Design and Implementation of Wireless Sensor Network Based Health Care Solution Using Memac

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Abstract — **Development in health care monitoring systems which allow a continuous remote patient monitoring and diagnostics by doctors. The previous work contains collecting data from sensor nodes and send to server .In previous work severity of data was not checked by server. Each individual node send their data to server because of this network congestion ,packet delay occurs and energy efficiency of nodes get decreased in the wireless network. To solve this problem this paper present an idea for better improvement in health care system . From sensors nodes data are taken the reading of patient and send it to doctor can help the patient for improving health. In this paper Load balancing technique and Memac(Mobility Aware and Energy Efficient Medium Access Control) protocol is used for performance improvement of wireless network. In this system severity of data is check if data is severe it is not store in queue it is directly send it to doctor for immediate action for patient. As per the current state of the system 20 % network performance has been improved. The main aim of this proposed system is critical patient can be operate by doctor as soon as early. So to save the life of critical patient wireless sensor network plays an important role.**

Key Words — Load balancing , Memac Protocol , Sensor, Wireless sensor network .

I. INTRODUCTION

A typical node in the WSN consists of a sensor, embedded processor, moderate amount of memory and transmitter/receiver circuitry. These sensor nodes are normally battery powered and they coordinate among themselves to perform a common task. These Wireless Sensor Networks have severe resource constrains and energy conservation is very essential. The sensor node's radio in the WSNs consumes a significant amount of energy. Substantial
research has been done on the design of low power electronic devices in order to reduce energy consumption of these sensor nodes.
The purpose of this paper is to provide a snapshot of current developments and future direction of research on wearable and implantable body area network systems for continuous monitoring of patients. This paper explains the important role of body sensor networks in medicine to minimize the need for caregivers and help the chronically ill and elderly people live an independent life, besides providing people with quality care. The paper provides several examples of state of the art technology together with the design considerations like unobtrusiveness, scalability, energy efficiency, security and also provides a comprehensive analysis of the various benefits and drawbacks of these systems. Wireless sensor network is a system which can continuously monitor the health of patient to prevent and early detection by of disease. A Wireless Body Area Network (WBAN) is a special purpose sensor network designed to operate autonomously to connect various medical sensors and appliances, located inside and outside of a human body. A WBAN system can offer two significant advantages compared to current to electronic patient monitoring system ,the first advantage is the mobility, in this patient is mobile due to use of portable monitoring devices. Second advantage is the location monitoring which is independent monitoring facility.
A Wireless sensor network is an autonomous network in which device can search and find a suitable communication network to transmit data to remote database server for storage. Health care is always a big area, since it involves the life a given individual can have[1][3].As body sensor network systems are capable of continuously monitoring a person's physiological and physical state , they can provide patients with the required information and motivation[4][6].Patient by staying at remote place can get operated by doctor with the help of wireless network. In health care monitoring the patient ECG(Electrocardiogram),blood pressure, pulse rate etc and send this record of patient to central unit. In this sensor nodes send records of patient to the central unit unit. In central unit records are maintained in queue then one by one record is send to the doctors computer and mobile. In previous system all records are kept in queue in central unit, suppose any patient blood pressure is get increase above the normal range so this record has reach to doctor as early as possible. But in previous system there is no such arrangement to send critical reading to doctor immediately. There is one more drawback is each sensor nodes broadcast there data to other nodes. So because of this congestion occur in the network, also time delay is get increased [11][12]. Because of this sensor nodes efficiency get decreased. To remove this drawback proposed system is used to remove congestion, time delay and improve energy efficiency of sensor nodes by using a mobility aware and energy efficient medium access protocol
(MEMAC) for mobile wireless sensor networks[17].For critical patient record we add priority field to identify critical record , that should be send immediately to doctor. To remove channel traffic we use the concept of clustering in this system [19].Some sensor nodes are far away from central unit, this nodes send their data to intermediate nodes that will send their data to central unit. But in this sensor nodes having limited battery life for transmitting data like this sensor nodes loss their energy and congestion also occur. To remove this the concept of clustering is used. The clustering phenomenon as we can see, plays an important role in not just organization of the network, but can dramatically affect network performance.

II. RELATED WORK

A sensor network consists of a large number of sensor nodes, which are deployed either inside the phenomenon to be monitored or very close to it. Sensor networks represent a significant improvement over traditional sensor networks, which are deployed in the following two ways ,

I. Sensors can be located far from the actual phenomenon to be monitored. With this approach, large sensors that use some complex methods to distinguish the targets from environmental noise are required.

II. Several sensors that perform only sensing can be deployed. The positions of the sensors and communications network topology are carefully designed. They transmit time series of data about the phenomenon to central nodes where computations are performed and data are fused.

Ya-Li Zheng [1] study overview emerging unobtrusive and wearable technologies, which are essential to the realization of pervasive health information acquisition,followings are findings includes:unobtrusive sensing methods, smart textile technology, flexible-stretchable-printable electronics, and sensor fusion, and then to identify some future directions of research.James Y. Xu, [2]presents a novel end-to-end system solution to some of these challenges. The system is built on the prescription-based context-driven activity classification methodology,To achieve the goal of enabling large-scale monitoring[2].Amita Murthy, K. V. Padmaja[3] gives an approach on the developments so far in three main factors of the device i.e. sensors used, the system design and the algorithm implemented in the design[3].A Distributed Scheme to Manage The Dynamic Coexistence of IEEE 802.15.4-Based Health-Monitoring WBANs[4] gives findings that analytically study the effects of dynamic coexistence on the operation of IEEE 802.15.4-based health
health monitoring WBANs. Mohamed Adel Serhani[5] study a framework to collect patient data in real time, perform appropriate non intrusive monitoring, and propose medical and/or life style engagements, whenever needed and appropriate.Xiaoliang Wang, [6]In this study, they propose a new hybrid mobile-cloud computational solution to enable more effective personalized medical monitoring. Jin Wang, Li, & Sungyoung Lee[7] gives an approach for elderly person monitoring that is based on smart sensors worn on the body and operating through consumer home networks. Different medical parameters can be analyzed, store and visualized using the graphical user interface of an android smart-phone designed for the end user. The Blue tooth based sensor nodes acquire physiological parameters of patients then perform signal processing and data analysis and send results to the coordinator node[8].

GuoChen Peng,Mark F. Bocko[9]suggested Non-Contact ECG Sensing Employing Gradiometer Electrodes[9].In this paper Noncontact, capacitive electrocardiogram (ECG) measurements are complicated by motion artifacts from the relative movement between the ECG electrodes and the subject. To compensate for such motion we propose to employ first and second order gradiometer electrode designs[9].Following methods are used,

1. Gradiometer Electrode Designs
2. Common Mode Noise (CMRR Sensitivity)

The drawback is Changes in source capacitance due to the relative motion of the electrodes and the subject leads to modulation of the signals Body Sensor Network[10]this paper presents a middle ware targeted for medical applications on smart phone-like platforms that relies on an event-based design to enable flexible coupling with changing sets of wireless sensor units, while posing only a minor overhead on the resources and battery capacity of the interconnected devices[10]. Remote Health Monitoring using Wireless Body Area Network [11]in this paper aim of wireless body area network is to facilitate continuously recording and monitoring of a person's health condition and transfer it over a long distance communication network.

Ebrahim Nemati, [12]finds that this sensor system combined an appropriate wireless protocol for data communication with capacitive ECG signal sensing and processing. A Novel Middle ware Solution to Improve Ubiquitous Healthcare Systems Aided by Affective Information[13]this paper proposes the Pervasive Environment for Affective Healthcare (PEACH) framework, a middle ware level support for affective healthcare. Photoplethysmogram Measurement Without Direct Skin-to-Sensor Contact Using an Adaptive Light Source Intensity Control[14] this paper developed a chair-attached, non intrusive photoplethym oogram (PPG)measuring system for everyday life,unconstrained monitoring using non skin-contacting sensor-amplifier circuits capable of emitting suitable light intensity adaptable to clothing characteristics[14].

myHealthAssistant:A Phone-based Body Sensor Network that Captures the Wearer's Exercises throughout the Day[15] this paper presents a novel witness and preventive health care system with a flexible and easy to deploy platform. With its low power, flexible and compact design, the BSN nodes provide a versatile environment for wireless sensing research and development. wireless biomedical sensor network for home based ECG monitoring[18]This paper focuses at the development of a mote platform for Wireless Biomedical Sensor Network(WBSN),named Telekom Research Group (TRG) mote that complies with IEEE802.15.4 standard and operates in 2.4 GHz ISM band.Since energy consumption is a major concern for any wireless sensor network, the mote design utilizes a low power 8-bit PIC18F452 microcontroller and XBee wireless transceiver module[18].TRG mote. Sink Mote technique is used in this paper. Body Sensor Network Platform For Pervasive Healthcare Monitoring[19]in this paper to facilitate research and development in BSN and multi-sensor data fusion, a BSN hardware development platform is presented. With its low power, flexible and compact design, the BSN nodes provide a versatile environment for wireless sensing research and development[19].IEEE 802.15.4 standards is used in this paper[19].The drawback is STSOM and Bayesian context detection framework for outlining the strength and research challenges of context aware sensing.

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III. METHODOLOGY

The aging population of developed countries present a growing slice of governments budget, and presents new challenges to health care systems, namely with elderly people living on independent senior housing. As body sensor network systems are capable of continuously monitoring a person's physiological and physical state , they can provide patients with the required information and motivation[4][6]. Combined with the additional information of the user's surroundings via ambient sensors, full-fledged Body and Ambient Sensor Network (BASN) health monitoring solutions can be built to face these upcoming challenges in health care systems.In proposed system wireless sensors are used for monitoring patient. For critical patient monitoring data has to reach to doctor quickly. So to provide immediate data to doctor proposed system use MEMAC protocol for communication. In proposed system threshold value is set for patient record if any patient record cross threshold value then immediately patient record is send to doctor,that record is not kept in queue in control unit. In Proposed system MEMAC protocol is used for avoiding congestion in network. For immediately sending selected. critical patient data to doctor priority field is added to patient record[6].In proposed system the concept of load balancing is used for reducing the number of data transmission[9].

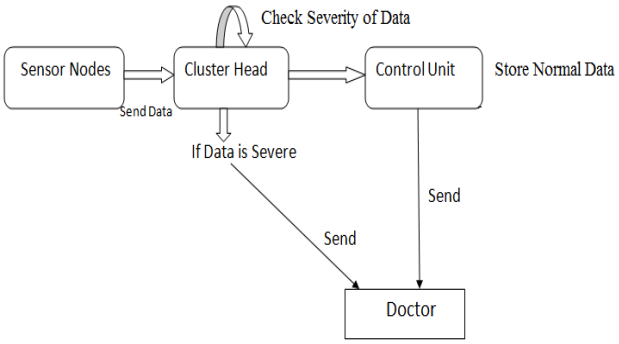

Figure 1:- Proposed System Flow

Cluster forms the group of sensor nodes from each group one node is select as cluster head. This cluster head will communicate with the central unit. Each sensor node will send data to only cluster head[25]. So by using concept of load balancing number of data transmission are get reduced and also remove congestion in the network. Figure 2 shows the working of the proposed system.

1.Clustering Algorithm-:

Collection of sensor nodes are called as clustering.In this the sensor nodes are partitioned into different clusters.Each cluster is managed by a node referred as cluster Head and other nodes are referred as cluster nodes.This cluster head collect data form nodes process it and send it to base station.clustering reduces the data transmission of nodes. Cluster nodes do not directly communicate with sink node.they have to pass collected data to cluster head.Cluser head aggregate data received from nodes and transmit it to base station.It minimizes the energy consumption and number of messages communicated to base station

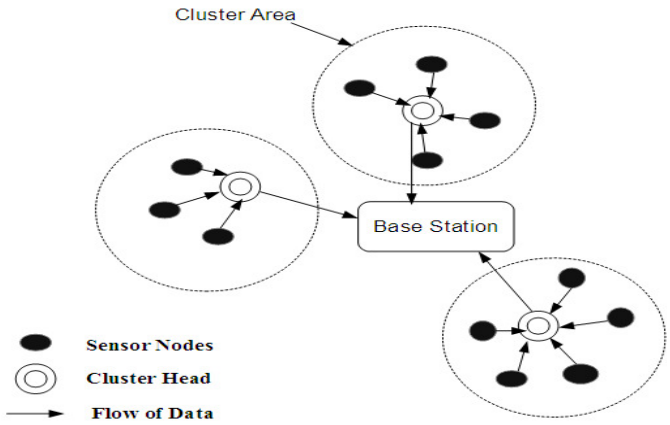

Figure 2 :- Clustering Concept

Clustering increases network lifetime through data aggregation. Followings are the clustering algorithm steps.
1.Sensor nodes Broadcast data to other nodes.
2.Node with highest energy is selected as cluster head
3.Cluster head send their data within cluster
4.If cluster head fails repeat from step 1

2.MEMAC Protocol-:

The challenges of mobility condition then we can describe it as change in position of node from one cluster to another or what happen when cluster head get removed or change in its own position in cluster. These all challenges overcome by MEMAC. MEMAC handles mobility by implementing clustering algorithm.

Let S be MEMAC protocol system in which S={C, CH,N,A}Where c= set of clusters & C={C0,C1,C2,…….,Cn}, CH= set of cluster heads & CH= {CH0,CH1,CH2,…….,CHn}, n=set of sensor nodes & N={n0,n1,n2,…….,nn},A=Analyser. Algorithm will execute following functions to get required result.Efficiency depends on how many times function will execute in moment-Creation of Network, Traversing,Creation of cluster and Calculation of Cluster heads.

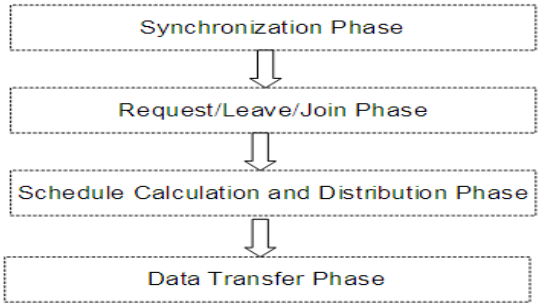

Figure 3 :- Flow of MEMAC Protocol

i) **Synchronization phase**-At the beginning all sensor nodes should be in receive node to capture SYNC message that broadcast by the head node. The SYNC message contains the synchronization information for the packet transmission.
ii)**Request\Leave\Join phase**-In case of request or leave phase the contention period should be long enough to enable all sensor nodes that have data to transmit contain for the channel in order to acquire the access to send its request to CH as well as those nodes which are expected to leave or join the cluster should the CH by sending message of leave or join.
iii) **Schedule calculation and distribution phase**-In this phase CH broadcast the calculated schedule to the other node within cluster. The schedule contains those nodes which have data to send only. The current schedule do not consider nodes that want to leave or join the cluster. If the number of request message is greater than number of join or leave messages, then frame length is increased otherwise decreased.
iv) **Data transfer phase**-In this phase TDMA slots transmit their data to CH or to communicate their neighbors through sensor nodes. Sensor nodes which have no traffic to receive data enter into sleep node. Once data are reported to CH, the base station collects data from CH and responsible for calculating and distributing time slot to CH and assume that random access period is removed.

IV. PERFORMANCE ANALYSIS

1.Platform

For implementation of system windows base operating system is required, we are using JAVA Net Beans IDE environment. The Net Beans project consists of an open-source IDE and powerful application platform that enable developers to rapidly create web, enterprise, desktop, and mobile applications using th JAVA platform , JavaS for script. For storing and retrieving parameters value dynamically use Database i.e mysql.
Followings are the input for system

2.Results

Results are drawn base on energy of nodes,latency of data sending and receiving.

A.Energy Efficiency (Reduced Battery Level) Between Proposed and Existing System(In Percent)-

Following table shows sensor node wise comparison between existing and proposed system based on energy(power) parameter. In proposed system clustering concept is used for reducing energy of nodes.

Table 1-Energy Consumption Difference Between Existing & Proposed System

Patient Records	Without Clustering (%) (Existing System)	With Clustering (%) (Proposed System)
10	20	5
20	40	10
30	60	15
40	80	20
50	100	25

In existing system no clustering technique was there, it requires more energy for data Communication. Following graph shows the graphical view of the above mentioned table

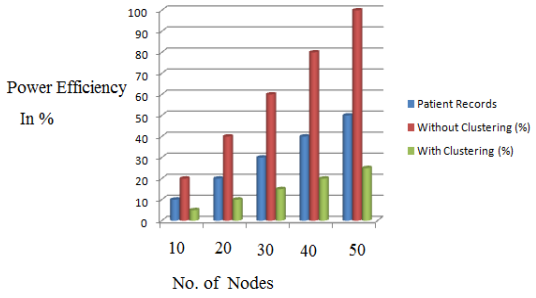

Figure 4 :– Power Efficiency between proposed and existing system.

B.Average Energy Efficiency Between With Clustering & without clustering technique -:

Following graph shows the difference between with clustering and without clustering technique.In proposed system clustering technique is used for grouping nodes that reduces energy for communication within nodes.But in existing system no such kind of concept is used, in that node to node communication is done.So it requires more energy as compared to proposed system.

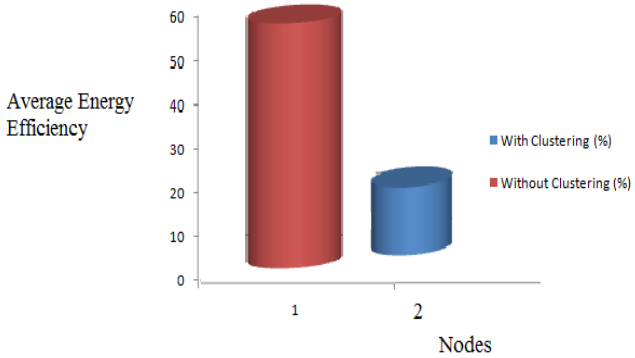

Figure 5 :- Averge Energy Efficinecy of nodes

C. Latency of Data Communication -:

While sending data from node to node latency of data is get increased because there is problem of large number of nodes are sending there data to central point.But in Proposed system with the help of MEMAC protocol and clustering latency

period is reduced.Following table shows the difference between proposed and existing system in terms of time (seconds)

Table 2 -: Latency of data Sending

No. of Nodes	Existing System (Sec)	Proposed System (sec)
10	5	1
20	10	2
30	15	3
40	20	4
50	25	5

Above table is represented in the form of graph as follows.Graph shows that proposed system requires less amount of time as compared to existing system.As shown in figure 5 x axis represent the time in seconds and y axis represent the number of nodes.If number of nodes are 10 then latency of data sending is 5 seconds in existing system & in proposed system it is 1 seconds.Same way for 20 nodes 10 seconds are required by existing system & 2 seconds are required by proposed system.As the number of nodes are get increased the time required by existing is more and as compared to existing system proposed system requires less time.Hence it is proved that proposed system requires less time for data sending than existing system.

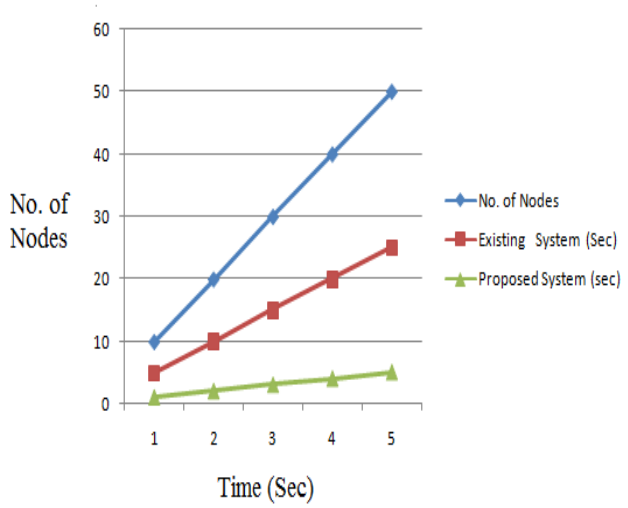

Figure 6 :- Comparison Between Latency Period of Data Sending in existing & proposed system.

D.Latency of Receiving Data -:

In proposed system nodes are grouped into cluster ,each cluster has one head and all other nodes in that cluster send there data to cluster head.So with the help of clustering network overhead or congestion in network is get reduced.Following graph shows the latency period for receiving data from different nodes. As shown in figure 6 x axis represnt the time in seconds and y axis represent the no. Of nodes.For 10 nodes 5 seconds are required for receiving data same way for 20 nodes it require 10 seconds for receiving data

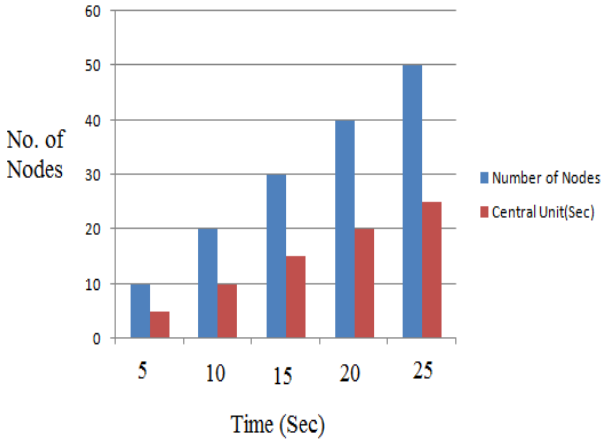

Figure 7 :- Difference Between latency period of data receiving between proposed and existing system.

CONCLUSION

In wireless sensor network data is routed using hierarchical or dynamic topology but this leads to high delay, congestion in network and more energy consumption so this leads to reduction in network performance. To overcome this limitation proposed system use the concept of Memac protocol and network load balancing(Clustering). By using this concept wireless network performance was improved. Proposed System helps to improve performance of communication and increase efficiency wireless network. It also provides communication opportunities to entities in intermittently connected network with a lower communication overhead. In Future It is still interesting to investigate other forwarding strategies to see if performance can be enhanced further.

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