routing. Routing decision is based on multipath routing table created by distance vector routing. Cluster head aggregate the data and forward that data towards the sink node. It is used multiple paths which is created with the help of distance vector routing and as a Euclidean distance calculates the distance among the two nodes and also on the base of its distance the next nodes are selected that is the shortest distance node is selected [10]. Every path created using multipath routing are calculated by cluster head and from this selected path, cluster head select the path which have shortest path to the sink [11]. Based on the location of sensor nodes, the routing is performed. Using distance vector routing, it select the best route according to the selection of multipath routing table for every node n. Multipath routing which is based on geographical safeguards that paths are reliable and in case one path is failure then there is always present the another path and data is aggregated by the cluster head and forwarded that data to the sink.

3.4 Performance Evaluation

Based on the following factors our approach shows the algorithm performance

- Whole distance saved
- Dependable data aggregation
- Total aggregation
- Communication Cost
- Loss of aggregated data if any
- Total energy saved

1. Whole distance saved :
   Forwarding a data packets completed the lesser distance to the sink node is the main propose of our paper. Based on the total aggregation the performance is evaluated.

2. Dependable Data Aggregation:
   Failures of intermediate node in the network, channel impairments, failure of path in the network etc are the several potentials that the data packets may loss. Multipath routing give guarantee that paths are trustworthy and cluster head aggregate the data and if there is failed the one path at that time there is always present the another path.

3. Total Aaggregation:
   Based on the total aggregation, performance is evaluated. There are chances of packet loss because of the channel impairments.

4. Communication Cost:
   Extra the communication cost cause the climbable system, at the time of measuring the performance communication cost should be abridged.

5. Loss of Aggregated Data if any:
   It is one of the most significant presentation events completed the network. It is nothing but an amount of data lost at the time of routing.

6. Total Energy Saved:
   The saving the energy of sensor nodes is the result of data packets forwarded over the lesser distance.

3.5 Mathematical Model

Problem Definition:
Formation of geographic routing for in network aggregation in wireless sensor network.
Mathematical model project:

Let N be the total number of wireless sensor,
Let n_i be the single sensor node
Where i= {1, 2… N}
Let $P_i = \{p_1, p_2, p_3, p_4 \ldots pmi\}$ be the set m multiple paths for node n towards sink *S*.

Let (C_{l_i}, C_{a_i}) be the set of co-ordinates of node n.

Let (C_{l_s}, C_{a_s}) be the set of coordinates of sink, S.

We express our problematic as from any node n, to Sink S, aggregate the packets after any event and with the help of geographic routing find the shortest path to sink S.

3.6 Algorithm

Step1: With the help of distance vector routing, generate the multipath routing table for every node n.

Step2: Election of cluster head
The node which has highest outstanding energy will be elected as a cluster head and all remaining nodes in the cluster forwarded data towards the cluster head.

Step3: the multiple path which are generated in Step1 are taken by the cluster head to calculate the distance among two nodes using the equation

$$C(n_1, n_2) = \sqrt{(c_{l_1} - c_{l_2})^2 + (c_{a_1} - c_{a_2})^2}$$

Where,
C (n_1, n_2) is the distance between two nodes. And

$$C(c_{l_1}, c_{a_1}) \ \& \ C(c_{l_1}, c_{a_2})$$

Are coordinates of node n_1, n_2 respectively.
The total distance for every path P_i is calculated by using the equation

$$C_{(n_i,s)} = \sum_{i=0}^{k} \sqrt{(c_{l_i} - c_{l_{i+1}})^2 + (c_{a_i} - c_{a_{i+1}})^2}$$

Where, K is the total number of nodes in path p_i.

Step4: After that the path which have shortest distance to the sink, is selected by the cluster head.

4 Implementation Details

The proposed application is implemented in the following environment

4.1.1 Modules

- **Simulation Set**: The application is implemented with the help of java language. Jung libraries are used for the

network topology. For generating the sensor nodes and networks the Jung libraries are used.

- **Network**: In the proposed, we built a network system were nodes are organized in a hierarchical structure used for implementation and simulation. These nodes are dynamically loaded.

There are mainly modules of the proposed system. The introductions of these four modules are as follows:

1) Build Graph:
   Were nodes are organized as hierarchical organization in the network. These nodes are dynamically loaded. The nodes are created by using the Jung libraries. These nodes are sends the data from source to destination.
2) Get Multiple Path:
   Here, with the help of geographical routing, the shortest path is found which is used by a cluster head to transfer the data to the sink node. The multiple paths are created from source node to the sink node, based on the Euclidian distance between nodes shortest path is selected which is having lesser distance to the sink node.
3) Clustering:
   Here, cluster formation process is done, were each node determined that in which cluster it have to joint and joined the cluster. Here also the node which have highest residual energy and closer to the sink node elected as a cluster head. It also calculates the distance between two nodes. The remaining node which called as a collaborator forwarded there data to the cluster head and cluster head aggregate this data with its own data.
4) Send Data:
   Here, the cluster head select the shortest path from the set of path generated by the multipath routing table and the send the data to the sink node from the selected shortest path.

4.1.2 Hardware Requirement

- Hard disk : 80 GB
- RAM : 512 MB
- Processor : Intel Pentium4 or above

4.1.3 Software Requirements

A. JAVA

The technology used for designing and implementation of this project is java as a coding language. We use the vector class for implementing the algorithm. The Vector class implements a grow able array of objects. Like an array, it contains components that can be accessed using an integer index. However, the size of a Vector can grow or shrink as needed to accommodate adding and removing items after the Vector has been created. Each vector tries to optimize storage management by maintaining a capacity and a capacity Increment. The capacity is always at least as large as the vector size; it is usually larger because as components are added to the vector, the vector's storage increases in chunks the size of capacity Increment. An application can increase the capacity of a vector before inserting a large number of components; this reduces the amount of incremental reallocation. For the GUI designing uses the swing class. For designing frames used jLabel, jTextFeildInputFile, jButtonBrows, jScrolPane, jButton object are used.

As for implementation of the coding we use Java, and we know that java is a platform independent language. Platform independent mean the software or the program or the application we can run on any operating system without making any changes. For the security purpose many medical firms use Linux for the security from the viruses hence this application can be run on any platform without making any changes. Only java is installed in the system, with NetBeans.

JDK 1.7

Here we use 1.7 version of jdk. The Java Development Kit is used for developing the java applications and applets. It is one of the software development environments. It contains jar, compiler, java runtime environment, interpreter, loader, documentation generator and other tools which is required for java development.

B. NetBeans IDE

NetBeans IDE are installed for implementing the java code. NetBeans is an integrated development environment (IDE) for developing primarily with Java, but also with other languages, in particular PHP, C/C++, and HTML5. It is also an application platform framework for Java desktop applications and others. The NetBeans IDE is written in Java and can run on Windows, OS X, Linux, Solaris and other platforms supporting a compatible JVM.

C. Jung Tool and Library for Forming Networks on the Frame.

Java Universal Network/Graph Framework is a software library, which is used for visualization, analysis the data which is represented as a graph or network. It is written in java. It is used to design directed or undirected graph, graph with parallel edges, multi-model graph etc. It also implements number of algorithms of graph theory, data mining, social network analysis such as optimization, decomposition, random graph generation, flows, etc. it is designed for to support the variety of representations of entities and their relations. It is also provide a visualization framework that makes it easy to construct the tools for the interactive exploration of network data. It is an open-source library; JUNG provides a common framework for graph/network analysis and visualization.

4.1.4 Network Model

In the proposed network model, here we form a tree network model in which contain root node which is also called as parent node and next is child node. The end nodes also called as leaf nodes. In tree network model contains different levels like level 1; level 2, etc depend on network model. In network may contain nodes which are denoted as a router, hubs, switches etc in the network. It also contains edges which are represented as a link in a network model. This network model is dynamically loaded and also we assign a weight to the each edge.

4.1.5 Simulation

After building tree, we enter a sink node. After that we get a shortest path which is generated by the multipath routing table. And it is used by the cluster head to forward the data towards the sink. Next, we enter the name of the cluster node. After entering the cluster node the cluster will be form. In which contain cluster head which is elected on the

basis of highest residual energy and which is closer to the sink node. And remaining nodes which are also called as cluster members. The cluster member forwarded there data to the cluster head and cluster head aggregates this data with own data and after that it calculate the distance between two nodes. The cluster head select the shortest path which is generated by the multipath router and send this aggregate data to the sink. This algorithm shows that this will be help in fast construction, effective energy and dependable WSN applications. And also shows that our approach solution gives outperformance in different situations and in different key characteristics needed by WSNs.

5 Result

Shortest path of node verses distance: Here, we show the result graph which gives shortest path of node from sink is calculated. For example Node 6 (N-6) having shortest path whose distance is 289 meters. Node 2 (N-2) is having shortest path whose shortest distance is 130 meters. Here euclidian distance is calculated between the nodes and finally multiple paths are created.

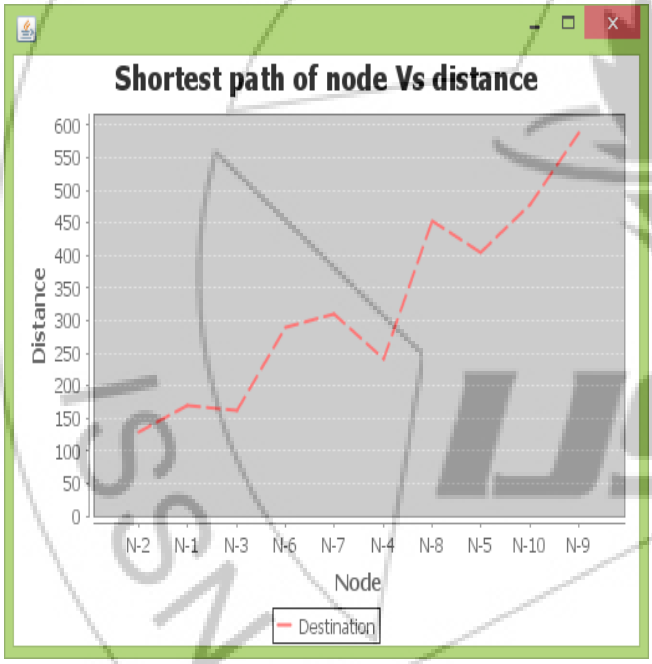


Figure 2: Shortest Path of node vs Distance

Comparative Graph for Shortest path of node Vs distance

Here comparision is made between Cluster based approach by considering number of hops required and second approach is cluster based approach considering distance between two nodes.

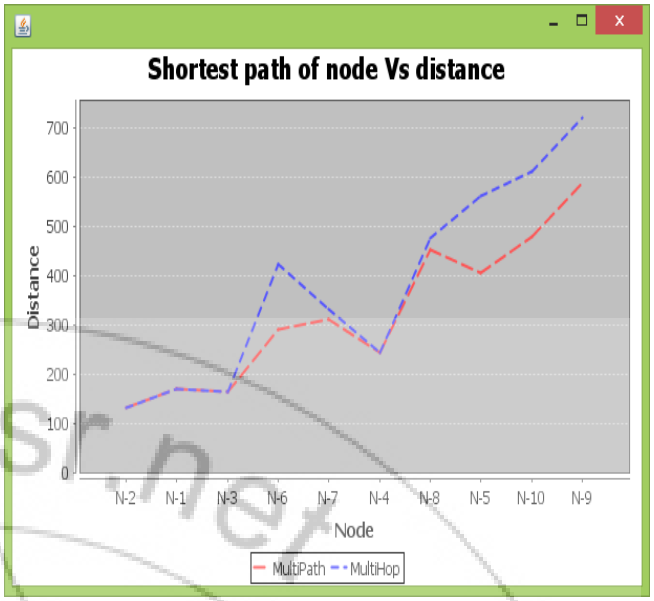
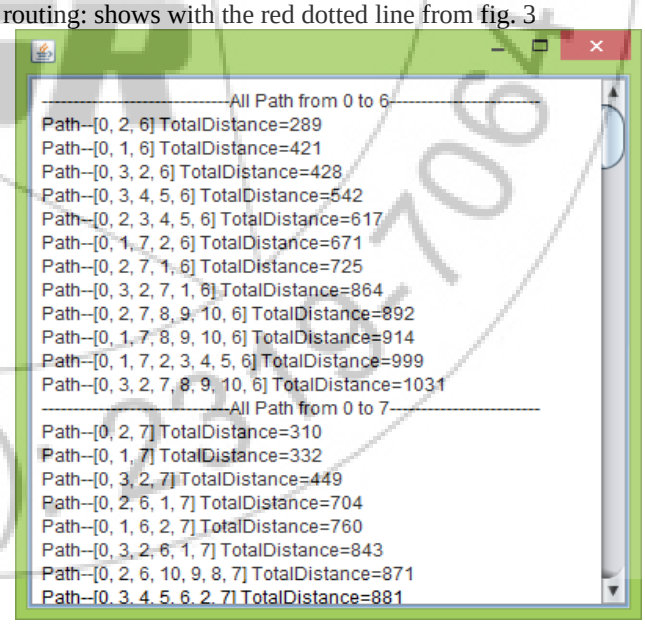


Figure 3: Comparative Graph for Shortest path of node Vs distance

Shortest path for Cluster based approach with hop based routing in fig. 3 shows with the blue dotted line
Shortest path from sink to 1 is [1, 0] distance=169
Shortest path from sink to 8 is [8, 7, 1, 0] distance=474
Shortest path from sink to 5 is [5, 6, 1, 0] distance=559
Shortest path from sink to 6 is [6, 1, 0] distance=421
Shortest path from sink to 3 is [3, 0] distance=162
Shortest path from sink to 2 is [2, 0] distance=130
Shortest path from sink to 9 is [9, 10, 6, 1, 0] distance=720
Shortest path from sink to 4 is [4, 3, 0] distance=242
Shortest path from sink to 10 is [10, 6, 1, 0] distance=611
Shortest path from sink to 7 is [7, 1, 0] distance=332
Shortest Path for Cluster based approach with distance based routing: shows with the red dotted line from fig. 3



Here in the comparision graph we can see that Hop based routing requires more distance as compare to distance based routing. Node 1,Node2,Node3 and Node 4 requires same distance in both the cases whereas Node 5 requires 559 meters distance from sink in cluster based approach with hop based routing , in cluster based approach with

distance based routing node 5 requires 404 meters distance, Node 6 requires (421 and 289) metersdistance , Node 7 requires (332, 310) meters distance, Node 8 requires (474 , 452) meters distance,Node 9 requires (720 ,588) meters distance and Node 10 requires (611 , 479) meters distance respective cases with hop based and distance based routing. Which shows distance based routing is more efficient for routing packet as data packets are travel over lesser distance as compared with the hop based routing.

Comparison with the Similar System

Sr. No.	Existing System	Proposed System
1.	Cluster based approach without considering distance between nodes.	Cluster based approach with consideration of geographical location.
2.	Energy Consumption is comparatively high.	Energy Consumption is low.
3.	Hop based routing	Distance based routing
4.	Total distance is maximum	Total distance is minimum
5.	Total time required is More	Total time required is less

Comparative Graph of Node Vs Time: Here in fig. 4 which shows comparision for time required for sending data packets in both cases (Cluster based apprach with Hop based routing and Cluster based approach with distance based routing.

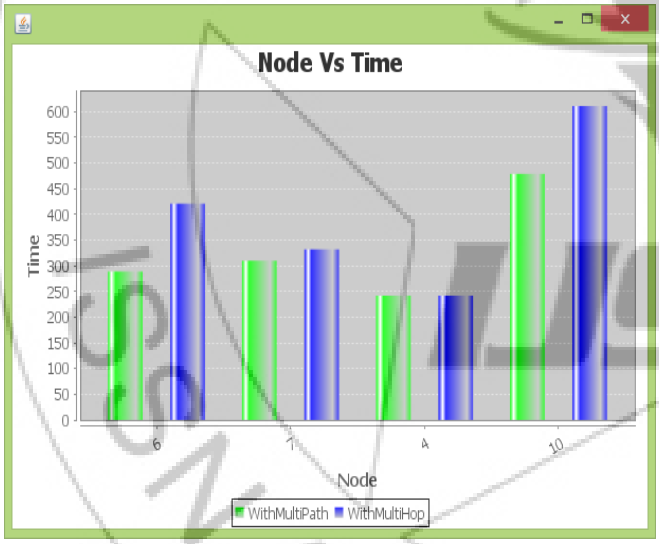


Figure 4: Comparative graph of Node vs. Time

i.e. Node 6 Requires (421 milliseconds shows with blue line) in tree based approach considering no. of hops & (289 milliseconds shows with the green line) in cluster based approach with distance based routing. Node 7 requires (332 & 310) milliseconds, Node 4 requires (242 & 242) milliseconds and Node 10 requires (611 & 479) milliseconds in both the cases , the result with graph shows that time required for sending data packet is less in cluster based approach with distance based routing.

6 Conclusion

In this paper, we have monitored the multipath routing which is based on the geographical distances, this helps in routing packets via shortest distance towards the sink node which results in saving of nodes energy. Moreover multipath routing helps in finding reliable and shortest path from a given set of paths. It is also used to verdict the trustworthy path from the present set of path. We have also compared it with the existing system. The contribution of the work is to design system architecture. We have also analyzed Time required for sending data packet from every node towards the sink. We believe that this will help in achieving fast, energy efficient, dependable and reliable WSN applications.

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