A New Method to Increase Fault Tolerance in Wireless Sensor Networks (WSNFT)

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Abstract
The most important challenge of wireless sensor network is to improve fault tolerance of each node and supply routing service energy. The aim of this paper is nodes' energy-efficient fault detection and its recovery for wireless sensor networks that this plan is provided to enhance the energy efficiency of wireless sensor networks and increase fault tolerance. The shortest route guarantees Energy Efficient Routing that the routing is done by Dijkstra algorithm.

Key-words:
wireless sensor network (WSN), Fault Tolerance (FT), Single rate routing

1. Introduction

One of the most important means of obtaining information and understand the environment that has been focused by many studies is wireless sensor networks. Despite advances in this type of network, sensor nodes due to the large number, small size and ad hoc placement are still dependent on low power batteries to provide their energy.

Also due to the use of such networks in harsh and inaccessible environments, it is not possible to recharge or replace the sensor nodes. Therefore, one of the most important issues in wireless sensor networks is the problem of severe energy constraints. Also, since the sensor network efficiency heavily depends on its lifetime and coverage, considering the energy storage algorithms in designing sensor networks with long lifetime is vital. Today dynamic power management techniques that reduce energy consumption of sensor networks after their design and placement is very important. A wireless sensor network routing is large system of parallel or distributed processing elements interconnected in a graph topology. Thus wireless sensor network routing can be a useful tool in wireless sensor networks and by reducing the need for wireless communication it has a significant impact on sensor networks and extending their lifetime. The aim of this study is to develop an optimized method to reduce energy consumption in sensor networks using Dijkstra's algorithm. In the following Figure a complete sensor is displayed:

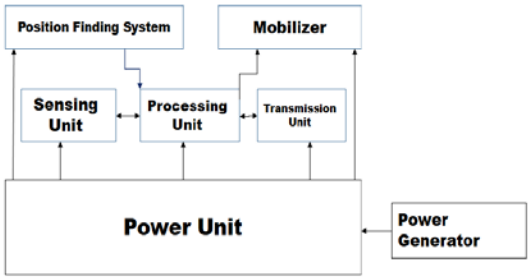

Fig. 1 Sensor Unit

2. Statement of the problem

Wireless communications have numerous advantages compared to traditional wired networks and they are able to develop small, low-cost, low-power and multi-functional sensing devices.

The sensor nodes' easy development, small size and low cost makes it possible to deploy them in large numbers in the area to be examined.

The route selection of each message is caused by the communication pattern in both network delay operations which is done by choosing long routes including the sensor nodes or reducing the network lifetime in short paths as a result of battery discharge.

In addition, unnecessary load on a network and the delay in performance not only leads to software degradation but also results in waste of network resources. All of these routing protocols have different characteristics in terms of quality and competition.

Therefore, choosing the correct routing protocols is critical.

In this paper, two main classes of wireless sensor network i.e. data collection and routing are studied.

We have identified the prerequisites for each of these classes precisely.

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Then the protocols and the design of communication challenges were studied in detail for routing protocols. An example of simulation and routing using Dijkstra's algorithm is provided below:

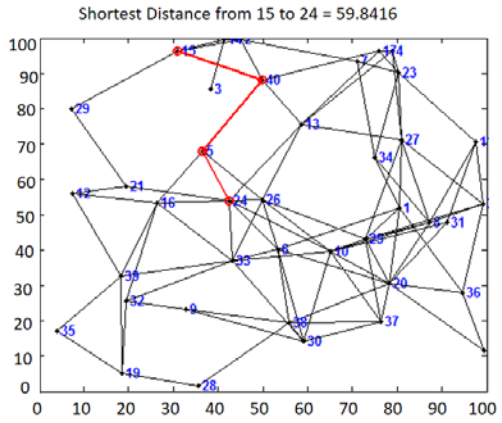

Fig. 2 simulation and routing using Dijkstra's algorithm

Wireless sensor networks can be developed due to various types of applications based on their need for information delivery, type of application and the target application. Routing is a challenging task in wireless sensor network that is distinguished from other wired and wireless networks such as cellular or temporary mobile networks due to unique features.

There are communication challenges and different designs in wireless sensor network because of its scope and network structure. Moreover, the limited nature of resources also makes it more difficult to deal with these challenges. A node in a sensor network can be expanded randomly or deterministically. In the deterministic method nodes are placed on predetermined routes and routing is done along these routes while in the random method the nodes are distributed over the wireless sensor network. In sensor applications the demand for message delivery varies from program to program. Some applications only need to have a successful delivery from the source to destination, while other applications are more interested in real-time message delivery. In Dijkstra's algorithm each sensor node transfers data to a base station via the shortest route. If network or node failure occurs, they will improve very quickly. Data can be transmitted to the base station with a minimum wasted time and energy. In Dijkstra's algorithm, when the data are sent to the cluster head or base station, the traffic controls the data. In Dijkstra's algorithm the size of the clusters is calculated based on the cluster head. The CH load depends on the number of received messages at the CH and the number of transmitted data from the top of the cluster. In FTWSN[1] algorithm the sensor nodes are arranged among small clusters. Each cluster contains a cluster head node and cluster member. Cluster member nodes send their data to the chain in the shortest path. Within a cluster a cluster member sends its data to other cluster nodes through the path. Node data are collected by the nearest neighbor and transfer to the CHs through the shortest route.

If a node does not receive data from its neighboring nodes for a period of time, the node sends a health message to adjacent nodes and waits for a broadcasted message. If all adjacent nodes are broadcast that health message, it concludes that a transfer fault has occurred in the previous transmission.

On the other hand, if a node does not receive any broadcasted message against the health messages, the node concludes that the receiver circuit is faulty.

However, if none of the neighboring nodes broadcast the health message, the node concludes that the transmitter circuit is faulty. Then the node notified all neighboring nodes about this. Fault in the sensing circuit is detected by the node by comparing its sensory data with data received from adjacent nodes. If the evaluated data is less than the threshold value, the sensor node circuit is active. If the evaluated data is higher than the threshold value, the sensor node circuit is faulty.

In this algorithm, each node creates an interval time between the transmissions of two different packets of data at the same route.

When a sensor node receives a new data from other nodes, it analyzes the shortest route condition for data transmission.

If the shortest path is not faulty and not used frequently, it receives the data transmitted via the shortest route. Each node it creates a time gap for data transmission via each route. Here a short route[2] is used to transfer and receive information and communicate between the nodes and in the next step using the fault detection algorithms[3] the possible faults between and within the nodes are addressed. In the following Figure data traffic management is expressed:

[1] Foult Tolerance In Wireless Sensor Network
[2] Dijkstra's algorithm
[3] FTMRS

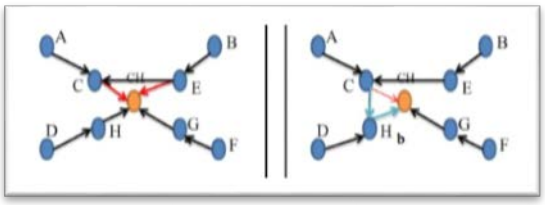

Fig. 3 data traffic management

In Figure3. a when node ‘E’ transmits data to cluster head then transmission fault occurs. For

this reason ‘E’ transmit data to neighbour node ‘C’. When ‘C’ receives E’s message then it sends

the data via available shortest path, as is shown in Figure 3 b, via node ‘H’. In our proposed

scheme, instead of initial multipath data propagation as in [2],[1], it sends the data through a

single shortest path. However, if data transmission faults occur in that path then it will send the

data through alternative backup path. Therefore, the energy wastage for multipath data

propagation can be saved in FTMRS. Transmission energy loss of a sensor node is TE [2, 4].

In previous algorithms such as Dijkstra's algorithm only routing is addressed that the lack of fault detection algorithm is among the most important disadvantages of these algorithms but in the FTMRS algorithm fault detection is the positive point that increases efficiency, system performance and fault tolerance that the data shall reach their destination under any condition. One of the FTMRS disadvantages is multiline routing and the use of the backup route; system efficiency is reduced in FTMRS because before starting communication between nodes the routes should be navigated and processed and stored in memory which reduces the node’s energy [3, 5, 6]. In this paper the FTWSN is proposed. In this way, navigation and routing between nodes is implemented by Dijkstra's algorithm, detecting the faulty nodes, faulty route and fault recovery using the FTMRS method.

3. Importance

Since time in wireless sensor network is one of the determining factors in the communication between the nodes and time has a direct relationship with the efficiency of the algorithm, in FTWSN the time to send and receive data is one of the priorities. One of the positive results in this algorithm is to choose the shortest path, fast fault recovery, deterministic data transfer at the shortest time and the knowledge of the base station about the system health and increased node energy.

4. Review of research

Multipath routing protocols as their name suggests choose different routes to deliver a message and reduce network delay. Since network routes are kept active by sending periodic messages, they should consume the highest energy. Inquiry based routing protocols work based on sending and receiving questions to data.

Negotiation based routing protocols: these classes of protocols use a high level of descriptor data to remove additional data transmitted through negotiation.

Integrated data processing routing protocol is used when efficient energy routing is required. Sensors are under routing operations due to the following reasons:

Node extension, transmission media, connection, coverage, fault tolerance, scalability, data collection and quality of services.

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