MODEL OF FAULT DETECTION AND RECOVERY FOR WIRELESS SENSOR'S NETWORK

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ABSTRACT: Wireless Sensor's networks (WSN's) are type of wireless ad hoc networks with reduced or no mobility. These networks combine wireless communication with minimal onboard computation facilities for sensing and monitoring of physical and environmental phenomena. Much work has been reported on different aspects of wireless sensor's networks; however, less attention has been paid on addressing fault detection and recovery in these networks. Fault could be any thing which can lead communication break down as a whole or part of a wireless sensor's network. Thus, detection of such fault attains a primary focus to support smooth communications within such networks.
Mobile Ad-hoc On Demand Data Delivery Protocol (MAODDP) belongs to on-demand data delivery type routing family of mobile ad-hoc networks. MAODDP has since then been extended to offer similar services in WSN's. The contribution of this paper is to introduce an efficient fault detection and recovery mechanism for WSN's network. We believe this two step model can offer a robust solution for the fault management in Wireless Sensor's Network.
KEYWORDS: MAODDP; Fault Detection; Fault Management; Wireless Sensors Network.

1. INTRODUCTION

With the recent advances in technologies miniaturization of computing and sensing technologies enables the development of tiny, and low-cost sensors and controller [A+C02]. There is an increasing focus on these systems is observed in the civil domain to monitor and to protect critical infrastructure such as bridges and tunnels etc [KW05]. Such wireless networks of distributed sensor nodes are commonly known as Wireless Sensor Networks (WSNs) [Kri05]. WSN's have its origin from mobile ad-hoc network [SMZ07]. Mobile ad-hoc network is the collection of mobile nodes establishing network without requiring any supporting infrastructure [Bak10a].
Sensor link the physical world with the digital world by capturing, interacting and revealing real-world objects into a form that can be stored, processed and analyzed [AV10]. Sensor can help to monitor and avoid catastrophic infrastructure failures, conserve precious natural resources, increase productivity, and enable new applications such as smart homes and smart cities technologies [CA06].
Mobile ad-hoc on-demand data delivery protocol (MAODDP) is an on-demand data delivery protocol focusing route establishment and data delivery one after the other simultaneously at the same time [Bak10b]. MAODDP has been extended to support similar operation in related network. The contribution of this work is to introduce a novel two step model of fault management for WSN's. In this context, this work has been organized as follows. In section 2 A detail overview of the proposed two step model is presented. In section 3 A conclusive discussions on the presented model is highlighted and conclusion and future work are covered in section 4.

2. MODEL OF FAULT DETECTION AND RECOVERY IN A WIRELESS SENSOR'S NETWORK

The structure of wireless sensor network could take one of many forms therefore standard fault detection mechanisms might not be suitable under different scenarios or structure formation. However, types of faults to some extent directly related with specific structural deployment of a WSN. It is therefore important to know what types of fault could encounter in an established WSN's.
Among the many types of faults, link breakage could be seen as one of the common faults which might be found in any wireless sensor's network irrespective of which structure it follows. Such faults could happen in one of many situations which depend of various restrictions of devices participating in a network. Therefore, it is important that fault detection mechanisms should put minimum or in ideal case no extra burden on network available resources. Examples of some such resources are bandwidth and battery power as in the case of wireless sensors networks.
It has been mentioned that devices in a sensors network generally operate at a low battery power. Extra operational requirements may develop a situation where most of the available battery power consumes in tasks other then real communication. Similarly the same could pose additional

requirements to the available bandwidth resulting slowing down communication or data transfer, thereby, degrading performance of a WSN.

It is quite understandable that the CLUSTER HEAD (CH) OR GROUP LEADER of a GROUP cannot all alone handle such failures OR errors. In due course, errors could also be some thing other then fault detection. However, this term has been used synonymously in place of faults in the available literature. CH can function better if a fault detection mechanism can follow a distributed set of an operation. Since, it is quite obvious that in most of the network life CH would be busy in communicating with SINK in order for collected data to be delivered at the base station. It is off interest that there is one of many possible ways of CH selection as reported in the existing literature. However, in a general sense a NODE or a STATION with high power and storage capacity could be a standard choice.

It is highly unlikely that a fault detection and recovery solution requiring some additional tasks for Cluster Head to perform could full-fill all the requirements. It is partially due to the same reasons that this particular area stands alone and requires some better mechanism of handling issue being discussed.

Fault detection and fault recovery are interrelated with each other. On one hand where fault detection is considered on other side fault recovery has to be taken on board at the same time. A general principle as outlined in the above discussion has been followed in the proposed fault detection and recovery for WSN's and is as follows.

2.1. Time State

It is in view of this a TIME state has been introduced as a part of HEADER of a data packet in MAODDP. Such factor could be used either to calculate or to determine a successful data delivery. It is useful to mention that TIME factor is one of some novel factor of the presented mechanism. Wireless node has also been made responsible to take necessary steps in case a node feels some communication disturbances. This model has been named as a two steps due to the above mentioned actions which are introduced to ensure error free communication. TIME state 'T' not only ensures effective communication but also validates known path entries of WSN's nodes.

2.2. Data Communication

If an acknowledged or replied is not receive within the time 'T' a wireless node regardless of status i.e. head or a member can either consider resending the data packet or a query could be initiated to the node closest to the desired destination. A limit of maximum two reattempts has been added as a crucial part of the proposed scheme. In between these two attempts the first one must be done and the second is optional. Therefore, if the node is not in a position where it can make a second attempt subsequent retry is not required.

A sensor node could chose to conserve power then to consume it in another attempt. If after first or second retries NO STATUS UPDATE is received, such destination is MARKED as UNAVILABLE OR DEAD. In order to minimize addition tasks, SOURCE node is not required to ISSUE any UPDATE notification about the DEAD node rather a NOVEL approach has been introduced.

2.3. Dead Node

In the adopted procedure in MAODDP, a node having information about a DEAD node, add a reference to it in the next communication to any node in the network. Such entries are marked with ('D' + 'MNO') where D represents a Dead node and MNO represent the dead node member number. A retry to any of the wireless node can alert all the nodes in the path to the destination node about a possible break. Such node would also follow the above procedure for minimum of one subsequent communication cycle. It is self explanatory that all group members became aware of a possible DEAD node in due time. An account of SLEEPING MODE has also been considered; therefore a soft measure of RE-ALIVE Header has been added. In essence if a node misses a communication due to being in a sleep mode and discover again, any such discovering could be marked as ('RAL'+'MNO'), here RAL denotes re-alive and MNO is for member number. Such MARKS are added only once by all the nodes in the path in very next data transmission.

2.4. Sleep Mode

In relation with SLEEP MODE depends on a wireless sensor's network formation, a node might be given permission to switch into SLEEP MODE. In other words, during such mode nodes are considered in an active transmission. In addition to the above, though Status Time calculation can also reflect such situation, however, such precaution is added to avoid any minor possibility. In second step of a two steps model if a node does not hear delivery confirmation from the CH, it can follow the same procedure of retries as mentioned earlier in STEP one.

2.5. Route Finder

Based on relation between CH and a member node retries does not mean that NODE should STOP sending collected data rather a ROUTE FINDER PACKET (RFP) is broadcast by a node who have lost path to the CH. Such measures are necessary to enable node performing primary tasks of such deployments. A ROUTE FOUND PACKET (RFP) is sent back to such node from any of the NODE having an active path to the CH.

3. DISCUSSION

It is evident from the above discussion that such approach is feasible in terms of refreshing route or communication path between the member nodes and the CH. Moreover, it is also beneficial in avoiding NETWORK REBOT option which could otherwise result in data lost. NETWORK REBOTTING is an available option if a WSN's suffers badly with huge faults resulting communication dropped at a large scale. Such situation could force a WSN's to reboot in order to reconfigure network topology.

In worst scenarios, network formation pattern could also be taken into account. It can be concluded that proposed mechanism offer a reliable and quick FAULT detection and recovery for a WSN. Similarly, based on the given specification very less temporary additional tasks are taken to make it an effective solution for fault management in a wireless sensor's network.

4. CONCLUSIONS AND FUTURE WORK

Wireless sensors networks are well known for providing data collection and monitoring services. The focus of on-going research is to develop future generation WSN's which are equipped with efficient fault discovery and recovery mechanisms. The presented two steps model if adopted can yield an efficient fault management system for WSN's. In future, we will be looking into a more practical side of the presented mechanism. We are committed to share our future finding with the ongoing research in this area.

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