Energy Efficient Multi-Path Routing Protocols in Wireless Sensor Networks (WSN): A Literature Survey

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Abstract: There has been a colossal improvement in the field of Wireless Sensor Networks (WSN) in the past years. The advancement is seen in this field because of the accessibility of little size sensor microphones and cameras. Such gadgets catch the multi-media information from the environment and viably transmit them. Wireless Multimedia Sensor Networks (WSMN) is likewise the today's theme of discussion because of its application in different fields. Keeping in mind that the ultimate goal is to enhance the channel utilization rate, decrease transmission delay and balance the transmission network load in WMSN multipath routing is a promising arrangement. Multipath routing exchanges information at the same time therefore by decreasing time delay and congestion in WMSN. In this paper, different routing protocols and methods are being examined on multipath routing protocols which will recognize the territories of further advancement for WMSN.

Index Terms - Wireless Sensor Networks (WSN); Wireless Multimedia Sensor Networks (WMSN), Multi-path Routing Protocols, Energy Efficient.

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I. INTRODUCTION

Since the previous years numerous Research Community has been dealing with Wireless sensor systems (WSN) due to its hypothetical, practical and reasonable challenges. It incorporates the applications for substantial scale network systems having small sized gadgets which are fit for extracting data from the real environment condition at that point performing straightforward operation on the extracted information and transmitting it to remote locations/areas. Noteworthy development in WSN has help in the improvement of civil and military applications. Till today the created framework utilizing WSN are utilized to quantify temperature, weight, humidity or the area of localized objects. The different uses of WMSN incorporate war zone visual checking, movement observing, condition checking, security observing, medical treatment, smart home, human healthcare services and different applications.

Transmission of mass information and handling the information requires lots of energy in WMSN. The essential thing is to give the required Quality of Service (QoS) and to have least end to end delay while gathering the data transfer bandwidth capacity prerequisites in the framework. The principle factor which should be considered for real time mult-media transmission are low transmission delay, adjusted energy dissemination and duplicated paths which are clarified beneath.

1. Low transmission delay: The transmission delay ought to be as little as possible because the delayed information useless from the perspective of real time application.

2. Adjusted energy dissemination: The sensor networks are battery empowered and get debilitate with time; in this manner to have adjusted energy dissemination equally must be circulated similarly on all the sensor networks in the environment.

3. Duplicated path: When the small sensor networks are affected by disturbances in the path, they attempt to reproduce another path for retransmission of data which may bring about development of new paths which we can state duplicated path which should be stayed away from the network system framework.

Subsequently, multi-path is an imperative feature for the advancement of WMSN. The multi path feature will build various transmission paths from each source to sink that combine and send the information packets through these multi paths. In wireless networks, bandwidth is generally shared among neighbor nodes and a node may meddle with its topographically close networks along these lines lessening the throughput of the network. Along these lines to guarantee viable constant transmission for WMSN it is in required to transmit the information through paths that won't meddle with each other. Other imperative factor for consideration additionally incorporates reliability, fault tolerance, load balance and bandwidth improvement which are clarified beneath.

1. Reliability and fault tolerance: The reliability can be increased by sending the information through multiple paths with the end goal that on the off chance that one path flops (fails) then it can be recovered by another path. In adaptation to fault tolerance some extra data is transmitted alongside the information and afterward the information is transmitted through multi-path with the end goal that if the recipient network gets a section of the information the entire information can be recovered.

2. Load Balance and Bandwidth Improvement: Multipath routing can support distinctive applications and can take care of the system collision issue by dispersing the traffic equally through multi-paths and furthermore can acquired equivalent load balancing for traffic.

This paper is composed in the accompanying manner as takes as follows. Section 2 gives a critical review on different protocols and methods in Multipath WMSN, including their working mechanisms, advantages and disadvantages so as to consider them as a wellspring of future work. Section 3 finishes up the paper with giving a look on different issues to be considered as a subject of research.

II. LITERATURE SURVEY

It incorporates the concise review of existing work of different routing protocols in Multipath WMSN.

The *Greedy Perimeter Stateless Routing [1]* method utilizes the places of routers and a packet's destination to settle on packet sending choices. It makes greedy forwarding decisions when it is impossible and it utilizes routing around the perimeter of the region. GPSR basically sends a packet to a neighboring node which sits closest to the sink node instead of developing and maintaining up a routing table. It can decrease a lot of memory required for keeping up a routing table and can respond effortlessly to topology changes. The significant

disadvantage of GPSR is that it sends a packet just to the network nearest to the sink and enables a network to change its next hop just when the first next hop is dead. Other than GPSR, there are additionally protocols that take both the perimeter and angle into consideration.

The **Two-Phase geographical Greedy Forwarding [2]** method assembles various network disjoint paths to increase the network use. It doesn't receive confront routing to sidestep openings of nodes which makes it unique in relation to other algorithms. It utilizes greedy algorithm, where one network is appointed to just a single path. It is quick and basic however it suffers from the inter-path interference.

Ni's On-demand geographic routing scheme [3] empowers a source to route information along two paths with no routing messages. The routing method depends on the supposition that the sensor networks know about their geographic position. It first sets a settled rectangular forbidden zone between the source and the sink, its width being double the transmission range and length not as much as the separation between the source and the sink. It can effectively set up two non-interfering paths yet the nodes in the paths are settled they won't change until the point when some are dead.

In **Ge et al. [4]** scheme to enhance path efficiency, the method gives every node a chance to store the two-hop neighbor data and partitions the region between the source– sink combine into different zones. The source can send information to the sink through various zones to accomplish network disjoint paths. Zone utilizes a different zoning technique in view of area to ensure that the nodes in numerous routes are distinctive separated from the source and the destination. There are two ways to deal with keep up the routes: one is nearby route maintenance and the other is global maintenance. It works admirably when the nodes are consistently distributed in the network with nearly high density. Whenever there are gaps in the network protocol it isn't so versatile. It expends more memory and furthermore the inter-path interference problem is left out unconsidered.

The **Non-Interfering Multipath Geographic Routing [5]** protocol by creating a deviation angle, the source sends packets along two paths deviate from the straight line amongst source and sink. The two paths are non-interfering special case in nearness to the source and the sink. The nodes have more opportunity to transfer informative data. It considers just nodes inside under 2R radius distance from the line of the source and sinks combined. It decreases the normal end-to-end packet delay. Additionally, it doesn't consider the residual energy of networks and has at most two ways at the same time and the networks near source and sink are interfering.

AOMDV [6] ensures loop freedom and disjoint of interchange paths. It can discover various paths without topographical data. In any case, it neglects to take care of the route coupling issue. Additionally the protocol can be enhanced to register more disjoint paths when source-goal sets are far separated. We have to precisely contemplate the collaboration between timeout settings.

Bee Sensor [7] is outlined with the alleged "bottom up approach" in which "the design begins with the meaning of the behavior and collaboration modalities of the individual node in the viewpoint of getting the needed global behavior as the result of the joint activities of all nodes associating with each other and with the condition at the local level". It utilizes Swarm Intelligence to discover the paths. It can discover different paths without topographical data yet it neglects to tackle the route coupling issue.

SDMR [8] is fit for finding various paths helped by the global local data of the entire network in one route discovery, estimating the distance amongst them and picking paths with generally division. It doesn't fit to mistake inclined and energy restricted remote systems.

Geographic Energy-Aware non-interfering Multipath (GEAM) [9] conspire separates the entire topology into different areas and the areas into various groups. The separation between any two areas of a group will be set more than double the transmission range to maintain a strategic distance from interference. To send a packet to the sink it utilizes the greedy algorithm. It accomplishes a non-interfering multipath transmission by utilizing area. It fits well in the error prone areas and keep up high throughput when the system topology changes. Sink report the energy and area data of network also, lessen the transmission load and expands the lifetime of network and system. It is actualized just for the single source-sink area network.

The reality for utilizing the **Energy Constrained Multipath Routing (ECMP) [10]** protocol demonstrated to have effective transmission capacity use alongside negligible utilization of energy in wireless sensor networks. The quality of the ECMP demonstrated that it chooses least number of hops and least energy by choosing a path with least number of hops just when it is the way with least energy or a more drawn out path with least energy fulfilling the limitations. It demonstrates that the QoS ought to be founded on very much characterized requirements to evade pointless energy utilization when conveying information. It has an outlining challenge for such a energy obliged arrange.

Reliable Information Forwarding Using Multiple Paths in Sensor Networks (ReInForM) [11] convey packets at required dependability at an appropriate communication cost. It sends different copies of every packet along various paths from source to sink, with the end goal that information is delivered at the desired dependability. It utilizes the idea of dynamic packet state what's more, utilizes the nearby learning of channel error rates and topology. Therefore it utilizes every single possible path and productive load balancing. The system topology related issues additionally should be managed to process the unwavering quality wanted by every network to convey its packets to the sink.

Directional geographical routing for real-time video communications in wireless sensor networks **(DGR) [12]** method is utilized for productive multipath routing of parallel sub-streams from the source to the sink. It illuminates the route coupling issue caused by obstruction between packets transmitted over various paths between the same source–destination match. It expands source-to-sink transfer speed and better load balancing. It accomplishes dependability, energy effectiveness and timely packet delivery to help constant video benefit over WSNs. In any case, it experiences the energy bottleneck issue.

Interference-Minimized Multipath Routing (I2MR) [13] method can altogether expand throughput by finding and utilizing maximally zone-disjoint briefest paths for load balancing, while at the same time requiring negligible localization support and bringing about low overheads. It doesn't utilize the directional radio antennas. It needs to take into account the impacts of between path set obstructions, in order to facilitate the organization of the WSN.

On the lifetime of large scale sensor networks (OLWSN) [14] conspire comprise of an extensive large scale sensor network with n randomly conveyed sensors communicating with a base station (BS), where every sensor node has the same likelihood to detect and report its information to the BS. Due to factors relying upon the way path loss, radio handset parameters and network density, these ideal cell sizes are not generally achievable. The hybrid plans can fundamentally enhance the system lifetime over uniform forwarding plan as the hybrid plans don't require any extra route support, they are reasonable for advancing the lifetime of wireless sensor networks. The lifetime of such sort of sensor systems relies upon transmission schemes, network density and transceiver parameters with various requirements on network mobility, position mindfulness and maximum transmission range which should be thought about.

In Pair-Wise Directional Geographical Routing (PWDGR) [15] the neighbor networks of the source initially send information to the match insightful network around sink utilizing DGR calculation and after that exchange information to the sink network by GPSR [1] calculation.

Consequently, it can viably soothe the genuine energy trouble around Sink and furthermore make a harmony between energy utilization and end-to-end delay. PWDGR is utilized to tackle the energy bottleneck issue. It can drag out 70% system life. At the point when the network thickness is too little to discover enough combine astute networks, the execution will be influenced. The delay time is additionally expanded by 8.1%. So it causes some additional postponement in the framework.

The above methods has been quickly outlined in the beneath table with their advantages and disadvantages.

Table 1:Multi-cast Routing Protocol: advantages and disadvantages

Routing Protocol	Advantages	Disadvantages
GPSR [1]	It can reduce a large amount, fit in the memory-Limited sensor networks and reacts easily to topology changes.	It sends a packet only to the node closest to the Sink and allows a node to change its next hop only when the original next hop is dead.
TPGF [2]	It is fast and simple.	suffer from the inter-path interference problem.
NI [3]	Can successfully set up two non-interfering paths.	But the nodes in the paths are fixed; they will not change until some are dead, just like GPSR.
Ge et. al. [4]	using the two-hop neighbor information may help nodes relay data more efficiently.	consume more memory the inter-path interference problem is also left out, unconsidered.
NIMGR [5]	is more efficient.	it does not take the remaining energy of nodes into account and has at most two paths at the same time.
AOMDV [6] Bee Sensor [7] SDMR [8]	all are able to find multiple paths without geographical information.	performance not fit the error-prone, energy-limited wireless networks & fail to solve the route coupling problem.
GEAM [9]	fits well in the error-prone sensor environments and can maintain high performance even when the network topology undergoes rapid changes.	able to achieve balanced energy consumption and load distribution for nodes only in certain situations and has more number of hop counts.
ECMP [10]	it takes smaller neighbor point set considering energy efficiency of link.	there is a designing challenge for a energy constrained network.
ReinForm [11]	use of all possible paths and efficient load Balancing.	network topology related issues also needs to be dealt with to compute the reliability desired by each Node to deliver its packets to the sink.
DGR [12]	lower delay, longer network lifetime, a better received video quality and PSNR by up to 3dB	It has an energy bottleneck problem.
I2MR [13]	increases throughput by discovering zone-disjoint paths for load balancing, require minimal localization support.	increases throughput by discovering zone-disjoint paths for load balancing, require minimal localization support.
OLWSN [14]	optimize the network lifetime.	Many network parameters need to Be taken into consideration for large sensor network
PWDGR [15]	Selection of pair wise node allows the system to remove the problem of energy bottleneck.	Cause some extra delay in the system

III. CONCLUSION

This paper has introduced a successful investigation of different routing and plans identified with multipath routing protocols in Wireless Sensor Networks (WSN). It has additionally given a tabular format containing all the multipath plans to refer it for snappy outline to recognize the regions of further advancement for WMSN. The future research can be led on diminishing the transmission delay in the system, expanding the efficiency and hence the throughput of the network, to actualize the framework with different source-sink sets, to take care of the energy bottleneck issue of sensor networks and some more.

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