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Promoting Health-Care Using Sensor Nodes in Telemonitoring System

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ABSTRACT
To provide an efficient facility to reserve the human resource appropriately, many aids has been proposed and thus one the measure used recently is sensor nodes with the efficient technology of android system with most available resource that is mobile phones which facilitates each person with security of their healthcare efficiently. As most common feature provided by smart phones is about alerting any person about any situation, this benefit is been utilized in medical healthcare system to provide one of the most important facility to preserve people's wealth of health.

Introduction

India being a populated country, the main responsibility comes over security and maintaining proper healthcare to the human resources. Various factors are having adverse effect over living beings due to population, climatic changes, adulteration of food. Thus, developing new technique day-by-day has made necessity of increasing and searching for new ideas to prevent the vulnerabilities and adverse effect over the people [6].

International Standardization committee has developed standard of IEEE 802 to make appropriate use of wireless technology in various fields. On research in medical system, the study had specified the count of 17 million people dying all the world due to heart cardio vascular diseases that is HEART ATTACK. Such diseases as blood pressure, heart failure, decreasing level of sugar, asthma etc needs quick remedy over temporarily time to control the situation and thus require emergency medication on the spot. Thus, wireless technology, has contributed over this using the sensor nodes.

Body area domain has made applicability of wireless medium with sensors to provide efficient medication without presenting itself in front of physician. A long distance treatment and communication between patient and doctor is nothing but the 'TELEMONITORING' system in simple words. Bluetooth, Wi-Fi like techniques gives their functionality in this system to get work**.**

Related Work

Much of the contribution has been already carried out over medical healthcare system and thus telemonitoring provides an efficient method of accurate medication for the people. Various protocols and methodology are been implemented to execute the flow of entire communication from user to doctor with intermediate entities.

The current scenario was studied and implemented in year 2013 by My health assistant: an event –driven middleware for multiple medical application on a smart-phone mediated body sensor network[1] in which the various application of body area network are discussed and implementation detail of Tele-monitoring system in health-care system is been explained through various methodology and techniques. Before this, In year 2012, An event based BSN middle-ware that support seamless switching between sensor configuration was been proposed which made study and efforts to present a middle-ware design for smart phone unit to support the health monitoring application using different scenario. In year 2012, Monitoring the behavior of dependent elderly people in community, detecting risk situation application basically used on the local computers and internet[4]. This system is validated and the physical activites are monitored appropriately. Further in year 2009, Medical application of wireless body area network specified as WBAN as a very useful technique for continuously monitoring the health conditions of patient and formulated that the technology of MEMS that is micro electromagnetic system can be used to developed the various application in BSN[4].

In year 2007, Body sensor network for mobile health monitoring : experience in Europe and Australia specified the overall description of medical application developed in Netherlands and Australia [7].In this alarms and bio signals are transmitted in Wireless communication link to a remote area.

Proposed System

Above block diagram specifies the functionality between doctor and patient and their intermediate entities used for communication. The architecture conveys the functionality using smart phones and sensor nodes which provides the input to the application through collecting readings of various parameters from the user. This system provides the domestic medication to the people with no efforts and only providing the cost for the sensor nodes.

User even does not require to put any effort and simply automatic input from the user is been accepted and further procedure is been fluently processed. BSN uses the sensor nodes which are wearable to the user over the body physically and is wireless. This is a wearable computing device. These sensors provides the monitoring of user's body activities and the continuous changes in the impulses or say parameters such as heart rate that is number of heart beats per second, the body temperature according to the its daily activities. Body sensor nodes are the device that can be placed on to the human body in able to calculate and sense the exact changes in body

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some fix position and some manner as it will able to calculate and sense the exact changes in body.

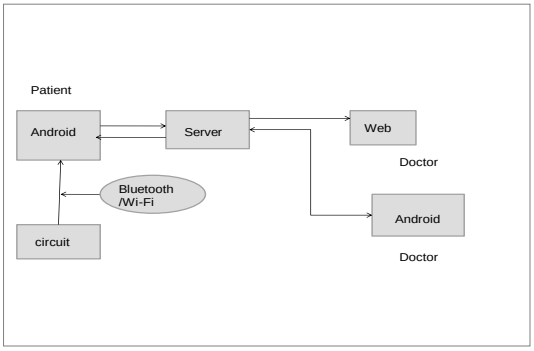


Figure 1. Block Diagram Functioning of Telemonitoring System

In this, the sensor nodes are connected to the central unit or node of control(NC) which perform the primary data processing and data analysis in this system.

GPS receiver having the Bluetooth interface which is used to measure the parameter such as heart rate and the saturation of peripheral oxygen and GPS is used to locate the place or location of the patient and to alert the doctor about the place and condition of the patient and its current readings of parameters [2]. In this, Bluetooth or Wi-Fi are the communication protocol for data processing is used between the sensor node and the smart phone to communicate and transfer of data.

Also use of two smart phones is the basic need of th system, one will be for user side and another for doctor's side. (figure 1). Patient side android application is for secondary data processing.

The output of the sensors is in the form of patient readings what actually doctor needs for verification and conclusion are shown in the patient smart phone. Here the signal conditioning and analysis is done.

The communication between the NC and Control Unit is done by using the HTTP protocol. The various algorithms and protocols that are applicable are JSON (java script object notation) parsing algorithm because which include the terms of HTTP protocol, handshaking method, acknowledgement, pairing, port assigning and socket programming.

The functioning is done between the android system and the central control unit which act as the medical server which allow to secure local and remote access used in medical field using Wi-Fi. All patient's details are stored in the database on the web server by using the HTTP Protocol at the doctor side. Doctor can access the data of the patient details in the form of web page and analyzes it, and then he/she can provide the prescription to the patient as per the requirement. In critical situations or emergency alert system is used at the doctor side to have a urgent look over the patients database. That is, if there is an emergency then the doctor will get an message alert on his smart phone.

Different modules used for this telemonitoring system are as follows

Body Sensors Platform

Here, use of different sensors such as ECG sensors, Temperature sensors, BP calculating sensors, Nonin 4100 oximeter etc. are been used to collect the proper data and readings from the patient to database and indirectly to doctor. This data or information is transmitted to the android smart phone by using the Bluetooth or Wi-Fi which is the output of the sensors is the input to the android application.

Bluetooth or Wi-Fi

The Communication mode used here is the basic medium of Bluetooth and Wi-Fi which provides 3mbps data rate over the distance of 20 meter appropriately .

Android

Android is the open source operating system or open source platform which comes under linux based system. Android support the wireless communication by using 2G,3G, 4G networks, 802.11 Wi-Fi network, and Bluetooth connectivity. Android thus provides an multiprocessing system to provide the user with benefits of less time consumption and reliable results.

Alert System

Another most important system used here is the healthcare alert system which is for promising outcome of the system and provide the adequate trusting responsiveness to each user. Thus, it overcomes the data loss problem in case of communication. The Patient or user can reliably use this system trustfully. Thus, alert system provides the functioning of acknowledgement that when a user is in critical situation then it alerts the doctor about the case to handle immediately and provide the required prescription so that this system can be worth of its proposal.

Mathematical Foundation

Problem Statement: Let 'S' be the Telemonitoring tool which will calculate BP, ECG, TEMPERATURE, SUGAR by using the sensor nodes.

S = {B,E,T,S,A,D,C,P}

Where,

B=BP of patient;

B = {B0 | ØB}

E=ECG of patient;

E = {E0 | ØE}

T=TEMPERATURE of patient;

T = {T0 | ØT}

S =SUGER of patient;

S = {S0 | ØR}

T=TEMPERATURE of patient;

T = {T0 | ØT}

A=ALERT for doctors;

A = {A0,A1,….,An | ØA}

D=DATABASE of patient;

D = {D0 | ØD}

C= DOCTOR;

C = {C0,C1,….,Cn | ØH}

P=PATIENT;

P= {P0, P1,P2…Pn| ØP}

B. Activity

1) Patient-doctor relationship

P->C

Let, FP be a rule of P in H Such that for every patient there is doctor.

FP (P)|->H

FP (P0, P1, P2, ….., Pn)->{C0} € C

2) Patient-database relationship.

P->D

Let, FP be a rule of P into D Such that for every patient there is Database.

FP (P)|->D

FP (P0, P1, …..,Pn)->{D0} €D

3) doctor-database relationship

C->D

Let, FH be a rule of C into D Such that for every doctor there is database.

FH (C)|->D

FH (P0, P1, P2,….., Pn)->{D0} €D

4) Patient-BP relationship

P->B

Let, FB be a rule of P in B Such that for every patient has a problem of blood pressure.

FP (P)|->B

FP (P0, P1, P2,…..,Pn)->{B0} €B

5) Patient-ECG relationship

P->E

Let, FE be a rule of P in E Such that for every patient has a problem of heart.

FP (p)|->E

FP (P0, P1, P2,…..,Pn) ->{E0} €E

6) Patient-TEMPERATURE relationship

P->T

Let, FP be a rule of P in T Such that for patient temperature.

FP (P)|->T

FP (P0, P1, P2,…..,Pn)->{T0} € H

7) Patient-SUGER relationship

P->S

Let, FR be a rule of P in S Such that patient has suger.

FP (P)|->R

FP (P0, P1, P2,…..,Pn)->{R0} €R

8) doctor –ALERT relationship

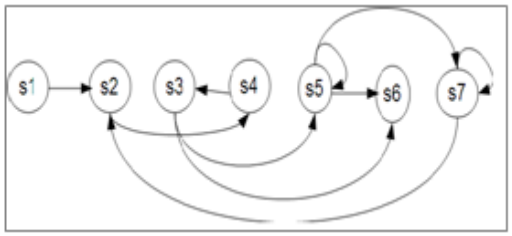
H->A

Let, FH be a rule of H in A Such that for doctor alert the patient.

FH (P)|->A

FH (P0, P1, P2,…..,Pn)->{A0}€A

State Diagram

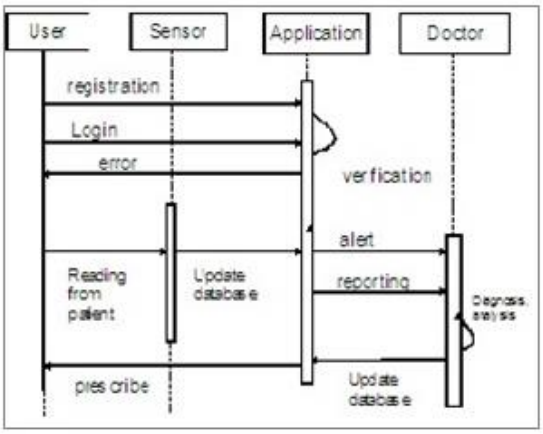


S1 : Patient registration.
S2 :Patient login.
S3: Doctor login.
S4 : Hardware interface.
S5 : analysis.
S6 : Prescription
S7 : send alert

Functional dependency

	S1	S2	S3	S4	S5	S6	S7
S1	0	1	1	0	0	1	0
S2	0	0	0	1	0	0	0
S3	0	0	0	0	1	0	0
S4	0	0	1	0	0	0	0
S5	0	0	0	0	1	0	1
S6	1	0	0	0	0	0	0
S7	0	1	0	0	0	0	1

Sequence Diagram



Conclusion and future work

As sensors are new implemented modes of transferring the crucial data over every application, also has wide impact over health-care systems and is providing a satisfactory outcome enhancing the health-care in efficient and assured manner.

WSN provides a reliable service using two common ethods of wireless medium and sensor technique to make impact ffectively over various fields including medical systems. The challenge of handling the critical data and readings in medical system , the sensors, networking protocols and different modes had successfully provided satisfactory results and implementation methods effectively.

This technique of telemonitoring can have a wide applicability to every user in future and also will be useful to common person to secure and preserve the health through this system. Thus, this system provides a continuous overlook to a person's itself healthcare in busy schedule avoiding the actual diagnosis physically.

Saving battery consumption in future to enhance the functionality for longer duration can be implemented more efficiently . Also other advance protocols can be used in future when newly studied to enhance more features to it efficiently.

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