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A Review on Multi-Path Routing Algorithm to Balance Energy Consumption in Wireless Sensor Networks

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ABSTRACT: Wireless networks offer a greater advantage in today's communication applications comparable to environmental, traffic, military and health observation. In such applications, there is need of a reliable routing protocol. A large variety of Wireless sensor Network (WSN) applications encourage researchers to develop and improve protocols and algorithms for rising challenges. One among the most objectives is to gather information and route it to the base station (via the sink nodes) while not recognition and where every node has no information on the network. During data transmission, energy consumption is main issue because sensor nodes have limited energy capacity. In fact, WSN needs load balancing algorithms that keep use of the limited energy source to route the collected data to the receiving node. In this paper, an outline of the symmetric multipath routing algorithm is given by focusing on the residual energy and also the number of hops of each node to seek out the best ways and insert them into the routing table. Therefore, the potential performance of the proposed algorithm is based on the most effective path to decide on, that should have the minimum number of hops, the maximum energy and therefore the weighted energy among the collaborating nodes to increase the duration of the network.

KEYWORDS: Routing Protocols, Route Discovering Algorithm, WSN, Energy Consumption, Battery Life.

I. INTRODUCTION

A wireless network is a collection of multifunctional, short lived and low power nodes with limited storage capability and wireless range [1]. These nodes have wireless interfaces with that they'll communicate with one another to create a network. These nodes are utilized in inaccessible areas wherever refilling the node energy isn't normally possible. A key drawback with wireless networking applications is maintaining node energy and extending network life [2].

In the current scenario, this technology is employed for wireless internet access with our laptops, for transferring information between phones and even for taking part in multiplayer games with portable game consoles. Ad hoc has several advantages as a result of they do not need infrastructure, are immediately distributed and are extremely versatile. An ad hoc network will increase both the scope and therefore the total network coverage space.

Various technologies and protocols is utilized in ad hoc networks. IEEE 802.11 meets all the wants to be used in ad hoc mode. Current Wi-Fi standards have a sufficient transmission speed and a high transmission speed. Future WLAN standards will reach previously inaccessible transmission speeds.

However, even old standards like Bluetooth have ad-hoc features which will be useful for wireless data exchange. On the opposite hand, the transmission of information on a wireless medium involves negative effects such as noise, attenuation and interference that reduce the necessity for nodes to reduce the effective bandwidth over a wired network connection. Higher headers, interframe interval times, and collision management lead to higher overall costs. cost value is to grow steady as information is transferred over many hops to an ad hoc network.

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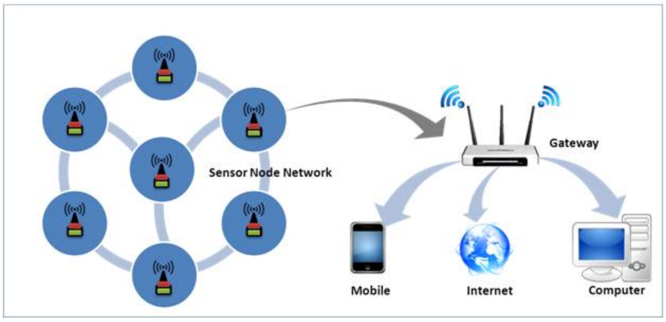

Figure 1: Wireless Sensor Network

II. Routing Protocols

Routing involves moving data from a source to a destination on a network. This technique finds at least one intermediate node within the internetwork.
The idea of routing involves principally 2 activities: on the one hand, the choice for best routing strategies and, on the opposite hand, the transfer of information groups (called packages) through an online job [3]. The subsequent construction is termed package modification, that is simple, and crucial the path can be very complicated.
According to properties routing protocols are classified as:

- Centralized and Distributed
- Static and Adaptable
- Reactive and Proactive

In centralized algorithms, all route choices are taken in the central node, whereas in distributed algorithms, the calculation of routes between nodes within the network is shared when another classification of routing protocols refers to the modification of routes. in response to input models. In static algorithms, the path employed by the destination pairs of the coverage is fastened despite the traffic conditions [4-6]. it's solely modified in response to a node or link error. this kind of algorithm cannot succeed a high level of output in a large kind of traffic input model. Most large packet networks use some kind of adaptive routing where routes will route source-destination pairs in response to congestion [7].
A proactive protocol continuously evaluates the roads of the network. Once a package has to be transferred, the route is already known and will be used instantly. Reactive protocols call a technique of determining the route only on request.
There is a substitute routing protocol for a communication network that has adaptive, scalable and secure aspects.

III. Challenges In WSN

While designing an efficient routing protocols for WSN following challenges are discussed:
Scalability Issues: In large WSN networks, scalability is the key to successful network execution with a large number of nodes. An evolving network is a network that grows with increasing network load. Logs must therefore evolve with the number of nodes. This can often be done by distributed algorithms [8-11].
Energy Issues: Wireless sensor network routing protocols faces an important issue of energy consumption during transmission of data as well as in node mobility. S, it is most serious issue as energy associated with the sensor nodes are limited. S, it is required to design an energy efficient as we fast algorithm that allows the sensor to minimize the energy used to transmit data among nodes.
Fault Tolerance: Sensors are sensitive due to their small size and limited power supply. For a single node, the error can be caused by exhaustion of the battery, failure of an external danger or simultaneous failure of several nodes. In our

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proposal, we have a multiple input in the routing table for each destination in order to guarantee a significant energy extension and fault tolerance by selecting the second destination when a node on the best routes is lost.

The main task of the WSN is to assume a lack of knowledge and resources (or node location or power source) and provide adequate data processing algorithm. In this article, we propose a new multi-path technique for data routing that uses only the node identifier. For example, Figure 2 shows three paths between the receiving node and node D, the values representing the residual energy of each sensor. We observe that R 1 is the best way in terms of shorter route, but R 3 is the best for the residual energy of the nodes. The challenge of this problem is the best path for the longest life of the entire network.

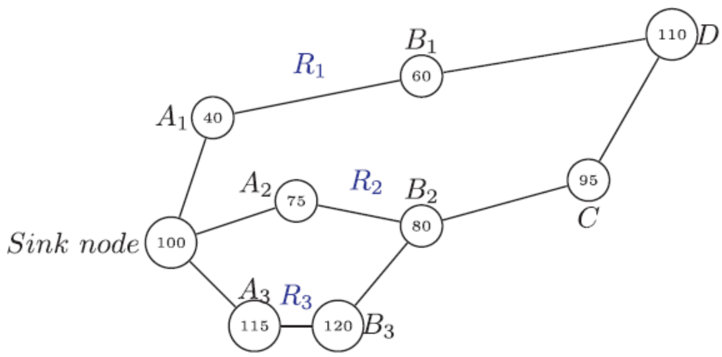

Figure 2: The Influence of the Residual Energy on the Selection of an Adequate Path

Much work has been done on multi-channel routing protocols, but balancing energy in sensor networks is a big challenge for researchers. Other challenges are discussed below [12-16]:

Scalability
Communication Overhead
End-to-End Delay
Fault Tolerance
Packet drop

IV. ENERGY CONSUMPTION MODES

Energy is very important part in Ad-hoc network because in this network all nodes communicate with each other by consuming power. The only source for power is battery of mobile node. The node consumes energy in Sending mode, Receiving mode, idle mode or sleep mode. In idle mode and sleep mode there is a constant power drain because transreceiver is constantly hearing signal for itself. When node sends packet or data at that time many Ad-hoc routing protocols and mobility models are available, each having different characteristics and scenario so each may consume different amount of energy, so the best one is who sends packets at successful rate with consuming minimum energy [14].

A. Transmission Mode

In this energy consumption mode energy consumed by the node to transfer the packets or data, in this the amount of energy is rely upon the quantity of packets being send by that node, massive the quantity of packets thus large amount of energy is consumed.Generally, the transmitted power is represented by Tx.

$$P_t = T_x / T_t \text{ Watts} \quad \text{(i)}$$

Where P_t is power consumed in transmission mode T_x is energy consumed in transmission, T_t is time to consume that energy.

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B. Receiving Mode

In this energy is consumed in receiving mode, because in this mode nodes are receiving packets from sender. The power in receiving mode can be given as:

$$P_r = R_x / T_x \text{ Watts} \quad \text{(ii)}$$

Where P_r is the power at receiver node in Watt, R_x is the energy in receiving mode.

C. Idle Mode

In this node neither sends nor receives packets so it is called as idle mode. Still it consumes energy the reason is that the node has to continuously check and update their status table to intimate that any new node added in network. The amount of energy consumed by node in idle mode is less than the energy consumed in sending or receiving mode because in idle mode the actual communication among node is not going on. So power in idle mode is nearly equal to power in receiving mode. $P_i = P_r$.

D. Overhearing Mode

When node receive packets that are not destined to it then it is a overhearing node and it may consume energy in receiving those packets, it is undesirable energy consumption, the power consumption in overhearing mode is given as:

$$P_{over} = P_r \quad \text{(iii)}$$

Where P_{over} is power consumed in overhearing mode and Pr is power consumption in receiving mode.

The main target of adding Energy model is to calculate energy in transmission, receiving, idle and overhearing mode. If consumed energy is minimum then the lifetime of network is longer because all nodes get energy from battery.

In WSN, the radio energy dissipation model is a simple model of wireless energy consumption. The transmitter circuit dissipates the energy needed to operate the transmission electronics and power amplifiers. The receiver circuit dissipates energy to operate only the electronics of the receiver [16].

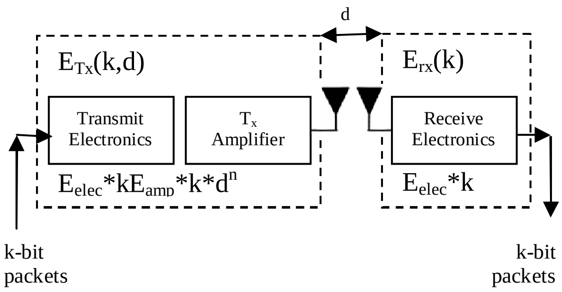

Figure 3: Radio Model

Depending on the distance between transmitter and receiver, multiple fade and free space channel patterns are used. The free space model (loss of power d^2) is mainly used for communication in a cluster or when the threshold distance is less than d_0, while the power loss model d^4 is used for communication between clusters. The threshold distance is greater than or equal to d_0. The radio energy consumed by the transmitter to transmit a 1bit message at a distance d is:

$$\begin{aligned} E_{Tx}(I,d) &= E_{Tx-elec}(I) + E_{TX-amp}(I,d) \\ &= IE_{elec} + IE_{fs}d^2, d < d_o \\ &= IE_{elec} + IE_{amp}d^4, d \geq d_o \end{aligned} \quad \text{(iv)}$$

And energy consumed by the receiver is:

$$E_{Rx}(I) = E_{Rx-elec}(I) = IE_{elec} \quad \text{(v)}$$

where E_{elec}=Per bit energy consumed to execute transmitter and receiver

E_{fs}=amplifier energies for free space

E_{amp} = amplifier energies for multipath models

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V. EXISTING WORK

In [7], the authors use a flood technique to seek out the shortest route, however it's not always useful for energy consumption if the detected streets don't have enough energy to send information between an origin and therefore the destination. Otherwise, we perpetually assume that the energy capability of the nodes could be an essential resource and should be consumed to make sure most network life.

In [8], the authors proposed a new routing methodology for WSN to increase network life employing a combination of a fuzzy approach and an A-star algorithm. The proposed methodology aims to see a best routing path from the supply to the destination giving priority to the best residual power of the battery, the minimum range of hops and therefore the lowest traffic load. extend. However, this method requires position support, that entails considerable quality in terms of communication and computational complexity.

The approaches in [9] use a multipath technique to balance energy consumption to extend network life. The proposed heuristic technique implements a mechanism to construct a path in which the next communication sensor node is selected based on its distance and on the signal strength level of the received signal (RSSI). Furthermore, when creating a path, the algorithm avoids cycles and is able to reconstruct the path once the path of discovery has arrived in a leaf. When several paths of the same destination reach a particular well, this node performs an energy balancing strategy that consists in determining the amount of flow to be transmitted on each of the paths.

In [10], the authors present two approaches. First of all, a traffic load distribution technique is used to optimize the energy consumption of the nodes in a network topology with a base station in a corner. Subsequently, a distributed heuristic algorithm is proposed to combine load balancing with transmission power control to find the right traffic share between nodes to ensure an optimal balance of their energy consumption. However, this method works only for a raster topology.

In [11], author proposedan energy efficient multi-channel routing protocol (EEMRP) that searches for multiple disjointed methods and uses a load equalization technique to allot traffic to every designated route. The residual energy state of the nodes and therefore the variety of jumps are considered integrated within the connection cost function. The connection cost function is used by the node to select the next hop during the route search phase. As a result of EEMRP solely causes delays in information transfer, the reliability of successful ways is usually limited.

In [12], the authors proposed an Energy Balancing and Clustering Algorithm (EBCAG) that divides nodes into clusters of unequal size, with every node of the sensor maintaining a gradient value outlined because the minimum immersion within the cluster. The dimensions of a cluster is set by the worth of the gradient of its cluster head and also the information collected by the cluster parts should follow the direction of the descending gradient to reach the destination. However, this approach relies on a homogenous WSN distribution. In some real-world applications, the unified sensor delivery approach may be technically or practically impossible.

Likewise, the authors of [13] developed a technique for balancing cluster energy consumption in WSN, a cluster algorithm that selects a sensor because the head of a cluster based on the rest.

In [14] author represented a complete overhaul of the existing routing protocols for WSAN to investigate and list its benefits and drawbacks. The study roughly separates the prevailing routing protocols into 2 classes, i.e. Cluster-based and non-clustered protocols.

In [15], author proposed an algorithm for multipath routing based on residual energy of the network. This parameter is based on the hop count of every node in order to find simplest route and insert them into the routing table. The main idea of this algorithm comes from ant colony optimization (ACO).

VI. CONCLUSION

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In this paper,a comparative discussion and analysis different routing protocols of the Wireless Sensor Network (WSN) is presented. In this paper, an energy based routing algorithm is analyzed to balance energy consumption at the levels of each sensor and the entire network. Overall, it can be concluded that the proposed model takes into account the constraints of resources and the lack of initial knowledge starting from the identifier of each node and using the model to evaluate the residual energy.Due to the limited amount of energy in the sensor nodes, the analysis of the energy consumption of the WSN is very important. The proposed algorithm may be scalable, energy-efficient and may reduce packet drop ratio. In future proposed algorithm would be enhanced with concept of secure, energy-efficient, scalable and reliable algorithm.

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