Energy Constraint Node Cache Based Routing Protocol for Wireless Sensor Networks

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Abstract

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to one or more sinks, generally via multi-hop meeting the needs of applications/users as the mobile nodes are battery limited. While satisfying the energy saving requirement, it is also necessary to achieve the quality of service. In case of emergency work, it is necessary to deliver the data on time. In order to achieve this requirement, Power-efficient Energy-Aware routing protocol is proposed that saves the energy by efficiently selecting the energy efficient path in the routing process.

Keywords: Ad-Hoc Network, MANET, WSN, Quality of Service, Power-Efficient Energy-Aware Routing

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I. Introduction

A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to one or more sinks, generally via multi-hop communication. The sensor nodes are typically expected to operate with batteries and are often deployed to not-easily-accessible or hostile environment, sometimes in large quantities. Since the sensor energy is the most precious resource in the WSN, efficient utilization of the energy to prolong the network lifetime has been the focus of much of the research on the WSN. The communications in the WSN has the many-to-one property in that data from a large number of sensor nodes tend to be concentrated into a few sinks. Since multi-hop routing is generally needed for distant sensor nodes from the sinks to save energy, the nodes near a sink can be burdened with relaying a large amount of traffic from other nodes. Sensor nodes are resource constrained in term of energy, processor and memory and low range communication and bandwidth. Limited battery power is used to operate the sensor nodes and is very difficult to replace or recharge it, when the nodes die. This will affect the network performance. Energy conservation and harvesting increase lifetime of the network. Optimize the communication range and minimize the energy usage, we need to conserve the energy of sensor nodes. Sensor nodes are deployed to gather information and desired that all the nodes works continuously and transmit information as long as possible. This address the lifetime problem in wireless sensor networks. Sensor nodes spend their energy during transmitting the data, receiving and relaying packets. Hence, designing routing algorithms that maximize the life time until the first battery expires is an important consideration. Designing energy aware algorithms increase the lifetime of sensor nodes. In some applications the network size is larger required scalable architectures. Energy conservation in wireless sensor networks has been the primary objective, but however, this constrain is not the only consideration for efficient working of wireless sensor networks. There are other objectives like scalable architecture, routing and latency. In most of the applications of wireless sensor networks are envisioned to handled critical scenarios where data retrieval time is critical, i.e., delivering information of each individual node as fast as possible to the base station becomes an important issue. It is important to guarantee that information can be successfully received to the base station the first time instead of being retransmitted. In wireless sensor network data gathering and routing are challenging tasks due to their dynamic and unique properties. Many routing protocols are developed, but among those protocols cluster based routing protocols are energy efficient, scalable and prolong the network lifetime .In the event detection environment nodes are idle most of the time and active at the time when the event occur. Sensor nodes periodically send the gather information to the base station. Routing is an important issue in data gathering sensor network, while on the other hand sleep-wake synchronization is the key issues for event detection sensor networks. The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost

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constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

II. MOTIVATION

A. Akhtar presented a new technique for intra cluster routing which is more energy efficient than a well-known routing protocol that performs multihop routing. They proved their idea by simulating a network of 30 nodes in TOSSIM. While justifying the idea through results of the simulation had been considered the parameters that include number of packets sent in the network, energy consumed by the network, remaining energy level of nodes at specific time and network lifetime of the network. By using proposed technique shows that they had increased the network lifetime and number of packet sent in the network. Zijian Wang presented an energy efficient and collision aware (EECA) node-disjoint multipath routing algorithm. The main idea of EECA is to use the broadcast nature of wireless communication to avoid collisions between two discovered routes without extra overhead. Additionally, EECA restricts the route discovery flooding and adjusts node transmit power with the aid of node position information, resulting in energy efficiency and good performance of communication. They used NS-2.33 simulator to evaluate the proposed scheme in terms of the average packet delivery ratio, the average end-to-end delay, the average residual energy and the number of nodes alive. Their preliminary simulation results show that ECCA algorithm results in good overall performance, saving energy and transferring data efficiently. Ming Liu has presented a novel energy efficient data gathering protocol with intra-cluster coverage. EAP clusters sensor nodes into groups and builds routing tree among cluster heads for energy saving communication. In addition, EAP (Energy Aware Routing Protocol) introduces the idea of area coverage to reduce the number of working nodes within cluster in order to prolong network lifetime. Simulation results show EAP outperforms far better than LEACH. Compared to HEED, though EAP performs almost the same as HEED when node density is low, it has far better performance than HEED when node density goes higher than 0.01nodes/m2.EAP, Lu Su has presented the challenges of routing in intermittently connected sensor networks and proposed an on demand minimum latency routing algorithm (ODML) to find minimum latency (ODML) to find minimum latency routes. They proposed two proactive minimum latency routing algorithms: optimal PML and quick PML. The schemes proposed in this paper can provide generic routing functionalities for most of the existing scheduling schemes Basil Etefia has presented an improvement on the implementation of information routing capabilities in ad hoc wireless sensor networks. Improving the protocols used by each sensor node can increase the network's localization and power conservation abilities. Using novel and creative schemes to generate shortest paths for information routing from source to destination nodes, they had been implemented an approach to limit the inefficiencies of routing protocols used by sensor networks for information transfer. A.P.Subramanian has presented Multipath Power Sensitive Routing (MPSR) Protocol for Mobile Ad hoc Networks has been presented. Providing multiple paths is useful in ad hoc networks because when one of the routes is disconnected, the source can simply use other available routes without performing the route discovery process again. The simulation was done using the Global Mobile Simulator (GloMoSim) Library. The results of extensive simulation show that the performance of MPSR protocol is on an increasing trend as mobility increases when compared to the Dynamic Source Routing and using this protocol is that the end-to-end packet delay does not increase significantly. Charles E.Perkins has presented presented a distance vector algorithm that is suitable for use with ad-hoc networks AODV avoids problems. Their new routing algorithm is quite suitable for a dynamic self-starting network as required by users wishing to utilize ad-hoc networks. AODV provides loop-free routes even while repairing broken links. They have simulated AODV using an event-driven packet level simulator called PARSEC which was developed at UCLA as the successor to Maisie and shows that there algorithm scales to large populations of mobile nodes wishing to form ad-hoc networks. They also include an evaluation methodology and simulation results to verify the operation of their algorithm. Fan Ye has presented TTDD, a two-tier data dissemination design, to enable efficient data dissemination in large-scale wireless sensor networks with sink mobility. Instead of passively waiting for queries from sinks, TTDD exploits the property of sensors being stationary and location-aware to let each data source build and maintain a grid structure in an efficient way. Queries are forwarded upstream to data sources along specific grid branches, pulling sensing data downstream toward each sink. They implement the TTDD protocol in ns-2 and used the basic greedy geographical forwarding with local flooding to bypass dead ends. Their analysis and extensive simulations have confirmed the effectiveness and efficiency of the proposed design, demonstrating the feasibility and benefits of building an infrastructure in stationary sensor networks. Maurice Chu has describes two novel techniques, information-driven sensor querying (IDSQ) and constrained anisotropic diffusion routing (CADR), for energy-efficient data querying and routing in ad hoc sensor networks for a range of collaborative signal processing tasks. The key idea is to introduce an information utility measure to select which sensors to query and to dynamically guide data routing. There simulation results have demonstrated that the information-driven querying and routing techniques are more energy efficient, have lower detection latency, and provide anytime algorithms to mitigate risks of link/node failures. Sameer Tilak has presented "A Taxonomy of Wireless Micro-Sensor Network Models examines this emerging field to classify wireless micro-sensor Networks according to different communication functions, data delivery models, and network dynamics. This taxonomy will aid in defining appropriate communication infrastructures for different sensor network application subspaces, allowing network designers to choose the protocol architecture that best matches the goals of their application. In addition, this taxonomy will enable new sensor network models to be defined for use in further research in this area. Ian F has presented Survey on sensor networks can be used for various application areas (eg. health, military, home). For different application areas, there are different technical issues that researchers are currently resolving. The current state of the art of sensor networks is capture in this article, where solutions are discussed under

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their related protocol stack layer section. This article also point out the open research issues and intends to park new interests and developments in this field. M. Younis has presented novel energy-aware routing approach for sensor networks. A gateway node acts as a cluster-based centralized network manager that sets routes for sensor data, monitors latency throughout the cluster, and arbitrates medium access among sensors. The gateway configures the sensors and the network to operate efficiently in order to extend the life of the network. Simulation results demonstrate that the algorithm consistently performs well with respect to both energy-based metrics, e.g. network lifetime, as well as contemporary metrics, e.g. throughput and end-to-end delay. Schurgers has argued that optimal routing in sensor networks is infeasible and proposed a practical guideline that advocates a uniform resource utilization, which can be visualized by the energy histogram. They also propose a number of practical algorithms that are inspired by this concept. Their DCE combining scheme reduces the overall energy, while their spreading approaches aim at distributing the traffic in a more balanced way. Several techniques, which rely only on localized metrics, are proposed and evaluated. This result shows that they can increase the network lifetime up to an extra 90% beyond the gains of our first approach. Curt Schurgers has presented optimal routing in sensor networks is infeasible and proposed a practical guideline that advocates a uniform resource utilization, which can be visualized by the energy histogram. They proposed a number of practical algorithms that are inspired by this concept. There DCE (Data Combining Entities) combining scheme reduces the overall energy, while there spreading approaches aim at distributing the traffic in a more balanced way. Several techniques, which rely only on localized metrics, are proposed and evaluated. And there result shows that they can increase the network lifetime up to an extra 90% beyond the gains of their first approach.

III. PROPOSED METHOD

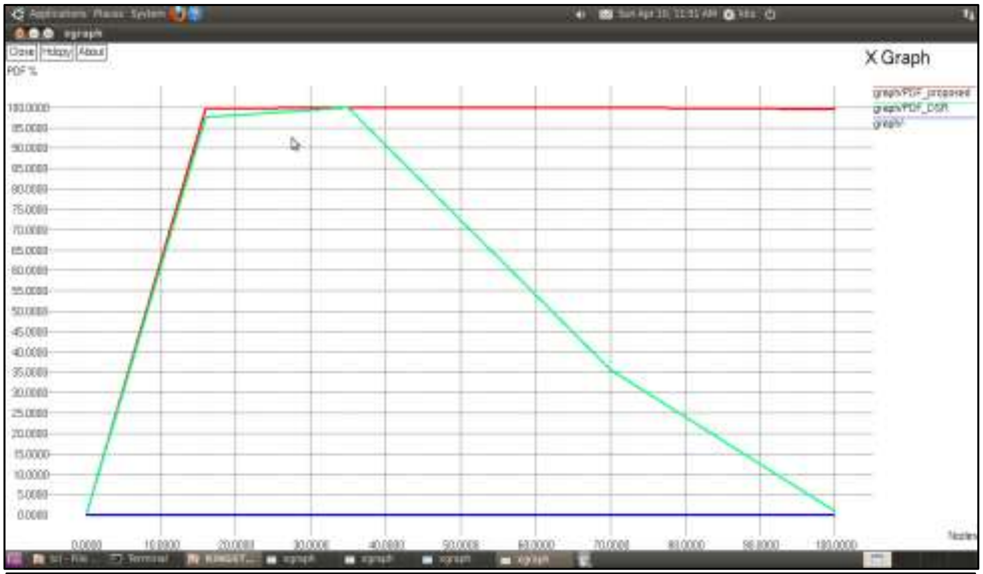
In the proposed system it focus on the problem of maximizing the lifetime of a wireless sensor network where the sensor nodes communicate with the sink by delivering the sensed data across multiple hops with different transmission energy requirements. That is, there is flexibility of transmitter power adjustment and the energy consumption rate per unit information transmission is not the same for all neighbours of a sensor, but depends on the choice of the next hop node. The lifetime of the network is defined as the time until a sensor node drains out of battery energy for the first time, a definition commonly used in the literature. Proposed system implements the energy saving routing protocol in the battery limited wireless sensor network in order the lifetime of the network. The proposed protocol performs a route discovery process similar to the AODV protocol. But it considers the residual energy level of the node and hop count along the path towards the sink. (Minimum Residual Energy) field is added to the RREQ message. The Min-RE field is set as a default value of -1 when a source node broadcasts a new RREQ message for a route discovery process. To find a route to a destination node, a source node floods a RREQ packet to the network. When neighbour nodes receive the RREQ packet and update the Min-RE value and rebroadcast the packet to the next nodes until the packet arrives at a destination node. That is, the proposed protocol collects routes that have the minimum residual energy of nodes relatively large and have the least hop-count, and then determines a proper route among them, which consumes the minimum network energy compared to any other routes. It uses the formula to select the optimum route. The formula is based on the hop count and the Minimum Residual Energy.

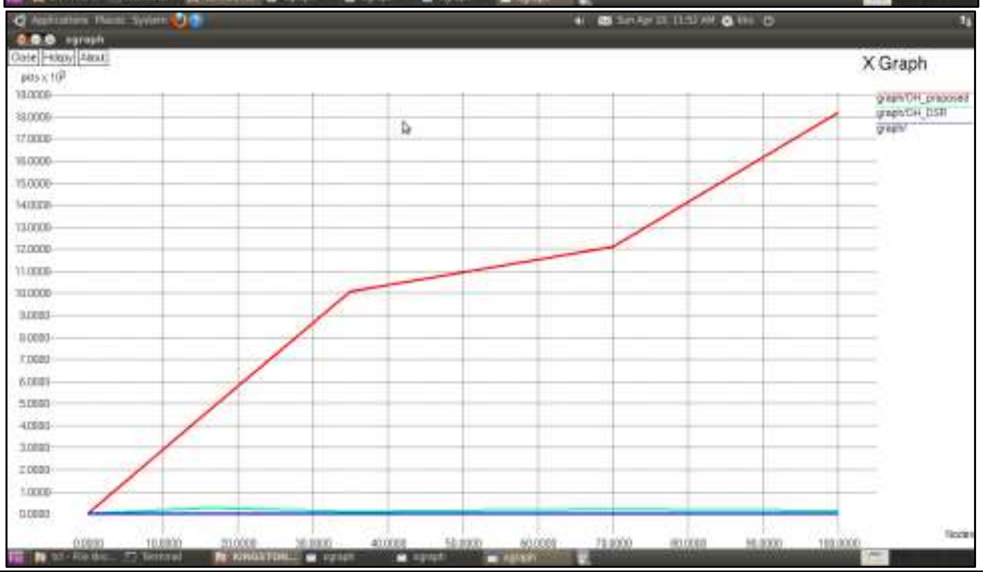
IV. SIMULATION RESULTS, PERFORMANCE EVALUATION AND ITS COMPARISON

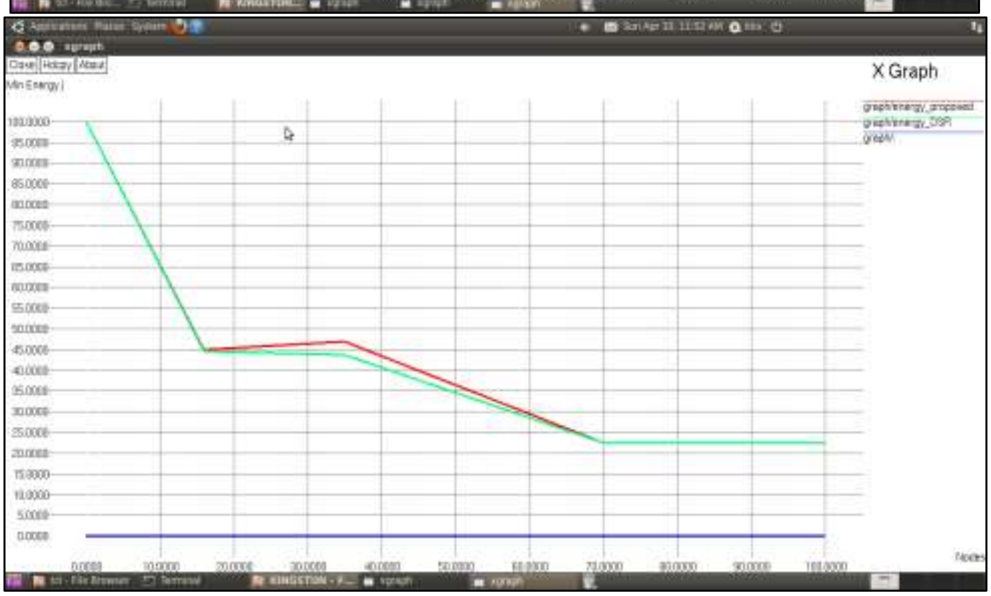
A. *Simulation Model NS-2*

Simulation Model NS-2 is an event driven simulation tool useful in studying the dynamic nature of communication networks. A simulation study is carried out in order to evaluate the performance of routing protocols such as DSR and AODV is used to find convergence time and packet delivery

B. Simulation Results







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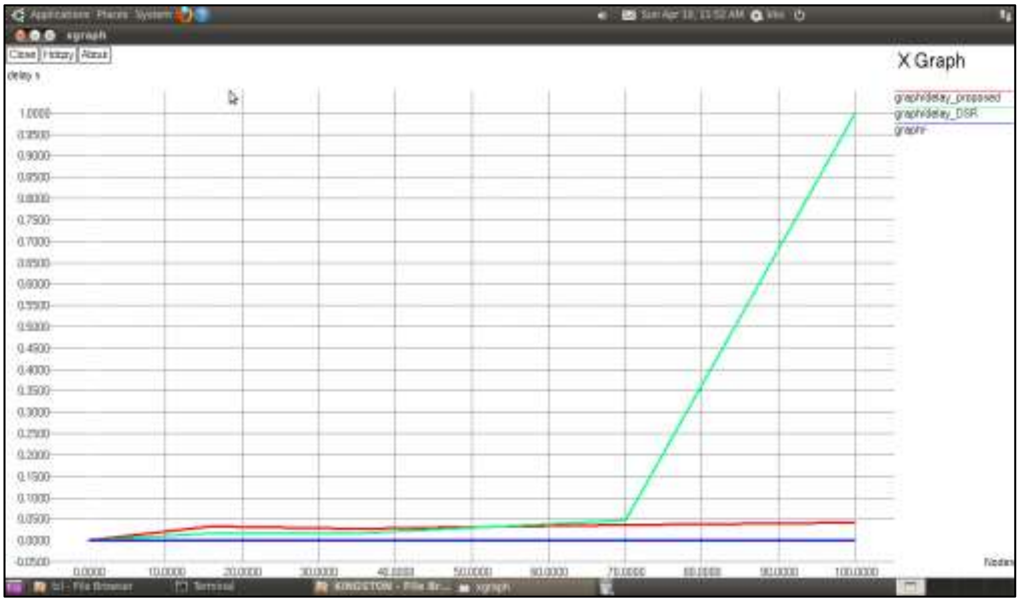

V. CONCLUSION

Proposed Energy efficient routing protocol for wireless sensor network invokes the residual energy and hop count as parameters. In the routing process path with largest minimum residual energy and least hop count is chosen. Transmission power of the node is adjusted according to neighbour's range of the node. Proposed Energy efficient routing protocol is compared with the existing protocols. Proposed protocol achieves the higher energy consumption. This improves the lifetime of the nodes in the network. Quality of service of the communication network is also improved by achieving the lesser end-to-end delay. Thus proposed routing protocol provides better lifetime and Quality of Service than the AODV and Max_Min energy routing protocol. Proposed system implements the energy saving routing protocol in the battery limited ad hoc network in order the lifetime of the network. The proposed protocol performs a route discovery process similar to the AODV protocol. But it considers the residual energy level of the node and hop count along the path between source and destination. In this project it also consider about energy of neighbour nodes That is, the proposed protocol collects routes that have the minimum residual energy of nodes relatively large and have the least hop-count, and then determines a proper route among them, which consumes the minimum network energy compared to any other routes. It uses the formula to select the optimum route. The formula is based on the hop count and the Minimum Residual Energy. Effectively reduce the energy consumption of nodes and balance the traffic load among them in this work, Reliable minimum Energy Cost Routing (RMECR) is proposed which can. Furthermore, RMECR is able to find reliable routes, in which constituent links require less number of packet retransmissions due to packet loss. This in turn decreases the latency of packet delivery and saves energy as well. To prolong the network lifetime, power management and energy-efficient routing techniques become necessary to have Overall network life time increased, Reliable routing in ad hoc networks.

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