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Design and Implementation of Efficient Path with Error Detecting Scheme in WSN

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***Abstract*— Wireless sensor network is a network that contains of a large amount of low-cost and low power-driven sensor strategies, called sensor nodes, which can be organized in strict environment; sensor nodes are disposed to to have errors. It is thus needed to sense and locate defective sensor nodes to ensure the quality of service of sensor networks. This thesis will cover a fault management system which provides a shortest path between senders to receiver even in presence of faults. In dispersed fault detection scheme for wireless sensor networks the position of each sensor node to be either good or faulty based on the neighbouring nodes, but in the proposed algorithm when the sensor liability probability increases the fault detection accuracy decreases and the false alarm rate increases quickly. Sensor nodes are disposed to failure due to energy reduction and their placement in an uncontrolled or even antagonistic environment. In this thesis an improved fault tolerant system is proposed to detect intermittently faulty sensor nodes and to stringent power budget during fault diagnosis process on sensor nodes in wireless sensor network. Simulation results will establish that the improved proposed scheme performs well in the above situation and increase the fault finding accuracy by using the new approach and reduce energy consumption in contrast with previous algorithm. Accordingly, this study proposes a mechanism which can both tolerate and locate data inconsistency failures in sensor nets. Node-disjoint paths and an involuntary diagnosis scheme are utilized to identify the faulty sensor nodes. The projected mechanism is implemented with MATLAB**.

***Keywords*— Shortest Routing, path in Networks, wireless sensor networks, faults detection and recovery**.

I. INTRODUCTION

Due to recent technical advances, the manufacturing of minor and low cost sensors became technically and economically possible. The sensing electronics extent ambient circumstances related to the environment nearby the sensor and transform them into an electric indicator. Processing such a signal discloses some possessions about objects located and events happening in vicinity of sensor. A large number of these throwaway sensors can be networked in many applications that require unattended operations. A Wireless Sensor Network (WSN) contains hundreds or thousands of these sensor nodes [1].

Sensing is a technique used to gather information about a physical object or process, including the occurrence of events (i.e., changes in state such as a drop in temperature or pressure). An object performing such a detecting task is called a sensor. For instance, human body is equipped with sensors that are able to capture optical information from the environment (eyes), acoustic information such as sounds (ears), and smells (nose). These are examples of remote sensors, that is, they do not need to tracemonitored object to gather information. From a practicalperception, a sensor is a device that translates parameters or events in the physical world into signals that can be measured and analysed. Another commonly used term is transducer, which is often used to define a device that converts energy from one form into another [2].

A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomena like temperature, moisture, vibrations, seismic events, and so on. A WSN is a collection of millimetre-scale, self-contained, micro-electro-mechanical devices. These tiny devices have sensors, computational processing ability (i.e. CPU power), wireless receiver and transmitter technology and a power supply. Wireless sensor networks have seen tremendous advances and utilization in the past two decades. Initial from petroleum examination, mining, weather and even battle processes, all of these require sensor applications [3].

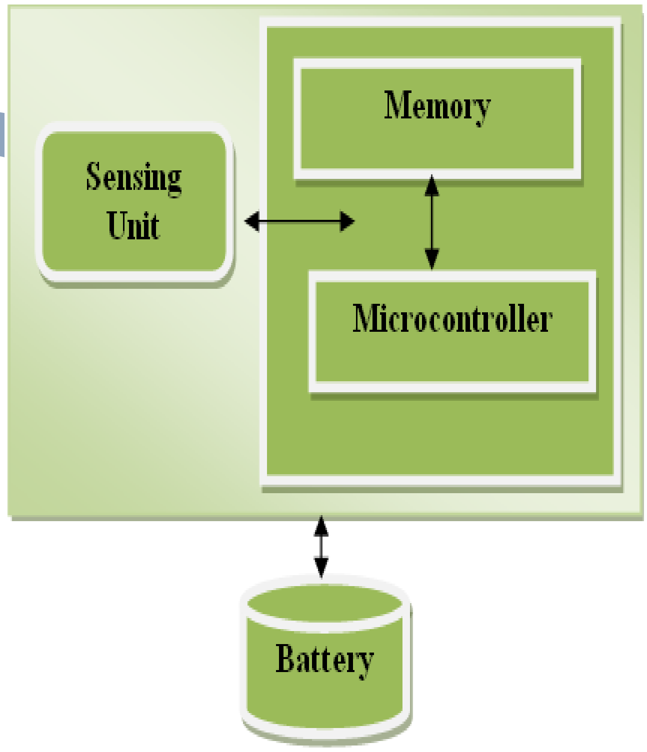

Figure 1: Wireless SensorArchitecture

One reason behind the growing popularity of wireless sensors is that they can work in remote areas without manual intervention. All user needs to do is to fold the data sent by sensors, and with certain examination extract meaningful information from them. Usually sensor applications involve many sensors organized together. These sensors form a network and collaborate with each other to gather data and send it to the base station. The base station acts as the control centre where the data from the sensors are gathered for further analysis and treating. In a husk, a wireless sensor network is a system consisting of spatially dispersed nodes which use sensors to monitor physical or environmental circumstances. These nodes combine with routers and gateways to generate a WSN system [4].

The development of sensor networks requires technologies from three different research zones: sensing, communication, and computing (as well as hardware, software, and procedures). Thus, combined and separate progressions in each of these areas have driven investigation in sensor networks. Examples of early sensor networks comprise the radar networks used in air traffic regulator. The national power grid, with its numerous sensors, can be viewed as one large sensor system. These systems were recognized with specialized computers and communication capabilities, and before the term “sensor networks” came into vogue [5].

The paper is ordered as follows. In section II, we discuss correlated work with wireless sensor networks. In Section III, It defines system architecture, routing techniques. In Section IV, it describes proposed work of fault management system. After this, it designates the main results of this system. Finally, conclusion is explained in Section VI.

II. LITERATURE REVIEW

Authors proposed a fault node recovery procedure to improve the lifetime of a wireless sensor network when some of the sensor nodes closed down. The algorithm was based on the grade diffusion procedurejoined with genetic algorithm. The procedure could result in fewer substitutes of sensor nodes and more reused routing paths. In this simulation, proposed procedure increased the number of active nodes up to 8.7 times, reduced the rate of data loss by approximately 98.8%, and reduced the rate of energy depletion by approximately 31.1% [6].

Some proposed that multipath routing protocols improve the load balancing and quality of service in WSN and also provided reliable communication. This paper investigated various multi-path routing protocols of the WSN in the literature and illustrates its assistances. The main elements of these systems and their classifications based on their attributes had been also discussed. A comparison of these protocols which were of great help to understand the properties and limitations of existing solutions had been done in the following study [7].

Some authors proposed that Wireless Sensor Networks (WSNs) were well-defined as dynamic, self-deployed, highly controlledorganized network. It`s high computational situation with limited and controlled communication range, handling, as well as limited energy sources. The sever power constraints strongly affected the existence of active nodes and hence the network lifetime. In order to extend the network life time it had to overcome the scarcity in energy resources and preserved the processing of the sensor nodes as long as possible. Power management approaches efficiently reduced the sensor nodes energy consumption individually in each sensor node and the adaptive efficient routing technique had greatly appeals a great consideration in research. The potential standards of soft-computing highly addressed their adaptability and compatibility to overwhelm the complex challenges in WSNs. This paper was introducing and surveying some of the Soft Computing proposed routing models for WSNs that optimally prolongs its life time [8].

Some proposed that Wireless Sensor Networks (WSN) is an interconnection of a large number of nodes deployed for monitoring the system by means of measurement of its parameters. Recent investigation in wireless sensor networks had led to various new protocols which are particularly designed for sensor networks. To project these networks, the factors desired to be considered are the handling area, mobility, power consumption, communication capabilities etc. In this, a survey was given regarding the architecture design issues, classification of protocols. The paper explored with research issues for the realization of networks [9].

III. WSN OPERATION

Generally, operation of WSN involves communication between sensor node and base station. The sensor node senses environment, perform some computation (if required) and report gathered information to the base station. If base station is connected with some actuator which triggers the alarm for human intervention in case of an event of interest [4].

A. Communication Model

Although sensor nodes are identical devices but their characteristics varies with the network structures. Sensor deployment, coverage, transmission power, computation, reporting, addressing and communication pattern greatly affects the routing protocol operation both at nodes and at base stations. Routing protocol used for WSN communication support unicast (one -to -one), multicast (one-to -many) and reverse-multicast (many-to -one) in the following ways [4].

1. Node-to-Node

In a multi-hop communication data nee ds to be passed by intermediate nodes in order to reach to destination. Node to node communications is used to pass data from one node to other till the destination. Generally, this type of communication is not required in WSN communication.

2. Node-to-Base Station

When sensors node wants to send responses back to base station, this communication pattern is used. This is a reverse -multi path communication which means that more than one node can communicate to base station directly or indirectly. This communication pattern can also be unicast if there is multiple base stations or there is a special node (group leader), who is responsible to gather sensed information and transmit it to base station.

3. Base Station- to-Node

This type of communication is required when base station wants to request data from nodes. Typically, the mode for communication is any cast (one -to -many) which means any sensor node having the requested date can respond to the base station. This pattern of communication can also be multicast or unicast if the identification of nodes is unique by their IDs or positions etc. [4].

B.Routing Challenges and Design Issues in WSNs

Despite of applications of WSN, these systems have somelimitations, e.g., limited energy supply, limited manipulative power, and incomplete bandwidth of the wireless links connecting sensor nodes. One of the main design goals of WSN is to carry out data communication while trying to extend the lifetime of the network and prevent connectivity deprivation by retaining aggressive energy management techniques. In order to project an efficient routing procedure, several challenging issues should be addressed precisely. The following factors are discussed below [10]:

1. Node Deployment

Node placement in WSN is application reliant on and disturbs the performance of the routing protocol. The placement can be either deterministic or randomized. In deterministic placement, the sensors are physically placed and data is directed through pre-determined tracks; but in random node placement, the sensor nodes are dispersed randomly creating an infrastructure in an ad hoc manner. Hence, random deployment raises several subjects as coverage, optimal clustering etc. which need to be addressed.

2. Energy Depletion without Losing Accurateness

Sensor nodes can use up their incomplete supply of energy performing calculations and transmitting info in a wireless atmosphere. As such, energy conserving procedures of message and computation are essential. Sensor node lifetime shows a strong requirement on the battery lifetime. In a multi-hop WSN, each node plays a double role as data sender and data router. The malfunctioning of some sensor nodes due to power failure can cause significant topological changes and might need rerouting of packets and reorganization of the network.

3. Node/Link Heterogeneity

Some applications of sensor networks might need a diverse mixture of sensor nodes with dissimilar types and abilities to be organized. Data from different sensors, can be produced at different rates, network can follow dissimilar data reporting models and can be exposed to different quality of service constraints. Such a heterogeneous atmosphere makes routing more composite.

4. Fault Tolerance

Some sensor nodes may flop or be congested due to lack of power, physical injury, or environmental intrusion. The failure of sensor nodes should not affect the overall job of the sensor network. If many nodes fail, MAC and routing procedures must accommodate formation of new links and routes to the data collection base stations. This may require vigorously adjusting transmit powers and signaling rates on the existing links to decrease energy consumption, or rerouting packets through regions of the network where more energy is available. Therefore, multiple levels of redundancy may be needed in a fault-tolerant sensor system [11].

5. Coverage

The coverage of a WSN node means either sensing exposure or communication coverage. Typically with radio infrastructures, the communication coverage is significantly superiorto sensing coverage. For applications, the sensing coverage describes how to reliably guarantee that an event can be noticed. The coverage of a network is either scarce, if only parts of the area of interest are enclosed or dense when the area is almost totally covered. In case of a redundant coverage, multiple sensor nodes are in the same area.

IV. DESIGN AND IMPLEMENTATION

In this approach a new fault management scheme is suggested to deal with fault discovery. It proposes a hierarchical structure to properly distribute fault management tasks among sensor nodes by heavily presenting more self-managing functions. The proposed failure detection procedures have been compared with some existing related procedure and proven to be more energy effective.

Detection of faulty sensor nodes can be attained by two mechanisms i.e. self-detection (or passive-detection) and active-detection. In self-detection, sensor nodes are required to periodically monitor their remaining energy, and identify possible failure. In this scheme, it considers battery reduction as a main cause of node sudden death. A node is named as failing when its energy drops below the threshold value. When a common node is failing due to energy depletion, it sends a message to its manager that it is going to sleep mode due to energy below threshold value .This requires no recovery stages. Self-detection is considered as a local computational procedure of sensor nodes, and requires less in-network communication to preserve the node energy. In addition, it also decreases the response delay of the management system towards potential failure of sensor nodes [13].

To proficiently detect the node sudden death, our fault management system engaged an active detection mode. In this method, the message of updating the node residual battery is applied to track the existence of sensor nodes. In active detection, cell manager asks its cell members on regular basis to send their updates. Such as cell manager sends "get" messages to associated common nodes on regular basis and in return nodes send their updates. This is called in-cell update cycle. The update message consists of node ID, energy and location information. Exchange of update messages takes place between cell manager and its cell members. If cell manager does not receive an update from any node then it sends an instant message to the node acquiring about its status.If cell manager does not receive acknowledgement in a given time, it then declares node faulty and passes this information to remaining nodes in the cell [15].

Cell managers only concentrate on its cell members and only inform the group manager for further assistant if the network performance of its small region has been in a critical level.In this approach it deployed sensor nodes which may vary from a few hundreds to thousands. More the number of nodes deployed, more will be the accuracy. To achieve such a task some steps are followed which are,

Total of 3 scenarios will be implemented

1. The one with no faulty nodes (ideal situation)
2. The one where information will stop when a faulty nodes occur
3. The one where faults will be detected and accordingly shortest path will be made.

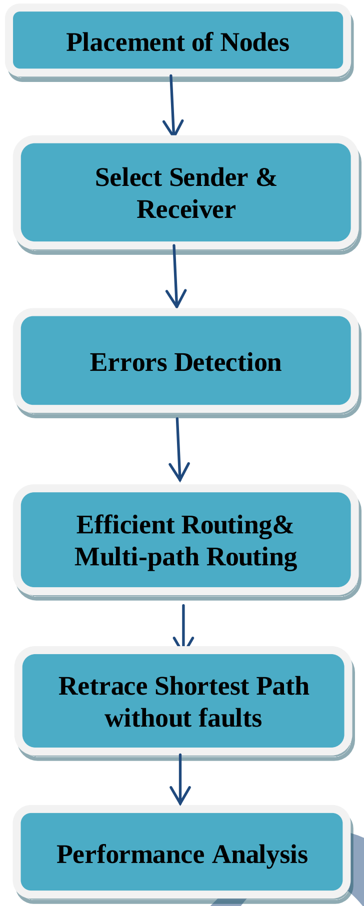

Figure 2: Proposed Steps of a System

Short-path algorithms generally have polynomial complexity and generally only produce a single path between a source and destination. In shortest path routing, the topology network is represented using a directed weighted graph. The nodes in the graph represent switching elements and the directed arcs in the graph represent communication links between switching elements. Each arc has a weight that represents the cost of sending a packet between two nodes in a particular direction. This cost is generally a positive value that can inculcates such factors as delay, throughput, and error rate, monetary cost etc. A path between two nodes may go through several intermediary nodes and arc. The objective in shortest path routing is to find a path between two nodes that has the smallest total cost, where the total cost of a path is the sum of the arc costs in that path [14].

V. RESULTS AND DISCUSSION

Since the ultimate goal of this work is to assess the performance of routing algorithm, it is essential that it comes up with tests that are fair measures of the performance of these algorithms.

A. Proposed Results

In this work, take the scenario for 100 nodes and following result will show the information about the placement of sensor nodes in an area.

1. Placement of Sensors Nodes

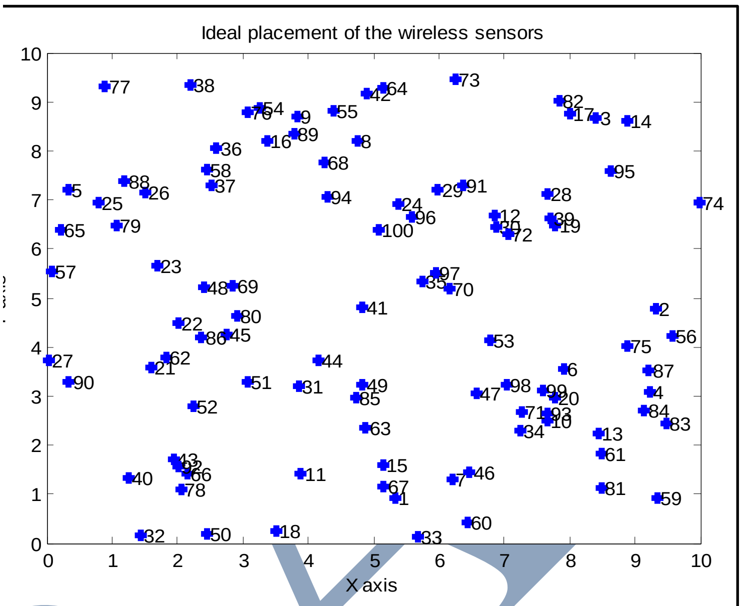

Figure 3: Ideal Placement of the Sensor Nodes

The above figure 3, displays how the sensors are being deployed in an area. Sensors are randomly spread over the area. Each sensor has a sensor ID shown along with it. It will be used to address any sensor throughout the process. This placement is an average function of coordinate variables defined in the vectors. They are random in nature. No two nodes overlap each other.

2. Fault Detection in Proposed System

After the deployment of the sensor nodes, the system will ask you to enter one sender id and one receiver id. That sender will become the master node and will send acknowledgement request to all the other nodes in the scenario. The nodes which will be able to reply back properly will be the non-faulty nodes, rest all the other nodes will be declared as faulty nodes. Faulty nodes are shown with a different color (red) in figure 6.

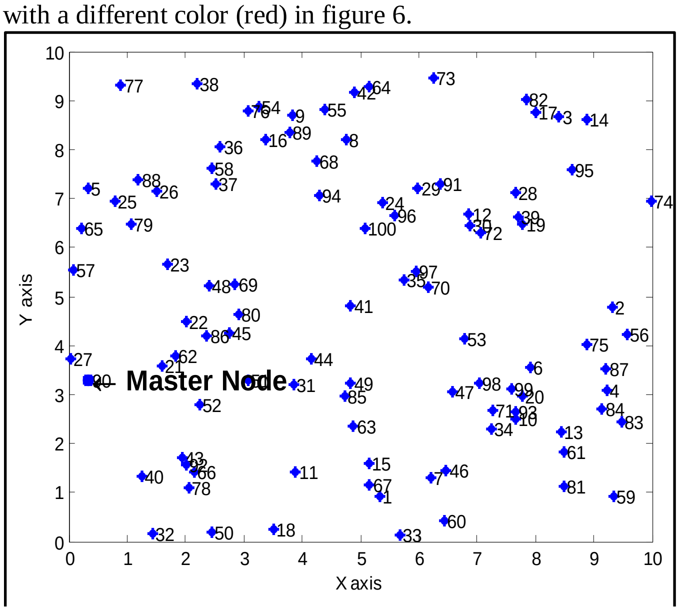

Figure 4: Master Node in Sensor Nodes

After mastering the node as shown in fig 4, it sends the signal to each node for knowing the distance between them. All nodes sends acknowledge to master node as shown in fig

5. In this fig, it also describes the distance between them. After this, master node finds the faults between them. Here faults are generated randomly depends upon no. of nodes.

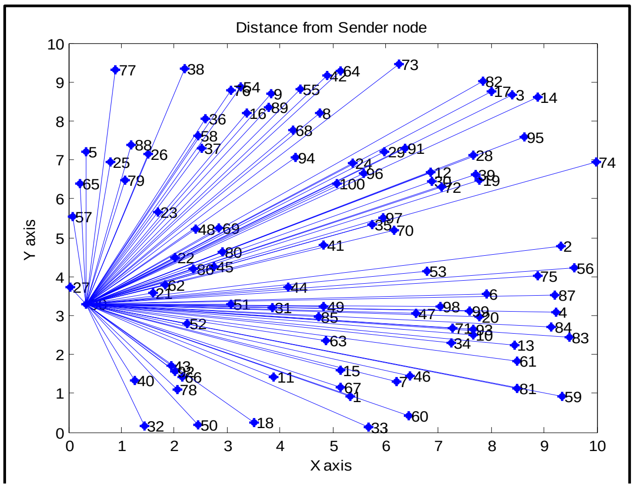

Figure 5: Distance from Each Node

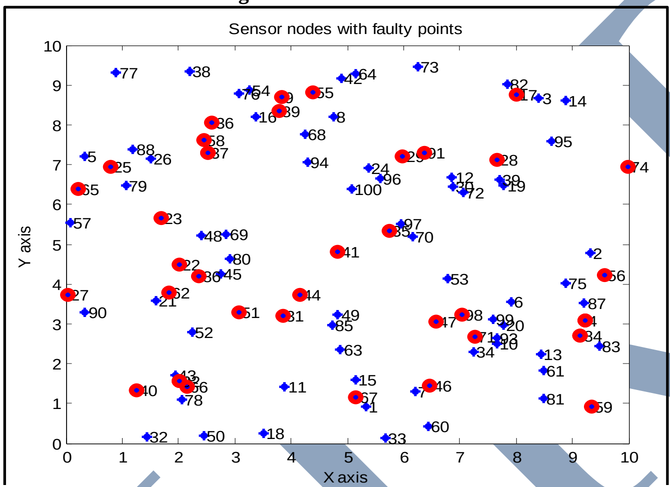

Figure 6: Faults Detected In the Scenario

3.Routing without Errors

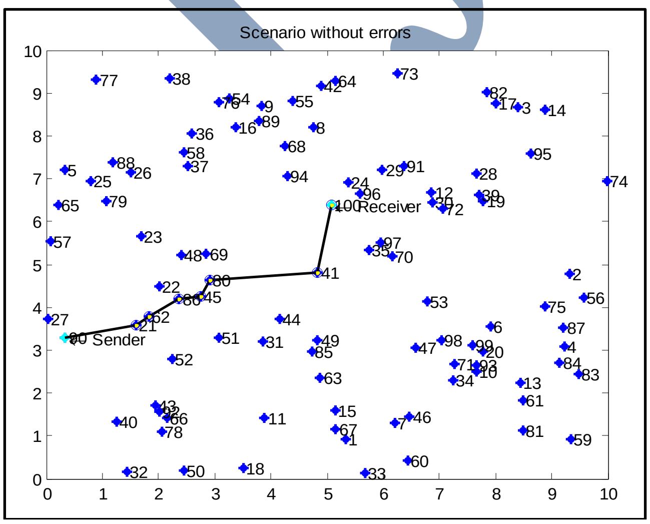

Figure 7: Optimal Route without Errors

The routing consists of two basic mechanisms: Route Discovery and Route Maintenance. Route Discovery is the mechanism by which a node S wishing to send a packet to a destination obtains a source route. To reduce the cost of Route Discovery, each node maintains a Route Cache of source routes it has learned or overheard. Route Maintenance is the mechanism by which a packet's originator S detects if the network topology has changed such that it can no longer use its route to the destination because some of the nodes listed on the route have moved out of range of each other. This is the ideal scenario as shown in fig 7. Here, we assume that there are no faulty nodes. All the nodes are authentic and fault free. Information is securely transferred from sender to the receiver. It selected the shortest path from sender to receiver.

4.Multi-Path Routing

This is the scenario when the sender finds more than 1 route to the receiver. And even after occurrence of a faulty node, the information loss does not intervene in the route formation. The route is still completed even after a faulty node occurs. This scenario is meant to show the path hopping between sender and receiver. Information can be transferred from more than 1 route also.

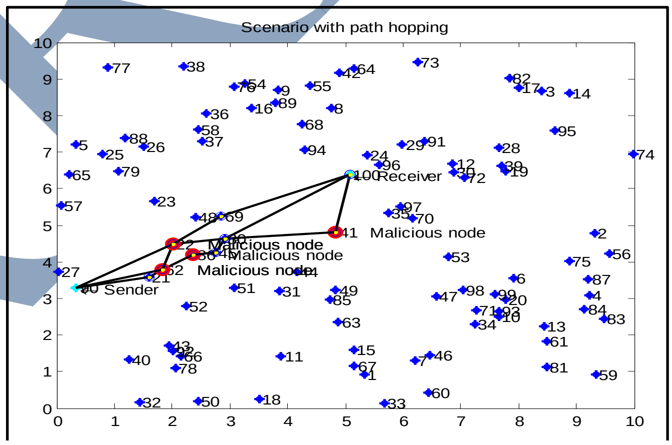

Figure 8: Path Hopping Scenario

5. Retraced Path (Final Path)

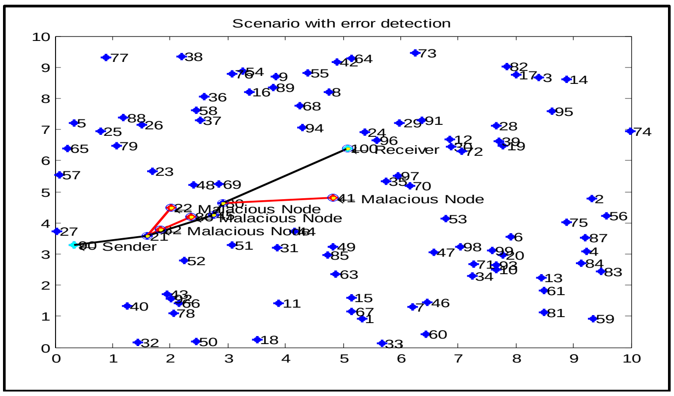

Figure 9: Proposed Retraced Shortest Path

This is the final scenario. Here, the faults are detected and the route will change accordingly. The system will find the shortest path between sender and receiver despite of fault occurrence. When faults occurred in the path, it changes the path and follows the new path to reach the destination as shown in fig 9.

B. Performance Parameters

1. Bit Error Rate

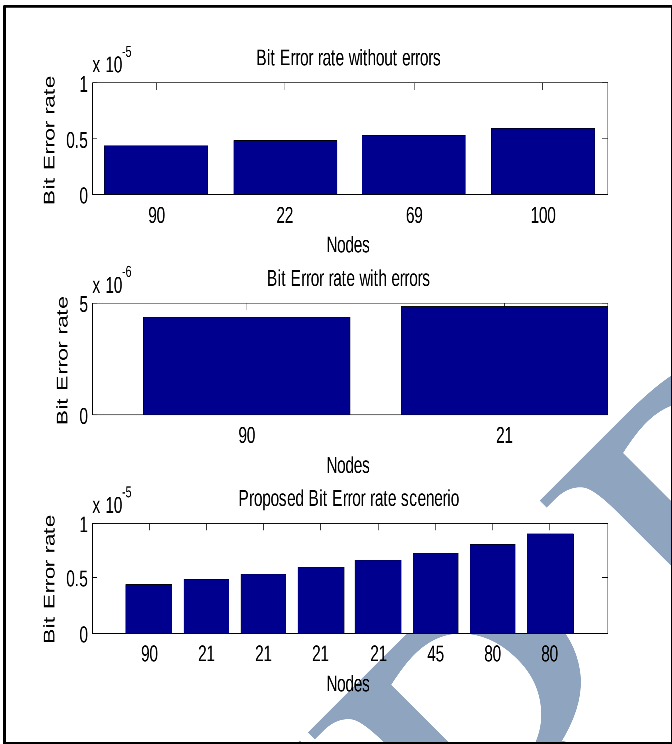

Figure 10: Bit Error Rate Analysis for 100 Nodes

Bit error rate is defined as the percentage of errors present in bits of data. It depends upon energy of system and noise power. Energy is consuming when travelling from sender to receiver so BER increases and vice-versa. The results are shown in fig 10.

2. Packet Delivery Ratio

This figure shows the packet delivery ratio in the Path Hopping Mechanism in Distributed Fault Detection. In this fig, it compares the packet ratio of path hoping ways (1st three bars shown) to proposed technique (4th) and it shows that the proposed technique transfers 100% packets from sender to receiver even in the presence of faults while others are losing packets in presence of faults as shown in fig 10.

Blocking probability is simply the ratio of total number of calls blocked to the total number of calls expressed in percentage. Minimum blocking is always desired condition for provisioning. It is clear that if the nodes have a smaller transmission radius then the interference constraints on each hop are fewer but the calls hop through many links to reach the destination. The results are shown in fig 11. In this fig, blocking probability of all possible scenarios is compared

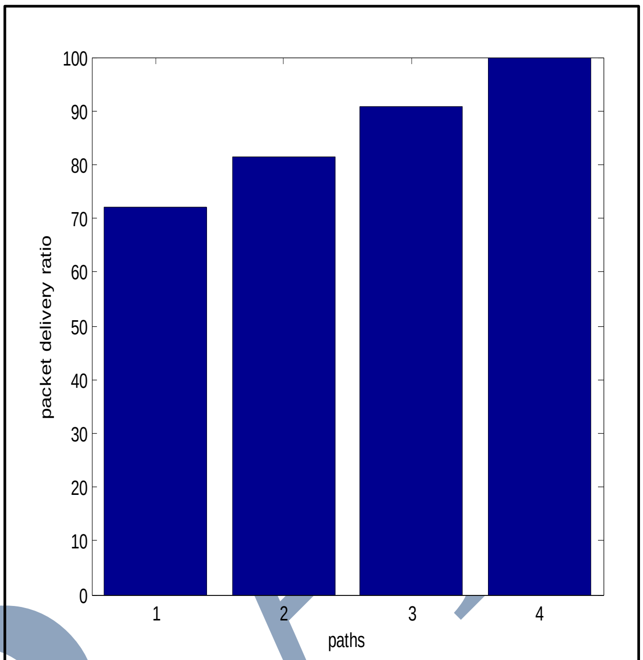

Figure 11: Packet delivery Ratio

3. Blocking Probability

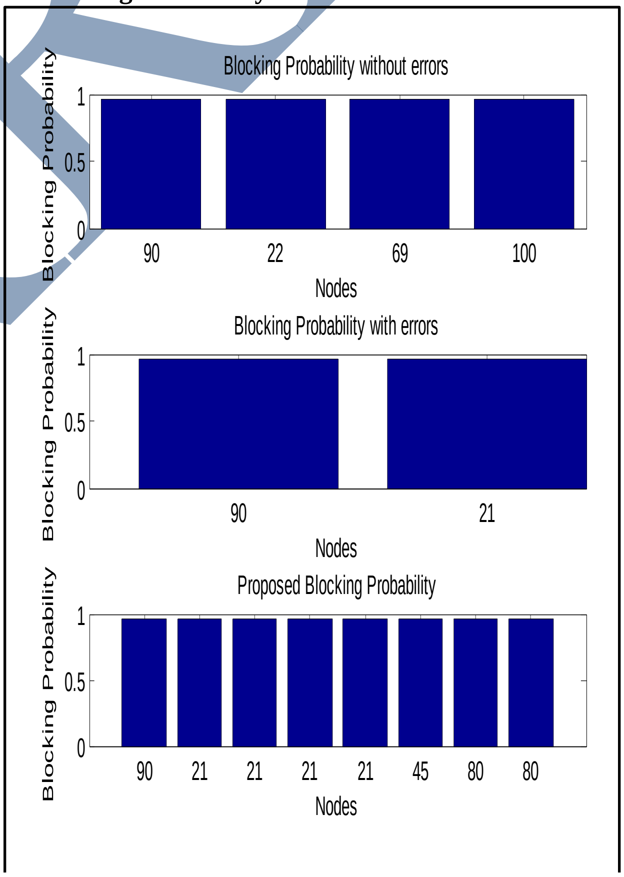

Figure 12: Blocking Probability Analysis for 100 Nodes

4. Delay Comparison

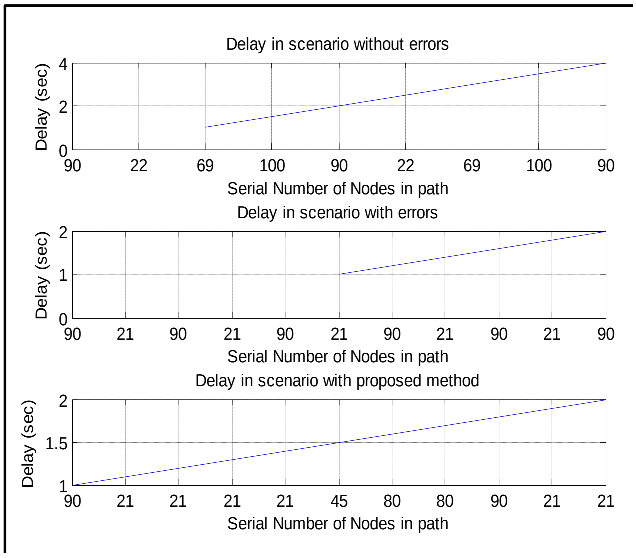

Figure 12: Delays in the Scenarios

This figure 12 shows the delay response. In this fig, 1st shows the delay response without errors and 2nd shows with errors. In this, delay is quite high as compared to proposed technique. As no. of nodes increases, delay increases as shown in fig 12 but proposed system provides less delay as compared to other systems. If there is large distance between nodes, then delay increases.

The packets delivery ratio is shown in table 4.1. It contains the packets value for various path hoping mechanisms and also for proposed scenario. It shows that proposed path transfers complete packets from sender to receiver even in presence of faults.

Table 1: Packets Delivered in case of 100 Nodes (out of 100)

S.N.	1st Hoping Path	2nd Hoping Path	3rd Hoping Path	Proposed Path
Packet Ratio	72	82	91	100

VI. CONCLUSION

In this work, it designs fault detection and recovered shortest path mechanism in wireless sensor networks. It includes Distributed Fault Detection algorithm to determine the faulty nodes. It covers shortest path mechanism to transfer data from sender to receiver. It provides a path hoping mechanism for compare the results. It assumes the case of power failure as there is to recovery techniques in that area. Therefore it has to change the direction of information when transmitted from a Sender Node to the Receiver Node. The deployment of Thousand Numbers of Sensor Nodes in Area needs energy performance and better Packet Delivery from the Sender to the Receiver. The new approach will provide a methodology for the Retracing of Path having good Packets with an Energy Efficiency and Accuracy. This assessment becomes the power performance booster among the previous workout as it automatically determines the shortest path after path hopping is traced. A self-Management approach links the sensor nodes from the source to the destination with in a shortest path and shows distributed accuracy. The results show that proposed path transfers packets completely without any loss as compared to path hoping mechanisms. As number of nodes increases in network, its complexity increases and it affects the computation time. Increase in nodes also increases delay in network.

REFFERENCES

[1] S. Ozdemira, Y. Xiao, "Secure data aggregation in wireless sensor networks: A comprehensive overview", 2009.

[2] L.T Nguyen, X.Defago, R.Beuran, Y.Shinoda, "An Energy Efficient Routing Scheme for Mobile Wireless Sensor Networks", 2008.

[3] W.H Liao, H-H Wang, "An asynchronous MAC protocol for wireless sensor networks", 28 July 2008.

[4] J. Zhua, K.L Hunga, B. Bensaoua, F.N Abdesselam, "Rate-lifetime tradeoff for reliable communication in wireless sensor networks", 29 September 2007.

[5] H. Shih, J. Ho, B. Liao, "Fault Node Recovery Algorithm for a Wireless Sensor Network" IEEE Sensors Journal, Vol. 13, No. 7, 2013.

[6] M. Masdari and M. Tanabi, "Multipath Routing protocols in Wireless Sensor Networks: A Survey and Analysis", International Journal of Future Generation Communication and Networking Vol.6, No.6, 2013.

[7] M. Sharawi, I.A Saroit, H. Mahdy, E. Emary, "Routing Wireless Sensor Networks Based On Soft Computing Paradigms: Survey", International Journal on Soft Computing, Artificial Intelligence and Applications (IJSCAI), Vol.2, No.4, 2013.

[8] S. Sharma, Dr. P. Mittal, "Wireless Sensor Networks: Architecture, Protocols", Volume 3, Issue 1, 2013.

[9] E.P.K Gilbert, B. Kaliaperumal and E.B singh, "Research Issues in Wireless Sensor Network Applications: A Survey",International Journal of Information and Electronics Engineering, Vol. 2, No. 5, 2012.

[10] Ms. P. Tyagi, Ms. S. Jain, "Comparative Study of Routing Protocols in Wireless Sensor Network", Volume 2, Issue 9, 2012.

[11] O.D Incel, "A survey on multi-channel communication in wireless sensor networks", 2011.

[12] L.D.P. Mendes, J.J.P.C. Rodrigues, "A survey on cross-layer solutions for wireless sensor networks", 2011.

[13] C.Tana, J.Zoua, M. Wanga, R. Zhang, "Network lifetime optimization for wireless video sensor networks with network coding/ARQ hybrid adaptive error-control scheme", 2011.

[14] M.A Yigitel, O.D Incel, C.Ersoy, "QoS-aware MAC protocols for wireless sensor networks: A survey",2011.

[15] L. Almazaydeh, E. Abdelfattah, M. Al- Bzoor, and A. Al- Rahayfeh, "Performance Evaluation Of Routing Protocols In Wireless Sensor Networks", International Journal of Computer Science and Information Technology, Volume 2, Number 2, 2010.