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Smart Healthcare Monitoring and Tracking System

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Abstract - *Providing appropriate medical services to patients without any delay, especially in case of emergencies, has been a major challenge in the field of medical sciences. The proposed system tries to overcome this problem. Studies have shown that high blood pressure or hypertension affects a large number of people throughout the world. The system tries to provide an efficient application for healthcare monitoring and tracking. Heartbeat and temperature are considered as the main health metrics in the considered system model. The system monitors the patient's health condition by measuring the heartbeat and temperature and also tracks his/her location. The measured values and the patient's geographic coordinates can be sent to the doctor as a short message service (SMS) in case of emergencies. The system generates a map of the entire region by using the patient's geographic coordinates and lists out all the nearby doctors/hospitals for the patient. The closest doctor/hospital is found by using a distance algorithm and displayed to the patient.*

Key Words: smart healthcare; sensors; smart city; monitoring; IOT.

I. INTRODUCTION

With the advent of globalization, there has been an increasing demand for Smart cities. A Smart city is a concept of integrating information and communication technology (ICT) and Internet of things (IOT) technology in a secure fashion to manage a city's assets [3]. It involves a number of attributes and services like information systems, schools, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement and other community services. Among these, healthcare is a very important field that needs development. Smart systems can be designed that can present sustainable medical interventions efficiently at low cost in a user friendly manner [5]. Statistics of medical records collected over years, show that death rates due to heart diseases have increased. Blood pressure is a crucial risk factor for ischemic heart diseases and thus, preventive measures must be taken against it [4]. Over the years, systems have been designed to monitor heart rate, blood sugar levels, body temperature and to synchronize and display this information on a smart mobile phone or a standard computer using wireless communication technologies [6]. Our proposed system aims to monitor the patient's blood pressure and temperature.

II. PROPOSED PROTOTYPE

The system uses Arduino Uno as the main microcontroller. A temperature sensor (LM35) and heartbeat sensor are connected to the Arduino Uno. The temperature sensor gives the temperature value in degree Celsius. To measure the heart rate, the heart beat/pulse is detected and the number of pulses for one minute is counted to get the beats per minute. Light (using an LED) is passed from one side of the finger and the intensity of light received on the other side is measured (using an LDR). The GPS and GSM modules are interfaced with the Arduino microcontroller. The GPS module finds out the latitude and longitude of the patient. The temperature and heartbeat values are measured and compared with a configurable threshold to be classified as "low", "normal" or "high". The GSM module is used to send a short message service (SMS) to the doctor's mobile in case of emergencies. The message contains the temperature, heartbeat values and the patient's latitude and longitude. The doctor can thus take immediate action with the help of this alert system.

The concept of IOT (Internet of Things) has been implemented by sending the collected data to an online webpage [2]. This is done by initially creating a text file containing the measured values. A PHP script is used to check whether the text file has been created or not. Once the text file is created, an AJAX call is performed via java script to read the contents of the file and display them on the webpage. A map of the entire region is generated using the patient's geographic coordinates with the help of the Google Maps API. The map will display all the nearby doctors/hospitals in that region with contact and route details. The patient can choose a doctor from this list of doctors for consultation in case of emergencies. Moreover the Haversine distance algorithm is used to find out the nearest doctor/hospital from the list and display it on the webpage.

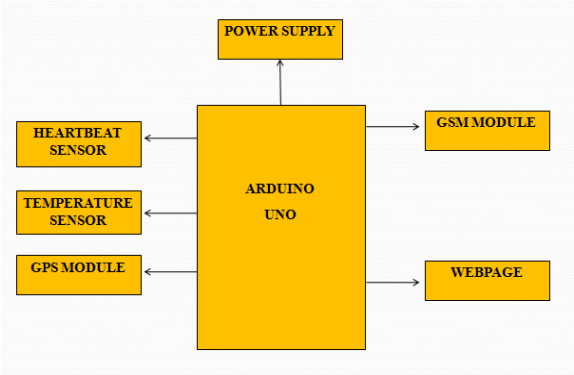

Fig 1- Block Diagram of the system

III. HARDWARE DESIGN

A. Microcontroller

The microcontroller acts as the main processing unit and controls the operations of all the components connected to it. Arduino Uno is used in this system. Arduino Uno is a microcontroller board based on the ATmega328P . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The USB interface simplifies the connection of the microcontroller with the computer, and also acts as a power supplier for the microcontroller board.

B. Temperature sensor (LM35)

The LM35 temperature sensor has been used to detect the temperature of the patient. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. These do not require any external calibration to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range.

C. Heartbeat sensor

To measure the heart rate, the heart beat/pulse is detected and the number of pulses for one minute is counted to get the beats per minute. Light (using an LED) is passed from one side of the finger and the intensity of light received on the other side is measured (using an LDR). Whenever the heart pumps blood, more light is absorbed by increased blood cells and a decrease in the intensity of light received on the LDR, is observed. As a result, the resistance value of the LDR increases. This variation in resistance is converted into voltage variation using a signal conditioning circuit, usually an OP-AMP. The signal is amplified enough to be detectable by the microcontroller inputs. The microcontroller can be programmed to receive an interrupt for every pulse detected and count the number of interrupts or pulses in a minute. The count value of pulses per minute gives the Heart rate in bpm (Beats Per Minute).

D. GSM module

This module is used to send the short message service (SMS) to the doctor. It is a device which can be used to make a computer or any other processor communicate over a network. A GSM digitizes and reduces the data and then sends it down through a channel with different streams of client data, each in its own particular time slot. A GSM module requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection. The working of GSM modem is based on commands. The commands always start with AT (which means ATtention) and finish with a <CR> character.

E. GPS module

It is used to find the latitude and longitude of the patient. A GPS navigation device or GPS receiver is a device that can receive information from GPS satellites and accurately calculate the geographical location. The Global Positioning System (GPS) is a global navigation satellite system (GNSS) made up of a network of a minimum of 24, but currently 30, satellites placed into orbit by the U.S. Department of Defense. A GPS device can retrieve the location and time information in all weather conditions, anywhere on or near the Earth. A GPS reception requires an unobstructed line of sight to four or more GPS satellites and is subject to poor satellite signal conditions.

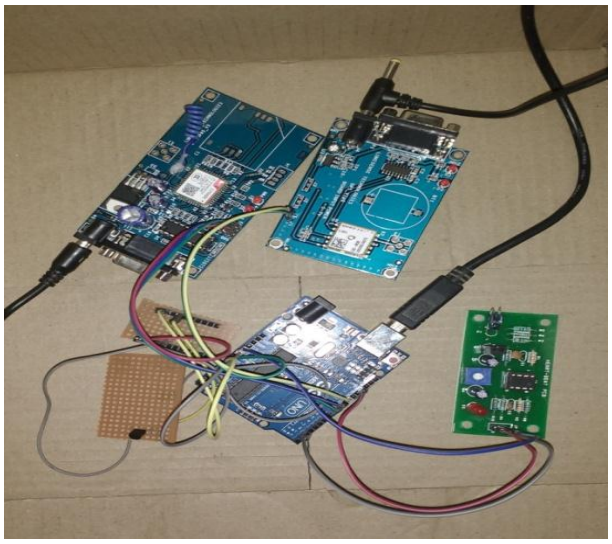

Fig 2- Hardware setup

IV. SOFTWARE DESIGN

The microcontroller is programmed using Arduino IDE to handle all the operations of the hardware components connected to it. A web page is made which displays the measured parameters and also a map of the entire region. The map is created with the help of the Google Maps API by using the patient's latitude and longitude values obtained from the GPS module. HTML and CSS are used in the front-end portion to make and design the webpage. Java script is used to to read the contents of the file (using an AJAX call), to generate the map, list of doctors, contact and route details and to implement the Haversine distance algorithm to locate the closest doctor/hospital in the region. PHP is used to handle the back-end portion of the webpage. It uses Server Sent Events (SSE) architecture to continuously check whether the text file has been generated or not, and to automate the redirection process to the specific web pages, thus making the system real-time.

V. RESULTS AND DISCUSSION

The proposed system has been designed with the hardware and software specifications as discussed before. It has been tested for a number of patients. The results are shown in the following figures.

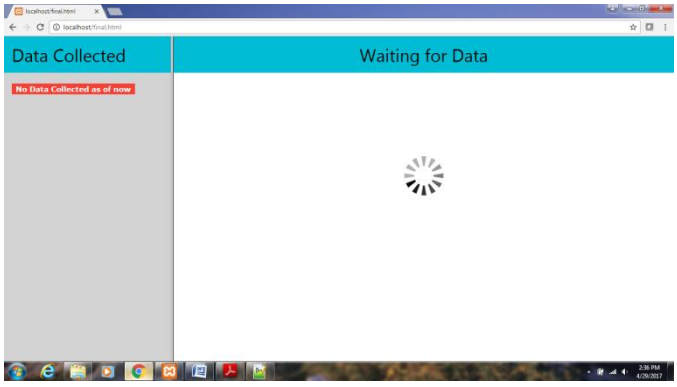

Fig 3- The webpage before the data is collected

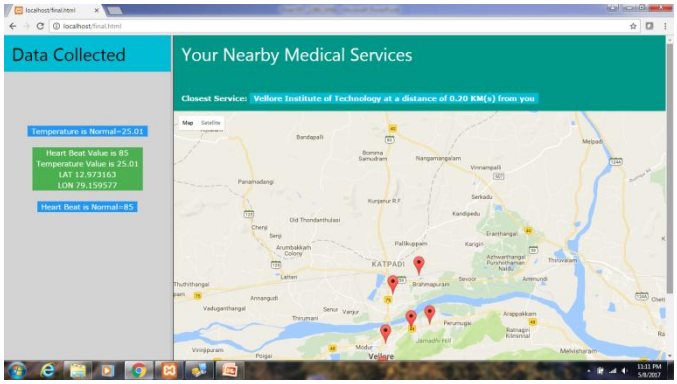

Fig 4- The webpage showing the measured parameters, the map and the list of doctors in that region

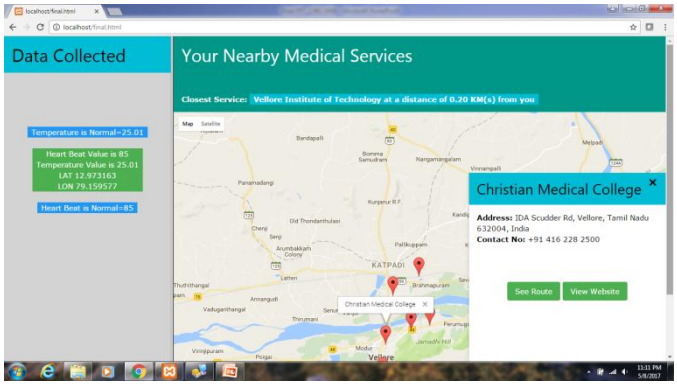

Fig 5- The webpage showing the contact details of a particular doctor/ hospital

Fig 3 and Fig 4 show the webpage before and after the data is collected from the microcontroller. The map is displayed in Fig 4 pointing out the nearby doctors/hospitals in that region. Fig 5 and Fig 6 show the contact and route details of a particular doctor/ hospital. Fig 7 shows the SMS received by the doctor.

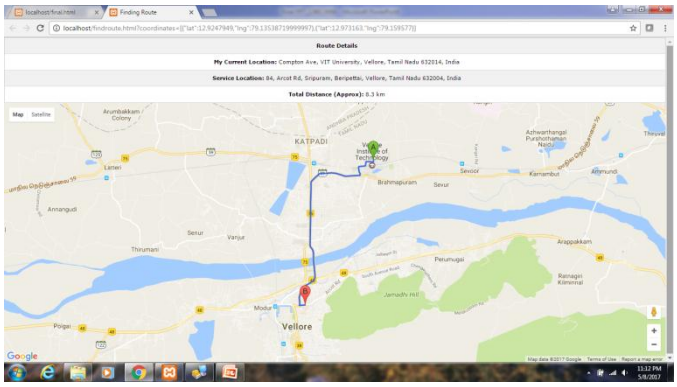

Fig 6- The webpage showing the route details of a particular doctor/ hospital

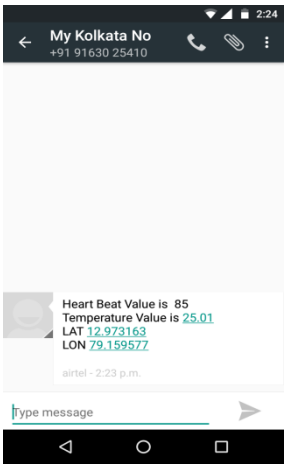

Fig 7- The SMS received by the doctor

VI. CONCLUSION

The concept of Smart City is aimed at providing a better life to the people by improving the efficiency of services and by coming up with innovative solutions to solve the issues commonly faced by the people. Healthcare is a very important field that needs immediate attention. The proposed system provides an inexpensive and efficient IOT based application for healthcare monitoring and tracking that can help in taking care of the patient's health by providing effective medical services at the right time. This system will thus be beneficial for both the patient and the doctor in case of medical emergencies.

VII. REFERENCES

[1] N. Bressan, L. Bazzaco, N. Bui, P. Casari, L. Vangelista, and M. Zorzi, The Deployment of a Smart Monitoring System Using Wireless Sensor and Actuator Networks, Proc. of IEEE SmartGridComm, Gaithersburg, MD, USA, Oct. 2010.

[2] John A. Stankovic, Research Directions for Internet of Things, IEEE Internet of Things Journal Volume 1 pp. 3-9, Jan 2014

[3] Sarwant Singh, Smart Cities – A $1.5 Trillion Market Opportunity, Accessed: (29/11/2015), available http://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/

[4] A. V. Chobanian, The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, JAMA, the Journal of the American Medical Association, May 21, 2003.

[5] Tanja Bratan; Malcolm Clarke, Optimum Design of Remote Patient Monitoring Systems, Engineering in Medicine and Biology Society, 2006. EMBS '06. 28th Annual International Conference of the IEEE

[6] Kahtan Aziz, Saed Tarapiah, Salah Haj Ismail, Smart Real-Time Healthcare Monitoring and Tracking System using GSM/GPS Technologies, 2016 3rd MEC International Conference on Big Data and Smart City

[7] World Health Organization, The Global Burden of Disease,2008.

[8] P. M. Kearney, M. Whelton, K. Reynolds, P. Muntner, P. K. Whelton and J. He, Global burden of hypertension: analysis of worldwide data, Elsevier Ltd, 15 January 2005.

[9] World Health Organization, Disease and injury country estimates,2009.

[10] Ying-Wen Bai, Chao-Lin Lu,.Enterprise networking and Computing in Healthcare Industry, 2005. HEALTHCOM 2005. pp. 278- 281, 2005

[11] V. Jones, V. Gay, and P. Leijdekkers, Body sensor networks for mobile health monitoring: Experience in Europe and Australia, International Conference on the Digital Society, pages 204–209, 2010

[12] M. R. Yuce et al, A MICS wireless body sensor network, IEEE Wireless Communications and Networking Conference (WCNC), pp. 2473-2478, March 2007.

[13] T. Gao et al, Vital Signs Monitoring and Patient Tracking Over a Wireless Network, IEEE-EMBS 27th Annual Int. Conference of the Eng. in Medicine and Biology, Sept. 2005, Page(s):102 – 105.

[14] Mikhail St-Denis, LifeLine, Accessed:(29/11/2015), available http://www.mikhailstdenis.com/projects/personal LifeLine.html

[15] A.R. Al-Ali; M. Al-Rousan; M. Al-Shaikh, Embedded system-based mobile patient monitoring device, Computer-Based Medical Systems, 2003. Proceedings. 16th IEEE Symposium