

A Health Care Monitoring System with Wireless Body Area Network using IOT

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Abstract: *IOT Internet of Things is the network of physical device, vehicle, Health Care industry monitoring appliances and other items embedded with electronics, software, sensors, actuators and network connectivity which enable these objects to connect and exchange data. Healthcare monitoring application a wireless body area network is implemented. It is a particular principle sensor network designed to operate separately to connect a variety of medical sensor and appliances located in a human body. This project introduces a multiple wearable sensor nodes with support vector machine that enables the implementation of WBAN. The multiple sensor nodes are placed in the different parts of human body for measuring the body temperature, pressure, heart rate, and ECG, sugar rate and heart beat detection. A windows based application is developed to display the sensor data's to check the variations in the above measurements. The flexible support vector machine with maximum power point tracking technique power up the sensors more and extends its lifetime. The proposed system with SVM demonstrates continuous healthcare monitoring based on WBAN and continuous 24 hour operation is possible*

Keywords: IOT, Health Care Industry, WBAN, SVM

1. Introduction

Internet of Things (IoT) is a new technological paradigm that gains attention from vast research fields in the past few years. In the future healthcare circumstance, the IoT will connect the subjects and the healthcare professionals seamlessly. With the advancement of wearable sensors, low-power integrated circuit (IC) and wireless communication technologies, the wireless body area network (WBAN) is becoming an emerging research field worldwide. It's also known as body sensor network (BSN) wireless network to enable the health monitor anywhere anytime around the human being body. This can be used for the e-health applications, such as the computer-assisted rehabilitation, early detection of medical issues and emergency notification. In recent years, the portable devices, especially smartphones, have almost been an indispensable part of people's daily life

Currently remote patient health monitor using wireless knowledge plays very lively role in a society. This technology help monitoring of physiological parameters like body temperature, heart rate, respiration, blood pressure and ECG. The main aim of this paper is to propose a wireless sensor network system in which both heart rate, body temperature, pressure, heart rate of multiple patients can monitor on PC at the same time via RF network. The proposed prototype system includes two sensor nodes and receiver node (base station).

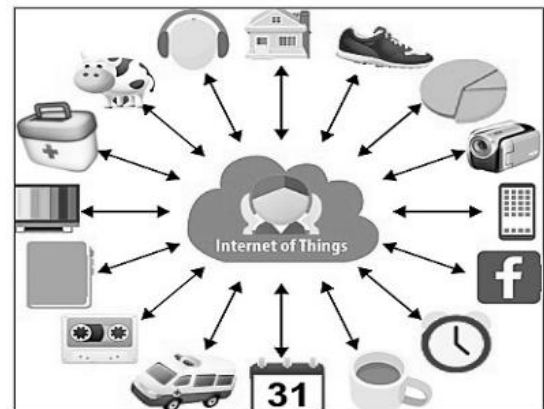


Figure 1: Internet of Things (IoT)

The sensor nodes are able to transmit data to receiver using wireless module. The trans receiver module is used to transfer the data from microcontroller to WBAN and a graphical user interface (GUI) is developed to display the measured data and save to database. This system can provide very cheaper, easier, and quick respondent history of patient.

2. Literature Survey

H. Ting and W. Zhuang [1] in this author *Patient* monitoring using Bluetooth enabled device Bluetooth enabled device also used for in-home patient monitoring. A Bluetooth enabled in-home patient monitoring system was proposed to detect Alzheimer disease. In the patient's home, patient carries the Bluetooth enabled monitoring device and an access point is placed in each room then all are connected to the local database. When a patient moves from one room to another, the monitoring device selects any one of the access point with strongest signal strength. Once the connection is established the current location and movement of the patient are traced and stored in a local database with the help of Bluetooth communication. The collected location information and the corresponding timestamps are

forwarded to the decision engine which is placed in the hospital.

Luan Ibraimi [2] in this author patient monitoring systems to ensure security proposed different schemes for ensuring security in patient monitoring systems. Confidentiality is one of the issues when storing patient related data. Cipher text Policy Attribute Based Encryption (CP-ABE) was proposed. The patient data is encrypted and decrypted based on access policy. After encrypting data, it can be stored in a server. So everyone can download the copy of the data, but the access policy which was satisfied by the user can decrypt it. Here different algorithms were used to generate keys, encrypt the data and decrypt the data.

Juan M. Corchado [3] in this author Wireless Sensor Network (WSN) is also used for in-home patient monitoring. A distributed telemonitoring system was proposed in. It uses Services layers over Light Physical devices (SYLPH) model. It is a service oriented architecture model. The objective of this model was that resources to be distributed among multiple WSN and to execute over different wireless devices independently. Various networks from different wireless technologies can also be connected using this model.

Jae Hyuk Shin [4] in this author Infrared (IR) sensor based system was used. IR based monitoring system was installed in house to collect motion values of the patient and different feature values like activity level, mobility level and non response level. To differentiate normal and abnormal behaviors, Support Vector Data Description (SVDD) method was used. To classify the behavior patterns, behavior pattern classification algorithm was used here. The need for a PC was eliminated. The WSN was installed home. These nodes are then connected to the hospital sever through internet. Here number of sensors was used to collect only ECG signals. The ECG signals were first sampled and transmitted to the access point placed in patient's home. Then these signals were transmitted to the hospital through internet and analyzed to detect heart related diseases.

Alexandros [5] in this paper body sensors are used in health monitoring for acquiring body parameters continuously. Wearable sensor based health monitoring system architecture was reviewed in . The bio sensors continuously acquire the physiological signals and transmit them to the central node. The central node may be PDA, smart phone, micro controller etc. Before sending to the central node the vital signs are converted into digital form if they are in analog form. The A/D converters have amplifier and filtering circuits. Bio sensors and central node are connected by any one of the wireless transmission like bluetooth, Zigbee, etc... or wired transmission like conductive yarns and cables.

Johannes Barnickel [6] in this paper the security architecture for health net is based on sensor network placed on clothes. It collects patient's vital signs and transmits to the mobile phone which is carried by the patient. The mobile phone securely receives, store and forward the data to the trusted medical professionals. Access of data to other parties like emergency services is controlled by patient only. Here PC is not used for processing data, but all the processes are done

by mobile phones. Using data mining techniques, the unwanted data sequences are filtered and only the necessary data are transferred by the handheld device. Communication between patient's mobile and expert's device is done by Bluetooth or WLAN 802.11. In case of any emergency conditions, emergency calls are generated by patient's device and forwarded to the caregiver's device.

3. IOT and Healthcare Monitoring

Healthcare is one of the sector in which IoT technology is flourishing. According to Forbes magazine IoT market in healthcare industry will be more than 127 Billion by 2020 and According to P&S Market Research report, there will be a compound annual growth rate (CAGR) of 28.6% in the healthcare Internet of Things industry between the years 2018 and 2020. IoT have the capability to reduce human dependent healthcare IoT wearable devices (medical sensors) records patient health related information like blood pressure, body temperature and breathing pattern etc. This data will be delivered to concern hospital or caretaker for further action.

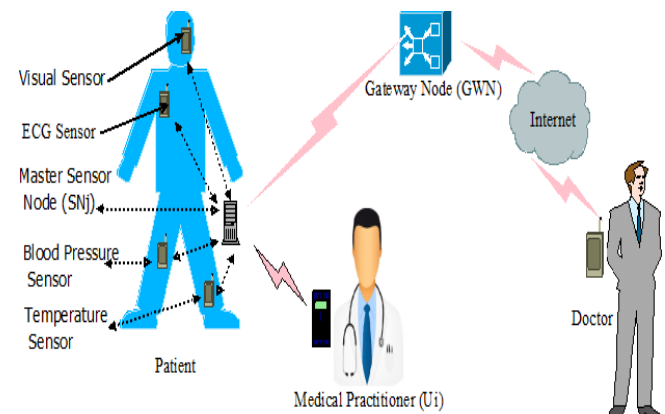


Figure 3: Body Area Networks

3.1 Medical Sensors and Wearable used in IOT based Healthcare Monitoring

Medical sensors can be categories into two categories: on body contact sensors and Peripheral Non-contact sensors. on body contact sensors can be further divided into two categories :

- Monitoring sensors for physiological behavior (ECG, EMG, EEG), chemical (sweat, glucose, saliva) optical (Oximetry, tissue properties),
- Therapeutic sensor for medication (drug delivery patches), stimulation (chronic pain relief) and emergency (defibrillator). Peripheral Non-contact sensors can be further divided into three categories:
- Monitoring fitness & wellness by measuring motion(physical activity, calorie count), location(GPS, indoor localization)
- Behavioural monitoring of Activity(fall, sleep, exercise), Emotion(anxiety, stress, depression) and Diet(calorie intake, eating habits) and
- Rehabilitation by speech (language development) and camera (technology for blinds).

3.2 IoT Applications in Health Monitoring

IoT could have various applications in medical industry for improving the quality of life, saving lives and reduce treatment cost. By using IoT based technologies, medical industry can improve the ability of the healthcare system in minimizing human error, simplifying the treatment process and quality of life for caregiver as well patient. IoT based monitoring system can help doctors in treatments and predict a symptom before starting diagnosis. Monitoring system can also alarm in medical emergency situations like falling of old age patient, patient has abnormal behavior as in the intensive care unit (ICU). There are many IoT based healthcare use cases/application area as follows:

- 1) Health Monitoring
- 2) Personal Fitness Monitoring
- 3) Chronic Disease Monitoring
- 4) Safety Monitoring
- 5) Medication Monitoring
- 6) Home Rehabilitation
- 7) Real Time Location Tracking

Health Monitoring

Medical sensors and wearable devices can capture vital health sign for health monitoring and personal fitness program. Sensors can capture blood pressure, blood glucose, weight, ECG, heart rate and body temperature etc to monitor pediatric and aged person.

Personal Fitness Monitoring

This class of sensor application is for those who want to stay fit and health. Sensors can track personal fitness / progress of fitness level also. Individual can track and record many parameters to check his/her performance and workout routine. sensor are used here are weight measuring sensors, activity monitors sensors like walking time counter, step counter, speed counter, calorie counter and heart rate and blood pressure measuring sensors.

Chronic Disease Monitoring

Millions of people are suffering from Chronic diseases like cancer, diabetes, asthma, heart diseases, sleep disorders and arthritis. special care is need in such kind of disease. It required disease specific diet and treatment plans. By using physiological sensors like ECG(electrocardiogram), MG(Electromyography) and EEG(electroencephalogram) with activity monitor sensors like step counter, speed counter, calorie counter etc can be used for early detection of symptoms and adverse changes in a patient's health condition that will cause to early and timely medical treatments.

Safety Monitoring

There are many sensors and wearable devices are available to improve healthcare system for aged and pediatric population. Sensor for fall detection, epileptic seizures detection and heart attacks symptom detection can be used for safety monitoring of patient

Medication Management

It is general human tendency of noncompliance of medication prescribed by physicians. this may cause threat to patient health as well financial loss. IoT based an

intelligent packaging method for medicine boxes can be used for medication management.

Home Rehabilitation

IoT based healthcare has the potential to improve rehabilitation. IoT based Sensing technology with Virtual Reality environments and augmented feedback systems can be used for home-based rehabilitation system for aging population. IoT based technologies can be used for remote consultation.

Real Time Location Tracking

Through IoT Patient and equipment used for treatments tracking is possible. By using RFID tag health care providers can track real time location, assigned physician and progress of treatment etc.

3.3 Challenges and Issues

Healthcare devices and applications captures private healthcare information and these devices are connected to internet for anytime, anywhere access. So it may attract hacker to steal private information. Private health information must be used after patient authorization.

Data security in healthcare should address the following challenges:

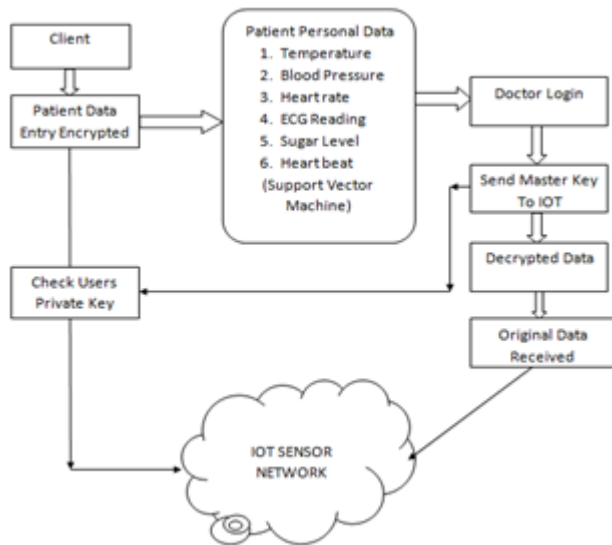
- Physical security of health devices
- Providing secure routing for data communication
- Providing data transparency in cloud computing environment.
- Maximum security with minimum resource consumption

In IoT Based healthcare patient health information is collected from various medical sensors and wearable devices. Medical devices have to connect to other devices and multiple users for data gathering. There are thousands of vendors who manufacture devices without following any standard rules and regulations for compatible interfaces and protocols for inter device communication. So data captured by these device are not visible to other devices. This cause interoperability issues. Because of lack of interoperability, data from different IoT devices may remain locked in each individual system and lose its potential value and increase system integration cost.

4. Proposed System

This system implements an IoT based healthcare monitoring system with wireless body sensor area network. The system architecture consist of three major parts 1)Body Health Reading 2)Wearable sensor nodes with a Support Vector Machine and 3)Windows application act as IoT gateway. In this project the proposed method uses artificial neural network as a gateway to communicate with various sensors such as body temperature, pressure, heart rate, and ECG, sugar rate and heart beat. The sensors are made small and efficient so that their energy storage can last for long time. The data's detected by these sensors can be accessed by doctors, family members and emergency health care centers at any time. The proposed system is differ from other Implemented ones because the monitoring of several

parameters from many patients simultaneously represents a real time implementation in hospital environments.



5. Conclusion

This paper presents a healthcare monitoring system with wireless body area network (WBAN) using internet of things (IoT) and the system is able to carry a long term monitoring on patient's condition. The proposed Wireless sensor nodes can be attached to different positions of the human body to measure physical signals like the temperature, pressure, pulse rate, ECG and also detects fall condition using the wireless sensor node by providing a emergency notification. In the future development, the Wireless sensor node can accommodate more signal detections to cover many areas of health detection in WBAN applications. A Windows-based application is designed and used to display the sensor data and transmits emergency notification through Support Vector Machine. In order to extend the lifetime of Wireless sensors with SVM technique is used as the all reading. The SVM technique is used to extract the maximum human body to measure from the flexible panel. The Wireless sensor node works more efficiently when it is exposed to more project.

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