Design Engineering

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

# Position Aware Congestion Control (PACC) algorithm for Disaster Management System using WSN to improve QoS

**Dattatray Waghole[1], Vivek Deshpande[2], Divya Midhunchakkaravarthy[3], Makarand Jadhav[4]**

[1]Postdoctoral Fellow, Lincoln University College, Malaysia.
Associate Professor, JSPM's Jayawantrao Sawant College of Engineering, Pune, Maharashtra (India),
dattawaghole10@gmail.com
[2]Co-Supervisor, Lincoln University College, Malaysia.
Director, Vishwakarma Institute of Information Technology, Pune, Maharashtra (India),
[3]Supervisor, Lincoln University College, Malaysia
[4]Postdoctoral Fellow, Lincoln University College, Malaysia.
Associate Professor NBN Sinhgad School of Engineering, Pune, Maharashtra (India),
makj123@yahoo.com

**Abstract**

Because of its technical advancements in processors, communication, and low-power utilisation of embedded computing devices, WSN (Wireless Sensor Network) is currently the most widely used service in corporate and industry use. The wireless sensor network design is made up of nodes that monitor variables such as temperatures, humidity, pressure, location, vibration, and sound. These sensor nodes can be used in a variety of real-time applications to perform tasks such as smart monitoring, neighbouring node discovery, information transmission & storing, collection of data, target tracking, supervise and track, synchronisation, node mapping, and efficient routing among the base station and nodes. WSNs are currently being arranged in a more advanced manner. Congestion and collisions are the biggest problems in WSNs. To address this issue, the author introduced the PACC protocol, which contributes to the achievement of good QoS in WSNs such as latency, data delivery ratio, loss ratio, and network channel efficiency. PACC is invented with regression model of Machine learning to improve results. Applications such as patient monitoring systems and disaster management systems operate in real time. Congestion and traffic management are major challenges. This protocol aids in the resolution of this issue and improves network reliability.

**Keywords**: wireless sensor networks, sensor nodes, congestion and traffic, disaster management system.

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

## I. Introduction

A wireless sensor network is a collection of geographically dispersed distributed devices that use sensors to track physical and environmental variables. WSNs are made up of a variety of nodes that range in size from a few to hundreds or even thousands of node, which are connected to one or more sensors as desired. A sensor node is made up of a radio transceiver with an integrated antenna, a microprocessor for communicating with the sensors, and an energy source, which is typically a battery. The size of a sensor node can be tiny or large. Sensor nodes can range in price from a few hundred dollars to tens of thousands of dollars. A WSN's nodes communicate with a base station, also known as a sink. These massive numbers of nodes communicate wirelessly with one another and with the base station, and are able to sense data from their surroundings, store it, send it to neighbouring sensor nodes or the base station, and do calculations on it. WSN uses include physical security, air traffic control, environmental monitoring, healthcare monitoring, military, and others. Depending on the application, sensor networks might be very different.

The sensor node is a low-power wireless device that can be used for a variety of tasks. Sensor nodes are used in a variety of industrial settings. A cluster of sensor nodes collects data from the environment to meet specified application goals. Nodes can connect with each other thanks to transceivers. In a wireless sensor network, the number of sensor nodes might range from hundreds to thousands. Unlike sensor networks, ad hoc networks will have few nodes and no architecture.

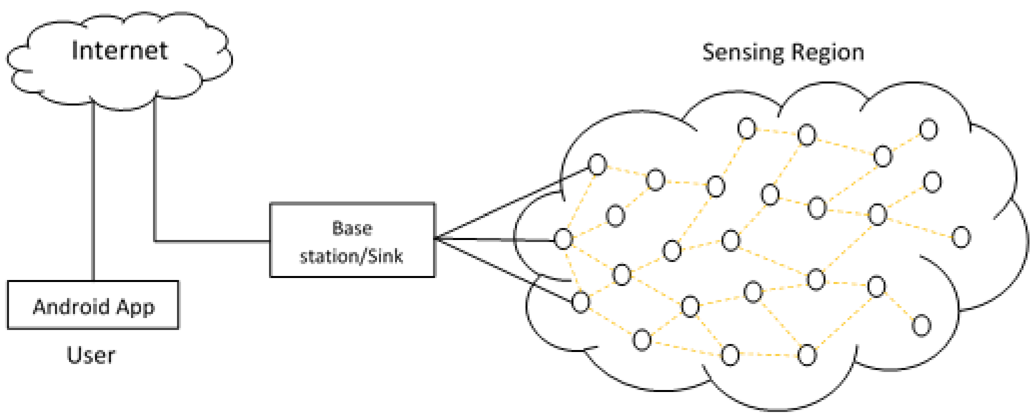


**Fig.1** Architecture of Wireless Sensor Network

A wireless sensor network (WSN) is made up of one or more sink nodes and spatially distributed sensors (also called base stations). Sensors generate sensory data by continuously measuring physical elements like temperature, vibration, and motion. A sensor node can be a data source as well as a data router. A drain, on the other hand, receives data from sensors. Sensors must convey data to the sink(s) in an event monitoring application, for example, when they identify the occurrence of events of interest. To communicate with the end-user, direct connections, the Internet, satellite, or any type of wireless communication can be employed. The diagram depicts a typical WSN architecture shown in Fig. 1.

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

## II. Literature Survey:

WSN congestion [1] may decrease the chances of a successful data transfer, decrease the quality of transmission service, and result in higher energy usage from new transmitting data. As a result, network congestion control measures must be managed. The PI queue congestion algorithm, PID queue congestion algorithm, PID queue congestion algorithm, and PI algorithm were simulated and compared in response to circumstances such as intermediate node congestion, severe performance deterioration, and high packet loss rate. as well as the PNPID algorithm It can be determined that, in most circumstances, the PNPID method can either stabilise or reduce the queue length at a position close to the expected value at various bit rates. The fluctuation of queue length is similarly low, indicating the PNPID algorithm's stability. The packet loss rate and waiting time of the PNPID method are improved when compared to the other three algorithms, demonstrating the PNPID algorithm's superior performance.

This research provided [2] a WSN reliability model that is generated automatically using the WSN architecture, as well as information on the routing methods employed and the mote's battery state. According to this paradigm, WSNs can fail in two places: connections and sensor nodes. The proposed models were evaluated using three scenarios. It was simple to show how the routing protocol, number of nodes in the area, and distance between these regions and the sink node all affect the region's reliability using these situations. In this paper, we studied at [3] the throughput and delay of wireless sensor networks using directional antennas. This study will look into the benefits of using directional antennas. Our findings apply to wireless ad hoc network latency investigations as well. We discovered that using directional antennas increases network throughput capacity while minimising multi-hop transmission delay. In reality, using directional antennas can minimise interference significantly, resulting in higher throughput. Additionally, directional antennas can increase transmission range, resulting in fewer hops.

## III. Proposed PACC Algorithm for Smart Disaster management

The general flow chart for PACC algorithm is given in Fig. 2.

Design Engineering

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

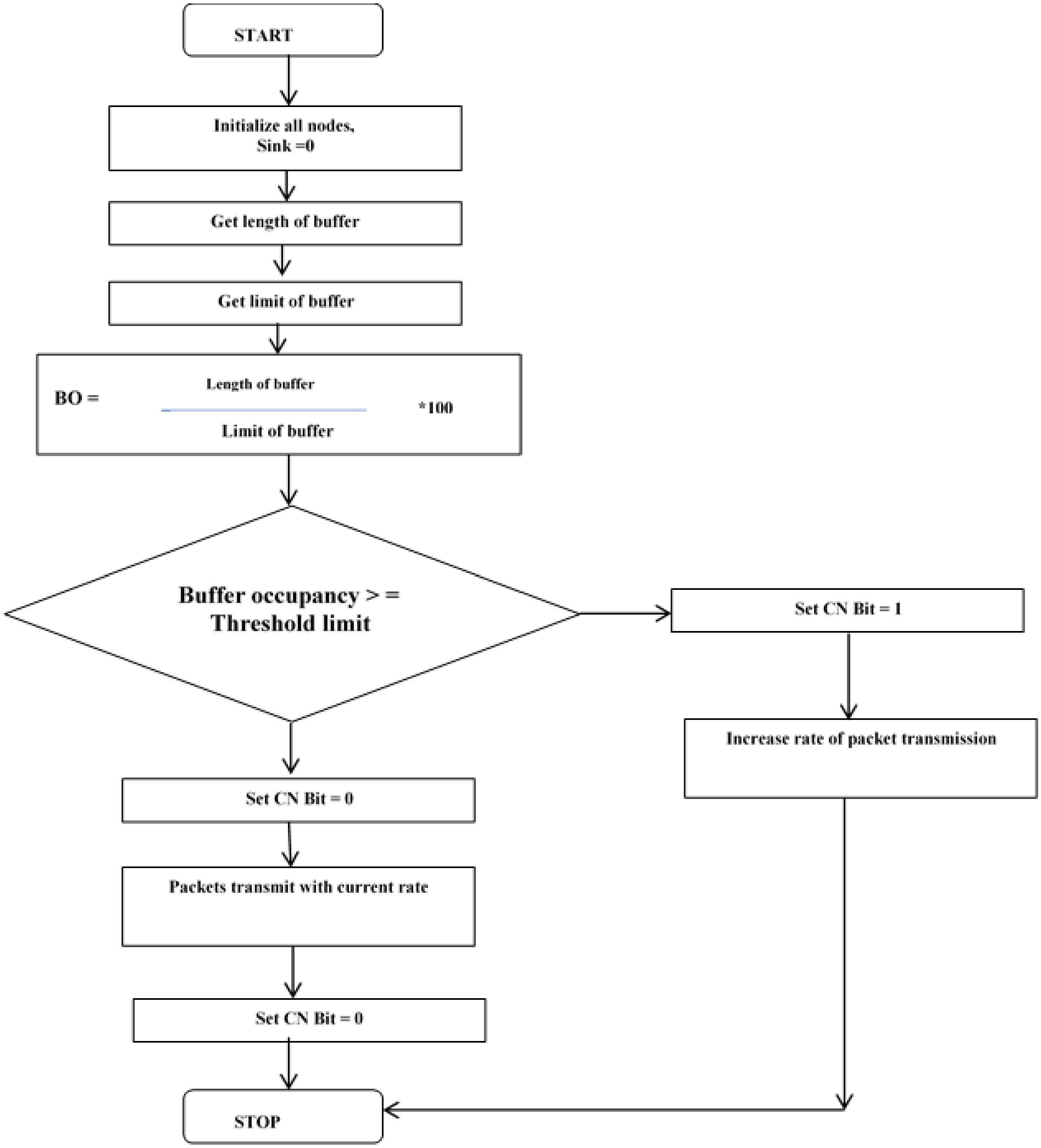


**Fig 2.** Flowchart: PACC technique

**Result Analysis: -**

| | |
|---|---|
| Tool Used | NS2 |
| Number of nodes | 30 |
| Packet Size | 50,100,150,200,250 |

Design Engineering

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

| | |
|---|---|
| Reporting Rate | 10 packets/sec |
| Routing Protocol | AODV |
| MAC Protocol | CSMA,TDMA, 802.15.4 (ZigBee), PACC (With ML) |

**1. Average PDR for Packet size**

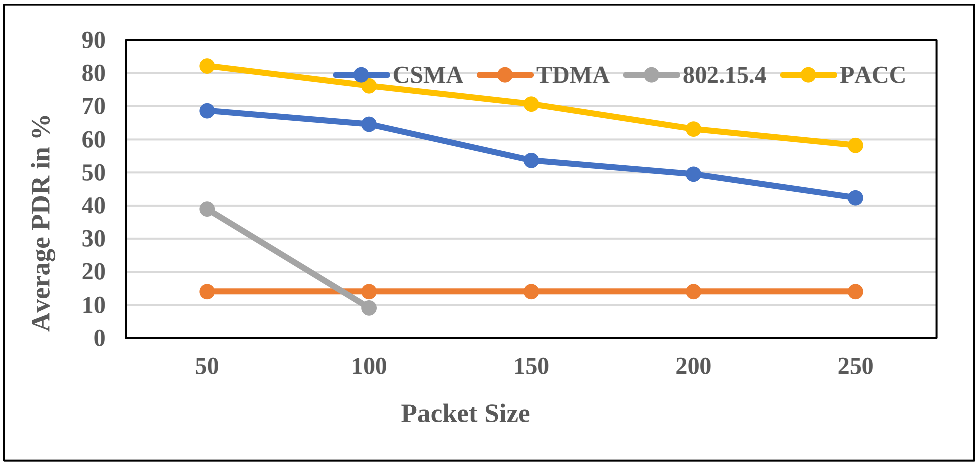


**Figure 3. Average PDR for Packet Size**

The average PDR for packet size in bytes is shown in Figure 3.In wireless sensor networks, a large number of packets successfully transmitted determine PDR. When compared to other protocols, PACC performs better. It achieves 10 to 16 percent better results than CSMA protocols and 30 to 55 percent better PDR results than ZigBee and TDMA protocols. An adaptive reporting rate management mechanism in the PACC protocol aids in increasing the packet delivery ratio in wireless sensor networks. The congestion notification bits (CN Bits) in each node's buffer are used by PACC. After the buffer surpasses the buffer's threshold value, the congestion notice bit is set. PACC increases the reporting rate for data packets to the sink node automatically. As a result, PACC's results are superior to those of other protocols. PACC initially outperforms for PDR while the packet size is 50 bytes, but as the packet size is increased to 250 bytes, the performance of the all-protocol drops. The 802.15.4 MAC returns results for packet sizes of 50 and 100 bytes. It doesn't deliver results after the 100-byte packet size since the node can only transmit the 100-byte packet size packet to the sink node.

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

### 2. Average PLR for Packet Size

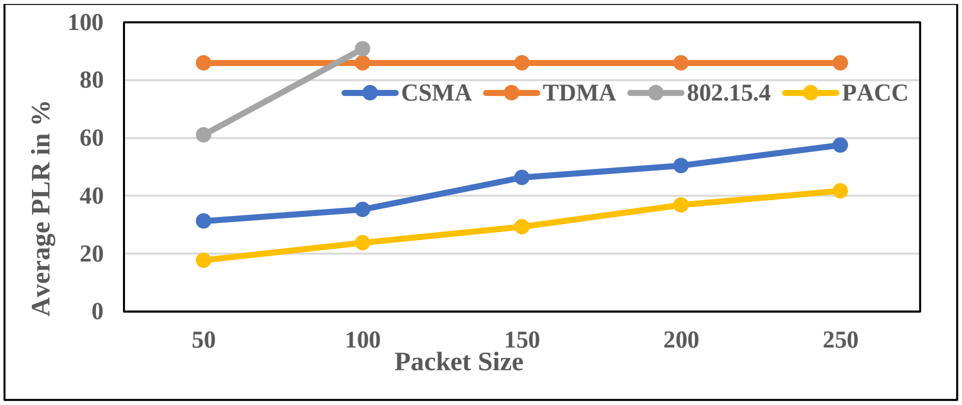


**Figure 4. Average PLR for Packet size**

The average PLR for packet size in bytes is shown in Figure 4. PACC adjusts the current reporting rate of nodes based on network conditions or congestion. When the congestion notification bit is set, the packet transmission rate from source to destination is increased. The PACC MAC Protocol can handle packets of up to 50 bytes. However, when the packet size changes between 50 and 250 bytes, the PLR's performance deteriorates. Congestion rises in accordance with the increase in packet size. However, the PACC protocol has a packet loss ratio that is 12 to 16 percent better than CSMA and 34 to 59 percent better than ZigBee and the TDMA protocol.

### 3. Average Delay for Packet Size

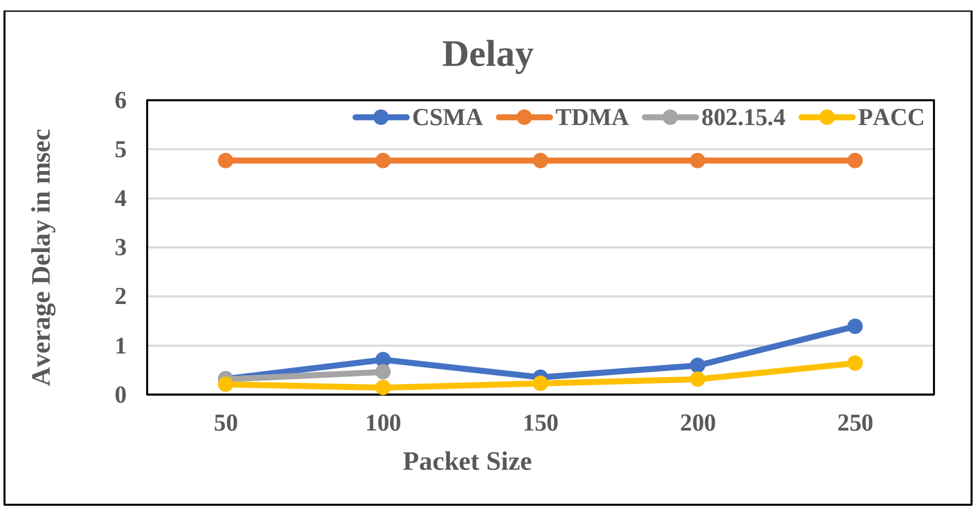


**Figure 5. Average Delay for Packet Size**

Figure 5 depicts the average EE latency as a function of packet size in bytes. An EE delay is the average time it takes to move packets from one point to another. The speed at which packets are transmitted from one point to another is affected by network congestion and traffic. The PACC

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

protocol achieves a lower average delay, and node congestion notification alerts the user when the packets' buffers are full. PACC automatically increases the rate of data transmission from the source to the sink node, resulting in a low average EE delay parameter when compared to other protocols When compared to other algorithms, it produces a 10 to 12 percent superior result. When compared to the TDMA protocol, PACC provides 40 to 50% better outcomes for the delay. Initially, the PACC protocol has a minimum delay of 50 bytes packet size, but after that, the packet size varies from 50 to 250 bytes, and the PACC protocol's delay grows somewhat.

**4. Average Throughput for Packet Size**

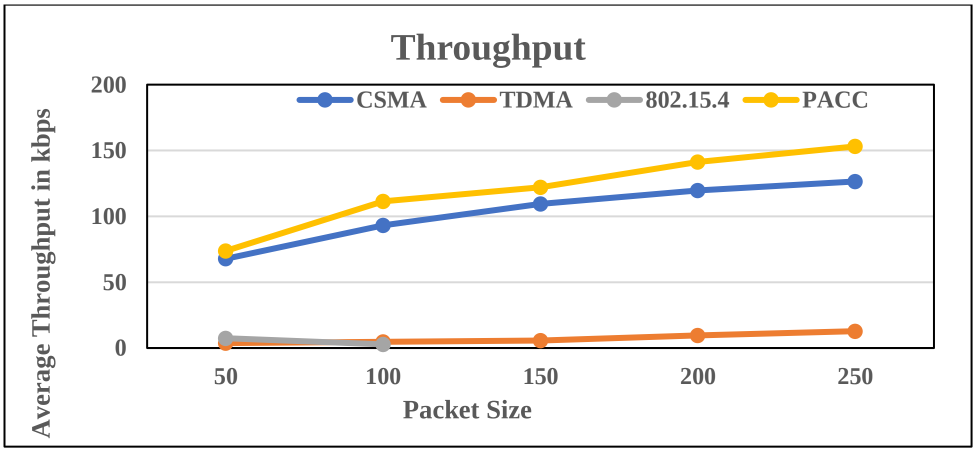


**Figure 6. Average Throughput for Packet Size**

Figure 6 shows the average throughput by packet size. PACC is a protocol for controlling the RR. For packet transmission to the sink node, the PACC protocol uses the appropriate communication channel. The performance of PACC is superior to that of other algorithms. When compared to the CSMA protocol, it performs 12 to 15% better and 24 to 54 percent better than ZigBee and the TDMA algorithm.

## IV. Conclusion

PACC is a WSN MAC that uses "position aware congestion control." A network congestion handling algorithm is proposed. The PACC protocol's operation is dynamic, depending on network congestion and node buffer occupancy. WSN performance is influenced by congestion at the node and link levels. PACC's performance was evaluated and compared to that of Zigbee, CSMA, and TDMA protocols. The PACC's average PDR performance against packet size is better than that of other protocols. PACC outperforms CSMA by ten to twenty-two percent, TDMA by 37 to 64 percent, and ZigBee by 35 to 72 percent. For packet sizes 50 and 100 bytes, PACC's average PLR performance is 10 to 21% better than CSMA, 29 to 58 percent better than TDMA, and 42 to 71 percent better than 802.15.4. PACC has been found to have a higher average throughput than protocols. It has an average throughput of 8 to 12 percent higher than CSMA, 28 to 61 percent higher than TDMA, and 25 to 46 percent higher than 802.15.4. The PACC protocol's EE delay performance is shown to be 12 percent better than CSMA, up to 5% better than ZigBee, and 48 to 52 percent better than TDMA. As a result, the PACC protocol's overall performance is excellent, and it is effective in attaining QoS in WSN. Future study is needed to enhance parameters such as control overheads and energy usage using PACC in relation to WSN, as well as to create a hybrid MAC protocol to meet all QoS criteria.

## Reference:

[1] E. F. Ahmed Elsmany, M. A. Omar, T. Wan and A. A. Altahir, "EESRA: Energy Efficient Scalable Routing Algorithm for Wireless Sensor Networks," IEEE Access, vol. 7, pp. 96974-96983, 2019, doi: 10.1109/ACCESS.2019.2929578.

[2] W. Wu, N. Xiong and C. Wu, "Improved clustering algorithm based on energy consumption in wireless sensor networks," in IET Networks, vol. 6, no. 3, pp. 47-53, 5 2017, doi: 10.1049/iet-net.2016.0115.

[3] Deepak Mehtra,Sharad Saxen,"MCH-EOR: Multi-objective Cluster Head Based Energy-aware Optimized Routing algorithm in Wireless Sensor Networks",Sustainable Computing: Informatics and Systems, Vol.28, 2020

[4] K. Haseeb, N. Islam, A. Almogren and I. Ud Din, "Intrusion Prevention Framework for Secure Routing in WSN-Based Mobile Internet of Things," IEEE Access, vol. 7, pp. 185496-185505, 2019, doi: 10.1109/ACCESS.2019.2960633.

**[5]** Dattatray S Waghole, Vivek S Deshpande, "Characterization of wireless sensor networks for traffic & delay", IEEE conf on Cloud & Ubiquitous Computing & Emerging Technologies, pp. 69-72, 2013.

[6] M. Premkumar, T.V.P. Sundararajan,"DLDM: Deep learning-based defense mechanism for denial of service attacks in wireless sensor networks", Microprocessors and Microsystems, Vol.79, 2020

[7] V. Bibin Christopher, J. Jasper,"Jellyfish Dynamic Routing Protocol with Mobile Sink for Location Privacy and Congestion Avoidance in Wireless Sensor Networks", Journal of Systems Architecture, July 2020

**[8]** Dattatray S Waghole, Vivek S Deshpande, "Reducing delay data dissemination using mobile sink in wireless sensor networks", international Journal of Soft Computing and Engineering (IJSCE), vol 3 issue 1, pp. 305-308, 2013.

[9] S. Anitha, P. Jayanthi, V. Chandrasekaran,"An Intelligent Based Healthcare Security Monitoring Schemes For Detection Of Node Replication Attack In Wireless Sensor Networks", Measurement, 2020.

[10] Thomas Haakensen and Preetha Thulasiraman,"Enhancing Sink Node Anonymity in Tactical Sensor Networks using a Reactive Routing Protocol", IEEE, 2018

**[11]** Jadhav, M. M. (2021). Machine Learning based Autonomous Fire Combat Turret. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(2), 2372-2381.

ISSN: 0011-9342 | Year 2021
Issue: 7 | Pages: 11470-11478

[12] Roberto Milton Scheffel, Antônio Augusto Fröhlich,"FT-TSTP: A Multi-Gateway Fully Reactive Geographical Routing Protocol to Improve WSN Reliability", IEEE, 2018

[13] Yang, X., Chen, X., Xia, R., & Qian, Z. (2018). Wireless Sensor Network Congestion Control Based on Standard Particle Swarm Optimization and Single Neuron PID. Sensors, 18(4), 1265.

[14] Marne, H., Mukherji, P., Jadhav, M., & Paranjape, S. (2021). Bio-inspired hybrid algorithm to optimize pilot tone positions in polar-code-based orthogonal frequency-division multiplexing–interleave division multiple access system. International Journal of Communication Systems, 34(3), e4676.

[15] Dâmaso, A., Rosa, N., & Maciel, P. (2014). Reliability of Wireless Sensor Networks. Sensors, 14(9), 15760–15785.

[16] Dai, H. (2009). Throughput and delay in wireless sensor networks using directional antennas. 2009
International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP).

[17] Jadhav, M. M., Dongre, G. G., & Sapkal, A. M. (2019). Seamless Optimized LTE Based Mobile Polar Decoder Configuration for Efficient System Integration, Higher Capacity, and Extended Signal Coverage. International Journal of Applied Metaheuristic Computing (IJAMC), 10(3), 68-90.