INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACTFACTOR:6.514(2020); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and UGC Approved: VOLUME: 9, ISSUE:1(2), JANUARY: 2020

UBIQUITOUS HEALTHCARE SYSTEM AND WIRELESS BIOSENSORS

S. M. Ghatole
Department of Electronics
Shivaji Science College
Rashtrasant Tukdoji Maharaj
Nagpur University, Nagpur

Abstract
This paper describes the structure for ubiquitous healthcare system by means of wireless biosensors. In this system the wireless biosensor network has been used for monitoring vital signals. It consists of two sections; first biomedical sensor wireless network has been used to collect the body parameter signals, the signals then processed using wireless communication system that utilizes a number of biosensors and in the second section local base station transmits the collected biosensor signal using ZigBee transreceiver. The base station is constituted using a receiver ZigBee modem. The system has been tested in real time where data was processed, recorded and displayed successfully.

Key Words : Ubiquitous Healthcare, Biosensors, Vital Signals, ZigBee

I. introduction

The health monitoring has become the essential requirement of the rapidly increasing health problems and enormously growing population for survival of patients. Wireless Body Area Network (WBAN) is growing research area in the healthcare industry across the globe. As numerous wireless body area network technologies emerged out, the interest for applications such as health monitoring, smart homes and industrial control growing significantly. ZigBee is the first industrial standard WPAN technology that provides short-range, low-power, and secured communication, and supports mesh networking and multi-hopping. It is a new wireless network protocol stack of IEEE 802.15.4 used in industrial equipment and home appliances in order to capture in multi-type, multi-point biosensor information. While many smart home application areas such as lighting, security, and climate control have been suggested using the ZigBee standard, health-care applications have not received much attention even with their importance and high-value added. The recent advances in electronics and communication technology had been enabled the development of bio-medical sensors that would be worn on or implanted in the human body. The wireless sensors have the capability to collect vital data about the health

condition of patient and thus facilitating the creation of new type of networks among which are Wireless Body Area Networks (WBANs)
This paper presents a ubiquitous wireless communication system for real-time health monitoring with secure transmission capability using ZigBee RF module. Wireless biosensor network is one of the most promising applications of human healthcare monitoring. A number of tiny wireless biosensors, strategically placed on the human body, create a wireless body area network that can monitor various vital signals, providing real-time feedback to the user and medical caretaker/caregiver. The wireless body area networks assure to develop the health monitoring system. However, designers of such systems face a number of difficult tasks, as they need to address often quite contradictory requirements for size, operating time, precision, and reliability. Wireless biosensors are a group of embedded smart sensors that

facilitates continuous recording and monitoring about health condition of a person and transfer it over a long-distance communication network.

II. System Design

The traditional system was widely used in biomedicine to collect different parameters for daily homecare. The traditional system adopts wired way which makes the system complex, bulky and expensive. The wireless communication healthcare system is illustrated in figure 1. With the advent of technology, wireless communication technology was evolved. The wireless communication healthcare System is convenient and economical. Wireless biomedical sensors are a group of embedded smart sensors that form a network from wireless communication links and operate within the human body.

Figure 1: System Structure Design

The suggested wireless system has the minimum requisites of an autonomous system. It uses a ZigBee RF transceiver module and via GSM signal was transmitted. A biosensor system was to be worn by the individuals for a long

duration. This limits the size of the battery and it has made energy the most critical resource in WBAN. The parameters sensed by the individual devices are to be transferred onto a mobile phone or a tablet via wireless network. This data is then gathered, stored and then sent to the doctor/caregiver for continuous monitoring of health condition. The doctor can then access the health status of patient on the go and it helps the patient to acquire immediate treatment. An Asynchronous Receiver-Transmitter) and an enhanced USB interface working with a clock frequency up to 20 MHz is internally implemented RISC architecture gives an instruction runtime between 80 and 200 ns depending on the chosen oscillator. The dot matrix sensors array contains several sensors, which can sense one or more physical quantities. The addressable sensor interface chip provides the address, the amplification and analog-to-digital conversion of the sensed signal. It contains an analog multiplexer, a programmable analog front-end and a ten bits analog to digital converter, makes the sensor interface chip a versatile component, which can be programmed at any time. It offers options for intelligent power management. Indeed, all channels which are not in use can be switched off individually. Thus, the microcontroller performs several important tasks:

1. It controls the sensor interface chip and provides its settings, such as the configuration of the readout electronics like sensor address and analog front-end configuration as well as sensor-specific software routines.
2. It gathers the data coming from the sensor interface chip and stores it in a memory.
3. It implements some smart compression algorithms that are base-band coder/decoder to reduce the energy consumption during data transmission.

Each body sensor node serve as transmitter and considered to collect, process, and transmit the pulse rate, body temperature, and location of the patient's signal in real time. The system was operational within working range from the base station and the performance was adequate up to the level **Sensor Nodes:**

It uses open resource and low power utilization hardware to apply in the sensor node and to attain a power competency in the network. The sensor network design consists of the sensor node and the actual node. Both nodes require one off-the shelf ZigBee wireless module for wireless transmission, pulse sensor, temperature sensor and GPS module. The ZigBee wireless module operates at frequency 2.4 GHz on 802.15.4 protocol, output power 1mW and data transmission rate of 250 kbps.

Base Station:

The base station acts as network coordinator; it performs the activities of individual nodes by periodically requesting data. In addition to data integration and analysis, the base station also transmits processed data to display devices

and PDAs. The base station is operational with the Microcontroller for system coordination, a receiving ZigBee module and a Wi-Fi module for wireless communication. The data has transmission capacity over 802.11 b/g wireless networks which make it possible to access the collected data via internet.

The bi-directional communication link sends the sensor's data to the transceiver and provides the microcontroller with new programming instructions. Hence, the accuracy, sensitivity, acquisition rate and data processing can be changed during operation, which are necessary to adapt the system to the environment changes and to compensate for drift phenomena.

III. BIOMEDICAL PARAMETERS

The measurement of biomedical parameters determines the overall condition of the patient. Transducers and Thermistors are the key links in all sensors planned to describe and analyze the bio-medical parameters. The transducers used in the system find applications in patient monitoring systems and experimental work on parameters namely temperature, blood pressure, pulse and respiratory activity.

A. Temperature Sensor:

Thermistors or thermal resistor is a two-terminal semiconductor device whose resistance is temperature sensitive and used for the measurement of temperature. The value of such resistors increases/decreases with increase in temperature. The Thermistors have very high temperature coefficient of resistance of the order of 3% to 5% per ℃, making it an ideal temperature transducer. The temperature co-efficient of resistance is normally negative. The output of the temperature sensor is given to the amplifier stages. Resistance thermometers can also be used to measure the body temperature. Important characteristics of resistance thermometers are high temperature co-efficient to resistance, stable properties so that the resistance characteristics does not drift with repeated heating or cooling or mechanical strain and high resistivity to permit the construction of small sensors. LM35 can also be used as temperature sensor for the measurement of body temperature.

B. Respiration Sensor:

The prime function of the respiratory system is to supply oxygen to the tissues and remove carbon dioxide from the tissues. The breathing action is controlled by muscular action causing the volume of the lung to increase and decrease to affect a precise and sensitive control of the stress of carbon dioxide in the arterial blood. Under normal circumstances, this is rhythmic action. Respiratory activity can be detected by measuring changes in the impedance across the

thorax. Several types of transducers have been developed for the measurement of respiration rate. A Strain Gauge type Chest Transducer is a suitable transducer to measure the respiratory activity. The respiratory movement results in the changes of the strain gauge element of the transducer hence the respiration rate can be measured.

C. Heart beat Sensor:

It is very important that heart beat rate of everybody has to be in normal. Normal heart beat rate is 72 Beats/minute. Heart beat rate define the working condition of our body. A sensor is designed for monitoring the changes in the heart beat of the human body. There are 2 ways of monitoring heart beat rate information from the body.

1. Electrocardiogram (ECG)
2. Pulse

Electrocardiogram (ECG):

The ECG or Electrocardiogram generates the electrically picked up signals from the limbs due to the nervous activity of the heart. The electrodes are pasted on to the two hands and the left leg, the right leg electrode serves as the common or ground reference. The signals are picked up and amplified by high gain differential amplifiers and then the electrocardiogram signal is obtained and then transmitted.

Pulse:

The pulse signal refers to the flow of blood that passes from the heart to the limbs and the peripheral organs once per beat. Usually, the physician looks for the pulse on the wrist of the patient. The artery is near the surface of the skin and hence easily palpable. This pulse occurs once per heart beat. These pulse signals can be selected up by keeping a piezo-electric pick up on the artery site of the wrist.

IV. Conclusion

The focus of this paper was to develop a Ubiquitous microcontroller based healthcare system design for real time wireless biomedical parameter measurement based on ZigBee and GSM wireless data transceiver. It provides the facility to monitor biomedical signals from multiple biosensors by means of different communication standards. The system performance has been tested through standard sensors such as temperature, pressure, and oxygen sensors with enhanced user graphical interface to visualize and monitor the data in real-time. In the fast pace of life, it becomes necessary to develop a ZigBee compliant wireless system that has low power consumption, low cost and advanced network configuration. The reliability of the system has been

measured and tested through experimental results. Thus an affordable transmitting power level has been selected to reduce the power consumption and saves the energy. Taking into account the use of higher transmission frequency for the real implantable system, our future work can be concentrated on ZigBee and Wi-Fi wireless data link system to evaluate the most sufficient wireless link to be compliant with such a biomedical Ubiquitous healthcare systems.

References

[1] Tavares j, Velez, Fiji. Ferro, Jam. (2008), "Application of wireless sensor networks to automobiles", Measurement science review, 8, pp 65-70.

[2] Wittenberg, g., terflosth, k., villafuerte, f.l., naumowicz, t., Ritter, h., chiller, j. (2007). International Conference monitoring – experimental evaluation of a use case for wireless sensor networks. In wireless sensor network. Lecture notes in computer science. Berlin: Springer, pp 163-178.

[3] IDEE computer society (2003). IEEE 802.15.4 wireless medium access control (Mac) and physical layer (phy) specifications for low-rate wireless personal area networks (lr-wpans), IEEE specification.

[4] Latré, Benoît, Bart Braem, Ingrid Moerman, Chris Blondia, and Piet Demeester. "A survey on wireless body area networks", Wireless Networks, vol. 17, 2010, pp 1-18.

[5] Changhong Wang, Qiang Wang, and Shunzhong Shi. "A Distributed Wireless Body Area Network for Medical Supervision", Instrumentation and Measurement Technology Conference (I2MTC), 2012 IEEE International, May 13-16 2012, pp 2612-2616.

[6] Sanjay Sharma, Anoop Lal Vyas and Bhaskar Thakker, David Mulvaney and Sekharjit Datta, "Wireless Body Area Network for Health Monitoring", Biomedical Engineering and Informatics (BMEI), 2011 4th International Conference, Vol.4, October 15-17 2011, pp 2183-2186.

[7] Joonyoung Jung, Kiryong Ha, Jeonwoo Lee, "Wireless Body Area Network in a Ubiquitous Healthcare System for Physiological Signal Monitoring and Health Consulting", International Journal of Signal Processing, Image Processing and Pattern Recognition, volume 1, pp. 47.

[8] Mark A. Hanson, Harry C. Powell Jr., Adam T. Barth, Kyle Ringgenberg, Benton H. Calhoun, James H. Aylor, and John Lach, "Body Area Sensor Networks Challenges and Opportunities", IEEE Computer Society, Vol.42, Issue 1, January 2009, PP. 58-65.

[9] Lim, S., Oh, T. H., Choi, Y. B., & Lakshman, T. "Security Issues on Wireless Body Area Network for Remote Healthcare Monitoring", 2010 IEEE International Conference on Sensor Networks Ubiquitous and Trustworthy Computing, 2010, pp. 327-332.

[10] I.F.Akyildiz, W.Su, Y.Sankarsubramaniyam and E.Cargici, "Wireless Sensor Networks: A Survey", Computer Networks, Vol. 38, No. 4, PP393-422, 2002.

[11] K. Bilstrmp, "A Preliminary Study of Wireless Body Area Network", Tech. Report, IDE0854, University of Halmstad, Sweden, PP 1-36, Aug. 2008.

[12] D. Lewis, "Application in Body Area Network", Doc: IEEE P802.15-08-0407-00-0006-TG6, Nov. 2008.

[13] http://www.who.int/mediacentre/factsheets/fs317/en/ index.html. World- Health Organization [online].

[14] International Diabetes Federation (IDF) [Online] http://www.idf.org/.

[15] Georgakakis E., Nikolidakis S. A., Vergados D. D., Douligers C. (2011), "An Analysis of Bluetooth, ZigBee and Bluetooth Low Energy and Their Use in WBANs", In: L in J. C., Nikita K. S. (eds) Wireless Mobile Communication and Healthcare, MobiHealth 2010, pp

168-175. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering Volume 55, Springer, Berlin, Heidelberg.

[16] K. Jamil, Y and Y. Mehmet, R, "Wireless Body Area Network (WBAN) for Medical Applications", New Developments in Biomedical Engineering, no. 1, pp. 591-628, 2010.

[17] H.-B. Li, K.-i. Takizawa, B. Zhen, and R. Kohno, "Body area network and its standardization at IEEE 802.15.MBAN", in Mobile and Wireless Communications Summit, 2007. 16th IST, Budapest, Hungary Jul. 2007, pp. 1-5.

[18] B. Gyselinckx, J. Penders, and R. Vullers, "Potential and challenges of body area networks for cardiac monitoring", Journal of Electrocardiolog, vol. 40, December 2007, pages s165-s168, no. 6, pp S165 S168.

[19] C. a Otto, E. Jovanov, and A. Milenkovic, "A WBAN-based System for Health Monitoring at Home", in 3rd IEEE/EMBS International Summer School and Symposium on Medical Devices and Biosensors, 2006, pp 20-23.

[20] http://pulsesensor.com/2012/07/26/were-migrating-here-please-join-us/

[21] S. M. Ghatole, K.Y. Rokde, S. S. Shende, P. B. Dahikar, "Role of Wireless Body Area Network in Remote Healthcare Monitoring" published in International Journal of Researches in Biosciences, Agriculture and Technology (IJRBAT), ISSN: 2347-517X, Volume II, issue (7), Nov 2015, pp 154-157.

[22] K. Y. Rokde, P. B. Dahikar, M. J. Hedau, S. M. Ghatole, S. S. Shende "Study of Biosensors using nanotechnology" published in International Journal of Advances in Science, Engineering and Technology (IJASEAT), ISSN: 2321-9009, Special Issue-1, June- 2015, pp 155-157.

[23] S. M. Ghatole, K. Y. Rokde, S. S. Shende, P.B. Dahikar "Healthcare System with Interactive Biosensors" published in International Journal of Electronics, Communication & Soft Computing Science and Engineering (IJECSCSE), ISSN: 2277-9477, Volume 4, Issue 4, July 2015, pp 1-4.

[24] S. M. Ghatole, P. B. Dahikar, "Survey on Wireless Body Area Network for Healthcare Applications", International Journal of Researches in Biosciences, Agriculture and Technology (IJRBAT), Vol. IV, Issue (3), Sept. 2016: ISSN 2347 – 517X, pp 14-17.

[25] S. M. Ghatole, K. Y. Rokde, P. B. Dahikar, "ZigBee: A Wireless Communication Network" Kamla Nehru Journal of Science & Technology (KNJST) Vol. - 1 ISBN: 978-93-81432-97-6, pp 62-66.

[26] S. M. Ghatole, P. B. Dahikar, "Use of Innovative ZigBee Technology in Homecare Monitoring System", International Journal of Researches in Biosciences, Agriculture and Technology (IJRBAT), Vol. V, Special Issue 2, July 2017: ISSN 2347 – 517X, pp 101-104.

[27] K. Y. Rokde, P. B. Dahikar, S. M. Ghatole, S. S. Shende, M. J. Hedau, "A Non-Invasive Blood Pressure Measurement Using Embedded Technology" International Journal of Scientific Research in Science and Technology (IJSRST), Volume 4, Issue 1, IJSRST 4132/ NCRDAMDS/January-February-2018, pp 137-141.

[28] S. M. Ghatole, P. B. Dahikar, "Advancements in Smart Biomedical Wearable with Technical Challenges", International Journal of Electrical and Electronics Engineering (SSRG-IJEEE) ISSN: 2348-8379, Volume 5, Issue 9, September 2018, pp 16-20.

[29] S. M. Ghatole, P. B. Dahikar, "Wireless Body Area Network Enabled Advancement in Bluetooth and ZigBee", International Journal of Research and Analytical Reviews (IJRAR) ISSN: 2349-5138, Volume 5, Issue 4, December 2018, pp 1275-1279.