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INTEGRATION OF PATIENT BODY HEALTH SENSING AND TELE MEDICINE SYSTEM USING IOT PLATFORM

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Abstract

In-home healthcare services based on the Internet-of-Things (IoT) have great business potential; however, a comprehensive platform is still missing. In this paper, an intelligent home-based platform, the iHome Health-IoT, is proposed and implemented. With the health requirement increasing, telemedicine is turning from the idea into the reality. However most current telemedicine systems are actually implemented by traditional video conference tools, which is very reluctant to support more complex medical activities. intelligent pharmaceutical packaging (iMedPack) with communication capability enabled by passive radio-frequency identification (RFID) and actuation capability enabled by functional materials, and 3) flexible and wearable bio-medical sensor device (Bio-Patch) enabled by the state-of-the-art inkjet printing technology and system-on-chip.. From this view, an integrated reference implementation is introduced, through which several crucial technologies are discussed including the multimedia streaming, secure communication and interoperability between the gateway of internet of things and medical peripherals.

Key words – Multimedia, telemedicine, interoperability, internet of things.

1. INTRODUCTION

Now a days global ageing and the prevalence of chronic diseases have become a common concern [1]. Many countries are undergoing hospital restructuring by reducing the number of hospital beds and increasing the proportion of home healthcare [2]. A promising trend in healthcare is to move routine medical checks and other healthcare services from hospital (Hospital-Centric) to the home environment. By doing so, firstly, the patients can get seamless healthcare at anytime in a comfortable home environment; secondly, society's financial burden could be greatly reduced by remote treatment; thirdly, limited hospital resources can be released for people in need of emergency care.

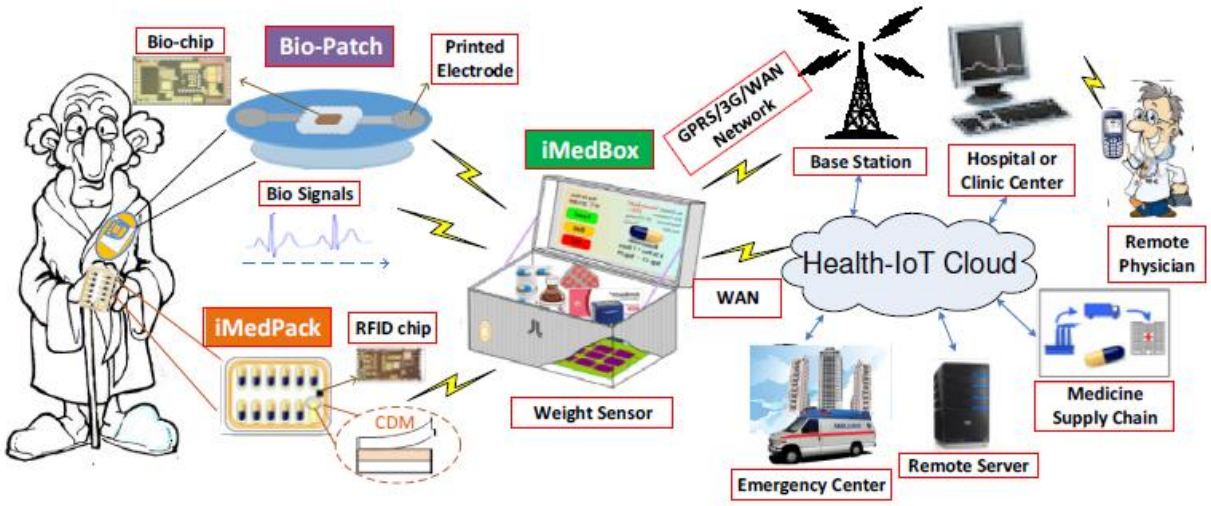

Fig.1. Application scenario for the proposed i-Home Health-IoT system

In-home healthcare and services can drastically reduce the total expenditure on medical care or treatment. Telemedicine is defined by the WHO as "the practice of medical care using interactive audiovisual and data communications. This includes the delivery of medical care, diagnosis, consultation and treatment, as well as health education and the transfer of medical data [1]." In 1906, Wilhelm Einthoven experimented the first telemedicine by transmitting ECG recordings through telephone [2]. They object to such new models of working, especially when real time physiology data from patient is seriously needed but lacking in common video consultation. Real time life data feeding and transmitting in telemedicine must be overcome if telemedicine is to reach its potential. As a new generation information technology, Internet of Things brings telemedicine new chance, which applies sensors and network to traditional medical devices, therefore is able to assign the intelligence to them, implement deeper communication and interaction between patients and remote specialists. In addition, the existing systems seldom integrate new materials or apply new manufacturing approaches, which are always the key elements for bringing new devices or solutions into healthcare fields. By taking the aforementioned issues into consideration, an intelligent home-based healthcare IoT system, iHome Health-IoT, is proposed in this paper. Fig. 1 illustrates the concept of the iHome Health-IoT System. An intelligent medicine box (iMedBox) serves as a home healthcare gateway.

2. BODY HEALTH IOT SYSTEM

The network architecture consists of three network layers: smart medical service layer, medical resource management layer, and sensor data collecting layer. A smart medical service layer is directly linked to professional medical facilities such as hospitals, emergency centers, and medicine supply chain. For example, doctors can efficiently manage a large group of patients.

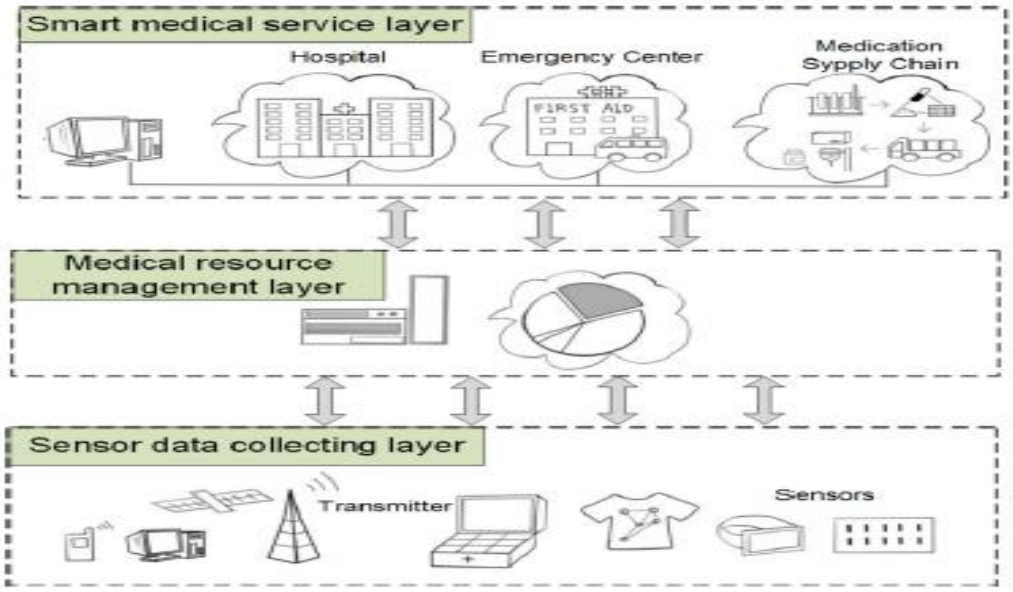

Fig.2 . Three-layer structure of the proposed iHome Health-IoT system

They can inspect the medication history as well as the physiological status history of a specific patient, make further analysis of a suspicious portion of patient's bio-signals (e.g., ECG) and based on that make a new e-prescription accordingly. Besides patients' benefit, IOT even helps entire health industry, in which

wide scope of medical devices are connected to existing health network, patient crucial life signal is captured by sensors and transmitted to remote medical centre, and doctor is able to remotely monitor patient condition, provide medical suggestion and aiding. On the whole, the above-mentioned systems focus either on making improvements to a specific condition or developing devices for a specific problem, which only covers some limited aspects of home healthcare. A comprehensive solution for in-home healthcare is still missing. A desirable system should be capable of taking care of the patients from all aspects, covering personalized medication, vital signs monitoring, in-site diagnosis and interaction with remote physicians. Also, the doctors can perform an overall examination of a patient group by using dedicated software which automatically analyzes the variation of an individual patient's physical condition over a period of time, for example, one week or one month. Subsequently, the doctors can easily identify the patient group whose health conditions have improved, and make them aware of their progress. Both patients and their family may feel reassured which helps build positive loops into rehabilitation and selfcare. The sensor data collecting layer is the basis of the entire network. It consists of data sensing and acquisition devices, local computing and processing units, data storage devices, and wired/wireless transmitting modules. It is a multi-standard wireless sensor platform, compatible with different wired/wireless protocols, such as Ethernet, RFID, Zigbee, Wi-Fi, Bluetooth, and 3G/4G network. With this three-layer iHome Health-IoT system, interaction between clinical professionals and home-stay patients can easily take place on demand or on a regular basis.

3. INTELLIGENT MEDICINE PACKAGING

Nowadays, for senior citizens and patients with chronic diseases, it is critical to follow the doctors' advice. An intelligent medication administration system is desirable to timely remind and dispense the medicine to individuals, and in the meantime, register and track their medication history. Prescribing clinicians frequently do not often detect or ask about non-compliance and are not always good at recognizing when patients stop taking their medication.

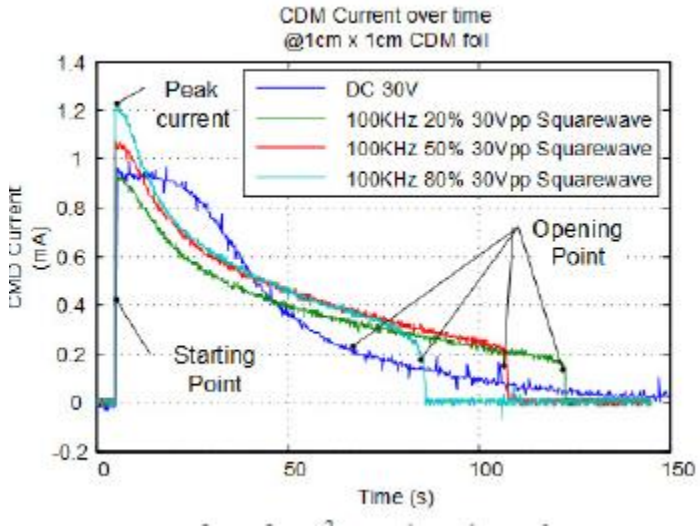

Fig.3. The delamination current waveform

If possible, it is important to maintain routine contact with the doctor to discuss, among other things, compliance issues. However, this is not as easy as it sounds. Moreover, the misuse and abuse of prescription medication can cause a range of adverse drug reactions, sometimes even leading to de-

manufacturing industries, logistics providers, supply chain management, retail outlets, banks, location tracking and process detection. Due to the low-power consumption, quick response, and electrically-controlled delamination features, we combined CDM into an aluminum foil covered capsule package.

4. ANALYSIS

In particular for premature heart attacks, a very high proportion of lethal attacks happen during sleep or daily activities. The sooner the symptom is detected, the earlier medical treatment and the In this federated framework, MCAP means Multichannel Adaptation Protocol, HDP refers to Health Device Protocol, L2CAP presents Logical Link Control and Adaptation Protocol.

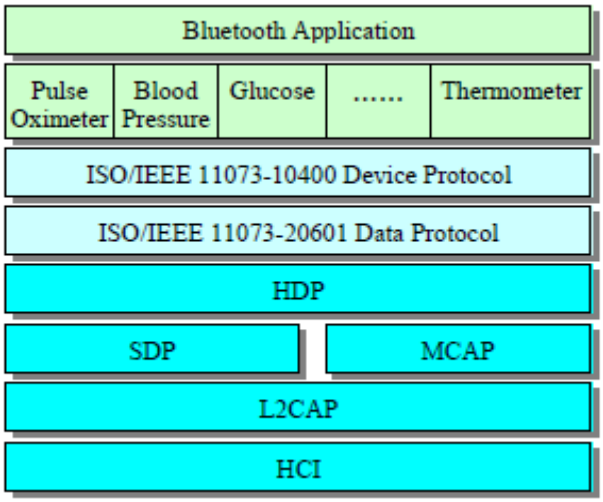

Fig.4. The federated Bluetooth health framework

HCI is Host Controller Interface, SDP stands for Service Discovery Protocol, they all belong to Bluetooth medical/health device standard. Among them, MCAP and L2CAP guarantee robust connection, support retransmit model, streaming model and interoperability requirement definition, while HDP provides Bluetooth application framework. The iMedPack is sealed by CDM and integrated with an RFID tag as introduced in the previous section. The medicines are kept in the iMedBox just as in a normal in-home medication unit.

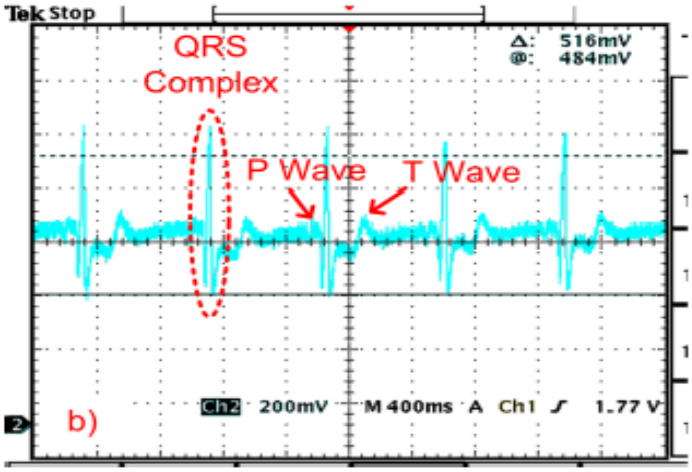

Fig.5. Miniaturized Bio-Patch for single-channel ECG measurement

The iMedBox recognizes and registers the medicine information by the RFID number, and meanwhile, compares the medicine with the prescription. We thereby substituted the original single-layer adhesive aluminum layer with a sandwich-structured CDM to seal the packages. Combined with advanced RFID technology, an iMedPack was implemented. An RFID tag is attached along the edge of the medicine package, and connected to the CDM. The RFID tag is wireless-powered by the reader embedded in the iMedBox. The tag can convert the near-field magnetic wave emitted by the reader into a DC supply, and an integrated charge-pump circuit can boost the DC voltage to around 30 V for CDM opening. The RFID always keeps the charge-pump module shut down until it receives an opening-command issued by the iMedBox.

CONCLUSION

In recent decades, the rapid growing of aging population has been a challenge to global healthcare systems [1]. Many countries have been active in undergoing hospital restructuring through optimizing medical resources and increasing the use of home healthcare . IoT now has been recognized as a revolution in ICT and is expected to be applied to many industrial sectors including healthcare . This paper presents an IoT-based intelligent home-centric healthcare platform (iHome system), which seamlessly connects smart sensors attached to human body for physiological monitoring and intelligent pharmaceutical packaging for daily medication management.

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