International Journal on Applicationsin Information and Communication Engineering
Volume 2:Issue 5: May 2016, pp 70-75. www.aetsjournal.com ISSN (Online) : 2394 - 6237

Smart Alert System by Tuning Data Rate of Sensors for Wireless Body Area Networks

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Abstract— Wireless body area networks (WBANs) are intelligent wireless monitoring systems, consisting of wearable and implantable computing devices on or in the human body. In a WBAN, Quality of Service is a major challenge due to the due to lack of sufficient methodology for modeling the behaviour of different kinds of traffic being generated from different kinds of events. The Physiological data collected by multimodal sensors have different importance, the provisioning of quality of service (QoS) for the sensory data in WBAN is becoming a critical issue. Data rate tuning mechanisms have influenced the Quality of Service eminently but they experience an extensive computational process and message exchange processing. Therefore, Data rate tuning mechanism along with data Classification algorithms plays a key role towards making Quality of Service a better one. To provide effective quality of service and reliability, Dempster Shafer algorithm is proposed. This approach classifies the data rate of sensors as normal and abnormal values. Meanwhile, in order to convey the information regarding the criticality of the patients; it is provided as notification message. The notifications are conveyed as smart based system by integrating the arduino hardware with an android and cloud service.

Keywords— WBAN-Wireless Body Area Networks,IoT-Internet of Things,LDPU-Local Data Processing Unit,QOS-Quality of Service.

I. INTRODUCTION

Body Area Networks which is referred to as wireless Body Area Networks, an emerging technology which has helped in many applications. A number of many small sensors could be integrated to form a Wireless Body Area Networks. These sensors are capable of monitoring to prevent any critical risks. The sensors could be placed either on the surface of the human body or it can be embedded inside the human body. The Sensors which are placed on the surface of the human body are referred to as Wearable devices. The sensors which are being placed helps us to monitor the physiological activities Which provides the related information to the external processing unit. This processing unit further provides monitoring information to the doctors or who cares the patients.

Wireless body area Networks supports ubiquitous health care,gaming,entertaintment and other military applications, training schedules for professional athletics, prevention of public accidents, safeguarding of uniform personnel and consumer electronics. In case of health care, the body area networks help the doctors and the care takers to monitor the activities of the patients. These are made to detect the abnormal activities so that the patients can be prevented from the serious issues. Now days, small well equipped sensors are being discovered which has improved the performance in the health care. Since Wired connections are not much more effective, so they prefer wireless body area networks. Since resources are limited and the patients could not afford to stay in hospitals for long days due to economic reasons. So their activities can be analyzed in real time [1] for short time of period. Thus, Wireless Body Area Networks Play a Major role in medical applications.

The Quality of Service in Wireless Body Area Networks is very much difficult to improve.In,this case,to increase the Quality of Service (QoS), with an efficient data classification algorithm which tunes the data-rate of a sensor based on the criticality of health parameter and also to provide a reliable network with efficient feedback to the patients by integrating with android application and cloud service.

II. RELATED WORK

The Wireless Body Area Network, an emerging technology helps the patients to be aware about their and also to recover soon from their illness[].For example, the heart beat rate and the temperature of the human body could be detected so that the patients could be given prior treatment in order to recover soon from their illness. This is considered to be the main motive of the today's wireless body area networking field.Normally, in wireless body area networks the transmission of information will usually have the higher average waiting time for the Local Data Processing Unit. So, an algorithm which is based on the priority .The critical information (i.e.) the patients who are in critical condition, will be given the highest priority. So, that the critical patient will be given more importance to take care and treatment will be provided accordingly. The Constant model hawk-dove game algorithm [14] is proposed based on the priority which prioritizes the LDPU'S based on the critical parameters.The LDPU considers the properties such as critical information, dissipation of the energy and the time which was elapsed between the sensor nodes. Based on the evolutionary game approach involves repeated interactions with the sensor nodes, the constant mode hawk-dove game algorithm is proposed .This algorithm based on the evolutionary approach helps to have the idea of strategizing the LDPU'S.This makes to give

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importance (i.e.)to give better treatment towards the critical patients.

The class based QOS model is the technique which has been designed to improve the quality of service in wireless body area networks. The class based QOS model [3] is being proposed on the multihop network topology. In this technique, the QOS has increased by categorizing the services as the guaranteed service, real time services and the best effort services.

As usual the body sensors are being implanted or placed to measure the temperature, pressure and heart beat rate of the body. These sensor nodes help us to collect information of the human body and it is passed to the sink node. Then the sink node sends this collected information to the base station of the whole wireless body area networks. The sensors are being classified as critical and non critical. The traffic between the sensors placed and the sink nodes are being classified into three categories. They are the guaranteed services, real time services and the best effort services. The traffic to and fro from the critical sensor nodes with minimum delay is said to be considered as the guaranteed service (ECG, EEG).Same way, the traffic between the non critical sensor nodes with minimum delay is said to be real time services (Video information).whereas, the traffic between the non critical sensor nodes with high delay is considered as the best effort service.

First the information from all the sensor nodes is being collected and it is stored in the data storage area. Then it is sent to the classifier part, which is considered as the database for the class based QOS model. In this area, the sensors are being separated and kept based on the critical and the non-critical as the guaranteed services, real time services and the best effort services. So, based upon the critical information which is collected the priority of the sensed information is decided and it is passed to the necessary location. Thus the class based QOS model increases the quality of the services. This technique has produces high throughput and also with minimum delay. This has been performed during the critical situation of the patients.

The main issue with the wireless body area networks is the quality of the service. The QOS error recovery mechanism [9] is the technique which is based on the adaptive network coding. In this approach, the QOS is increased in terms of Marinkovic and Popovici's Mechanism by using the adaptive service differentiation and adaptive error recovery.

The adaptive service differentiation is used to provide adaptiveness to the users by segregating the sensors as the critical and non-critical sensors. Based upon the criticality of the sensed information, the priority will be allocated. The sensed critical information will be sent to the relay nodes. The role of relay nodes may help in minimizing the overhead of the sensor nodes. The work of the priority levels is based on the Marinkovic and Popovici's approach [9].

The adaptive error recovery mechanism is performed by embedding it with the service differentiation. The recovery mechanism uses the time division multiple access. By using the TDMA technique, the information from the sensors is being passed to the relay nodes in the same Tdma frame. This is called as the same generation information. The same generation information from the sensors is being encoded at the same time. While the process of decoding is performed at the destination node by using the same generation information collected.

The sensors such as the temperature sensor, heartbeat sensor, pressure sensors are being implanted or placed on the human body to detect the values of the sensed information. Based upon the critical condition of sensed information, the information is being sent to the necessary care takers to make patient recover soon. They are performed by using the efficient data rate tuning mechanism which is called as the cooperative bargaining solution. The parameters used in this technique are criticality index, probability in failure, power consumption.

The criticality index provides the abnormal value detected which differs almost from the normal value.

The probability in failure parameter provides the sensor information regarding the unsuccessful transmission of information.

The Power consumption determines the amount of power being consumed within the particular time of interval. Thus these are the certain parameters used in the Nash Bargaining Solution [14] for providing an efficient and reliable work progress. By using these parameters, the information which are sensed and detected from the sensor nodes. The sensor nodes which produce abnormal values are tuned by using the efficient data rate tuning mechanism. The above mechanism is evaluated through the real time system implementation by using the sensors such as heart beat sensor; temperature sensor etc. Thus the bargaining solution of cooperative method has made the wireless body network a reliable one by increasing the quality of service.

Figure 1 Hardware setup of Temperature sensor.

III. PROPOSED SYSTEM

A. Creation of temperature sensor node

The first main work in this wireless body area network scenario is to create a temperature sensor node. The temperature sensor node is created to measure the temperature of the human body. The temperature sensor which is used is the DSB1820 one wire temperature sensor. The DSB1820, a single wire temperature sensor [7] is a waterproof one which is made up of stainless steel. This is being integrated with the arduino tool kit to measure the temperature of the human body. The normal arduino UNO board uses the Dallas Temperature library [8] for the operation of DSB1820 digital device. The hardware setup of the temperature sensor is shown in figure

The DSB1820 should be powered between either 3.0v and 5.5v.It is necessary that ground pin should be connected to the 0v and the VDD pin should be connected to the +5v of the arduino board. A 4K7 ohm resistor which is also called as pull-up resistor is used. This pull-up resistor helps to pull up it up to 5V.Thus; the above explanation provides the hardware setup for the temperature sensor.

The programming part is done with the help of the arduino software. The arduino software is used since the hardware setup is integrated with the arduino board. The program for sensing the temperature of the human body is being uploaded to the arduino software. After uploading, the program is saved and the specified communication port should be selected from the tools option. Then the process of compilation is done and the output i.e.(temperature of the human body)will be displayed in the serial port monitor.

Figure 2 Hardware Setup of Blood Pressure Sensor

B. Creation of Blood Pressure Sensor Node

The second sensor node which is used in this scenario of the wireless body area network is the Blood Pressure sensor node. The Blood Pressure sensor node is created which is used to measure the blood pressure of the human body. The blood pressure sensor used is IW2 automated wrist watch blood pressure monitor of Omron consists of LCD digital display. The Blood Pressure sensor is integrated with the arduino tool kit. It is powered to 3.3V, 5V and GND of the arduino board. The output is gained through any one of the analog output pin. The blood Pressure sensor consists of the wrist cuff which should be around the wrist of the left hand and support by right hand. Upload the program to the arduino software .After the cuff is held and the program is uploaded, switch on the start button and calculate the systolic and diastolic blood pressure. After the measurements are detected, the cuff automatically deflates itself. Then, press the start/stop button to stop the process.The hardware setup of the Blood Pressure sensor node is shown in the figure

C. Creation of ECG Sensor Node

The ECG Sensor used is AD8232. It measures the electrical activity of the heart. This electrical activity is nothing but the Electrocardiogram. This measurement is used to diagnose the condition of the heart. First, it is integrated with the arduino software and then with the processing software. Since, the processing mode software could provide the results in the graphical representation. Another two more important requirements for the ECG sensors are the ECG electrode pads and the Sensor cable which should be connected to the electrode pads. The ECG electrode pads are nothing but the disposable electrode pads which are being placed on the left arm, right arm and right leg. The ECG sensor cable consists of three electrode pad leds, so the three led can be connected to the attached electrode pads on the left arm, right arm and right leg respectively.

The ECG Sensor AD8232 is integrated with the arduino UNO board to measure the ECG value of the human body. The AD8232 consists of nine pins such as GND, 3.3V, OUTPUT, LO-, LO+, SDN, LA, RA and RL.The ECG sensor is powered to the 3.3V and ground of the arduino board. The output pin of ECG Sensor is connected to the A0 pin of the arduino UNO board. The pins LO- and LO+ are connected to the pins 10 and 11 of the arduino UNO board. The ECG sensor cables from pins RA, RL and LA are being powered to the ECG sensor electrode pads. Once all these connections are made, the program is uploaded and the output is displayed in the Communication serial port monitor.

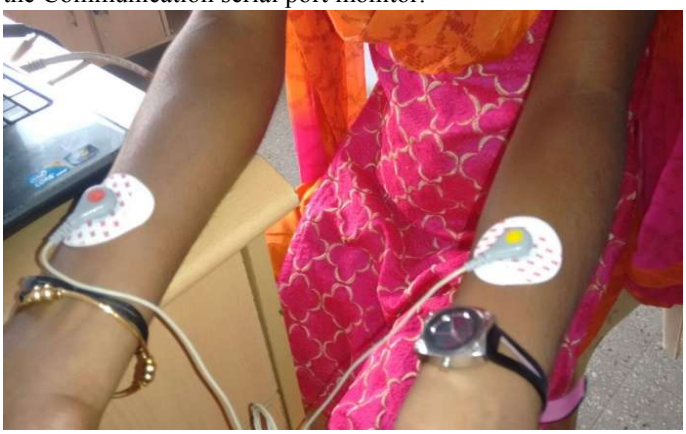

Fig 3 Hardware Setup of ECG Sensor

Secondly, it is integrated with the processing software. Once the operations are completed and the output is defined in the arduino software. The arduino software is closed and then the processing software is opened and the program is uploaded

to it. The program fetches the data from the arduino software and the results are obtained in the processing mode (i.e.) graphical representation.

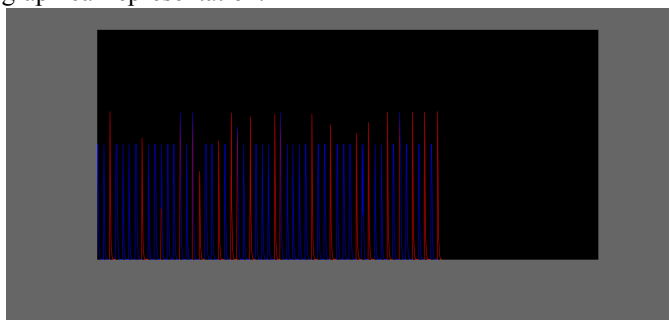

Fig 4 Processing mode Output

D.Integration of The Sensor Nodes And Connection Establishment

The temperature sensor node, Blood Pressure sensor node and the ECG Sensor node are integrated together into the arduino board. The process of integration is done so that the value of the temperature sensor node, Blood Pressure sensor node and the ECG sensor node will be displayed together in the communication serial port monitor of the arduino software. Instead of normal arduino UNO board, the arduino BT device is used in order to provide connection establishment through by means of Bluetooth. Hence, the Blood Pressure value, ECG rate and the temperature of the human body could be monitored either by means of mobile devices or laptop through Bluetooth connection.

In order to provide quicker feedback to the care takers, the detected measurements are being classified as normal and abnormal values.So, that the measurements can be conveyed to the care takers by means of message as notification. The above mentioned process is done by using the Dempster Shafer algorithm. The notification message is sent by creating an android application which is an advanced technology in today's world.

The hardware setup of the integration of sensors and connection establishment is shown in the figure

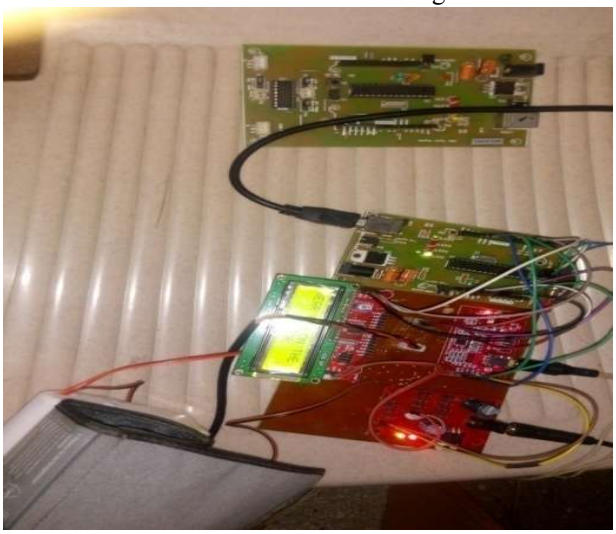

Figure 5 Integration of Sensor nodes.

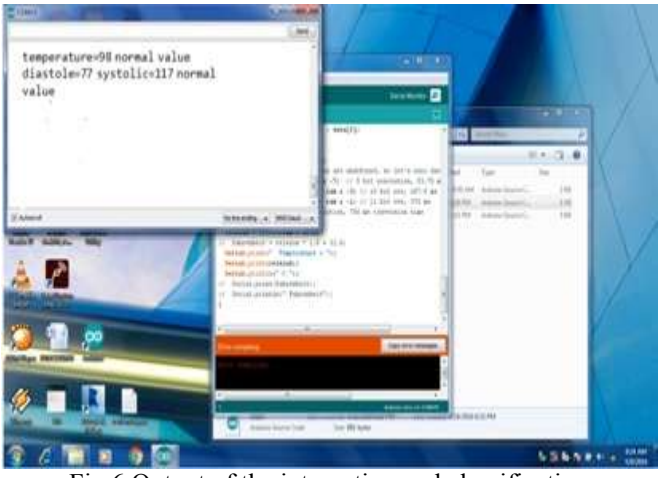

Fig 6 Output of the integration and classification

E. Integration of Arduino with Android and Cloud Service

Android is the most popular operating system in the smart phone. It is software stack made for mobile devices which consist of an operating system, applications and middleware. So the user can develop an android application according to its requirements. Android software development kit (ADK) is used to develop android applications.

According to our objective, the wireless body area network is integrated with the developed android application. The integration is done in order to convey the classified information. The normal and abnormal measurements are detected by different sensors .The threshold value is defined. If the value exceeds the threshold value, then it is considered as the abnormal value. The communication from the arduino hardware to the android application is done by using the blue tooth connectivity. As soon as, the care takers receive the message, the decision of treatment can be made based on the criticality of the parameters. This type of notification system helps them to be aware about the body conditions.

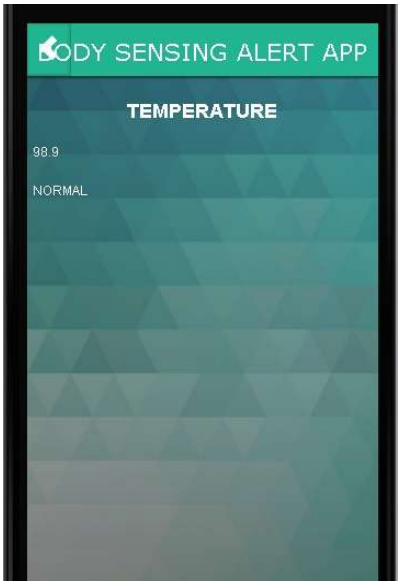

Fig 6 Temperature Value Normal in android

The arduino is integrated with another important advanced technology, Cloud service. The arduino is integrated for sending the message either through the SMS or Email. The cloud service can able to configure itself to interact with the Cloud in a secure way. when the user turns on the cloud service and connect it via WiFi,The messages can be received and viewed. The sensed data are being stored in the cloud for periodic amount of time and the notification message is passed to the users.As soon as the data is sensed, the information is transferred to the cloud service.So,the the patients care takers can view the updates through the cloud service from anywhere. This is the one of the main advantage. Based upon the sensed values, the care takers can be aware about their patients conditions. If any abnormal conditions occurred, it can be recovered soon as per the treatment.

Fig 7 Temperature value abnormal in android

Fig 8 Blood Pressure Value normal in android

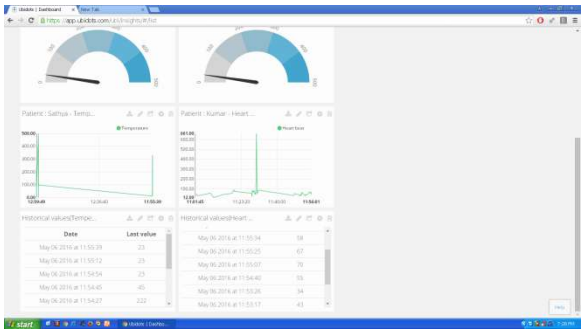

Fig 9 Values in cloud service

Thus the classification of the sensed data values by using Dempster Shafer algorithm and smart based system communication by android application has provided better Quality of Service and Reliability.

IV. Results And Discussion

The Performance Analysis is shown in the figure.

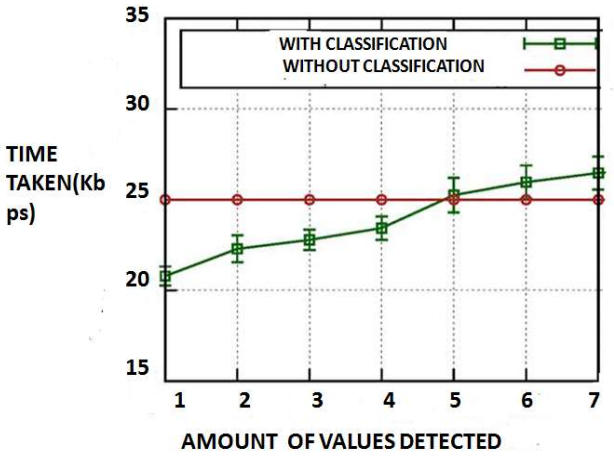

Fig 10 Comparison of proposed and existing in case of Time taken for detecting

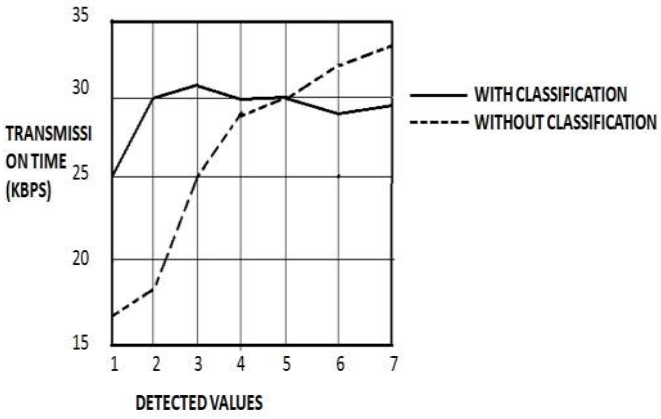

Fig 11,Transmission Time Comparison

From Figure , the amount of time taken for the detection of values is considered. The result shows that, by using Dempster Classification Algorithm, the amount of time taken to detect the sensor values was decreased. Seven percent of data

detected was detected in 25 Kbps without using classification algorithm. Where as,by using the classification algorithm, seven percent of data was detected in 20 Kbps.This shows that ,by using classification algorithm, the Quality of Service can be increased. Thus the effective Dempster classification algorithm has made the Quality of service to probably increase.

From Figure 10, the transmission time of the detected values is considered. The result shows that, by using Dempster Classification Algorithm, the transmission time of detected values has decreased. Thus the effective Dempster classification algorithm has made the Quality of service and reliability to probably increase.

V. Conclusion And Future Work

In order to improve the Quality of service and Reliability, the amount of detected sensor value and transmission delay is considered. Based upon the effective data classification algorithm and creation of smart based system of android application and integration with cloud service; the Quality of service and Reliability has improved. The less computational processing involved in the Data Classification technique has made the work easier The future work of the proposed system is to provide with the more reliable security features by new techniques which will also increase the Quality of service and Reliability. Moreover, it should help every person who is in need with very low cost. Implementation of specific health data importance factor is also a challenge as each collects health data from the heterogeneous body sensors over a very large environment for every second which will provide betterment towards health care system.

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