Increasing Energy Efficiency of WSN using Cluster Based Routing

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Abstract:
Wireless Sensor Networks (WSN) are developing as both a vital new domain in the IT environment and a hot research including system design, networking, distributed algorithms, programming models, data management, security and social components. So in the proposed work we aim at modifying the broadcasting as well as way to choose the new node in case of fault and will be focusing on reducing the energy consumption in the wireless sensor network using the modified process of broadcasting and group based routing scheme to handle faults more effectively.

Index Terms: Cluster Head. Clustering, Actuator Networks, Leach.

I. INTRODUCTION

WIRELESS SENSOR NETWORKS:

As the world business is becoming more portable and computational provisions are coming to be broadly appropriated, wireless sensor networks are crossing over any barrier by making distance and movement consistent. As the computing and communications devices continue to proliferate, wireless networks require some creative medium access procedures to share the limited broadcast bandwidth in a fair and efficient manner. The magnetic characteristics of the wireless sensor networks pulled in numerous analysts to work on various issues related to these types of networks. Wireless Sensor Networks (WSN) are developing as both a vital new domain in the IT environment and a hot research including system design, networking, distributed algorithms, programming models, data management, security and social components. Wireless sensor networks are rapidly picking up the popularity as they are potentially low cost solutions. The fundamental thought of sensor network is to scatter minor sensing gadgets over a particular geographic zone for some specific purposes like target tracking, surveillance, environmental screening and so on. These tiny devices are equipped for sensing a few progressions of parameters and communicating with different units. A wireless sensor network (WSN) is a remote system comprising of an extensive number of geologically dispersed sensor nodes. These sensor nodes could be effectively conveyed at vital districts easily at a low cost. Sensor nodes collaborate with one another to screen physical or ecological conditions, for example, temperature, sound, picture, vibration, weight, movement or contaminations with the assistance of different sorts of sensors. However, while much consideration is constantly paid to the routing strategies and wireless sensor network modeling, the security issues are yet to receive extensive focus. Essentially the utilization of any effective security conspire in wireless sensor systems is encouraged by the span of sensors, the processing power, memory and kind of functions anticipated from the sensors. Sensor networks are not universally traditional computing devices; subsequently the existing security models and strategies are lacking to run with them. In sensors, the geographic dissemination of the units allows an attacker to physically have control of nodes and study mystery key material, or to capture messages. The hierarchical nature of sensor networks and their route maintenance protocols permit the attacker to confirm where the root node is placed. WSNs are picking up interest in the research community due to their unique qualities. WSNs are very little watched. Consequently it is effectively conceivable for an assaulter to catch a hub physically, altering its code and getting private data like cryptographic keys. Wireless medium is inherently broadcast in nature which makes them vulnerable to attacks. These attacks can disturb the operation of WSN and can even kill the purpose of their deployment. Wireless networks can be recognized of two sorts: infrastructure network and ad-hoc (infrastructure less) network. Infrastructure network is a sort of a network with fixed and wired gateways. A mobile host interacts with a bridge in the network within its communication radius. The mobile unit can mobile geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This phenomenon is termed as handoff. On the other hand, Mobile ad hoc network is an aggregation of wireless mobile nodes in which nodes team up by sending packets for each other to permit them to communicate outside range of direct wireless transmission. Ad hoc networks require no fixed network infrastructure such as base stations or access points, and could be rapidly and economically set up as required.

II. RELATED WORK

Qian Zhao, Yukikazu Nakamoto [1] The authors have investigated energy efficiency and fault tolerance for wireless sensor networks (WSNs), addressing the need to minimize the communication distances so that the energy used for communication is minimized since energy consumption is proportional to the 2nd to the 6th power of the distance. They have also investigated the energy hole phenomenon, in which
non-uniform energy usage among nodes causes some of the nodes to run out of power sooner. This in turn increases the communication distances and results in premature shutdown of the entire network. Since some sensor nodes in a WSN may be unreliable, fault tolerance is required for optimizing the communication topology. They have developed a routing algorithm, the "energy hole aware efficient communication routing algorithm (EHAEC)," that solves the energy hole problem to the maximum extent possible while minimizing the amount of energy used for communication by generating an energy efficient spanning tree. A variation of this algorithm, EHAEC for one-fault tolerance (EHAEC-1FT) identifies redundant communication routes by using the EHAEC tree and tolerates the failure of one node. In evaluation simulations, EHAEC outperformed direct data transmission by more than 3.4 to 4.8 times in terms of energy efficiency, thereby extending the WSN lifetime. EHAEC-1FT outperformed EHAEC in terms of energy efficiency when fault tolerance was the first priority and fault tolerance redundancy was created when or before a failure occurred.

Lutful Karim, Nidal Nasser, Tarek Sheltami [2] Energy efficiency in the clustering protocols in highly desired in Wireless Sensor Network (WSN). The Dynamic Static Clustering (DSC) protocol is an energy efficient clustering protocol; however, it does not provide any fault tolerance mechanism. Moreover, the non-Cluster Head nodes send data to the Cluster Heads (CH) in every time slot of a frame allocated to them using TDMA scheme, which is an energy consuming process. Considering these limitations of the DSC protocol, the authors have proposed a more energy efficient and fault tolerant Dynamic Static Clustering (FT-DSC) protocol of WSN to enhance the performance of DSC. The performance of the proposal protocol has been tested by means of simulation and compared against the original DSC protocol. Simulation results show that the FT-DSC protocol has better performance than the DSC protocol in terms of energy efficiency and reliability.

Gebere Akele, Hassen Redwan, Ki-Hyung Kim [3] A distributed system is a collection of nodes interconnected by a communication network in which each node can work together and has its own local memory and other peripherals. The communications between the nodes are held by message passing over the communication network. An important challenge confronted in distributed wireless sensor network (WSN) is the adoption of suitable and efficient algorithms for leader election. The goal of a leader election in distributed WSN of autonomous nodes is to select one of the currently alive nodes as a leader so as to manage the coordination activities of the other nodes in the system. The authors put forward that most existing leader election algorithm have limitation either fault tolerance, message passing overhead or if the leader fails an election process could be initiated by communicating all the nodes in the distributed WSN. So, these types of algorithms have a great impact on the performance and the energy efficiency of the WSN because of communication overhead. To mitigate these type leader election limitations, in this paper, they have proposed a virtual group leader election algorithm by combining a group of nodes (including a master leader and multiple backups) on the WSN into a leader group. Their proposed algorithm improves the energy efficiency and the performance in message passing and less time complexity that results in electing a new leader node faster. The proposed algorithm analyzed and validated through extensive mathematical results. And also the simulation result shows that the proposed algorithm can minimize a lot of energy when the number of nodes increases.

L. Karim, N. Nasser [4] Designing energy efficient and reliable routing protocols for mobility centric applications of wireless sensor network (WSN) such as wildlife monitoring, battlefield surveillance and health monitoring is a great challenge since topology of the network changes frequently. Existing cluster-based mobile routing protocols such as LEACH-Mobile, LEACH-Mobile-Enhanced and CBR-Mobile consider only the energy efficiency of the sensor nodes. However, reliability of routing protocols by incorporating fault tolerance scheme is significantly important to identify the failure of data link and sensor nodes and recover the transmission path. Most existing mobile routing protocols are not designed as fault tolerant. These protocols allocate extra timeslots using time division multiple access (TDMA) scheme to accommodate nodes that enter a cluster because of mobility and thus, increases end-to-end delay. Moreover, existing mobile routing protocols are not location aware and assume that sensor nodes know their coordinates. In this study the authors proposed a location-aware and fault tolerant clustering protocol for mobile WSN (LFCP-MWSN) that is not only energy efficient but also reliable. LFCP-MWSN also incorporates a simple range free approach to localize sensor nodes during cluster formation and every time a sensor moves into another cluster. Simulation results show that LFCP-MWSN protocol has about 25-30% less network energy consumptions and slightly less end-to-end data transmission delay than the existing LEACH-Mobile and LEACH-Mobile-Enhanced protocols.

Rana E. Ahmed [5] Multi-hop Wireless Sensors Networks (WSNs) consisting of several nodes and links are vulnerable to frequent node/ link failures. Energy saving at a node is another major consideration in WSN. Dynamic Source Routing (DSR) is a popular protocol commonly applied to WSNs; however, there is no provision of fault-tolerance and energy efficiency. In this paper, a new fault-tolerant routing and energy-efficient protocol, that modifies the conventional DSR protocol, is proposed. The protocol tries to find two routing paths (if they exist) from the source to the destination node, considering the present energy levels at intermediate nodes in the path. Simulation results show that the proposed protocol also achieves better packet delivery ratio and network throughput as compared to conventional DSR.

Samira Chouikhi, Inês El Korbi, Yacine Ghamri-Doudane, Leila Azouz Saidane [6] One of the common challenges in Wireless Sensor Networks (WSNs) is the degradation of the performance due to several factors. In one hand, the interference between concurrent transmissions can affect the efficiency of the network and considerably degrades its performance. The exploitation of the multiple channels available in sensor technology and the development of protocols for WSNs can be a solution to mitigate this interference. In this case, the way the channels are assigned has a significant impact on the performance of multi-channel communication. In the other hand, the faults occurred in WSNs are another factor that degrades the WSN performance. In this paper, we propose a distributed
energy-efficient solution for multi-channel allocation based on
the routing. This solution implements a fault recovery
mechanism to reconnect the network after an articulation node
failure. A main task of the proposed approach is to minimize the
number of interferences when allocating the limited number of
available channels. As a second task, the approach minimizes the
energy consumption by defining a sleeping/activity strategy. The
fault recovery mechanism aims to restore the network
connectivity and reallocate channels without affecting the whole
WSN. The performance of the proposed solution is evaluated by
simulation.

Shilpa Mahajan, Jyoteesh Malhotra, Sandeep Sharma [6]
One of the challenging tasks in wireless sensor network is to
route data efficiently from source to destination. Sensors collect
data from the sensor network area and pass on the aggregated
data to the base station. Three techniques have been proposed in
the literature: namely, direct, hierarchical and hybrid to fulfill this
data transmission task. Sending data on a single path multiple
times results in depletion of energy and hence failure of those
nodes. Thus, a fault tolerance mechanism is essential for finding
multiple disjoint paths for data transmission. In this mechanism,
the system can switch from an inaccessible path with broken
links to available candidate paths. In this study, a new graph
theory method for optimal path selection based on quality of
service parameters is proposed. To prolong the lifetime of the
network, a fault tolerant mechanism is also adopted. Simulation
results show that the proposed approach enhances network
lifetime and improves path stability.

III. PROBLEM DEFINITION

The basic motive as to why the wireless sensor networks are
deployed in the hostile environments is the gathering of useful
information by the sensor nodes and getting them transferred to
the base station for useful interpretation. The question the arises
here is how long actually the nodes can continue to gather data
and keep sending it to the base station. The answer lies in the
fact that these nodes are battery driven, so lesser the batteries are
used more efficient will be the network. Better scenario would
be that more amount of battery to be used in the data forwarding
activities as compared to other activities such as route formation.
Route formation is based on the broadcasting which consumes
much more energy. Apart from this once the routes have been
formed in the network, as discussed by the authors in [7] when
the source node continues to transfer the data over a single path
for a considerable period of time, the nodes tend to die out soon
resulting in link breakage or better say fault in the network.
To remove or to tackle such kind of faults, the authors have
proposed a system that allows the source node to send the data
over a different path to the destination node.

Choosing a different path will allow the data transmission to
continue without any interruption. As discussed above,
broadcasting and using a node for over a longer period of time
are two factors driving the energy consumption in wireless
sensor networks. Since broadcasting cannot be avoided but it can
be reduced or modified in a way that this process takes up lesser
ergies and increase the efficiency of the network. So in the
proposed work we aim at modifying the broadcasting as well as
way to choose the new node in case of fault.

IV. PROPOSED SCHEME

In the proposed work, we will be focusing on reducing the
energy consumption in the wireless sensor network using the
modified process of broadcasting and group based routing
scheme to handle faults more effectively.

• In the modified broadcasting, the base station will be first
asking for location coordinates as well as the remaining energy
of its one hop neighboring nodes.
• After the nodes have replied to base station, it will be finding
out the ratio of the residual energy as well as distance. It will be
choosing two nodes to forward the route request message further
in the network.
• These two selected nodes will find out their one hop
neighbors, these neighbors will be acting as the relay group
members with the two nodes itself acting as relay leaders.
• The relay while forwarding the route request messages must
repeat the procedure described earlier and must forward their
relay group member list along with request.
• When the request reaches the source node (the node which has
to send data to base station), it will be going for the path
selection process.
• The node will be selecting the path from the relay leaders.
• The existing scheme has taken into consideration the faults in
the nodes which can occur if any node is sending data over a
longer period of time, in such situations our proposed scheme
will work in the following fashion.
• If any node goes out of energy, then the predecessor node can
choose any one node from the relay leader group to forward the
data, since it knows the relay members.
• This fault tolerance process is quick, as the source node does
have to choose another path, the intermediate node instead can
make the robust decision to choose the relay member from the
group.

V. CONCLUSION

A WSN is a combination of wireless communication and sensor
nodes. broadcasting and using a node for over a longer period of
time are two factors driving the energy consumption in wireless
sensor networks. Since broadcasting cannot be avoided but it can
be reduced or modified in a way that this process takes up lesser
energies and increase the efficiency of the network. So in the
proposed work we aim at modifying the broadcasting as well as
way to choose the new node in case of fault.

VII. REFERENCES

[1]. Qian Zhao, Yukikazu Nakamoto, "Routing Algorithms for
Preventing Energy Holes and Improving Fault Tolerance in
Wireless Sensor Networks", Second International Symposium on
Computing and Networking. December 2014 IEEE.

Tolerant Dynamic Clustering Protocol of Wireless Sensor
Networks", Global Telecommunications Conference, GLOBECOM December 2009 IEEE.

[3]. Gebere Akele, Hassen Redwan, Ki-Hyung Kim, "Virtual
group leader election algorithm in distributed WSN", Sixth
International Conference on Ubiquitous and Future Networks (ICUFN), July 2014 IEEE.

[4]. L. Karim, N. Nasser, "Reliable location-aware routing protocol for mobile wireless sensor network", IET Communications November 2012, IEEE.

