LINK QUALITY BASED ROUTING APPROACHES IN WIRELESS SENSOR NETWORK

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ABSTRACT - A wireless sensor network is made up of several sensor nodes that are dispersed at random throughout any physical location and are used for certain purposes. It monitors the physical amount, processes it according to the requirements, and then communicates the information.sent the data that was seen to the base station or sink through the intermediate nodes. The sensing, processing, and communication elements that make up an individual sensor node are all separate entities. Each individual unit receives its electricity from a power unit that has certain energy requirements. When the sensor nodes have been deployed, the nodes are given the instructions necessary to self-organize. Unfortunately, it is a time-consuming process to either recharge or replace the battery in each individual sensor node. In order to achieve efficiency and lengthen the lifespan of a wireless sensor network, one of the challenges that must be overcome is the effective management and use of the resources that are available. The sensing, processing, and communication phases each put a strain on the available resources. It is very necessary to detect the event in order to fulfil the criteria of an application. Processing is necessary and cannot be avoided; it is also dependent on the requirements specified by users. As opposed to the process of communication, sensing and processing use the least amount of electricity possible. A node's energy level, as well as the energy level of its neighbours, may be impacted by redundant communication (to whom it communicates). The primary goal of preserving the energy level is to cut down on the amount of power that is used during communication, which will ultimately result in an extension of the lifespan of the whole network. If an incorrect judgement is made when routing a packet via a route, it might result in duplication. The choices that are taken and the condition of the connection that the data needs to travel through both influence the routing. In order to provide an estimate of the connection's quality for dynamic networks, an approach for link quality evaluation that is based on fuzzy logic has been presented. If a node is still active, there is synchronisation, and data is received at the appropriate moment, then the link between the nodes is stable.

Keywords: *Routing, WSN, Link, Quality, Energy Aware*

I. INTRODUCTION

The sensor nodes in wireless sensor network have limitations such as limited battery power, unreliable communication links, and frequent topology changes. These limitations lead to a challenge in the design of routing protocols. The major energy consumption in WSN node is during the communication process. Pottie& Kaiser (2000) revealed the possibility of execution of over 3000 instructions for the same cost as the transmission of one bit over 100 m. Hence the battery energy of the node can be utilized effectively by reducing the number of transmissions. This can be achieved by

(i) Avoiding redundant transmission

(ii) Choosing shortest path data transmission

(iii) During idle state make node to sleep

(iv) Minimizing the number of retransmissions.

Many energy based routing protocols choose their next hop on the basis of either the node with highest residual energy or the node which sends the packet through the path with minimum energy from the sender node to the sink (Heinzelman et al 2000, Kim & Kim 2006 and Shah &Rabaey 2002).

II. ROUTING

Wireless sensor networks are extremely versatile and can be deployed to support a wide variety of applications in many situations, whether they are composed of stationary or mobile sensor nodes. The way these sensors are deployed depends on the nature of the applications. In environmental monitoring and surveillance applications, for example, sensor nodes are deployed in an adhoc fashion so as to cover the field to be monitored. In health care applications, smart wearable wireless devices can be attached to the human body to monitor vital signs of the patients. Once deployed, sensor nodes organize themselves into an autonomous wireless adhoc network, which requires very little or no maintenance. Sensor nodes then collaborate to carry out the tasks of the applications for which they are deployed (kazemsohraby et al 2010).

Despite the disparity in the objectives of sensor applications, the main task is of WSN is to sense and collect target data, process such data and transmit the information back to the sink. Efficient achievement of this task requires the development of energy - efficient routing protocol to set up paths between the source node and the sink. The path election must be such that the life time of the network is maximized. The characteristics of the environment within which sensor nodes typically operate, coupled with sever resource and energy limitation, make the routing problem very challenging.

Routing is the process of forwarding the data packets over the network from source to destination by selecting the best path. Many routing protocols are proposed in the area of wireless sensor networks by researchers to overcome the issues faced during transmission phase.

In the following sections, the primary challenges, design goals, strategies and various techniques have been proposed for routing in wireless sensor networks are discussed (KazemSohraby et al 2010).

III. ISSUES AND CHALLENGES IN ROUTING

Although WSNs share many commonalities with wired and adhoc networks, they also exhibit a number of unique features which distinguish them from existing networks. These unique characteristics bring sharp focus to new routing design requirements that go beyond those typically encountered in wired and wireless adhoc networks. Meeting these design requirements presents a distinctive and unique set of challenges. These challenges can be attributed to multiple factors, including severe energy constraints, limited computing and communication capabilities, the dynamically changing environments within which sensors are deployed, and unique data traffic models and application-level quality of service requirements (KazemSohraby et al 2010).

Designing efficient routing protocols for wireless sensor networks is a challenging task due to several constraints. WSNs are subjected to the limitations of the network resources like limited available energy level and bandwidth (Jamal Al-Karaki& Ahmed Kamal 2004) (Kemal Akkaya& Mohamed Younis 2005). The design challenges involve the following main aspects.

IV. SURVEY ON LINK QUALITY BASED ROUTING

Modeling and optimization of energy-efficient routing in wireless sensor networks was proposed by Jeong-Hun Lee and Ilkyeong Moon (2014). Under the context of a wireless sensor network, the focus of this research is on the mathematical models that underpin the design of a routing protocol (network layout) given certain resource constraints. Both the physical distance that separates the connected sensors as well as the amount of energy that each sensor consumes are regarded to be sorts of restrictions. The models that have been suggested have as their goal the identification of energy-efficient pathways that reduce the amount of energy that is used by the network between the source sensor and the base station.

Vinay Kumar et al. (2011) examine effective clustering techniques for use in wireless sensor networks with the goal of increasing the network's lifetime. Clusters give rise to hierarchical WSNs, which allow for more effective usage of the limited resources available at sensor nodes and, as a result, a longer lifespan for the network.

The General Self-Organized Tree-Based Energy-Balance routing protocol (GSTEB) was proposed by Zhao Han et al. in 2014. This protocol constructs a routing tree by employing a procedure in which, for each iteration, the BS assigns a root node and broadcasts this selection to all sensor nodes. In addition, the GSTEB protocol builds an energy-balanced network. As a consequence of this, GSTEB is a dynamic protocol since every node chooses its parent based only on the information pertaining to itself and its neighbours.

Jianwei Niu et al. (2014) propose the Reliable Reactive Routing Enhancement, or R3E, as a means of boosting the robustness of WSNs and IWSNs in terms of their ability to connect dynamic processes. R3E was developed to improve upon already existing reactive routing protocols in order to ensure dependable and energy-efficient delivery of packets despite the unreliability of wireless networks. This was accomplished via the use of local path diversity. R3E is able to achieve a remarkable improvement in the packet delivery ratio while simultaneously preserving both a high energy efficiency and a low delivery delay.

Roseline and Sumathi (2011) explore a variety of energy-efficient routing methods and algorithms that may be used for wireless sensor networks. They talk about the features of sensor nodes and the purposes of constructing a network. With the purpose of extending the lifespan of the whole network, numerous proactive and reactive protocols, as well as their varied characteristics, are analysed.

Xiao Chen et al. (2013) provide a framework protocol that they term reverse path (RP) to deal with asymmetric networks. After that, they describe two efficient routing algorithms named LayHet and EgyHet that are based on RP for the purpose of meeting performance criteria. LayHet is a performance guaranteed layer-based routing protocol that embeds information about the shortest route and saves energy by decreasing the amount of broadcasts and the likelihood of forwarding. It does this by embedding the shortest path information. EgyHet is an improved version of it that takes into account the energy that is still present in nodes.

A strategy for energy-balanced routing that is based on the forward-aware factor was proposed by Degan Zhang et al. (2014). (FAF-EBRM). In this step, a next-hop node is chosen by taking into account the connection weight and the forward energy density. In addition to that, the design furthermore includes a mechanism for the spontaneous regeneration of the local topology.

A technique for effectively clustering wireless sensor networks that makes use of compressive sensing was proposed by RuitaoXie and XiaohuaJia (2014). It lowers the amount of the amount of transmissions and maintains a consistent distribution of the network's traffic load throughout its throughput. In the context of sensor networks, clustering is a strategy that makes use of hybrid compressive sensing. Clusters are created out of the sensor nodes that are present. Nodes inside a cluster send data to cluster heads (CH) without using compressive sensing as a data transfer method (CS). CHs employ CS to convey data to sink.

ProHet is a distributed probabilistic routing protocol that was proposed by Xiao Chen et al. (2013). It makes use of asymmetric networks in order to achieve a guaranteed delivery rate while maintaining a minimal cost. The ProHet protocol generates a bidirectional routing for each connection by locating a route in the opposite direction. The selection of forwarding nodes thereafter occurs on the basis of previous data.

Density-based Energy-efficient Game-theoretic Routing Algorithm (DEGRA) is a routing algorithm that was proposed by Zhanyang Xu and colleagues in 2012. DEGRA makes use of game theory, and its utility function is framed based on the density of nodes, residual energy, and average energy consumption of its neighbouring nodes. Iteratively, a cluster head is chosen to represent the cluster.

The authors of MarwaSharawi et al. (2013) address the use of soft computing paradigms in wireless sensor networks' routing protocols. It is necessary to overcome the limited availability of energy resources in order to maintain the processing of the sensor nodes for as long as possible in order to lengthen the lifespan of the network. This study presents and analyses a selection of the Soft Computing community's suggested routing models for wireless sensor networks (WSNs), with the goal of maximising their longevity.

AbderrahimMaizate and Najib El kamoun (2012) offer an improved passive clustering for wireless sensor networks that is based on distance and the residual energy. This method uniformly distributes the energy dissipation across the sensor nodes in order to increase the network lifespan. In order to do this, the residual energy of the nodes and the distance between them are taken into consideration during the selection of nodes to serve as cluster heads and the election of cluster heads to serve as backups.

The observation of the suggestion for a variety of decision making strategies for the purpose of effective power management in sensor networks has been made. In the event of mobility, it is necessary for every node in the network to be capable of self-configuration. It should be emphasised that this form of topology changes in response to the movement of nodes; however, due to the fact that these shifts occur instantaneously, it cannot be defined. For this reason, it is essential to consider the decision-making process to be effective in order to bring the overall network's level of instability down.

Within the realm of wireless sensor networks, several routing algorithms have been suggested, the majority of which focus on minimising energy consumption while also ensuring security and scalability. There is a class of routing protocols known as LEACH, HEED, and PEGASIS. These protocols were developed specifically for wireless sensor networks. In these sorts of protocols, the power to make decisions is delegated to the cluster head in the case of architectures based on clusters, and it is delegated to the root node in the case of architectures based on trees. Several protocols for routing networks are developed on the basis of decision-making processes such as game theory, fuzzy logic, and similar approaches. Nevertheless, only a small number of routing protocols that are based entirely on metaheuristics have been suggested.

Syed Ali Fathima and Sindhanaiselvan (2013) present the ant colony optimization based routing in wireless sensor networks. In this kind of routing, the routing is done based on a bio-inspired method, which prevents network congestion and the rapid consumption of energy in the individual node. This is based on the way that actual ants look for food, which can be broken down into two categories: forward ants (also known as FANTs) and backward ants (also known as BANTs) (Backward ANTs). The primary function of these agents is to make it possible for BANTs to make use of the valuable information that FANTs have obtained on the travel time between the source and the destination. There have been a few steps taken to demonstrate how these agents communicate the information to others, and the FANTs have a variety of fields that are used by them when they are doing the search. The following three steps make up this algorithm: the route discovery phase, the route maintenance phase, and the route failure management phase.

In their 2009 paper, Selcuk Okdem and Dervis Karaboga put out the idea of employing an Ant Colony Optimization (ACO) Router Chip for routing in wireless sensor networks. The ACO technique is used on wireless sensor networks by the authors of this research. These networks are made up of fixed nodes. With this strategy, each ant works towards the goal of finding a route that requires the fewest number of steps. This has been accomplished on the basis of a probabilistic decision rule, an equation that has been constructed in accordance with the value of the pheromone, the value of a heuristic connected to energy, and the list of identities of previously received data packages. A pheromone is a chemical molecule that occurs in ants and is released as they walk about, causing other ants to follow in their footsteps.

An method known as the Bat Swarm was proposed by MarwaSharawi et al. (2012) for use in wireless Sensor Networks Lifetime Optimization. The social behaviour of bats served as an inspiration for this population-based Meta heuristic algorithm that is called the bat swarm. It does this by optimising the network as a nonlinear problem with the goal of choosing the most effective cluster head nodes across all of the generations.

Hussein Abbass (2001) came up with the idea for MBO, which stands for Marriage in Honey Bees Optimization, A Haplometrosis Polygynous Swarming Approach. This theory was motivated by the phylogenetic of sociality in Hymenoptera, which includes insects like bees, ants, and wasps, as well as the mating process in honey bees. The overlapping of at least two generations, reproductive division of labour, and collaboration among adults in brood care and nest building are the three primary characteristics of eusocial insects. Eusocial insects are distinguished from other types of insects by these characteristics. The behaviour of honeybees is the result of a number of factors, including their genetic potential, the ecological and physiological environments in which they live, the social conditions of the colony, and the various interactions that have taken place in the past and continue to take place between these three factors. Since the queens mate when they are on their mating trip, which takes place distant from the nest, the marriage process represents one form of behaviour that proved challenging to analyse. The organisation of the honey bee colonies is a significant factor in this regard.

The Flower Pollination Optimization Algorithm was suggested by MarwaSharawi et al. (2014) for use in wireless sensor network lifespan worldwide optimization.optimization and are based on the natural inspiration of the pollination process, which simulates the process of blooming plants reproducing through the act of pollination. Pollinators are responsible for spreading pollen from one bloom to another, and the process may be broken down into two categories: biotic pollens transferring mechanism and abiotic pollens transferring mechanism. In the process of biotic pollination, certain insects or animals are responsible for the transmission of pollen from one bloom to another. On the other hand, in the process of abiotic pollination, the flower does not rely on any pollinators. The even distribution of power consumption across all sensor nodes contributes to an extended lifespan for the network as a whole.

A novel metaheuristic called the Grey Wolf Optimizer was developed by SeyadaliMirjalili et al. (2014). This heuristic was inspired by grey wolves, and it describes the leadership hierarchy as well as the hunting mechanism of grey wolves. In a pack of 5–12 wolves, on average, there is a leadership hierarchy that is claimed to be based on four sorts of wolves called alpha, beta, delta, and omega. The alpha wolf is considered to be at the top of the leadership hierarchy, which indicates that it is the leader of the whole pack. Every other wolf in the pack defers to the alpha wolf, who is the dominant member of the pack and is responsible for making decisions, as well as leading the pack in hunting and other activities of a similar kind. The second rung of the wolf pack's hierarchy is occupied by the beta wolf, which sits directly below the alpha wolf. The role of the beta wolf in a pack is to provide the alpha wolf with advise and to maintain order and discipline among the rest of the wolves in the pack. The Omega wolf is at the very bottom of the hierarchy, and its only purpose is to seek prey and generate offspring in front of the leader. The pack's alpha wolf will then share the food with the other wolves in the pack. The wolves who do not fit into any of these three categories will be referred to as delta wolves. They are located on the third level of the hierarchy, which places them below the beta wolves and above the omega wolves. It is the duty of the delta wolves to keep an eye on the outside of their home range and sound the alarm if they see any signs of impending danger. In addition to this, it watches out for the welfare of the sick, injured, and frail members of the pack, as well as providing protection for the pack as a whole. Gray wolves engage in yet another fascinating social behaviour, which is hunting. The primary stages of which are I locating, pursuing, and closing in on the target animal

V. CONCLUSION

It is extracted from the above literature survey that efficient techniques based on fuzzy logic could serve as better energy management approaches, contrasting binary decision making. The motivation of this research was to develop and analyze fuzzy based, game theoretic and optimization algorithms to achieve high efficiency in energy management. This work proposes a Fuzzy Link Quality Assessment algorithm (F-LQA) that determines the link quality thereby improving routing. The game theoretic approach aims at imparting additional semantic knowledge to the system and the Grey Wolf Optimization approach ascertains the optimization efficiency of energy management of the aggregation system.

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