7 PC. The health monitoring uses Signove Antidote ISO/IEEE 11073 stack library for all Android ICS OS 4.0 and after supporting Android HDP SDK.

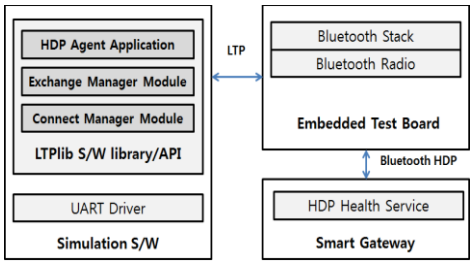

Figure 4. Configuration of HDP Agent Simulator

Embedded Test Board is a client that has a role of MDC (Medical Device Controller) under LTP protocol and communicates with HDP Agent Application through LTP. HDP Agent Application consists of Connect manager and Exchange Manager using FSM (Connection Management, Data exchange Management) in LTPlib API and controls Embedded Test Board through FSM. Then it also controls BlueDev+P25/G2/HDP thus Bluetooth HDP connection is operated as desired.

Figure 5 shows the overall HDP Manager Module structure.

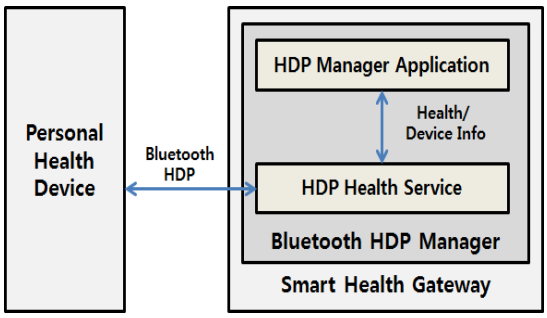

Figure 5. HDP Manager Module Configuration

HDP Health Service is a Bluetooth HDP based Android service that provides Antodote stack to HDP Manager Application to connect with PHDs. In this paper, our HDP Manager does not use D-Bus due to the limited capability of smart phone Android Linux in that Android applications cannot access Linux Bluetooth SDK BlueZ due to the unauthorization of using D-Bus. Instead, HDP Manager transfers information to Android-Activity of HDP Manager Application through HDP Health Service on Android Service and Android-Intent as the module configuration is shown as Figure 5.

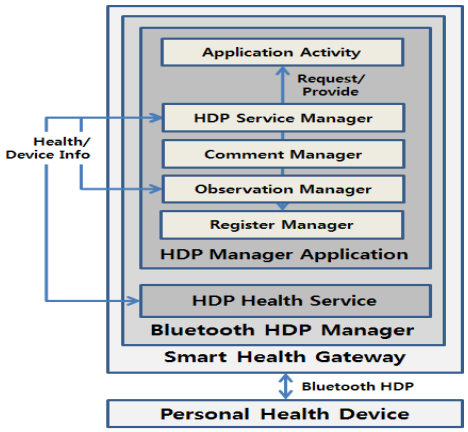

Figure 6. Software Module Configuration in HDP Manager Application

Figure 6 shows the Software Module Configuration in HDP Manager Application. The procedure to obtain PHD information through HDP Manager Application is as follows.

1) Waiting for the connection call from PHD after connecting with HDP Health service through HDP Manager Application.
2) After PHD sends Connect message through Bluetooth Transfer Layer and HDP Service Manager gets the signal, transfer 'Connected' status to Application_Activity.
3) When PHD and HDP Service manager is at 'Connected' status, PHD sends Association request message and transfer 'Associated' status to Application_Activity.
4) Ask PHD's configuration information through HDP Service Manager and finishes the connection for measurement after obtaining that information.
5) After connection is done and the targeted biomedical information is measured by PHD, send that information to HDP service Manager and parse the XML formatted health and device information and output them to Application_Activity.

4. Conclusion

In this paper, we introduce the design and implementation of our smart health monitoring system concentrated on the HDP Manager using ISO/IEEE 11073 as data standard and Bluetooth HDP as the communication standard to increase data reliability and interpretability between HDP and smart phones. While it has the environmental limitations of Android smart phone functionality, the proposed HDP Manager for smart phone is successful to connect with Bluetooth HDP through HDP Agent application and Embedded Test board of HDP Agent simulator.

Acknowledgements

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