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Lifetime Estimation of WSN with Enhanced Pairwise Directional Geographic Routing

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Abstract: ***This research work proposes an enhanced pair-wise directional geographic routing (EPWDGR) technique using the directional antenna and compares it with the conventional pair-wise directional geographic routing (PWDGR) method that uses the Omni-directional antenna. PWDGR has two key limitations - minimum network lifetime and its use of static nodes. The EPWDGR technique aims to overcome these pitfalls by incorporating a directional antenna patch that requires lesser power, thereby increasing the network lifetime. The validations have been performed through simulations that use a random waypoint mobility model which is more practical. Varying performance metrics have been used for the estimation of network lifetime. The EPWDGR also solves the energy bottleneck problem at the nodes near the sink.***

Keywords : Wireless sensor nodes, Network lifetime, Directional geographic routing, Enhanced Pairwise directional Geographic routing (EPWDGR), Pairwise directional Geographic routing (PWDGR), Random waypoint model

I. INTRODUCTION

A Wireless Sensor Network is a pack of a specifically designed device with a transmission infrastructure for tracking and to read the conditions at different places. In this experimental work, an enhanced routing technique is compared with PWDGR by evaluating the performance metrics. Here, routing refers to geographic routing (also called geo routing or position-based routing), which is a directing technique that depends on information received from various geo-locations.

This method is mainly suggested for unwired networks and depends on the basic idea that the header node sends a piece of information to the specific geographical location of the endpoint instead of considering its physical address in the network. The problem that is discussed in both protocols is to develop a way to prolong the network lifetime with minimal delay. The conventional PWDGR uses three nodes for efficient routing, namely, Cooperative node, three-hop node, and the source node. PWDGR has been simulated in a static network but simulation validation for EPWDGR is done using a mobile network with a random waypoint mobility model.

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II. LITERATURE SURVEY

The energy-medium multi-directional path which is based on relative arrangement of paths is analyzed in the research paper titled, PWDG routing depends on Wireless Sensor Network. GPSR is the leading greedy path algorithm, which it relies on the various geo points, and it propagates the information to the adjacent nodes which are nearest to the base station. In addition to GPSR, there is also a path depends on a gradient by choosing the adjacent node with a decreased angle as the next node [1].

In another paper on Multipath Balancing and Expanding for Wireless Multimedia Sensor Networks, Chen et al. suggested DGR understand the utilization - specific count of node-disjoint routing directions to extend the total bandwidth for the quality of service provided in Wireless Multimedia Sensor Nodes (WMSN). DGR is a procedure framed specifically for visual sensor networks and can significantly boost the running behavior in terms of lifetime and delay [2].

The algorithm explained in the paper Energy-oriented multiple-way finding in wireless sensor networks has primarily been forced by the AOMDV for finding node-disjoint or desired link-disjoint routes. By updating the initial-hop to the RREQ header, and bookkeeping of the initial-hops of the immediate arrivals of RREQs, nodes that accepts false RREQs by various adjacent nodes can quickly find whether the paths are node-disjoint. Every node retains an energy value calculation for each of its path entries. This value finds the possibility that a packet is directed through a specific path [3]. the frame structure, the nodes can form close to send the information within the groups. Then, the extraction of information by hop by hop method and multiple-trip route-finding methods are combined to the implied MIMO method to mutually provide power efficiency, reliability and assured point to point Quality of Service. The alternate usage of noncontinuous routes, GRAB uses a route interleaving method to obtain high reliability. The routing based on a geographical structure can be stateless because the second hop is chosen in such a way that, the geolocation of the endpoint, which is saved in the packet header [4].

Directed Diffusion is an inquiry-based multiple-path routing algorithm, in which the aggregating node starts the path detection work. The collector node floods the specific data through the network. These specific messages consist of information for the task which will be operated by the sensors. At the time of specific data flooding, all the agent nodes save the interest data which are arrived from the adjacent nodes for future use. As the interest data is extracted by the nodes, the receiver node produces an angle towards the node from which the information has been received.

At this stage, multiple routes can be located between every source and collector node pair. After this process, when the header node finds the process matched with the available data in the interest table, it sends the information through all the constructed angular points. Depends on the functionality of the data reception over each path, the aggregating node chooses the way, i.e. the path with minimum delay.

Then, the aggregating node supports the chosen paths by transmitting a low-rate reinforcement message towards the header node after which the header node forwards the message through the selected route [5].

A. *System Analysis*

PWDGR strategy is used to solve the energy congestion issue. At first, the header node can transmit the message to the pair-wise node which is nearer to the collecting node for a certain sequence and then, forwards the data to the sink node. These pair-wise nodes are uniformly distributed in 360◦ scopes around collecting node. Therefore, it efficiently replaces the typical energy overhead near the sink and also produces an equilibrium between energy consumption and end-to-end delay.

B. *Demerits of Existing Systems*

The energy-efficient multipath routing protocol is not suitable with low interference for many applications.These issues are addressed in the EPWDGR model that uses a directional antenna with a scope of 180 degrees around the sink. Hence, the usage of this directional antenna patch considerably reduces the power consumed by the nodes for the detection of pair-wise node and the successive cooperative nodes to pass the message, thereby increasing the network lifetime. Here, the random waypoint model is used to monitor the mobility of the nodes. Every node starts by holding for a fixed number of seconds. Then, the node finds an endpoint with a stochastic speed between 0 and a final value within the simulation area. The node proceeds to the endpoint and again holds for a constant period before finding another variable position and speed. This practice is repeated throughout the simulation. Simulation validation has been done with varying performance metrics for estimating network lifetime. In EPWDGR, the energy bottleneck problem at the nodes nearby the sink is solved.

III. ALGORITHM FOR EPWDGR

1.The source node tries to find the first destination 3 hop neighbor and then route to the sink.

2. The route from a source node to the 3-hop neighbor is (180 – α) where the 180 is the angle of the straight line.

3. Since the work focuses on the 2-dimensional structure there are two coordinates namely (x,y).

4. Each of the M different paths has a different angle

5. It exchanges handshake message with control packets and selects the nearby node.

6. The source node checks for the co-operative node based on two criteria-Cumulative number and distance.

The cumulative number here, defines the average energy consumption and distance signifies the distance to the sink.

Note: All the exchanges here are done with a directional antenna with an increased communication range.

A. *Comparison Between PWDGR And EPWDGR*

1) PWDGR is simulated in wireless multimedia sensor network whereas EPWDGR makes use of a wireless sensor network. The primary discrimination in the protocols of these two sensors is that wireless multimedia sensor networks are delay insensitive and uses UDP protocol. To increase the transmission rate EPWDGR uses FEC (Forward error correction codes). This increases the overhead. So, this work is The consumption of energy is too high • Network lifetime is decreased validated using wireless sensor networks.

2) The topology used in PWDGR is a hemispherical transmission range with 180 degrees whereas this proposal focuses on a 360 spherical transmission range.

B. *Merits of Proposed System Units*

The consumption of energy is reduced and the network lifetime is enhanced.

Table- 1: Simulation parameters

Protocol Used	PWDGR	EPWDGR
Channels	1	5
Static Sink	5	
Number of nodes	100	
Simulation duration	500 seconds	
Terrain	1000 × 1000	
Packet size	512 Bytes	
Initial energy	5 joules	
Transmission Range	100 meters	
Data transfer rate		
Transmission power	1Watt	
Receiving power	0.1 Watt	
Mobility pattern	Random waypoint	
Beacon interval	5 seconds	
Antenna model	Directional antenna	

IV. SYSTEM DESIGN

The system design is discussed in this section.

A. *Network Model*

This research work utilizes the earlier system model as DGR in which the visual observatory node VN is at an end corner in a region so that the receiving-end node is at the other end. It is observed that both the receiving-end node and general sensor nodes are stable. The perceived sensor node is a 4-layered algorithm. Sensor application module consists of an information source with a constant bit rate and its response is to generate a type of multi-medium stream with some quality of service demand. In this model, IEEE 802.11 DCF is low-level MAC.

To describe the function of PWDGR, it is compared with DGR through numerous tests studies. Here, discrete event simulation functions are carried out by OPNET. The positioning system fixes the geo-locations of all other nodes. The launch power of the sensor node is adjusted in a controlled manner. i.e., a node can change its launch power for the distance of the receiver node.

The geo-locations of other nodes can be identified by itself within the communication radius and remaining nodes are termed as neighbors or as accessible nodes. The sensor nodes are driven by battery except the collecting node. The collecting node or supe node is assumed to have sufficient energy supply. It is assumed that both the super node and other nodes are stable. The super node is placed on one side of the region while the source is represented on the other side. In the entire network arrangement, only a few visual observatory nodes (VN) cover observing region and the battery capacity equipped for VN node is larger than that of general nodes. The responsibility of other general node is to forward the data to the collector node through many hops. The super node has infinite energy. The parameter values used in the simulations are presented in the table below.

B. *Consumption of energy*

The framework of DGR is employed in this work. Every node point consists of the required energy level, except the header node and super node. To calculate the consumption of energy the following equations are involved.

$$E = m_{tx} \cdot T_{tx} + m_{\text{recv}} \cdot T_{\text{recv}} + m_{\text{overhearing}} \cdot T_{\text{overhearing}} + m_{\text{idle}} \cdot T_{\text{idle}}.$$

$$E = m_{tx} \cdot T_{tx} + m_{\text{recv}} \cdot T_{\text{recv}} + m_{\text{overhearing}} \cdot T_{\text{overhearing}} + m_{\text{idle}} \cdot T_{\text{idle}}.$$

V. SIMULATED RESULTS

A. *Transmission Range*

Simulations have been performed to analyse the various parameters against the transmission range

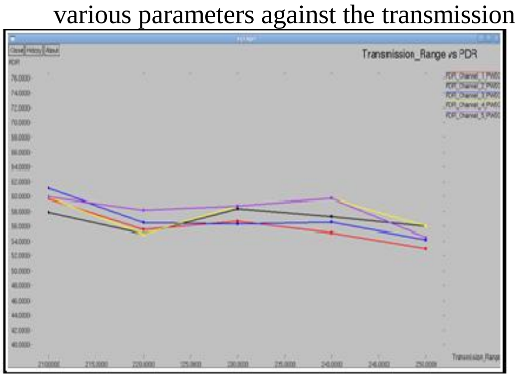

Fig. 1. **Transmission range Vs PDR.**

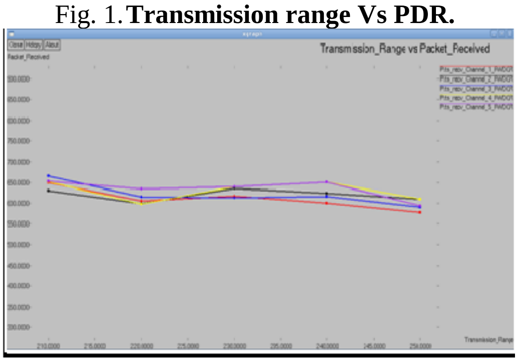

Fig. 2. **Transmission Range vs Packet Received**

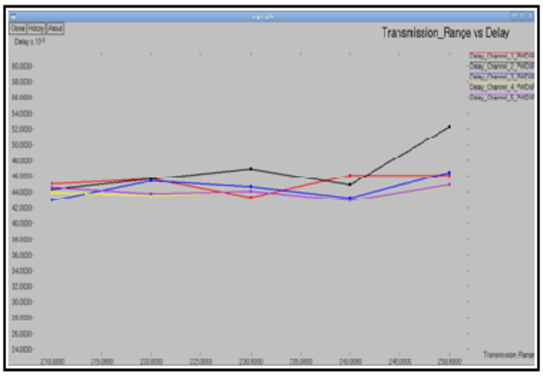

Fig 3. Transmission Range vs Delay

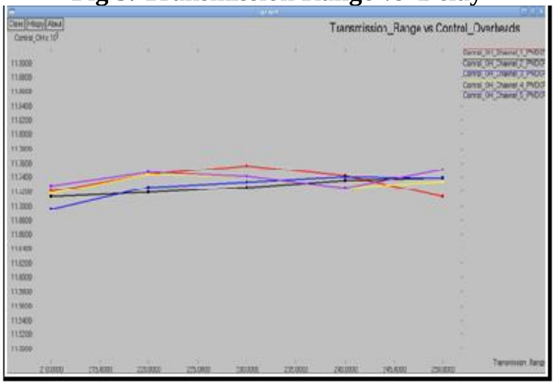

Fig. 4.Transmission Range vs Control overheads

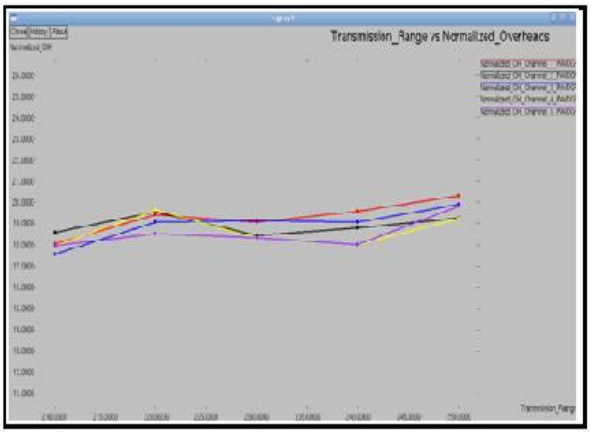

Fig. 5. Transmission Range vs Normalized Overhead

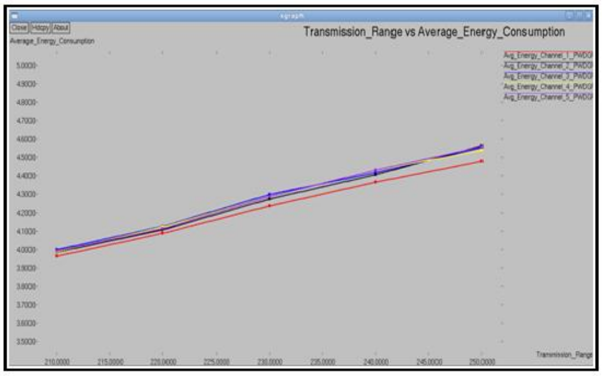

Fig 6:Transmission Range vs Avg. Energy Consumed

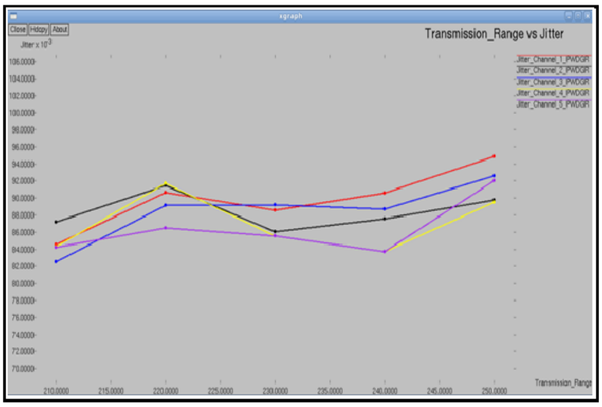

Fig. 7.Transmission Range vs Jitter

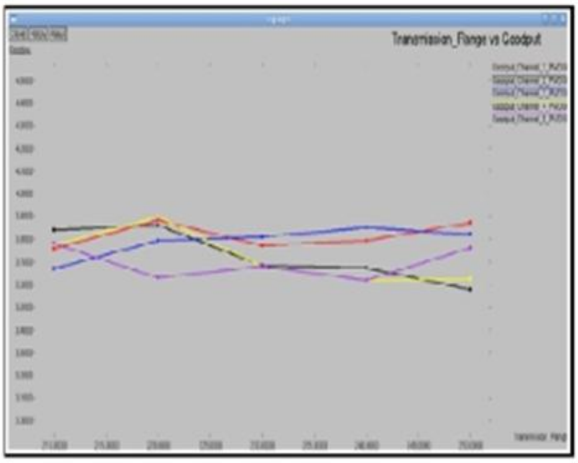

Fig 8 :Transmission Range vs Goodput

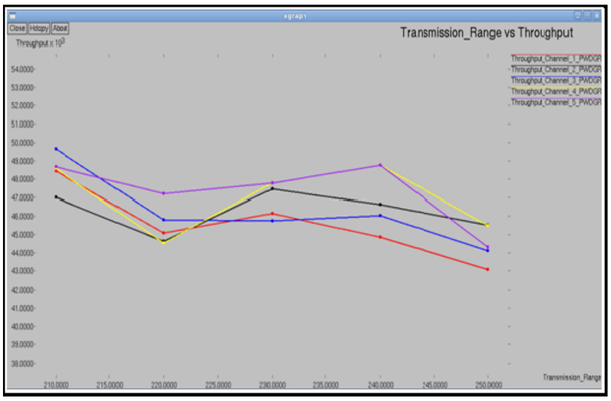

Fig. 9 .Transmission Range vs Throughput

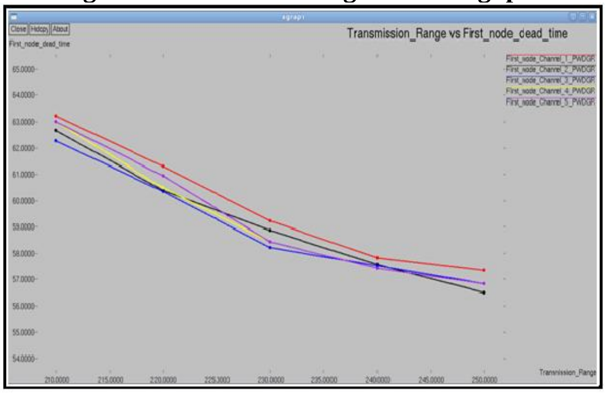

Fig. 10. Transmission Range vs First node dead time

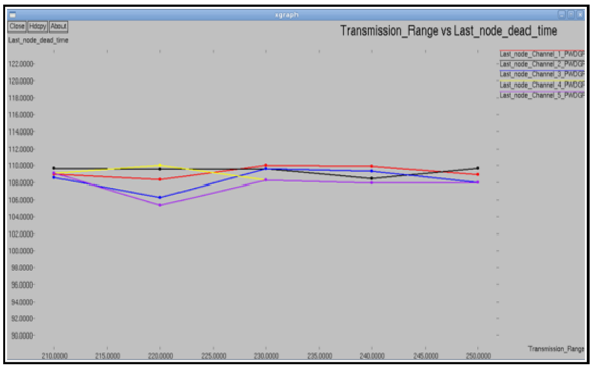

Fig. 11. Transmission Range vs Last node dead time

A. *Transmission Power*

Simulations have been performed to analyse the various parameters against the transmission power

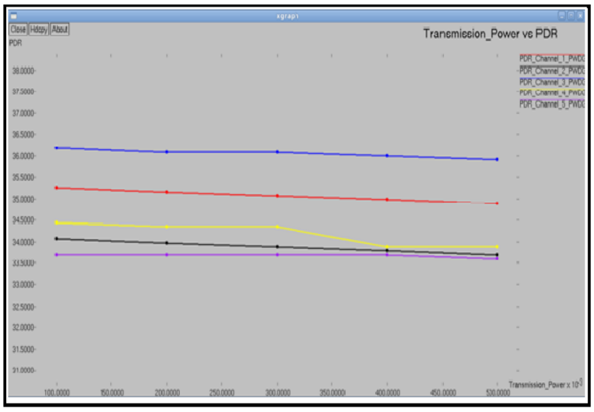

Fig. 12. Transmission power vs PDR

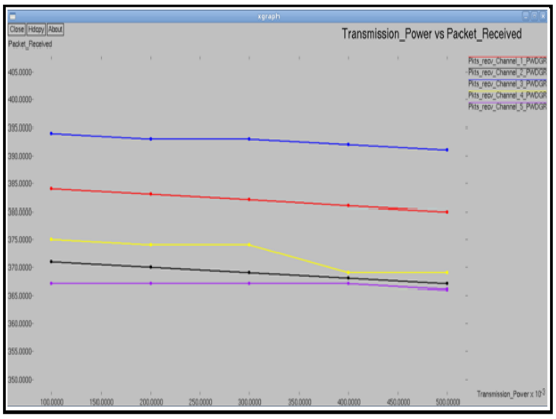

Fig. 13.Transmission Power vs Packet Received

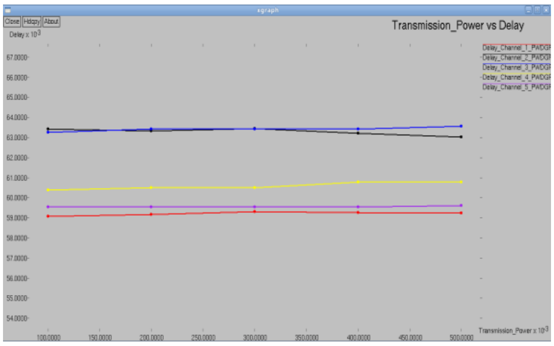

Fig. 14 . Transmission Power Vs Delay

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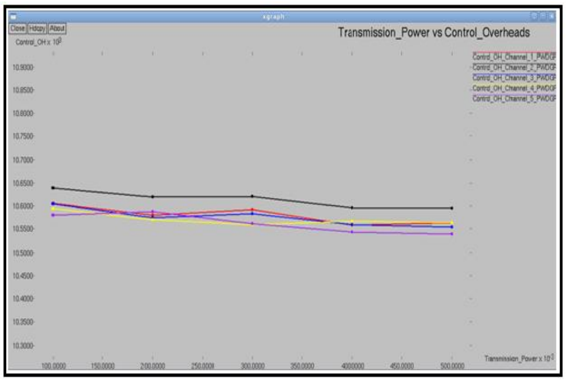

Fig. 15. Transmission Power vs Control overheads

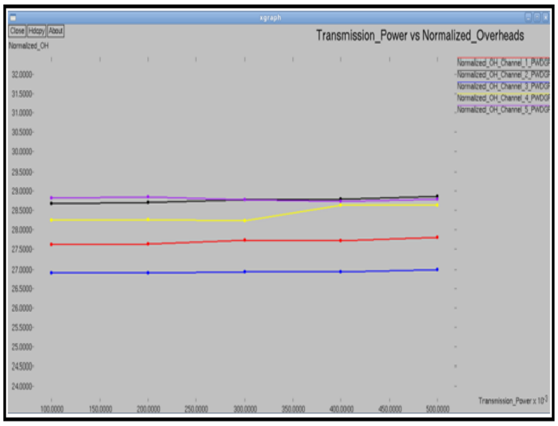

Fig. 16. Transmission Power vs Normalized overhead

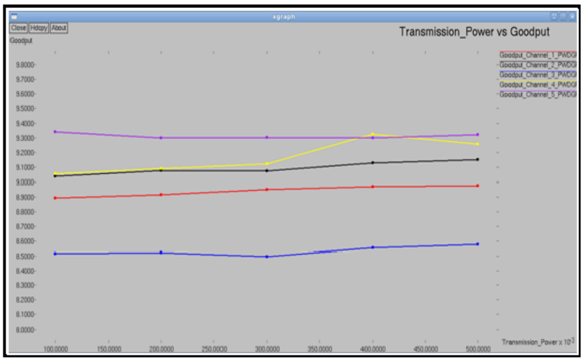

Fig 17: Transmission Power vs Goodput

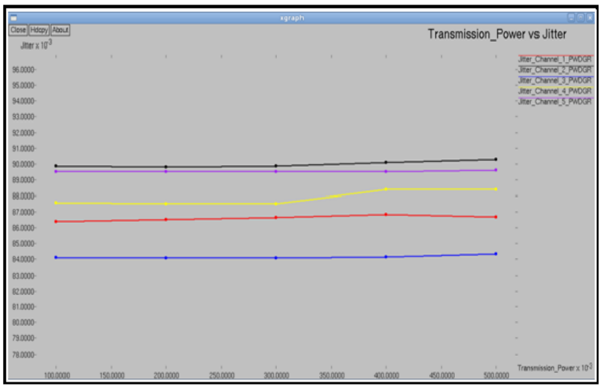

Fig 18: Transmission Power vs Jitter

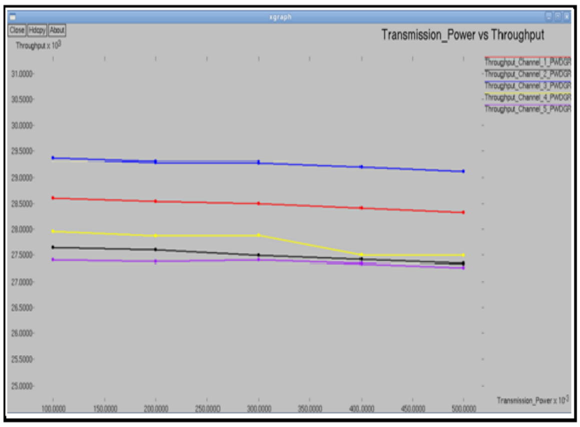

Fig. 19. Transmission Power vs Throughput

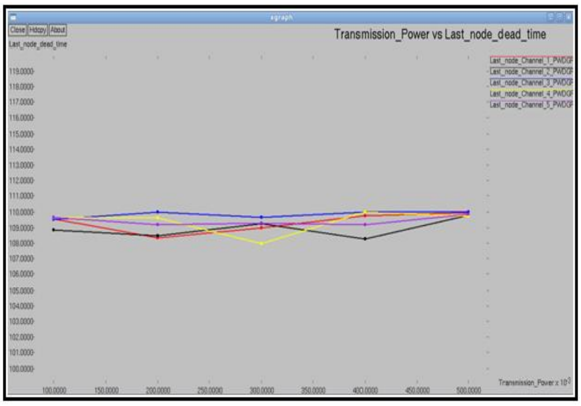

Fig. 20. Transmission Power vs Throughpu

VI. CONCLUSION

This research uses the EPWDG routing with directional antenna. And this work was compared with PWDGR routing. Simulations were done and both the protocols were compared. The proposed routing method produced better results. The network lifetime was improved and energy consumption was reduced.

VII. FUTURE WORK

In future the performance of this protocol can be tested with swarm optimization.

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