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Patient Monitoring System using IoT

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Abstract- **Internet of thing (IOT) is vital part in every sector of day to day life. Now a days it is trending area. Smart city related projects, smart homes, intelligent transportations, patient monitoring system are all associated with single concept called IOT. Internet of Things is nothing but communication between objects that contain embedded technology with existing internet infrastructure. By using wireless sensor network, intelligent monitoring and reliable communication between things can be achieved. Data dissemination and data aggregation are big challenges in wireless network (Sensor).The target of paper is to achieve efficient transmission of data from source (patients) to destination (Doctors) by data aggregation and data dissemination. Data aggregation means collection or gathering of data in such a manner to increase energy efficiency and Data dissemination to route the data in sensor network to reduce delay of transmission of data from source to destination.**

Keyword- **Internet of Things, patient monitoring system, wireless body area network, energy efficiency, delay.**

I. INTRODUCTION:

Internet of Things (IOT) is advanced area which includes embedded technology, wireless sensor network, artificial intelligence and machine learning etc. to intercommunicate things. IOT improves user convenience and also enhances data collection. It optimizes various technologies in single area called IOT. IOT has applications across different fields like industries, engineering and medical. To improve existing medical systems IOT is applicable. In medical IOT, Wireless Body Area Network (WBAN) is key concept which is network of autonomous medical sensors which are deployed inside or outside of the patient body for health monitoring. In WBAN, deployed wearable sensors senses health conditions like pulse rate, heart beats, blood pressure, temperature etc. using IOT exploited devices. Data from multiple sensor nodes is collected to sink called data fusion and it is transmitted to analyser.

In wireless sensor networks, data is passes through communication from one end to another end. Information can be travel hop by hop or multihop manner in the sensor network [5]. But for reliable data delivery over the network, faster data transmission is necessary during communication. So, different types of routing protocols are used by researchers. Routing protocols are helps to search minimum distance path between sources and sink node [6] [7]. Energy efficiency is important factor in wireless sensor networks. Heavily congested network will be consuming more energy in the network. So, different MAC and routing protocols are used for to increase the energy efficiency of the node [8]. Some hybrid protocols also designed for reduce power consumption by the nodes. Clustering technique is a better solution for achieve energy efficiency over the network communication [9] [10]. Energy parameter effected due to the collision of packets during packets travel from one node another node. In case of large application, multiple nodes can send packet at a same time to the receiver end [11] [12]. So collision event will be generating near the receiver end. Hybrid MAC protocols are designed and developed for solve congestion and collision problem in wireless sensor networks [13][14]. Routing as well as MAC protocols are necessary for reliable data delivery in the network.[15] In case of intermediate node failure, routing protocols should be select alternative path for packets delivery over the network [16] [17].

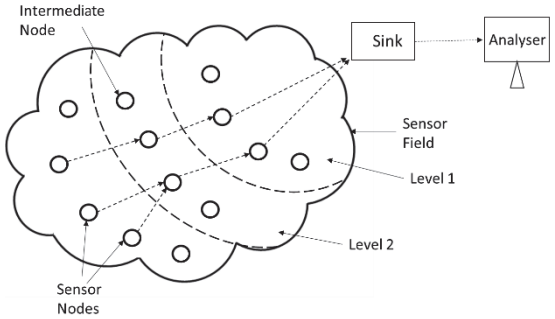

Fig. 1. Basic Architecture of Wireless sensor Wireless sensor networks (WSN) consists anywhere from a few hundreds to thousands of sensor nodes. These sensors are spatially distributed autonomous sensors which monitor physical or environmental conditions, such as temperature, sound, pressure, etc.

Figure 1. shows the collected data is then passed through the network to the sink node. The sink node is a node where the data is collected from the deployed nodes. The parameters for the measurement of performance of the networks are throughput, delay, energy efficiency, reliability, packet delivery ratio, bandwidth utilization, energy consumption etc.

II. LITERATURE SURVEY:

To implement an Autonomous WBAN, author Taiyang Wu et. al. proposed a wearable sensor node with Solar Energy Harvester. It is controlled by an output based MPPT (Maximum Power Point Tracking) technique. BLE transmission technique is used for transmitting sensor data. To

display such data and to send notifications in case of emergency, web based smart phone application is designed. MPPT technique is used to extract the maximum power from a flexible Solar Panel. Experimental analysis shows, under different conditions, Solar panel can be controlled by proposed MPPT technique. 24 hrs work of the sensor can be achieved, when sensor node is set to 10 min wake-sleep mode. In the future work, for the backup of Energy, battery may also be used as a secondary storage in case of bad weather condition [1].

A wearable sensor system is proposed containing ECG (electrocardiogram), PPG (photoplethysmogram) and IMU (Inertial measurement units) to analyze the behavior of dog. Vital sign such as heart rate may serve as sign as stress or excitement, this information can be used by handlers to improve the training. ECG and PPG are connected to Beagle Bone black (BBB), BBB is used as processing unit. The output of ECG and PPG are in analog so they are connected to ADC pins of BBB. In case Wi-Fi is not available Texas instruments SOC (cc2541) can be used. It could be connected to smart phone and data can be analysed [2].

For the purpose of continuous cardiac health monitoring, Udit Satija et. al. has proposed an ECG telemetry system which provides novel signal quality aware IOT system. The system consists of 3 modules: 1. Sensing module for sensing ECG signal
2. A module for automatic signal analysis 3. ECG analysis and transmission module which is signal quality aware. The prime objective of this paper was to produce a light weight ECG signal quality analysis module which classifies an ECG signal into the class of acceptable and unacceptable signals. The major challenge was that majority of the energy which amounts to 80% was used for communication purpose only. Energy consumption was significantly reduced as only the acceptable ECG signals were transmitted and the unacceptable signals were rejected and for unacceptable signals the IOT device was put into sleep mode thus saving a lot of energy. From evaluation results was observed that smart phone application framework had the ability to render the ECG signals noise free and send them to the cloud server or doctor. From the analysis and results it was evaluated that power consumption was reduced by almost 33% by eliminating the unwanted bad signals [3].

Monitoring patients continuously is very crucial and for this body sensor networks are an excellent technology. In WBSN's the physiological measurements are taken periodically from the biosensors which then send the collected data to the coordinator where in the next successive steps the data fusion occurs. Biosensors collect a huge amount of data which has to be processed but they have limited lifetime so the task of processing the data and taking the right decisions in case of an emergency is a major challenge. The paper proposes a data management framework called the 'modified LED*' for biosensors which begins its working right from data collection to making the right decisions. The proposed system works in such a way that it reduces the amount of data collected but at the same time maintains the nobility of the data. In other systems, several readings are taken on several periods and based on it the decisions are made however the proposed system can take a decision at one period with only one set of reading. The main objective is to select a decision which is a

best match to the score values obtained after computations. Experiments done on the parameters of respiration and body temperature shows that the proposed system led to data reduction of up to 50% and resulted in 3 to 4 times more saved energy. This shows the effectiveness of the proposed 'modified LED*' which considerably reduces the energy consumption as well as the data collected and all the while maintaining significant amount of data integrity [4].

LITURATURE SURVEY TABLE

TABLE 1. Literature Survey

Paper No.	Used Technique/ Algorithm/ Protocol	Parameter Achieved
1	Solar Energy Harvester which is controlled by an output based MPPT (Maximum Power Point Tracking) technique	Maximum power
2	Wearable sensor system combining ECG, PPG and IMU	Impedance below stainless steel
3	ECG telemetry system for IOT-base health care monitoring system.	1] Reduce energy consumption 2] Reduce noise from ECG signal.
4	Modified Local Emergency Detection (LED)	1] Data reduction 2] Less energy consumption 3] Sustained data integrity
5	Delay-constrained energy multi-hop (DCEM)	Optimal trade-off between energy

		consumption and end to end delay
6	Markov Chain Model	Accurate Delay Analysis
7	COPE(Cooperative Power and Energy-efficient Routing Protocol)	1] Number of dead nodes: Less 2] Number of alive nodes: More 3] Better energy efficiency, throughput 4]Packet delivery ratio 50% more
8	HEER(Hybrid Energy Efficient Reactive Protocol for Wireless Sensor Networks)	1] Energy consumption: Reduced 2] Efficiency: More
9	LEACH protocol	1] Efficiency increase 2] Avoid data loss.
10	Approximation algorithm like MC-ERDD, BC-ERDD	1] Reliability in data dissemination 2] Improve energy efficiency.
11	CSMA\CR (Collision Resolution)	1] Shorter Delay 2] Lesser packet drops.
12	Improved Aggregation Scheduling (IAS)	Minimal Delay
13	Delay Minimization algorithm	1] low complexity 2] distributed optimal solutions 3] good delay performance
14	CHEERS(Cost-based Hierarchical Energy Efficiency Routing Scheme)	1] Energy consumption: Reduced 2] Energy efficiency, lifespan, quality of network and network stability: Increased
15	Seamless Streaming Data Delivery (SSDD)	1] Better E2E transmission 2] Uninterrupted data stream 3] Shorter delay 4] Better energy efficiency

III. Result Analysis:

In patient monitoring system, numbers of 11 sensor node are randomly deployed in environmental area. Ad-hoc on demand distance vector (AODV) routing protocol is used for finding shortest path and TDMA (Time division multiple access), CSMA (carrier sense multiple access), SMAC (sensor MAC) and 802.15.4 (ZigBee) MAC protocols are used for performance analysis of the system. Reporting rate (Number of packets per second) is 10 packets /sec and packet size varies from 50 to 250 bytes.

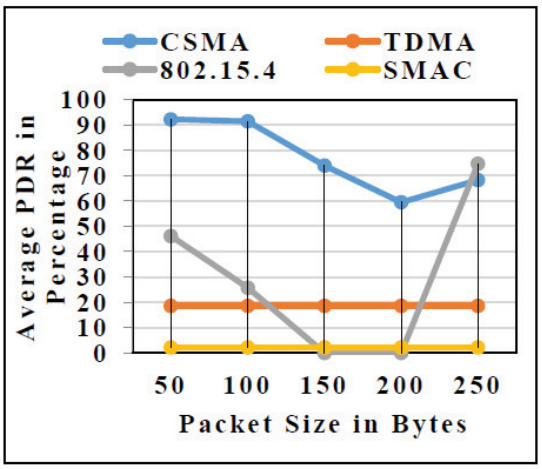

Fig 2: Average PDR for Packet Size in bytes

Figure 2: shows that average PDR for packet size in above graph. Performance of the CSMA protocol is drastically better as compare to other MAC protocols like TDMA, 802.15.4 and SMAC. CSMA is designed for collision avoidance in wireless network. So performance of the CSMA protocol is 50 to 60% better as compare to other protocols. Initially PDR for CSMA is drastic better but when packet size varying from 50 to 250 packets then performance of the CSMA is slightly decrease but still it is better as compare to other protocols. TDMA gives very poor performance in case of PDR as compare to CSMA and 802.15.4 but it gives better result compare to SMAC.

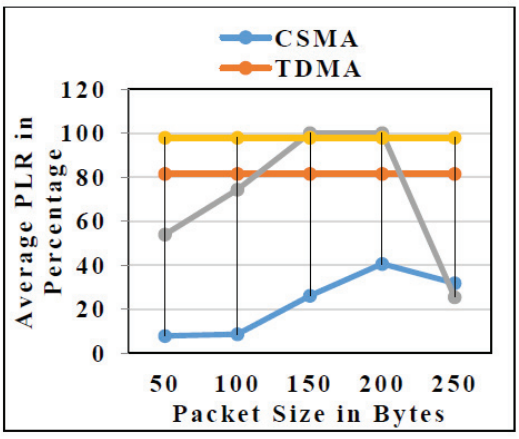

Fig 3. Average Packet loss ratio for packet size in bytes

Average packet loss ratio for packets size shown in figure 3. Average PLR for CSMA is drastically better as compare to other MAC Protocols. When packet size varies from 50 to 250 bytes packet loss ratio for CSMA increase slightly compare to TDMA, 802.15.4 and SMAC. Size of packets increase congestion and collision, so when packets size increase then PLR also increase for different protocols. SMAC gives very poor results as compare to TDMA, CSMA and 802.15.4. Performance of the TDMA and 802.15.4 is very poor for packet loss ratio.

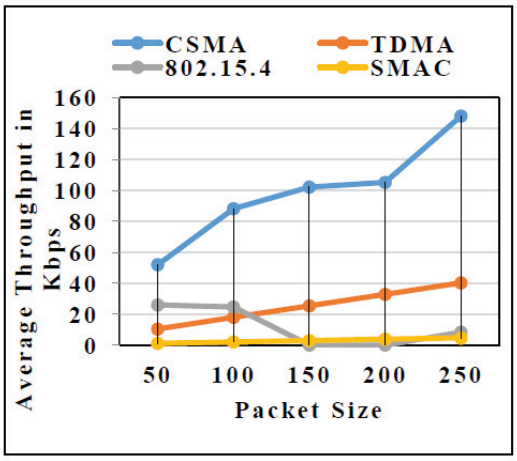

Fig 4. Average throughput for packet size in bytes

Figure 4. Shows average throughput for packet size. Performance of the CSMA for average throughput for 50byte packet size is 15% better as compare to TDMA, 802.15.4 and SMAC. When packet size varies from 50 to 250 bytes packet size then average throughput for CSMA increase from 15% to 40%. Collision free data delivery through communication channel and utilization of communication channel increase network throughput for CSMA. Less utilization of communication channel in SMAC, TDMA and 802.15.4 decrease network throughput in the network.

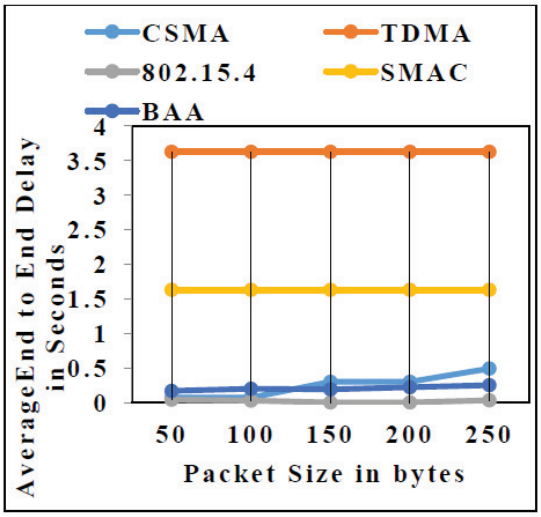

Fig 5. Average End to End delay for packet size in bytes

Average end to end delay for packet size shows in figure 5 for different protocols. Packet delivery within time and using minimum delay is a need of networks. Collision avoidance and detection are the properties of CSMA protocol. It works with RTS and CTS signals, so congestion over the networks and delay reduces using CSMA. So performance of the CSMA protocol for average end to end delay is drastically good as compare to other MAC protocols. It gives 50% better end to end delay as compare to TDMA and 5 to 10% less delay as compare to SMAC and 802.15.4. time slot allocation strategy and scheduling in the TDMA increase end to end delay during data delivery from source to sink node.

IV. Conclusion:

In this paper, we have studied different papers for patient monitoring system. Data collection is a main challenge in patient monitoring system. MAC protocols are important in wireless communication system for transfer data from source to sink. Performance of the CSMA is drastically good for varying reporting rate from 10 to 50 packets per sec. CSMA gives 20 to 45% better result for PDR, 40 to 60% better result for PLR, 10 to 40% better result for delay and 15 to 45% better result for throughput as compare to TDMA, SMAC, 802.15.4 MAC protocols. Rate of packet transmission increase then congestion of the network will be increase. So when reporting rate varies then performance of the MAC protocols also decreases like TDMA and SMAC. In future work, will studied more good MAC protocols papers in the network.

REFERENCES

[1] T Wu, F Wu, Jean-Michel R, and Mehmet R, "An Auto-nomous Wireless BodyAreaNetwork Implementaton towards -IOT connected to Healthcare Applications", IEEE Access, vol.5, pp.11413-11422, June 2017.

[2] Rita B, T, James Dieffenderfer, K Walker, S Yuschak, B L. Sherman, David L. Roberts, and AlperBozkurt, "Wearable Heart-Rate Sensor Systems for Wireless Canne Health Monitoring", IEEE Sensors-Journal,vol. 16, issue. 10, pp. 34543464, May 2016.

[3] Udit S, B Rahkumar, M. Sabarimalai Manikandan, "Real-time Signal Quality-Aware ECG-Telemetry Systemfor IOT base Health Care Monitoring",IEEE Internet of Things Journal,vol. 4, issue. 3, pp.815 – 823, June 2017.

[4] C Habib, A Makhoul, RonyDarazi and C Salim, "Self-Adaptive Data Collection and Fusion for Health Monitoring Based on Body Sensor Networks", IEEE Transactions on Industrial Informatics, vol. 12, issue. 6, pp. 2342 - 2352, Dec 2016.

[5] T. Huynh, A. Dinh-Duc, and C Tran, "DelayConstrainedEnergy-Efficient Clustr-based MultiHop Routng in WirelessSensorNetworks", IEEE Journal of Commun.and Networks, vol.18, issue. 4, pp.580-588, Aug 2016.

[6] MichealDriebergVijanthSagayanAsirvadam, and Fu-Chun Z, "Accurate Delay-Analysis in Prioritized Wireless-Sensor Netwrks for Generalized Packet Arrival", IEEE Wireless Communications Letters,vol.3, issue.2, pp. 205208, April 2014.

[7] Saima J, Saqib Jamil, S Ahmed, M Zubair, F Sikandar, "COPE: Coopertive Power and Energyefficient Routing-Protocol for Wireless-Sensor Networks", IEEE Computer and Informtion Science (ICIS)2015 IEEE/ACIS 14th Interntional Conf.,pp.47-52, July2015.

[8] N. Javaid, S. N. Mohammad, K. Latif, U. Qasim, Z. A. Khan, M. A. Khan, "HEER: HybridEnergy Efficient-Reactive Protocol for Wireles-Sensor Networks", IEEE Electronics, Communications and PhotonicsConference(SIECPC), pp.1-4, July 2013.

[9] M. Salah, A. Boulouz, "Energy-Efficient Clustring Based on LEACH", IEEEEngineering & MIS (ICEMIS) Interntional Conf, Nov2016.

[10] K Han, J Luo, L Xiang, M. Xiao, L. Huang, “Achieving Energy-Efficiency &Reliablity for Data Disemination in Duty--Cycled WSNs”, IEEE/ACM Tranction on Networkng, vol. 23, issue. 4, pp. 1041-052, Aug 2015.

[11] Hyun-Ho C, I Lee, and H Lee, “Delay -Analysis of Carrier Sense MultipleAccess with Collision Resolutions”, IEEE Journal of Communcations and Network-s, vol. 17, issue. 3, pp. 275-285, June 2015.

[12] Xiaohua-Xu, Xiang-Yang Li, X Mao, S Tang and S Wang, “A Delay-Efficient Algorthm for Data Aggrgation in Multihop Wireless-Sensor Networks”, IEEE Transctions on Parallel and Distributed Systms, vol. 22, issue. 1, pp. 163-175, Jan 2011.

[13] Doina-Bein, B B. Madan, Intellignt Computr Communiction and Procesing (ICCP), “Reducing the Data Communiction Delay in Wireless-Sensor Networks”,Intelligent-Computer Communiction and Processing (ICCP), 2016 IEEE 12th International Conference, pp. 361-368, Nov 2016.

[14] Zain M, M Ali Khan, H Ahmed, U Ayub Sheikh, Ghulam-Shabbir, “Cost-based Hierarchicl Energy Efficie-nt Routng Scheme for WSNs”,Robotics and Artificial Intelligence (ICRAI), 2016 2ndInterntional Confe, pp. 218-224, Dec 2016.

[15] L Cheng, Jianwe-iNiu, Mario Di-Francesco, Sajal K. Das, ChengwenLuo and Yu Gu, “Seamless Streaming DataDelivery in Cluster-Based Wireless Sensor Networks with Mobile Elments”, IEEE Systems Journal, vol. 10, issue. 2, pp. 805-816, June2016.

[16] Dattatray S. Waghole & Vivek. S. Deshpande, “Characterization of Wireless Sensor Networks for Traffic & Delay,” IEEE, International Conference on CUBE, Pune, pp.69-72, Nov-2013.

[17] Dattatray S. Waghole & Vivek S. Deshpande, “Reducing Delay Data Dissemination Using Mobile Sink in Wireless Sensor Networks.” IJSCE, Vol-3, Issue-1, ISSN 2231-2307 pp.305-308, March-2013