Reference paper 3

A Smart Healthcare Monitoring System Using Smartphone Interface

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Abstract:- The present work proposes an efficient architecture of a smart health care monitoring framework using sensors and Internet of Things. With 1: 1674 doctor-patient population ratio in India, the shortage of health providers and infrastructure is the most acute in rural areas. The paper presents an efficient model wherein a doctor can monitor the health of the patient from a remote location through the efficient use of technology, thereby addressing this shortage of healthcare personal in Indian scenario. In the proposed system, the vital health parameters like Electrocardiograph (ECG), Body Temperature, Blood Pressure (BP), Heart Beat rate, Glucose Level Detection and Galvanic Skin Response of patient are collected and evaluated through the use of smart devices. The data is further transmitted wirelessly through Zigbee IEEE 801.15.4 technology for further analysis using data analytics. Next the android application of the system displays this data about vital statistics on a Smartphone of a doctor enabling him to receive the current status of the patient without being physically present there. Whenever there is a variation in any physiological parameter of a patient beyond a pre-assigned threshold value, an automated notification will pop up in doctors' android mobile application. Hence the present IOT based smart health care monitoring system enables the remote monitoring of medical parameters along with the tracking of medical equipments leading to smart hospital services.

Keywords: Smart Healthcare; IoT; ZigBee; Android; Healthcare Monitoring.

I. Introduction

Real time collection and dissemination of information about the vital parameters of a patient is crucial in critical healthcare issues including trauma and post-surgery recovery. The latest advancement in smart phones and Internet of Things (IoT) can play a very crucial role in achieving this goal and reducing mortality rate [1]. IoT technology involves millions of interconnected objects, interacting with each other, sensing and sharing the information through various communication modules like bluetooth, wifi, zigbee, etc. The concept of IoT was initially coined by the RFID development community in the year of 1999 [2]. However, it has become more pertinent with the advent of embedded system communication, cloud computing and exponential increase in usage of mobile devices. [3]. Also, technical advancements in physiological sensing devices and wireless connectivity provided by the IoT has enabled a paradigm shift in real time health monitoring.

Rural Health care in India poses one of the biggest challenges in India due to lack of quality infrastructure, dearth of qualified medical professionals, and non- access to medical facilities. The use of IoT sensing technologies using wireless data transfer protocols can be used for remote monitoring of physiological parameters in rural settings in order to overcome the shortage of qualified medical[professionals in India, thereby improving people's general health care standards. [5]

Nowadays, in many countries, the focus is to reduce the number of hospital beds and increasing the proportion of home healthcare by undergoing hospital restructuring. The smart health monitoring system not only provides the patients a seamless healthcare in a comfortable home environment along with drastically reduced expenditure on medical treatment but on the other hand, the limited hospital resources can be used for people in need of emergency care. Therefore, the Smartphone based wireless healthcare monitoring system proposed in the paper provides an appropriate framework for developing advanced and practical health-related technologies and services by leveraging Internet of Things and Zigbee data protocols through real-time monitoring and analyzing vital signs to early detect or predict life-threatening adverse events. The present framework is designed as an integration of all the above mentioned matrices in a single chip by measuring and monitoring important physiological data of a patient to accurately describe the status of his/her health and fitness and send alarming message about the patient's critical health data. through the use of sensors, the data acquisition unit, microcontroller, and software. The patient's temperature, heart beat rate, muscles, blood pressure, blood glucose level, and ECG data are monitored, displayed, and stored by our system.

II. Methodology:

Main objective of the proposed system is to monitor the real time health status of patient and notify the concerned medical professionals instantly. The complete methodology of smart

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healthcare monitoring system is explained stepwise as given below.

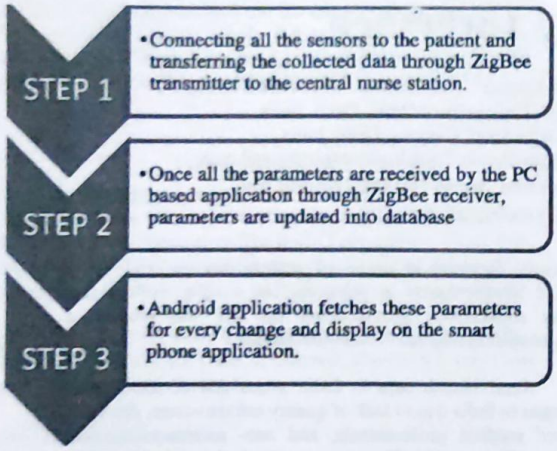

Fig.1. Methodology of the smart healthcare monitoring system.

The integrated system for real time health monitoring of patient, consists of hardware such as Arduino Uno ATMEGA 328/ 2560 board, sensors, power supply, ARM7 based LPC2148 microcontroller, , buzzer, Zigbee IEEE 801.15.4 modules and software (Flash magic, Visual Studio IDE, Eclipse IDE.

III. Components

HARDWARE REQUIREMENTS

Constant 5 V Power Supply- It uses IC 7805 to save the circuit from high current and to maintain a constant input supply of 5V, Capacitors to remove ripples, Transformer to step down input supply of 220 V, bridge rectifier for rectification of voltage, and few resistors.

Arduino UNO 328 / 2560- The heart of the project is Arduino UNO 328 / MEGA 2560. Arduino 2560 is used instead of Arduino 328 since the number of pins in Arduino 2560 is more (100) than that in the Arduino 328 (28) Although 8051 microcontroller is faster than Arduino, but Arduino UNO has been used since it is cheaper. It has all inbuilt features such as Clock, Memory, ADC, PWM etc.

Various sensors studied with Arduino UNO are Temperature sensor, Glucose Level Detector, Heartbeat sensor, and Galvanic Skin Response (GSR). A brief idea about components is describe here:

Temperature Sensor- LM 35 sensor has been used to sense temperature. LM35 is a three terminal device, whose one terminal has a constant input of 5V, other terminal shows the output Voltage, while the third terminal is grounded. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Celsius temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Celsius scaling.

Features:

- Calibrated Directly in Celsius
- Linear + 10-mV/°C Scale Factor
- 0.5°C Ensured Accuracy (at 25°C)
- Rated for Full −55°C to 150°C Range
- Suitable for Remote Applications
- Low-Cost Due to Wafer-Level Trimming
- Operates from 4 V to 30 V
- Less than 60-µA Current Drain
- Low Self-Heating, 0.08°C in Still Air
- Non-Linearity Only ±¼°C Typical
- Low-Impedance Output, 0.1 Ω for 1-mA Load

Pulse Sensor- Pulse Sensor is a well-designed, easy to use plug-and-play heart-rate sensor for Arduino. The sensor clips onto a fingertip or earlobe and plugs right into Arduino with jumper cables to get the pulse reading.

Bluetooth Module- BlueLinkSilver Bluetooth module is interfaced to the Arduino board to transmit the data that is to be sent to the Bluetooth enabled smartphone. BlueLinkSilver is a compact Class-2 Bluetooth Module (5V & 3V Compatible).

LCD (Liquid Crystal Display)- LCDs are used over seven segment displays because LCDs are economical; easily programmable; have no limitation of displaying special and even custom characters (unlike in seven segments), animations. A 16x2 LCD is used here. 16x2 means it can display 16 characters per line and there are 2 such lines.

Glucose Bottle Sensor- The concept of IR sensors and receivers has been used. Whenever the level of fluid in the glucose bottle comes below a predefined value, using a pair of IR sensor and receiver, a buzzer/ alarm will get activated which will indicate the nurses to refill the bottle.

Galvanic Skin Response (GSR)- The Galvanic Skin Response (GSR) is defined as a change in the electrical properties of the

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skin and can be used for capturing the autonomic nerve responses as a parameter of the sweat gland function. The measurement is relatively simple, and has a good repeatability. Galvanic Skin Response will use the concept of Voltage Divider Rule. In this, a voltage supply and pair of resistor coil, along with multimeter have been used to measure the readings with respect to any change in the Galvanic Skin Response.

IV. Observation and Results

Body Temperature sensor

Designed circuit was used to find the desired parameter and show the results. Parameters like Body Temperature, Heart Beat, Galvenic Skin Response (GSR) were measured and the results so obtained are shown in table-1, table-2, and table-3 respectively.

Results obtained for Body temperature measurement shown that the module gives us the value of different objects in a very close proximity as given in Table-1.

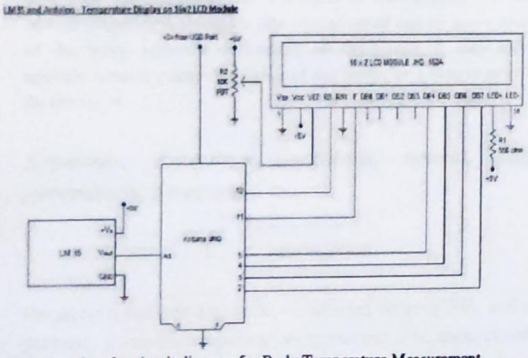

Fig.2. Showing the circuit diagram for Body Temperature Measurement.

Fig.3. Showing designed circuit for Body Temperature Measurement.

Table-1: Shows the results for Body temperature.

S.No.	Temperatures Readings	In °C
1	Room Temperature	18
2	Steam Temperature	Above 37
3	Sunshine Temperature	36
4	Ice Temperature	5
5	Body Temperature	33

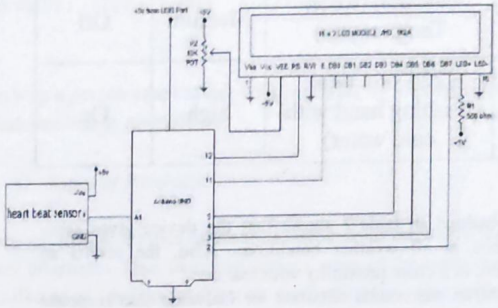

Fig.4. Showing the circuit diagram Heart Beat Measurement.

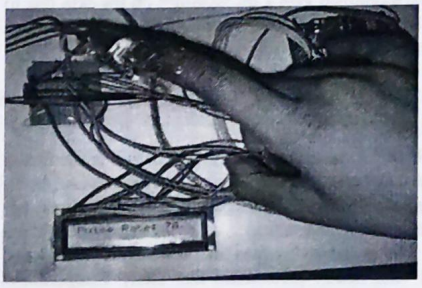

Fig.5. Showing the designed circuit for Body Temperature Measurement.

Table-2: Shows the results for Heart Beat.

	Heart Beat		
	Morning	Daylight	Evening
Person 1	71	73	72
Person 2	73	75	74
Person 3	72	74	73

Table-3: Shows the results for Galvenic Skin Response.

S.No.	Skin Condition	GSR	Buzzer
1.	Sweating (Sunshine Temperature)	high	On
2.	Dry skin (Room Temperature)	Medium	Off
3.	Cold skin (after washing hand with cold water)	high	On

Results obtained in table-2 shows that the device gives same performance in all weather conditions. Also, the results so obtained are in a close proximity with real one.

Table-3 shows the results obtained for Galvanic skin response for 3 different conditions. GSR can also be used in Lie detector machine. It can be used as if a person is lying then the body of the person to be examined gets a bit moisture on the skin due to the fear, and this moisture can be captured by the GSR which can tell us whether the person is lying or saying truth.

V. Conclusion

The design and implementation of an efficient and smart health care framework has been presented for remote patient care by by monitoring important physiological parameters/ vital signs, on-site diagnosis and interaction with remote healthcare professionals. The proposed system successfully measured and monitored the vital health parameters like Body Temperature, Blood Pressure (BP), Heart Beat rate, Glucose Level Detection, Galvanic Skin Response of a human body etc. Zigbee IEEE 801.15.4 is used in the system for transmitting of data providing low cost effective solution.

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