ISO/IEEE 11073 Interoperability for Personal Health Devices Based on ZigBee Healthcare Service

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Abstract-- In this paper, we present an efficient method for establishing interoperability between legacy (nonstandard) personal health devices (PHDs) and standard PHD managers. Because legacy PHDs usually do not conform to the 11073 PHD standards, we propose a ZigBee Adaptation Module (ZAM) that can provide ISO/IEEE 11073 interoperability for legacy PHDs on the basis of the ZigBee Health Care (HC) profile. The ZAM allows for the exchange of the nonstandard messages of the legacy PHD with the messages corresponding to the 11073 standard in an interoperable manner. The ZAM also supports an HC profile for standard ZigBee communication with the PHD manager. To demonstrate this, we developed a PHD manager and the ZAM using a legacy device that measures blood pressure and glucose levels.

I. INTRODUCTION

Of late, the increasing demand for value-added mobile healthcare services and the dramatic transition to an aging society have motivated efforts to develop more efficient health services. Given the development of personal health devices such as blood pressure monitors, pulse oximeters, and glucose meters, to allow for the delivery of ubiquitous healthcare services, the standardization of health devices is important, as this will ensure the compatibility of the health-related data between the various devices [1].

The ISO/IEEE 11073 personal health device (PHD) standard provides interoperability to guarantee compatibility and scalability between PHDs and their managers. This standard defines the structure of the data and the protocol to be used between individual medical devices and the manager that collects and manages the information from the individual medical devices [2]. Recently, a number of studies have been performed on PHD standards, which focus mainly on devices for home and mobile environments [3]. Further, the Continua Health Alliance has presented industry profiles based on the ISO/IEEE 11073 PHD standards and is aiming to ensure the adoption of these profiles as a de facto industry standard [4].

Although the 11073 PHD standards have been established for many healthcare devices, those of many existing ones have not yet been standardized [5]. A number of health device manufacturers have developed their own individualized systems and protocols; as a result, their systems do not exhibit interoperability with the systems of other vendors. The standardization of their systems would require the replacement of some parts in the healthcare devices, which could make interoperability an expensive proposition [5].

Several studies have investigated the 11073 PHD standards [6], [7]. However, these studies only introduced PHD standardization and did not develop the technical systems required to ensure interoperability. An adapter board that converts the protocols used by legacy devices to those of the 11073 PHD standards had been developed with the Bluetooth Health Device Profile [8], [9].

Fig. 1. Overall architecture for ISO/IEEE 11073-based interoperable health devices using the ZAM

![Fig. 1. Overall architecture for ISO/IEEE 11073-based interoperable health devices using the ZAM](image)

As the ISO/IEEE 11073 PHDs can communicate wirelessly with the manager via ZigBee, the corresponding standard communication is based on the ZigBee Health Care (HC) Profile [10]. In this paper, we propose an efficient architecture for ensuring interoperability between legacy devices and standard ones based on the ZigBee HC Profile. Although the legacy devices do not conform to the 11073 PHD standards, it is possible to provide health devices with interoperability using standard protocol conversion based on the ISO/IEEE 11073 standard and the ZigBee HC Profile, that is, through the so-called ZigBee Adaptation Module (ZAM).

Fig. 2. Protocol conversion for blood pressure measurement

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II. HEALTH DEVICES INTEROPERABILITY FOR ZIGBEE-BASED HEALTHCARE SYSTEM

To ensure intersystem interoperability, we propose a ZAM, which is shown in Fig. 1. The ZAM is capable of exchanging the nonstandard messages of legacy devices with those based on the 11073 standards. The ZAM has a device-specific protocol container for various legacy healthcare devices. The PHD manager supports the ZigBee HC profile for the standard communication protocol of health care devices over IEEE 802.15.4 and focuses on the integration of the IEEE 11073 protocol over it. The measurement data from body sensors can be securely transmitted by the ZigBee HC profile.

Figure 2 shows protocol conversion as it relates to blood pressure measurement. Legacy health devices such as blood pressure monitors, pulse oximeters, and glucose meters encode health data using device-specific protocols. The ISO/IEEE 11073 protocol is composed of the Association Request/Response, Attribute Request/Response, Data Reporting, Confirm Measurement, and the Association Release/Response.

Figure 4 shows the hardware block diagram and the main board of the ZAM. The ZigBee module has a battery life long enough to allow for the creation of a scalable network of low-power wireless nodes. In the proposed system, the PHD manager uses the ZigBee dongle for supporting ZigBee HC profile communication. The ZigBee dongle is connected to a universal serial bus (USB) port on the PHD manager. The medical records of the manager are shared with an external platform server after being converted to the Continuity of Care Record (CCR) or HL7 specification [11]. This way, medical records relating to various healthcare services such as telemedicine services and health-reporting services can be made available to chronic patients.

III. CONCLUSION

In this paper, we proposed a health devices interoperability scheme for a ZigBee-based healthcare system. The standardization of legacy health care devices involves time and entails high costs on the part of the manufacturer. The proposed system should allow legacy devices to exhibit interoperability while following the established standards.

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