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Research Article

Cross-Layer Optimization for Wireless Systems Using Computer Vision Methods

D. N. V. S. L. S. Indira,[1] M. Sobhana,[2] M. Sitha Ram,[3] Rajendra Kumar Ganiya,[4] J. Nageswara Rao,[5] and Afework Aemro Berhanu[6]

[1]*Department of Information Technology, Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru, 521356, AP, India*
[2]*Computer Science and Engineering, V.R. Siddhartha Engineering College, Kanuru, Vijayawada, India*
[3]*Lakireddy Bali Reddy College of Engineering (A), India*
[4]*Department of Information Technology, Vignan's Institute of Information Technology, Visakhaptnam, 530049 AP, India*
[5]*Department of Computer Science and Engineering, Lakireddy Bali Reddy College of Engineering, 521230, AP, India*
[6]*Department of Environmental Engineering, College of Biological and Chemical Engineering, Addis Ababa Science and Technology University, Addis Ababa, Ethiopia*

Correspondence should be addressed to J. Nageswara Rao; nageswararaoj459@gmail.com
and Afework Aemro Berhanu; afework.aemro@aastu.edu.et

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Ad hoc network nodes are aggregate data packet from different environment; there is multiple path communication causing the sudden energy depletion in network. This type of energy loss can lead to failure of connectivity between the two intermediate nodes. If link gets failure, then it has frequent loss of data packets. Less energy nodes do not classify data from the network structure. It reduces packet delivery ratio and increases the energy consumption. The proposed cross-layer method for data agglomeration (CLA) is designed to organize the data packet frequently among the various communication routes; the nodes in the path can able to proceed packet organization for the support of cross-layer scheme. Magnificent path discovery algorithm is constructed to offer the better packet collection route to target node. This process uses multisource node with multiple path for packet transmission in network. It minimizes the energy consumption and increases the packet delivery ratio. The simulation parameters are delay, detection efficiency, energy consumption, network lifetime, and packet delivery ratio.

1. Introduction

Different output is analyzed by the present scheme to improve packet forwarding in excess of ad hoc wireless networks: data are forwarded by modified MAC layers and devoted routing techniques. This aims a cross-layer result where the application layer needs to forward data packets with many possibilities. The network layer also constructs the many routes and chooses the most energetic one for the maximum possibility for data packets and different routes for the residual data packets [1]. The creation of route depends on rejecting radio intrusion among the route. Based on this condition, the MAC layer is also concerned in communication process. Vital goal is to broadcast the maximum possibility packets on the energetic route, while the network is concerned to reject the minimum possibility packets. Though, whether all minimum possibility packets are rejected, it desires to reject all maximum possibility packets of network area, since it measures the packet drop [2].

The source node needs to forward packet to the target node, except that the routing nodes execute some form of data collection at the satisfaction of the data originated at many source nodes. This is a process of arranging relay nodes in ranking manner. In this scheme for packet organization, integration proceeds sequence to minimize the quantity of data packet which is forwarded to target node [3].

This scheme is better manner to reducing the energy usage. In this scheme, the sensor nodes are pointed by means of their node position. Space between the neighboring node is estimated depending on the incoming signal force. Sequence to maintain residual energy of the sensor node is inactive state; therefore, it is no process [4].

The inspired algorithm is a different method for better communication procedure. This firefly algorithm is used to discover an optimal route in sensor network. Logically, fireflies emit luminance for discovery their food [5]. These illumination insects have particular organs to create the brightness which live in hot surroundings. By this lighting attractiveness character, every firefly should without difficulty to discover and attract their partners for mating. By this combined procedure, nodes can successfully obtain its aim. This should manage the restricted energy for packet broadcasting and stay away from communication connectivity breakdown due to fixing of sensor nodes in network [6]. This process is obtained by localization test. The firefly algorithm growth is the leading process for discovery best path. Routing is a novel technique for providing solution for short of link for the centralized manage of access point.

Convenient is a little protection drawbacks to be confronted along with the amount of data packet. Because of this remote total, listening silently and packet collection is made [7]. Providing protection in the sensor network is more difficult than the transferable ad hoc network structure. To achieve the better protection in wireless sensor network, proceed the various cryptographic processes such as encoding, separating, and authentication. For any security operation, it can utilize any of the solution such as symmetric key [8]. On the off chance, symmetric key is used and then it is extremely inflexible to prepare for protection basis. In the process, deviated key is used and then it is high cost. Any of the encoding plot then has extra bits and storage need, and packet latency is measured. In the present network structure, various estimations are used to achieve the protection, for data packet gathering.

Frequent estimations focus on the specific problems. The iterative sift estimation is just focal point on arrangement issues. The network can be efficient in the locality of nonstochastic fault and insufficiency and malicious node can organize packet; moreover, it can provide an estimation of the steady quality and reliability of the data packet obtained from the sensor nodes in network [9]. Unique evidence of yet another complex plot penetration over the IF-based tainted network architecture that uncovered a serious network weakness. The narrative scheme is used for the evaluation of sensor nodes, which is authoritative in a wide selection of sensor nodes and does not exposed to the intruder nodes. Organization of a dynamic and well-built total plan provoked by the routing process is an evaluation of the invalid metrics attained [10].

Residual of the paper is designed as follows. Section 2 provides related works. Section 3 presents the details of proposed multievent path routing (MPR) method and offers efficient routing based on similar resource available node to construct path. Section 4 provides simulation performance result analysis obtained under various metrics. At last, Section 5 concludes the paper with future direction.

2. Related Works

Vinh et al. [11] propose a multipath for occasion-driven group-based steering in WSN called Vitality Aware Mesh Routing Protocol (EMRP) with primary outline highlights: solid information transmission, stack adjust, and vitality productivity. What is more, by utilizing the lingering vitality as fundamental parameter for progressively exchanging between two option routes, EMRP can be likewise sent for reason for virtualization of WSN. The results of the reenactment show that our solution outperforms previous event-driven group-based steering conventions in terms of preferred execution.

Zhou et al. [12] proposed the Occasion Aware Anycast, which utilizes the entire or part information combination as indicated by the relativity of the information. The EAA calculations ideally fathom the development of the direction in WSNs driven by occasions and diminish the spending of the course redevelopment in light of the moving of the sensor hubs, and it remains the occasion area data amid the information combination. In contrast with the conventional calculation, EAA calculation has been turned out to be a superior arrangement in the cost of vitality and time.

Agarwal et al. [13] proposed a novel WSN packet estimate lessening procedure utilizing adaptable limits for constant attack forecast in wind ranches which is an expansion to the creators' work proposing application-particular network lifetime upgrading tri-level grouping and directing convention for expanding the network lifetime. The choice of adaptable edge uses the level of link between information tests gathered at various circumstances of the day. Utilizing mix summation and stream heading of obtained information, exact failure expectation is accomplished. The technique is contrasted and the crude mean strategy. The proposed strategy adapts the limit choice and failure expectation. FTSFP gives a straightforward intention to anticipate ongoing deficiency events in the towers and aides in diminishing the message measure impressively, along these lines expanding the network lifetime of the framework almost by ten times. The outcomes are that FTSFP has better failure expectation precision over the current strategy.

Niranchana and Dinesh [14] proposed network structure comprising of evaluating the situation of hubs, and after that, the evaluated positions are utilized to foresee the area of hubs. Once the protest is resolved, the versatile hub moves to cover the specific protest. On the off chance that the target cannot be characterized, then the arrangement of new hubs is found and every hub is appointed a situation to limit the aggregate voyage separate. The estimation and forecast of hubs are finished by interval theory and the relocation of hubs is finished by utilizing ant colony optimization. ACO is the localization of sensor nodes which tracks the targets. In this proposed paper, the recreation comes about are contrasted with question checking strategies considered for networks with static hubs.

Glatz et al. [15] improved WSN technology, the best in class technology for continuous frameworks given by overall ecological vitality. Along these lines, a few viewpoints have been considered in writing up until this point: EHS outline, vitality prephrasing demonstration, reaping mindful media

get to control (Macintosh), and steering lastly control administration. This paper hypothesizes that distinguishing and upgrading these angles without anyone else does not really prompt attainable arrangements. We take a cross-layer point of view and give network administration convention for verification or express EHS strategy transaction under the requirement of two prototypical communication designs.

In Sivasakthiselvan and Nagarajan [16], forecast-based clustering algorithm for movement discovery strategy is utilized to get the ideal information correspondence way. On the off chance that the portable hubs move inside the range of the open area, it gathers the information from neighbor group member (CM), and if mobile data collector (MDC) moved out, it gets the steering data from neighbor group head (CH) and trade that data with another MDCs. Present scheme calculation limits the group overhead, and it enhances the three-level directing issue utilizing adaptive dynamic clustering (ADC). Here, the MDCs are performed like node movement and social occasion on the data from neighbor CHs and CMs. The performance assessment comes about demonstrate that the proposed framework effectively underpins for hub versatility administration with low control overhead and postpone applications when contrasted with other group based calculations and furthermore upturns the lifetime of the CH and packet conveyance proportion when the quantity of sources Increments.

Sharma, M. K., et al., [17] present scheme contains the investigation of an asset consumption assault in WSN which is known as Vampire Attack. Additionally propose an alleviation network which initially recognizes the Vampire hub and after that isolates that hub from the sensor network to spare the vitality of casualty hubs. Here, two diverse methodologies of vampire assault have been analyzed and relieved utilizing depleting rate forecast technique.

Raheem et al. [18] proposed the information organization model for brush needle display-based group that data can be communicated with the help of push/pull networks and steering plan for way revelation. So the packets are exchanged through the empowered way. In our work, we assign particular edge esteems for the neighboring hub. Subsequently, it is broken down that transmission of packet enhances the network lifetime, wastage of vitality utilization, and furthermore blockage avoidance.

Hang et al. [19] presents a novel arrangement joining of vitality aware, occasion-driven steering convention, and dynamic conveying plan to bolster the prerequisites for multievent WSN. Recreation comes about demonstrate that the present arrangement lessens packet misfortune rate for high unwavering quality prerequisite occasions and broadens the network lifetime of multievent WSN. Also, if there should be an occurrence of high movement conditions, sharing load over various routes would decrease inactivity for the earnest occasions in the various occasions organized.

Shehab et al. [20] presented that data can be transmitted using the aid of push/pull procedures and steering plans for way revelation, as shown by the informed accumulation display for brush needle showcase-based bunch. So the packets are exchanged through the empowered way. In our work, we designate particular limit esteems for the neighboring hub.

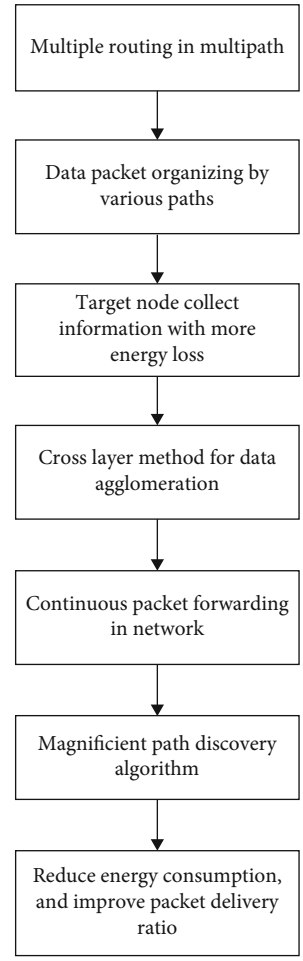

Figure 1: Block diagram of cross-layer method for data agglomeration.

Thus, it is examined that transmission of packet enhances the network lifetime and wastage of vitality utilization.

Rajaram Ayyasamy et al. [21]. Here, we initiated to create an enhanced distributed certificate authority scheme in the motive to give away the data of high integrity. While doing so, the network we use becomes more secure inwards and also outwards. The results show more packet delivery when low delay and overhead occur.

A. Rajaram et al. [22]. As we know, the network that has the mobile nodes sometimes is unstable that does not maintain the accuracy of data. To fix this, a new method termed magnificent path discovery is introduced to collect data with a high accuracy rate. Further, it can detect congestion and energy consumption and size is reduced.

A. Rajaram et al. [23]. Here, we have introduced a security system that is a trust-based protocol depending on the Mac layer method which reaches the confidentiality and authentication of packets. It has packets in routing layer and route.

In Vaneetha and Vivekanandhan [24], the paper implements the node connectivity in the entire network system based on the first and the second part of the entire networking system; this paper implements the interposition network detection in the way of three parts; the first part analyzes the

```
Step 1: measure the path effectiveness
Step 2: For each node threshold energy level
Step 3: multiple packet forwarded along the multiple path
Step 4: if {node energy loss==less}
Step 5: Packet transmission in continous manner
Step 6:Target node organize data packet frequently.
Step 7: else
Step 8: if { node energy loss==high }
Step 9: switch over next routing path
Step 10: end if
Step 11: end for
```

Algorithm 1: Algorithm for cross-layer method for data agglomeration.

novel, the second part reduces the disturbance, and the third part reduces the interaction.

3. Overview of Proposed Scheme

Ad hoc network nodes are able to organize the data packet from various networks, in which many route packet transmission should be unexpected energy reduction in network structure. These kinds of energy dropping in node damage the connectivity of two relaying nodes. Breakdown of connectivity for ad hoc wireless nodes needs to drop data packet continuously. Lesser energy nodes do not organize information from the network structure. This decreases the packet success rate and increases the energy usage.

Then, in implementing cross-layer method for data agglomeration (CLA), this method needs to aggregate the data packet continuously through the various routing paths, and the nodes in the path should proceed aggregation for the support of cross-layer method. Magnificent path discovery algorithm is designed to provide the better route constructed from sender node to the target node. This communication process is performed by multiple source node with multiple path for packet transmission to single target node in the network structure. The packet retransmission is avoided by this routing method. This reduces the energy usage and improves the packet success rate.

Figure 1 shows block diagram of cross-layer method for data agglomeration. Multiple packet transmission in multiple path; these data packets are organized by different routes. Data packet is collected by target node with lesser residual energy. The cross-layer is supported to gather data packets, and Magnificent path discovery algorithm is constructed to optimize the magnificent path. This improves packet delivery ratio and reduces energy consumption.

3.1. Multiple Routing in Multipath. Every node contains the similar communication assortment, and the packet transmission parameters following quality of service are accepted for transmitting data packet to target node by opportunistic communication. Every node keeps a table of its neighbors' information, including the packet acceptance ratio (also known as the packet success ratio of connectivity between the node and one neighbor node) for each access by a neighbor node. Consider that the packet success rate can be

```
Step 1: search various paths in network.
Step 2: for each node resource level is measured.
Step 3: if {path==efficient}
Step 4: select that path
Step 5: sequence of communication is performed
Step 6: else
Step 7: if { node==inefficient}
Step 8: search another efficient path
Step 9: End if.
Step 10: End for
```

Algorithm 2: Magnificent path discovery algorithm.

achieved among searching at MAC layer. The provided sentence is incomplete. Kindly amend as deemed necessary.

$$\mathrm{MP} = \mathrm{Sp} + \mathrm{Rs}. \tag{1}$$

This is unfeasible to achieve accurate condition of a point-to-point connectivity in network considering the dynamic wireless medium. Therefore, it is necessary to divide each hop's quality of service needs into point-to-point needs. Whether needs on all hop are connected, the quality of service of point to point can be assured. Consider the packet latency and dependability needs correspondingly; sender node quality and receiver node quality indicate the quality of service needs of the ith hop node on the path from source to destination. The individual hop node improvement and hop counts are maintained in packet transmission.

$$\begin{aligned} \mathrm{Sp} &= \mathrm{Tr} + \mathrm{RC} = \mathrm{Tr} + \mathrm{Pd}, \\ \mathrm{Pd} &= R\ \max + R\ \min. \end{aligned} \tag{2}$$

The individual hop evolution between the first hop node and the following hop. Path is the mean improvement of all data broadcasting intermediate node of the sender node. Consider the target node representing the time taken for a packet success from the source node to the next hop node. The maximum packet broadcasting intermediate nodes, the higher dependability of individual hop node transmitting. The larger the improvement of individual hop node data

Table 1: Proposed MPR packet format.

Source ID	Destination ID	Multievent processing in various paths	Multievent path routing	Resource capability-based nodes are used	Resource assignation-based node selection algorithm
3	3	4	3	2	2

packet transmitting, the minimum the point to point data transmission hop nodes. Using several Quality of service resources for routing and the measurement for a surrounding area, create an integrated quality of service characteristics.

$$\begin{aligned} \mathrm{RC}(N) &= (R\max + R\min)N, \\ \mathrm{RC}(N) &= R\max(N) + R\min(N). \end{aligned} \tag{3}$$

The many intermediate nodes as the packet forwarding, the maximum probability of individual hop node containing trustworthiness, though at the charge of maximum for energy usage. The possibility allocated for improving the individual hop node progression for process minimizes the hop nodes and lesser the individual hop node packet latency needs. The precedence assignment as condition is minimized as individual hop node packet latency. Though, below the dynamic wireless connectivity, the additional the data packet transmission space, the lesser the packet acceptance ratio.

3.2. Cross-Layer Method for Data Agglomeration. Normal preference in wireless sensor network to minimize communication energy supposition is used to minimize the packet broadcasting energy level so that the packet transmission arrives at the intended target node with difficulty for a quantity of threshold possibility. Though the merits of minimizing communication energy are not maximum, the communication range does not forever inactive state, since for that condition, packet transmission could probably made as the communication range, the network resources by which the wireless nodes share data packets with neighboring node. Search for to take a more holistic method than present process, captivating into account MAC layer method functionalities and resources to minimize the energy usage of data packet collection.

The process of accelerating communication range depends on time gap for path finding for performing as some calculation perception for the threshold should be lesser, considering that every wireless node analyzes the packet transmission; it uniformly distributed data packets through the network and nodes observing information of various nodes are autonomous. Considering the information following derivations exhaustive in the methodological information, this should obtain the possibility of a measuring data packet being the highest value of every information in network structure.

$$\begin{aligned} \mathrm{Sp} &= \mathrm{Tr} + \mathrm{Pd}, \\ \mathrm{Pd} &= \mathrm{select}(\max R(N)). \end{aligned} \tag{4}$$

The packet latency of each wireless node as a process of the possibility is measured having higher value; it could bias the

Table 2: Simulation setup.

No. of nodes	100
Area size	1170 × 935
Mac	802.11 g
Radio range	250 m
Simulation time	50 ms
Traffic source	CBR
Packet size	512 bytes
Mobility model	Random way point
Protocol	AODV

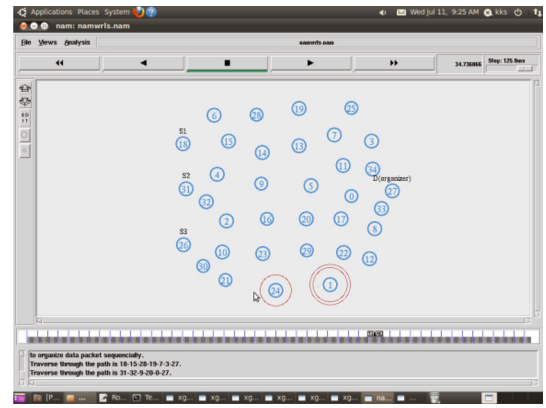

Figure 2: Proposed MPR result.

coverage from the wireless such that the maximum packet transmission rate as former; it allows wireless nodes with lesser packet loss rate to reject its coverage range and higher residual energy. Packet latency is maximized on the routing process. It additionally minimizes the energy usage by minimizing the count of wireless nodes which are ready to transmit data packet by only allowing wireless nodes with monitor the network area and fix specific threshold level for communication. This aggregates data packets from multiple source node through multiple path.

$$\mathrm{Pd} = \mathrm{reject}(\min R(N)). \tag{5}$$

Cross-layer method is used to organize packet sequentially through different paths without packet losing route; the interference occurred in the routing path is identified and removed from specific network area. The interference free routing path obtains the continuous packet forwarding. The nodes in the path can be able to continue packet aggregation for the support of cross-layer scheme. This scheme

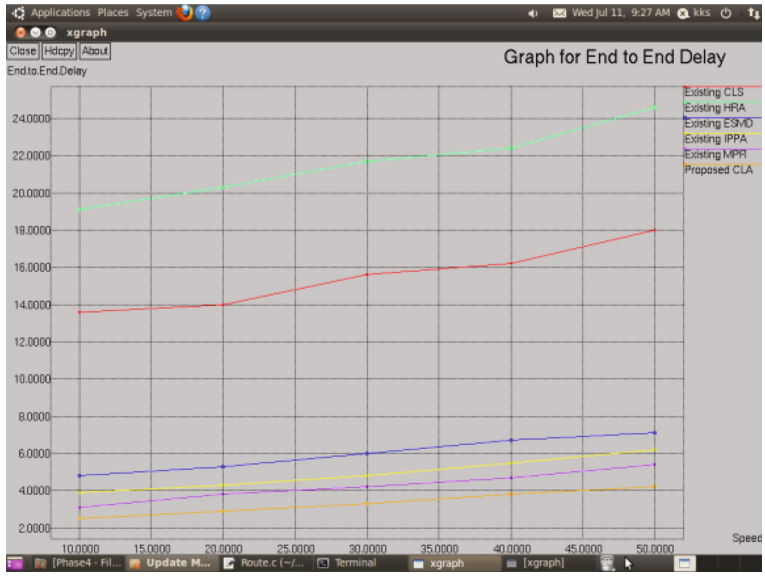

Figure 3: Graph for speed vs. end to end delay.

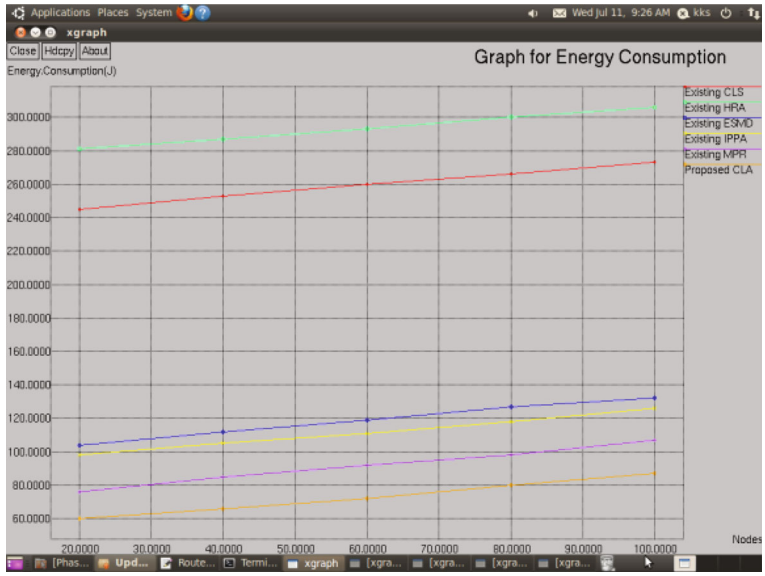

Figure 4: Graph for nodes vs. energy consumption.

provides the efficient connectivity against interference among the routing node.

3.3. Magnificent Path Discovery Algorithm. The wireless nodes accept the data packets that can decode the specific route accordingly. Whether threshold at the data packet is lesser the current packet transmission process at the node, the node should effort to transmit; thus, whether a node's monitoring network structure is above the threshold value, it should transmit data packet during the current packets. Because the data packets are lesser, the interference occurred by this greeting procedure does not make ineffective the overhead; this entire routing procedure can transmit the data packet to the target node. Since a node which share packet is dropped and must not be needed to retransmit considering the maximum values, the reply function of the technique is not used to indicate retransmit and consider for use packet forwarding.

$$\begin{aligned} \mathrm{Sp} &= \mathrm{Tr} + \mathrm{select}(\max R(N)), \\ \mathrm{MP} &= \mathrm{Tr} + \mathrm{select}(\max R(N)) + \mathrm{Rs}. \end{aligned} \tag{6}$$

The magnificent path discovery algorithm is designed to achieve the sequence of packet sharing along the wireless network nodes; this obtains the energy-efficient routing path from multiple paths. Data packets are sequentially organized by target node from multiple source nodes in network environment.

This algorithm is designed to discover the better routing path from network structure. It improves packet delivery ratio and decreases the energy consumption.

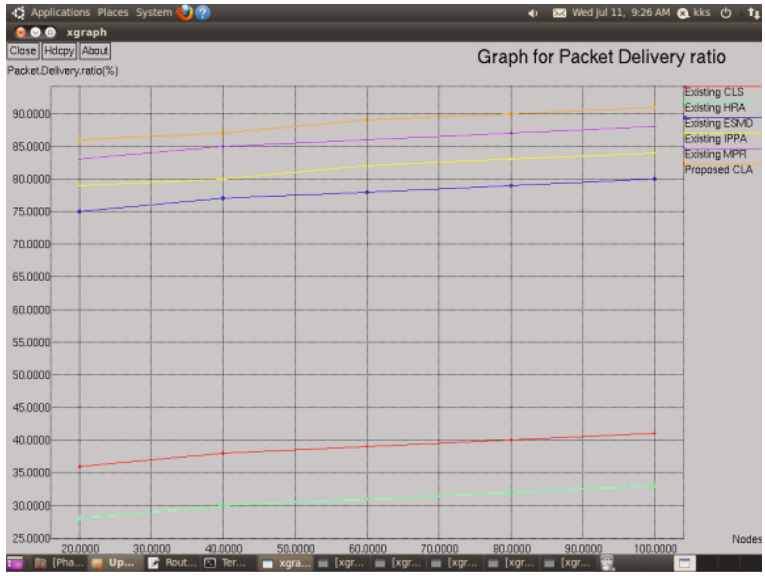

Figure 5: Graph for nodes vs. packet delivery ratio.

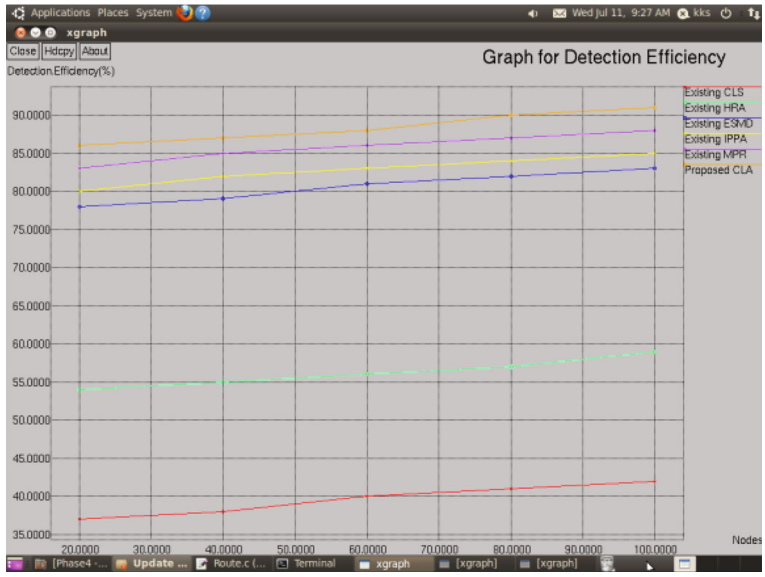

Figure 6: Graph for nodes vs. detection efficiency.

Packet ID. Packet ID contains every sensor node information. It needs to obtain every node's resource availability and location, and the distance between source and target node is also measured.

In Table 1, the proposed MPR packet format is shown. Here, the source and destination node ID field each caries 3 bytes. Third one is multievent processing in various paths; the data packets are transmitted along different routes in network that occupies 4 bytes. Multievent path routing is used to provide the multiple communication process in network. The fourth field occupies 3 bytes. Resource capability-based nodes are used; this selects the higher resource availability node for communication purpose. The fifth occupies 2 bytes. Resource assignation-based node selection algorithm occupies 2 bytes; it assigns the efficient node for transmitting data packets.

4. Performance Evaluation

4.1. Simulation Model and Parameters. The proposed multievent path routing (MPR) technique is simulated with Network Simulator (NS 2.34) tool. In our simulation, 100 wireless ad hoc nodes are placed in a 1170 meter × 935 meter square region for 50 milliseconds simulation time. Each mobile node goes random manner among the network in different speed. All nodes have the same transmission range of 250 meters. CBR (constant bit rate) provides a constant speed of packet transmission in network to limit the

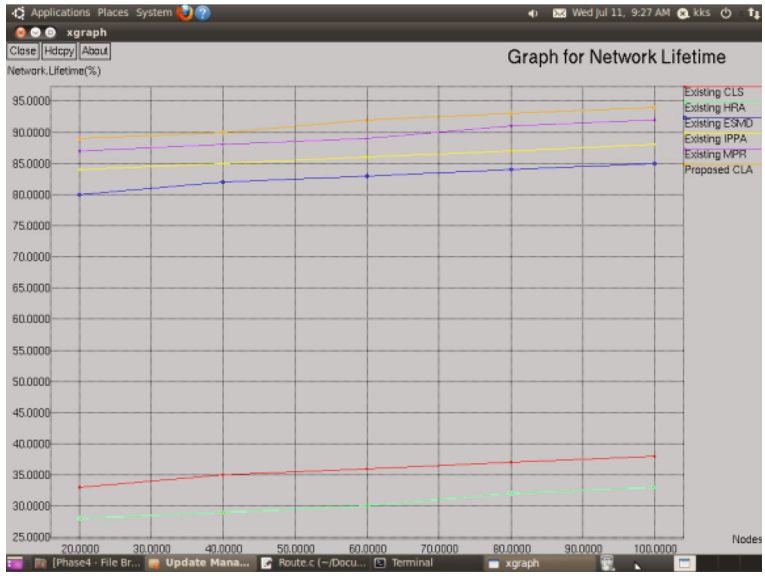

Figure 7: Graph for nodes vs. network lifetime.

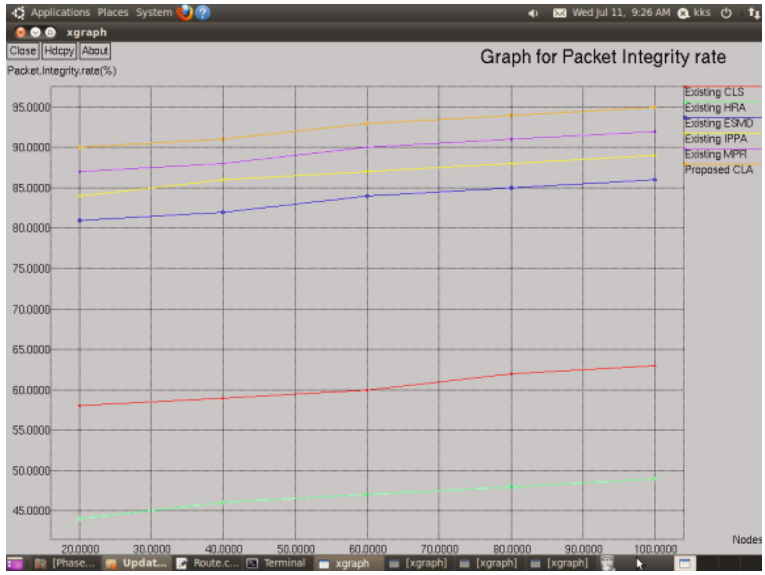

Figure 8: Graph for nodes vs. packet integrity rate.

traffic rate. AODV (ad hoc on demand distance vector) routing protocol is used to provide multiprocessing in single path and also used to prolong network lifetime. Table 2 shows simulation setup estimation.

Simulation Result. Figure 2 shows that the proposed multievent path routing (MPR) method is used to obtain higher resource available nodes for communication process compared with existing EAE [19] and SOS [20]. MPR is capable to assign the better energetic routing path. Resource assignation-based node selection algorithm is designed to collect data packet without packet drop. It improves packet delivery ratio and reduces end to end delay.

4.2. Performance Analysis. Using a graph from Figures 3–8, analyze the following performance measures in simulation.

4.2.1. End to End Delay. Figure 3 shows that end to end delay is estimated by amount of time used for packet transmission from source node to destination node, and resource assignation-based node selection algorithm is designed to use only higher resource node. In the proposed MPR method, end to end delay is reduced compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{End to End Delay} = \text{End Time} - \text{Start Time}. \quad (7)$$

4.2.2. Energy Consumption. Figure 4 shows energy consumption and how extended energy spends for communication; that means calculate energy consumption starting energy level to ending energy level. The proposed MPR method provides multiple communication process on single path;

energy consumption is minimized compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{Energy Consumption} = \text{Initial Energy} - \text{Final Energy}. \quad (8)$$

4.2.3. Packet Delivery Ratio. Figure 5 shows that packet delivery ratio is measured by no. of received from no. of packet sent in particular speed. Node velocity is not a constant, and simulation mobility is fixed at 100 (bps). In the proposed MPR method, packet delivery ratio is improved compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{Packet Delivery Ratio} = \left(\frac{\text{Number of packet received}}{\text{Sent}}\right) * \text{speed}. \quad (9)$$

4.2.4. Detection Efficiency. Figure 6 shows detection efficiency; attacks are occurred packet transmission repeated from source node to destination node. Extra Time is taken to find the breakdown or failure node. In the proposed MPR method, detection efficiency is improved compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{Detection efficiency} = \frac{\text{attack detection rate}}{\text{overall time}}. \quad (10)$$

4.2.5. Network Lifetime. Figure 7 shows that lifetime of the network is measured by node process time taken to utilize network from overall network ability; it had resource assignation-based node selection algorithm to select maximum resource available node, to observe the information of network processing. In the proposed MPR method, network lifetime is improved compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{Network Lifetime} = \frac{\text{time taken to utilizenetwork}}{\text{overall ability}}. \quad (11)$$

4.2.6. Packet Integrity Rate. Figure 8 shows that packet integrity of particular communication in network is estimated by node transmit packet with coverage limit. In the proposed MPR method, packet integrity rate is improved compared to existing method EAE, SOS, IPPA, and ESMD.

$$\text{Packet integrity rate} = \left(\frac{\text{Number of packet successfully sent}}{\text{coverage limit}}\right) * 100. \quad (12)$$

5. Conclusion

Ad hoc wireless network communication process is changeable, and minimum resource nodes are difficult for performing communication process, since it must not organize information from network structure. The resource availability is mainly focused on energy range of every node and data transmission speed. This is minimum to loss packet while communication time. This minimizes the packet delivery ratio and increases the end to end delay. So, in the proposed multievent path routing (MPR) method, individual network must not focus multievent, since node resource level is unstable every time. The same resource-level nodes are detected, and then proceed the communication process. Resource assignation-based node selection algorithm is constructed to achieve the energetic communication route. The maximum resource available nodes are selected to construct path. It improves the packet delivery ratio and reduces end to end delay. In future enhancement, the work can be improved with efficient optimization scheme and cross-layer-based routing model is performed.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] M. Li, C. Hua, C. Chen, and X. Guan, "Application-driven virtual network embedding for industrial wireless sensor networks," in *2017 IEEE International Conference on Communications (ICC)*, Paris, France, 21-25 May 2017.

[2] M. Radi, B. Dezfouli, K. A. Bakar, and M. Lee, "Multipath routing in wireless sensor networks: survey and research challenges," *Sensors ISSN*, vol. 12, no. 1, pp. 650–685, 2012.

[3] O. B. Akan and I. F. Akyildiz, "Event-to-sink reliable transport in wireless sensor networks," *IEEE/ACM Transactions on Networking*, vol. 13, no. 5, pp. 1003–1016, 2005.

[4] J. R. Gallardo, A. Gonzalez, L. Villasenor-Gonzalez, and J. Sanchez, "Multipath routing using generalized load sharing for wireless sensor networks," in *Proceeding of the International Conferences on Wireless and Optical Communications*, Montreal, QC, Canada, 30 May–1 June 2007.

[5] N. A. Pantazis, S. A. Nikolidakis, and D. D. Vergados, "Energy-efficient routing protocols in wireless sensor networks: a survey," *IEEE Communications Surveys & Tutorials*, vol. 15, no. 2, pp. 551–591, 2013.

[6] W. Lou, "An efficient N-to-1 multipath routing protocol in wireless sensor networks," in *IEEE International Conference on Mobile Adhoc and Sensor Networks Conference*, pp. 665–672, Washington, DC, USA, 2005.

[7] M. M. Alam, M. A. Razzaque, M. Mamun-Or-Rashid, and C. S. Hong, "Energy-aware QoS provisioning for wireless sensor networks: analysis and protocol," *Journal of Communications and Networks*, vol. 11, no. 4, pp. 390–405, 2009.

[8] A. V. Sutagundar and S. S. Manvi, "Location aware event driven multipath routing in wireless sensor networks: agent based approach," *Egyptian Informatics Journal*, vol. 14, no. 1, pp. 55–65, 2013.

[9] R. Singh, B. K. Rai, and S. K. Bose, "A joint routing and MAC protocol for transmission delay reduction in many-to-one communication paradigm for wireless sensor networks," *IEEE Internet of Things Journal*, vol. 4, no. 4, pp. 1031–1045, 2017.

[10] M. Elhoseny, X. Yuan, H. K. El-Minir, and A. M. Riad, "Extending self-organizing network availability using genetic algorithm," in *Fifth International Conference on Computing, Communications and Networking Technologies (ICCCNT)*, pp. 1–6, July 2014.

[11] T. T. Vinh, T. N. Quynh, and M. B. T. Quynh, "Emrp: energy-aware mesh routing protocol for wireless sensor networks," in *Advanced Technologies for Communications (ATC), 2012 International Conference on*, pp. 78–82, IEEE, 2012.

[12] C. Zhou, J. Luo, and R. F. Li, "An event aware anycast rooting protocol in wireless sensor networks," in *Wireless Communications, Networking and Mobile Computing, 2007. WiCom 2007. International Conference on (pp. 2515-2518)*, IEEE, 2007.

[13] D. Agarwal, N. Kishor, and A. S. Raghuvanshi, "Flexible threshold selection and fault prediction method for health monitoring of offshore wind farm," *IET Wireless Sensor Networks*, vol. 5, no. 4, pp. 183–192, 2015.

[14] S. Niranchana and E. Dinesh, "Object monitoring by prediction and localisation of nodes by using ant colony optimization in sensor networks," in *Advanced Computing (ICoAC), 2012 Fourth International Conference on (pp. 1-8)*, IEEE, 2012.

[15] P. M. Glatz, L. B. Hörmann, C. Steger, and R. Weiss, "HANS: harvesting aware networking service for energy management in wireless sensor networks," in *Telecommunications (ICT), 2011 18th International Conference on (pp. 180-185)*, IEEE, 2011.

[16] S. Sivasakthiselvan and V. Nagarajan, "Mobility management and adaptive dynamic clustering for mobile wireless sensor networks," in *Communication and Signal Processing (ICCSP), 2017 International Conference on (pp. 2246-2251)*, IEEE, 2017.

[17] M. K. Sharma and B. K. Joshi, "Detection & prevention of vampire attack in wireless sensor networks," in *Information, Communication, Instrumentation and Control (ICICIC), 2017 International Conference on (pp. 1-5)*, IEEE, 2017.

[18] S. A. Raheem, M. Prabhakar, and P. P. Kumar, "Compressive data aggregation technique based on comb needle model with deterministic scheme for military application," in *Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2017 2nd IEEE International Conference on (pp. 2061-2064)*, IEEE, 2017.

[19] N. T. T. Hang, N. C. Trinh, and N. T. Ban, "Energy aware event driven routing protocol and dynamic delivering scheme for multievent wireless sensor network," in *Recent Advances in Signal Processing, Telecommunications & Computing (SigTelCom), 2018 2nd International Conference on (pp. 224-229)*, IEEE, 2018.

[20] A. Shehab, M. Elhoseny, A. T. Sahlol, and M. A. El Aziz, "Self-organizing single-hop wireless sensor network using a genetic algorithm: Longer lifetimes and maximal throughputs," in *Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), 2017 IEEE International Conference (pp. 1-6)*, IEEE, 2017.

[21] R. P. Premanand and A. Rajaram, "Enhanced data accuracy based PATH discovery using backing route selection algorithm in MANET," *Peer-to-Peer Netw. Appl.*, vol. 13, no. 6, pp. 2089–2098, 2020.

[22] A. Rajaram and S. Palaniswami, "Malicious node detection system for mobile ad hoc networks," *(IJCSIT) International Journal of Computer Science and Information Technologies*, vol. 1, no. 2, pp. 77–85, 2010.

[23] S. Palaniswami and A. Rajaram, "An enhanced distributed certificate authority scheme for authentication in mobile ad hoc networks," *The International Arab Journal of Information Technology (IAJIT)*, vol. 9, no. 3, pp. 291–298.

[24] V. Vaneetha and C. Vivekanandhan, "Link interposition detection based revamped routing in manet based on buffer efficient restore connectivity," *The international science press (IJCTA)*, vol. 9, no. 34, pp. 843–856, 2016.