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An Multipath Routing approach for Delay and Data Integrity using DCN in WSN

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Abstract

In the world of today WSN has made an extremely commendable impact in the various fields of sensor and computer technology because of its tremendous advancement. Sensor nodes plays important roles in the network, these nodes are deployed randomly in the network they are capable of communicating and sensing the gathered data from source to destination node. There are several problem's regarding the scalability, cost, topology change and power consumption of the networks. Researchers work on developing novel technologies to overcome all these issues. There are various QoS (Quality of Service) requirement of each WSN application which run on the same WSN platform. Two fundamental requirements are less delay and more data integrity. Current techniques have failed to provide these requirements. In the existing system, there is a system which fulfills this requirement but, the system fails to run when the hotspot is generated at the sensor nodes. In this work, to overcome this issue and improve the performance of the network delay and energy consumption of the network, the clustering and scheduling algorithm with IDDR algorithm is implemented. In this system if the hotspot is generated at sensor node at the time of communicating with node for sending data, node creates a cluster and finds the Cluster Head (CH) with high energy and minimum depth value. CH is selected on the basis of energy and distance of the node. Data in the queue within the hotspot will redirect through different rout using CH. This will reduce the packet drop and delay in the network. These systems gave less accurate results therefore we have proposed another system by using data cluster node(DCN). In this system DCN are deployed in the network and when the hotspot is generated then the data will be sent through the DCN which is nearest the to the hotspot node. This system improves the lifetime of the network and it also minimizes the loss of data.

Keywords: wireless sensor networks, energy consumption, IDDR, DCN, CH.

INTRODUCTION

Researchers throughout the world are showing a keen interest in WSN techniques, because of their attention and applications. The smart sensors are developed because of the production in Micro-Electro-Mechanical Systems (MEMS) technology. As compared to the existing sensor nodes, these sensors are small in size, low in cost, with restricted processing and computing resources. These sensors have lots many applications such as, they can measure, sense and collect the data from another nodes. These nodes communicate with other nodes to sense the data. Smart sensor nodes are low power devices equipped with one or more sensors, a processor, memory, radio, power supply, and an actuator. In the next generation of technological world WSN plays a very important role for securely communicating within the networks. In such networks the Quality of Service guarantee gains a great attention in the research community due to the multiplicity and difficulty of applications running over WSNs.

Researchers focus on the requirement of QoS, which is application or network specific. It has different requirements for different perspectives such as, for event tracking applications it can focus on coverage, optimum number of sensors that need to be active, exposure etc. For network perspective, the QoS requirement can be maximum usage of the sensors resources. There are some challenges faced by the researcher while developing the QoS protocol such as, resource constraint, mixed data, dynamic topology, scalability, multiple base station, and redundant data etc. which have to be addressed.

In this work we have focused on two basic requirements of Quality of Services which are; high data integrity and low delay. In most of the situations these requirements cannot be satisfied simultaneously. The most important to bjective of the paper is, how to design routing protocol tha tprovides data integrity and delay differentiated services over the same Wireless Sensor Networks simultaneously without wasting much energy and which should work efficiently even when the network is congested.

In this work basically we focus on:

- The two systems for fulfilling the requirements of QoS. In first system clustering process is used. In second system DCN is used.
- While generating the hotspot by the network, cluster is generated by it ,by the nearest neighbor node. After that CH node is selected and data is sent through it.

- IDDR algorithm is implemented for improving the performance of the network delay and energy consumption of the network.
- The technique of DCN is introduced, DCN are deployed in the network and when the hotspot is generated then the data will be sent through the DCN which is nearest to the hotspot node.
- The result is compared on different parameters: Energy Consumption
  - Throughput in percentage
  - Delay in milliseconds
  - Residual Energy in Joules

LITERATURE REVIEW

This work plans to simultaneously enhance the loyalty for high-trustworthiness of the applications and reduction of the end-to-end delay for delay-sensitive ones, when the system is congested. To make the queue management powerful, a queue scheduler distributes network resources by choosing a packet in the characterized queue to get to a single physical connection with fixed limit. Author proposes a dynamic queue management approach utilizing fuzzy logic to quality of service (QoS) prerequisite in information integrity and delay differentiated routing (IDDR)[1].

In this paper, on the basis of idea of potential in physics, author has proposed IDDR, a multi-path dynamic data routing algorithm, to determine this contention. By building a virtual hybrid potential field, IDDR isolates packets of uses with various QoS necessities as indicated by the weight assigned out to every packet, and sends them towards the sink through various paths to enhance the information loyalty for integrity-sensitive applications and additionally reduce the end-to-end delay for delay-delicate ones. Utilizing the Lyapunov drift procedure, we demonstrate that IDDR is steady [2].

In WSN, real-time system, applications require good quality-of-service (QoS) guarantees, for example, low packet delay and little excess. Differentiated services (D-iffServ) technique is proposed to fulfill the QoS prerequisites in WSN. The stochastic attributes should be considered for the QoS execution analysis of DiffS ervice-based WSN. Moreover, the current working s imply determine the average packet delay as well as backlog in steady states. In this paper, author utilizes stochastic network calculus (SNC) to examine the stochastic per-stream delay and backlog in Diff Service-based WSN. Initially, the stochastic administration curve for every information stream is determined under strict policy (SP) service scheduling discipline. At that point, stochastic per-stream delay and backlog bounds are obtained. [3]

In paper [4], a Velocity Energy-effective and Link-careful cluster Tree (VELCT) strategy for data gathering in WSNs is proposed which will adequately control the issues of coverage distance, portability, delay, traffic, tree intensity, end-to-end connection. The proposed VELCT makes the Data Collection Tree (DCT) in context of the cluster head position. The made VELCT technique mitigates the vitality method and the energy used, diminishes the end-to-end postpones the movement in cluster head in WSNs by effective utilization of the DCT. The strength of the VELCT algorithm is to create a straightforward tree structure, by diminishing the energy use of the cluster head and prevents a strategic distance from successive cluster arrangement. It furthermore keeps up the cluster for an amount of time.

In paper [5], authors initially conclude the upper and lower limit for data gathering limit in self-confident networks under protocol model and disk graph model. They show that a fundamental BFS tree based method can lead to arranged, ideal execution for any subjective sensor framework. They at that point learn limitations of data collection under a general chart model, where two close-by nodes may not be ready to interact due to boundaries or path distortion and discuss efficiency suggestions.

Periodical data gathering from inaccessible remote landscape and after that transmitting data to a remote base station is one of the targeted applications of sensor systems. But the energy restriction of battery worked sensor nodes surely makes this task difficult and complicated because once deployed in the objective field, it is not feasible to change the battery occasionally. Along these lines, so as to keep the systems working for a long time, effective use of energy is considered as the highest priority. In this paper, author proposes COSEN - a chain oriented sensor network for gathering data effectively. COSEN is effective in the ways that it guarantees maximal usage of system energy, it makes the lifetime of the system longer, and in comparison it requires much lower investment to finish a round[6].

An energy-efficient data gathering protocol for wireless sensor network based on tree (EEDCP-TB) is proposed in this paper. EEDCP-TB develops information aggregating tree through the technique for flooding avoidance and utilizes the cascading planning plan to allocate aggregation time so as to conserve node's energy and promote more data. This protocol represents the node energy state parameter to meet energy balance to a certain extent when we choose forwarding nodes. Finally, compared with Flooding protocol and tree based data collection scheme (TBDCS), simulations show that the EEDCP-TB requires less transmission)saves node's energy and prolongs network lifetime[7].

PROPOSED SYSTEM

A. Proposed System Overview

Following figure 1 shows the system flow of the proposed system.

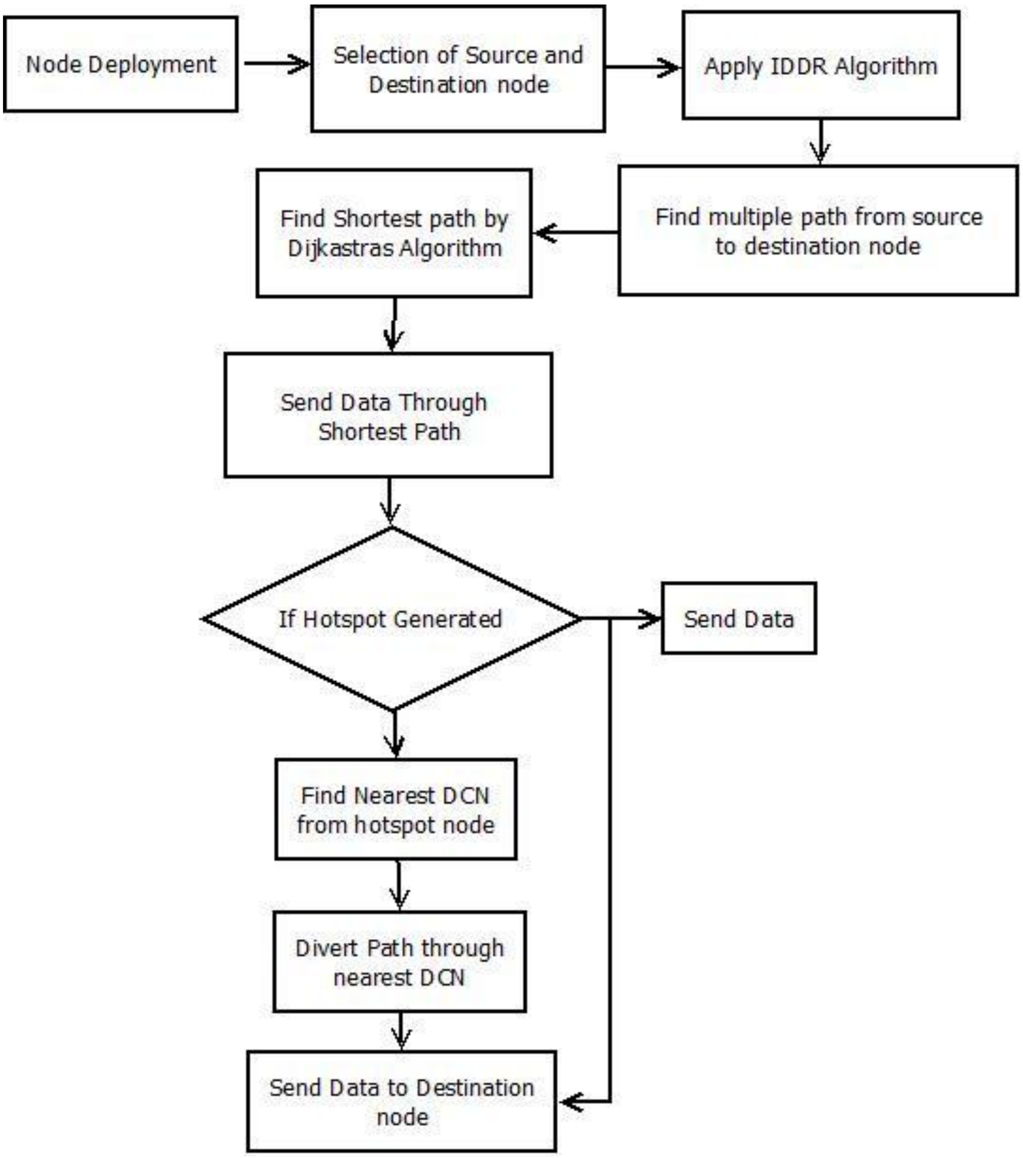


Figure 1. Proposed System Architecture

In this work, two systems are implemented which are compared with the existing system for testing the performance of the both systems. In the first system weight is assigned to each packet on the basis of its delay sensitivity and high integrity. IDDR algorithm is applied to the system at the time of communication between the nodes. Cluster is formed with the immediate neighbor node when the hotspot is generated. After generating the cluster, CH is selected on the basis of energy and distance. Second method is by using the DCN technique, DCN are deployed in the network and when the hotspot is generated then the data will be sent through the DCN which is nearest the to the hotspot node.

Initially network is generated with the respective sensor nodes connecting with the edges. System displays the graph which we will represent in the next section. After that source and destination node is selected by the user for sending the data packets or for communicating within the nodes. After that IDDR algorithm is implemented to decide whether the data is delay sensitive or integrity data. This data should reach the sink node early/ quickly but for integrity data there is no such time constraints. Sensitive data packets occupy more limited bandwidth and buffers in the network to reach the sink node. So the delay sensitive packets are assigned greater weight then the high integrity data packets. To identify the type of data, initially weight is assigned to the data of each node. The node with high packet is identified as delay sensitive data otherwise it is High integrity data. After that system evaluates the entire possible path from selected source node to sink node. Routing table is generated with all possible number of paths. There is need to find the shortest path for sending the data, the shortest path is evaluated by Dijkastra's Algorithm.

After the paths are recognized by the system, source nodes send their data to base station. The shortest path is used to send the delay sensitive data and one of the remaining possible path is used for sending the High integrity data. At the time of sending the data, sometimes hotspot is generated, which leads to a delay in sending the data. Hotspot is the node, where two or more shortest paths are combined. At this node the data is colluded from two different source nodes. To resolves this issue, technique of clustering is used. In this technique, cluster is formed around the hotspot node based on distance criteria. Once the cluster is formed, cluster head (CH) is selected with minimum distance to destination and highest available energy. Through this CH one of the path is diverted. It means that one node sends its data through the path containing hotspot and another node sends its data through the path containing CH, this reduces the delay during data routing to destination nodes.

Another technique for sending the data through the source to destination node is by sending the data by using DCN. DCN is collection of data collection nodes. The location of DCN in each cluster will be based on its distance nearer to the sink from that cluster. All the DCN will be connected in mesh topology. While sending the data when hotspot is generated, the DCN is activated. The node which is near to hotspot node is activated and data is sent through the DCN securely.

B. Proposed System Algorithm

Input: Collection of node V

subset V= {n1,n2......,nm}

R = Residual Energy

D = Distance

Output: Energy efficient routing from source to Sink node

CH -> Cluster Head

S to Si -> Energy efficient path
Result -> TH-Throughput
E -> Energy
EED -> End to End Delay

1. Node Deployment
   - Dynamic node deployment
   - Find route between connected node
   - (Ei,...En+1) Energy of each node
2. Size(packet)=P1
   if P1>p
   P ->Delay Sensitive
3. IDDR algorithm
   Allocation of Weight (Wi)
   if queue of node is not empty
   $$\propto = \propto\ + P(Wi)/0xff$$
   Where Wi = weight
   $\propto$ = Depth
   0xff = initial depth
4. Send packet from $S \propto \rightarrow Si$
   By using shortest energy efficient route
5. Cluster formation
   sensitive node conjunction occurred due to delay.
   Then
   Selectnode (N)),where conjunction occurred
   C=N (conjunction node+CN(connected node)
6. Cluster Head Selection
   CH ->Node ->DminEmax
7. Load Balancing
   Assign Load of N ->CH
8. Rerouting
   find route depth from CH to Sink
   CH ->Si
9. Repeat step 3.

C. Stepwise Description

Generating Network:

The network is generated

Initially the network is formed with number of sensor nodes which are connected by the edges.

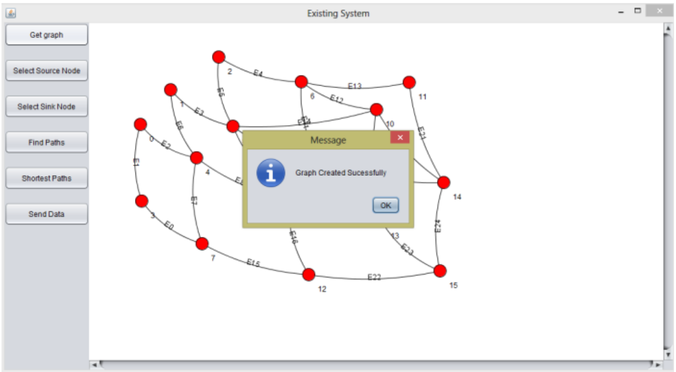


Figure 2. Network Formation

Selecting Source Node:

After the graph is generated with respective number of nodes and edges the system should select the source node for further transmission of data.

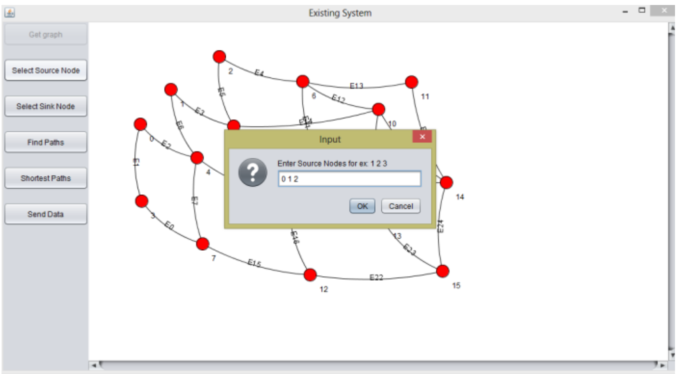


Figure 3. Selecting Source Node

Destination Node Selection:

After selecting the source node, there is a need to select the sink node or destination node for data transmission between them.

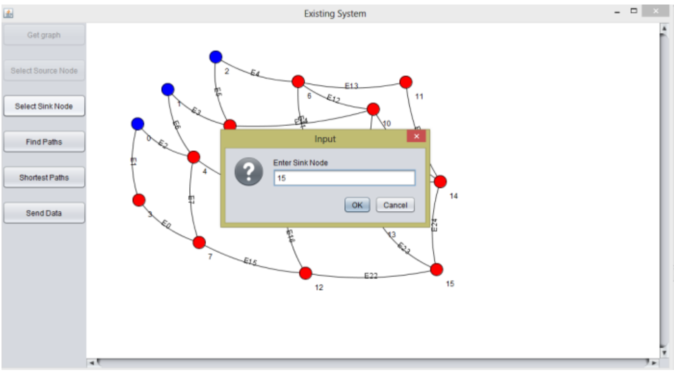
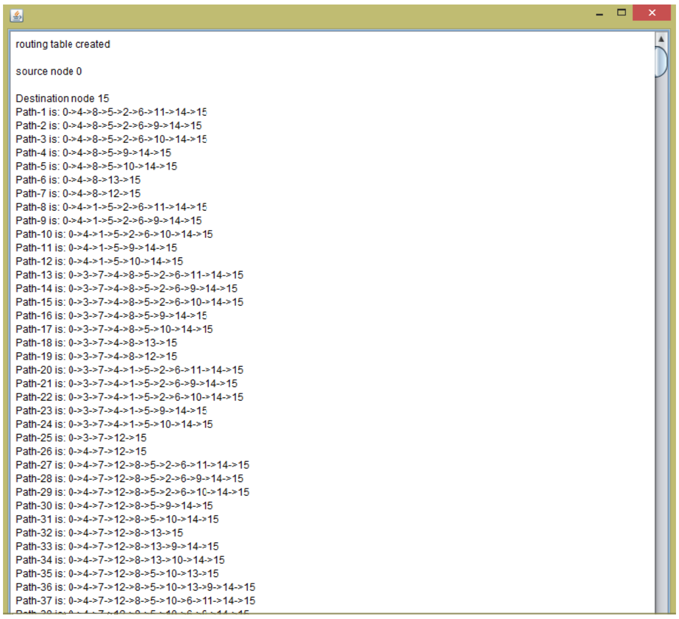


Figure 4. Sink Node Selection

Routing Table formation:

After selecting the source and destination node, system generates the number of possible paths for sending the data this term is known as routing table. Following screen shows all routing paths from source node 0 to sink node 15.



routing table created

source node 0

Destination node 15
Path-1 is: 0->4->8->5->2->6->11->14->15
Path-2 is: 0->4->8->5->2->6->9->14->15
Path-3 is: 0->4->8->5->2->6->10->14->15
Path-4 is: 0->4->8->5->9->14->15
Path-5 is: 0->4->8->5->10->14->15
Path-6 is: 0->4->8->13->15
Path-7 is: 0->4->8->12->15
Path-8 is: 0->4->1->5->2->6->11->14->15
Path-9 is: 0->4->1->5->2->6->9->14->15
Path-10 is: 0->4->1->5->2->6->10->14->15
Path-11 is: 0->4->1->5->9->14->15
Path-12 is: 0->4->1->5->10->14->15
Path-13 is: 0->3->7->4->8->5->2->6->11->14->15
Path-14 is: 0->3->7->4->8->5->2->6->9->14->15
Path-15 is: 0->3->7->4->8->5->2->6->10->14->15
Path-16 is: 0->3->7->4->8->5->9->14->15
Path-17 is: 0->3->7->4->8->5->10->14->15
Path-18 is: 0->3->7->4->8->13->15
Path-19 is: 0->3->7->4->8->12->15
Path-20 is: 0->3->7->4->1->5->2->6->11->14->15
Path-21 is: 0->3->7->4->1->5->2->6->9->14->15
Path-22 is: 0->3->7->4->1->5->2->6->10->14->15
Path-23 is: 0->3->7->4->1->5->9->14->15
Path-24 is: 0->3->7->4->1->5->10->14->15
Path-25 is: 0->3->7->12->15
Path-26 is: 0->4->7->12->15
Path-27 is: 0->4->7->12->8->5->2->6->11->14->15
Path-28 is: 0->4->7->12->8->5->2->6->9->14->15
Path-29 is: 0->4->7->12->8->5->2->6->10->14->15
Path-30 is: 0->4->7->12->8->5->9->14->15
Path-31 is: 0->4->7->12->8->5->10->14->15
Path-32 is: 0->4->7->12->8->13->15
Path-33 is: 0->4->7->12->8->13->9->14->15
Path-34 is: 0->4->7->12->8->13->10->14->15
Path-35 is: 0->4->7->12->8->5->10->13->15
Path-36 is: 0->4->7->12->8->5->10->13->9->14->15
Path-37 is: 0->4->7->12->8->5->10->6->11->14->15

Figure 5. Routing Table Formation

Shortest Path Selection:

After searching /surveying all the possible paths, there is need to find shortest path between source and destination node. Shortest path is calculated by applying Dijkastras algorithm. Here following paths are found:

Node 0 -15 = [0-4-8-12-15]

Node 1-15 = [1-4-8-12-15]

Node 2-15 = [2-5-8-12-15]

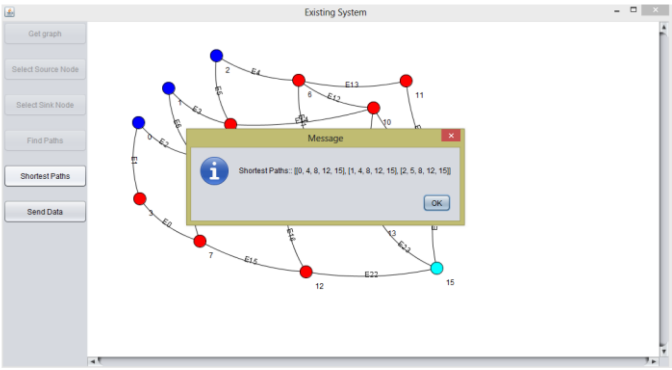


Figure 6. Shortest Path Selection

Sending data by using existing system:

System identifies the hotspot during this data routing. Hotspot is the node where the data from two paths or from two source nodes colludes.

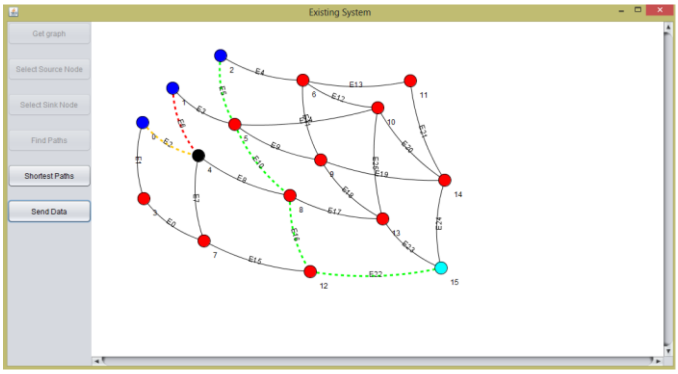


Figure 7. Hotspot Generation

Send data through clusters:

Another technique for sending the data, in this technique the data is send through clusters.

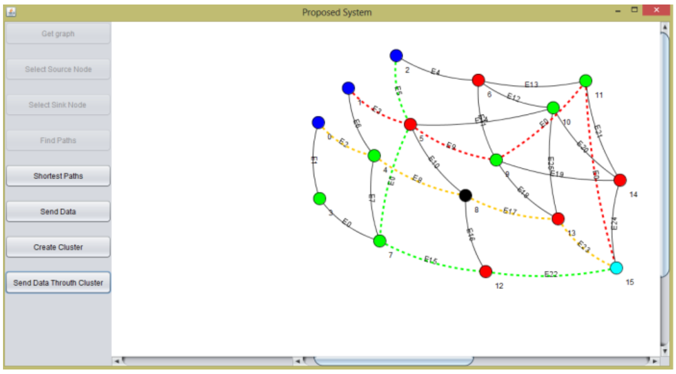


Figure 8. Send Data through clusters

Send data through DCN:

Proposed technique in which data is send through DCN node.

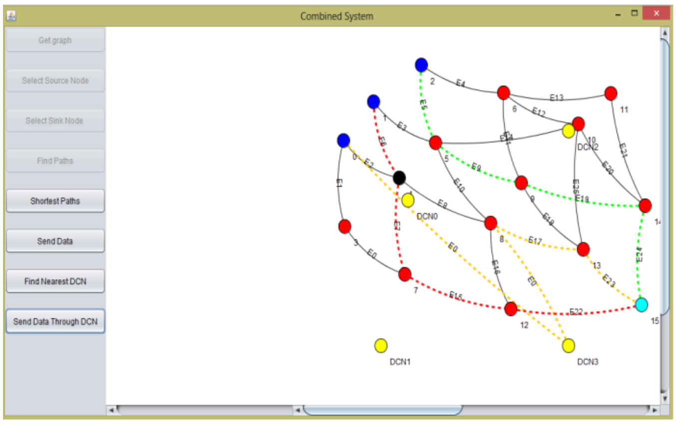


Figure 9. Send data through DCN

RESULTS AND DISCUSSION

A. Experimental Setup

The system is built using Java framework(version JDK 6)on Windows platform. The Netbeans (version 6.9) is used as a development tool. For network creation system the Jung tool is used. The system doesn't require any specific hardware to run; any standard machine is capable of running the application.

B. Evaluation Results

In the proposed system we are trying to improve the network lifetime, high data integrity and low delay to improve the performance of the network.

The performance of the system is tested with different sized networks. The system is tested with 5 different networks consisting of 8, 10, 12, 14, and 16 nodes respectively. The Performance of the system is by the following parameters:

- Energy Consumption
- Throughput in percentage
- Delay in millisecond
- Residual Energy in Joules

Energy Consumption:

Table II and figure 10 represent the comparison of three systems: existing system by using simple clustering technology, proposed system by using IDDR algorithm and combined system by using DCN techniques. From the below graph and table it is concluded that the system with DCN consumes less energy than the existing systems.

Table II. Energy Comparison

Number of Nodes	Existing System	IDDR	DCN
8	348	248	110
10	500	360	240
12	545	460	300
14	648	510	480
16	710	600	500

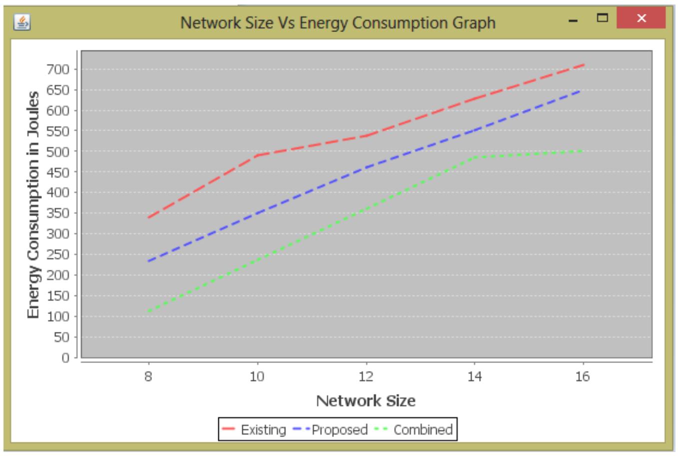


Figure 10. Energy Consumption Comparison

Throughput:

Table III and figure 11 represent the comparison of three systems: existing system by using simple clustering technology, proposed system by using IDDR algorithm and combined system by using DCN techniques. Throughput is the total number of data packets delivered to the destination node. The throughput of proposed system is improved because it makes use of DCN approach once the hotspot is detected.

Table III. Throughput Comparison

Number of Nodes	IDDR	IDDR with routing	IDDR with DCN
8	26	27	29
10	55	58	60
12	51	54	57
14	39	42	46
16	34	35	35

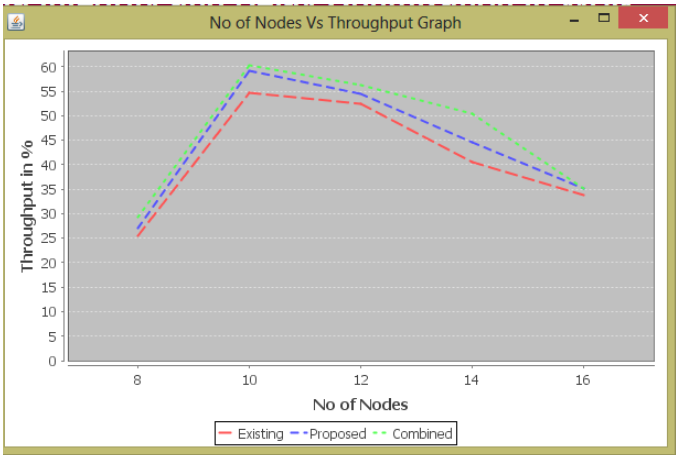


Figure 11. Throughput Comparison

Residual Energy:

Table IV and figure 12 represent the tabular and graphical comparison of existing and proposed system in terms of residual energy. The residual energy is measured in terms of joules.

Table IV. Residual Energy Comparison

Number of Nodes	IDDR	IDDR with routing	IDDR with DCN
8	43250	42220	44120
10	44120	46325	48120
12	54320	59820	61100
14	60428	64532	66234
16	71432	78455	80000

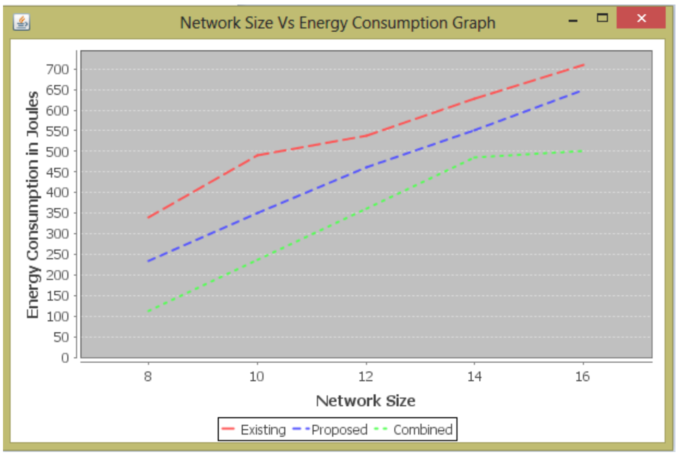


Figure 12. Residual Energy Comparison

Delay Comparison:

Table V and figure 13 represent the tabular and graphical comparison of existing and proposed system in terms of delay. The delay is measured in terms of milliseconds. The delay is reduced in proposed system because; the hotspot situation is removed with DCN approach.

Table V. Delay Comparison

Number of Nodes	IDDR	IDDR with routing	IDDR with DCN
8	15188	15032	14981
10	15000	14680	11234
12	18000	17622	15000
14	46871	45000	30124
16	22156	20000	18765

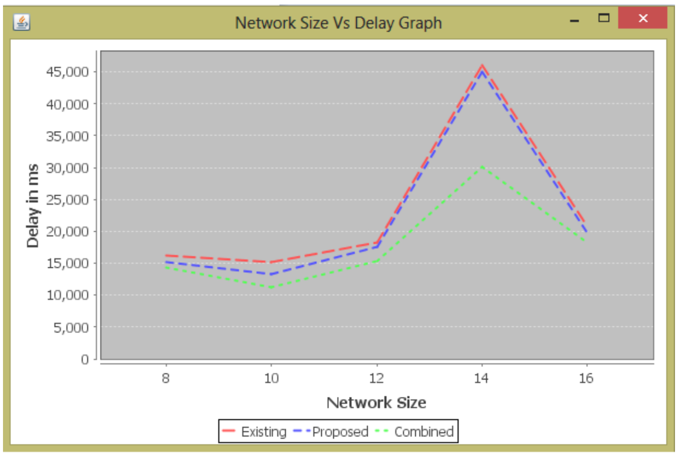


Figure 13. Delay Comparison

CONCLUSION AND FUTURE SCOPE

In this work, the three systems for improving and fulfilling the two distinctive QoS necessities which are high information fidelity and low end-to-end delay, over the similar WSN are compared. The existing system has a limitation such as, system failed to transmit the data when the hotspot was generated. To overcome this issue two systems are proposed in this work. In the first system a dynamic multi-path routing algorithm IDDR is proposed, which implements clustering and scheduling algorithm with IDDR. When the packets create hotspot at any sensor node, clustering is performed at neighboring node and CH is selected on the basis of energy and distance, data is transmitted through the alternate path. Second system proposed in this work is by generating the DCN node. DCN is generated at the time of network deployment, when the hotspot is generated the DCN node is activated and data is sent by the alternate path. In this work results are compared on the basis of different parameters which are: Energy Consumption, Throughput in percentage, Delay in milliseconds, and Residual Energy in Joules. From the comparison it is concluded that the system by using DCN gives more accurate result as compared to the other systems. The system saves energy and improves network lifetime of the network.

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