TO IMPROVE SELECTIVE RELIABILITY USING ADAPTIVE SCHEDULING MECHANISM IN WIRELESS BODY AREA SENSOR NETWORK

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ABSTRACT

Recent technological advances in sensors, low-power microelectronics and miniaturization, and wireless networking enabled the design and proliferation of wireless sensor networks capable of autonomously monitoring and controlling environments. One of the most promising applications of sensor networks is for human health monitoring. A number of tiny wireless sensors, strategically placed on the human body, create a wireless body area network that can monitor various vital signs, providing real-time feedback to the user and medical personnel. The wireless body area networks promise to revolutionize health monitoring. However, designers of such systems face a number of challenging tasks, as they need to address often quite conflicting requirements for size, operating time, precision, and reliability. In this paper we present hardware and software architecture of a
working wireless sensor network system for ambulatory health status monitoring. The system consists of multiple sensor nodes that monitor body motion and heart activity, a network coordinator, and a personal server running on a personal digital assistant or a personal computer. The objective of the proposed work is to design a hardware model which would constantly monitor the health parameters such as pulse rate, oxygen content, temperature, sweating, blood pressure and falling of the patients. These parameters are sensed by the respective sensors and it is then transmitted wirelessly over the internet to a Database using IoT technology which would be accessible to the patient's family and doctors. It focuses on monitoring especially the elderly patient's vitals anywhere and at anytime. The system also alerts the necessary authorities when there is an emergency. This would help the doctors to monitor and attend multiple numbers of patients at ease.

Keywords:- *Wireless sensors, body area networks, health monitoring, wearable computing.*

1.Introduction

During the last quarter of the century, there has been a tremendous increase in the use of electrical and electronic equipment in the medical field for clinical and re- search purpose. In medical instrumentation, the main function is to measure or determine the presence of some physical quantity that may be useful for diagnostic purposes. Therefore, many types of instrumentation systems are used in hospitals and physician's clinics. The primary purpose of medical instrumentation is to measure or determine the presence of some physical quantity that may assist the medical personnel to make better diagnosis and treatment. Accordingly, many types of instrumentation systems are presently used in hospitals and other medical facilities. Certain characteristic features, which are common to most instrumentation systems, are also applicable to medical instrumentation systems. In the broadest sense, any medical instrument would comprise of the following four basic functional components: Measurand, Transducer/Sensor, Signal conditioner and display system.

Patient monitoring system in all ICUs is the most needed and essential device for monitoring the patient's vitals. As the physicians cannot stay next to the patients for all time round the clock, we go up for the wireless patient monitoring and tracking system, to have a quantitative assessment of the important physiological variables of the patients. Patient monitoring systems are used for measuring continuously or at regular intervals, automatically, the values of the patient's important physiological parameters. The choice of proper parameters, which have high information content, is an important issue in the patient monitoring system. The important parameters are ECG, heart rate, pulse rate, blood pressure, body temperature, respiratory rate and SPO2. Wireless telemetry permits examination of the physiological data of hu- man under normal conditions and in natural surroundings without any discomfort or obstruction to the person

under investigation. This system consists of simple and low-cost components that are capable of processing real time temperature, ECG, BP, heart rate and transmitting the same. There exists a demand for such a system, as current implementations are complex to use and high in cost. Our system design aims to provide solutions to the problem encountered in acquiring temperature, ECG, BP and heart rate from the subject, as well as providing remote transmission of the data. All papers which we followed states that, patient is stationary and the observer in a remote location. The availability of the patient stationary can be possible to make a good hardware and software development is possible. The main aim of our work is to show how persons suffering from cardiovascular and other hypertension disease can directly monitor their physiological parameters without effecting to their daily activities by using the GSM,GPS and Zigbee.

Recently, the reason for a patient staying in the hospital is not that he or she actually needs active medical care. Often, the principal reason for a lengthy stay in the hospital is simply continual observation. Therefore, efforts have been made to avoid acute admissions and long lengths of stay in the hospital. Wireless Sensor Networks (WSNs) with intelligent sensor nodes are becoming significant enabling technology for wide range applications. Recent technological advances in integrated digital electronics and miniaturization of physical sensors, microprocessor, and radio frequency devices into a single micro-chip has led to the emergence of very lightweight, ultra- low power, monitoring sensor devices. These sensor devices have the capability of sensing, processing and transmitting vital physiological signals using wireless technology. Contrary to the traditional sensor networks that are carefully planned and deployed in the predetermined positions, WSNs can be deployed in an ad-hoc manner which make them robust, fault tolerance, and increase in spatial coverage. They can greatly be used to monitor and track conditions of patients in both cities and rural areas using an intranet or internet thereby reducing the stress and strain of healthcare providers, eliminate medical errors, reduce workload, increase efficiency of hospital staff, reduce long term cost of healthcare services, and improve the comfort of the patients. Also, these systems provide useful methods to remotely acquire and monitor the physiological signals without the need of interruption of the patient's normal life, thus improving life quality. Sensor nodes can be strategically placed on the human body to create a cluster that is called wireless body area network (WBAN) that can be used to collect patient's vital signs. It is worth noting that sensor nodes are being operated by batteries, their power consumption during transmission must be minimal for efficient and reliable data transmission between WBAN and personal server. Using sensor nodes with communication technologies such as mobile phones i.e. PDA, General Packet Radio Service (GPRS), 3G, and the internet, the sensor network can keep patient, caregivers, and doctor informed while also establishing trends and detecting variations in health.

2. LITERATURE SURVEY

2.1 A.WIMX

Based on the IEEE 802.16 standards, so-called Wireless MAN standards, WiMAX is created by the WiMAX Forum, which has strong-security wireless data transmission over long distance, up to 50km, with high data rate, up to 70 Mbps, and high mobile capability, up to 150km/hour. The standard is the in- corporation of several advanced radio transmission technologies such as adap- tive modulation and coding (AMC), adaptive forward error correction (FEC), well defined quality of service (QoS) framework and orthogonal frequency division multiplexing (ODFM).

2.2 B.WLAN

WPANs using ZigBee or Bluetooth standards are gaining in popularity, with wireless motes available from industry. A number of physiological monitoring systems based on the motes have been proposed and deployed in real clinical settings. In addition to patient monitoring these systems can be used for patient tracking in situations where location information is essential, such as mass casualty incidents. Another technology using in WPANs is ZigBee, a so-called IEEE 802.15.4. The standard is an ultra-low power, low-data rate which is used for monitoring and controlling applications. Devices using ZigBee has less than 1% life time in active status. In most of the life, the devices are in sleep mode to save device's power.

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2.4 D.WBAN

Recent technological developments in low-power integrated circuits, wireless communications and physiological sensors promote the development of tiny, lightweight, ultra-low-power monitoring devices. A body-integrable net- work, so-called WBAN, can be formed by integrating these devices. WBAN with sensors consuming extremely low power is used to monitor patients in critical conditions inside hospital. Outside the hospital, the network can transmit patients' vital signs to their physicians over internet in real-time. WBAN usually uses ZigBee, or UWB standard.

2.5 Wireless Sensing Network

As recent technological advances in integrated circuits, wireless communications, and physiological sensing allow miniature, lightweight, ultra-low power, intelligent monitoring devices, therefore a number of these devices can be integrated into a Wireless Body Area Network (WBAN). These types of smart sensors are integrated electronics that can perform one or more functions such as logic functions, two-way communication, decisions making, etc. The wire- less sensor networks consist of data acquisition devices along with data distribution network, monitored and controlled by a central computer.

The basic design of communication network consists of nodes having computing power which can transmit and receive messages over wireless communication links. The basic network topologies include fully connected, mesh, star, ring, tree, bus or several interconnected subnets of different topologies.

Networks are further classified as Local Area Networks (LAN), e.g. inside one building, or Wide Area Networks (WAN), e.g. between buildings, etc. The various types of wireless networks mostly used for making body area network are 802.11 Wireless Local Area Network, Bluetooth, etc. IEEE had ratified the IEEE 802.11 specification in 1997 as a standard for WLAN. Current versions of WiFi (802.11b) support transmission up to 11Mbit/s.

The cost of installation of a WiFi router and receivers is within the budget and capability of common users. Bluetooth was initiated in 1998 and standardized by the IEEE as Wireless Personal Area Network (WPAN) specification IEEE 802.15. Bluetooth is a short range RF technology aimed at facilitating communication of electronic devices between each other and with the Inter- net, allowing for data synchronization that is transparent to the user. Almost all the common electronics gadgets are supported by this standard such as mobile devices, laptops, etc. Bluetooth uses the unlicensed 2.4 GHz band and can transmit data up to 1Mbit/s, can penetrate solid non-metal barriers, and has a nominal range of 10m that can be extended to 100m.A master station can service up to 7 simultaneous slave links. Forming a net- work of these networks, e.g. a piconet, can allow one master to service up to 200 slaves. Home RF was initiated in 1998 and has similar to Bluetooth for WPAN and has shared data/voice transmission. It interfaces with the Inter- net as well as the Public Switched Telephone Network and uses the 2.4 GHz band with a range of 50 m. A maximum of 127 nodes can be accommodated in a single network. IrDA is also a WPAN technology that has a shortrange, narrow-transmission-angle beam suitable for aiming and selective reception signals.

An example of a medical WBAN used for patient monitoring is shown in Figure . Several sensors are placed in clothes, directly on the body or under the skin of a person and measure the temperature, blood pressure, heart rate, ECG, EEG, respiration rate, SpO2- levels etc. Next to sensing devices, the data is wirelessly transferred to central computer immediately (when a sensor notices a problem), which is connected to the doctor's end through internet who analyzes the data as in figure. One example is the monitoring of the glucose level in the blood of diabetics. If the sensor monitors a sudden drop of glucose, a signal can be sent to the central computer in order to provide the injection of insulin.

In this way less time is wasted to provide the required medication to the patient. Lots of work is going on towards the monitoring of physiological signals based on mobile telephony and internet. The challenges lie towards having low power consumption and light weight amidst other considerations such as bio vital signs detection and determination on a 24 by 7 basis by simply having a low power system located on the clothes of the patients which will enable the caregivers to respond to them in the fastest possible time.

Fig 1: Measurement and transmission of Physiological data through Body area network.

3. PROPOSED SYSTEM

The proposed wireless body area sensor network for health monitoring integrated into a broader multitier telemedicine system is illustrated in Figure 1. The telemedical system spans a network comprised of individual health monitoring systems that connect through the Internet to a medical server tier that resides at the top of this hierarchy. The top tier, centered on a medical server, is optimized to service hundreds or thousands of individual users, and encompasses a complex network of interconnected services, medical personnel, and healthcare professionals. Each user wears a number of sensor nodes that are strategically placed on her body. The primary functions of these sensor nodes are to unobtrusively sample vital signs and transfer the relevant data to a personal server through wireless personal network implemented using ZigBee (802.15.4) or Bluetooth (802.15.1). The personal server, implemented on a personal digital assistant (PDA), cell phone, or home personal computer, sets up and controls the WBAN, provides graphical or audio interface to the user, and transfers the information about health status to the medical server through the Internet or mobile telephone networks (e.g., GPRS, 3G).

The medical server keeps electronic medical records of registered users and provides various services to the users, medical personnel, and informal caregivers. It is the responsibility of the medical server to authenticate users, accept health monitoring session uploads, format and insert this session data into corresponding medical records, analyze the data patterns, recognize serious health anomalies in order to contact emergency care givers, and forward new instructions to the users, such as physician prescribed exercises.

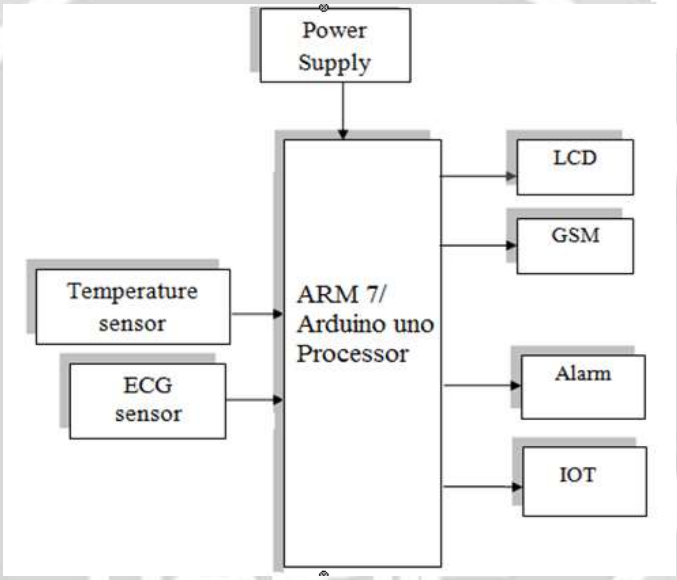

Fig 2: Block Diagram of Proposed System

The patient's physician can access the data from his/her office via the Internet and examine it to ensure the patient is within expected health metrics (heart rate, blood pressure, activity), ensure that the patient is responding to a given treatment or that a patient has been performing the given exercises. A server agent may inspect the uploaded data and create an alert in the case of a potential medical condition. The large amount of data collected through these services can also be utilized for knowledge discovery through data mining. Integration of the collected data into research databases and quantitative analysis of conditions and patterns could prove invaluable to researchers trying to link symptoms and diagnoses with historical changes in health status, physiological data, or other parameters (e.g., gender, age, weight). In a similar way this infrastructure could significantly contribute to monitoring and studying of drug therapy effects. The second tier is the personal server that interfaces WBAN sensor nodes, provides the graphical user interface, and communicates with services at the top tier. The personal server is typically implemented on a PDA or a cell phone, but alternatively can run on a home personal computer. This is particularly convenient for in-home monitoring of elderly patients.

4. WORKING OF PROPOSED SYSTEM

Fig: Architecture of Proposed System

1. The wearable sensor nodes are responsible for acquiring the physiological data and transmitting it to the base-station. The sensor nodes are designed to be tiny in size and consume low operating power to reduce battery size which can last for longer durations.

2. The Hardware prototype is designed to collect the sensor data and process it for wireless transmission over the internet.

3. The internet carries all the transmitted data to the database created in an IP address.

4. These details can be accessed by the doctors and guardians for providing effective treatment.

Thereby the design of the proposed system starts with the selection of the sensors to measure various vital parameters, interfacing the sensors with the processor, trans- mission of the collected data to the database, getting access to an IP, designing the webpage and the database for multiple patients to store their data.

The various steps involved in the proposed system are:
1. The patients under monitoring are placed with respective Bio-medical sensors which will be used to acquire various parameters like temperature, pulse rate etc. from their body.

2. All this sensor data will be collected and processed within the microcontroller embedded inside the Arduino board.

3. By activating the GSM module the sensor data is wirelessly transmitted to the online database. This database stores all the patient's details. The database is then linked to the main website and here the patient's conditions are displayed ubiquitously.

Another added feature is when one or few of the sensors data cross a specified threshold value the GSM module will start to call and message about the severity of the patient's conditions along with their location to their corresponding guardians/doctors.

6. CONCLUSION

The advent of new enabling technologies for health monitoring are discussed briefly which can be used for long term measurement of biological signals and also, without interrupting patients ordinary activities. These techniques are non-intrusive and meet the requirements for patients health parameter monitoring. The non-intrusive methods for biological signal measurements have some disadvantages related to power consumption, consistency and range due to the fact the wireless body area networks usually prone to these types of problems. The authors have provided the brief in- formation related to the physiological data acquisition in non- invasive mode, data processing and transfer to central hub along with alarm system to avoid any emergency situation. Further this data can be sent to the doctor's place to get the feedback or the required medication.

The proposed system will help the elderly patients those who require continuous monitoring or periodic monitoring of their health conditions. The doctors or care takers can also easily monitor the patient's health condition and provide them with the necessary treatment. This system also leans towards making the sensors as mo- bile and wearable as possible. As a future work a compact module will be designed for ubiquitous health monitoring that will further reduce power consumption.

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