Review Article **Bio Informatics**

International Journal of Pharma and Bio Sciences **ISSN 0975-6299**

REMOTE E-HEALTH: INTELLIGENT IOT BASED UBIQUITOUS HEALTHCARE SYSTEMS

[1] GOVINDA. K, [2]SHAIK SHAMA ZABEEN, [3]ALAPATI SAIJAGATHI AND [4]RAJKUMAR.R

[1,2,3,4]School of Computer Engineering, VIT University, Vellore, Tamilnadu, India.

ABSTRACT

Due to the rapid growth of population and constantly increasing diseases, it's becoming highly difficult for medically knowledgeable persons like doctors to constantly monitor a patient's health condition and this has become a very hard task in case of patients from rural areas, where transportation costs incurred to see the best doctors in urban areas. In order to minimize expenses and for emergency care, the health care monitoring system has been brought into picture. This paper proposes a methodology using latest technologies like internet of things to diagnose and monitor the health conditions of patients with minimal medical facilities and improper medication. The data extracted from the patient are transferred to the server locally using the ZigBee Protocol and hosed on the cloud using a WiFi module called ESP-8266. The reason behind storing over the cloud is to obtain a second opinion from medical experts.

KEYWORDS: ZigBee, IOT, ESP8266, LM35, Arduino UNO.

GOVINDA. K
School of Computer Engineering, Vellore Institute of Technology, India.

INTRODUCTION

A concept that reflects a set of anytime, anyone, anything, any network, any service and any place is known as the Internet of Things. It is such a huge trend in upcoming technologies for the next generation that it can affect the entire spectrum of business. We can think of it as something that interconnects unique smart devices as well as objects with extra benefits within the internet infrastructure of the present day. These advantages may include the connectivity of services, systems and devices that carry on further beyond the scenarios of machine to machine. Introduction of conceivable automation is therefore applied in every field. Appropriate solutions are provided by the IOT for a wide range of applications such as traffic congestions, emergency services, smart cities, waste management, industrial control, structural health, logistics, health care, and retails[1–5]. Medical care, health care is among the most important application areas in the current scenario[6]. This area has the power to give power to major medical fields such as health monitoring, fitness related programs, monitoring chronic diseases, and elderly care. Apart from treatment and medication at home, healthcare provides is another important application. Therefore, several medical devices, sensors, and imaging and diagnostic devices can be seen as smart devices or objects being an important part of the earth. Healthcare services are known to reduce costs, increase quality of our lives, and enhance the user experience[6]. From the view of healthcare provider, then it has the strength to put down device downtime using remote provision. The IoT can also correctly look at optimum times to replenish supplies for various devices for their smooth operation. In addition, the IoT, for the efficient scheduling of limited resources ensures their best use and service of more patients. Simplified cost effective interaction through secure connectivity across patients, clinics, and healthcare centers are an important trend recent health network driven by wireless technology are foreseen to support chronic diseases, early diagnosis, real-time monitoring, and medical emergencies. Gateways, medical servers, and health databases play important roles to create health records and deliver on demand health services to stakeholders. In the past years, this health care field has a wide attention of all the researchers to address potential of this IOT in this field by considering the various challenges. Now there are various numerical applications and various services in this field. Research Works in this area includes the network architecture, new applications, security, interoperability, various new platforms and etc. among others. Besides, new guidelines and several policies have also developed in the medical field for exploiting the IoT Technology in many countries and organizations. However, the IoT has its infancy in this health care field. A perfect understanding of this paper on it in the healthcare field is expected to be very useful for the stakeholders in their research[7-10]. This paper examines the healthcare research based on IoT and finds the solutions for various issues that addressed to transform healthcare through IoT innovation.

LITERATURE REVIEW

As the advent of the health monitoring system has promised to revolutionize the healthcare methods using Iot in these systems increases the flexibility, intelligence and interoperability[11,12]. The devices that use the IoT are uniquely identified at any time through the Internet. IoT based devices in health care monitoring systems can exchange information with each other when the devices are automatically connected through the Internet. As it is exemplified in[13]. These systems are able to provide services to the neighboring healthcare instituting if there is a critical accident for a patient. The critical components of healthcare monitoring system are stored, data analysis, easy access and visualization[14-15]. Diagnoses and the monitoring of the patient's condition rely on the analysis containing various characteristics over a long period of time. It deals with the high dimensional data in both time and quantity makes the analysis task quite irritating for clinicians. Although the use of data mining and visualization techniques have previously addressed as a solution to the aforementioned challenge[16, 17]. The methods have recently gained a lot of attention in health care monitoring systems[19, 20, 21].

PROPOSED METHOD

The major idea of this work is to monitor the basic health conditions of a patient like temperature, blood pressure, pulse, blood cell count, and hemoglobin count, sugar levels before and after taking the food as shown in Figure1. All these parameters are extracted from the patient using different sensors and transmitted to the local server using either ZigBee or Bluetooth module and transmitted, stored over the cloud (things speak) using the ESP-8266 module as well the data will be transmitted to doctors and nurses and nurses through a Wi-Fi module.

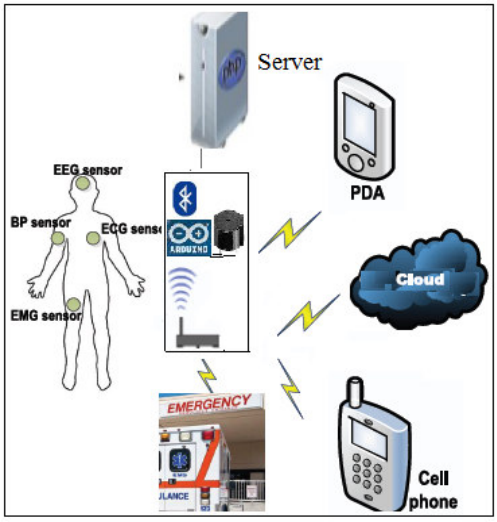

Figure 1
Architecture of IOT HMS

The diagnostic sensors are attached to the human body and the readings are stored in the tablet using the database connectivity. The sensor readings are sent to the cloud system and to the respective medical Centre for proper medical prescription and a notification is sent to the patient.

OBJECTIVE FUNCTION

$$\text{Minimize } z = p + f \quad \ldots\ldots 1$$
$$2.44f - p <= 166.3 \quad \ldots\ldots 2$$
$$7.30f - 10p <= -1 \quad \ldots\ldots 3$$
$$-p <= -65 \quad \ldots\ldots 4$$
$$-f <= -96 \quad \ldots\ldots 5$$
$$80 < bs < 130 \quad \ldots\ldots 6$$
$$110 < as < 180 \quad \ldots\ldots 7$$
$$4.32 < cm < 5.72 \quad \ldots\ldots 8$$
$$3.90 < cf < 5.03 \quad \ldots\ldots 9$$
$$13.5 < hm < 17.5 \quad \ldots\ldots 10$$
$$15.0 < hf < 15.5 \quad \ldots\ldots 11$$

"P" represents the pulse and "f" represents the temperature in Fahrenheit. "bs" represents the blood sugar before food and "as" represents blood sugar after food. "cm" represents the blood cells count in men and "cf" represents the blood cells count in female. "hm" represents the hemoglobin level of male and "hf" is the hemoglobin range of the female. The objective function Z represents the relationship between the temperature and pulse and a graph is established depending on the relationship that has been generated. Similar graphs are drawn for all the other attributes so that any change in one parameter will reflect the other parameters.

ARDUINO

Arduino is an open-source prototype platform based on hardware and software. The inputs for the Arduino board are light on the sensor, finger on the button, activation of a motor, turning on of an LED.A set of instructions can be given to the micro controller on the board to perform a set of actions. To give a set of instructions we use the Arduino programming language and the Arduino Software (IDE) based on the processing.

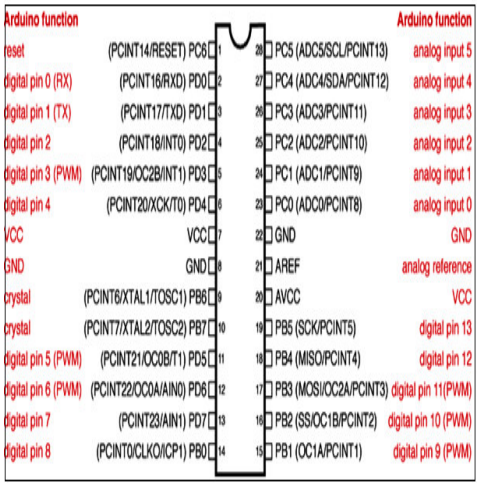

Figure 2
Arduino microcontroller

TEMPERATURE SENSOR

The two main parts of a functional module consist of the function module box and the probe head. The LM34 temperature sensor is mounted on the probe head. The LM34 temperature sensor is replaced by the LM35 temperature sensor the output voltage we get is proportional to the centigrade temperature. The LM35 temperature sensor has a linear +10.0 mV/°C scale factor and its temperature ranges between -55°C and +150°C.The LM34 and LM35 are among the same series of temperature sensors.

PULSE SENSOR

Optoelectronics is the basic principle involved in the working of the heart beat sensor. A microcontroller, a pair of LDR and LED are used to measure the heart rate. When the heart pumps the blood into the heart, the pulse is felt due to the expansion and contraction of blood vessels when the blood enters and leaves it. For a healthy person, the pulse rate is around 72 to 84 times a minute. Heart rate is measured by the intensity of light using the LED and measuring the intensity reflected in the LDR side. If the Heart pumps more blood, more light are absorbed by the increased blood cells and a decrease in the intensity of the light at the LDR side is observed. The microcontroller is programmed to receive an interrupt for every pulse detected and count the number of heart rate in BPM (beats per minute).

ZIGBEE MODULE

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create a personal area network with low-power, small digital radios. The technology defined by the Zigbee specification is intended to less expensive, yet simpler WPAN's like BLUETOOTH or Wi-Fi. Zigbee devices can transmit data through a mesh network of intermediate devices over long distances to reach more distant networks.

BUZZER

A Buzzer or Beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of Buzzers and Beepers include Alarm Devices, Timers, and Confirmation of user input such as a Mouse Click or Keystroke mechanical. A joy buzzer is an example of a purely mechanical buzzer.

GLUCOSE MONITORING SENSOR

Monitoring the glucose levels helps the patients with diabetes to manage the disease and avoid the further problems. With the output results the patient can take the precautions at an early stage about the intake of the food, physical activities and medications. The common way to check the glucose levels of a patient is by using the blood samples of that patient. The sensors are inserted under the skin of a patient to check the glucose levels in the tissue field.

ESP 8266

The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and microcontroller capability. This module allows micro-controllers to connect to a Wi-Fi network and make TCP/IP connections using Hayes-style commands. Making use of this module, all the data of the patient is stored in the cloud server and is made accessible by the medical experts across the globe.

IMPLEMENTATION

The proposed method is implemented using Arduino Uno microcontroller and sensors. The temperature, pulse, blood sugar level before and after food, hemoglobin count, blood cell count and the blood pressure of the patient are recorded as shown in Figure3.

	A	B	C	D	E	F	G
1	Temperature	Pulse	Blood Sugar(Before Eating)	Blood Sugar (After Eating)	Heamoglobin count	Blood Cell Count	Blood Pressure
2	37	72	68	98	13.9	3.98	110/90
3	38.32	64	78	101	16	4.52	120/50
4	37.33	69	87	90	15.4	4.81	125/90
5	37.2	71	67	114	17.2	2.89	100/80
6	38.41	63	98	116	15.4	3.1	60/70
7	37.29	61	87	125	14.3	5.72	120/90
8	37.47	67	98	103	14.3	5.1	70/80
9	39.02	58	90	99	14.3	4.9	40/80
10	37.12	73	70	89	14.3	5.12	150/60
11	38.11	68	87	123	14.3	4.72	220/90
12	37.01	72	98	178	16.7	3.98	160/70
13	37.04	78	70	100	17	5.78	80/50
14	37.07	78	78	95	16	3.62	80/70
15	37	82	90	90	15	5.02	110/100

Figure 3
Values of parameters

RESULTS

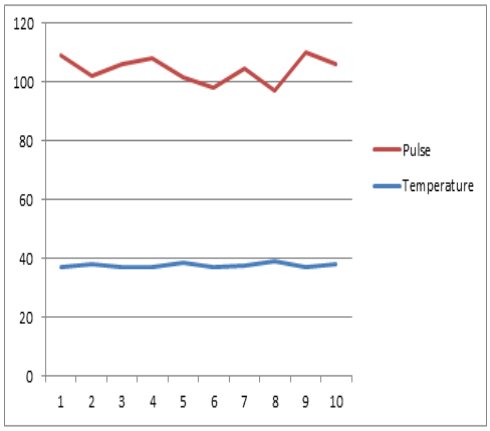

Figure 4
Pulse Vs Temperature

In the above Figure4. The serial numbers of the patient are shown on the X-axis and the values of the pulse and temperature are shown on the y-axis. As the temperature increases, the pulse decreases and vice-versa.

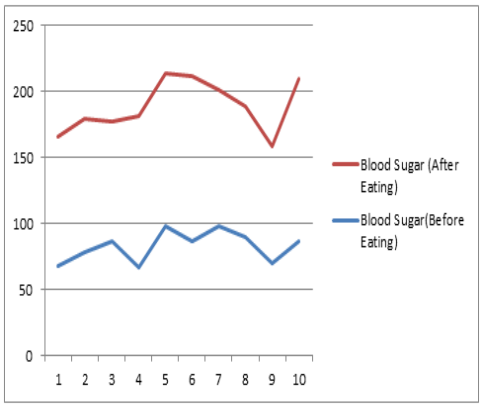

Figure 5
Blood sugar (After Eating) vs Blood sugar(Before Eating)

In the above Figure5. Serial numbers of the patients is shown on the X-axis and the level of Blood sugar before eating and after eating are shown on the Y-axis. As the Blood Sugar before meals increases, the Blood Sugar after meals also increases.

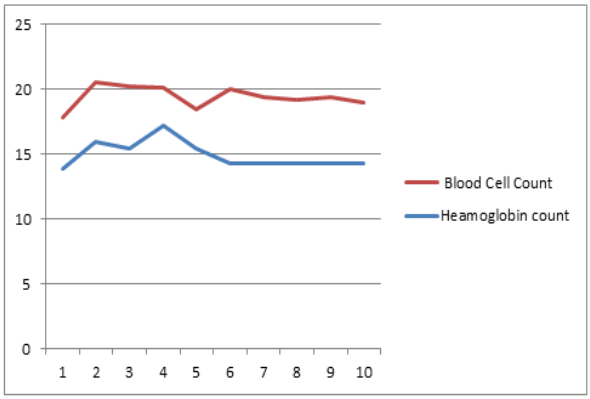

Figure 6
Blood cell count vs Hemoglobin count

In the Figure 6. The serial numbers of the patients are shown on the X-axis and the values of the blood cell count and the values of the hemoglobin count are shown on the Y-axis. The blood cell count and the hemoglobin count are directly proportional to each other.The existing model deals with manually collecting the health parameters and it requires a medically knowledgeable person to monitor the health conditions of patient which is always not feasible in the current world which has become a global village. As the technology has advanced in every domain, the implementation of this advanced technology in health care will result in less manual intervention and provides more accurate result for diagnosis and medication.

CONCLUSION

This real world Healthcare DBMS involves huge amount of research and collection of information and its implementation is possible, profitable, and realistic. Through this system, the health care center can retrieve, update, and report information efficiently and greatly improve the data sharing and communication. However, the future improvement is necessary and continuous modification is needed to approach the final success: 1) The security problem should be solved; 2) Visual Basic and/or other language should be more used to implement different functions; 3) A more user-friendly interface should be provided; 4) The system should be web-based.In this paper, we survey the state-of-art on the IoT which includes the manifold definitions, enabling technologies and other applications and open research issues with efforts. However, this paper provides a comprehensive review of the relevant technologies. It is believed that in the near future the achievement of the vision of "from anytime, anyplace connectivity for anyone, we will now have connectivity for anything" should depend on cross-discipline and cooperative efforts in related fields.

REFERENCES

1. Holler J, Tsiatsis V, Mulligan c, Karnouskos s, Avesand S. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence. Amsterdam, The Netherlands: Elsevier, 2014.
2. Kortuem G, Kawsar F, Fitton D, Sundramoorthy V. Smart objects as building blocks for the Internet of Things, IEEE Internet Computing. 2014; 14(1) :44–51.
3. Romer K, Ostermaier B, Mattern F, Fahrmair M, Kellerer W. Real-time search for real-world entities: A survey, IEEE Proceedings.2014; 98(11): 1887-1902.
4. Guinard D, Trifa V, Wilde E. A resource oriented architecture for the Web of Things, in Proc. Internet Things (IOT).2010 Dec.1–8.
5. Tan L, Wang N. Future Internet: The Internet of Things, in Proc. 3rd Int. Conf. on Adv. Computing. Theory Eng.2010 Aug; Vol(5) :376-380.
6. Pang Z. Technologies and architectures of the Internet-of-Things (IoT) for health and well-being, M.S. thesis, Dept. Electron Comput.Syst., KTH-Roy. Inst. Technol. Stockholm, Sweden, Jan. 2013.
7. Bazzani M, Conzon D, Scalera A, Spirito M, Trainito C. Enabling the IoT paradigm in e-health solutions through the VIRTUS middleware, in IEEE 11th Int. Conf. on Trust, Security and Privacy in Computing and Com. (TrustCom). 2012;1954–1959.
8. Ray P. Home health hub internet of things (H3IoT): An architectural framework for monitoring health of elderly people,in Int. Conf. on Science Eng. and Management Research (ICSEMR). 2014: 1– 3.
9. Bui N, Zorzi M. Health care applications: A solution based on the internet of things, in Proc. of the 4th Int. Symposium on Applied Sciences in

Biomed and Com. Tech. ser. New York. USA: ACM. 2011 ;(131):1-5.
10. Wei L, Kumar N, Lolla V, Keogh E, Lonardi S. A practical tool for visualizing and data mining medical time series, in Proc. 18th IEEE Symposium on Computer-Based Med. Sys. 2005 June, 341–346.
11. Mao Y, Chen Y, Hackmann G, Chen M, Lu M .Medical data mining for early deterioration warning in general hospital wards, in IEEE 11th Int. Conf. on Data Mining Workshops (ICDMW). 2011:1042–1049.
12. Ukis V, Tirunellai R, Balachandran B, Friese T. Architecture of cloud-based advanced medical image visualization solution, in IEEE Int. Conf. on Cloud Computing in Emerging Markets (CCEM). 2013: 1–5.
13. Rao B. The role of medical data analytics in reducing health fraud and improving clinical and financial outcomes, in Computer-Based Medical Systems (CBMS), 2013 IEEE 26th International Symposium on. 2013 :1-3.
14. Govinda.K, RA.K.Saravanaguru. Review on IOT Technologies, in International Journal of Applied Engineering Research.2015;11(4): 2848-2853.
15. Santucci Gerald. From Internet of Data to Internet of Things, *in Proceedings* of International Conference on Future Trends of the Internet. 2009.
16. Atzori L, Iera A, Morabito G. The Internet of Things: A Survey. Journal of Computer Networks. 2010;54(12) :2787–2805.
17. Lionel MN, Cui Li, Luo Q, Ngan H, Zhao Ze. Status of the CAS/HKUST Joint Project BLOSSOMS. *in Proceedings* of the 11th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications, Hong kong (China). 2005: 469–474.
18. Sruthi M, Rajkumar R. Securing the patients data on IOT in Healthcare. International Journal of Pharm Bio Sciences. 2016; 7(2): 168 – 172.