

HEALTHCARE MONITORING SYSTEM USING BODY SENSOR NETWORK

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Abstract-Technology plays the major role in healthcare system, not only for recording parameters through sensory devices but also in communicating, recording and displaying the measured parameter. It is very important to monitor various medical parameters and post operational data. To access the patient's medical parameters in local and remote area, healthcare communication using Internet of Things (IoT) method is adapted. The main objective of this paper is to transmitting the patient's health monitoring parameters through wireless communication. These input data are uploaded in cloud server and transmitted to the computer and mobile for doctor's reference. The data from microcontroller is transmitted to cloud server through M2M gateway. 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.

Keywords:-Cloud Computing, GSM (Global System for Mobile communication), Internet of Things (IOT), M2M (Machine to Machine) Gateway, Proteus software

I. INTRODUCTION

Health is one of the global challenges for humanity. According to the constitutions of World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. Healthy individuals also reduce pressure on the already overwhelmed hospitals, clinics, and medical professionals and reduce workload on the public safety networks, charities, and governmental (or non-governmental) organizations. To keep individuals healthy an effective and readily accessible modern healthcare system is a prerequisite. A modernized healthcare system should provide better healthcare services to people at any time and from anywhere in an economic and patient friendly manner. Currently,[5] the healthcare system is undergoing a cultural shift

from a traditional approach to a modernized patient centered approach. In the traditional approach the healthcare professionals plays the major role. They need to visit the patients for necessary diagnosis and advising. 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, [2] 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. 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. Most of the proposed PMS are centralized in a sense that all patient's data are stored in a single server, by using necessary firmware and software the server can be connected to an open communication network via TCP/IP protocol. Thus a patient can be monitored from a remote location. Existing and widespread mobile phone networks can

assist in this regard. Recently, [7] mobile networks are considered critical for solving future global health challenges. With the global market penetration of the mobile phones the mobile healthcare system is a matured idea now. By using the mobile phone healthcare system can be made available for people, who are living in remote areas without much access to other types of communications. Even a simple mobile phone can become a powerful healthcare tool now. Text messages and phone calls can quickly deliver real-time and critical information of a patient to a remote location. Thus the patients, living in remote areas, can reduce unnecessary back-and-forth travel to the far located healthcare centers.

II. LITERATURE REVIEW

The study of a Wireless Multimedia Sensor Network (WMSN) and Radio Frequency Identification (RFID) based u-Healthcare system. The system [11] 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 [3] 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 [12] 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 Wi-Fi (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).

III. PROPOSED METHOD

In this paper, the proposed method uses PIC18F452 microcontroller as a gateway to communicate to the various sensors such as temperature sensor, pulse oximeter sensor and stress sensor. The microcontroller picks up the sensor data and sends it to the network and hence provides real time monitoring of the health care parameters for doctors. The data can be accessed anytime by the doctors. The controller alerts the caretaker about variation in sensor output. But the major issue in remote patient monitoring system is that the data as to be securely transmitted to the destination end and provision is made to allow only authorized user to access the data.

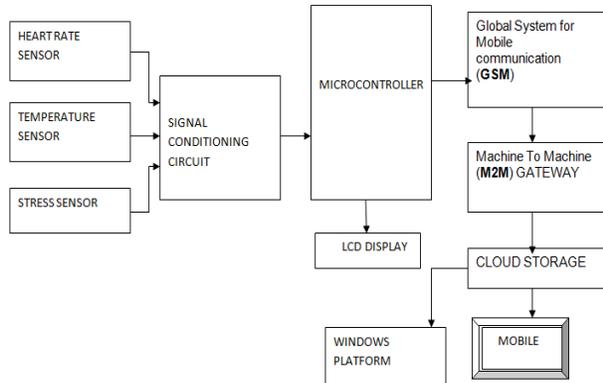


Fig3.1 Block Diagram of Proposed Method

The security issue is been addressed by transmitting the data through the password protected Global System for Mobile communication (GSM) module which will be encrypted and the users/doctor can access the data by logging to the html webpage. At the time of extremity situation alert message is sent to the doctor through GSM module. Hence quick provisional medication can be easily done by this system. This system will be efficient with time to time response.

A. Pulse Oximeter Sensor

The principle of pulse oximeter is based on the red and infrared light absorption characteristics of oxygenated and deoxygenated hemoglobin. Oxygenated hemoglobin absorbs more infrared light and allows more red lights to pass through. Deoxygenated (or reduced) hemoglobin absorbs more red light and allows more infrared light to pass through. Red light is in the 600-750 nm wavelength light band. Infrared light is in the 850-1000 nm wavelength light band.

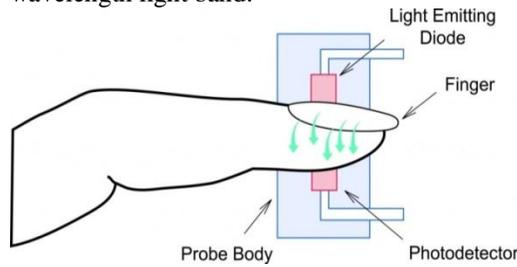


Fig.3.2 Pulse oximeter sensor

Pulse oximeter uses a light emitter with red and infrared LEDs that shines through a reasonably translucent site with good blood flow. Typical adult/pediatric sites are the finger, toe, pinna (top) or lobe of the ear. Infant sites are the foot or palm of the hand and the big toe or thumb. Opposite the

emitter is a photo detector that receives the light that passes through the measuring site.

B. Temperature Sensor (LM35)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range.

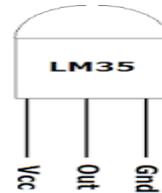


Fig.3.3 Temperature sensor

C. Stress Sensor

Stress is a physiological condition in which the body becomes excited to face an emergency situation. A number of physiological changes including increase in heart rate, breathing rate etc occurs during a high stress state. The resistance of the skin varies if the stress level is high, the skin offers less resistance and if the body is relaxed the skin resistance is high. During high stress there is increase in the blood supply to the skin, this increase the permeability of the skin. High stress causes sweating and leakage of water from the blood vessels in the skin. This makes the skin moist and electrical conductivity increases.

D. Machine to Machine

Machine to Machine (M2M) refers to technologies that allow both wireless and wired systems to communicate with other devices of the same type. M2M is a broad term as it does not pinpoint specific wireless or wired networking, information and communications technology. This broad term is particularly used by business executives. M2M is considered an integral part of the Internet of Things (IoT) and brings several benefits to industry and business in general as it has a wide range of applications such as industrial automation, logistics, Smart Grid, Smart Cities, health, defense

etc. mostly for monitoring but also for control purposes.

E. Android

Android is open source and Google releases the code under the Apache License. This open-source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. Additionally, Android has a large community of developers writing applications that extend the functionality of devices, written primarily in a customized version of the Java programming language.

F. Cloud Computing

Cloud computing relies on sharing of resources to achieve coherence and economies of scale, similar to a utility (like the electricity grid) over a network. At the foundation of cloud computing is the broader concept of converged infrastructure and shared services. Cloud computing, or in simpler shorthand just the cloud, also focuses on maximizing the effectiveness of the shared resources. Cloud resources are usually not only shared by multiple users but are also dynamically reallocated per demand. This can work for allocating resources to users. Cloud computing comprises of types. They are private cloud and public cloud.

G. INTERNET OF THING

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to use automation in nearly all fields, while also enabling advanced applications like a Smart Grid. Things, in the IoT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue.

H. PROTEUS SOFTWARE

The Proteus design suite is a unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode circuit simulation. With this Virtual System

Modeling (VSM) facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development. If one person designs both the hardware and the software then that person benefits as the hardware design may be changed just as easily as the software design. In larger organizations where the two roles are separated, the software designers can begin work as soon as the schematic is completed; there is no need for them to wait until a physical prototype exists.

IV. RESULTS AND DISCUSSION

Figure 4.1 shows the heart rate, temperature and stress level of patients in LCD display. Therefore number of patients ID data are logged each and every seconds to the cloud uploader data base management.

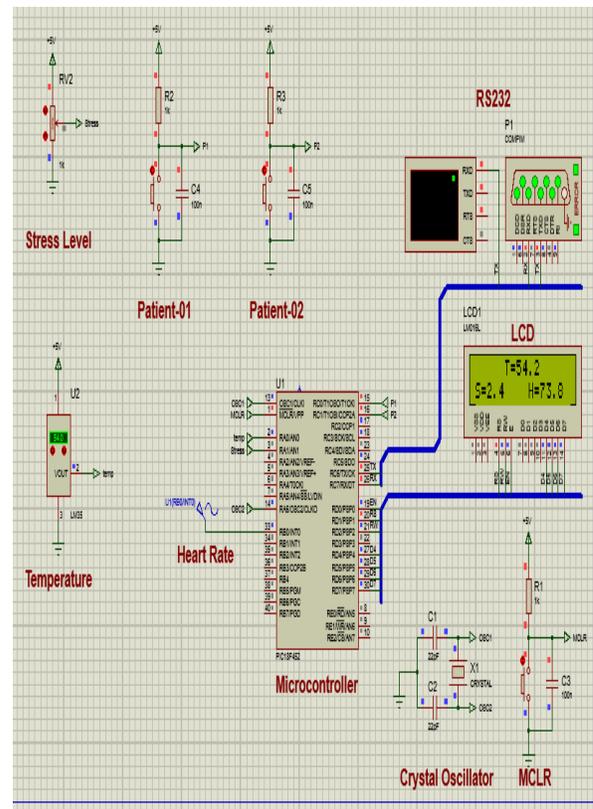


Fig 4.1 Snapshot of patient health details

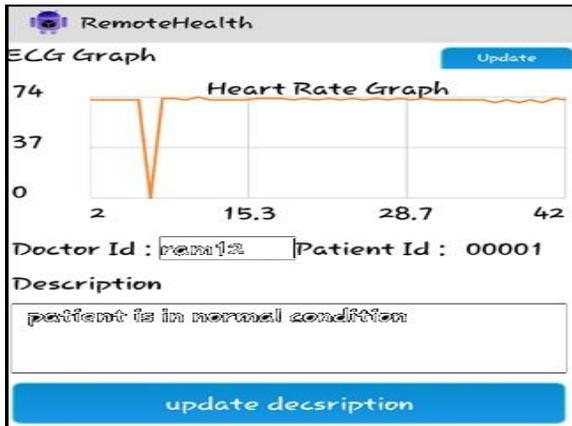


Fig 4.2 Result of remote health app

Figure 4.2 shows the result of remote health app, where the doctors can be able to monitor the patient's health from the remote area. In case of emergency, doctors can be able to send the patients health details to other doctors for their treatment.

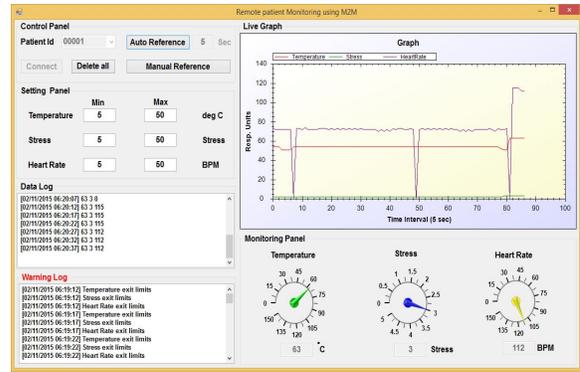


Fig 4.3 Remote monitoring using M2M

The above figure shows the results of remote patient's monitoring using M2M; this is developed by visual studio software. It shows the control panel which displays the patients ID, Live graph, data log and monitoring panel. If there is an emergency case the warning log displays the abnormalities. The reconfigurable smart sensor interface for health care monitoring WSN in IoT environment was analyzed. The systems can collect sensor data intelligently. It is designed based on M2M technology using the microcontroller and the application of wireless communication using GSM modem. It is very suitable for real-time and effective requirements of the high speed data acquisition system in IoT environment. Different types of sensors can be used as long as they are connected to the system. Finally, by taking real time monitoring of health care monitoring in IoT environment as an example, the system is verified and achieved good effects in simulation output.

V. CONCLUSION&FUTURE SCOPE

In mobile physiological monitoring systems, sensor connected to microcontroller through wired communication and data from microcontroller are transmitted to cloud server through wireless communication. Mobile physiological monitoring system is simulated using Proteus software, and the parameters are viewed by remote health app and M2M patient monitoring screen. 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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