A SHORTESH PATH ALGORITHM FOR WIRELESS SENSOR NETWORKS

D. Rajendra Prasad[1], Machhindranath M Dhane[2], R. Pitchai[3], A Thiruppathi[4], E Rajesh kumar[5], Charanjeet Singh[6], S.Kannadhasan[7]

[1]Department of Electronics and Communication Engineering, St. Ann's College of Engineering and Technology, Chirala, Andhra Pradesh 523187, India. **rp.devathoti@gmail.com**

[2]Department of Mathematics, Govt. First Grade College, Bengaluru, Karnataka 560064, India. **drdhani.99dce@gmail.com**

[3]Department of Computer Science and Engineering, B V Raju Institute of Technology, Narsapur, Telangana 502313, India. **pitchrks1984@gmail.com**

[4]Department of Mathematics, Panimalar Engineering College, Chennai, Tamil Nadu 600123, India. **thiruppathiap@gmail.com**

[5]Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Andhra Pradesh 522302, India. **rajthalopo@gmail.com**

[6]Department of Electronics and Communication Engineering, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Haryana 131039, India. **charanjeet.research@gmail.com**

[7]Department of Electronics and Communication Engineering, Study World College of Engineering, Coimbatore, Tamilnadu, India, kannadhasan.ece@gmail.com

Abstract:-

The association between network traffic and power levels in wireless sensor nodes brought about by dynamic duty cycling is shown in this research using the idea of information leakage. We demonstrate how the power levels of sensor nodes may be remotely estimated using this correlation. Our basic idea is that the broadcast rate of a wireless sensor node may be used to deduce the node's available power level and current duty cycle mode. Dynamic duty cycling seeks to optimise power consumption in wireless sensor nodes by reducing radio use, which has a direct impact on the node's network traffic send rate. This is the driving force behind our solution, Power Efficient Path Selection (PEPS). Since the energy level of nearby nodes and their statuses are inferred rather than communicated via control packets, PEPS is an improvement to the shortest path algorithm that enables us to 1) decrease the volume of periodic messages and 2) increase the lifespan of a wireless sensor network (WSN) through the selection of energy-aware communication paths. By simulating PEPS and comparing it to the standard Shortest Path method, we can show its effectiveness and viability. The findings show that using PEPS results in considerable energy savings and increases the lifespan of the wireless sensor network.

Keywords:- WSN, Routing, Nodes, Shortest path and PEPS

1. INTRODUCTION

As the battery power level drops below functioning levels, nodes continue to reduce the amount of network traffic they transmit as their power drains. Power-efficient path selection (PEPS) may be accomplished by identifying the nodes with the greatest network traffic send rate (and the shortest path) and employing them as multi-hop routes to the gateway. Here, advantages include 1) longer path-level lives and 2) no longer requiring certain periodic messages (i.e., health and status, energy level). By considering a node's available power level prior to utilising it as a hop in a prospective route, PEPS improves shortest path routing. This is comparable to energy-aware routing, however PEPS needs nodes to infer the power-level of their neighbours by leveraging current network traffic delivered during discovery rather than delivering messages to collect energy or power level. We think that allowing each node to dynamically duty cycle based on its internal power level and send all messages via the shortest and most energy efficient path is one way to achieve an energy (or power) efficient WSN. By doing this, each node is able to use radio more efficiently, communicating only when it is absolutely necessary and doing so in the most energy-efficient way possible. This implies that a control framework is required to propagate sensor node energy levels continuously throughout the WSN and to enable communication between nodes with different duty cycles. The impact that dynamic duty cycling has on a WSN serves as our driving force [1]-[5]. By default, dynamic duty cycling lowers power consumption by reducing packet send rate as a node's power level decreases, which leads to an unintentional correlation between network traffic and hardware state. This exploitable behaviour makes PEPS possible. We suggest a solution that, in our opinion, increases the viability of the aforementioned energy-efficient WSN by addressing the issue of control message overhead brought on by the requirement for continuous synchronicity. Instead of relying on control messages to spread this information, our system infers the power level in each node using the network traffic that dynamically duty cycled sensor nodes transmit [6]-[10].

Initially during network discovery and continually throughout routine continuing data transfers, nodes may estimate the power level of their neighbours. Instead of the typical out-of-band message-based communication employed by most systems, our solution essentially suggests message-less in-band control communication. As a result, we may do away with the need for a control system to spread power level information [11]-[16].One of the primary problems with sensor networks is reliability. A node has the ability to pick up a message from its surroundings and transmit it to a sink node. Between them, there are many intermediary nodes. The message will be garbled or lost if an intermediary node fails or if there is a compromised node in the network, which prevents the sink node from receiving the data [17]-[21]. But another, shorter, and more dependable channel should be used to transmit the message. We provide graph theory methods in this research to deal with node failure or compromised nodes and choose the shortest, most reliable route from sender node to sink node is shown in Figure 1.

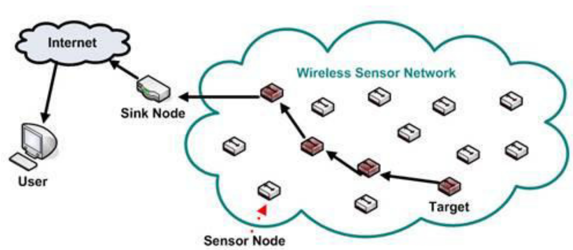

Figure.1. Wireless Sensor Networks

The sensor nodes in a WSN are able to sense their surroundings, process the data they collect, and transmit the information to the destination node. The sensor node gathers information about its surroundings and sends it to the base station. Base station is powered indefinitely and has a variety of features. Continuous Monitoring (CM) and Event-Detection Driven (EDD) Monitoring are the two main types of monitoring used in WSN. While in EDD the monitoring is done in accordance with applications like air pollution monitoring, landslide detection, natural disaster, forest fire detection, and temperature power, the nodes in CM continuously sense the environment. The primary trend in WSN design is the utilisation of sensor node power. The main purpose of the routing process is to reduce network energy consumption. Therefore, the researchers' primary focus is on developing an energy-efficient and trustworthy algorithm [4]. Direct Transmission (DT) and Multi-Hop Transmission are the two categories needed for transmission (MH). Direct transmission involves the source node sending data directly to the base station, whereas multi-hop transmission involves the source node sending data to the base station via multiple nodes, with additional nodes acting as relays. Although MH has a larger total than DT, it is more dependable and efficient in terms of energy. The nodes closest to the BS will also be overloaded with various information messages due to system operation. This results in the problem area issue, which has the effect of hastening the energy loss.

Several measurements, including energy cost, hop count, and residual energy, can be used to evaluate MH ways. MH transmissions are divided into two categories based on the number of hops involved: short-hop routing, which directs information over a large number of short hops, and long-hop directing, which directs information through fewer long hops. A few factors that support the second strategy were listed including overall energy usage, overhead costs, unchanging quality, sleep modes, and latency. In terms of overall energy usage, it is generally acknowledged that a decrease in transmit (or transmitted) energy yields corresponds to a decrease in overall energy consumption. In fact, for any practical power amplifier, this isn't true even without taking received energy into account. In low-power transceivers, in particular, the adjacent oscillators and inclination hardware will overpower the energy use, preventing short-hop routing from producing any appreciable energy gain if a more remote transfer node can be reached with sufficient consistent quality. In this way, it is proven that long hops directing is more engaging, secure, and focused than short ones.

2. PROPOSED WORK IN WSN

Wireless sensor networks (WSNs) use a large number of wirelessly interconnected sensor nodes dispersed over an area to take control of or maintain many physical or environmental parameters. WSNSs are utilised for a variety of purposes, including detecting landslides and forest fires as well as monitoring air quality, health care, and other areas. WSNs are becoming more and more common because they are adaptable, affordable, dependable, simple to deploy, and accurate. WSNs were primarily created for the purpose of sensing, gathering, and sharing data regarding environmental conditions. Each sensor node detects the difference, gathers pertinent data, and then communicates it over many hops to the base station or gateway. Data is initially converted into radio waves by WSNs, which are then amplified before being received by receiving nodes. Routing algorithms created for mobile ad hoc networks are the foundation of many WSN applications. WSNs often resemble mobile ad hoc networks in many ways (MANETs). Both devices employ hop-to-hop routing, are wirelessly linked to a dispersed network, and run on batteries. MANETs are primarily utilised for internet-based data transfers between devices and for communication. However, each are unique in a number of ways. Compared to MANETs, WSN nodes are much larger (on the range of several hundreds) and have far less memory power. While data collection is more vital for WSNs than communication, communication is the sole goal of MANETs. Because there are so many variations, WSN routing mechanisms should change. The WSN network is shown in figure 2.

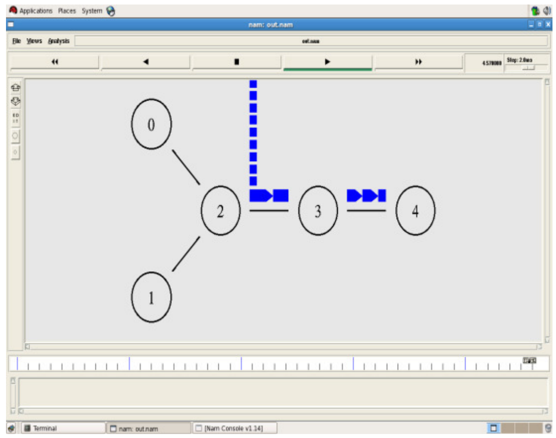

Figure.2. Network Model in WSN

Wireless Sensor Networks (WSNs) are networks of small, resource-constrained, self-organizing sensor nodes that are capable of monitoring both environmental and physical variables. Low power wireless data routing techniques are used by these small sensor nodes to connect with one another. Since the precise placement of sensor nodes cannot be predicted, they may be randomly distributed without any human involvement within inaccessible places. WSNs are hence capable of self-organization and are fault tolerant. The researchers are driven to provide appropriate procedures for effective usage of these severely resource-constrained sensor nodes in sensor area networks since the sensor nodes have limited power, memory, and computing resources. As seen in Fig. 4, a wireless sensor network serves as a link between the physical world and the digital one. A subtype of ad hoc network, wireless sensor networks allow a collection of sensors that can take measurements to communicate with one another through data packets. The shortest path is shown in Figure 3.

Wireless adhoc sensors have become more and more popular over the last several decades and are utilised in a variety of applications. A wireless adhoc sensor network consists of an increasing number of sensors dispersed throughout a geographic region. Each sensor has some degree of wireless communication capability as well as signal processing and information networking skills. Military sensor networks (MSN) and wireless observation sensor networks are two types of wireless ad hoc sensor networks (WSSN). Adhoc networks are completely necessary for certain applications, such as object tracking, vehicle monitoring, and forest fire detection, since their usage, design, and exploitation are fixed and need a high level of reliability. Therefore, there are two approaches to categorise wireless ad hoc sensor networks: (a) if the nodes are individually accessible; and (b) whether the network's data is aggregated. A parking lot network's sensor nodes should be individually addressable so that the complete item may be tracked. In certain applications, broadcasting a message to every node is necessary. As a result, each node in the network is responsible, and the order in which they are placed also matters. According to the idea previously mentioned, it is crucial for adhoc networks to make sure that the necessary data is dispersed to the right end users through the direct and quickest route. The research suggested in this article demonstrates that if the routing route is shortest, adhoc networks may be readily maintained and modified for particular uses. If the connecting route is shortest, sensors can better plan and execute their duty. For self-powered sensor nodes in adhoc networks, the shorter route length also improves localisation and power consumption.

Without the aid of any pre-existing fixed communications, wireless mobile nodes form Wireless Sensor Networks (WSNs). Such excellent WSNs provide a wide range of application possibilities. Sensors are battery-powered, tiny devices with hardware limitations (limited memory storage and processing resources). As a result, energy-efficient algorithms are necessary for Sensor Networks to function correctly in accordance with their hardware characteristics and application needs. A low power sensor node can only connect with a small group of nodes, known as its neighbourhood, because to its restricted transmission power. Data is routed from source to destination via multi-hop communications. The source analyses the location of the destination with the coordinates of its neighbours and propagates the information to the neighbour that is closest to the ultimate destination whenever a node chooses the transmission route based on the position of its neighbours in this method. The procedure is carried out once again till the packet arrives at its intended location. The most often used metrics in this field are the projected line between the relaying node and the destination and the Euclidean distance. These metrics are connected to the notion of proximity. The retransmissions in this plan do not account for unreliable neighbours. SPEED (Stateless Protocol for End-to-End Delay), a different geographic information protocol, is proposed in order to approximatively determine the transmission packet delay. The primary drawback of greedy algorithms is the possibility of transmission failure when the present message bearer has no neighbours closer to the target than itself. Even though there is a route between the two extremes, this might still happen, for example when an obstruction appears.

The simulation findings show that creating a power-efficient route selection system for the shortest path is feasible for dynamic duty cycled WSNs. The main characteristic of such a WSN is the exploitable correlation between the power consumption of the sensor nodes and their network traffic. Future research should investigate the impact of nodes dynamically cycling their duty on the WSN's overall objective. Additionally, we want to use actual wireless sensor nodes to implement PEPS. The results indicate a significant role for the values shown in this graph. In an ad hoc sensor network, the number of nodes and their proximity may be observed for the shortest route utilised to transmit data between nodes. For the suggested strategy to provide results that are applicable to these kinds of deployments, a specific rationale and testing are required before application. The graph's xaxis displays the number of nodes, the yaxis displays time in seconds, and the blue line depicts the information flow

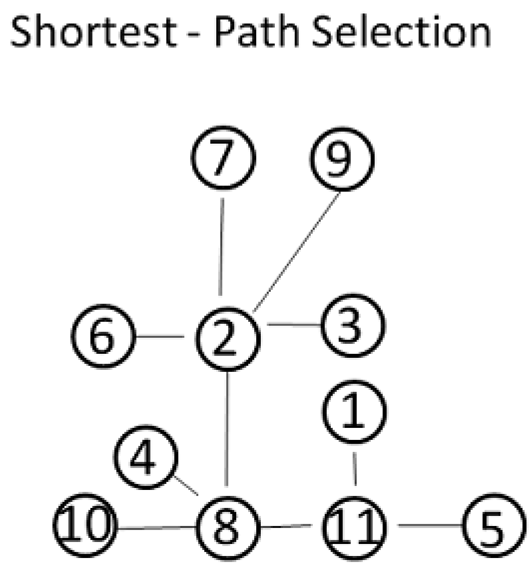

Figure.3. Shortest Path

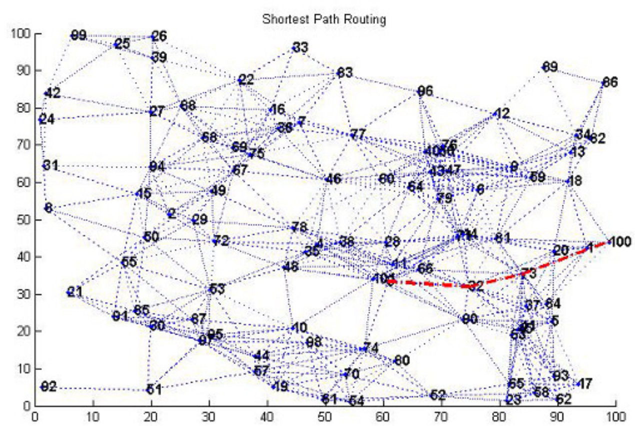

Figure.4. Shortest Path Routing

WSNs use a variety of routing algorithms, each of which was created for a particular use. Every protocol is designed to only function in the ideal situation or setting. Here, a few of them are described. The routing methods used in WSNs might be flat, hierarchical, or location-based. Low Energy Adaptive Cluster Hierarchy (LEACH), Two Level Hierarchical LEACH (TL-LEACH), Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN), Adaptive TEEN (APTEEN), Energy Efficient Cluster Scheme (EECS), Hybrid Energy-Efficient Distributed Clustering (HEED), Power Efficient Gathering in Sensor Information System (PEGASIS), and CCS are examples of hierarchical routing protocols. e3D, a brand-new algorithm, is also suggested. Maximum Information Routing (MIR) and Conditional MIR are two further protocols that are suggested to increase information flow (CMIR). On the basis of hop count, they are superior than LEACH, PEGASIS, and Geographical and Energy Aware Routing (GEAR). A packet is routed to the target area using the location-based routing protocol GEAR using an energy-conscious and geographically informed neighbour selection heuristic. A 20% longer network life is presented for a Wireless sensor network Longevity (CRAWL) that uses a best hop algorithm for scalability and flexibility. For high density WSNs, an intra-cluster routing technique is used. The Energy-Efficient Minimum Routing method (EEMR), which modifies the wireless communication module's activity, increases the energy efficiency of sensor networks. It performs well in deployments with low traffic and high density. ARIC, which employs cooperative image compression to share the computational cost among the sensor nodes, is an adaptive transmission range assignment technique for in-routing image compression.

This technique has shown the network's longer lifespan. Energy Efficient Geographic Routing Algorithms interferences and computing expenses are dependent on geographic routing. A new protocol called Adaptive Coverage-Preserving Routing Protocol (ACPRP) is suggested in order to attain 100% coverage is shown in figure 5. In order to determine the best weight parameters to feed into the cluster head mechanism and hierarchical routing selection mechanism, ACPRP employs the Particle Swarm Optimization (PSO) method. In sensor networks, improving the energy economy of sensor nodes and the accuracy of data transmission nodes are both critical challenges. In order to address these problems, a new method known as A Trust Degree of Node based on Aware Routing Protocol was presented (TDAR). With its energy-aware methodology, TDAR extends network lifespan and boosts network data transmission dependability. Low-power radio characteristics are not taken into account by multi-hop routing algorithms, hence TABS (Try-Ancestors-Before-Spreading), a unique link loss tolerant data routing protocol, was developed. With TABS, wireless network broadcast advantages are combined with conventional retransmission-based routing. It is designed for static and dynamic topologies, thus it does not need backlisting or periodic link quality evaluation. The Dijkstra's method is used in the new routing algorithm known as Shortest Path Routing Protocol (SPRP), which was created for wireless networks. For the purpose of extending the lifespan of sensor networks and achieving energy efficiency, a beaconless multi hop routing protocol (BMR) has been created. BMR is lightweight, uses little energy, and bases routing choices on the remaining node energy. A system called Correlation based Collaborative Medium Access Control (CC-MAC) is also suggested for energy savings. In contrast to IEEE 802.11, CC-MAC employed a medium access control technique based on spatial correlation. It is also suggested to use a gradient model to extend the lifespan of the sensor network in a gradient-based load balancing routing algorithm (GLOBAL). Each sensor node in GLOBAL calculates its gradient using a weighted average of the traffic load and cumulative route load of the node that is overloaded the greatest along the path. GLOBAL forwards data via the least-loaded route.

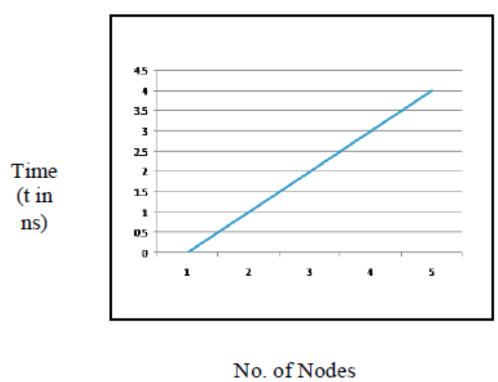

Figure.5. Analysis of Nodes

The method for information transmission between nodes that travel by various pathways is possible. Over Nam, the route prophesy is carried out (Network Animator). Nam offers a crystal-clear prediction of how packets will flow between nodes distributed from a network. The first path taken is as indicated in fig. 5, going from node 0 to node 4, with a duration t of around 0.5 ns. The path begins from node 1 to node 4 as illustrated in fig. 5 during the second mode of packet forwarding, with the prior amount of delay time. It should be noted that, as illustrated in Fig. 6, information packet collisions between Nodes 2 and 3 occur at the same time. Information flow is sporadic and the route is interrupted. The important thing to remember is when the road between nodes 1 and 2 and the route between nodes 0 and 2 are broken. Figure 5 illustrates how the information flow begins from node 2 to node 4 adaptively in the quickest way to encourage the information flow continuously. The graphs in Figure 8 that are highlighted in red depict the simulated outcomes that were recorded in a nam trace file.

3. CONCLUSION

Various routing protocols created for wireless sensor networks have been discussed in this paper. The idea of creating a new protocol for sensor networks with the aid of other routing protocols which were essentially developed for ad-hoc networks is also put forth as a solution to the most prevalent problem for WSNs. The angle-based mechanism will be applied in other MANET routing protocols in our upcoming work.. Nodes aim to power the variable range transmit power from the standpoint of the transmission run. A comparable transmission power level might also be used for communication between the nodes without any power control. It is undeniable that excessively high-power transmission quickly depletes the energy of nodes and introduces unnecessary impedance. The lowest transmit power that could be achieved while maintaining system availability was investigated. A power aware routing system was looked at, which was focused on the remaining power of nodes along the route. Not only does it reduce the energy consumption per packet, but it also increases the nodes' average remaining energy. This lengthens the network's lifespan and minimizes the energy fluctuation of the nodes.

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