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ENHANCED IOT SYSTEM IN HEALTHCARE APPLICATION USING WIRELESS BODY SENSOR NETWORKS

M. Minni Pamela Janet [#1] and R. Dharmalingam [*2]

[#] *Student, Department of embedded system technology, Maharaja Institute of Technology, India*

[*] *Assistant professor, Department of embedded system technology, Maharaja Institute of Technology, India*

***Abstract*— In the modern health care environment, IoT technologies are used for convenience of physicians and patients. Health care monitoring for patients and physically disabled persons has become a focus of recent researches and developments. Identification and solving the health issues of patients have become difficult, because of poor mobility and weak interaction in existing healthcare systems. This paper proposes a secured Mobile Health care System using Wireless Body Sensor Network (WBSN). The nodes of WBSNs include ECG sensors, EEG sensors, EMG sensors, BP sensors, Motion sensors, Thermometer sensors etc. This proposed people-centric sensing system is efficient in solving the problems faced by patients and physician by monitoring human activities and interacting with the living environment. In this paper, three parameter viz., heart beat rate, temperature and stress level are monitored and transmitted. The healthcare system setup is simulated using Proteus software, and the parameters are viewed by remote health app and M2M patient monitoring screen.**

***Index Terms*— Healthcare, Wireless body sensor networks, Proteus software, Patient monitoring system.**

I. INTRODUCTION

The body sensor network (BSN) technology [1] is one of the most imperative technologies used in IoT-based modern healthcare system. It is basically a collection of low-power and lightweight wireless sensor nodes that are used to monitor the human body functions and surrounding environment. Since BSN nodes are used to collect sensitive information and may operate in hostile environments, accordingly, they require strict security mechanisms to prevent malicious interaction with the system. The healthcare remote monitoring systems have become a key contributor to the human life quality [2]. The market sector of healthcare remote monitoring systems has increased significantly due to several reasons. The number of elderly people is increasing over the time where today in developed countries it is quite normal that elderly people usually live independently in their own homes. Furthermore, Internet of things (IoT) makes these healthcare remote monitoring systems technically feasible (IoT as the concept of a monitor able and modifiable world in which sensors and actuators over living and non-living objects) [3] and the even decreasing cost of sensors makes it economically feasible.

Due to the penetration of smart mobile technology, it is also expected that population is already prepared to accept this kind of solutions collecting in real time people's private and sensitive data such as temperature, blood glucose, heartbeat, pulse oximetry sensor etc. For instance, healthcare personal analyzers such as smart beds automatically inform who are occupying them and even more, they are able to inform about different patients' physiological levels, making real smart home medication dispensers to, for instance, automatically alert when medication is not taken [4]. Several healthcare remote monitoring systems adopt different technologies for monitoring and/or tracking patients and/or biomedical equipment within Hospitals and at their homes. Unfortunately, as far as we know, most of these solutions are not flexible at the moment of adding new sensors during runtime. The fig.1 presents the body area network for smart healthcare system.

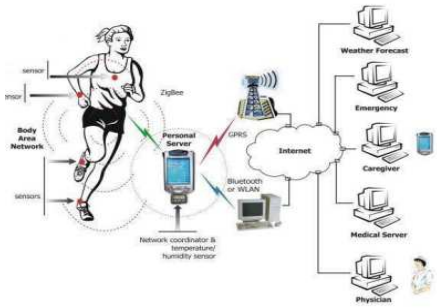

Fig.1. Body area networks for smart healthcare system

There are two basic problems associated with this approach. Firstly, the healthcare professionals must be on site of the patient all the time and secondly, the patient remains admitted in a hospital, wired to bedside biomedical instruments, for a period of time. In order to solve these two problems, [5] the patient oriented approach has been conceived. In this approach the patients are equipped with knowledge and information to play a more active role in disease diagnosis, and prevention. The key element of this second approach is a reliable and readily available Patient Monitoring System (PMS). The need for a real time recording and notification of vital signs of a patient is of prime importance for an effective PMS. By encapsulating the

advantages of modern bio instrumentation, computers, and telecommunication technologies a modern PMS should acquire, record, display, and transmit the physiological data from the patient body to a remote location at any time [6]. For more efficient, timely, and emergency medical care the PMS must also be incorporated with an alarm system. In order to alert the patient as well as the health care service providers the PMS should not only monitor and analyze the critical patient's data but it should also send alarming messages in case the monitored data go outside their normal ranges. Hence, an active database system must be associated with the PMS.

The rest of the paper is organized as follows: Section II presents the related work; Section III presents the proposed work; Section IV depicts the experimental analysis and concludes in Section V.

II. RELATED WORK

The study of a Wireless Multimedia Sensor Network (WMSN) and Radio Frequency Identification (RFID) based u-Healthcare system. The system [7] is capable of monitoring the patient's medical status by using RFID body sensor and wirelessly transmits the medical data to a local workstation (WMSN gateway) before transmitting it to the central database server. Due to the patient's movements, WMSN node's movements will be patterned with the functionality of the Mobile IPv6. Patients can be alerted in case of emergency through their wearable device and can also receive messages with their Smartphone's. The proposed system is designed [8] to measure and monitor important physiological data of a patient in order to accurately describe the status of her or his health and fitness proposed a system is designed to measure and monitor important physiological data of a patient in order to accurately describe the status of her or his health and fitness.

The patient's temperature, heart beat rate, muscles, blood pressure, blood glucose level, and ECG data are monitored, displayed, and stored by their system. To ensure reliability and accuracy the proposed system has been field tested. The test results show that their system is able to measure the patient's physiological data with a very high accuracy. Proposed system comprises [9] the design and implementation with subsystems. Information is sent via IP to a database server containing clinical data, which can be accessed on the smart phone and can also be shared with the physician anytime to seek medical advice when needed. Two wireless protocols were investigated: a Bluetooth (IEEE 802.15.1) ad-hoc network and a WiFi (IEEE 802.11) ad-hoc network. To do so, two subsystems were designed: a sensor system and a display system. The sensor system consists of two thermometers and a wireless transmitter/receiver.

The data will be communicated to the display system wirelessly. The display consists of a wireless transmitter/receiver and an iOS mobile device. The results concerning the efficacy and practicability of the designed system and the integration with a radiometer will be presented. The monitoring system has the capability to monitor physiological parameters from multiple patient bodies. In their proposed system [9], a coordinator node has attached on patient body to collect all the signals from the wireless sensors and sends them to the base station. The attached sensors on patient's body form a wireless body sensor network (WBSN) and they are able to sense the heart rate, blood pressure and so on. This system can detect the abnormal conditions, issue an alarm to the patient and send a SMS/E-mail to the physician. Designed and developed body temperature measurement device[13] that can be observe by the doctor in real time as well as history data via internet with an alarm/indication in case of abnormalities. The temperature sensors will send the readings to a microcontroller using Zigbee wireless communication. To send the real-time data to health monitoring database, wireless Local Area Network (WLAN) has been used. Arduino with Ethernet shield based on IEEE 802.11 standard has been used for this purpose. Test results from a group of voluntary shows the real-time temperature reading successfully monitored locally (at home) and remotely (at doctor's computer).

Some patient has heart attack, up to 29% people of them died before reaching to the hospital. This heart attack will happen without any indication. Currently, ECG (Electrocardiogram) Holter monitoring is mostly used technique for providing ambulatory cardiac monitoring for capturing disturbances in the body. This Holter monitor can record up to 24 hours of ECG signals, and the recorded data is subsequently retrieved and analyzed by a clinician. They can also detect and signal a warning in real-time if any abnormal changes in the body is captured. Recent research has also focused on the development of wireless sensor networks (WSN) and monitoring systems for cardiac patients. For example, number of wearable systems has been proposed with integrated wireless transmission, GPS (Global Positioning System) sensor, and local processing. For example, the proposed cardionet provides a remote heart monitoring system and ECG signals are send to a PDA (Personal Digital Assistant) and then routed to the central server by using the cellular network. Recently Pentland presented the proposed wearable mithril system in which ECG data, GPS position, skin temperature and galvanic skin response can be captured by using PDA [10].

The FLC system receives data from sensor as input and the fuzzification module converts input into fuzzy linguistic variable and its output is sent to Patient or Doctor. These systems have the main purpose: to provide or transmit the health information to the patient, to the medical staff or for both at the same time. They demonstrated the use of wearable Wireless Body Sensor Network and ambulatory health monitoring. If there is any change in the patient body that physiological parameter information is transferred through sensor, if there is any emergency then these message is transferred to doctor or relative or emergence unit. This application main aim is to provide the quickly facility of hospital. Their paper proved [5] wireless sensor networks can be widely used in healthcare applications which could improve the quality of life. The wearable sensor widely used that can be that can be continuous monitored the patient performance at the time of therapy from the accurate analysis from the sensor. The doctor and medical care can be alert and provide efficiently treatment to patient. The wearable sensor senses the recording of the unidirectional and multidimensional data. The context aware approach is used

for analyzing the patient activity in semi supervised or in unsupervised manner for identifying patterns. In this paper the author uses the MBM O Algorithm. The proposed system has the scalability and efficiently of the approach that collects the online analysis and monitored the patient in healthcare application.

III. PROPOSED WORK

The consolidation of the intelligent low cost sensor nodes kept in or on or around the human body to monitor the body functions and its environment is commonly referred as 'BSN in healthcare system'. This research study is being concentrated by several academia and industrial persons. The Body Sensor Networks (BSN) consists of both in-body and on-body sensor networks. The communication process held in in-body network comprises of implanted devices and base station. Contrarily, the communication process in on-body network comprises of wearable devices and a coordinator. Our proposed framework BSN care consists of wearable and implantable sensors. The sensor nodes are associated with biomedical devices like Electrocardiogram, Electromyography, Electroencephalography, etc. Local Processing Unit (LPU) acts as coordinator where the collected parameters are processed. With the help of wireless communication medium like 3G/CDMA/GPRS, the LPU behaves like router between nodes and the BSN server.

A predefined threshold value is set to LPU in order to detect the occurrence of the abnormalities. When the BSN-Care server receives data of a person (who wearing several bio sensors) from LPU, then it feeds the BSN data into its database and analyzes those data. Subsequently, based on the degree of abnormalities', it may interact with the family members of the person, local physician, or even emergency unit of a nearby healthcare center. Precisely, considering a person (not necessarily a patient) wearing several bio sensors on his body and the BSN-Server receives a periodical updates from these sensors through LPU. Now, our BSN-Care server maintains an action table for each category of BSN data that it receives from LPU.

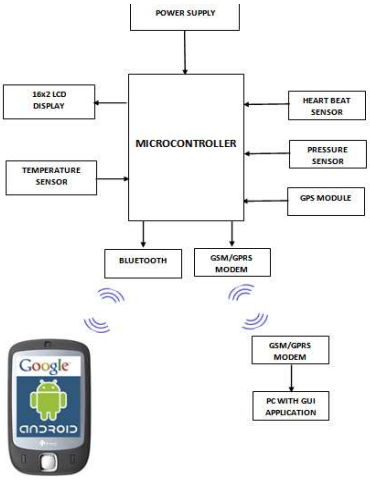

Fig.2. Proposed block diagram

IV. IMPLEMENTATION

The proposed algorithm is implemented in both hardware and software technologies.

1.1 Hardware Description:

a) LM35 temperature sensor

LM35 are the precision integrated circuit that monitors the temperature sensors. The obtained output is linearly with Celsius temperature. It does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°Cat room temperature and ±3⁄4°C over a full −55 to +150°Ctemperature range.

b) Heart beat sensor

Heart rate is the health parameter that deals with the soundness of the human cardio systems. Using PIC microcontroller, the heart rate is measured. This fluctuation of blood can be detected through an optical sensing mechanism placed around the fingertip. The signal can be amplified further for the microcontroller to count the rate of fluctuation, which is actually the heart rate.

c) Pressure sensor

Pressure sensor measures the temperature in ranges which is further split into absolute pressure sensor and gauge pressure sensor. Pressure sensors are variously named according to their purpose, but the same technology may be used under different names.

d) Liquid crystal display (LCD)

LCD is an electronic display system which is commonly used in different circuits and devices. The merits of LCDs are as follows:

- Economical in range
- Easy to use
- Characters used are displayed
- Very compact and light in nature
- Less power consumption

e) Power Supply

The power supply is designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function.

1.2 Software Description

a) Keil C

Keil C is the programming language that contains µVision IDE. It is a powerful environment that facilitates editing the source codes, debugging the programs and complete simulation. It is an embedded tool which supports the developer at different levels. The Keil Software ARM development tools are designed for the professional software developer; any level of programmer can use them to get the most output of the ARM processor architecture. Keil C µ Vision 4 help provides the various simulation output. The built-in embedded functions, PROTEUS (PROcessor for Text

Easy to Use) that covers various languages like C, BASIC, Assembly, Clipper /dBase. Transforming data from one form to another is the main usage of this language.

b) Proposed Algorithm

Step 1: Enrolment of patients

Step 2: Login

Step 3: Insert normal data into data base for comparison

Step 4: Every 2 secs is gathered data from patient and stored

Step 5: Collected data check with normal data

Step 6: If any changes found in data then find patient doctor, relative, & friend number

Step 7: Send message patient doctor, relative, & friend number

c) Simulation results

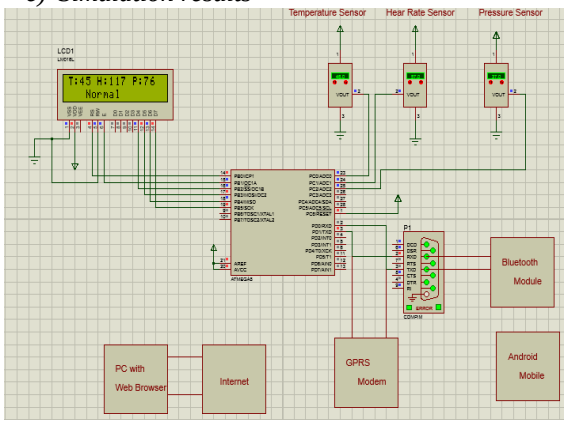

Fig.3. Simulation results of the proposed BSN care

V. CONCLUSION

The biggest benefit of a wireless network is that it allows providers to deploy technology at the bedside, as part of normal healthcare workflow. It can be used in military for security purposes that assists seamless communication between individual and machine. Aiming at the current problems in Health monitoring system, a secured health care system using wireless body sensor network has been proposed in this paper. In the simulation, the health monitoring parameter viz., heart beat rate, temperature and stress are continuously uploaded in cloud server. From the cloud server the data is accessed using mobile for remote area and in computer from local area. The system is able to carry out a long-tem monitoring on patient's condition and is equipped with an emergency rescue mechanism using SMS. This system can be enhanced by acquiring other health parameter from the patient's body.

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