SURVIVAL STUDY ON TRAFFIC AWARE RESOURCE OPTIMIZED ROUTING IN WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless sensor network includes the small low-cost sensor nodes with restricted broadcast range and their processing, storage competences. The network collects information from the nodes and sends data to base station for processing. Wireless message is one of the major power overwhelming events on sensor nodes and its usage is measured by direction-finding protocol. Direction-finding protocol is used to transmit the data from basis node to destination node. During the data transmission, traffic remained unaddressed and energy consumption was not reduced. In order to address these problems, traffic aware resource optimized routing is carried out using machine learning techniques with minimum energy consumption and delay.

Keywords: Wireless Sensor Network, Transmission Range, Direction-Finding Protocol, Energy Consumption, traffic, resource optimized routing

I. INTRODUCTION

Wireless Sensor Network (WSN) is a collection of distributed sensors for recording the environmental activities. In WSN applications like location monitoring or farming scenarios, more of sensor nodes are used over large protected area. Crowding in wireless sensor networks with negative impact on performance reduces throughput, enhances packet rebroadcast, and reduces energy consumption. In WSN, traffic has central pattern where avoiding the hot spots was not efficient in reducing the crowding as it gets reappear near sink node.

This paper is arranged as follows: Section II reviews on existing traffic aware resource optimized routing technique in WSN. Section III gives brief discussion about traffic aware resource optimized routing technique. Section IV identifies the probable assessment between them. Section V explains the boundaries and the associated work. Section VI completes the paper; key parts of study is given as to improve the performance of traffic aware resource optimized routing in WSN.

II. LITERATURE REVIEW

A Congestion Aware Traffic Load Balancing Scheme was introduced in [1] by composite metric. Congestion was identified through monitoring buffer space, consecutive packet interval time utilization. CTLS diverted congested node by local reparation method or varied traffic to unfocussed path for enhancing the packet distribution ratio. But, CTLS failed in reducing the data loss rate during directing process. A traffic aware routing algorithm was introduced in [2] for distributing the loads in WSN. The designed scheme decreases the no of packet rebroadcasts and packets dropped through preventing the nodes with buffers. The bandwidth consumption during routing was not reduced by traffic-aware routing algorithm.

Hamilton Energy Efficient Routing Protocol was presented in [3] to carry out interruption-aware and energy efficient routing in WSN. HEER failed to need every node with universal location info comparison using cable-based protocols like PEGASIS. However, load-aware routing was not performed which increases the data loss during transmission. An adaptive cuckoo search based optimal rate adjustment (ACSRO) was presented in [4] for crowding avoidance in WSN. ACSRO improved the quantity, postponement, regularized packet loss, and regularized queue size. But, the energy and bandwidth utilization rate in WSN was not minimized by ACSRO.
Energy Balanced Routing Protocol (EBRP) was introduced in [5] by loop elimination method to upsurge the network generation and coverage ratio in WSN. Crowding Aware, Energy Efficient on Request Fuzzy Logic Based Clustering Protocol was introduced in [6] for Multi-hop WSN. The designed protocol minimizes the redundant control message communication. The bandwidth utilization was not minimized. Enhanced Congestion Aware Routing (E-CAR) was designed in [7] to avoid the crowding effects in the network. E-CAR enhanced the packet delivery ratio. The resource optimization remained unaddressed in E-CAR. A circulated traffic-aware routing scheme was introduced in [8] for WSN with numerous sinks. In more sink networks, traffic moving to one sink congested with other one. The designed algorithm considered traffic of nearby neighbors before moving to sink. But, the delay time was not reduced.

III. TRAFFIC AWARE RESOURCE OPTIMIZED ROUTING IN WSN

Routing protocol is an essential component of wireless sensor network. Routing protocol monitors the variation of network topological structure, routing information exchange, find destination node, select the route and transmit the information through the route. A suitable protocol design is used for reducing the energy consumption. The main objective of hierarchical routing is to efficiently preserve the energy utilization of sensor nodes through linking them in multi-hop communication within the specific cluster.

3.1 Crowding-alert and traffic load balancing system for directing in WSNs

Congestion in Wireless Sensor Network (WSN) is the main reason for performance degradation because of the severe packet loss resulting in large amount of energy consumption. WSN avoid the congestion through choosing the sensor nodes with adequate buffer space and varying the traffic rate at basis node over through exposed route that reductions the End-to-End (ETE) throughput. On request routing protocols identifies the least overfilled route when it is essential. In WSN, on-request routing protocols restore routing metric of prevalent directing protocol with designed routing metric and maintain route detection mechanism intact. A new Congestion Aware Traffic Load Balancing Scheme (CTLS) was introduced for avoiding the congestion through route discovery method to select the optimum node depending on the complex metric. When congestion takes place, CTLS identifies and alleviates it through ripple-based search approach. CTLS for routing was developed to avoid, identify, and improve crowding to reduce the traffic load in WSNs. CTLS is classified into three mechanisms. The initial module in CTLS is employed to reduce the crowding. In second component, timely detection of crowding was performed and third component alleviates the crowding reactively. An intellectual view of the CTLS with these mechanisms is shown in Figure 1A.
In first section, a new route-finding device with inverse and onward route process is introduced. The additional components present new process to identify the congestion in reactive way through monitoring the buffer, channel consumption and traffic path movement to alternating route correspondingly. The traffic path movement is derived by ripple-based finding mechanism to bypass overfilled node/link to sub-optimal least overfilled route.

Congestion Avoidance: When the source node is activated, the initial step achieved by sensor node is to check the obtainability of route to location through Checked Route Obtainability process. When route to destination does not exist in routing table, sensing node sends the request through incorporating routing metric determined through compound metric composition. Compound Metric Composition process is appealed when the sensor node transmits the broadcast request to find the route to chosen location. Reverse Route Formation process is initiated when midway sensor node collects the broadcast request. The process preserves reverse route entry in data store called Reverse Routing Table. When the desired location is identified, Forward Route Formation process is performed. Forward Route Formation preserves the chosen node in data store of Forward Routing Table and transmits the unicast reply to chosen forward node. A route to destination is accessible and data packet is sent to chosen location over identified route. The buffer and link among sensor nodes are experiential to identify the crowding.

Congestion Detection: A procedure to observe the node state and link between the nodes is started to identify the congestion. When node or link between the nodes appears congested in future, process to report the source or predecessor node gets activated. Crowding Notification procedure is invoked by sensor node when crowding or short energy is detected. Based on location of affected node, report is sent to sidestep the affected area or re-path data traffic to another route to improve the congestion.

Congestion Alleviation: A Ripple-created Search is activated when sensor node gets a report message. The overfilled node is avoided to preserve the route. An additional process to alleviate congestion is to Re-Route data traffic to substitute congestion-aware and energy effective route. The process is started by node after determining estimated position of overfilled or affected node overactive route. An event-based Optimized Route Table (ORT) clock (TORT) maintains and remove the entries for finest route selection is preserved at sink.

3.2 Hop to Hop Traffic Aware Routing to Congestion Control in WSN

Congestion avoidance, discovery and improvement are essential thoughts in WSN. The routing protocol is an essential role to choose the finest nodes and to route the data traffic flow from basis to the end point node to avoid the mobbing proactively. Sensor nodes observe the buffer tenancy and channel use to identify the crowding in timely way during the data continuance process. Congestion alleviation techniques manage the control congestion reactively through varying the basis traffic rate or through re-noticing the new route.

A traffic aware routing algorithm was introduced to route the packets around overfilled areas by indolent or below loaded nodes. The objective of algorithm is to build the two autonomous gradient fields through complexity and traffic loading congruently. The complexity is constructed in additional gradient founded routing protocols to identify the shortest path for packs. The additional factor solves the traffic payload of adjacent nodes that arrived from the next forwarding node. When the traffic payload goes beyond the threshold, then there is a crowding at node to the sink node and the packets flow through sub ideal paths. Traffic incline Gradient field presents the Traffic Aware resolution and the depth field presents the routing support to transmit the data packets to the end. The two fields are joined into the hybrid potential field to take routing conclusions. The designed method resulted in tradeoff between the direct path and traffic at loaded node. A hop-by-hop crowding control system is introduced where the congestion is handled through changing the data transmission rate of nodes.

The concepts of queue length field are to avoid the packet from going to conceivable crowding area. The designed method routes the packets around the overfilled area and throw the large number of packets through numerous paths. Due to significance nature of the traffic in WSN, the in-between local hot spot avoids the crowding as the hotspots reappear near sink when the distributed packets approach sinks from diverse directions at the same time. Hop-by-hop congestion control scheme distributes the MAC layer network channel info of downstream node with transportation layer of upriver node and handles the network crowding through adjusting the data broadcast rate and channel admission priority. The rate changing plan reduced the network message system of measurement such as energy exchangeable, broadcast fairness and data throughput. When upriver node
transmits the AP, indication collected from the downriver node, it considers own crowding condition and vary scope of resident channel and data broadcast dependent on the information.

3.3 A Delay Aware Energy Efficient Routing Protocol for Wireless Sensor Networks

Wireless Sensor Networks (WSNs) are employed for different applications like target chasing, truck motion, quake detection, persistent monitoring systems and pollution controller system etc. WSN comprise the sensor node (SN) with minimum system factor, cost, and energy ingesting. Sensor networks are battery power-driven and arbitrarily used in Field Of Interest (FOI). Then it is difficult to collect the spare batteries often periods. In ranked routing protocol, SNs form the local construction termed clusters with one cluster head (CH) and number of non cluster heads. Cluster Head and Non Cluster Heads in cluster are termed as Cluster Members (CMs). Non Clusters transmission the data with help of cluster head that handles Non Clusters in its cluster through allocating the transmission slots. All cluster heads form the message backbone of network at higher ranked level. Classified protocol improved the energy consumption efficiency. In hierarchical protocol, CHs perform different tasks like node connotation, verification, data combination, data synthesis and task preps.

Hamilton Path ideas are employed for connecting the members in every cluster without the need for separate node global location information. The path reduces the broadcast distance for every CM and power weight at CH. Clusters is formed once where the network administrative overhead is less. The cluster size is controlled and linked it to maximum frame length. An energy delay aware routing protocol was introduced depending on clustering and Hamilton path ideas. The data payload are transmitted and aggregated by Hamilton path with all cluster memberships to minimize the total network energy ingesting. The design attained additional stable power ingesting for CHs. When number of CM gets increases, the rate of Hamilton path and data combination also increased. The utilization of each packet gets increased when regular delay for data broadcast to BS gets controlled. With path formation, HEER protocol methods its clusters at primary round where CM on path become CH.

An enhanced delay aware and energy efficient grouped protocol termed Hamilton Energy Efficient Routing Protocol was introduced. HEER groups to form the clusters in network loading phase and relations the members in every cluster on the Hamilton Path with help of greedy algorithm for data broadcast. The cluster renovation was not necessary and the associates on path are taken as cluster head. The plan allows HEER to consume lesser network management energy and stability load comparing to the cluster-based protocols.

IV. COMPARISON OF TRAFFIC AWARE RESOURCE OPTIMIZED ROUTING IN WSN & SUGGESTIONS

To compare the traffic aware resource optimized routing techniques in WSN, number of sensor nodes and data packets is occupied to perform the trial. Numerous parameters are used for traffic aware resource optimized routing using classification techniques in WSN.

4.1 Energy Consumption

Energy consumption is defined as the quantity of energy used to transmit the data to end point node from source node. Energy consumption is the product of energy utilized by one sensor node for data broadcast and no of sensor device nodes in WSN. It is measured in terms Joules (J) and formulated as,

\[
ECR = n \times E_{sn}
\]

From equation (1), ‘n’ is total no of sensor nodes and ‘\( E_{sn} \)’ is energy employed by a single node for traffic aware routing. While energy consumption is lesser, the technique is more efficient.
Table 1A Table for Energy Consumption

<table>
<thead>
<tr>
<th>No of Sensor nodes (number)</th>
<th>Energy Consumption (Joules)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CTLS</td>
</tr>
<tr>
<td>10</td>
<td>45</td>
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<tr>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>30</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>54</td>
</tr>
<tr>
<td>50</td>
<td>57</td>
</tr>
<tr>
<td>60</td>
<td>55</td>
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<tr>
<td>70</td>
<td>51</td>
</tr>
<tr>
<td>80</td>
<td>54</td>
</tr>
<tr>
<td>90</td>
<td>57</td>
</tr>
<tr>
<td>100</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 1A describes the energy consumption with respect to no of sensor nodes ranging as of 10 to 100. Energy consumption comparison takes place on existing Congestion Aware and Traffic Load balancing Scheme, traffic aware routing algorithm and Hamilton Energy Efficient Routing Protocol. From the table value, it is observed that the energy consumption using Hamilton Energy Efficient Routing Protocol is lesser when compared to Congestion Aware Traffic Load Balancing Scheme and traffic aware routing algorithm. The graphical analysis of energy consumption is shown in figure 2A.

Figure 2A Measure of Energy Consumption
As shown in figure 2A, energy consumption during Hamilton Energy Efficient Routing Protocol (HEER) for different no of sensor nodes is calculated. From the figure 2A, it is clear that the energy consumption using Hamilton Energy Efficient Routing Protocol (HEER) is lesser when compared to Congestion Aware Traffic Load balancing Scheme (CTLS) and traffic aware routing algorithm. When the no of sensor nodes gets augmented, energy consumption also gets augmented correspondingly in all three approaches. This is because HEER procedures clusters in network loading phase and link associates in every group on Hamilton Path using greedy algorithm for data broadcast. Research in Hamilton Energy Efficient Routing Protocol reduces the energy consumption by 42% than Congestion-aware and Traffic Load balancing Scheme and by 31% than traffic-aware routing algorithm.

4.2 Packet Loss Rate

Pack Loss Rate is well-defined as the ratio of no of data packets dropped during the data transmission process in WSN to the total no of data packet sent. The packet loss rate is calculated in standings of percentage and calculated as,

\[ DLR = \frac{\text{Number of data packets lost}}{\text{Number of datapackets sent}} \times 100 \]  

(2)

From equation (2), packet loss rate involved throughout the data delivery is calculated with admiration to diverse no of data packets. When data loss rate is lesser, the technique is said to be more well-organized.

Table 2A Table for Packet Loss Rate

<table>
<thead>
<tr>
<th>No of Sensor nodes (number)</th>
<th>Packet Loss Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CTLS</td>
</tr>
<tr>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>40</td>
<td>17</td>
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<tr>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>60</td>
<td>21</td>
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<td>80</td>
<td>27</td>
</tr>
<tr>
<td>90</td>
<td>30</td>
</tr>
<tr>
<td>100</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 2A explains the packet loss rate with respect to no of sensor nodes ranging from 10 to 100. Pack loss rate comparison takes place on existing Congestion Aware Traffic Load balancing Scheme (CTLS), traffic-aware routing algorithm and Hamilton Energy-Efficient Routing Protocol (HEER). The graphical analysis of packet loss rate is shown in figure 3A.
As shown in figure 3A, packet loss rate throughout traffic aware resource optimized routing for different number of sensor nodes are calculated. From the figure, it is clear that the packet loss rate using traffic-aware routing algorithm is lesser when compared to Congestion Aware Traffic Load Balancing Scheme (CTLS) and Hamilton Energy-Efficient Routing Protocol (HEER). When the no of sensor nodes gets augmented, packet loss rate also becomes increased correspondingly in all three methods. This is because the designed algorithm constructs two autonomous gradient fields through depth and traffic loading respectively. When the traffic loading goes beyond the threshold, there is crowding at node in path to sink node and the packets movement along additional suboptimal paths to reduce packet loss rate. Research in traffic-aware routing algorithm reduces the packet loss rate by 33% than Congestion-aware and Traffic Load balancing Scheme and by 45% than Hamilton Energy-Efficient Routing Protocol.

4.3 Endways Delay

Endways Delay is well-defined as the amount of time needed for data packet transmission from source to destination in WSN. From that, endways delay is measured as the distinction among data packet influx time and data packet directed time. The endways delay is calculated in terms of msecs (MS) and expressed as,

$$ED = N \ast (A_T - S_T)$$  \hspace{1cm} (3)

From equation (3), endways delay in WSN is calculated with admiration to different number of data packets ‘(N)’. Here, ‘$A_T$’ designates influx time of a data packet whereas ‘$S_T$’ point outs distribution time of a data packet in wireless network. When endways delay is minimal, the technique is said to be more effective.

Table 3A Tabulation for Endways Delay

<table>
<thead>
<tr>
<th>NO of Sensor nodes (number)</th>
<th>CTLS</th>
<th>Traffic-aware routing algorithm</th>
<th>HEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>35</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>20</td>
<td>38</td>
<td>45</td>
<td>53</td>
</tr>
</tbody>
</table>
Table 3A explains the endways delay with respect to no of sensor nodes reaching from 10 to 100. End-to-End Delay comparison takes place on existing Congestion Aware Traffic Load balancing Scheme (CTLS), traffic-aware routing algorithm and Hamilton Energy-Efficient Routing Protocol (HEER). From the table value, the endways delay using Congestion Aware Traffic Load balancing Scheme (CTLS) is lesser when compared to traffic-aware routing algorithm and Hamilton Energy Effective Routing Protocol (HEER). The graphical representation of endways delay is shown in figure 4A.

As shown in figure 4A, endways delay during Congestion Aware and Traffic Load balancing Scheme (CTLS) for different number of sensor nodes is computed. From the figure, it is observed that the endways delay using Congestion-aware and Traffic Load balancing Scheme (CTLS) is lesser when compared to traffic-aware routing algorithm and Hamilton Energy-Efficient Routing Protocol (HEER). When the no of sensor nodes gets amplified, end-to-end delay also gets increased correspondingly in all three methods. This is because Congestion-aware and Traffic Load balancing Scheme (CTLS) evades crowding through the route detection instrument to select the optimal node based on the compound metric. When the mobbing takes place, CTLS identifies and alleviates through ripple-based search approach. Research in Congestion Aware and Traffic Load balancing Scheme (CTLS) minimizes the end-to-end delay by 13% than Congestion-aware and Traffic Load balancing Scheme and by 26% than traffic-aware routing algorithm.
V. DISCUSSION ON LIMITATION OF TRAFFIC AWARE RESOURCE OPTIMIZED ROUTING IN WSN

Congestion Aware And Traffic Load balancing Scheme (CTLS) was introduced for routing that avoids the crowding through route discovery mechanism to choose the optimum node depending on the composite metric. When the congestion takes place, CTLS identify it in timely way and alleviates it by ripple-based search approach. But, CTLS not reduced the data loss rate during routing process in WSN. HEER is to minimize and stability the network energy ingesting by Hamilton Path in graph theory to identify the data broadcast path. Hamilton Path is a path that navigates graph and accesses every node once. HEER travel all nodes once in cluster for each round where the nodes were not frequently accessed. But the end-to-end delay was not reduced using HEER.

A Distributed Traffic Aware routing scheme was introduced for altering the data broadcast rate of nodes that distribute the traffic from source node to sink nodes. The designed algorithm was constructed in hybrid simulated incline field by depth and standardized traffic loading to provide the balance between the ideal paths and possible crowding on routes to the sinks. But, load-aware routing was not performed that increases the data loss during transmission.

5.1 Related Works

A multi-path dynamic routing algorithm called IDDR was introduced in [9] to address the issues. IDDR divides the packets with various QoS needs consistent with the weight allocated to every packet and transmits them to the sink through diverse paths for increasing the data reliability for integrity-sensitive applications and minimizing the endways delay. Though the delay was reduced, the energy consumption was not minimized using IDDR algorithm. Traffic Aware Dynamic Routing (TADR) algorithm was introduced in [10] to course the packets round crowding areas and distribute large amount of packets along several paths with shiftless and under loaded nodes. TADR algorithm constructed the fusion simulated possible field through complexity and regularized queue length to force the packets to clear impediments generated by crowding. But the delay time was not reduced using TADR algorithm.

A scheme was introduced in [11] for managing the crowding in wireless sensor network. The key objective of designed method is to minimize the crowding through considering significance of data. Consistent with data priority, the packets get categorized. But the time consumption was not reduced. Energy and storage capabilities are a key issue to execute the routing in wireless sensor network with lesser power. Routing protocols are employed for determining and preserving routing in sensor networks. Hierarchical routing protocols were introduced in [12] for wireless sensor networks.

5.2 Future Direction

The future direction of the work is to perform traffic aware resource optimized routing techniques in wireless sensor network by using machine learning techniques.

VI. CONCLUSION

A comparison of different techniques for traffic aware resource optimized routing in WSN is studied. From the survival study, the energy consumption was not minimized using IDDR algorithm. In addition, load-aware routing was not carried out that increased the data loss during transmission. The end-to-end delay was not reduced using the HEER. The extensive range of experiments on standing methods and algorithm estimates the comparative results of traffic aware resource optimized routing in WSN with its limitations. Finally, from the constraint recognized with existing works, further examine work can be accepted out for attaining traffic aware resource optimized routing in WSN.

REFERENCES


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