'E'-Way for Health Monitoring and Alert Systems using Wireless Mode of Transmission

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Abstract— This paper presents a project on monitoring a person's health and in case of emergency, sending the data to the nearest hospital to take the further action using wireless networks. With large-scale wireless networks and mobile computing solutions, such as cellular 3G, Wi-Fi, Wi-MAX, Bluetooth, and Wireless Sensor Networks, health care personnel can tap into vital information anywhere and at any time within the health care networks. Ubiquitous healthcare, although promising, there are myriad challenges associated with realizing its vision. This paper highlights some snapshots of current uses and future trends of various wireless communications in the healthcare domains, addresses their applications for e-health, states the challenges faced in a ubiquitous healthcare environment equipped with different wireless technologies, and how the resulting issues might be addressed by developing a framework that provides a flexible and convenient medical monitoring, consultation, and healthcare.

Key words: Ubiquitous Computing, Telemedicine, E-Health, Wireless Communications

I. INTRODUCTION

E'-way for Health Monitoring and Alert System using Wireless Mode of Transmission is done using Wireless Networks. This work describes the implementation of a complete health monitoring system to deploy in medical environments. It includes hardware, software and wireless protocol designs to transfer the information at a particular destination. The wireless system uses medical bands to obtain physiological data from sensor nodes.

The medical bands are selected to reduce the interference and thus increase the coexistence of sensor node devices with other network devices available at medical centers. This system can offer two significant advantages compared to current electronic patient monitoring systems.

The first advantage is mobility of patients due to use of portable monitoring devices, and second is location independent monitoring facility.

The collected data is transferred to remote stations through wireless networks. The gateway nodes connect the sensor nodes to the local area network or the Internet.

As such facilities are already available in medical centers; medical professions can access patients' physiological signals anywhere in the medical center. A prototype is designed consisting of a number of sensors for each vital parameter which is in contact with patient or person.

II. IMPLEMENTATION IN MEDICAL FIELDS

The sensor electronics should be miniaturized, low-power and detect medical signals such as pulse rate, blood pressure, and temperature. The monitoring devices currently used in medical centres are not completely wearable because their electronics are bulky and wires are used for connections to multiple sensors.

Blood pressure is the pressure of the blood in the arteries. The heart contracts and expands when it beats. Contraction pushes the blood through the arteries to body, and this force creates pressure on the arteries. Blood pressure is measured as high blood pressure and low blood pressure which called systolic pressure (as the heart beats) and the diastolic pressure (as the heart relaxes between beats). Blood Pressure must be measured when the body is relaxed whether sitting or lying down [1].

Heart rate is the speed of the heartbeat measured by the number of contractions of the heart per minute (bpm). The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide. It is usually equal or close to the pulse measured at any peripheral point. A normal resting heart rate for adults ranges from 60 to 100 beats a minute.

Normal human body temperature, also known as normothermia or euthermia, is a narrow temperature range indicating optimal health and thermoregulation. Individual body temperature depends upon the age, exertion, infection, sex, time of day, and reproductive status of the subject, the place in the body at which the measurement is made, the time of day, the subject's state of consciousness (waking or sleeping), activity level, and emotional state. Normal body temperature is 37 degrees Celsius.

III. TECHNOLOGIES

A. Ubiquitous computing

In healthcare, ubiquitous computing integrates computation into the environment through the use of wired sensor networks. Miniature sensors can perform long-term and ambulatory health monitoring, such as heart rate and blood pressure monitoring. The use of smaller, cheaper and less power hungry diagnostic devices, allows obtaining health related information from wearable or embedded sensors. Coupling the pervasive communications mentioned above with the lightweight portable devices such as tablets, notebook PCs, etc., Healthcare personnel can access vital signs information, review patient data, and update patients' records seamlessly. The main benefits of ubiquitous computing integration in healthcare include, but are not limited to the following: mobility and continuity support in medical monitoring and treatment, patient status report through the placement of a wide range of monitors in a home environment, improved patient satisfaction through on-line viewing and self-management of the healthcare process, improved quality of patient care by reducing medical errors through automated order entry and alerting

systems, as well as remote access provisioning to medical facilities and specialists [5].

B. Comparison of Communication Technologies

Protocols	Bluetooth	ZigBee	Wi-Fi	GSM/ GPRS
IEEE spec.	802.15.1	802.15.4	802.11 a/b/g	802.21
Frequency Band	2.4 GHz	868/915 MHz; 2.4 GHz	2.4; 5 GHz	850/ 9001800/ 1900 MHz
Max Signal Range	720 Kb/s	250 Kb/s	54 Mb/s	168 Kb/s
Channel Bandwidth	1 MHz	0.3/0.6 MHz; 2 MHz	25-20 MHz	200 kHz
Modulation Type	GFSK, CPFSK, 8-DPSK,	BPSK QPSK, O-QPSK	BPSK, QPSK, OFDM, M-QAM	GMSK, 8PSK
Spreading	FHSS	DSSS	MC-DSSS, CCK, OFDM	TDMA, DSSS
Success Metrics	Cost, Convenience	Reliability, Power, Cost	Speed, Flexibility	Range, Cost, Convenience,
Application	Cable Replacement	Monitoring, Control	Data Network, Internet, Monitoring,	Internet, Monitoring, Control

Table 1: Comparison of technologies

Wireless technologies are on their way of becoming pervasive; covering different niches and making communications available at anytime, anywhere. Various low cost broadband wireless solutions have emerged over the last decades, due to the proliferation of Radio Frequency (RF) and microwave techniques, including Wireless Personal Area Networks (WPANs), WLANs, cellular systems, Wireless Wide Area Networks (WWANs), and Wireless Metropolitan Area Networks (WMANs) [5]. Other short range technologies such as Infrared Data Association (IrDA), Radio Frequency Identification (RFID), Bluetooth, ZigBee, and Ultra-wideband were also introduced [6]. Wi-Fi (IEEE 802.Ila/b/g) mesh networks, where nodes operate as a host and also as a router, forwarding packets on behalf of other nodes that may not be within direct wireless transmission range of their destinations, have also emerged recently. These networks are characterized by a dynamic self-organization and self-configuration which result in low up-front cost, robustness, easy network maintenance, and reliable service coverage over extended areas [5]

IV. Database, Software Programs and Monitoring

In order to monitor data, several computer programs have been developed during this project. Software is developed at the monitoring PC to control the communications to get readings from sensors and then forward them through the network/internet to an application on a remote PC (at a medical profession centre) [7].

While performing this task, the software also verifies the data integrity and schedules retransmission if required.

Fig. 1: Wearable prototype of the project

The application can collect and store readings automatically so that no person is required to be stationed at the application. It can undertake the administration of patients' particulars such as assigning new sensor ID (i.e. user ID) to patients, segregating sensor readings from different patients and storing them into the database.

Using sensor ID for each patient will ensure safety in healthcare environments when multiple patients are monitored. The monitoring of the continuous signal like blood pressure is more complicated compared to parameters such as pulse rate and temperature signals.

A database server has been developed to maintain data integrity which is necessary for big medical centres. In the GUI, a more detailed of patients' particulars can be seen from the database. Clicking on a patient shows the sensors attached to them and their personal information/picture.

Clicking on a sensor displays the sensor's information (e.g. interval). It also depicts the number of recordings that are available. Single clicking a record shows when the record was made.

V. Working

The device containing the sensors would be implanted on a person's body. The sensors will sense the parameters like Blood Pressure, Temperature, Heartbeats and keep collecting data after certain intervals. During the time of emergency, the parameters would cross a certain threshold level and an alert would be sent to the Emergency contact as well as to the nearest hospital tracked through GPS along with the current parameters.

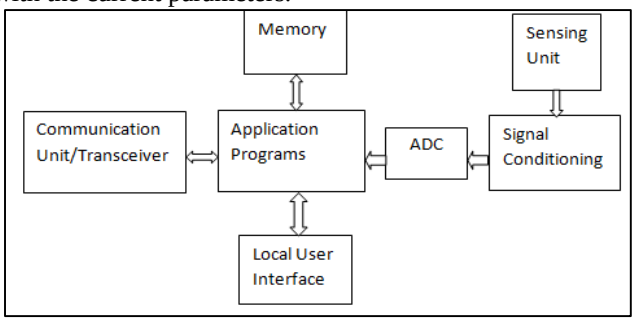

Fig. 2: Block Diagram of the E-way System

Accordingly, the arrangements for patients would be made well in advance before patient actually reaching the hospital. The communication occurs through ISM band

which is Industry, Science & Medical band and communication is made possible via 3G GSM technology. An emergency button would also be provided in case of sensor failure and the alert would intimate nearest hospital about person's emergency condition and help would be provided as early as possible.

The base station (i.e. the remote PC) is capable of displaying all the received data on a graphical user interface (GUI) and is also capable of storing all the data in the database system of a medical centre.

VI. IMPLEMENTATION OF SENSORS

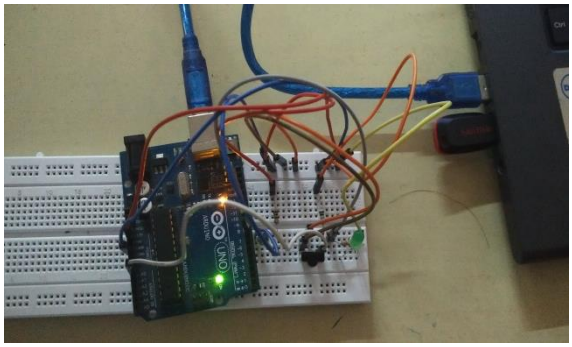

Fig. 3: Heart beat sensor circuit

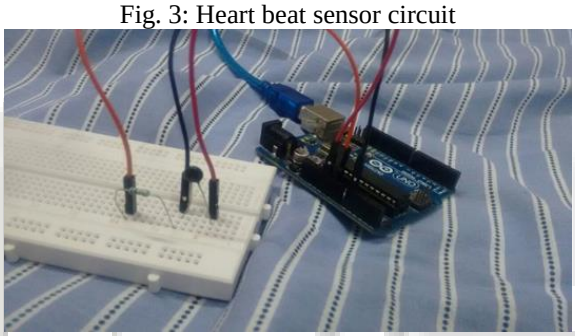

Fig. 4: Temperature Sensor circuit

VII. RESULTS

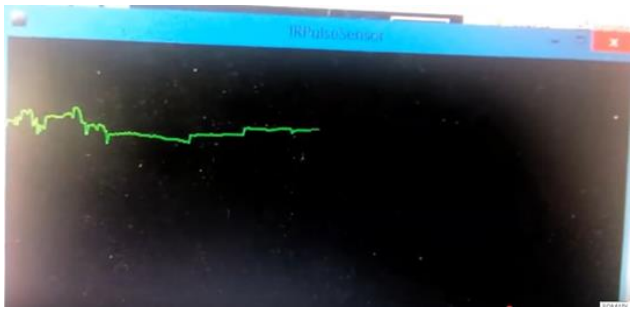

Fig. 5: Heart beat sensor results

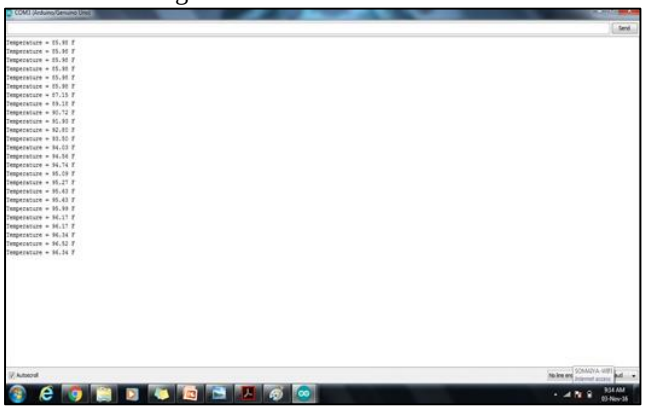

Fig. 6: Temperature Sensor Readings

VIII. CONCLUSION

Through the literature survey, we have come across advantages and disadvantages of the existing systems and will try to overcome problems faced with existing system and make an upcoming system more efficient than the existing ones.

The common goal of designing and implementing telemedicine solutions is to provide patients suffering from chronic diseases with mobile services that enhance their quality of life, support, and optimize their treatment in case of emergency. A conclusive system for improving the efficiency of healthcare should be designed taking into consideration the use of wireless communication networks, local intelligence in the form of a powerful mobile information unit, and connection to a global network. Wireless technology in e-health is heavily driven by technological advancements and by implementation we have provided a more efficient way to advance the health management systems.

Thus we have designed an E-way system which measures the three vital parameters: body temperature, blood pressure and heart rate via sensors.

We are currently working on the transmission of data provided by the sensors using a wireless technology.

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