

Integration of Bio-Sensor in iHome Health IoT System

P.Arul¹ Munukuru Deekshitha Sai² M.Nandhini Devi³ C.Pavithra⁴

¹Assistant Professor ^{2,3,4}UG Scholars

^{1,2,3,4}Department of Electronics and Communication Engineering

^{1,2,3,4}R.M.D. Engineering College, Kavaraipettai, Tamilnadu

Abstract— In today’s busy life, patients may forget to take their medicines as per the prescription. Hence it may cause elongate period to recover from the disease. The physical status of the patient can be monitored by analyzing the vital signs and checking whether they are taking their prescribed medicine. One review estimates that, about 25% of adult population suffers poor health outcomes and increased mortality due to improper following of prescribed medication. In-home healthcare services based on the Internet-of-things (IoT) involves an open platform based intelligent medicine box (iMed Box) with automatic medication remainder system that is enabled by passive radio frequency identification (RFID) and a wearable bio-medical sensor device. This method fuses IoT devices with in-home healthcare services like Telemedicine. Intelligent medicine packaging (iMed Pack) system is also implemented which is used to provide a clear knowledge to patient about the medicine consumption. This iMed Box may improve prolong health care of the people.

Key words: Bio-Sensor, iHome Health, IoT

I. INTRODUCTION

Now-a-days, patients may forget to take their medicines as per the prescription. Hence it may cause elongate period to recover from the disease. So, in many countries restructuring of hospitals is done by reducing number of hospital beds and increasing the part of home health care. By doing so continuous health care can be given to the patients at any time in a home environment. This also reduces the financial burden by using limited hospital resources. The physical status of the patient can be monitored by analyzing the vital signs and checking whether they are taking their prescribed medicine. One review estimates that, about 25% of adult population suffers poor health outcomes and increased mortality due to improper following of prescribed medication. Internet of things defines connecting of physical and embedded devices with the internet that enables the objects to collect and exchange data. IoT-GSI defines the IoT as “The Infrastructure of the Information society IoT extends internet into our everyday life by interacting with smart devices. Some researchers attempt to introduce healthcare using different technologies to achieve better e-health services. A Smart real-time healthcare monitoring and tracking system using GSM/GPS Technologies to monitor the Health of the patient. BIOTEX-Bio sensing textiles for personalized healthcare management to sense the condition of the patient. Even these methods of health is implemented successfully, there are some flaws regarding physical size and short battery life. An intelligent home based healthcare IoT system(iHome health IoT) is proposed by considering the aforesaid issues. IMedBox is the central platform in home healthcare system. IoT devices like wearable sensors and intelligent medicine packaging (iMedPack), are flawlessly connected to the iMedBox via a

heterogenous network which is compatible with multiple existing wireless standard.

In these system, Bio-patch is used as a sensor to sense and transmit patients health situations to the iMedBox. iMedPack is also connected to iMedBox via RFID, which help the users about their recommended medication. After analysis, the collected data is deposited and displayed in network.

II. IHOME HEALTH IOT SYSTEM

A. Network Architecture of Ihome Health Iot System

The network architecture of iHome health IoT system is classified into three layers: 1)Smart medical service layer;2)medical resource management layer; and 3)sensor data collecting layer. These three layers are shown in fig 2. A Smart medical service layer is linked to medical facilities like hospitals, emergency centers and medicine supply chain. For example, if patients are suffering from certain health problems, physician can accomplish and evaluate the medication and status history of specific patient easily. They can monitor and analyze the bio signals of ECG and can examine the discrepancy of individual health over a period .They can also identify the improvement of their health conditions and can reassure the patient and family members. The Medical resource management layer works as a transition supporting layer in which administration and management of medical resources can be done in an efficient manner and smooth operation of the iHome system can be enabled. It provides efficient way for data security and patient privacy protection through cloud computing and services. The sensor data collecting layer involves wearable and wireless devices for sensing and data storage. It is compatible with different wired/wireless protocols such as Ethernet, RFID, Zigbee, WI-Fi, Bluetooth and 3G/4G networks. With these three layers of iHome health IoT system interaction between clinical professionals and home stay patients can be done.

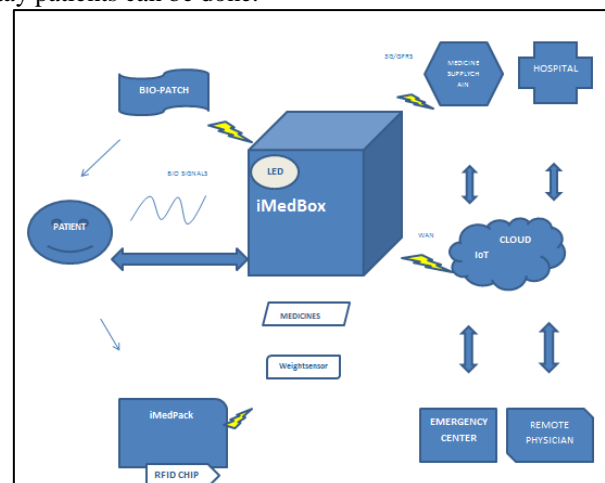


Fig.1: Block Diagram of ihome health IOT systems

B. Imedbox Architecture

The idea of iMedbox comes from InHome medicine container and it is the central platform of the iHome health IoT system shown in fig 3. The iMedBox serves as a medication inspector which consists of high frequency (HF) and ultra-high frequency (UHF) RFID reader, a Wi-Fi unit, a Zigbee receiver, a tablet PC with extension ports are embedded into the lid. A high resolution weight bridge is integrated at bottom of the iMedBox to track the weight variation of medicine in iMedBox based on dosage of medication taken by the patients. Variable Medical Sensors(Bio Patch), Intelligent medicine packages and the sensors/devices are connected as third parties to the iMedBox via various wireless technologies. It can also deliver variety of services like health social network telemedicine, emergency and medication management services.

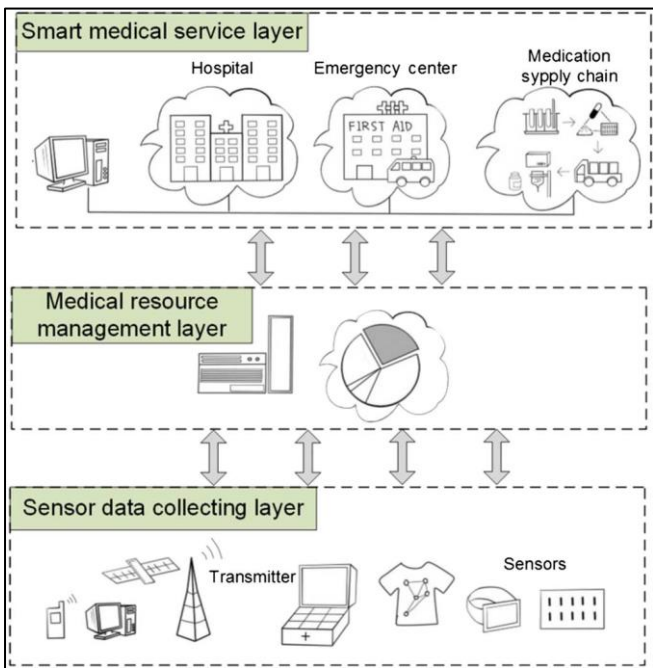


Fig 2 IOT Health system

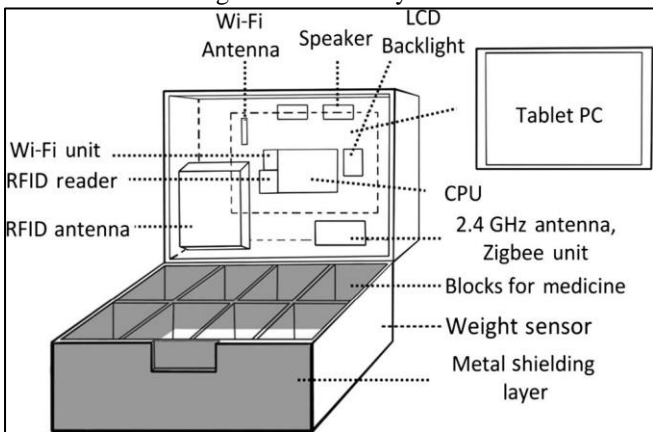


Fig 3 Imed box architecture

C. Intelligent Medicine Package

Now days, it is more critical for senior citizens and patients with chronic diseases to follow the doctor’s advice and to follow their prescribed medicine at the proper time. Especially, the patients or senior citizens suffering from amnesia often forgot to take the recommended medicine on

time. It is difficult for the clinicians to detect or ask about noncompliance and it will not be always good at recognizing the delay of the patient’s medication. So, it is important for the patient to maintain routine contact with the doctor to discuss about the issues. It will not sound easy in detecting the misuse of prescribed medication. So these adverse drug reactions may sometimes leads to death.

IMed package is proposed utilizing two key technologies: RFID Technology and controlled delimitation materials (CDM) with the purpose of solving the medical issues, improving pharmaceutical noncompliant situation and making the work easy as well as smart. RFID has larger memory, faster reading speed, and higher information security. In recent years RFID technology is also more popular in the applications of manufacturing industries, banks, location tracking. CDM is a thin layer form of adhesive sandwiched between two metal substrates. It is used as the adhesive to stick the RFID tags that are attached at the end of the medicine and to seal the packages. RFID tag is wireless and is powered by the RFID reader which is embedded in the iMedBox. Another RFID Tag will be given to the patient proving with a particular track number. This track number is used to track the details and prescription of the patients.

III. UNOBSTRUSIVE BIO-SENSOR

Physical conditions of the patients can be easily monitored by using biological signals, ECG. Cardiac diseases and many chronic diseases are asymptomatic and are difficult to diagnose. So, regular health monitoring is essential for sensing and treating diseases. In the previously used technologies a strap based ECG sensor is used to detect the conditions of ECG, strap will be tightly attached to the body and it is so difficult to carry for long period. Now unobtrusive biosensor is used which has comfortable properties. Power consumption of this unobtrusive biosensor is low so it leads to long battery life and is also cost effective.

Bio-Patch is placed on the relevant body parts which can monitor the physiological parameters. It wirelessly transmits the bio-signals into iMedBox by converting into electrical signals. These electrical signals are stored in the iMedBox and will be send to the physician or emergency center through IoT.

IV. SYSTEM ASSIMILATION AND PROTOTYPE DEMONSTRATION

A. Remote Prescription

In this system, patients are provided with iMedCard with an unique registration number. Patient details will be stored into the database by the physician by using this registration number. If the patient with iMedcard comes within the range of the iMedBox RFID reader sense and compare the ID/registration number which is already stored. If the number gets matched then patient prescription will be displayed along with the details of the patient. If the number is not matched then the iMedBox will turn off, which means that the prescribed medicine is not available.

B. Medication Remainder

Medicines connected with RFID tags and sealed with CDM material are placed in the iMedBox as like normal medicine box. When the patient take the particular medicine then reader will compare the RFID number mentioned in the prescription and based on that it will intimate the person about the medicine usage. If the patient takes the wrong medicine then iMedBox will intimate them about the misuse. By considering the difficulties of visual impairment and hearing loss audio and video reminders are also provided. Tracking the weight of the medicines before and after consumption and comparing them is also an alternative method is also provided to track the quantity of consumption of medicine. In this method, RFID tag is placed underneath each bottle. This short range RFID reader recognize lifting of medicine bottle from the iMedbox and record its ID number that is directly linked to the medicine taken. The weight bridge sensors which are placed at the bottom of the iMedBox will measure the weight difference of the medicine bottles before and after the consuming the medicine. iMedBox calculate the quantity of consumed medicine by considering the measured weight difference.

C. Intelligent Analysis and Firstaid Alarm

In general, elderly people will not be able to remember the timings of the prescribed medicine and even sometimes they will not be in a condition to remember what medicine to take. In this situation, there will be a probability of consuming medicine in wrong time and even misuse of medicine may occur. This may leads to improper healthcare. The iMedBox will acts as an intermediate between the doctor and patient during these circumstances.

V. RESULTS



Fig 4. imed box system integration

VI. CONCLUSION

This paper presents an Integration of biosensor in iHome health care system, in which wearable sensor devices are connected with the users and the network. In this system, daily monitoring of health conditions of the patients can be done easily in the home environment. This proposed iHome health system has three key factors like iMedBox, iMedPack, Bio-sensors. iMedBox acts as central platform of the iHome Health IoT system, which connects the patients and the doctor/emergency centers. In this system, details of the patients and their medical prescriptions should be

uploaded into the cloud/database by the physician. iMedBox consists of LCD Display and weight bridge sensors are placed at the bottom of the box upon which medicines with RFID tags are placed. Patients were provided with the particular ID number which will be already registered in the iMedBox. When patient with particular track number reaches near the iMedBox, the RFID sensor placed in the box will sense the track number and the details of that registered will be displayed in the LCD. By checking the details the user can take the medicine correctly in correct time. Bio-patch sensor will be placed on the particular parts of the body to sense the ECG and temperature conditions. This will send the sensed signals to the iMedBox which transmits the signals to the doctor/health care centers. This system provides user friendly and interactive multimedia interface which gives us better user experience.

REFERENCES

- [1] C. E. Koop et al., "Future delivery of health care: Cybercare," *IEEE Eng. Med. Biol. Mag.*, vol. 27, no. 6, pp. 29–38, Nov. 2008.
- [2] E. Welbourne et al., "Building the Internet of Things using RFID: The RFID ecosystem experience," *IEEE Internet Comput.*, vol. 13, no. 3, pp. 48–55, Jun. 2009.
- [3] S. Tozlu, M. Senel, W. Mao, and A. Keshavarzian, "Wi-Fi enabled sensors for internet of things: A practical approach," *IEEE Commun. Mag.*, vol. 50, no. 6, pp. 134–143, Jun. 2012.
- [4] S.-Y. Lee, L.-H. Wang, and Q. Fang, "A low-power RFID integrated circuits for intelligent healthcare systems," *IEEE Trans. Inf. Technol. Biomed.*, vol. 14, no. 6, pp. 1387–1396, Nov. 2010.
- [5] J. Morak, H. Kumpusch, D. Hayn, R. Modre-Osprian, and G. Schreier, "Design and evaluation of a telemonitoring concept based on NFC-enabled mobile phones and sensor devices," *IEEE Trans. Inf. Technol. Biomed.*, vol. 16, no. 1, pp. 17–23, Jan. 2012.
- [6] H. Baek, G. Chung, K. Kim, and K. Park, "A smart health monitoring chair for nonintrusive measurement of biological signals," *IEEE Trans. Inf. Technol. Biomed.*, vol. 16, no. 1, pp. 150–158, Jan. 2011.
- [7] S. Coyle et al., "BIOTEX—Biosensing textiles for personalised healthcare management," *IEEE Trans. Inf. Technol. Biomed.*, vol. 14, no. 2, pp. 364–370, Mar. 2010.
- [8] C. R. Merritt, H. T. Nagle, and E. Grant, "Fabric-based active electrode design and fabrication for health monitoring clothing," *IEEE Trans. Inf. Technol. Biomed.*, vol. 13, no. 2, pp. 274–280, Mar. 2009.
- [9] H. Fuketa et al., "1 μ -thickness 64-channel surface electromyogram measurement sheet with 2V organic transistors for prosthetic hand control," in *Proc. IEEE Int. Solid-State Circuits Conf. (ISSCC)*, Feb. 2013, pp. 104–105.
- [10] H. Liu, "Exploring human hand capabilities into embedded multifingered object manipulation," *IEEE Trans. Ind. Informat.*, vol. 7, no. 3, pp. 389–398, Aug. 2011.
- [11] L. Tang, X. Zhou, Z. Yu, Y. Liang, D. Zhang, and H. Ni, "MHS: A multimedia system for improving medication adherence in elderly care," *IEEE Syst. J.*, vol. 5, no. 4, pp. 506–517, Dec. 2011.

- [12] J. Gao, Z. Pang, Q. Chen, and L.-R. Zheng, "Interactive packaging solutions based on RFID technology and controlled delamination material," in Proc. IEEE Int. Conf. RFID, Apr. 2010, pp. 158–165.
- [13] J. Yoo, Y. Long, L. Seulki, H. Kim, and H.-J. Yoo, "A wearable ECG acquisition system with compact planar-fashionable circuit board-based shirt," IEEE Trans. Inf. Technol. Biomed., vol. 13, no. 6, pp. 897–902, Nov. 2009.
- [14] A. Nathan et al., "Flexible electronics: The next ubiquitous platform," Proc. IEEE, vol. 100, pp. 1486–1517, May 2012.

