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WBAN BASED HEALTH GOVERNING SYSTEM

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ABSTRACT

Based on the applications of Wireless Body Area Networks (WBAN) integrated with Internet of Things (IoT), it is proposed to design a health monitoring system which finds the heart rate of patient, temperature where the patient is available and any gas environment(abnormal condition) of the patients in hospitals. In this paper, a cloud environment/IoT is created with the help of Visual studio 2010 and a Local Host(Hospital) is created which gives the information of the heartbeat of patient and his/her environment. This information is updated to a server (medical server) for getting any additional information from doctor/nurse.

Keywords: healthcare, hospital, IoT, WBAN.

1. INTRODUCTION

WBAN (Wireless Body Area Network) consists of numerous sensors integrated on body or may be implanted within the body. Wireless Body Area Networks (WBANs) of intelligent medical sensors present an emerging technology which can offer health-care services far beyond what the traditional telemedical systems can possibly provide. A typical WBAN consists of a number of inexpensive, lightweight and miniature sensor platforms, each featuring one or more physiological sensor, e.g. Motion sensor, ECGs, EMGs and EEGs. The sensor could be located on the body as tiny intelligent patches, integrated into clothing or implanted below the skin or muscles. All messages from sensors are collected by the Network controller and processed on a personal server. A personal server application can run on a Personal Digital Assistant (PDA), cell phone or PC. Network controller could be an add-on device or integrated into the personal server. WBAN based m-Health technologies have great potential for continuous monitoring in ambulatory settings, early detection of abnormal conditions, and supervised rehabilitation.

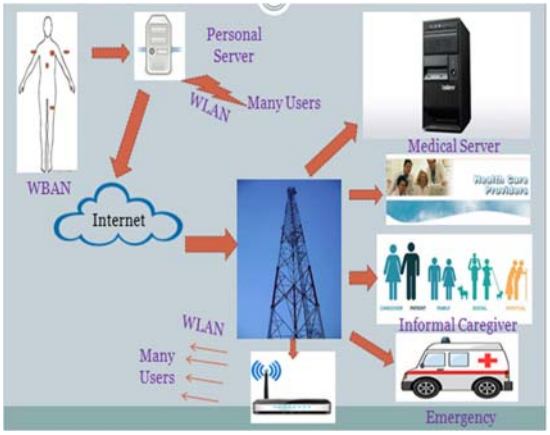

Figure-1. WBAN based Health Governing System.

Figure-1 shows the WBAN Health Governing System where the information from WBAN is given to the medical server which inturns gets/sends information via Internet. The Emergency services and the doctor/care-giver is informed if there is any abnormal conditions.

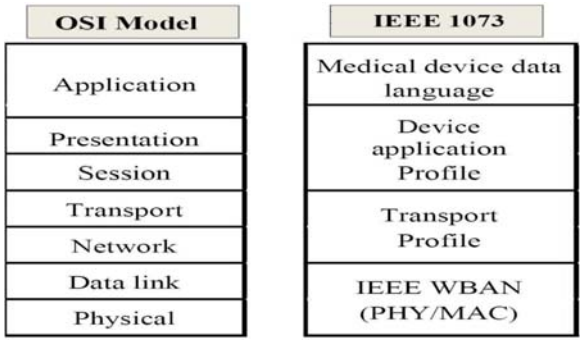

Figure-2. ISO Model and IEEE 1073.

Embedded technologies being used in applications like tele-health systems that deliver care to people in remote locations and monitoring systems that provide a continuous stream of accurate data for better care decisions [1].

M-Health [2] can be defined as "mobile computing, medical sensor, and communications technologies for health-care. Evolution of e-health systems from traditional desktop "telemedicine" platforms to wireless and mobile configurations. Current and emerging developments in wireless communications integrated with developments in pervasive and wearable technologies will have a radical impact.

Its key features, such as universality, extensibility, and stability, have attracted a lot of attention and may become the de facto solution for future Internet technology. In order to enable IP connectivity in resource constrained sensor networks, the IPv6 over Low Power WPAN (6LowPAN) Working Group has been established

and works on protocol optimization of IPv6 over networks using IEEE 802.15.4. Specifically, the 6LoWPAN protocol discusses how to apply IPv6 to the MAC and PHY layers of IEEE 802.15.4 [3].

Medical monitoring [4] lies in the tracking of activities of multiple subjects. A compelling solution to caring for the aging population is to enable pervasive and assistive healthcare for the elderly in their own homes. Such a system would have to promptly and accurately determine the activities and potential injuries of the subject.

The developed system [5] allows the incorporation of diverse medical sensors via wireless connections, and the live transmission of the measured vital signs to healthcare providers as well as real-time feedback to the patient.

A review of WBANs Projects is given in chapter 2, followed by description of sensors in chapter 3, the experimental setup description is given in chapter 4, the results are discussed in chapter 5 and the conclusion is given in chapter 6.

2. REVIEW OF WBANs PROJECTS

MobiHealth [6] system provides highly customizable vital signs tele-monitoring and tele-treatment system based on a body area network and a mobile health care service platform utilizing next generation public wireless networks.

A number of ongoing projects such as CodeBlue, Mobi-Health, and iSIM have contributed to establish a proactive WBAN system [8-10]. A system architecture presented in [11] performs real-time analysis of sensor's data, provides realtimefeedback to the user, and forwards the user's information to a telemedicine server.UbiMon aims to develop a smart and affordable health care system [12]. MIT Media Lab is developing MIThril that gives a complete insight of human machine interface [13]. HIT lab focuses on quality interfaces and innovative wearable computers [14]. NASA is developing a wearable physiological monitoring system for astronauts called LifeGuard system [15].

IEEE 802.15.6 aims to provide low-power in-body and on-body wireless communication standards for medical and non-medical applications [16]. IEEE 1073 is working towards a seven layers solution for wireless communication in WBAN [17]. Figure-2 shows the IEEE 1073 model.

3. SENSORS

The sensors used in this project are Heartbeat sensor, Gas sensor and temperature sensor. The main concept in choosing these sensors are patient must be surrounded by a nice environment, temperature is being monitored. [18] In addition to that, considering that he should not be in any form of critical situation, Gas sensor is used for checking any smell of gas related thing taking place, and finally Heartbeat sensor is used for checking the patient is in a good condition.

The diagrams of the sensors are shown for better understanding. Figure-3 shows the heartbeat sensor provides a simple way to study the function of the heart which can be measured based on the principle of psycho-physiological signalused as a stimulus for the virtual-reality system [19]. The amount of the blood in the finger changes with respect to time. The sensor shines a light lobe (a small very bright LED) through the ear and measures the light that gets transmitted to the Light Dependent Resistor (LDR). The amplified signal gets inverted and filtered, in the Circuit. In order to calculate the heart rate based on the blood flow to the fingertip, a heart-rate sensor is assembled with the help of LM358 OP AMP for monitoring the heartbeat pulses.

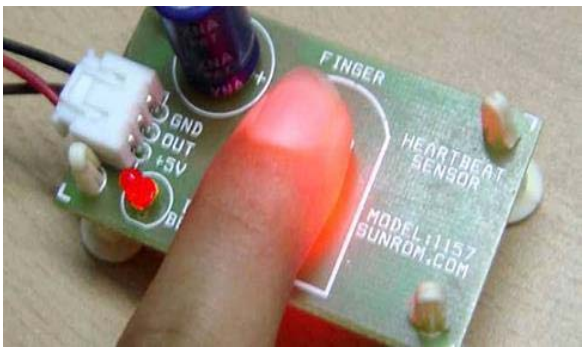

Figure-3. Heartbeat Sensor.

The Heartbeat sensor helps in getting information about the patient's health condition, whether he is perfectly alright or not and he will be also analyzed in terms of issues related to all types of health condition [20].

Figure-4. Temperature sensor.

The most commonly used type of all the sensors is those which detect Temperature or heat is shown in Figure-4. These types of temperature sensor vary from simple ON/OFF thermostatic devices which control a domestic hot water heating system to highly sensitive semiconductor types that can control complex process control furnace plants. Temperature Sensors measure the

amount of heat energy or even coldness that is generated by an object or system, allowing us to "sense" or detect any physical change to that temperature producing either an analogue or digital output.

Finally detection of oxygen level in a human body by using oxygen gas sensor as shown in Figure-5 and those results will send through 4G by using IOT to server. Then the doctor will access the readings of a human body.

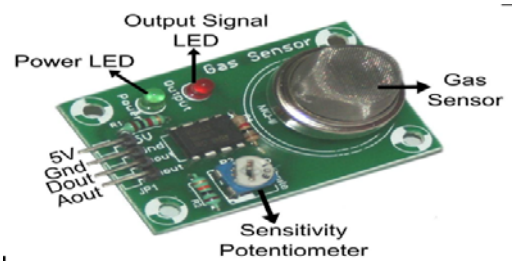

Figure-5. Oxygen detection sensor.

4. EXPERIMENTAL SETUP

The Figure-6 shows the experimental setup of WBAN based health governing system. PIC Microcontroller (16F877A), MAX232, LCD Display, Power Supply, Crystal Oscillator and Sensors are used.

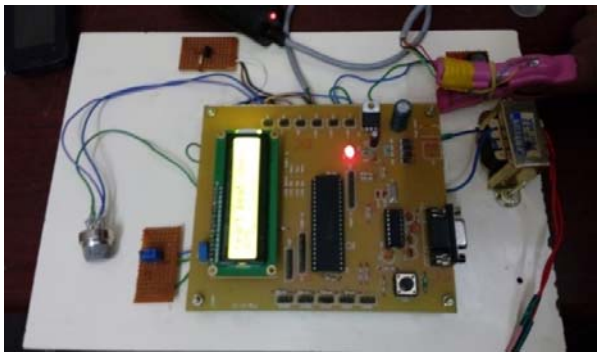

Figure-6. Experimental setup

5. RESULTS AND DISCUSSIONS

The Local Host is created with the help of Visual Studio 2010, which can be taken as a hospital computer or PDA of the nurse which gives information of the patient's condition. This is shown in the Figure-7, which clearly depicts the web page of the hospital.

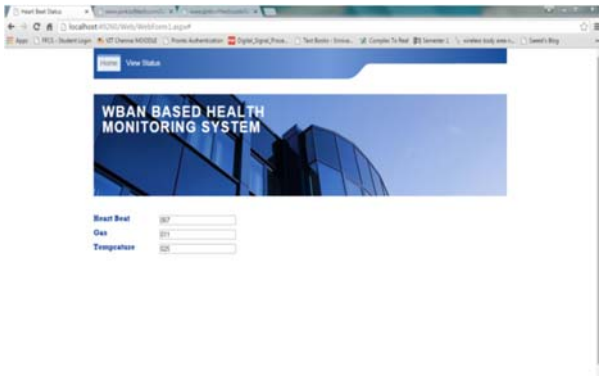

Figure-7. Local host/hospital

The Web Server is also created which depicts the information regarding the patient in the medical server. This medical server shown in Figure. 8 sends the information to all the hospitals connected to that server. So that the doctor connected to that server will get information regarding the patient's health and his surrounding environment. If he is in a safe environment, then there is no need for worrying, otherwise the doctor should immediately alert the ambulance and the nurse in that hospital to take care of the patient immediately through the Medical server and Local Host.

Figure-8. Medical server.

Table-1. Experimental values of five different patients.

Patient	Temperature	Heartbeat	Gas level
Patient 1	23	67	11
Patient 2	24	68	14
Patient 3	28	66	20
Patient 4	23	65	50 (abnormal)
Patient 5	21	70	50 (abnormal)

The table shows the temperature values of the surrounding environment where the patient is present, Heartbeat rate of the patient and the gas level of the surrounding atmosphere in which the patient lives.

The values of patient 1 and patient 2 are absolutely normal since the surrounding temperature is between 20 and 25, Heartbeat rate varies from 65 to 68 and the surrounding atmospheric gas level is within 25. Patient 3 shows an environment which is very heat (28),

which is above 25. If the temperature is below 20, then also doctor should immediately advise the nurse to see whether the patient is really in a bad environment and steps must be taken for moving the patient to a suitable environmental condition. The heartbeat rate is normal but the gas level indicates there is some smell of kerosene or methane gas which must be sensed and informed to nurse's PDA or medical server through web. Patient 4 shows normal conditions in temperature of environment and heartbeat rate, whereas the gas level is very much higher (50), so the nurse must be informed to take the patient to a safer place. Patient 5 shows normal surrounding temperature whereas his heartbeat rate is very high (70), so the ambulance must be at once informed to take him to a nearby doctor's home and medicine must be given immediately. Here the gas level sensor also shows some abnormal gas level of the surrounding environment, which must be informed to nurse's PDA.

The HyperTerminal shown in Figure-9 also shows the values of the environment where the patient is available, the heartbeat of the patient and also the gas level of surroundings.

Figure-9. Results in hyper terminal.

Whenever the heartbeat sensor senses the patient's blood flow level, then only it sends the values to the HyperTerminal, otherwise it gives zero value only. The first three readings of heartbeat are zero since the patient has not connected the finger clip to measure his heartbeat rate. The last reading correctly shows the heartbeat rate since the finger clip senses the blood flow level.

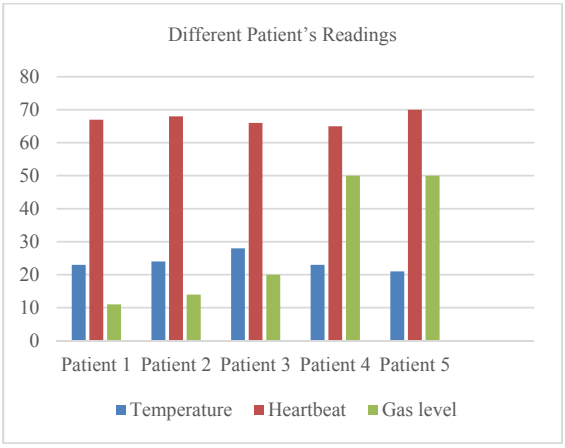

Figure-10. Readings of five different patients in bar chart.

The Figure-10 shows the bar chart graph of five different patients clustered in a single bar chart. The Temperature, Heartbeat rate and Gas level are shown in Blue color bars, Maroon color bars and Green color bars respectively.

From the graph, it is clear that the Patients 1, 2, 3 are showing normal readings whereas the Patients 4 and 5 are in abnormal surroundings of dangerous gas which must be at once informed to nurse's PDA through the remote monitoring of any doctor through web.

6. CONCLUSIONS

In this paper an IoT cloud infrastructure for monitoring the physical health condition of a patient from anywhere from doctor's home is presented. The proposed methodology will definitely help the patient in terms of real-time monitoring of his data through IoT. In future, this technology will be enhanced in terms of its real-time data analysis in Hospitals by including other features of disease management.

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