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# A Novel Communication Pathway Metric Evaluation using Throughput and Energy Improvements over Wireless Sensor Networks

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**Abstract-** Lifetime connectivity and low power consumption are two requirements for WSNs. Additionally, increasing WSN commercialization, application monitoring for higher QoS. Maintaining the improvement of the wireless sensor networks effectiveness requires the establishment of the energy-efficient and consistent connection. In order to increase the efficiency of routing algorithms in latest technology assisted WSNs, a novel method is developed. The gadgets with the lowest power consumption are carefully selected for the appropriate use and carefully managed. The goal of this research is to develop low-power routing algorithms for use in WSNs. Numerous sectors, including the military, the medical profession, surveillance of observing, public transportation sectors etc., can benefit from wireless sensor networks deployed with a large number of mobile nodes in a communications system. To examine data from nodes that are freely moving about the zone, we developed and simulated a wireless network system based on the Distributed Internet of Things. The proposed method of Intelligent Route Metric Analyzer (IRMA) improves upon the efficiency of the standard algorithm with regards to energy consumption. In addition, the ground wireless sensing design's ideal trajectory is identified using a realistic tempering approach. In the end, this concept is compared to similar ones like AODV and the findings reveal that it performs better with regard to of energy consumption, delay and other important metrics. According to the paper we analyzed, the primary objective was to devise a routing method that would sustain network operation for as long as feasible by decreasing the energy needed for different operations at each individual sensor node while keeping the total energy consumption of the nodes constant over their lifetimes. Finally, the study makes a contribution to the ongoing discussion of the difficulties in developing a routing protocol for WSN, taking into account the interdependency of different network factors. Median throughput, median network latency, and standardized route load are only few of the efficiency metrics addressed in this article.

**Keywords-** Intelligent Route Metric Analyzer, IRMA, AODV, WSN, Routing Efficiency, Throughput, Delay Estimation, Route Load

## I. INTRODUCTION

WSN is a type of network made up of numerous tiny nodes. The processing, storing, and transporting capability of WSN nodes is constrained [1]. Most WSNs aim to differentiate between functions and carefully examine the QoS for settlement information packets. WSN are the most alluring new developments. WSN can be used to carry out activities related to observing, observation, detecting, and estimating. Sensor nodes in a WSN are used to find environmental or physical information. These sensors are small and have limited preparation and processing capabilities. These sensors are able to gather, measure, and communicate data from their immediate environment to the sink. WSN is a growing field in the greater expansive area of remote networking, with applications ranging from social insurance to observation [2]. The following figure Fig.1 illustrates the route's node failure.

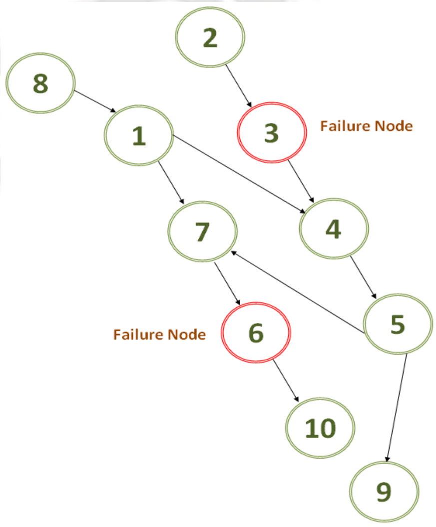


**Fig.1 Node Failure**

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Wireless networks of sensors are being used more frequently to address new demands as the fields of computing science, communication via wireless sensors, and various other technologies continue to advance. WSNs have significant advantages over conventional sensor networks when it comes to deployment as well as upkeep. WSNs have impacted every aspect of life and have evolved into a key sort of infrastructure for smart cities, businesses, industries, and everyday life. 6 WSNs have been used in a variety of fields due to their significance and excellence, as well as their advantages of being flexible and inexpensive without the need for cables [3][4]. WSNs in particular are being used more and more for environmental monitoring, namely to track environmental variables including pollution, noise, temperatures, forest fires, as well as many more.

Due to their profound influence on many important military and civilian applications, wireless sensor networks have attracted a lot of academic attention. The network's performance is significantly impacted by the architecture chosen. For instance, it was demonstrated in that as the quantity of nodes within the network rises, the mean throughput for a node disappears. This suggests that the network shouldn't be entirely unstructured for effective communications. Investigation of the performance of a multi-hop many-to-one network using a time division access protocol and uniformly distributed nodes demonstrated that clustering the network could possibly increase the throughput.

The acting node in a Wireless Sensor Network also known as is said to have a significant role in data transmission and in keeping the nodes active for a longer time. The goal of this study is to extend the life of the node in the WSN cluster by improving energy efficiency as well as smart routing [5]. The following figure Fig.2 illustrates how nodes are distributed.

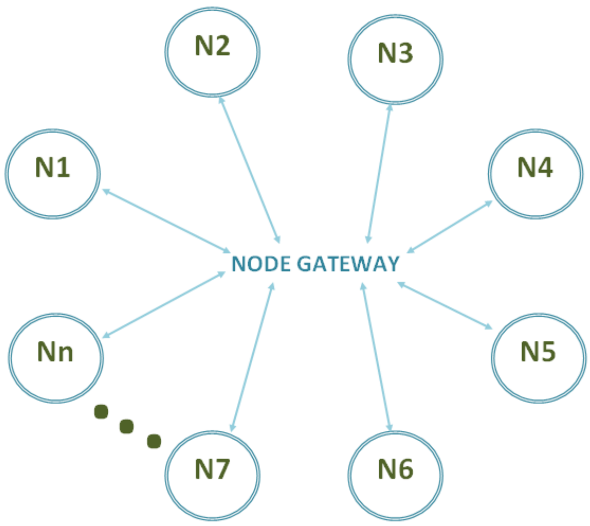


**Fig.2 Nodes Distribution**

## II. RELATED STUDY

To address the problem of insufficient energy storage, the authors of this research [6] presented a clustering protocol for routing of Wireless Sensor Networks operating with solar energy harvesting. This protocol dynamically updates the cluster head by factoring in the node's residual energy, node's harvested energy, and node's position in the cluster head update criteria [6]; in the data transfer stage, the node sleep schedule is optimized to minimize the amount of data lost during transmission; as well as during this clustering stage, the genetic algorithm is used to improve the problem that the K-Means computation is subject to outliers. Using simulation and correlation between the LEACH, LEACH-improved, as well as SEP standards, a protocol manages to increase network performance and extend the life of the network [6] [11].

Due to a lack of access to wired networks, wireless data transfer is essential. As a result of the planned effort [7], the stated infrastructure (WSNs) now looks better. A wireless sensor network (WSN) is a multiple-hop, distributed, self-organizing network. Since WSNs are in constant flux, consumers would benefit from in-depth research into a variety of concerns. The primary issue with WSNS network is the drain on the battery. In this work, we design and simulate an Energy Balancing Routing Protocol, which is used to calculate the energy balance. The most effective utilization of node energy guarantees the identification of a safe route [7].

Wireless sensor networks use a variety of routing methods to exchange data [8]. Cluster-based routing protocol is one of the most common types of routing protocols. Cluster creation and CH selection for optimal transmission energy are the backbone of every cluster-based routing technology. Data packet transport between nodes is the sole purview of CH. However, such protocols can be compromised by malicious network activity. In this research, we develop a brand-new secure cluster-based routing system for the transport of sensitive information. The results show that the developed approach provides cutting-edge performance in key areas like packet delivery ratio, consumption of energy, throughput, and End-to-End latency [8][12].

Research into the creation of a suitable routing protocol utilized for distant applications within Wireless Sensor Network is necessary since it may alleviate problems with energy, packet delay, and throughput [9]. However, limiting energy sources is the fundamental limitation of sensor networks. Improving the network's longevity via increased energy efficiency requires a methodical strategy. Energy efficiency in terms of decreased energy consumption and increased network lifetime has been demonstrated using a newly developed clustering protocol. In order to maximize the efficiency with which each Sensor Node's energy is used, the suggested Adaptive Ranking based Energy Efficient Opportunistic Routing [8] protocol uses an adaptive ranking method to rank the Forwarder Nodes and Cluster Head. For each transmission, the CH with the highest residual energy as well as the shortest distance to the source node is chosen using the adaptive ranking method. Improvements of End-to-End Delay, Message Success Rate, Energy Consumption and Packet Delivery Ratio [9] are the results of using the suggested protocol, which also extends the lifespan of the network. Using a total of 30 samples and a CI of 0.85 for simulation, it was shown that the protocol demonstrated superior statistical validity when compared with conventional routing protocols [9] [13].

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Globally, routing strategies for Wireless Sensor Networks are of paramount importance [14]. Communication as well as networking applications benefit greatly from the use of any and all routing along with clustering technologies. In particular, wireless sensor networks rely heavily on environment-based as well as traffic-based routing techniques. This research looks into the issues of routing, as well as the energy and power needs of different WSN applications. Reliability, network longevity, and throughput are only few of the performance characteristics heavily addressed in various WSN applications. Different routing and clustering techniques and how they affect WSN applications [15] are the subject of this research.

## III. METHODOLOGY

In this research, assuming that the information nodes has data destined for the node of destination, WSN routing is used to enable the transfer of data via the information node towards the destination node, where the gateway has data on all the nodes frequently communicating with it. With the aid of the message's beacon technique, we are examining the data of the mobile nodes in the wireless network region here. The various network topologies include point-to-point, star, trees, linear, and mesh connections and relationships for each node. Each topology has a unique means of adhering to the rules.

The wireless sensor network now used for the Internet of Things uses less energy. Particularly, the correct information cannot be received while the nodes are moving. To examine the data of nodes wandering close to the zone region, we constructed and simulated a distributed IoT-based wireless network system. The suggested structure for moving nodes continuously reports on their presence in the surrounding space. We have enhanced WSN characteristics including average end-to-end delay, average throughput, average node energy, packet delivery ratio as well as normalized routing load in the proposed research effort. From the perspective of energy conservation of routing as well as its related features, we have focused on the problem of increasing network throughput. Cluster-based routing protocols are extensively covered in the literature, and they primarily include (i) cluster design, (ii) route construction, and (iii) CH rotation operations.

The following figure Fig.3 describes the many functions that nodes in a clustering network design perform throughout time. The steps of this approach's operation include broadcasting, clustering, designating group leaders, preparing the flight trajectory, as well as gathering WSN data.

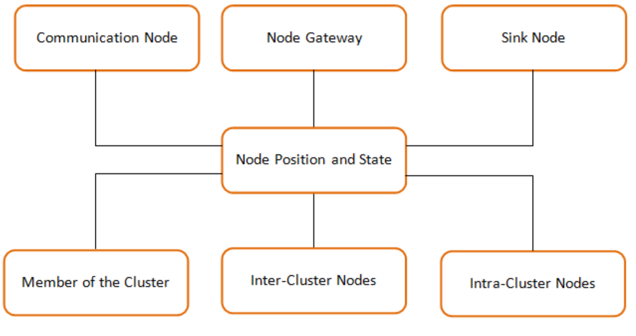


**Fig.3 Functions of Nodes in Clustering Network**

The light traffic WSNs used for environmental monitoring, agricultural applications, and greenhouse reports are the focus of our proposal. To remove and compress the aggregated knowledge of group leaders in these applications, temporal-spatial correlation along with additional data fusion techniques can be used. The following figure Fig.4 shows the brief description of the strategy

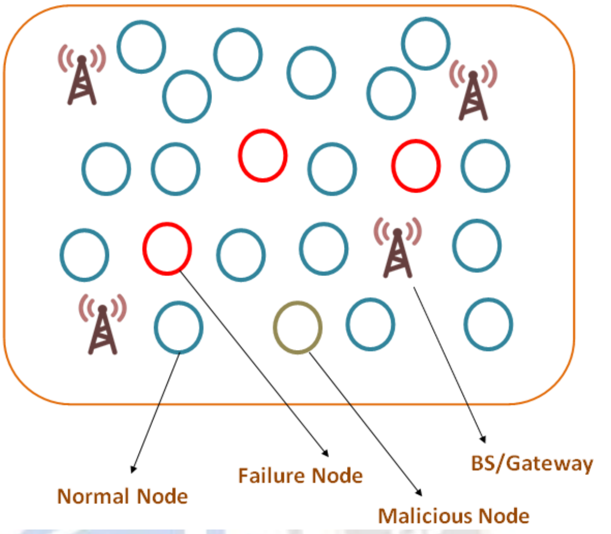


**Fig.4 Brief Description of the Strategy**

The following characteristics of WSN:

(i) Regulated network growth and extended network lifetime
(ii) Transmitting data in a timely manner
(iii) Better network security
(iv) Efficient use of energy
(v) Improved scalability, resilience, and resilience of the network

## IV. RESULTS AND DISCUSSIONS

Developing a trustworthy routing system is not as easy as just doing your homework. The design incorporates a lot of different quality factors, some of which might potentially have a detrimental influence on one another. It is important to create a routing strategy that reduces the amount of power required to run the network's various nodes and maintains a constant state for the energy levels of all of the sensor nodes in order to keep the network active for as long as is practically possible. This is required in order to keep the network active for as long as is practically possible. It is expected that there would not be any untimely deaths among the nodes. It is not appropriate for the routing protocol to be created based on characteristics such as the structure of the network, the environment, the number of nodes, or how they are deployed. In this study, a unique routing protocol known as Intelligent Route Metric Analyzer (IRMA) was proposed. Its purpose was to identify the path that would provide the best possible connection and to prevent disruptions along the way. Research on a trustworthy multi-path key is something that should be done because it is so simple for a malicious node to change the contents of the network. Taking into consideration a more diverse set of potential outcomes results in the emergence of new challenges and makes it

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necessary to make considerable adjustments to the conventional design that is expected by the majority of routing algorithms. In this article, we present an overview of the relevant assessment parameters for various routing strategies. In this section, we demonstrate how the number of hops in a network as well as malicious attacks can cause it to move at a more glacial pace. We look at shortest path routing when there are no harmful attacks, multipath routing when there are malicious attempts despite the reliable networking decision-making approach, and fastest route networking when there are no malicious attacks at all. Assume that there are three alternative routes (R1, R2, and R3), each having a hop count of X1, X+1, and X+2, respectively, and that route R2 has been penetrated. The throughput is shown against the hop count in figure 5, which is a scatter plot. And the following table, Table-1 illustrates the same in descriptive manner. If the protected route selection mechanism were not in place, there would be an equal probability of taking any of the alternative routes. When routing route selection is performed, data is transmitted over the two uncompromised pathways R1 and R2, with preference being given to the path that is the shortest distance between two points. In this particular scenario, we make use of the constant metrics and suppose that the route deviations are XR1, X1 and XR1, X1. An approved route decision-making approach, as opposed to a non-adopted routing path selection strategy, results in a significant improvement in the amount of throughput that may be achieved while being subjected to destructive damage. It is also evident that there is a reduction in throughput whenever the hop count increases. This substantiates the evaluation of our theoretical framework.

**Table-1: Throughput Efficiency**

| S.No. | Nodes | AODV | IRMA |
|---|---|---|---|
| 1. | 50 | 515 | 612 |
| 2. | 75 | 626 | 748 |
| 3. | 100 | 714 | 875 |
| 4. | 125 | 725 | 897 |
| 5. | 150 | 764 | 911 |
| 6. | 175 | 803 | 923 |
| 7. | 200 | 819 | 956 |
| 8. | 225 | 829 | 1001 |
| 9. | 250 | 856 | 1083 |
| 10. | 275 | 877 | 1102 |
| 11. | 300 | 892 | 1156 |

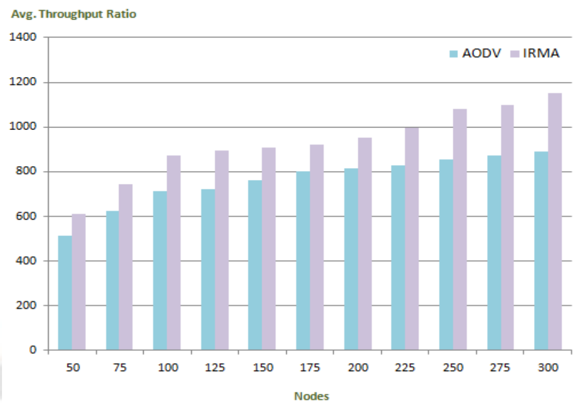


**Fig.5 Throughput Efficiency**

The following figure, Fig-6 illustrates the network delay and the following figure, Fig-7 illustrates the normalized routing load in clear manner with histogram representation, in which the proposed routing algorithm Intelligent Route Metric Analyzer (IRMA) is cross-validated with the conventional routing protocol called AODV to prove the efficiency of the proposed approach. In which the same factors are illustrated over the following tables, Table-2 and Table-3.

**Table-2: Network Delay Analysis**

| S.No. | Nodes | AODV (s) | IRMA (s) |
|---|---|---|---|
| 1. | 50 | 0.76 | 0.34 |
| 2. | 75 | 0.94 | 0.56 |
| 3. | 100 | 1.54 | 0.82 |
| 4. | 125 | 1.79 | 0.97 |
| 5. | 150 | 1.96 | 1.19 |
| 6. | 175 | 2.09 | 1.54 |
| 7. | 200 | 2.34 | 1.79 |
| 8. | 225 | 3.51 | 2.03 |
| 9. | 250 | 3.83 | 2.51 |
| 10. | 275 | 4.26 | 2.76 |
| 11. | 300 | 5.11 | 2.92 |

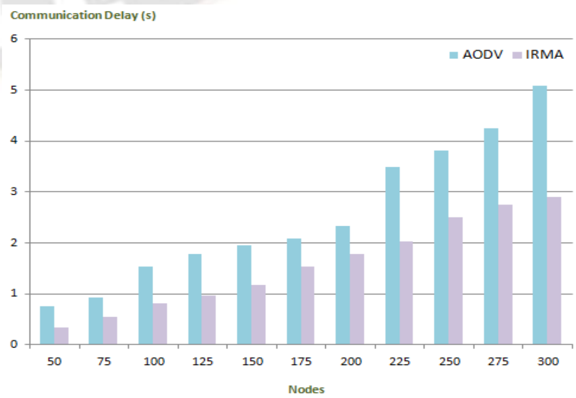


**Fig.6 Network Delay Analysis**

**Table-3: Route Load Estimation**

| S.No. | Nodes | AODV | IRMA |
|---|---|---|---|
| 1. | 50 | 12.6 | 7.64 |
| 2. | 75 | 13.1 | 7.93 |
| 3. | 100 | 13.4 | 8.06 |
| 4. | 125 | 14.2 | 8.27 |
| 5. | 150 | 15.3 | 8.64 |
| 6. | 175 | 15.9 | 8.93 |
| 7. | 200 | 16.4 | 9.26 |
| 8. | 225 | 16.8 | 9.38 |
| 9. | 250 | 17.2 | 9.54 |
| 10. | 275 | 17.7 | 9.72 |
| 11. | 300 | 19.5 | 9.94 |

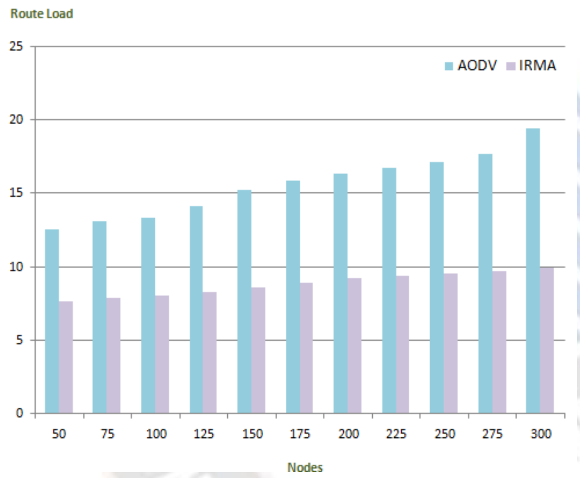


**Fig.7 Route Load Estimation**

## V. CONCLUSION

The efficiency of a network is the end outcome of several individual processes that all depend on and are interdependent on one another. As an effort to boost network efficiency and cut down on power consumption, the IRMA (Intelligent Route Metric Analyzer) project was initiated. The IRMA architecture was used in several places throughout this process, from the choice of forwarding nodes and the routing of inter and intra communication through the behavior of nodes and the delivery of final data, to reduce energy consumption. Empirical studies reveal that energy-aware routing is achieved by carefully selecting the forwarding node to be used, which in turn leads to more efficient intra- and inter-communication routing. The results also suggest that, while there may be a connection between cluster density and packet output, this is not the only element at play in achieving high throughput. If this happens, it only puts extra pressure on the network and increases things like congestion, packet loss, and latency. Therefore, a greater degree of energy consumption is needed to counteract these issues and maintain the network's functioning. Another possible inference from the trials is that it is not a sensible choice to implement node mobility in each round, and that it would be better to let the basestation work until it uses a certain portion of its energy, at which point its designation would be rotated to some other suitable node. This decision was made once it became clear that moving nodes after each round was not the best strategy.

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