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MAC-Based Physiological Signal Extraction Approach for WBAN on Body Postures

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Abstract

Wireless sensor Networks has taken its extension in health monitoring, telemedicine, human activity monitoring etc, through Wireless Body area Networks. Mobility in such systems are challenging issue since the human body posture is time varying based on the daily activities. The sensor nodes deployed within the human body are connected by the Network proximity. QoS Parameter like reliability and throughput in the data extraction (or) acquisition process must be high, for the accuracy of the data used to provide appropriate treatment to the subject that is considered.MAC protocol is used to address the channelization issues that arise during data forwarding process in the network. This article also describes the disadvantages in the star topology arrangement of sensor nodes following the centralized approach and gives a comparative study on the decentralized pattern of sensor node deployment. Rare body postures performed by the human body is studied and the network traffic are also briefed.

Keywords: Posture based, MAC, Traffic priority, signal extraction, proximity

INTRODUCTION

Evolution in technology and advancements which involve manpower in such systems has its impact on the health issues. Telemedicine, remote patient monitoring and child activity monitoring systems involve physiological signals like heartbeat rate, body temperature [1], galvanic skin response, respiration etc. Such processing of the signals is done with Wireless body area sensor Networks (WBASN). It can be used by the sports individuals to report any kind of abnormalities in the body during the sports activity [2].

The monitoring activities can be executed by placing the sensor nodes inside, on (or) around the body proximity. In general human body will experience several types of movements based on the activities they do. Irrespective of the deployment and placement of these sensor nodes, certain motions make the sensor nodes in the boy to take up mobility which results in displacement of the sensor nodes to other location. This mobility in the sensor network creates an impact on the accuracy and efficiency of the monitoring activity[15].

The topology that is used in such systems are star topology [3], which bounds the network area based on the human height. The central node or the hub gathers the signal from other sensor nodes and transmits the same to the sink (or) Base station for further processing. The issue with the topology results in hindering the actual signal when the body posture hinder the actual signal. In this regard rather than capturing the signals from dynamic movements, predefined motion capture can be done to increase the efficiency of the Network.

Posture can be defined as a non-verbal communication exhibited by the human body. Human postures depend s upon age, health, muscular strength and state of mind[4].But in addition to it certain body movements follow uniform succeeding motions. Such predictions can be made first by selecting the postures that an individual normally performs in a normal state after which it is stored in the database and retrieved for further use.

Selection of prompt posture in forwarding the critical data is essential irrespective of the subject's posture. Normal daily activities include postures like walking, running, sitting and sleeping. Star topology that is commonly used in WBAN which hinders the signal transmission. To attain maximum throughput the data rate must be increased while transmitting the data, this directly influence the energy efficiency as a challenge in wireless technology. When the data rate is increased the energy consumption of the sensor node also increases which diminishes the Network Lifetime.

MAC protocol has a feature to control the data transmission in the channel and handle all the collision and overhead issues of the data.MAC protocol enables in attaining maximum throughput, bandwidth and minimize the delay[3].

2. LITERATURE SURVEY

The Network issues like retransmission, collision, overhearing and changes in interference are raised once the sensor nodes move from the position of actual placement. A posture based data transmission based on the occurrence of potential posture captured over time in frequent posture assessment is made .The posture of a human body is analysed based on the sequence of postures or movements undergone by an individual, out of which the appropriate posture with accurate signal rate is determined. The technique [3] also maintains the active or sleep schedule for the deployed nodes inorder to maintain the network lifetime.

The QoS parameters that are in addressed with the results are throughput and energy consumption. Changes that occur in the RSSI values are analysed with the node wise posture sequences from all the deployed nodes. The prediction of next posture

sequence is done by using the Markov chain model for the detection of best posture after which beacon signals are used to forward the data to the sink with less interruption. The number of spans that are used to collect the posture sequences are high that creates an impact on the network latency. The main disadvantage is that the technique focusses only on walking posture.

Non uniform maintenance of threshold values become invalid for every experimental setup. This led to the proposal of enhanced ISODATA classification method which considers the adjacent node's similarity index followed by the cluster formation adaptively[14]. The algorithm makes us of the Euler angle to represent the join rotation where the joint movements are categorized into parent and child joints placed on a 3D space. Euler's formula is applied to measure the similarity between two gathered frames. The algorithm determines the key frame extraction [5], only on movements where active motions happen on the joints are analysed, the technique do not suit remote health monitoring as patients do not undergo fast motions.

A "Y" model token ring setup is maintained that is used to ensure authentication of the gathered data with the polling technique. The database used to store the gathered physiological signals, ensures the corrections of the data and maintains data reliability. The disadvantage of the model lies in the network properties to be considered for the data communication [6], in gathering the body signals on various postures.

MAC protocol addresses the network transmission issues to increase the throughput, the data in the sensor node are categorized into normal data, periodic data and emergency data[13]. The carrier sense multiple access protocol uses the contention period to access the channel without collision, hence modified IEEE 802.15.4 standard for wireless communication makes use of Contention Access period, Contention Free period and Inactive period. The above three categories of channel access overcome the traffic analysis in the Network to avoid physiological signal transmission. However emergency data transfer and prediction of emergency data for the net cycle remains as a challenge [7].

Along with throughput energy efficiency is another important factor to increase the network lifetime, a MAC approach for the changes that occur during the walking scenario was proposed. The related work first gathers the video postures of the subject in the walking scenario, after which the video stream captures static postures for further process with the MAC protocol. Analysis on periodic posture changes are made. In the walking posture the repetition of movements is gathered, and the prediction of next movement is done [8]. In walking posture, the repetition of the pose is gathered, and the next movement is predicted, this analysis will enable the sensor node that will gather the emergency data for transmission with less delay. However, analysis suit only for walking scenario[20].

MOTIVATION

Wireless Body Area Networks, are designed mainly for the health monitoring purpose, where the sensor nodes are to be deployed to meet the patient's need and all the Network parameters[19]. The following network issues must be focussed , for prolonged health monitoring service:

I. Maximization of throughput
II. Increased Network Lifetime
III. Avoid Packet delay
IV. Decrease the collision issues due to Network traffic

i. Maximization of throughput

Research areas have focussed very little on throughput and hence periodic data transmission acquires major energy, [10] which needs to be reduced when there is a need for emergency data which results into the possibility of channel fading thereby reducing the sensitivity of the data transmitted.

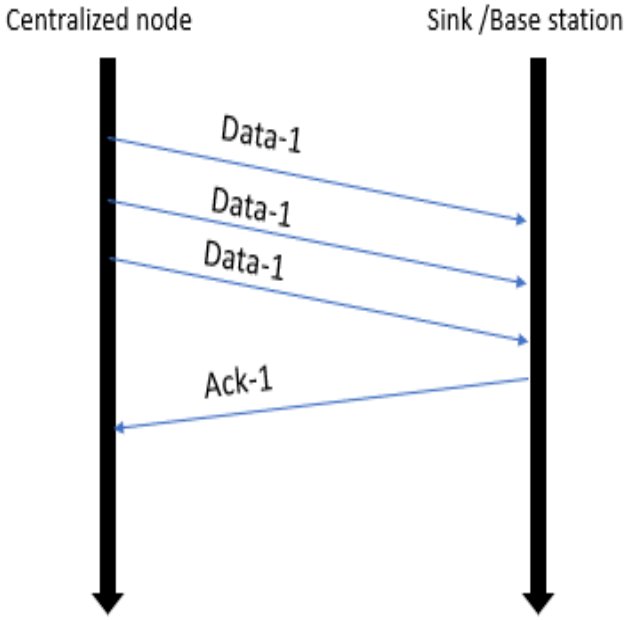

Fig.1. Repeated retransmission

The throughput of the network should be maintained to handle critical data transmission and hence need for repeated data transmission schemes is to be focussed[16].

ii. Increased Network Lifetime

Energy efficiency of the sensor nodes deployed inside the human body is an important factor to handle the Network Lifetime. [11] Contention based protocols, like Carrier sense multiple access (CSMA) and its variant Collision Avoidance protocols experience the Hidden and Exposed terminal problem for the following reasons:

Consider Fig.1. where C and D senses the abnormality in the physiological signal and transmits the signals to the central coordinator B , either of the transmitting nodes are unaware of the Network traffic already existing and will result to collision leading to packet loss [17]. This unnecessary transmission degrades the battery life of the sensor nodes.

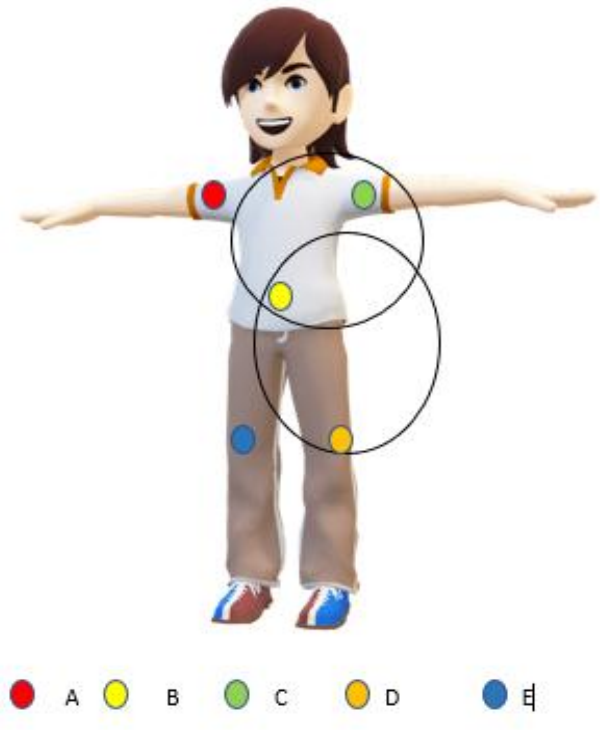

Fig.2. Exposed Terminal Problem

iii. Avoid Packet Delay

Critical data acquisition in appropriate time is essential for health monitoring, avoiding will risk the life of the patient under monitoring. The delay in data delivery occurs due to buffer overflow and collision related problems as a result of high network traffic and hence the data under transmission will be lost on its way to the destination[18]. Hence the need for emergency data management is highly essential.

iv. Reduce Collision Issues

The different data types categorized from the physiological signals are periodic data, normal data and emergency data handling in the channels are important such that the channel occupancy rate is not disturbed. [20]The sleep and the wake-up radio modes of the device will reduce the traffic generation in the deployed Body area Network.

STATE-OF-ART

In this section the disadvantages of the existing work is summarized as follows:

I. The traditional topology followed in body area networks depletes the Network performance due to its centralized approach for data gathering.
II. Degraded energy efficiency as the distance between the hub is high.
III. MAC issues are not considered as a part of posture analysis.

This article briefs about the following objectives that are to be addressed to improve the data gathering process in wireless body area networks[12].

1. To implement an algorithm to extract the key frame from human motion capture.
2. To increase the Network throughput by considering postural changes on various movements.
3. To optimize the Network behaviour in accordance with the posture change.

PROPOSED MODEL

The model includes MAC based network issues like collision, overhearing and idle active modes of the body sensor nodes. The channelization issues during the posture change is emphasized along with the network topology [9] of the monitoring system following the decentralized approach, where automatic switching of active nodes for data transmission is performed. The system considers heartbeat rate with varied age genre is taken. The algorithm is briefed following:

Algorithm (Data Gathering under Potential Posture)

I/p : Heart Beat rate (Based on the Age)

o/p: Trigger the Base

1. Abnormal data sensed.
2. Potential Posture Identification

   Based on the data Type

   if (Heart Beat rate== Normal)

   No Data gathering

   if (Heart Beat rate== Low) || if(Heart Beat rate==High)

   then

   Find the similarity between the posture frames(Cosine Similarity)

   do

   till the key frame is identified.
3. Transfer the data to the node near to the Base station.
4. Based on the proximity the data will be forwarded to the node.
5. Data forwarded to the Sink.

METHODOLOGY

The work relates with the optimization of postures and the implementation compares with the detection of optimized posture through Markov chain model and Machine learning model. The comparative analysis of the results from these approaches will be considered and the approach will be further analysed for implementation[13]. Both the approaches consider the heartbeat rate as the input.

CONCLUSION

This article considers the posture behaviour of human beings and the change in the input values when there is a change in the position of human beings while performing various activities. The study must be implemented in the Network Simulator considering various input parameters and the channelization issues as a future enhancement.

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