ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 2, February 2016

AN EFFICIENT HEALTHCARE SYSTEM IN IOT PLATFORM USING RFID SYSTEM

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Abstract— **The Internet-of- Things (IoT) based on in-home based healthcare services, have greater potential. In this paper, an intelligent home-based platform, is proposed and implemented using the iHome Health-IoT. This platform permits an open-platform-based iMedBox (intelligent medicine box) with superior connectivity and interchange ability for the integration of devices and services in the platform. The intelligent pharmaceutical packaging (iMedPack) with communication capability enabled by passive RFID (radio-frequency identification) and Arduino Ethernet field. The proposed platform integrates IoT devices (e.g., wearable sensors and iMedPack) with the in-home healthcare services (e.g., telemedicine) for improved user experience and service efficiency using the GSM and Arduino Ethernet field. In addition to that an IoT based Tuberculosis (TB) medication monitoring system is determines using adaptive K-means clustering method for medication monitoring.**

Index Terms— **IoT, iMedBox, iMedPack, Arduino Ethernet Field, RFID,K-Means clustering.**

I. INTRODUCTION

Nowadays, many countries are undergoing hospital restructuring by reduction in the number of hospital beds and also increasing the proportion of home healthcare systems. In global aging and the occurrence of chronic diseases have become a common distress and a promising trend in healthcare is to move the routine medical check-ups and other healthcare based services from various hospitals to home environment. By doing so, first, the patients can get a seamless healthcare at anytime in home environment comfortably; second, by remote treatment, society's financial burden could be greatly reduced; third, limited hospital resources for people in need of emergency care can be released. Therefore, it is vital in the near future for the healthcare services based industry to develop an advanced and practical health related technologies and communication technology (ICT) and services by leveraging information.

In order to track the physical status of the elderly person and, in the meanwhile, to keep them healthy, the following two daily tasks are essential,

Manuscript received Feb, 2016.

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1) Real-time analyzing and monitoring vital signs to early-detect or predict life-threatening situations.
and 2) Checking whether their prescribed treatment been followed by them, including taking their prescribed medicine on time. With fast paced aging populations, these daily tasks have been brought great pressure and various challenges to global healthcare systems. One review estimates that about 25% of adult populations do not stick on to their prescribed medication, and also in right time, which lead to poor health outcomes and increasing mortality rate. Poor medication adherence is one of the major problems for both individuals and healthcare providers. Various technology improvements in various parts in healthcare facilities and desirable services are highly desirable to meet the requirements of this giant group.

In the meantime, IoT (internet-of-Things) has been recognized as a revolution in the world. IoT technology offers facility to connect actuators, sensors or other devices to the Internet and is considered as an enabling technology to visualize the vision of a global framework of networked physical objects. IoT extends the Internet into our everyday lives by wirelessly connecting various smart objects, and will bring changes in the way the people live and user interact with smart devices. As part of IoT, intelligent components, RFID (radio-frequency identification) tags, embedded sensors and actuators, etc have been developed rapidly and significantly expanded in scope. As a result, the number of IoT-based applications has been flourished accordingly. All these technologies facilitate the exploitation of IoT devices for 24/7 healthcare in the home environment.

II.EXISTING WORK

Among various traditional systems, the nonintrusive methods for corresponding electrocardiogram, ballistocardiogram, and that include high-input impedance amplifiers, and conductive photoplethysmogram measurements that do not require direct contact. These methods were applied to the design of a diagnostic chair for unrestrained heart rate and blood pressure monitoring purposes. This methods were operationalized through capacitively coupled electrodes have been installed in the chair backside that comprises high-input impedance amplifiers and conductive textiles installed in seat for capacitive driven-right-leg circuit configuration that is highly efficient of recording electrocardiogram information through clothing.

Drawback:

- It is not easy to monitor the patient continuously.
- Patient need to be moved from chair to bed which is an constrained process for their uncomfortness.

In another method a comfortable health monitoring system named wealthy systems is presented. The system is built upon on a textile wearable interface implemented by integrating electrodes, sensors, and connections in the fabric form, advanced signal processing techniques for enhancing the signal, modern telecommunication systems

Drawback :

- It is simple but same garments can't be weared continuously and so permanent monitoring is not possible in real time .

In combination of the Internet and trending technologies such as near field communications, embedded sensors, and real-time localization lets us transform everyday objects into smart objects that can easily understand ,respond to their environment. Such objects are considered as basic blocks for the Internet of Things and enable new computing applications.

III. PROPOSED METHOD

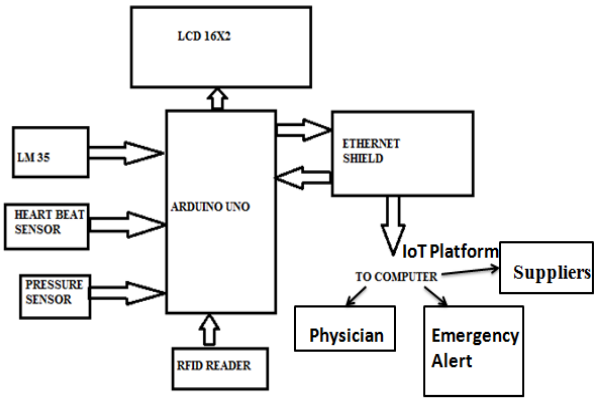

Figure 1. Block Diagram

By considering the aforementioned issues, an (iHome) intelligent home-based Health IoT, proposed concept of the iHome Health-IoT System. An iMedBox (intelligent medicine box) offers home healthcare gateway. IoT devices are seamlessly connected to the iMedBox, which is well-suited with multiple existing WIFI standards.

An RFID link is used to connect the iMedPack with the iMedBox to assist the patients with their prescribed medication. Therefore all the collected information is interpreted, stored, and displayed locally on the iMedBox. Then the processed information can served as a input to the Health-Bionetwork for medical diagnosis or further diagnosis of the patient record.

A. HOME HEALTH-IOT SYSTEM

The network architecture of iHome platform can be given as below .It consists networks layers such as:

1. Smart service layer
2. Medical resource management layer
3. sensor data collecting layer.

A smart medical service layer is directly linked to professional medical facilities such as hospitals, emergency centres, and medicine supply chain. 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 electronic-prescription simultaneously. The doctors, also can perform an overall examination of a patient by using dedicated software, which analyzes the degree of change in individual patient's physical condition over a considerable period of time automatically. For e.g., one week or one month. Subsequently, the patient group whose health conditions have improved and make them aware of their progress can be easily identified by the doctors. Both patients and their family may feel comforted which helps in promoting positive loops into rehabilitation and self-care. The clinical l resource management layer works as a transition layer, which involves the administration and management of medical resources in an effective manner and facilitates the levelled operation of the iHome system.

The sensor data collecting layer is the second basis of the entire network. It comprises of data sensing and acquisition devices, local computing and processing units, data storage devices, and wired/wireless transmitting modules. It is one of the multistandard wireless sensor platform, adaptable tovarious wired/wireless protocols, such as Ethernet, RFID, Zigbee, Wi-Fi, Bluetooth, and 3G/4G network. With this three-layer iHome Health-IoT system communication between clinical professionals and patients at home can easily take place on demand or on a regular basis.

B. IMEDBOX ARCHITECTURE

The iMedBox is the vital platform of the iHome Health-IoT system. The illumination for the iMedBox concept comes from the traditional in-home tablet container. The main difference varies in the fact it is equipped with a high performance and wireless transmission units, so the iMedBox is fully functional as a medication checker, and an on- site examiner for daily monitoring. The building blocks and interfaces of the iMedBox. An UHF (ultra-high frequency) RFID reader, a HF (high frequency) RFID reader, a Wi-Fi unit, GSM receiver with extension ports are encapsulated with the lid.

A weight bridge sensor with high resolution is encapsulated with the iMedBox in the bottom is to follow the variation in weight of the medicine in the box, based on which the iMedBox can serve as an iHome healthcare portal in order to collect the patients information, and so it can deliver services such as on-site analysis, telemedicine, health social network, emergency, and medication management services.

C. INTELLIGENT MEDICINE PACKAGING

Nowadays, for old-age citizens and patients with chronic diseases, it is difficult to take their prescribed medicine at the proper time by following the health experts' advice. However, refusal with intake of medication is becoming more prevalent. The levels of noncompliance may be affected by psychological factors such as the patients anxiety level, motivation to recover back, react toward their illness, as well as the fact that many amnesia suffered senior citizens often forget to take the prescribed medicine on time. If possible, it is important to maintain usual connection with the doctor to discuss among other things and compliance issues.

However, this is not as easy as it sounds. Moreover, the wrong method of intake of prescribed medication can cause a range of unfavourable drug reactions, sometimes even leading to death. An intelligent medication administration system is enviable to timely remind and dispense the medicine to every person, and registering in the meanwhile and tracking of their medication history for accurate analysis. Only way to solve the medicine misuse problem, improve pharmaceutical refusal situation, and make the daily task as easy and smart as possible, an iMedPack is proposed for making use of key technology, RFID technology .

In recent years, RFID technology has become more and more popular in the applications of manufacturing industries, logistics providers, supply chain management, retail outlets, banks, location tracking, and process detection .With the rise of Gen 2 protocol, RFID tags are becoming more powerful in terms of faster reading speed, larger memory, and higher information security . Therefore, RFID tags offers more Opportunities for commercial applications of Medicine package.

The RFID tag is wireless-powered by the reader which is embedded in the iMedBox. In the near-field tag can convert magnetic wave emitted by the reader into a dc supply, and an combined charge-pump circuit can boost the output dc voltage to 30 V for CDM opening. The RFID always keeps the charge-pump module in OFF until it receives a command to open issued by the iMedBox. During this process, the iMedBox works as a home healthcare platform (iHome).Based upon the clinical prescriptions stored inside, it will sends the commands to the targeted iMedPack timely, such that it emits magnetic waves to power up the passive iMedPack. Only the selected iMedPack sends back required information in return. e.g., packaging's ID, the number of medicine slots prevailed is opened up and the number of intact slots and acts accordingly to the command received by RFID tag. With the combination of the iMedBox and traditional the iMedPack (intelligent Medicine packaging), the system can remind the patients about their medication, and precisely control the amount and type of prescribed drugs, thus preventing medication misuse.

D. TB MEDICATION MONITORING SYSTEM

Under this system, TB patients are given medication encapsulated in a special envelope with dosage instruction and behind each of the pills has telephone numbers. Each time a patient consumes a dose, the numerical figure behind the pill is revealed and patient has been advised to give a missed call to the number, which will be monitored by the central server at the DOTS centre management system. Those who do not call will be reminded to take medication by the DOTS staff.

To overcome this system in case patient taken the medication, but failed to give missed call then there is a disadvantage to patients. Hence in our proposed system using iMed box, message to the server is automatically send by the iMed box to avoid this disadvantage.

Clustering method is used to organize various data efficiently in image processing.A popular technique which uses clustering method is K-means clustering in which data being portioned into various K-clusters. Number of clusters can be predefined or determined according to the image. Here adaptive K-Means clustering being used in this paper to determine the number of tablets reduced before and after the intake of the tablets by patients. In this, data being analyzed in Tuberculosis medication monitoring where regular intake of tablet is the important factor.

IV. HARDWARE DESCRIPTION

A. ARDUINO UNO RV3

Arduino is an open source hardware and software based platform. Arduino boards when connected to devices are able to read inputs like light, a finger on a button, or a Twitter message - and processed it into outputs such as motor activating , turning on an LED, publishing something online.

TABLE I

Technical specs

Microcontroller	ATmega328P
Input Voltage	7-12V
Operating Voltage	5V
PWM Digital I/O	6
Analog Input Pins	6
DC Current per I/O	20 mA
Digital I/O Pins	14 (of which 6 provide PWM output)
DC for 3.3V	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader

Figure2. Arduino board

B.HEARTBEAT SENSOR

A heart rate monitor used to monitors the real time heart rate of the patients continuosly.It has two elements as 1) a chest strap transmitter and 2) a wrist receiver or mobile phone. In early days the plastic straps, the water or liquid in good performance.

Figure 3. Heart beat signature

C. PRESSURE SENSOR

The 1620 is a pressure sensor fully embedded with piezoresistive for use in blood pressure monitoring .It is designed where can be easily automatized which can be used in customers blood pressure measuring.

D. ETHERNET SHIELD

The Arduino Ethernet Shield connects Arduino board to the internet in few minutes. Plug this module onto your Arduino board, and connect it to the network with an RJ45 cable and follow simple instructions to start for controlling the world through the internet technology. In case of Arduino, hardware, software and documentation is open-source.

V. SOFTWARE TOOLS

A. ARUDINO IDE

Arduino is open source hardware and software based platform. Arduino IDE is a cross-platform . In code editor with features such as syntax, and automatic indentation, and is also capable of uploading and compiling programs to the board with a single click. A Sketch is called as a program or code written for Arduino.

Arduino programs are written in C or C++ software language. The Arduino comes with "Wiring" a software library from the original Wiring project, which makes much of the common input, output operations much easier.

Setup (): a function that runs at the start of a program and then can used to initialize settings in the software.

loop (): a function called repeatedly until the board powers

B. PROTEUS V 7.9

Proteus 7.9 is best simulation software design development environment for various microcontrollers. It is popular because of availability of all microcontrollers available. So it is a easy tool to test programs and embedded designs for electronics designers. Proteus has a fully functional, procedural approach.

VI. EXPERIMENTAL RESULT

RFID reader read RFID tag (1B005721422F) in virtual terminal and LCD will display the respective session as Morning Tablet

RFID reader read RFID tag (1B0057126E30) in virtual terminal and LCD will display the respective session as Night Tablet

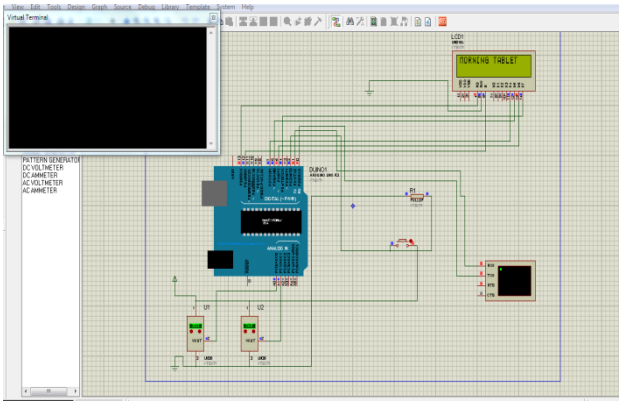

Figure 4. Result

VII. CONCLUSION AND FUTURE WORK

In recent years, the fast paced growing of aging population has been a greater challenge to global healthcare system. As ihome healthcare system provides comfortness to the patients getting treatment from the home itself. Despite of this various countries undergoing restructuring procedure of hospital and increasing home healthcare systems. IoT is the systematic platform for the database management and communication system in real-time environment, which connects various smart sensors attached to human body to monitor the vital signals and intelligent pharmaceutical iMed packaging for daily intake of medication management without any interruption. In here the patients can be communicated, any emergency situation can be alerted and also supply chain management system can also be maintained. In future work hardware needs to be implemented and also offers multiple opportunities to adapt a TB medication monitoring system effectively to improve medication in TB control unit.

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