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Mobile Agent Fault Management in Wireless Sensor Networks

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Abstract- Wireless sensor networks process the large amount of data sense by sensor nodes in low cost. Many factors are responsible in occurring of many types of errors or faults such as harsh environment and limited hardware resources for processing. For solving this problem, first i have discuss the faults or the types of failure in network, describe the approaches of fault management. Various effective algorithms or adaptive fault tolerant mechanisms are designed till now to achieve a good fault management. We will first describe fault management approaches and Limitations of these approaches and finally try to recover the faults by the concept of mobile agents.

K**eywords-*Wireless Sensor Nodes, Mobile Agent, Fault Management approaches.***

I. INTRODUCTION

A wireless sensor network is a collection of many sensor nodes which has a capability of wireless communication and sensing the network. Wireless sensor network has lot of nodes which has capability to convert the sensed characteristics such as temperature, pressure into a form recognize by user. These sensor nodes have limited processing power, finite energy supply. wireless sensor networks are deployed in the remote areas ,like environmental sensing such as oceans, glaciers, volcanoes etc. Where they can't operate properly. Hence different types of faults occur in the network.

II. FAULT MANAGEMENT

Fault management is very important because network service providers might loss customers if they do not provide efficient service. For example, if users wait for a long time in accessing information , it would be very frustrating for the user. So the fault management detecting, repairing problems in the network at that time. It also deals with the ability to trace faults, given many alarms in the system. Furthermore, it is also concerned with the use of error logs, and tracing errors through the error log reports or database. One of the problems faced by network control centers (which manage such networks) is that of handling extremely large volumes of data dealing with the performance of the networks. It is often very difficult to determine the existence and location of a problem in the network if a network operator (at the network control center) would have to analyze the data. The volume of such data would make the task of finding the problem a very difficult and resource-consuming process. However, unlike some of the other network management functions listed in the ISO model, in fault management, speed is very crucial and recovery from a problem has to occur quickly. If the downtime for systems is high, it could lead to a financial loss.

III. TYPES OF FAULTS

There are three different types of Faults in the network

A. Permanent Faults: Hardware fault of a sensor node is permanent fault. It exists until the repair action has taken place.

B. Intermittent Faults: It is due to the unstable consequences of hardware and software characteristics. This implies maximum degradation of the service level for short period of time.

C. Transient Faults: It is due to the environment impact on sensor nodes and implies minor degradation of the services.

IV. FAULT MANAGEMENT APPROACHES

We Categorize these existing approaches according to different phases of fault management architecture that are

1) Fault Detection

Fault detection process helps that the services being provided are functioning properly. Fault detection approaches are classified into two types

A) Centralized approaches

In this approach ,most of the task are performed by central manager or base station(sink node) which have powerful resources(eg. Energy, Computing, and Memory etc).base Station use models to detect faults and life of an individual sensor node. The base station construct the map of the network with the help of routing update message providing a methods for recovering corrupted routes. Sympathy[19] uses algorithm to minimise the number of communication messages, a Sympathy node can transmit the important events to base station. WinMS[1] Warfighter Information Network

Management System compares the current and previous state of sensor nodes against overall network information model to detect the faults.

Drawbacks of centralized approaches

This centralized approach provides good fault management while it is not suitable for large scale networks.

Another drawback is that the central controller becomes a single point of data traffic concentration and hence consumes large amount of energy of the nodes.

Third, this central controller becomes a single point of failure for the entire network. If this central controller fails due to some error whole process disturbs.

B) Distributed Approaches

This approach distribute management functions throughout the network .A local node can take decision by itself, some of the messages may need to be delivered to the central manager. This approach conserve a lot of sensor node energy.

Now ,the clustering uses to creates energy balanced application for wireless sensor networks. It divides the whole network into a group of sensor nodes called clusters where one node is selected as a cluster head(CH) ,which has its associated sensor nodes called cluster members.CH executes different fault management functions to detect fault inside cluster proposed by Chessa [3].

Advantages of Distributed approach over the centralized approach, In this approach management responsibilities are transferred more towards the sensor nodes ,instead of a central manager, which ultimately makes the network more reliable and self-managed.

2) Fault Diagnosis

Now Fault diagnosis is the second phase of fault management, It identify the real cause of faults. Many methods already given for finding the location and cause of that particular fault, and how can we find it.

Where the fault is located?

What type of fault it is like node failure, link failure, traffic congestion , energy depletion etc?

How does a fault occurs by environment changes, hacker attacks, protocol implementation etc.

S. Babaie [2] presents the design of a decentralized fault diagnosis for a wireless sensor networks. Their system distinguish between multiple root causes of degraded performance and provides efficient feedback into the network to troubleshoot the problems. The root cause of this reduced sensor data throughput have been attributed in large part to hidden terminal conflicts, congestion, connectivity that exhibits irregular, asymmetric , and time –varying behaviour.

3) Fault Recovery

This is the final phase of the fault management where the sensor network is reconstructed and reconfigured in such a way that failure do not impact further on the network performance.

WinMS uses a pro-active technique to instruct nodes to send data less frequently to conserve energy. LEACH(Low energy adaptive clustering hierarchy)[15focus on the balanced energy consumption mechanism and they believe that recovery through neighbouring cluster head is better than a gateway node, network is restructured or reconfigured. When the fault in the network is detected and diagnosed properly then comes the turn to recover from the faults. Sometime the techniques or the protocols used in the network automatically repair or recover from the fault. As we discussed in fault diagnosis recovery from a link failure will be automatically made by routing protocol used by selecting other links in the network for the data transmission to minimize some cost metrics such as (ETX) Expected Transmission Count . Gaurav et al. [8] proposed different mechanism to reconnect the failed nodes.

V. PROBLEMS AND ISSUES

- Some schemes only consider permanent faults and avoid intermittent and transient faults in detecting approaches.
- Some frameworks require the external human manager to monitor the network management functionality e.g. TINY DB, MOTE-VEW, SNMP
- Fault recovery mechanism are mainly focus on small region and individual nodes that fully scalable.
- Absence of testing tool makes it difficult to test the progression of packets in the network .
- Recovery presents a number of technical challenges which include automatic recovery as a source of fault, the problem in fault administration is the maintenance of fault reports logs which has been made difficult to add and delete records so the logging facility should performed in a dynamic manner.
- A single failure can affect many active communication paths because a single failure may generate many secondary failures, they may occur around the same time.

VI. MOBILE AGENTS

A Mobile Agent is a type of software agent, with the ability of mobility .It is a process that can transport its state from one environment to another. Mobile agents decide when or where to move. A Mobile Agent has unique ability to transport itself from one system in a network to another in the same network. An agent performs its task even if the mobile device is disconnected from the network. Upon the reconnection of mobile devices to the network, agent will back to it original position. Even, a network application can dispatch a mobile agent onto the mobile devices. The agent acting on behalf of the applications interacts with the user regardless of whether or not mobile device is connected. Mobile Agent can execute on several machines. For example, a travel agent program visits several hosts such as an airline ticket reservation system and hotel rooms reservation host etc. to achieve its function. This eliminates the need to have all the relevant databases on one host. Niklas [4] describe the general properties of Mobile Agents.

1) Working of mobile agents

A Mobile agent consist of a program code and the program execution state(the current value of variables, next instructions to be executed, etc.).Initially Mobile Agents reside on a network manager machine and the agent is then execute on a remote machine called mobile agent server. The mobile agent uses resources such as CPU, Memory, etc. of the host to perform its task. It can transferred its code or state to any other host for execution. After completing its task on the host ,the mobile agent migrates to another computer. State information is also transferred to the next host, mobile agent can resume the execution of the code from where they left off in the previous host instead of having restart execution from starting. This process continues until the mobile agent come back to its home machine. Mobile agents do their working by the following steps:

- The mobile agent software is installed in the home machine.
- The Mobile Agent is send to the Host Machine A for execution.
- Mobile Agent Execute on Machine A.
- After execution the agent is create two copies. One is send to Machine B and other is send to Machine.
- Now the both copies are execute on their Machines.
- After execution, both Machines send the Mobile agent back to the Home machine.
- The Home Machine pull back the agents and analyzed the data brought by the agent.
- Now the agent is terminated and its state is lost forever.

2) Advantages of mobile agents

- Minimize the Network Traffic
- In distributed system, multiple request send to the cluster head that increased the network traffic but in Mobile agent, the objective is to move the execution to other host that increases the efficiency.
- Reduction in network delay
- In distributed system, data wait for computation due to the traffic and central control but the mobile agent can execute locally on their host.
- Act Dynamically
- Mobile Agent can sense the surrounding environment and recover it dynamically.
- Independent operation
- Mobile Agents with tits task can dispatch into the network where they operate independently.
- Fault tolerance
- If any Machine is Being shut down ,then all agents will be warned and given time to dispatch it to any other host and execute their operations on that machine.

VII. PROPOSED WORK

Earlier till now, it was seen that most of the researchers work on the single cause of fault nodes that is battery depletion. But I have tried to identify all types of faults and cure them by the agent based fault management in wireless sensor networks. That faults are Node failure, Packet loss, Network Congestion , Battery Depletion, Link failure, Hardware Faults etc.

1) Terminology Used

A) Sensor Nodes: These sensor nodes are the objects of the network that sense the environmental condition and calculating values corresponding to it.

B) Cluster Head: This is the head node of the cluster that manages the working of all other nodes. All the transmissions done by this cluster head.

C) *Global Node*: This is a Mobile Agent with permanent large memory that stores all the data generated by sensors ,It just like the Management Information Base of the network.

D) *Local Agents*: These are embedded with each sensor nodes and stores all the data of the particular sensor node and have temporary memory in which values get replaced as the new values are sensed by the nodes.

2) Proposed Algorithm

The network is divided into clusters with each cluster assigned common task and different nodes are assigned with different tasks using the clustering approach. A Cluster Head is selected, A Mobile Agent is applied in the network which automatically traverse the network and collects data from nodes, check the faults and takes the recovery action. The algorithm designed will work as follows:

Step 1) S1, S2, S3…….. Si are the sensor nodes embedded with the Local Agents L1, L2, …. , Li respectively.

Step 2) All the data sensed by sensor node is stored in the memory of L.

Step 3) Mobile Agent is applied at the top of the network which periodically collects the data from the temporary memory of L, compiles it and send it to base station for further processing.

Step 4) Global Nodes also traverse the network and store the sensed data in MIB.

Step 5) After receiving the data by mobile agent, local agent memory will be replaced by new data.

Step 6) It is noticed that there are no data entries in a particular node , it means Node Failure has occurred due to some reason.

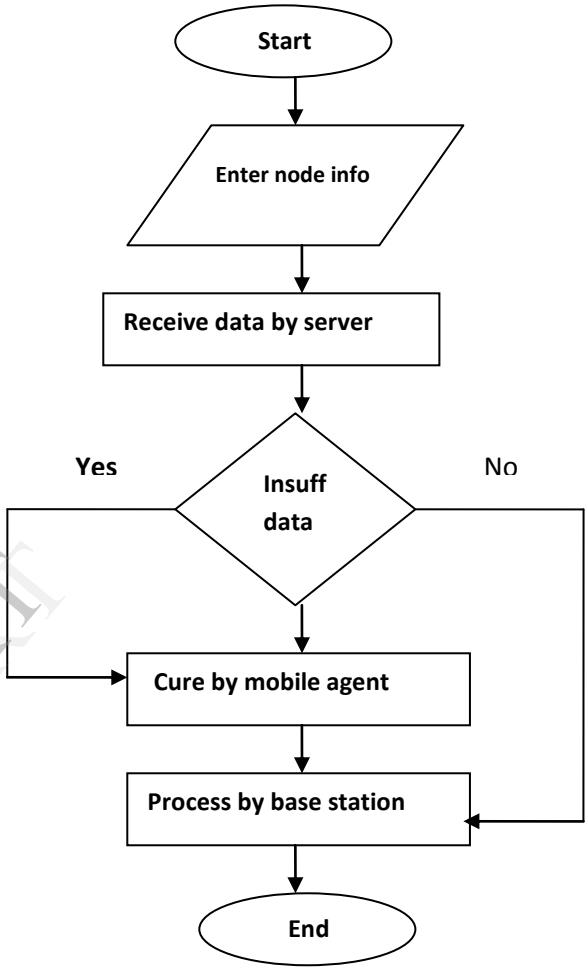
Step 7) Mobile Agent will diagnose the failure and take the recovery action by repairing the node or by sending the node replacement message.

Step 8) After collecting all the data, it is seen that a portion of data is not received and the error of packet loss has occurred.

Step 9) Mobile Agent sending the RESEND message to the node to get the duplicate copy of the data.

Step 10) When the data is received by the server it observes that the data takes more time ,it means there is congestion in the network.

Step 11) Mobile Agent cures the fault by Network Congestion by diverting the data from another route.



VIII. CONCLUSION AND FUTURE WORK

Fault management is most crucial step of network management. Conventional approach to accomplish it is polling network elements by request messages and fetched data is processed at the manager node. This involves huge amount of data to be travelled over network links. Processing capability of centralized node must also be strong enough to sustain such enormous fault data. The centralized approach has been considered as the common solution, which enables the base station with unlimited resources to execute a wide range of recovery functions in the network but the limited hardware and software capability of a node also places restriction on the design of management functions.

Another problems concerns encryption and authentication in our agent infrastructure and some alternate recovery action can also be proposed for all the problems discovered. So it can be topic of future research to propose some other recovery actions for better processing.

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