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Research Article

Proficient performance and data collection improvement in wireless sensors network over MAC protocol

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Abstract

The infrastructure of wireless sensor networks (WSN) is structured in an ad-hoc manner and arranged nodes reporting the events to the bottom Station (BS). A WSN is integrated with smart technologies to develop fast Internet of Things (IoT) communications among different applications. Recently, many researchers proposed their solutions to optimize IoT data transmissions in an energy efficient manner with cost effective support. The proposed framework is composed of two sub-components. The proposed protocol effects in higher dispensed sensors and a properly-balanced clustering gadget improving the community's lifetime. The Modified Energy Aware Routing (MEAR) method carries two protocols, which include MCP based totally Efficient MAC primarily based EAR. In segment, Transmission range adjusting by the initializing the utmost Capacity Path based multi hop routing by using imposing Energy Aware Routing. For the EAR implementation, want to calculate the nodes Initial Energy, Residual Energy and Optimum power path. The simulation results demonstrate notable improvement in comparison to existing solutions in terms of various network metrics.

Keywords: Wireless sensor network; Internet of things; Modified energy aware routing; Efficient medium access control.

Introduction

Advancement in wireless communication and electronics over the years has led to the development of Wireless sensor network (WSNs). WSNs are formed by sets of distributed autonomous devices with several distinct characteristics to sense, process, transmit and receive observed or measured condition. Its deployment has been enhanced by its small, inexpensive and smart sensor which is definitely deployable. In its simplest form, the sensor node is formed from a sensor component that measures the condition of the observed situation or physical surrounding of interest while the microprocessor component of the node ensures the knowledge obtained are intelligently computed. The wireless radio embedded within the nodes allows communication between the neighbouring nodes. A considerable number of these sensors are used to cover the area of interest since a single sensor node can only provide limited information [1].

Routing schemes in WSNs aim to deliver data from the info sources (nodes with sensing capabilities) to an information sink (typically, a base station) in an energy-efficient and reliable way. A survey of several routing algorithms may be found in literature survey. Most proposed algorithms are based on shortest path routing or multi-path approaches and may indirectly reduce energy usage, but they do not explicitly use energy consumption models to address optimality of a routing policy with regard to energy-aware metrics [2]. Such "energy awareness" has motivated a number of minimum-energy routing algorithms which typically seek paths minimizing the energy per packet consumed.

However, seeking a minimum energy path can rapidly deplete energy from some nodes and ultimately reduce the complete network's lifetime by destroying its connectivity. Conventional proposed an Energy Aware the project presents a mobile cluster head framework, which aims to longer network

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lifetime with lightweight efficient data routing between node and mobile IoT devices based on WSN. Unlike other solutions, our proposed framework fragments the IoT objects into various clusters and performs the cluster heads selection by using the indeterminacy principle. In addition, based on network measurement and analysis, the up to date position of mobile cluster heads are determined. Moreover, in most of the prevailing solutions, it's tough to ensure a secured and reliable end to finish data transmissions between mobile IoT objects because of their limited constraints. Unlike other solutions, our proposed framework presents a lightweight and reliable end-to-end efficient routing approach [3]. Accordingly, the proposed framework improves routing performance for mobile IoT devices in terms of security and energy utilization.

Proposed system

The EARR scheme specifically specializes in when the relay node will be brought about to perform the relocation method and in which to move to. Besides the sink relocation scheme, the whole operation of the WSNs for environment tracking additionally desires to incorporate the routing technique for reporting the sensed records from the source to the relay (sink), as well as the energy intake version. In this phase I record, we are able to first off in brief describe the strength consumption model for message relaying. Then, the electricity-aware routing approach (the MCP) that's followed within the EARR technique is often illustrated the usage of a routing instance. At the give up of this file, some related studies works for efficient routing can also be addressed.

Architecture diagram

Proposed architecture is shown in fig. 1. In this assignment change, we use a dynamic routing protocol, known as Maximum Capacity Path (MCP), as the underlying routing protocol of the proposed Energy Aware routing technique. The MCP mainly consists of 3 process steps. They are,

• Layering graph G right into a layered community N;
• Determining the maximum capacity course for each sensor node; and
• Routing accomplished and residual electricity up to date.
• The MCP will iteratively carry out the above 3 steps for each round of message reporting.

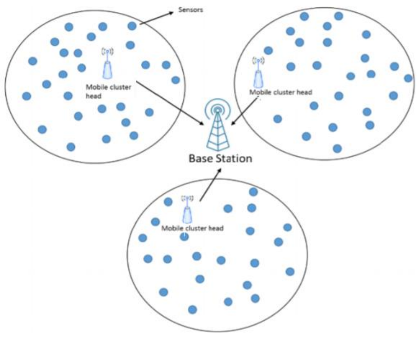

Fig. 1. Proposed architecture

The community lifetime of a WSN, energy saving is the key layout problem. Routing protocol designs of message reporting during a WSN can generally be categorized into two classes: static routing and dynamic routing. For the static routing type, when because the message reporting paths are decided, every sensor node will report its sensed information along the predetermined route to the sink at any time. On the alternative hand, a dynamic routing protocol would possibly modify the routing paths in every transmission round in keeping with the cutting-edge nation of the sensor nodes' residual battery electricity. Due to the reality that the dynamic routing protocols can stability the burden on every sensor node, it plays better for network lifetime prolonging than the static routing protocols.

In this work, we design, analyze and evaluate a highly efficient WSN MAC protocol specially designed to collect information from a large number of sensors, utilizing information theoretic concepts and novel signaling and decoding techniques which permit us to jointly optimize all layers together.

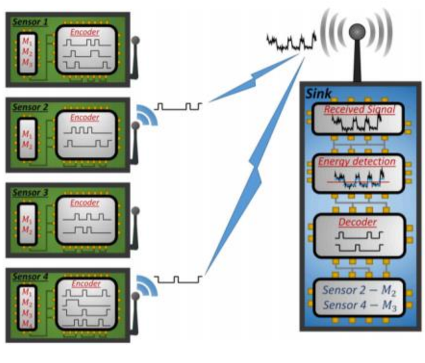

Fig. 2. Data is collected by a sink, when K sensors, out of a large population of N sensors in the network have a message to transmit over the wireless channel

Whenever a sensor wishes to transmit a report, it waits to receive a predefined periodic preamble sent by its designated sink, then transmits a sequence of impulses Interestingly, unlike Code-Division Multiple-Access Channels (CDMA), the sink node can rely on a simple energy detection in order to decode, and not on the exact received power or any power adaptation mechanism, thus dramatically improving robustness. To provide some insight into the suggested approach and illustrate its basic concept, consider the toy example. In this example, we assume four sensors transmitting to a sink. The four sensors have 3, 2, 2 and 4 messages each. Each one of the messages is assigned a novel pattern, comprised of high and low level elements which are known to the sensor itself and to the sink. For example, Sensor 1's first message is encoded starting with a low level symbol followed by a high level symbol, a sequence of 4 low level symbols, etc.

• After receiving a predefined beacon from the sink, which initiates a conceptual set of mini-timeslots, each sensor ready to transmit emits energy (transmits) according to the pattern assigned to the message to be transmitted.

• Specifically, it emits energy in the minislots which correspond to a high level in the message pattern and stays idle in the other minislots.

• In the above example only two sensors are awake and ready to transmit (sensors 2 and 4).

• Sensor 2 emits energy in mini-slots 2, 8 and 11 according to the pattern assigned to its second message, and Sensor 4 emits energy in minislots 1, 6 and 11 in line with the pattern assigned to its third message.

• The received signal at the sink is a combination of the two transmitted sequences (energy at minislots 1, 2, 6, 8 and 11, with some additional noise).

• The sink performs an energy detection procedure on the received signal according to a predefined threshold, identifying which minislots were busy and which were idle (below the energy threshold). Note that because of the energy aggregate, the receiver gain may be saturated (e.g., several sensors emitted energy into an equivalent minislot) yet all the sink must identify is on which minislots the energy is above the background noise level (above the threshold).

• In other words, each minislot should be at a length sufficient to decode one bit and the sink cares only about the Boolean sum of the "bit" patterns used by the transmitting sensors. Based on the filtered sequence the sink deduces which set of transmitted sequences could have generated the sequence received.

EAR-MCP Techniques

In this proposed work, we use a dynamic routing protocol, called Maximum Capacity Path (MCP), as the underlying routing protocol of the proposed routing method. The MCP is proposed to perform well in prolonging network lifetime during a WSN. In the following, we'll use an example for instance the procedure steps of the MCP routing algorithm.

A WSN and its current residual battery energy level of sensor node can be modelled by a capacity graph G = (V, E), where set V denotes the gathering of sensor nodes and E denotes all of the possible direct communication between sensor nodes. And let r: V → R+ be the residual battery energy function to represent each sensor's residual battery energy.

For example node s stands for the sink with infinity energy due to the very fact that it can connect to a power line or is provided with a very large capacity battery compared thereto of the sensor nodes. The value that's related to node a is adequate to 50, which stands for the present residual battery energy of sensor node a.

Detailed operations for layering the graph within the initiative are as follows. Let level number Lv with reference to each sensor node v ∈ V denotes the shortest path length from v to the sink s

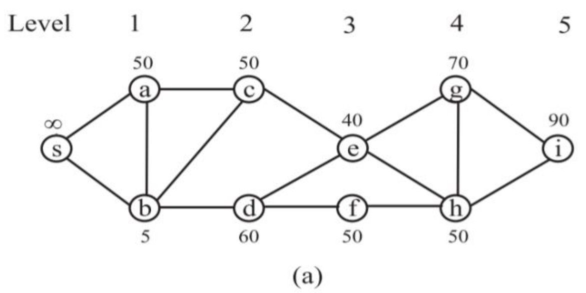

Fig. 3. MCP routing algorithm

For the example in Fig. (3), since the shortest path length from nodes g and h to node s are both 4, Lg = Lh = 4. The layered network N will be obtained from graph G by deleting the edges (u,v) ∈ E such Lu = Lv.

For example, as shown in Fig. (3), since La = Lb = 1 and Lg = Lh = 4, then edges (a, b) and (g, h) are going to be deleted from G. Then the layered network N obtained from G may be a directed graph, such for all of the remaining edges (u,v) ∈ E after the deleting operation, the directed edge (u,v) from node u to node v, if Lu = Lv + 1.

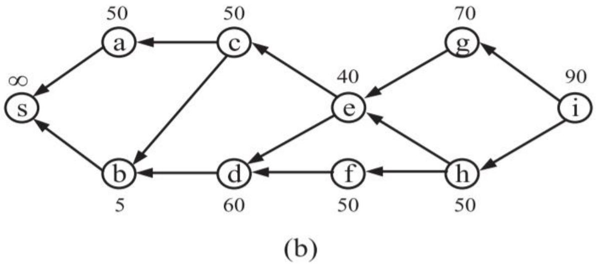

Fig . 4. MCP working 1

Fig. (4) shows the resulting network obtained from G in Fig. (3). Let Pus = u, u1, u2,..., ul, s be a path from node u to the sink s in N. And we let the capacity c(Pus) of path Pus be the minimum value of residual battery energy in path Pus; that is, c(Pus) = min{ r(u),r(u1),r(u2), . . . , r(ul)}. Let P∗us be the utmost capacity path with the utmost capacity value among every path from node u to s. The resulting graph of the union of each maximum capacity path P∗us, ∀u ∈ V will be the routing paths for message reporting.

For example Fig. (5) shows the resulting maximum capacity paths obtained from the layered graph N of Fig. (b). the above operations are the second procedure steps of the MCP. Now, as a sensor node u detects an abnormal event or has sensed data to report back to the sink node s, then the message are going to be relayed along the maximum capacity path P∗us to s.

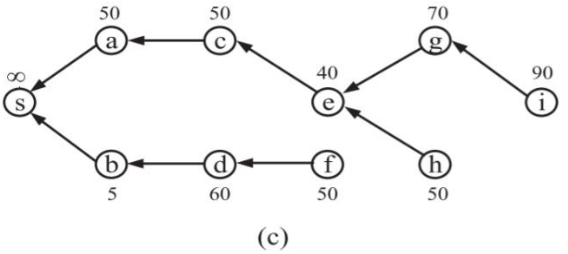

Fig. 5. MCP working 2

For example, the maximum capacity path P∗gs = g, e, c, a, s. After the message relaying from node g to s along path P∗gs, the residual battery energy of each sensor node in the path is updated accordingly. The above three procedure steps are going to be repeated for every transmission round until one among the nodes drains out its battery energy.

Experimental results

In this module, a wireless sensor network is created. All the nodes are configured and randomly deployed within the network area. Since our network may be a wireless sensor network, nodes are assigned with initial energy, transmitting energy and receiving energy. A routing protocol is implemented in the network. Sender and receiver nodes are randomly selected and therefore the communication is initiated. Initialize the wireless network nodes with multihop network by randomly deploying 30 nodes in an area of 1200 X 1200. Nodes are assigned with initial energy, transmitting energy and receiving energy. A routing protocol is implemented in the network. Sender and receiver nodes are randomly selected. Simulation parameters are listed in table 1.

Table 1. Simulation parameters

Simulator	NS2
Simulation time	10s
Area	1200X1200
Number of node	30
Physical Layer	IEEE 802.11
Routing protocol	AODV/EARR
Mobility model	Random way point
Radio type	802.11a/g
Transmission rate	10 packets/s
Packet Size	512/ 1024
Pause time	0 s

Here X Axis represents the number of nodes and the y axis represents the energy in the network. In case of proposed network, the predictive rules are implemented. The results shows that the conferred work offers the packet lost at the beginning, however because the algorithmic approach is enforced and thus the route reconfiguration is finished, then no a lot of knowledge lost is there.

Network deployment

All the nodes are configured to exchange the location and initial energy information among all the nodes. All the nodes are configured to exchange the situation and initial energy information among all the nodes.

A routing protocol is implemented in the network. Base Station is configured with highest communication range. The proposed scheme generates lower normalized routing overhead than the MCP-based WSN and existing routing.

The fig. 6 is showing the comparison graph to represent the number of packets delay over the network in Existing and Proposed Approach. Here X Axis represents the nodes and the y axis represents the number of packets delay in the network. The results show that the packet delay in proposed work is reduced.

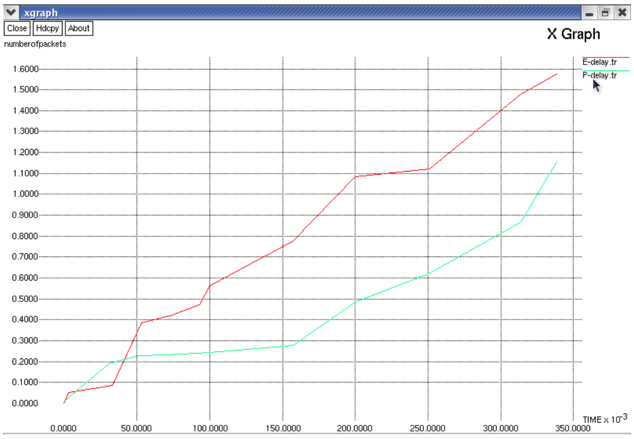

Fig. 6. Delay vs. Time

Fig. 7 shows the response time for node mobility events and is compared with the LEACH-networks. This experiment considers the link failure issue for a single data flow and the influence of other background traffic is not considered here. The fig. 7 is representing the graph which analysis on last packet time over the network. Here X Axis represents the number of nodes and the y axis represents the last throughput. The results here shows that the in both kind of network the communication is performed on same rate but the difference is in terms of packet forwarding and rerouting of the network.

As shown in fig. 8, the proposed TLS scheme generates lower normalized routing overhead than the AODV routing. The fig. 8 is showing the comparison graph to represent the number of energy over the network in Existing and Proposed Approach. Here X Axis represents the nodes and the y axis represents the number of packets delay in the network. The results show that the packet delay in proposed work is reduced. Data Transmission is established between nodes using UDP agent and CBR traffic. In this module, to enable all the nodes to get the global energy model, we propose a proposed algorithm, that under this general dynamic battery model, there exists an optimal policy consisting of time-invariant routing probabilities during a fixed topology network and these are often obtained by solving a group of problems. In this proposed work, we use a dynamic routing protocol, called MCP.

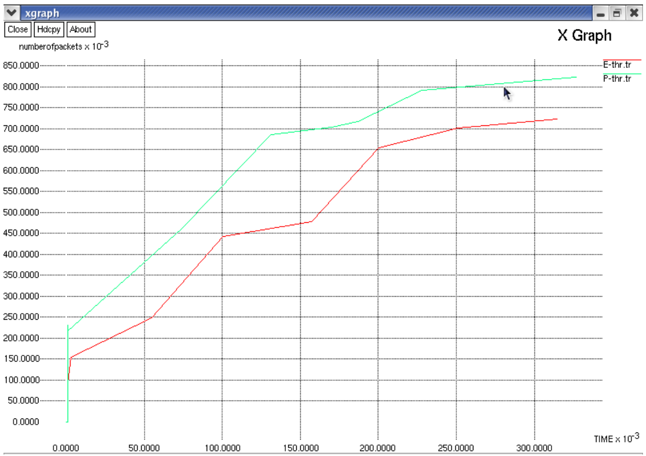

Fig. 7. Throughputs vs. Time

Exchange all node energy and location information. Determining the utmost capacity path for every sensor node; and Routing performed and residual energy updated. The MCP will iteratively perform the above three steps for every.

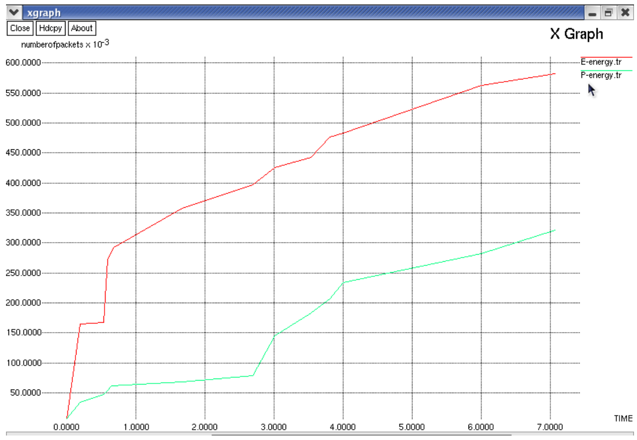

Fig. 8. Energy vs. Nodes

Performance metrics

Throughput

It is the ratio of the total number of bits transmitted (Btx) to the time required for this transmission, i.e. the difference of data transmission end time and start time (tstart).

Throughput = (Btx)/(tend – tstart) bps

Packet Delivery Ratio

The pktdi is the number of packets received by the destination node in the i^{th} application, and pktsi is the number of packets sent by the source node in its application.

Average End-to-End Delay

It is average transmission delay of packets transmitted from source to destination. D is computed as the ratio of the sum of individual delay of each received data packet to the total number of data packets received.

D= number of received packed/total time

Conclusion

Choosing an energy-efficient routing algorithm that distributes the load within the network evenly may be a challenging process. A relocatable sink is another approach for prolonging network lifetime by avoiding staying at a particular location for too long which can harm the lifetime of nearby sensor nodes. This approach can not only relieve the burden of the hot-spot, but can also integrate the energy-aware routing to enhance the performance of the prolonging network lifetime. In this thesis, proposed an energy-aware CH relocation method, which adopts the modified energy-aware routing MCP as the underlying routing method for message relaying. An energy-green routing set of rules that distributes the load inside the network calmly is a difficult process. Using the MEAR protocol, more advantageous routing process can be used correctly in scenarios like environmental tracking using IoT. Simulation outcome shows advanced community performance for metrics which incorporates residual electricity, packets sent to BS, throughput and lifelong

Conflict of interest

I declare no conflict of interest of this work.

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