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Patient Health Monitoring in Wireless Sensor Network

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Abstract: - The most fundamental appliance of Wireless Sensor Network (WSN) is health monitoring systems. The factors which make health monitoring modules efficient involve the transmission of data without any discrepancy and time delay. The Sensor Network of these wireless modules must have a reliable range and must be competent to deliver the signal. Former works [17] have shown the use of parallel offloading for transmission of data via the wireless Health network. The current work shown below applies the LEACH (Low Energy Adaptive Clustering Hierarchy) Protocol for sharpening the Health Monitoring Network's efficacy. This method ensures lowering of Packet Loss Ratio and Energy Consumption in the case of Mobile Health monitoring modules, providing a secure deportation of Patient Health Record (PHR).

Keyword:-Health Monitoring Design Issues, Wi-Fi, Wimax, Health Is Monitoring Design Issues, Wireless Sensor Networks, Etc.

I. INTRODUCTION

Nowadays, Health monitoring systems are used in nursing home setups to display the patient health record to their doctors and relatives. This is achieved with the help of the wireless network that has been established for such environment. These systems are developed in such a way that they show the essential health-related data of the patient uninterruptedly, which is helpful in cases of emergency as it establishes a way to analyze the patient health data without any time lapse. The main task of the researchers is to develop a method which is secure and fast for the transferring of such critical and life saving data. While refining the method one has to pay attention to certain determinants such as, power utilized by the sensor, estimated time that the to and fro of data will take, and the energy expenditure in these tasks. In the transmission of such health data from sensor to the coordinator, radio channels are used. The biomedical sensor is attached to the patient's body, which reads the physiological aspects of health and convert it into a signal. This signal, with the help of wireless monitoring devices is sent to the doctor. This method of monitoring clinical data of the patient possess many advantages, such as in the case of emergencies and the time saved by both the patient and the doctor. The doctor can examine more than one patient at any given time, whereas the patient saves time that would have been consumed in meeting with the doctor.

Wireless Sensor Network is a necessary technology for ambient assisted living . The health monitoring systems that are based on mobile and monitor PC, show the main physiological parameters; blood pressure, diabetes and heart rate on their screens. Before the use of wireless monitoring, the data was limited up to the side of patient bed. Now with the help of these systems one can transfer it to anywhere. In case of any hindrance in the transmission of data, the data is transferred with the help of 3G cellular networks. If by any chance the transmission stops and the patient is not in the range of cellular 3G, then the ad-hoc based wireless network is used. In the wireless ad-hoc network when more than one patient are sending data then multi-hop routing based scheme can be used in wireless network.

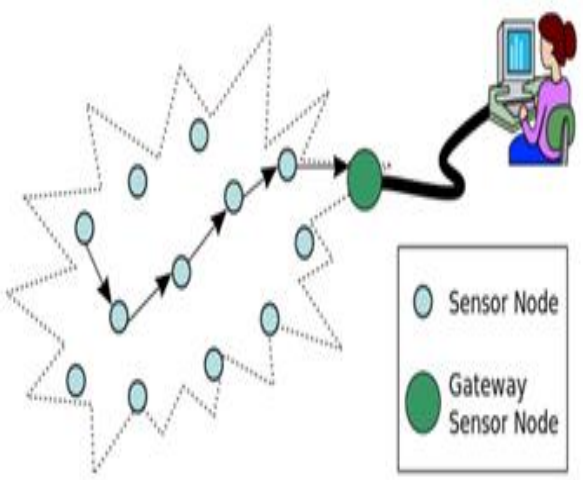

Fig 1. Multi- Hop Wireless Sensor Network Architecture

Certain of the technologies that have been used in monitoring health data are given below. These technologies use a wide range of transmission methods such as cellular/3G, Wi-Fi mesh, WiMAX. This ensures the accessing of data by both the doctor and the patient. Wireless sensor, Bluetooth, RFID, Zigbee are also some of the methods for health data transmission [18].

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A. WIMAX

As it is based on the IEEE 802.16 standard, therefore it is called the wireless MAN standard. WiMax is implemented for transmitting the data over a long distance. Having a range of up to 50 km and a speed of 70 Mbps, WiMax can transfer data with the advanced radio transmission based technologies such as adaptive modulation and coding (AMC), orthogonal frequency division multiplexing (OFDM), Adaptive forward error correction(FEC).

B.WLAN

WLAN was firstly introduced in 1997 by name IEEE 802.11. Its initial version had a speed limit of 1-2 Mbps. Later versions, such as IEEE 802.11a had achieved the speed limit of 54 MBPS and had a range of up to 100 feet while IEEE 802.11b contain the speed up to 54 MBPS with a range of 350 feet. After introduction of IEEE 802.11b and IEEE 802.11, a Wi-Fi alliance gets set up which activates the wireless sensor for the wireless transmission of health and structural type of data?

After many attempts to increase the range and speed of IEEE 802.11, in 2003, 802.11 g was introduced. The capability of 802.11 was 52 Mbps and it worked at 2.4 GHz based on the range of 350 feet outdoors and 150 feet indoors. Later on, IEEE 802.11n gave a speed up to 200 Mbps. In 2004 802.11 i was launched which had the feature of improved security and IEEE 800.11 s which worked with mesh networks.

C.WPAN

WPA was used with Bluetooth and Zigbee type of transmission standards with the goal of patient monitoring. It is used for tracking the patient and the location of the patient. Zigbee is extra technology in WPAN so it is called by 802.15.4. In this system, all the nodes utilized ultra low power and therefore proved good for monitoring the patient. This ultra low power consumption was due to the fact the Zig-Bee based nodes enter a sleep mode. The inactive state for these sensors was only for less than 1 % time.

D. WBAN

In the recent technology, the sensors that are used are generally tiny, have low power consumption, and are lightweight. WBAN (Wireless Body integrative Network) is designed to use these type of sensors. This kind of low power based sensors are used for transmitting the patient data who are in critical condition. Vital signals are sent with the help of these sensors, which work even from the range of outside the hospital. Zigbee and UWB type of sensors are the ones mainly used in WBAN medical field for health data transmission. These signals are sent over a personal server and is then put through a personal PC, mobile or laptop. The health data then is transmitted to the health care server.

II. RELATED WORK

In this literature, many applications of mobile computing and communication technologies are being presented. In paper [1], LV et.al has shown the employment of wireless sensor and smartphones for the monitoring of patients. Here, we have discussed certain methods and functions of the health care system which involve intimidating the patient's relatives and automatic calling of the ambulance in case of an emergency. Chowdharyet.al [4] explained a middleware for support, which use energy efficiently in the case of remote health monitoring system. It was further stated that the medical data generated by the physical biomedical sensor and transferred to the next server. The biomedical sensor was used to send the patient's data to the doctor and the patient's relatives so that they could access the information. Parallel offloading based health monitoring system is equivalent to the middleware based health monitoring system. The only difference is the amount of energy consumed in both the cases.

S.Reddyet.al [9] introduced the concept of back-end servers, which stored the data sent by the sensor for future purposes. S.Nathet.al [10] brought in the approach of web portal servers which provided indexed health data, queries and patient health report in the geocentric web.

Parallel offloading based health data transmission differs from these approaches as it provides local information of the patient through P2P overlay network and work for large scale sensing devices. J.H. Ahnn et.al [8] presented a P2P network based offloading for two-tier mobile health monitoring.

E.Cuervay et.al [5] conceptualised MAVI methodologies. Whereas, B.G Chun et.al [3] mentioned a clone cloud-based health monitoring based system for the patient. M.satyanarayanan et.al [7] further discussed it with cloud sets for patient monitoring. X.Zhang et.al [14] represented a model in which cost of the system design decided best execution configuration. Another model[15], was quite similar to the idea presented by X.Zhang et.al. The only difference was that in the new model [15], there was a lack of dynamic adaption between the mobile devices and cloud services.

Previously the models that were designed had only the goal of low energy consumption in mobile devices. But in the case of Parallel offloading based mobile health monitoring, optimized energy consumption is to be achieved for the desired network and cloud.

The mobile based monitoring systems had patients with biomedical sensors, and transmission of health data wirelessly witha cloud based medium for storage. All this was achieved at a low cost.

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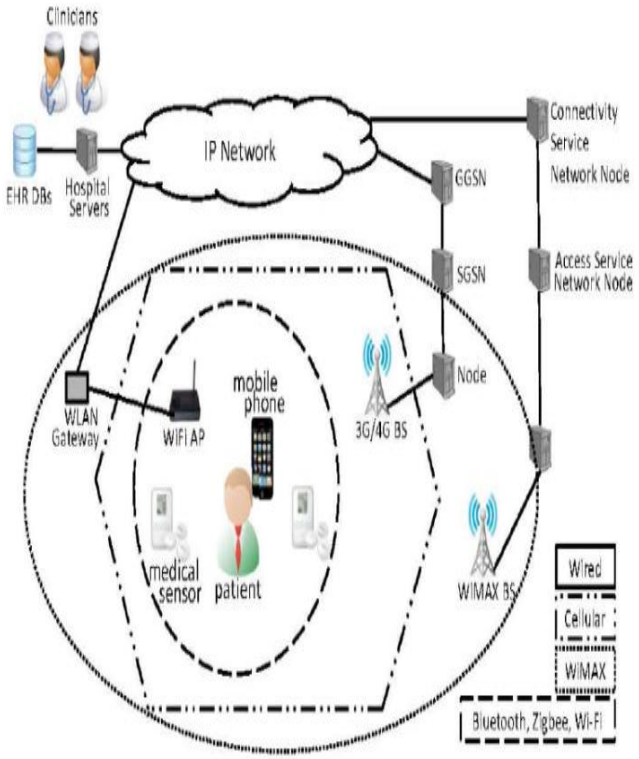

Fig 2.Smart Phone Based Mobile Health Network Architecture

JunyHoon et.al [17] presented distribution based solution for network allocation, network selection. They proposed location based sensor data retrieval methodology known as mhealthMon. This approach helped in health data transmission over a long distance and informed the relatives and the doctor of the patient's location in case of an emergency.

III. SYSTEM MODEL

J.H.Ahnn [8] refer to the idea as to how one can retrieve information and store it in an external data source system. For this, P2P overlay network was used for location awareness data management.

In another module [17], they applied a regression theory for computational modeling of mobile applications based on the empirical measurement of data. For transmission of health data, WLAN, the cellular network, WIMAX based networks were used.

A. Computational Model

Single basic functional blocks(BFB) software programs are computational model with both local and global variables. They require a set of inputs, giving a computed output accordingly.

Whereas the mobile based sensing application works with the help of a heterogeneous hardware environment, deriving the statistical interference model by applying theory of regression. For this, the numbers of sensors have to be small, where each sample will denote the BFB execution time for a particular machine.

B. Wireless Network Model

Wi-Fi, WiMax, GSM and UMTS consider multiple wireless network models for data transmission.

IV. PROBLEM IDENTIFICATION

As discussed, many methods can be used to transfer the data captured by the biomedical sensors, with the motive to inform the doctor and the relatives in the case of an emergency. Therefore the problems addressed here are of energy consumption and packet loss ratio. In wireless sensor network, every node consumes some power or energy which makes it the main issue. Any reduction in this will consecutively increase the sensor's lifetime and the total energy required by the network will diminish comparatively. In reference to the packet data loss, such an occurrence will hinder the doctor to see the patient due to loss in transmission. This can be curtailed by establishing a proper communication network

V. PROPOSED METHODOLOGY

For the problems associated with the energy consumption and packet loss ratio, we are introducing LEACH protocol based wireless sensor network for patient health data transmission.

In LEACH, each running process, reconstruction of cluster executive cyclic, process of reconstruction can be described as rounds. Every round comprises of two parts. First, the phase is established and then the data transmission phase is stabilized. Cluster establishment is done by the procedure of Node Selection, First Node cluster, Radio Establishment and mechanism of cluster scheduling. For the specific choice of cluster head node, a threshold is calculated for the sensor network for some factors. For selecting the rounds of cluster head node, every sensor is given a random value between 0 to 1. If the sensor node value is below from the threshold value then this type of sensor node will be selected as first node of the cluster.

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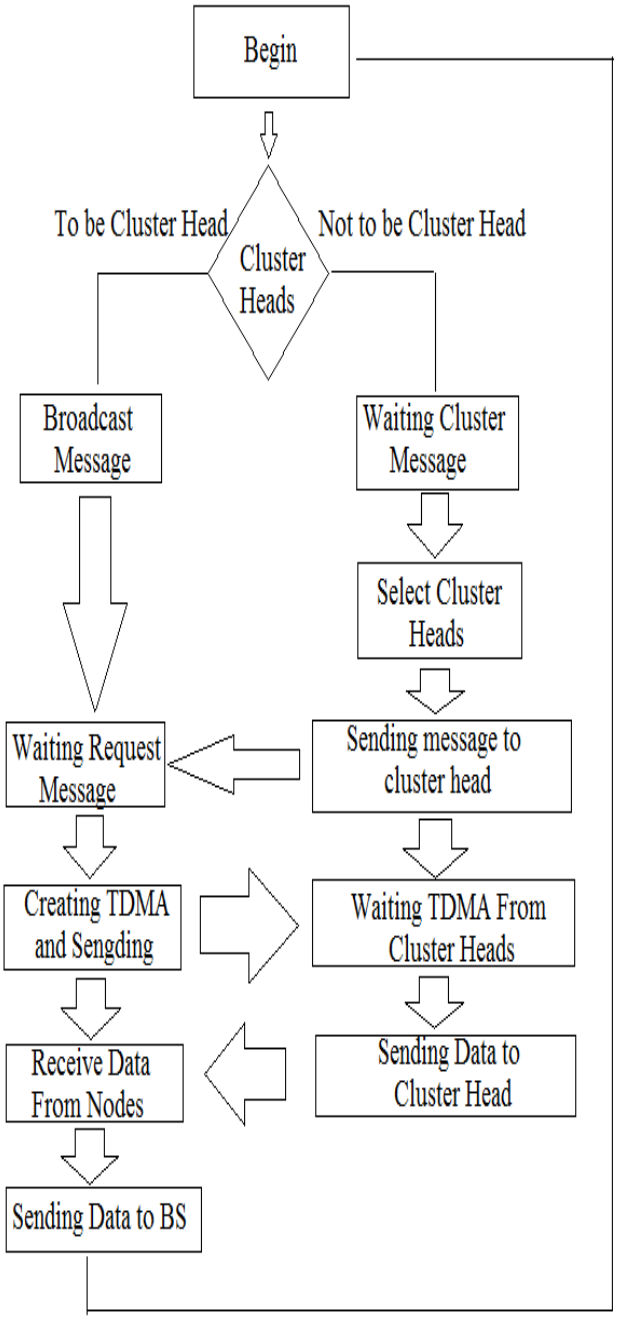

Fig 3. Flow Chart of LEACH Protocol

TDMA is using for cluster head nodes so that sequential timing distribution can occur. The data transmission will start from the stable state, where all wireless sensor nodes will send sending data to the cluster head node. In the cluster head, all the data will be integrated to form the information. Now cluster head will send the integrated information to the BS (Base Station). The flowchart for the algorithm is shown in figure3.

VI. RESULTS

In the Result session, we show the comparison for parallel offloading and LEACH protocol based wireless Health Data transmission. For show the improvement, we are showing results in energy consumption and Packet Loss Ratio for LEACH Protocol and Parallel Offloading methodology.

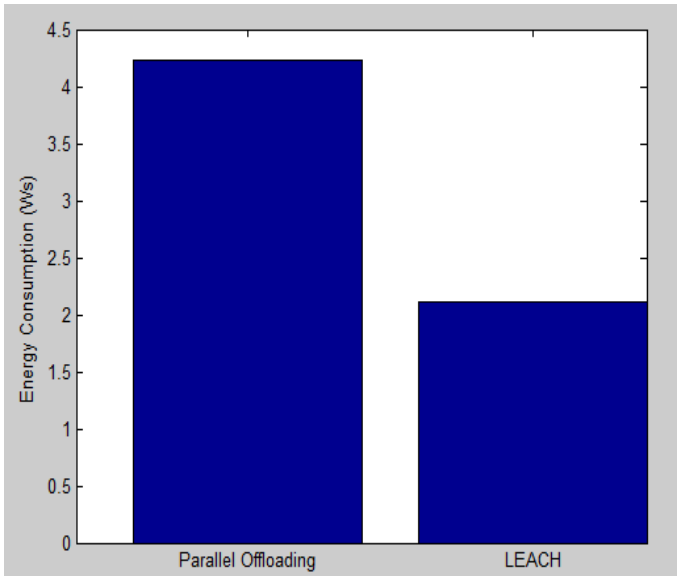

Fig 4. Energy Consumption for Parallel Offloading and LEACH Protocol

As we can see from figure 4 energy consumption is low for LEACH protocol based Health transmission compare to Parallel offloading health data transmission.

Figure 5 is showing the results comparison for packet Loss Ratio for LEACH and parallel offloading based health data transmission.

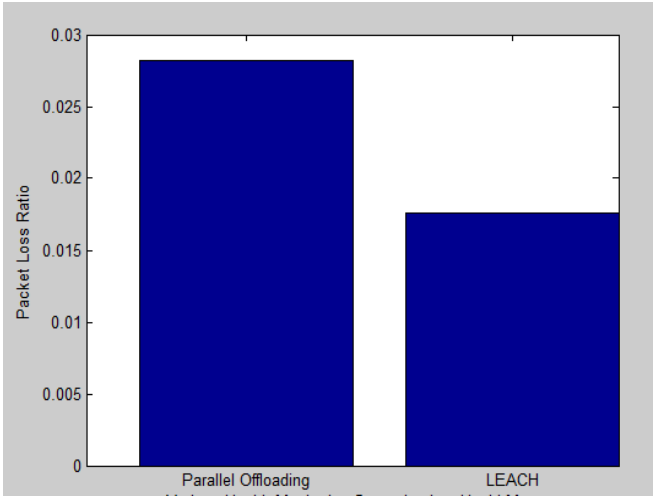

Fig 5. Packet loss Ratio for Parallel Offloading and LEACH Protocol.

VII. CONCLUSION

As discussed, the performance of the wireless Health monitoring system has to be increased so that Patient Data can be transmitted securely and easily, where the prime components are Packet Loss Ratio and Energy consumption. The biomedical wireless sensors work at a cycle with low energy consumption for increasing the life expectancy of the network. Whereas, from the results it can be inferred that the Packet Loss Ratio and Energy Consumption is small for LEACH Protocol.

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