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CHANGING EVERYTHING: CLOUD PATIENTS HEALTH MONITORING & 24-HOUR CARE OVER BODY SENSOR NETWORK

MOHAMMED AYAZ.R [*1], SADAF ZABEEN [2] AND R. RAJKUMAR[3]

[1,2]School of Information Technology and Engineering, Vellore Institute of Technology, India.
[3]School of Computer Science and Engineering, Vellore Institute of Technology, India.

ABSTRACT

Each and every vital sign has a direct impact on healthcare, so body sensors are used for constant healthcare monitoring. In existing methods, the sensors are implanted or wear by the user and the sensor data is transferred through PDA (personal digital assistant) and stored in the medical server. In this proposed system is for a hospital environment the doctors and nurses can get access to the user's medical information from the server. The wearable sensor's on the patient's body is connected to an Arduino board the sensed information is transmitted by relay node and stored in the cloud. The doctors and nurses can access the patient's medical information from cloud.

KEYWORDS: BSN, ECG, EEG, Airflow, HealthCare

MOHAMMED AYAZ.R
School of Information Technology and Engineering, Vellore Institute of Technology, India.

INTRODUCTION

BSN (Body Sensor Network) is a wireless Network of wearable computing devices. The sensors are wearable or implanted on the patient's body. In earlier works the sensors are used to record the body signs and the recorded data are stored in the hospital medical server. The recorded information is then used as applications of information and communication technology such storing the patient records and information. In this paper the proposed system the sensors on the patient's body senses the body signs and sensed information is stored in the cloud through wireless communication. Instead of storing the information in the medical server, it is stored in cloud by integrating the wireless sensor network with the cloud computing. The sensor network technology is used as an application in the hospitals can also switch to cloud as it is a pay as you go model. Wearable devices are used on the body surface of a human. The pierced wireless body sensors used for monitoring overall patient information from hospitals or for homes which can store individual health information and give fitness information's. The various types of sensors and the challenges in BSN were discussed and proposed a model in which the sensors were placed in patient body and the sensed information was transmitted through the internet, stored in medical server and accessed by the doctors and nurses [1]. The implementation of the ECG monitoring using low data rate ultra-wideband ECG monitoring system. In this paper a single channel real-time wireless Electrocardiogram monitoring system, was implemented using low data rate ultra-wideband impulse radio method, and based on clock rate the number of pulses transmitted. The received signal is then unmodulated by anon-coherent energy detector, receiver then the unmodulated data are then transferred to the PC. A digital notch filter is implemented in the PC to remove the noise [2] .A complete wireless body-area network (WBAN) system has been proposed to deploy in medical environments. The wireless system in the WBAN uses medical bands to get physiological data from sensor nodes. The medical bands are particular to reduce the intervention of other data and thus increase the coexistence of sensor node with nearby other network devices available at medical centers. The collected data is transferred to remote stations with a multi-hopping technique using the medical gateway wireless boards. The gateway nodes connect the sensor nodes to the local area network or the Internet [3]. In a hospital zone to render quality of service the system consists of a mobile-care device, which is responsible for capturing and wirelessly sending the patient's ECG data, a wireless multi-hop relay network (WMHRN) that is in charge of relaying the data sent by the former, and A residential gateway (RG), which is responsible for gathering and uploading the received ECG data to the remote care server through the Internet to carry out the patient's health condition monitoring and the management of pathological data. an emergency alert service using short message service (SMS), based on the detection of abnormal variation of HR, is also used in the RG to further enhance the healthcare service quality. Hande Alemdar, Cem Ersoy in "Wireless sensor networks for healthcare: A survey" Says about the challenges and various security issues in wireless sensor networks such as security low power consumption, unobtrusiveness, scalability, energy efficiency, security and provide a comprehensive analysis of the benefits and challenges of these systems [4]. In order to ensure integrity each user wearing sensors from different location sends the sensor information to the health care station from health care station the information are forwarded to the specialized physician based on the compliance of each user. The medical server will send a key to the user encrypt the sensor information using the key and get the guidance of the specialized physician. If needed the physician can inform the emergence care to reach the user. In this paper they have proposed an algorithm and implemented to encrypt the information using a key, send the information to the health care center [6]. The smart devices to senses the body sign uses Bluetooth to transmit the data. The Bluetooth thread collects all information and sends it to a main thread the main thread checks the message and draws a graph. They have calculated the transmission rate for various sampling rate and (considered the transmission rate up to 200 HZ as maximum) and found that Bluetooth idle time has declined the transmission rate and to overcome it future it is proposed a hybrid environment of combining a WBSN and cloud environment [7]. To improve the security and to maintain integrity on both user and hospital server there will be a PDS (Proxy Doctor Server) in doctors' side that contain previous medical history and PPS (proxy patient server) that has a data of the patient and previous history. The sensors are placed in user's body and the sensor information are transferred to a PDS server through a secure connection and from PDS server the information is accessed by the doctor. By maintaining data in PPS and PDS any change should be done in both so that prevents and make secure of data [8]. The sensor Data Are send to the cloud using cell phones and accessed by the customer care people for health care to provide services for users [9]. In order to ensure integrity each user wearing sensors from different location sends the sensor information to the health care station from health care station the information is forwarded to the specialized physician based on the compliance of each user. The medical server will send a key to the user encrypt the sensor information using the key and get the guidance of the specialized physician. If needed the physician can inform the emergence care to reach the user. In this paper they have proposed an algorithm and implemented to encrypt the information using a key, send the information to the health care center [6]. The smart devices to senses the body sign uses Bluetooth to transmit the data. 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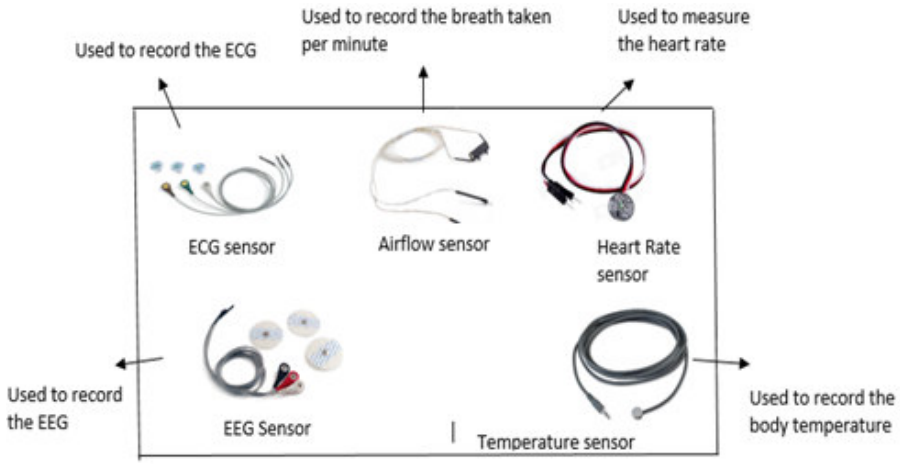
contains a data of patient and previous history. The sensors are placed on user's body and the sensor information are transferred to a PDS server through a secure connection and from PDS server the information is accessed by the doctor. By maintaining data in PPS and PDS any modification should be done in both so that prevents and make secure of data [8] the sensor Data are send to the cloud using cell phones and accessed by the customer care people for health care to provide services for users [9]. A secured communication channel between the sensor and the back end cloud is formed. The secure channel is formed by distributed crypto keys that can be hide by physiological signal. The physiology signal generated is unique for each patient and only physiological signal can access the information stored in cloud [10]. The patient is monitored using wearable sensor and the data are stored in cloud by passing through a mobile which act as a gateway [11] Patient's real-time vital diseases, symptoms are collected through a wireless body area network (WBAN) and then analyzed the collected data in a healthcare cloud platform with patient's historical repository of diseases, habits, rehabilitations and genetics. Here, the mental statuses of patient's have been modelled as the discrete set of states of hidden Markov model (HMM), where WBANs annotations and stored facts of patients in cloud are considered as the observations of HMM. Subsequently, the Viterbi, a machine learning algorithm has been applied to generate the most probable mental state sequence to monitor suicide risk of mentally disordered patients [12]. An authenticated identity-based key encryption scheme for patients to secure their healthy privacy based on wireless body sensor networks monitoring patients' health. A review of identity-based encryption and decryption is explained, and then describe an authenticated key establishment and encryption scheme based on the basic Boneh-Franklin algorithm for wireless body sensor networks [13]. The sensor information collected by wearable sensors is transmitted to a personal digital device such as the smartphones. These smartphones serve as a data forwarder and first-level analyzer. These medical data are transmitted to the remote healthcare data center. Remote health management system then read the data from the healthcare data center. The doctors can interact to the patients regarding their health condition. The healthcare data center is a central database, where all the patients' monitoring data is stored and the treatment and medication records are saved [14]. At present, medical care applications make use of medical and environmental sensors in order to obtain comprehensive health status information of the elderly and the patients. These heavy and highly obtrusive sensory devices affect the freedom of movement of the people. Unobtrusiveness becomes a major challenge. Obtaining heartbeat information with pressure cushion is a good method, which can collect heartbeat information without impacting people action. A new method to obtain heart rate by pressure cushions recording body vibrations with body sensor network. The rhythm and strength of heartbeat can also be noted, because of changes in human heart rate. A weak pulseis caused by heart disease or emotional state changing [15]. The design and development of a wireless router that integrates atmospheric Pressure, Humidity and Temperature (P-H-T) sensing functions for the body area network to relay different kinds of physiological signals from a comparatively further place is proposed . The advantages of the wireless router are 1. High network throughput rate: the network throughput rate is 73.6Kbytes/s when the data transmitted through three jumps; 2. Low packet loss rate: the packet loss rate is 0.4% when data is transmitted 50 meters through three jumps; 3. High transmission power: to enhance the wireless communication capability, wireless power amplifier is applied and the transmission power of the router can be up to 20dBm; 4.with the relay function, the router could also perform various functions such as the P-H-T environment monitoring function [16]. Various new technologies have been discussed for the future internet technology, especially integration of IOT and cloud is discussed [17]. During an emergency situation when a patient is admitted in a hospital whose records are in another hospital means, then both the hospitals can share the database through cloud. The proposed system combines cloud and peer to peer networks that uses cloud to connect peer networks to the service that carries the patient to hospital [18]

MATERIALS AND METHODS

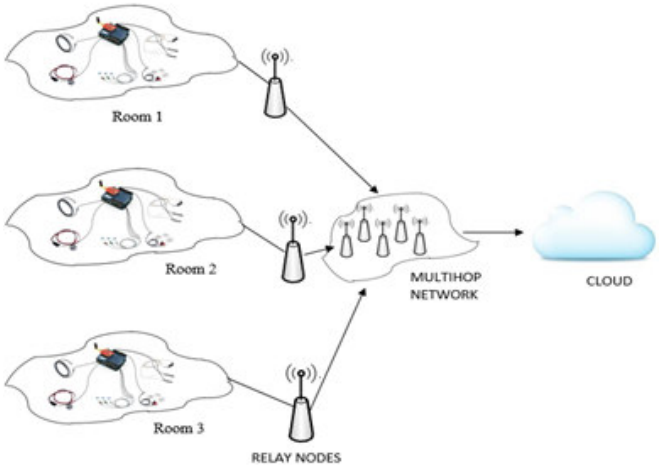
The proposed system is a wired MBSN (Managed Body Sensor Network).MBSN is a system where it can't operate autonomously or not that much intelligent. The MBSN will collect the sensor data of one or more BAN and send it to a third- party. The third- party will decide on the collected data. Thus, in this proposed system the MBSN is the BAN setup in each room, that send the sensor observation to the doctors (third party as specified in definition of MBSN) and makes necessary action. The autonomous body sensor networks are not used in the proposed system as because the proposed system is for a hospital environment. Autonomous body sensor network is suggested only when there is unavailable of expert. May be autonomous body sensor network are prescribed when the same set up is proposed for a home environment.

Figure 1
Sensors used to monitor the vital signs



a) ***System Architecture***
The approach is to place all the sensors in each room for different patients and their data's re transmitted through relay nodes.

Figure 2
Cloud Healthcare Monitoring Using BSN



- ✓ Whenever a patient is admitted in a hospital, then the temperature sensor, PPG sensor, an EEG sensor, ECG sensor, Heart rate sensor are put-up on the patient's body.
- ✓ The patient wears the biomedical sensor. The vital signs are constantly monitored by the biomedical sensors.
- ✓ The sensors are connected to an Arduino UNO board. The sensor will sense and collect the data.
- ✓ Arduino Wi-Fi shield is used to transmit data wirelessly. Using Arduino Wi-Fi shield we can connect to the internet using 802.11 Wi-Fi specifications.
- ✓ The messages send through the Wi-Fi reaches the relay node and the relay forwards the message to the multihop hop network and then uploads the sensor data to the cloud running in the back- end.
- ✓ Thus, each patient's vital sign are stored in the cloud. The vital signs of each patient is transmitted in similar manner periodically. The time period to transmit the data is specified in the Arduino program.
- ✓ The doctors and nurses can get access to the patient's vital sign from the cloud, and can make an analysis on the patient health condition.
- ✓ Thus, in an emergency situation when there is a change in the vital sign and if any of the parameter's reaches abnormal ranges, then alert message services can also be added to this system to indicate the critical situation to doctors and nurses by using a GSM shield, and immediate action can be taken in rapid manner.

SYSTEM DESIGN
The proposed system composed of a) BSN (Body Sensor Network) b) relay node c) Cloud setup.

a. ***BSN***
According to IEEE 802.15 a Body Area Network or Body Sensor Network is a communication standard optimized for low power devices and operation on, in or around the human body (but not limited to humans) to serve a

variety of applications including medical, consumer electronics / personal fitness and other". Thus wearable sensors connected to form a network. The sensors may be inserted in the user body or wearable. The BSN is mainly used for healthcare monitoring and specially for constant monitoring.

- ✓ The BSN consist of the EEG sensor, ECG sensor, heart rate sensor, temperature sensor, and airflow sensor connected to an Arduino board. The EEG sensor, ECG sensor, heart rate sensor, temperature sensor, and airflow sensor is used to monitor the vital signs. Whenever a patient are admitted in a hospital, then the temperature sensor, PPG sensor, EEG sensor, ECG sensor, Heart rate sensor are wear by the patient and the sensors are connected to the Arduino Wi-Fi shield.
- ✓ The Arduino UNO is a microcontroller board based on the ATmega328. The Arduino board is programmed by Arduino IDE software. Arduino board is connected to the system installed with the Arduino IDE software by a power cable or an USB cable. The patients wear the sensor and vital is monitored by using the sensors. The sensor data is transmitted wirelessly by Wi-Fi shield. The Arduino Wi-Fi shield is mounted on the Arduino UNO board. The above setup is will be in each room of the hospital. There will be a relay node in each room.
- ✓ The Arduino Wi-Fi Shield allows an Arduino board to connect to the internet using the 802.11 wireless specifications (Wi-Fi). It is based on the HDG204 Wireless LAN 802.11b/g.

b. ***Relay node***

The transmission range of the Wi-Fi shield 140 meters. When the transmission range between the source and the destination is more than the 140 meters it can't be transmitted directly to cloud so we place one or more relay node. The relay node will receive the sensor data when the range is greater than the 140 meters and then again retransmit the information to the multihop network.so in a larger hospital's the relay node is needed to transmit the sensor data to the cloud through internet.

c. ***Multihop relay network***

The multihop network is in charge of forwarding the data to the cloud. Multihop network consists of multiple relay nodes which will receive and again relay the received data to the nearby node. Thus, in larger environments the sensor information's are transmitted to cloud by means of the multihop relay node network.

CLOUD COMPUTING

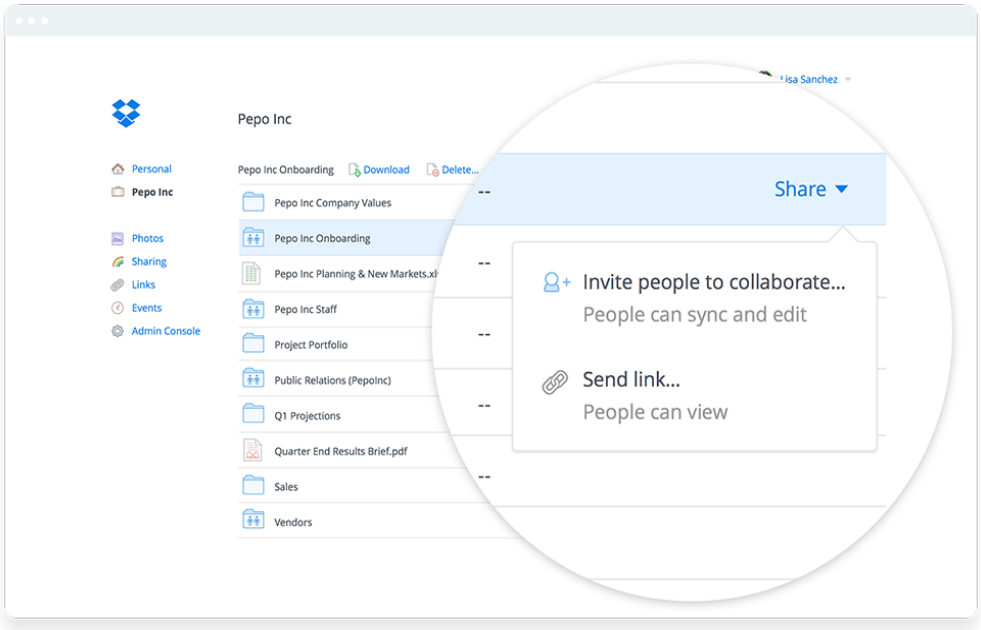
Cloud computing is a shared pool of resources and users can get access the shared pool of resources according to their need and charged only for the resources they used. It is a pay per use model. Whenever the load is higher in cloud it can be solved by integrating the cloud with a public cloud. Cloud storage is data is stored in a logical pool, the physical storage consists of multiple servers and the user doesn't know where the data is in exact physical server. Thus the cloud setup for this proposed system is setup in on premises. The data from the cloud is accessed by through some web services application program. The sensor data is stored in cloud. Since the medical data should be handled in a secured manner then there should be a private cloud setup within the hospital. These days all hospitals is computerized with internet facility. And the hospital should have the facility to handle the large amount of data and to balance the heavy loads during peak time and to take backup data. The information that is stored in cloud can be accessed by the doctors, nurses, and user. The information can also be accessed by their relatives in order to know the patient's condition during emergency situation.The hospital should approach cloud providers to setup a private cloud in on premises and for a web based API for retrieving the data from the cloud. For e.g. consider storing in drop box

a. ***Dropbox***

Dropbox is a file hosting service of Dropbox inc,that provide various services like cloud storage, file synchronization, personal cloud, and client software. Using Dropbox users can create a folder on their computers that can be synchronized by using Dropbox then so that it seems to be the same folder regardless of which computer is used to view it. Files placed in this folder are also accessiblevia the Dropbox website and mobile apps. All basic users are offered an initial 2 GB of free online storage space. Dropbox uses Amazon's S3 storage system to store the files. For synchronization drop box uses SSL transfers for and data's are stored by AES-256 encryption, this is done with Dropbox's own encryption keys, and not the users.

- ✓ To use the services of drop box the user has to be registered with the drop box.
- ✓ Then user has to login and to upload the files click the upload button.
- ✓ On clicking upload a popup window will window will appear that allow the user to browse and select the files to be uploaded.

Figure 5
Patient's Shared Data's



- ✓ Then click upload the files will be uploaded. After uploading the files the user can logout.
- ✓ Whenever want to retrieve the files then again login and select the file to retrieve then right click on it and click download.
- ✓ The drop box is also available as a mobile app and it I easy to store and retrieve files.

CONCLUSION

In this paper, we have proposed a system architecture which stores the sensor data to cloud the doctor can access the sensor information. The sensor data are processed in a system using Arduino IDE software. In the future this can implement in real time by using wireless wearable sensors. This can also be thought as medical internet of things. In future alert message can be send to doctor when a parameter reaches an abnormal value And this proposed system can be used by the hospital of clinical range to big hospital environment to use the cloud services similar to as internet services.

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