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Sensor Node Failure Detection Based On Round Trip Delay And Paths In Wsns

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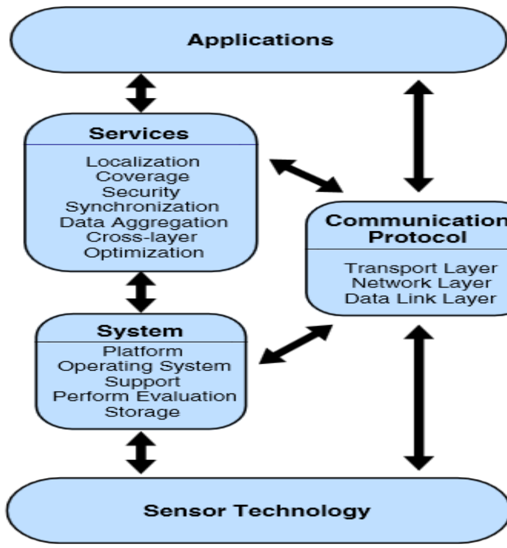
***ABSTRACT*--A Wireless Sensor Network (WSN) has essential applications that are used in remote coincidental monitoring and destination tracking. In this paper we propose sensor node failure detection based on the trip delay and paths using wireless sensor network. The architecture of a WSN may involves decidedly on the application and it must including some factor such as coincidental, the application architecture objectives, charge, fixtures, system restraint. Fault tolerance is the main crucial issues in wireless sensor network. The future state that handle the lifetime of a sensor nodes abandon and it involves on the combined with genetic algorithm. In the Fault Node Recovery algorithm which change the deactivated sensor nodes and used more reused finding way. In the reflection of Fault Recovery algorithm that recede the data loss rate by approximately 90% and reduces the rate of energy consumption by 70%.**

Keywords: WSNS, RTP, RTD, Sensor

I. INTRODUCTION

Wireless sensor networks (WSNs) have gained world- wide attention in recent years, particularly with the proliferation in Micro-Electro-Mechanical Systems (MEMS) technology which has facilitated the development of smart sensors [1]. These sensors are small, with limited processing and computing resources, and they are inexpensive compared to traditional sensors. These sensor nodes can sense, measure, and gather information from the environment and, based on some local decision process, they can transmit the sensed data to the user. A fault node recovery (FNR) algorithm to enhance the lifetime of a wireless sensor network (WSN) when some of the sensor nodes shut down, either because they no longer have battery energy or they have reached their operational threshold [2]. Using the FNR algorithm can result in fewer replacements of sensor nodes and more reused routing paths. Thus, the algorithm not only enhances the WSN lifetime but also reduces the cost of replacing the sensor nodes.

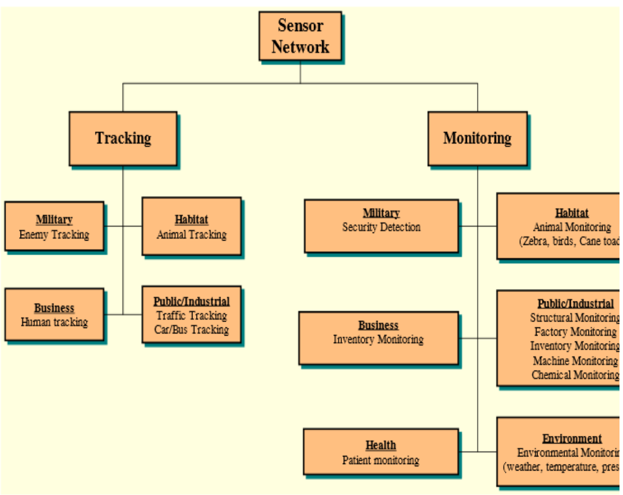


Various Issues of WSN

Smart sensor nodes are low power devices equipped with one or more sensors, a processor, memory, a power supply, a radio, and an actuator. A variety of mechanical, thermal, biological, chemical, optical, and magnetic sensors may be attached to the sensor node to measure properties of the environment. Since the sensor nodes have limited memory and are typically deployed in difficult-to-access locations, a radio is implemented for wireless communication to transfer the data to a base station (e.g., a laptop, a personal handheld device, or an access point to a fixed infrastructure). Battery is the main power source in a sensor node. Secondary power supply that harvests power from the environment such as solar panels may be added to the node depending on the appropriateness of the environment where the sensor will be deployed. Depending on the application and the type of sensors used, actuators may be incorporated in the sensors.

II. RELATED WORK

Round trip delay time of the RTP will change due to faulty sensor node. It will be either infinity or higher than the threshold value. Faulty sensor node is detected by comparing the RTD time of RTPs with threshold value. The sensor node common to specific RTPs with infinity RTD time is detected as failed. If this time is higher than the threshold value then this senor node is detected as malfunctioning. Detection time of faulty sensor node depends upon the numbers of RTPs and RTD time. Therefore, RTD time measurement and evaluation of RTPs is must to minimize the detection time. Terrestrial WSNs typically consist of hundreds to thousands of inexpensive wireless sensor nodes deployed in a given area, either in an ad hoc or in a pre-planned manner. In ad hoc deployment, sensor nodes can be dropped from a plane and randomly placed into the target area. In pre-planned deployment, there is grid placement, optimal placement, 2-d and 3-d placement models.



Over View of Sensor Applications

A. DIRECTED DIFFUSION ALGORITHM

In the Directed Diffusion algorithm the source node will broadcast the RREQ packets to all its neighbors and then the neighbors will broadcast it its neighbors and the process repeats until the RREQ packet is received by the destination node. Therefore such a huge transmission of data will consume lot of power and decrease the battery life by which the nodes in the network will become no longer functional. The DD algorithm is also called as query-driven transmission protocol. The data will be transmitted only if it fits the query from sink node.

B. GRADE DIFFUSION ALGORITHM

In the Grade Diffusion algorithm the source node will broadcast the RREQ packets to all its neighbors and then the neighbors will broadcast it its neighbors and the process repeats until the RREQ packet is received by the destination node. Therefore such a huge transmission of data will consume lot of power and decrease the battery life by which the nodes in the network will become no longer functional. This algorithm was proposed by H C Shih et al in 2012. The main aim of this grade diffusion algorithm is to improve the ladder diffusion algorithm with ant colony optimization (LD-ACO). The GD algorithm is used to reduce the transmission loading. The GD algorithm also identifies a nearest neighboring nodes and creates the routing path for each sensor node. Regarding the data transmission the GD algorithm once identifying the neighbors then it generate the path based on set of rules. This algorithm has less data transmission loss and less hop count compare to DD algorithm.

C. GENETIC ALGORITHM

The Genetic algorithm is one of the best energy efficient algorithms in wireless sensor networks. It optimizes the signal strength of sensor nodes. This algorithm also helps in reducing the energy consumption and thus increases the life time of wireless sensor networks.

III. ROUND TRIP DELAY AND PATHS ANALYSIS

The Round Trip delay of the RTP will change due to faulty sensor node. It will be either infinity or higher than the threshold value. Faulty sensor node is detected by comparing the RTD time of RTPs with threshold value. The sensor node common to specific RTPs with infinity RTD time is detected as failed. If this time is higher than the threshold value then this sensor node is detected as malfunctioning. Detection time of faulty sensor node depends upon the numbers of RTPs and RTD time. Therefore, RTD time measurement and evaluation of RTPs is must to minimize the detection time.

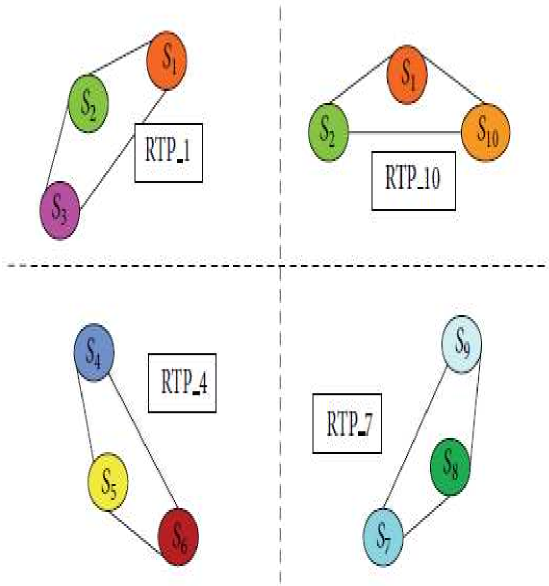
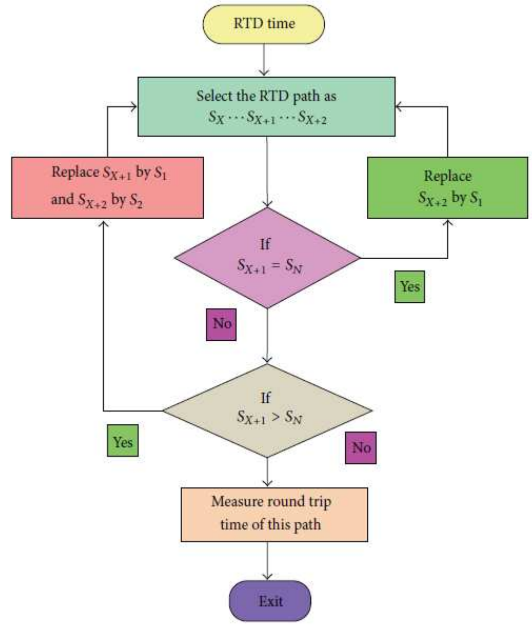


Illustration of four discrete RTPs

A RTD Time Estimation RTD time mainly depends upon the numbers of sensor node present in the round trip path and the distance between them. Some faults in communication and sensor reading may happen which can be tolerated to some extend by using time redundancy. To reduce the delay in time redundancy the interval in the sliding window is increased. Sensor nodes that are permanently failed in the network are identified with high accuracy. The round trip path (RTP) in WSNs is formed by grouping minimum three sensor nodes. Hence the minimum round trip delay time (τRTD) of RTP with three sensor node is given by $\tau RTD = \tau 1 + \tau 2 + \tau 3$ where $\tau 1$, $\tau 2$ and $\tau 3$ are the delays for sensor node pairs. On the basis of this RTD time, these RTPs are compared to detect the faulty sensor node. Detected faulty sensor node, which can be either failed or malfunctioning, is verified by comparing the RTD times of respective RTPs with threshold time.



Algorithm to measure RTD time of RTPs.

The accuracy can be increased by reducing the RTD time of RTP. It can be decreased only by reducing the sensor nodes in RTP because the distance between sensor nodes in WSNs is round trip path and the distance between them. The accuracy can be increased by reducing the RTD time of RTP. It can be decreased only by reducing the sensor nodes in RTP because the distance between sensor nodes in WSNs is particular applications and can't be decided. Selecting minimum numbers of sensor nodes in the RTP will reduce the RTD time.

IV. NODE FAILURE DETECTION

If a fault occurs in cluster head, its members should be recovered to other cluster heads. We have done recovery of sensors of faulty cluster head with genetic algorithm. So, the chromosome which represents a solution should show that each member of cluster assigned to which cluster head. A chromosome in the proposed algorithm is a vector which has a size equals to the number of cluster members and the contents of each gene is one of the live cluster heads which could be obtained by generating a random number between 1 and the number of cluster heads. A sample chromosome after fault occurring in cluster head, its nodes should be recovered.

Step-1: Select any sensor node K_X from WSN with N se
nodes. The values of X = 1, 2, 3, …….. N (K_1<=K_X<=K_2).
Step-2: RTP_X formed has sensor sequences as K_X –K
K_{X+2}.
Step-3: Call subroutine "RTD Time".
RTD Time subroutine
I. If $K_{X+1} = K_N$ then replace K_{X+2} by K_1.
Else if $K_{X+1} > K_N$ then replace K_{X+1} by K_1 and K_{X+2} by
respectively.
II. Measure the round trip delay time of corresponding R
Initially it is RTP_X.
III. Return to main program.
Step-4: If $\tau_{RTD\_X} = \tau_{THR}$ then increment K_X by 3($K_X = K_{X+3}$)
If $K_{X+3} > K_N$ then reset K_{X+3} to K_N and go to Ste
Else go to Step 2.
Else Call subroutine "RTD Time".
Measure RTD time of RTP_(X+1) having sequence as K
K_{X+2} - K_{X+3}.
Step-5: If $\tau_{RTD\_(X+1)} = \tau_{THR}$ then go to Step 7.
Else if $\tau_{RTD\_X} = \infty$ then K_X node is failed (dead).
Otherwise K_X node is malfunctioning.
Step-6: Go to Step 4.
Step-7: Call Subroutine "RTD Time".
Measure RTD time of RTP_(X+2) having sequence as K
K_{X+3} – K_{X+4}.
Step-8: If $\tau_{RTD\_(X+2)} = \tau_{THR}$ then go to Step 10
Else if $\tau_{RTD\_(X+1)} = \infty$ then K_{X+1} node is failed (dead).
Otherwise K_{X+1} node is malfunctioning.
Step-9: Go to Step 4.
Step-10: If $\tau_{RTD\_(X+2)} = \infty$ then K_{X+2} node is failed (dead).
Otherwise K_{X+2} node is malfunctioning.
Step-11: If $S_{X+2} > S_N$ then go to Step 4.
Step-12: Stop.

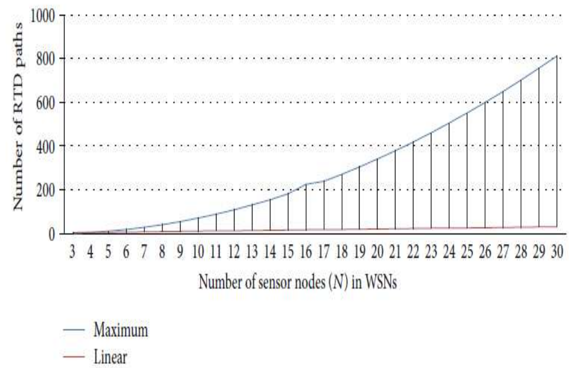
Algorithm for detecting fault node using RTP

The number of faulty cluster head nodes determines the length of each chromosome and the population size that is specified at the first number, chromosomes are produced whose gene contents is a random number between 1 and the number of cluster heads.

After producing the primary population, the quality of each chromosome should be evaluated, this is done by fitness function. Fitness function considers three parameters to recover each node to cluster heads where these parameters include the distance of a node being recovered to given cluster head, remained energy of cluster head and the member number of a cluster head for which the current node would be recovered.

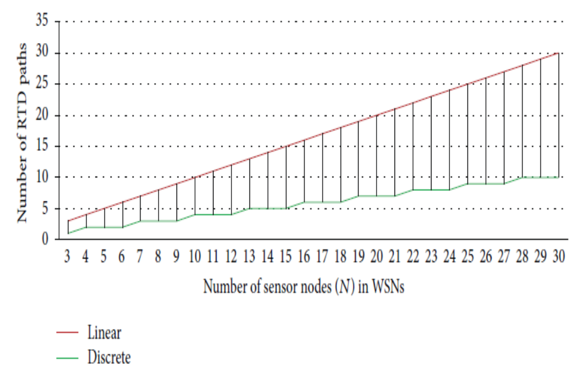
V. ALGORITHM TO DETECT THE FAULTY NODE

Initially all sensor nodes in WSNs are considered as working properly then program is executed in discrete steps to measure the RTD time of all discrete RTPs. The discrete round trip paths are selected by using step size of three; that is, incrementing sensor node value by three.



Maximum and linear RTPs for WSNs

The subroutine is used to measure the round trip delay time of respective RTP. Highest RTD time measured during this process is selected as threshold time for all discrete RTPs in WSNs. The algorithm designed to detect both cases of faulty sensor node sequentially like failed (dead) and malfunctioning.



Linear and discrete RTPs in WSNs

Faulty sensor node detection process starts sequentially by comparing the RTD times of discrete RTPs with threshold time. If the RTD time of particular discrete RTP is found to be higher than the threshold time, then this discrete RTP is analyzed in depth with two additional stages. Let discrete path RTP_*X* with source node S_X has the RTD time higher than threshold time, while other discrete RTPs have

RTD time less than the threshold time. Analysis time of the method suggested here to detect the fault is optimized to a large extent due to the discrete RTPs. Each discrete RTP has a unique source node and is formed by grouping three sensor nodes. Minimum contribution of sensor node in fault detection is effectively managed by discrete RTPs in WSNs. Energy consumed by sensor node is reduced due to less utilization in fault detection, therefore increasing the lifetime. Thus, the overall lifetime of WSNs is improved significantly. Quality of service (QoS) of WSNs is determined by its lifetime. Improvement in lifetime of sensor node eventually enhances the lifetime of WSNs and will provide better quality of service (QoS).

VI. CONCLUSION

The proposed method requires few calculation in case of balanced network conditions. Because of this it requires less time and has good accuracy. The faulty sensor node detection in wireless sensor networks. Unique round trip paths are tabbed and correlated with threshold time to find the failed in the malfunction sensor node. The algorithm is making easy to monitor and pinpoint the fault in WSNS completely. Fault detection completely is handled the node by selecting the discrete RTPS. The proposed methods are strongly analyzed on the sensor network with WSNs with different sensor nodes. Selection all the sensor node in WSNS is hardly utilized in fault detection due to node failure detection. The wireless device interfaced with sensor circuit plays a major role in the measurement of round trip delay time for sensor node failure detection.

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