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BLOCKING CONTROL AND DYNAMIC EXCHANGE BUFFER SWITCHING NEW APPROACH FOR MOBILE WIRELESS SENSOR NETWORKS

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ABSTRACT

Mobile sensor nodes are usually positioned in low battery power unattended surroundings. Wireless hypermedia sensor-based networks have a huge capacity and a continual flow of data from source to sink. The congestion emerges when the input amount exceeds the number of resources available. The effect of congestion is packet loss, buffer overflow, and waste of power, as well as increasing delays from end to end. The suggested dynamic alternating buffer technique for switching and management of the congestion, using the residual buffer, residual energy and sensor-mobile node confidence level, is applied to effectively control the congestion. The system is based on a cost-effectiveness analysis which calculates main and replacement buffers on time. The dynamic buffer shift is possible by this approach and the congest impact is optimized. The BETCC performance is compared to that of other current protocols such as TCEER and TFCC with respect to energy usage and data loss ratios.

Keywords: *Mobile network, Wireless Sensor Networks, Blocking control, congestion control.*

1. INTRODUCTION

The hubs concentrating on remote sensors are unfavourably sorted and the hubs may detect physical marvels[1]. The sensor hubs have limited battery strength and a physical zone without a reset source. So a vitality-productive convention structure is needed through which the existence time of the system is improved. As of late, the sensor systems have numerous applications such as well-being checking, ecological observing, industry robotization, and so on [2]. Massive amounts of information and continuous streams necessitated a higher number of assets than were available; consequently, a clog develops in the system. [3]. The clog causes parcel delays, lining postponement, and hubs will become associated with poor control of overhead [4]. The identification of coverage gaps and the repair of coverage holes are the two primary types of methods for increasing network coverage [5]. Gao [6] investigated multi-mode data integrated composite detection events produced by several sensor kinds. When the confidence of the composite events surpassed the threshold, they developed an algorithm for the optimal transmission method with the lowest cost as the constraint. Bhuiyan [7] presented a structural health monitoring technique that takes fault tolerance into account in order to ensure a specific level of system error. Li [8] presented a method for finding coverage holes based on an enhanced Delaunay algorithm. The static nodes are grouped into numerous triangles, and the circumcentre of each triangle is determined. The circumcentre is then detected to see if it is covered by the triangle made up of three sensor nodes. After discovering a network coverage hole, we often utilize robots or mobile nodes to fix the coverage hole. Zou [10] pioneered the use of virtual force in the research of WSN coverage improvement.

The disk model is the most often used model in the coverage problem [15]. The detection range of sensor nodes is considered to be a circular region with the node at its centre. If the target is within the detection range, the sensor's detection probability is one; if the target is beyond the detection range, the detection probability is zero. Although the disk detection model is commonly used, it is too simplistic to describe the node's real detection condition. The increase in distance between the node and the target cannot indicate a loss in perceptual capacity. Following that, each node stores a large amount of data. The transfer of this data to the sink node requires a significant quantity of power, energy, and bandwidth. This can be resolved by eliminating duplicated data from network flow. There are certain aspects of WSNs that need be emphasized on in order to practice in real-world applications [7].

- Minimum compute and memory needs.
- Autonomy and self-organization.
- Environmental friendliness.
- The ability to scale.
- Data aggregation inside the network is supported.

In wireless sensor networks, optimization plays a critical role. Optimization is a technique for achieving the best possible results under given conditions. There are several optimization strategies available that are utilized to achieve desired networking objectives. It is divided into two types: single-objective optimization and multi-objective optimization. The optimizer's job in single objective optimization is to decrease or exploit one goal under multiple constraints [13-16]. This creates the optimization as a challenging task in multi-objective scenarios.

The network is at risk of being blocked when all of the nodes in the WSN submit data to the same base station at the same time. Excess data should be held in a buffer when a sink node receives data packets at a rate faster than its capacity [11]. The buffer fills up due to a shortage of available capacity, and data packets (new or old) must be released as a result of congestion [12]. Congestion in a WSN reduces throughput, delivery ratio, delay, and per-packet energy consumption, all of which impair network performance [2,17]. It is critical to prioritize congestion concerns in sensor networks in order to achieve the needed transfer ratio for WSN applications and to extend network lifetime [3,18]. Congestion in a WSN might occur at the node or link level [14,19]. When the packet arrival rate is greater than the packet service rate, node level congestion occurs. This type of congestion causes packet loss and shortens the network's lifespan. When many sensor hubs within a comparable range attempt to send data at the same time, a major connection crash occurs. This type of collision will disrupt link usage as well as total output.

Congestion can be alleviated using a variety of methods. Congestion is managed in this work using hybrid bio-inspired multi-objective optimization approaches. The PSO algorithm is used with the GSA and GA algorithms [20-22].

The idea of virtual force is analogous to physical attraction and repulsion, and the node distribution is governed by the combined force of the two forces. To decrease overlapping sensing regions, Tao [11] suggested a distributed coverage improvement method. By structuring a two-dimensional directed coverage area subset, this technique saves network energy and decreases the complexity of coverage optimization computation. Howard [9] use the artificial potential field to enable the mobile sensor network to self-deploy. To identify the coverage hole, the sensor nodes throughout the monitoring region are repelled by barriers and other nodes.

Dealing with these conditions in a smooth way, clog control is a significant task. The control strategies are utilized to control the clog in the system, for example, lessening the traffic rate and viable assets of the executives [5]. The proposed convention DABCC is a widespread correspondence model for dealing with both huge just as consistent progression of information from the source to sink. This convention relies upon the rest of the vitality, staying cradle, and the sensor hub. This is the most intended part for viable cradle on the board in the wireless multimedia sensor networks (WMSNs).

2. RELATED WORKS

The observation of blocking control in the WSN is crucial; nevertheless, determining where the clog occurs in the system is a difficult task. Many solutions are based on controlling the clog by slowing the source's information rate or asset control concepts or a combination of both. [6]. They considered the line removes just as direct settings in each individual advanced neighbour just as recognizing the bottleneck in each hub by methods for new plans. By utilizing the estimation of bottleneck, each hub unexpectedly alters its bundle communication speed notwithstanding related load coordinating between them to stay away from bottleneck just as connected issues. Direness-based case precisely grouped resistor plan to distinguish in bottleneck system by methods for line-up plan of the hubs [7].

The plan is for the most part applied in fire disclosure and home automation notwithstanding interrelated uses [8], in which bottleneck focuses are recognized other source similarly suggest that once the hubs and bottleneck. Here each showing up bundle is requested as exceptional desperation in addition to bringing down need parcels. During clog, low need parcels are disposed. The disk model is the most often used model in the coverage problem [15].

The detection range of sensor nodes is considered to be a circular region with the node at its centre. If the target is within the detection range, the sensor's detection probability is one; if the target is beyond the detection range, the detection probability is zero. Although the disk detection model is commonly used, it is too simplistic to describe the node's real detection condition. The increase in distance between the node and the target cannot indicate a loss in perceptual capacity.

3. PERFORMANCE EVALUATION AND THE METHODS

The proposed work's implementation is evaluated based on the following network parameters:

1) Productivity
2) Postponement
3) The amount of energy used
4) Packet Loss
5) Level of Congestion
6) The length of the queue.

The quantity of data that a system can handle in a given length of time is referred to as throughput. The time it takes for data packets to travel from a source to a destination and back is referred to as end-to-end delay. Energy utilized is the amount of energy spent during data transmission. Congestion occurs at a given node when the packet arrival level exceeds the receiving level, which is known as congestion level. Packet loss is defined as the difference between the transmitted and received packets. The queue size refers to the number of packets in a queue at any given point in time. MATLAB R2010a was used to run the simulation. Table I lists the factors that were utilized in the simulation.

The developed model has the capacity to handle up to 26 nodes. Each node has the ability to link to any other node. The expected maximum number of links is 200. In the insertion sequence, the names of the nodes are taken alphabetically. Each node has a

Table 1: Calculated Throughput,Delay,Energy Used,Congestion Level,Packet Loss,Queue Size.

Parameters		
Throughput	0.5200	0.4800
Delay	0.456	0.0556
Energy used	0.0999	0.1010
Congestion Level	0.1000	0.0512
Packet Loss	0.4799	0.4999
Queue Size	0.0416	0.0972

duplex link, which means it may transfer data to both ends. All duplex links are assumed to have the same link speed. It is not possible to add two nodes in the same location. A duplex link can only be created between two different nodes.

If a link already exists, an error notice will appear to inform the user that he or she is attempting to create a link between nodes that already have a connection. Because the speed of each connection is the same, the time it takes to transmit a packet is proportional to the distance between them. The node-to-node connections are utilized to understand the traffic flow for different paths.

Each node will send data in equal-sized packets. For each packet transfer, the best path will be determined based on the amount of time it takes to deliver the packet between them. When there is just one destination for the packet transfer, the all pair shortest path algorithm is used to discover the shortest path. Instead of using an adjacency matrix, the implemented technique employs a 2-D linked list.

3.1 Trust-based blocking control protocol

This section proposes a protocol for a universal communication model that can be implemented in WMSNs for both massive and continuous data flows. The first subsection describes a creation of static hierarchical topology for initial deployment of the sensor mobile nodes. The next subsection defines a community confidence evaluation. In the next part, constructing a safe packet using DES algorithm [9] is presented to transfer a secure packet based on the CEM to next hop. The estimates on cost function are shown in the next section. By using different congestion metrics, congestion is identified, and the last segment focuses primarily on the implementation of an effective congestion reduction technique [10].

2.2 Trust evaluation

It is suggested in WSN's surrounding hubs that the hubs are under the radio broadcast scope [11]. The hub trust is a period subordinate substance that might adjust relying on the presentation of point in exchange. This history assesses the pace of confidence of the matter just as the suggestion of the neighbouring hub. Here, trust metrics (information and control package delivery, parcel postponement) and QoS (quality of service) characteristics were considered in appreciation of the hub's behaviour. The level of confidence taken out since the certitude known as primary trust (PT), and secondary trust (ST) are segregated from the neighbouring hubs' proposal. Such important ones are described in Figure 1 just as the auxiliary confidence assessments. Actually, the faith of hub Q depends on its own understanding

(PT). To determine the optional confidence (ST) of hub Q, hub P assembles hub Q data from its neighbours R, S, T, U, and V.

Guidelines: The mobile nodes P and Q are direct trust calculated based on various trust metrics as follows :

$$P,Q = \sum_{m=1}^{k} W_m \times t\ m_m^{P,Q} \tag{1}$$

where $m_m^{P,Q}$ metric of the mobile node P and mobile node Q.

$$\mathrm{TP},Q = \mathrm{WD} \times \mathrm{PT}\ P,Q + \mathrm{WI} \times \mathrm{ITP},Q \tag{2}$$

where WD and WI are the primary and secondary trust loads, respectively. Estimated confidence parameters are included in the neighbouring table .

listening stealthily and dynamic interruption [12]. Inactive listening implies that the programmer makes some private data and those are embedded alongside unique message, whereas in the dynamic interruption, the programmer erases chosen data in the message or supplements adulterated data alongside it or else imitation hubs end the well-being record just as no notoriety of WSN. To keep away from this sort of assaults, part of cryptographic systems are created. The triple DES (TDES) calculation is utilized in the proposed technique, in which DES is applied multiple times.

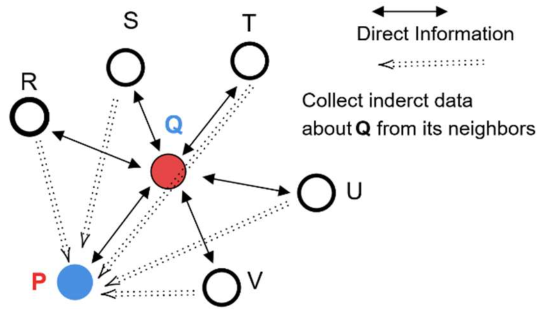

Figure 1: Mobile nodes between the trust relationships.

Three sorts of TDES modes are proposed, for example, DES-EEE3: Three-layered DES encryptions by methods for three self administering keys.

DES-EDE3: Three DES forms in request encode follow with unscramble again finished by scramble self-deciding keys.

DES-EEE2 just as DES-EDE2: Similar to the prior game plans barring that the head in addition to third assignments practices the comparable key.

Among the three, the proposed technique utilizes the second idea, for example, encode and decode scramble with three autonomous keys K1, K2, and K3. Each key is 64 bits since quite a while ago, planned for a total distance of the key 192 bits. The TDES turns triple level lesser than the DES. In any case, it offers additional security when accurately utilized. The procedure planned for decoding the correspondence is comparable as the encryption; barring the keys stays actualized in turned-around request. The encryption and decryption processes are spoken to underneath:

$$\mathrm{CT} = (\mathrm{EK3}(\mathrm{DK2}(\mathrm{EK1}(\mathrm{PT})))) \text{ (Encryption operation)}$$
$$\mathrm{PT} = (\mathrm{DK1}\ (\mathrm{EK2}\ (\mathrm{DK3}\ (\mathrm{CT})))) \text{ (Decryption operation)} \tag{3}$$

The key size of DES stays 64-piece long; anyway true key utilization through DES is 56 piece extensive. The littlest critical piece in each byte is applied in the interest of equality bit. It is fixed so that an odd quantity of ones remains constantly in each byte. If we overlooked the bits of equality in each byte, the subsequent key length is 56 pieces in DES and 168 bits in TDES. The charge estimation manner (CEM) is built

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on the leftover cradle, extraordinary vitality just as the confidence estimates. The following table is used to properly discover the CEM during package transmission :

$$\mathrm{CEM}(Q) = \max\{1/d\ (\mathrm{TQ}, P + \mathrm{RB}(P) + \mathrm{RE}(P)\} \tag{4}$$

Alot of sensor hubs in a particular level fulfill high outstanding vitality and staying cushion with least separation; then, one hub is picked sequentially

as essential CEM, which goes about as next bounce for steering. This next process of determining a bounce proceeded until the sink was found. Earlier hubs are pronounced as extra CEM, and its subtleties in the neighbouring hub are refreshed in Figure 2.

The difference between P and Q is determined according to the following :

$$d = \sqrt{(N_{Q.x} - N_{P.x})^2 + (N_{Q.y} - N_{P.y})^2} \tag{5}$$

$$\begin{aligned} \mathrm{ETX} &= \mathrm{Eele}(ki, di) + \mathrm{Eap}(ki,\ di) \\ &= ki \times \mathrm{Eele} + ki \times \mathrm{fs}\ (d < d0) \\ &= ki \times \mathrm{Eele} + ki \times \mathrm{mp}\ (d >= d0) \end{aligned} \tag{6}$$

The receiving energy is computed as follows:

$$\mathrm{ERX} = ki \times \mathrm{Eele} \tag{7}$$

The hub's remaining energy is the proportion of the present vitality to the full sensor point vitality in Figure 4.

Typically, organized administrations utilize twofold plans, open space trench conspire just as radio-based plan. If the message separation "d" is smaller than the starting stage d0 separation, open space channel conspire is currently being implemented, or multipath way blurring strategy is being applied. The radio program characterizes the vitality used for transmitting k-bit information by separating d, if the vitality utilized is characterized with the radio plan in Figure 3.

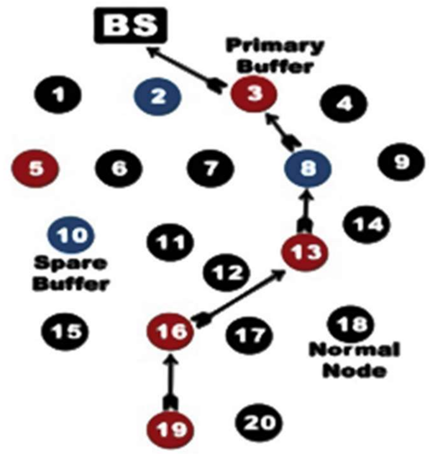

Figure 2 : Buffer switching mobile nodes.

The transmitting energy is computed as follows

$$\mathrm{EP} = \mathrm{Ei} - \{\ \mathrm{ETX}(k, d) + \mathrm{ERX}(k)\} \tag{8}$$

The vitality of the present situation is determined as where Ei is the underlying vitality of the sensor hub (assessed during various leveled creation), ETX(k, d) is the energy used to move a k number of bits to separate d, and ERX(k) is the energy used to obtain k bits.

In sensor hub, whole vitality is characterized as follows :

$$\mathrm{ET} = \mathrm{ETX}(k, d) + \mathrm{ERX}(k) + \mathrm{Eproc} + \mathrm{Esense} \tag{9}$$

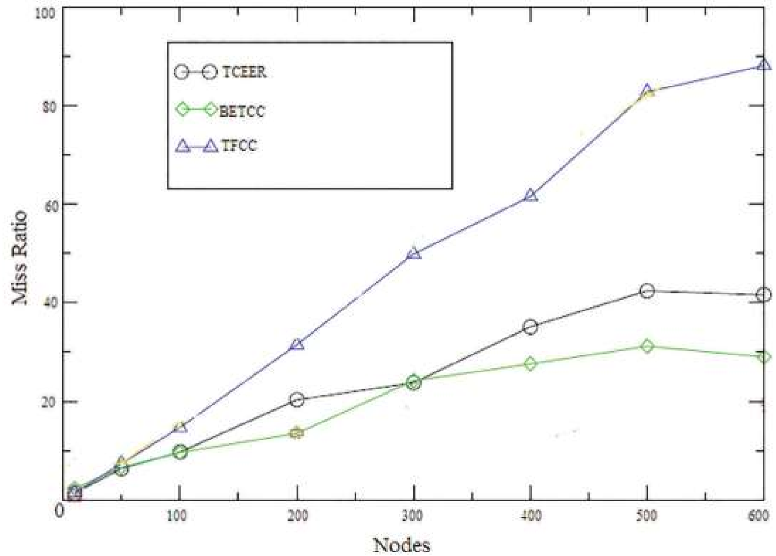

Figure 3: Mobile nodes versus miss ratio.

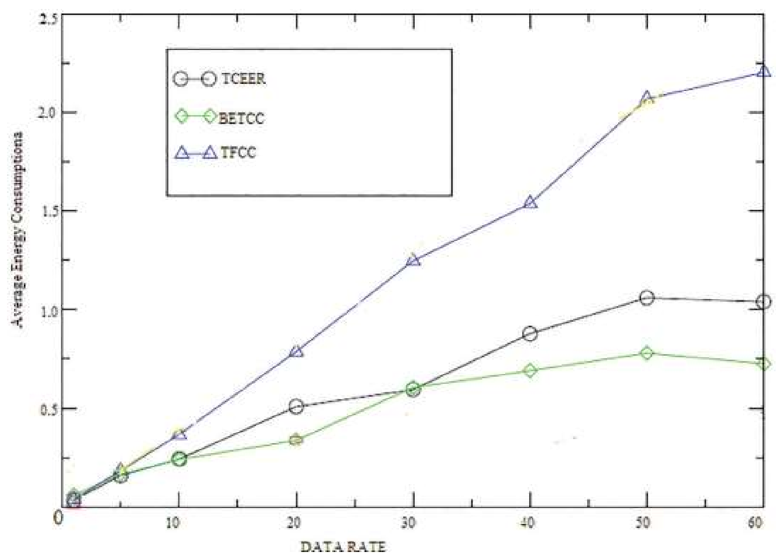

Figure 4: Data rate versus average energy consumption.

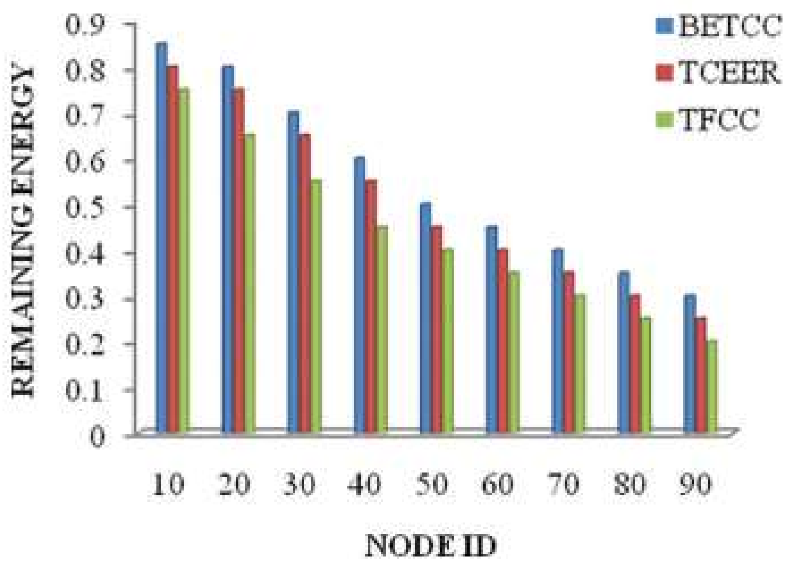

Figure 5: Remaining energy of the mobile nodes.

The energy remaining in hub P is calculated as follows:

$$RE(P) = EP/ET \tag{10}$$

where EP is the present vitality – the sensor hub resides, and ET is the whole vitality of the sensor hub. The remaining cushion of the mobile node is processed dependent on present cradle position just as the anticipated measure of parcels to be conveyed beginning from hub P toward its most extreme level in Figure 5. The remaining support of the hub P is characterized in condition.

$$RP(P) = Bi - \sum_{n=1}^{N} K_N \tag{11}$$

where Bi is the current supporting status of the sensor hub, KN is the number of bundles, N transmitted from P to its greater level.

4. CONCLUSION AND FUTURE WORK

The suggested convention is intended to rely on buffer, great power, and trust-based congestion control to keep a strategic distance from clog. Various static levelling topologies for basic WSN are created here. The neighbouring hubs' confidence estimates are assessed using trust measures. The safe information bundle is made by utilizing TDES; this information is sent to the following bounce. The following bounce choice depends on the CEM. This strategy sorts the cradle into essential and extra support. On the off chance that there is no blockage in the system, essential support is dealt with the information parcel. During information transmission, blockage happened implies that the cradle exchanging is performed. The essential support made a wake-up signal through which the extra cushion to deal with blocked locale is empowered successfully. The productive next bounce determination of the proposed convention improves the rest of the vitality level of the cradle and diminishes the number of bundle errors.

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REFERENCES

[1] Kafi, M.A., Djenouri, D., Ben-Othman, J., Badache, N.: Congestion Control Protocols in Wireless Sensor Networks: A Survey. IEEE Communications Surveys and Tutorials 16(3), 1369–1390 (2014).

[2] Ganesh Babu, R.: Helium's Orbit Internet of Things (IoT) Space. International Journal of Computer Science and Wireless 1(1), 123–124 (2017).

[3] Sonmez, C., Incel, O.D., Isik, S., Donmez, M.Y., Ersoy, C.: Fuzzy-Based Congestion Control for Wireless Multimedia Sensor Networks. EURASIP Journal on Wireless Communications and Networking 1, 1–17 (2014).

[4] Ganesh Babu, R.: Mismatch Correction of Analog to Digital Converter in Digital Communication Receiver. International Journal of Advanced Research Trends in Engineering and Technology 3(19), 264–268 (2016).

[5] Sakthidevi, I., Srievidhyajanani, E.: Secured Fuzzy Based Routing Framework for Dynamic Wireless Sensor Networks. In: International Conference on Circuits, Power and Computing Technologies, pp. 1041–1046. Nagercoil, India (2013).

[6] Ganesh Babu, R., Amudha, V.: Cluster Technique Based Channel Sensing in Cognitive Radio Networks. International Journal of Pure and Applied Mathematics 119(16), 3341–3354 (2018).

[7] Bakra, B.A., Lilien, L.T.: Extending Lifetime of Wireless Sensor Networks by Management of Spare Mobile nodes. Second International Workshop on Communications and Sensor Networks 34(1), 493–498 (2014).

[8] Ganesh Babu, R.: WIMAX Capacity Enchancements Introducing Full Frequency Reuse Using MIMO Techniques. International Journal of Advanced Research in Biology Engineering Science and Technology 2(16), 1–7 (2016).

[9] Kafi, M.A., Djenouri, D., Ben-Othman, J., Ouadjaout, A., Badache, N.: Congestion Detection Strategies in Wireless sensor Networks: A Comparative Study with Test Bed Experiments. 5th International Conference on Emerging Ubiquitous Systems and Pervasive Networks 37, 168–175 (2014).

[10] Ganesh Babu, R.: Cognitive Radios Spectrum Allocation in Wireless Mesh Networks. International Journal of Global Research and Development 1(6), 289–294 (2016).

[11] Ganesh Babu, R., Karthika, P., Manikandan, G.: Polynomial Equation Based Localization and Recognition Intelligent Vehicles Axis using Wireless Sensor in MANET. In: Second International Conference on Computational Intelligence and Data Science in association with Elsevier-Procedia Computer Science 167, 1281–1290 (2020).

[12] Karthika, P., Ganesh Babu, R., Jayaram, K.: Biometric Based on Steganography Image Security in Wireless Sensor Networks. In: Second International Conference on Computational Intelligence and Data Science in association with Elsevier-Procedia Computer Science 167, 1291–1299 (2020).

[13] Chandni, Anjali Bharti, Jyoti, "Optimization through Bio Inspired Algorithms in Wireless Sensor Network: Survey and Future Directions," International Journal of Electrical and Electronics Engineering, pp. 243-246, 2015.

[14] C. Raghavendra, K. Krishna, T. Znati,"Wireless Sensor Networks",Springer-Verlag, 2004. [9]Kemal Akkaya, Mohamed Younis "A survey on routing protocols forwireless sensor networks",IEEE Communication Magazine on AdHoc Networks, pp.325–349, 2005.

[15] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci,"A surveyon sensor networks", IEEE Communications Magazine,pp.102–114, 2002. [11]Anu Verma, Nitin Mittal, "Congestion Controlled WSN using Genetic Algorithm with different Source and Sink Mobility Scenarios,"

International Journal of Computer Applications, vol. 101, no.13, Sep 2014.

[16] PavlosAntoniou, et al "Congestion control in wireless sensor networks based on bird flocking behavior", Comp Net, vol. 57, No.5,pp. 1167-1191, Apr. 2013.

[17] Mirjalili, S, Hashim, SZM , "A new hybrid PSOGSA algorithm for function optimization", International Conference on Computer and Information Application, , pp.374–377, 2010.

[18] Abbas Ali Rezaee ,Mohammad Hossein Yaghmaee ,Amir Masoud Rahmani, "Optimized Congestion Management Protocol for HealthcareWireless Sensor Networks", Wireless Personal Communications An International Journal, vol. 75, no.1, Mar. 2014.

[19] C. Raghavendra, K. Krishna, T. Znati,"Wireless Sensor Networks",Springer-Verlag, 2004.

[20] S.Sivasakthiselvan and V.Nagarajan "Design and Performance evaluation of Sugeno fuzzy interface system for multi-disciplinary WSNs applications with optimized network structure", J of Comp com,Vol.146,.pp.22-31

[21] Kemal Akkaya, Mohamed Younis "A survey on routing protocolsforwireless sensor networks",IEEE Communication Magazine on AdHoc Networks, pp.325–349, 2005.

[22] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci,"A surveyon sensor networks", IEEE Communications Magazine,pp.102–114, 2002.

[23] Nazmul Siddique, Hojjat Adeli "Nature Inspired Computing: An Overview and Some Future Directions", Cognitive Computation, vol. 7, no.6, pp. 706–714,Dec. 2015.

[24] Venkata Vijaya Geeta. Pentapalli, Ravi Kiran Varma "Cuckoo Search Optimization and its Applications: A Review", International Journal of Advanced Research in Computer and Communication Engineering, vol. 5, no.11, Nov. 2016.

[25] A. Raha, M.K. Naskar, A. Paul, A. Chakraborty, A. Karmakar, "A Genetic Algorithm Inspired Load Balancing Protocol for Congestion Control in Wireless Sensor Networks using Trust Based Routing Framework", I.J.Computer Network and Information Security, 2013. 9: p. 9-20.

[26] Mukhdeep Singh Manshahia, Mayank Dave, Sata Bir Singh "Improved Bat Algorithm Based Energy Efficient Congestion Control Scheme For Wireless Sensor Networks", Wireless Sensor Network, vol.8,pp 229-241,Nov. 2016.