Journal of Theoretical and Applied Information Technology
31st March 2023. Vol.101. No 6

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

NRP-WMSN : A NOVEL ROUTING PROTOCOL FOR MULTIMEDIA TRANSMISSION IN WIRELESS MULTIMEDIA SENSOR NETWORKS

CH.JANAKAMMA[1] AND DR.NAGARATNA P. HEGDE [2]

[1]Research Scholar, Osmania University, Hyderabad, India
[2]Vasavi College Of Engineering, Hyderabad, India

E-mail: janaki.chawalam@gmail.com, nagaratnaph@staff.vce.ac.in

ABSTRACT

Wireless Sensor Networks(WSN)s have gained more attention in the field of research for support a wide range of applications including multimedia transmission. WSNs are widely used in real world applications. Due to rapid innovation in wireless sensor networks , more networking nodes participate in multimedia data transmission. Many multimedia applications utilize WSNs , such as video surveillance, object tracking, healthcare system, traffic monitoring, etc.. The traditional WSN have open challenges in multimedia transmission like delay in data transmission, high energy consumption and throughput performance. The proposed novel routing protocol for multimedia transmission in Wireless Multimedia Sensor Network(NRP-WMSN)addresses the limitations of traditional WSNs. The proposed routing protocol improved network performance by applying a routing algorithm in multimedia data transmission. The implementation is made using NS2 to exhibit the proposed routing concept. The experiential outcomes showed the effectiveness of the proposed routing approach. The proposed routing algorithm performance is compared with basic multimedia data transmission approach in terms of delay, throughput and packet delivery ratio

Keywords - *Wireless Sensor Network, Multimedia Application, Data Transmission, Routing Algorithm, Packet Delivery Ratio.*

1. INTRODUCTION

The tremendous advancement in wireless communication technology has a highly impact on Wireless Sensor Network(WSN)s. Data transmission is an essential operation in WSN. From the last decade many mechanisms have been proposed to improve the performance of data transmission. Efficient data transmission is essential for both research and the real time industry. The WSN is used in a wide range of applications from military to health care applications and environment monitoring applications to smart city innovations[1]. The WSN has a large number of distributed sensor nodes. The traditional WSN has different levels of communication. The network partitions into many clusters , in each cluster elected one CH. The different multimedia applications used cluster based networks with sensor nodes. Base station received data transmission from the sensor node through CH[2].

The traditional WSN has the limitations of multimedia data transmission. The sensor nodes have very less computing and communication abilities. The range of sensor nodes is very limited and enhancement is needed to improve the communication performance. Traditional WSN mainly used Base Station and CHs for data transmission[3]. In Figure 1 observe a model architecture of WSN.

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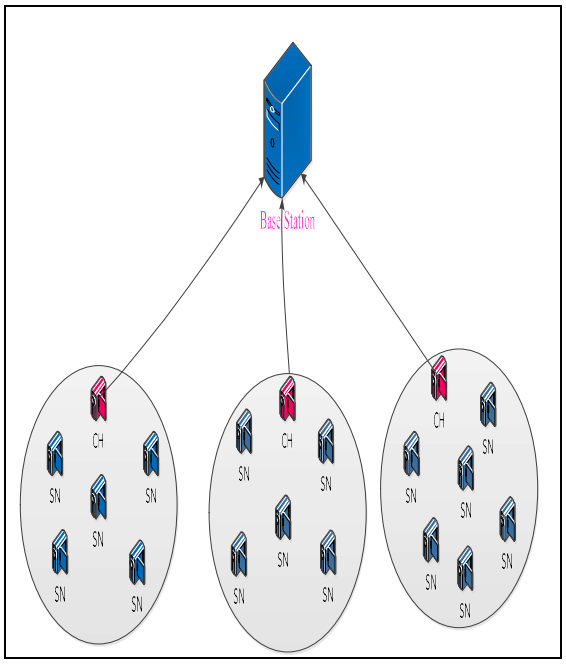

Fig 1 A Model Architecture Of Wireless Sensor Network

The traditional WSN mainly follows a clustering mechanism. As per the cluster mechanism, each cluster has a group of sensor nodes. The sensor nodes collect the surrounding data and send it to the CHs. The CHs process collected data and sent it to BS. Each sensor node in the network consumes energy to collect and forward the data. Even though the sensor nodes are shutdown due runs out of energy. So it's essential to develop an energy efficient algorithm for WSN[4]. The Wireless Multimedia Sensor Network(WMSN)s are different in nature compared to traditional WSN. Multimedia transmission such as image, video and audio is more complicated due to huge data size, so wireless networks lead to degraded performance. To address these limitations in the WMSN emergency of developing a novel routing algorithm. The novel routing algorithm in WMSN, which improves the performance in terms of throughput, delay and PDR. The empirical results shown that maximize the throughput and PDR, minimize network delay [5].

The remaining paper is divided into different sections, each section discussed as follows. Section II provides a comprehensive overview of the state-of-the-art of WSN multimedia data transmission mechanisms. In Section III, discussed the proposed methodology deployed routing algorithm for energy efficiency. In Section IV, discuss the empirical results proposed mechanism and perform comparative analysis of proposed results. In Section V conclude the paper with betterment of proposed algorithm, besides that discuss future outline research work.

2. LITERATURE REVIEW

The wireless sensor networks applied in multiple applications such as monitoring, healthcare system and object tracking . The traditional WSNs are limited to monitoring and sensing applications. Below section gives brief discussion on different multimedia data transmission approaches.

Wael Ali Hussein et al proposed smart, greedy forwarding algorithm based on throughput and energy-awareness (SGFTEM) for multimedia data transmission in WSN. The SGFTEM address the limitations multimedia data transmission problems in WSN. The proposed mechanism select optimal paths to send multimedia data from source to destination. However, the proposed SGFTEM achieved better results in terms of throughput and energy with comparisons of AGEM, TPGF, GPSR, and AODV. But the system equally distributed the energy and other resources among the network nodes. The network does not have optimal resource utilization, so its leads to waste of network resources[1].

Jawwharlal R and L. Nirmala Devi introduced Quality Aware Multipath Routing which selects multiple paths based on transmission count, energy and delay. The QAMR constructs a composite metric by combining these three metrics and selects nodes that disjoint multiple paths from source to destination. The simulation results stated that proposed QAMR achieved better performance in terms of energy, delay, throughput and pdr. The MWSN impact in research and industry applications. Even though QAMR performs with QoS metrics , the system is unable to address the failure of common nodes[6].

Murat Koyuncu et al introduced a model for energy efficient and accurate object detection and classification. In order to save energy in WMSN nodes are made as sleep nodes until transfer multimedia content. The object recognition performance is increased by fusing of object recognition results obtained from video and audio applications. The auditory data

requires less process freedom compared to visual data and overhead of auditioning data helps to extend the network[7].

Tong Wang et al introduced Simultaneous Wireless Information and Power Transfer(SWIPT) technique for wireless power body area networks. The SWIPT networks address the problem of energy consumption minimization with throughput heterogeneity. The problem is solved by the battery free scenario and a low complexity time allocation schema. The battery-assisted scenario has a lower probability of outages and a lower energy consumption than the battery-free scenario. In addition, we consider a unique circumstance in which the feasible set of the aforementioned ECM-TH problems may be devoid due to SNs' high throughput requirements or poor channel conditions[8].

Wireless networks have continuous data transmission from source to destination. The continuous data traffic leads to energy consumption in wireless multi-hop networks. Energy harvesting problems raised due to continuous interaction, node random movement. **Xiang Tian et al proposed** Throughput-Optimal Broadcast for Time-Varying Directed Acyclic Wireless Multi-hop Networks. An online max-weight broadcast algorithm was proposed by the network, which took into account the time-varying property of supportable link transmission rates brought about by energy-harvesting dynamics in the scheduling of transmission slots. Through simulations, the proposed algorithm's throughput and latency performance is evaluated empirically, and the simulation results support our theoretical analysis..[9]

3. PROPOSED METHODOLOGY

3.1 Problem Definition

The WSNs are interconnected with sensor nodes that communicate with each other to gather the information from surrounding environments. With decentralized fashion and low energy the sensor nodes are operated in WSN. The WSN is deployed in many emerging applications, such as healthcare systems, industrial applications, environment applications, military applications. The traditional WSN operates with three different levels like base station, cluster head and sensor node. The sensor nodes collect the surrounding data and transmit it to the cluster head node. But the cluster head receives multimedia information for a fixed amount of time and the behavior changes rotationally. The rotational changes of cluster head leads to energy consumption and delay in data transmission. To address the limitations of the present state of the WSN, in this research paper introduced a novel routing protocol with nearest path selection.

3.2 Novel Routing Algorithm

The optimize path selection mechanism follows two different phases in proposed MWSN. In first phase applied optimize path selection algorithm, its sends RREQ packet from source node destination node. The RREQ packet broadcast from intermediate nodes and reaches the destination node.

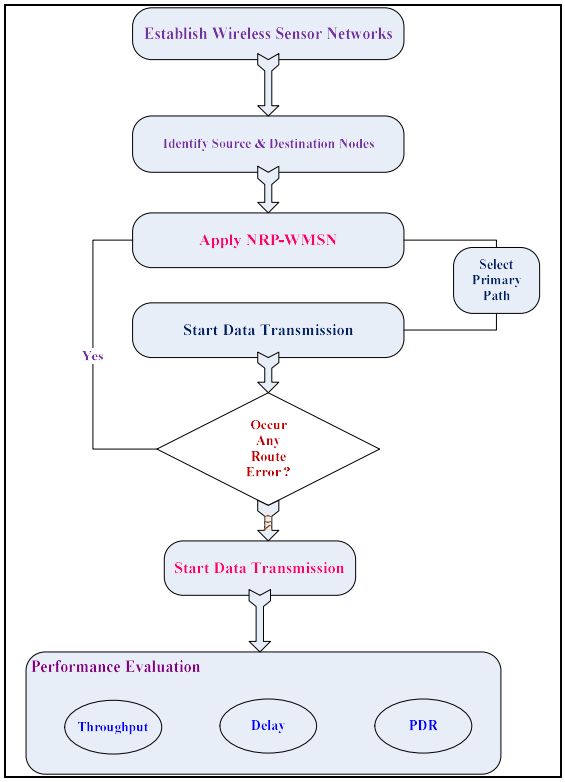

Fig 2 Proposed Novel Routing Protocol For Multimedia Transmission In Wireless Multimedia Sensor Network Architecture .

The sensor node have the status about the distance between the neighbor node and previous node and next neighbor node in the network. Finally the sink node receives RREQ from different nodes nodes with different paths.

Algorithm Name : Nearest Optimize Path Selection
Input: Network nodes with distance factor
Output: Optimize Primary Path

1. Initialize WSN
2. Identify Source & Destination Node
3. RREQ packets send from Source Node
4. RREQ packet broadcast by sensor nodes with the information of node distance factor
5. Next sensor node maintain information of node distance factor
6. Calculate total path distance value
7. Path Distance = NDs +NDn1 + NDn2 + ------- +NDnn + NDd
8. Maintain path order based on node distance values
9. Primary optimize path selection
10. Send RREP packet .
11. Start Data Transmission from source node.
12. Link failure occurs in primary path
13. Alternate optimize path selection
14. Send data transmission from alternate path.
15. Evaluate Performance Metrics
16. End

The summation of node distance values calculated and ordered all optimized paths. Using the primary optimized path the destination send a RREP packet to the source node. Also optimized alternate paths available in the network. If any link/node failure occurs in the network use the alternate paths for data transmission. To optimize path selection algorithm given detailed implementation steps in WSN.

4. RESULTS ANALYSIS

The proposed novel routing algorithm for WMSN is implemented using Network Simulation(NS) version 2.35. The empirical simulation results show the performance of MWSN with multimedia data transmission. The comparative results discussed in below sub sections.

4.1 Simulation Environment

Table 1 Given The Environment For Network Simulation For The Empirical Study.

S NO	Network Parameter	Network Value
1	Type of Channel	WirelessChannel
2	Radio-Propagation	Propagation/TwoRayGround
3	Network Interface	WirelessPhy
4	Interface Queue Type	DropTail
5	Model of Antenna	OmniAntenna
6	Length of Queue	50
7	Routing Protocol	AODV
8	Number of Nodes	75
9	Data Rate	2MB
10	Basic Rate	1MB
11	Total Simulation Time	50

Table 1: Simulation Environment

Table 1 gives detailed network parameters which are used in the design of WMSN simulation.

The two ray ground radio propagation is used for deployment of WSN. Different performance metrics are compared for evaluation of proposed mechanisms. The improved performance is measured in terms of delay, throughput and packet delivery ratio. The different previous mechanisms such as Smart Greedy Forwarding algorithm based on Throughput and Energy-Awareness (SGFTEM)[1] for efficient performance in WSN, Adaptive Greedy Compass Energy-Aware using Multi-path (AGEM) approach[10], Two-Phase Greedy Forwarding (TPGF)[11], efficient hybrid routing for WSNs is compared with the Proposed NRP-WMSN. The definition performance metrics are given in the section below.

4.2 Metric Comparative Analysis

The proposed algorithm simulation results compare with performance metrics. The

definition and equations discussions is given below.

4.2.1 Packet Delivery Ratio

The packet delivery ratio calculate by the ratio of the number of packets sent and number of received packets at destination node. The formula given in Eq(1).

$$\text{Packet Delivery Ratio} = \frac{\sum_{i=1}^{n} \text{RPi}}{\sum_{i=1}^{n} \text{SPi}} \text{ ---------- Eq(1)}$$

In Table 2 Demonstrate The Comparison Results Of PDR Performance Of NRP-WMSN.

No.Of Nodes	PDR Performance			
	TPGF	AGEM	SGFTEM	NRP-WMSN
35	97.9	97.9	98.1	98.5
55	97.1	97.15	97.3	98.3
75	97.7	97.75	97.9	98.1

Table 2 PDR Performance

In Figure 3 observe that the performance graph on PDR with respective simulation time. It shown the comparative results between proposed mechanism and existing mechanism.

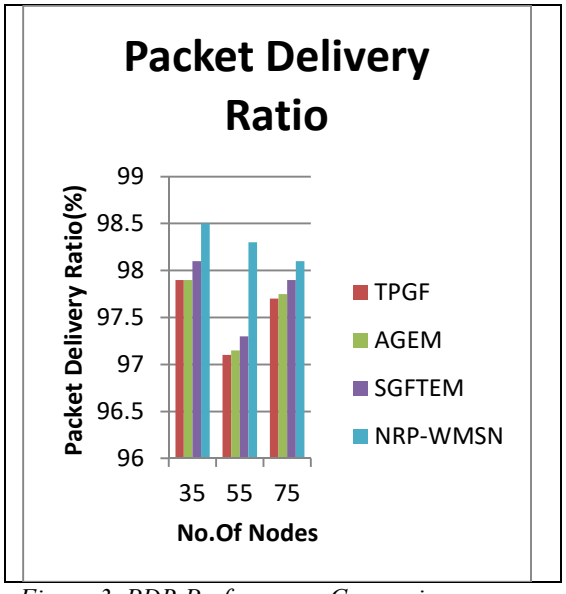

Figure 3 PDR Performance Comparison

Figure 3 shows the empirical results of NRP-WMSN routing algorithm and existing mechanisms of TPGF[10], AGEM[11], SGFTEM[1]. The X-Axis took number of nodes from 35 nodes to 75 nodes. The Y-axis is the percentage of PDR. The PDR of the NRP-WMSN network recorded higher PDR with comparison other WMSN approaches with a respective number of nodes. The same kind of fashion is observed in existing mechanisms, but the performance results stated that NRP-WMSN routing algorithm outperforms with comparison of TPGF, AGEM, SGFTEM .

4.2.2 Throughput

Throughput calculation given by the number of bytes received at the destination node in the network. The formula given in Eq(2).

$$\text{Throughput} = \sum_{i=1}^{n} \frac{Pi}{Time} * 8 \text{----------Eq(2)}$$

Table 3 demonstrate the comparison results of Throughput performance of Proposed WSN.

No.Of Nodes	Throughput Performance			
	TPGF	AGEM	SGFTEM	NRP-WMSN
35	55	58	68	84
55	51	54	64	72
75	48	51	59	68

In Figure 4 shown that the throughput performance of proposed mechanism with respective nodes communication range. The throughput performance NRP-WMSN routing algorithm. The number of nodes recorded from 35 to 75 on the X-axis. The number of bytes received at the destination node is taken on the Y-axis. The NRP-WMSN shown significant performance improvement in terms of kilobytes. The NRP-WMSN network destination node received 84 kilo bytes with comparison of existing mechanism SGTEM[12], AGEM[2], and TPGF received 68 kilo bytes, 58 kilo bytes and 55 kilo bytes respectively.

4.2.3 Delay

The difference between the packets received time and packet sent time.

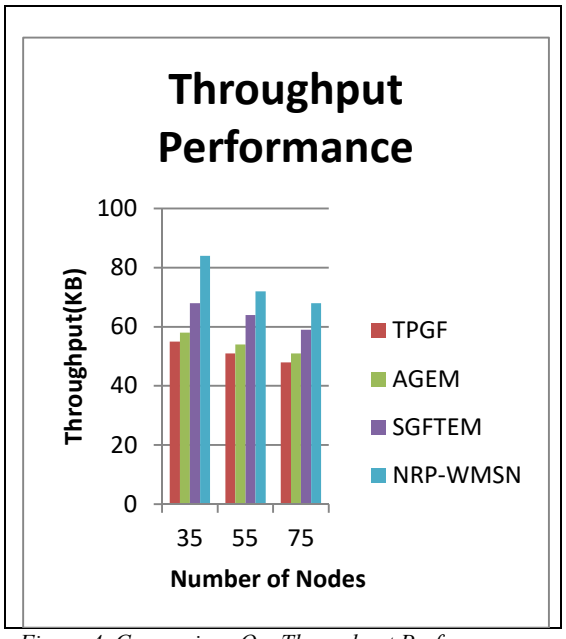

Figure 4 Comparison On Throughput Performance

The formula given in Eq(3).

$$\text{Delay} = \sum_{i=1}^{n} \text{PSTi} - \text{PRTi} \quad ------\text{Eq}(3)$$

In Table 4 demonstrate the comparison results of delay performance of WSN.

No. Nodes	Delay Performance			
	TPGF	AGEM	SGFTEM	NRP-WMSN
35	1.95	1.9	1.9	0.95
55	2.6	2.8	2.4	1.65
75	3.9	3.8	3.8	2.12

Table 4 Delay Performance Results

In figure 5 shows that the delay performance of proposed mechanism with respective number of nodes. The results proposed mechanism is compare with the present state-of-art-of the system.

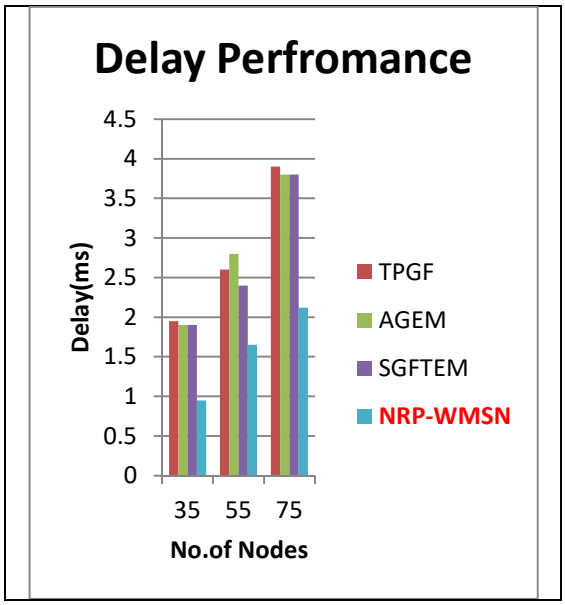

Figure 5 Delay Performance Comparison Results

Figure 5 shows the performance comparative results of network delay of the proposed mechanism. The number of nodes is taken on X-axis which is measured seconds and network delay is taken on Y-axis which is measured in milliseconds value. The empirical results proved that the proposed MWSN routing algorithm achieved better performance with comparison of the present state of the system. The proposed algorithm showed significant performance improvement results recorded from 35 to 75 nodes. Even though initially have high network delay, the proposed mechanism gradually reduces and minimizes.

5. CONCLUSION

The advancement in WSNs is utilized in many real time applications such as military, healthcare, agriculture, smart cities, etc. The WSN is highly efficiently used for data transmission. The operational capabilities of sensor nodes are based on the real time environments. The sensor nodes are highly resource constrained due to the nature of WSN. The present WMSN has many problems to solve, but the performance efficiently and network delay is essential. To address the issues in WSN, in this research paper proposed a novel WMSN routing algorithm. The proposed routing algorithm plays a key role in multimedia data transmission and selection of optimized paths between the source and destination nodes of the network. The proposed routing algorithm

maintains node distance status and also constitutes alternate paths. Which can be utilized if any link or node failure occurs in the primary path. The proposed routing algorithm improved performance in terms of delay, throughput and PDR. However, the NRP-WMSN outperforms with the comparison of different throughput WSN approaches. In other words, the WMSN is optimized in order to enhance multimedia data transmission in WSN. The implementation is done using NS2 simulations. The empirical results revealed that the proposed approach has significant performance improvement over the standard system. This research is further extended in future to overcome link failure problems by enhancing WMSN with energy efficiency

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