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Mobility Based Reconfigurable System under Disaster Management in WSN Using Shortest Path Algorithm

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Abstract: Localization is one of the most important applications for wireless sensor networks since the locations of the sensor nodes are critical to both network operations and most application level tasks. WSNs consist of tiny sensor nodes that can be easily embedded in the environment, establish a wireless ad-hoc network, and compose a distributed system to collaboratively sense physical phenomena and process sensed data, or to react to the environment based on the sensed data. To address these requirements, we need to study the fundamental issue of reprogramming and software reconfiguration in WSNs. In this work, it proposes mobility based dynamic reconfiguration system in WSN. By providing access for the user to construct different virtual fields, proposed protocol will accomplish the goal of meeting the need of different applications and different network conditions. In this work, it will take scenario for environmental monitoring and data collection. The proposed mechanism will be implemented with MATLAB.

Keywords: WSN System, Dynamic Reconfiguration System, Localization, Mobility Management etc.

I. INTRODUCTION

Due to recent technological advances, the manufacturing of minor and low cost sensors became officially and economically feasible. The sensing electronics measure ambient circumstances related to the environment surrounding the sensor and convert them into an electric signal. Processing such a signal reveals some properties about objects situated and/or events happening in the vicinity of the sensor. A large number of these disposable sensors can be networked in several applications that require unattended operations. A Wireless Sensor Network (WSN) covers hundreds or thousands of these sensor nodes [1].

A wireless sensor network (WSN) is a self-organized system of small, independent, low cost, low powered and wirelessly communicating nodes distributed over a large area with one or possibly more powerful sink nodes gathering readings of sensor nodes and, may handle a variety of sensing, actuating, communicating, signal processing, computation, and communication tasks, deployed in the absence of permanent network infrastructure and in environments with limited or no human accessibility. The sink serves as the gateway between the user application and the sensor network. The WSN nodes have no fixed topology, but they can configure themselves to work in such conditions [2].

Sensor networks may consists of many different types of sensors like acoustic, seismic, infrared, thermal, magnetic etc. which are able to monitor a wide range of ambient conditions like temperature, humidity, pressure, vehicular movements, lightening conditions, noise levels etc. WSNS supports variety of applications, ranging from habitat monitoring to battlefield management, from perimeter security to inventory management and from environmental sensing to vehicle tracking. Sensor nodes can also be used to detect and control forest fires, disaster prevention, structure health monitoring, area monitoring, landslide detection etc (shown in fig 1) [3].

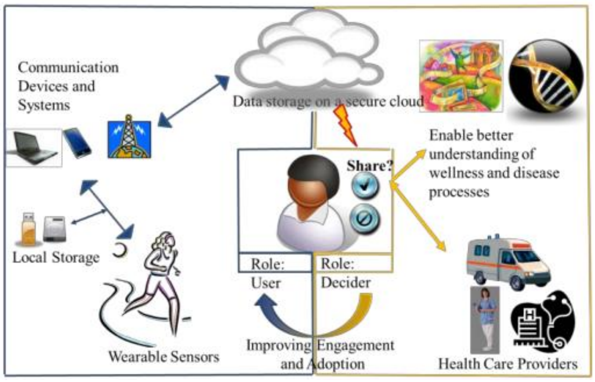

Fig 1: Sensors and their Role in System [1]

Ubiquitous healthcare systems take advantage of a large number of hardware and software components, including Wireless Body Area Networks (WBANs), mobile devices and wireless cloud services, in order to achieve pervasive delivery. A ubiquitous healthcare system must: 1) provide accessibility to several available services from an healthcare provider, 2) be flexible, 3) provide security in information exchange, 4) enable remote health data etc.

To design a WSN application, knowledge of many elements of the context is essential as they influence the operation greatly. However, because some aspects of the context are unpredictable and changing, many design choices are based on assumptions and approximations. As an example, consider the case study of a sensor network for structural health monitoring. During the development of such a WSN, it is unknown which influences the nodes might experience, which nodes might crash, and how long exactly the sensor nodes will last with the available energy [4].

Achieving automatic reconfiguration requires some intelligent component to reason about when to change which components. In the larger area of computer science, artificial intelligence has been a research topic for many years and has branched into many subcategories. Some of these can be interesting to apply in the context of wireless sensor networks. When considering WSNs that reconfigure according to their context, one solution could be to treat the reconfiguration as a multi-parameter optimization problem.

Several methods exist for solving these types of problems, like genetic algorithms or linear programming techniques. An alternative solution is to use a heuristics based approach like expert systems, to reason over reconfiguration. In expert systems, the necessary information is represented by facts in a database. A repository of rules encapsulates knowledge about the system and is used to infer new information or determine which action is suitable. In FACTS these constructs are used to support an event-condition action based middleware. DSN uses similar constructs, but only to simplify WSN development by creating a new declarative programming language.

The rest of paper is ordered as follows. In section II, we discuss the related work of dynamic reconfiguration system in WSN networks. In Section III, It defines general reconfiguration scheme. In Section IV, it describes proposed work of system. Finally, conclusion is explained in Section V.

II. LITERATURE REVIEW

Authors proposed DRRP protocol, a routing algorithm with the ability of dynamic reconfiguration. By providing access for the user to construct different virtual hybrid potential fields, DRRP accomplished the goal of meeting the need of different applications and different network conditions. To make the effect of their routing protocol more excellent, they set a parameter, which can be changed dynamically, to influence the virtual hybrid potential field. By regulating the parameter according to the situation, they could optimize the routing protocol constantly. Moreover, they provided a convenient method for the administrator of the WSN to reconfigure the routing protocol just by a remote desktop application [3].

Some authors [4] presented an accurate and efficient localization method that makes use of an improved RSSI distance estimation model by including the antenna radiation pattern as well as nodes orientations. Mathematical models for distance estimation, cost function and gradient of cost function that can be used in a distributed localization algorithm were developed. This study also introduced a sensor data fusion approach, combining accelerometer data, RSSI, antenna radiation pattern and node orientation to reduce the computation complexity during the tracking phase. The proposed algorithm was implemented in MATLAB. Simulation results showed that the proposed approach increased the accuracy of existing methods using RSSI by up to 59%.

Authors [5] introduced a notion of “Mobility Enabled Protocol Stack” based on the concept of mobility management protocol coexistence. They presented a case study for co-existence of Host Identity Protocol (HIP) and Session Layer Mobility (SLM) to provide a complete mobility solution. They were working on generalizing the key principles of mobility management protocol co-existence and consolidating these principles with the development of mobility aware protocol stack which combines a number of common mobility protocols.

Some [6] proposed and evaluated different approaches for the distribution of the mobility management functionalities. They initiated our mobility decoupling from the most common split into data and control planes. They go further in splitting the control plane of mobility management into location and handover management. They evaluated the distributed approaches, based on the proposed decoupling, and they compared them with the most adopted fully centralized approaches. The results of the evaluation demonstrated that the distribution of mobility management functionalities through elements closer to the end-user improve both user and network performance, even in a hierarchical network topology.

Authors [7] proposed a session-to-mobility ratio (SMR) based mobility management scheme. The scheme enabled the Mesh Clients (MC) to send location update message to the gateway, used forward chain, tunnelling and a threshold SMR value for reducing the cost of mobility management. The effect of selection of the threshold SMR on cost per handoff, cost per packet delivery and total communication cost per time unit had been investigated.

Some [8] analysed and compared existing IPv6 mobility management protocols including the recently standardized PMIPv6 and FPMIPv6. They identified each IPv6 mobility management protocol’s characteristics and performance indicators by examining handover operations. Then, they analysed the performance of the IPv6 mobility management protocols in terms of handover latency, handover blocking probability, and packet loss. Through the conducted numerical results, they summarized considerations for handover performance.

III. DYNAMIC RECONFIGURATION SYSTEM

Recently, techniques of dynamic reconfiguration have attracted increasing attention from the research community. These techniques enable reconfiguration of the sensor network hardware at run time to adapt to external dynamics, providing an innovative approach to designing an energy-efficient WSN in a highly dynamic environment. Due to advances in hardware technology, several reconfiguration techniques have been developed on the sensor node level. These include Dynamic modulation scaling (DMS) (used to reconfigure modulation schemes in communication), dynamic voltage scaling (DVS) (used to reconfigure voltages and operating frequency of processors), adaptive sampling rate (used to change the

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sampling rate of sensors), and intelligent node activation (used to change sensor node status) [9].
The energy efficiency achieved by these dynamic reconfiguration techniques can be categorized into two different types. At node-level reconfiguration, the DVS, DMS, and adaptive sampling rate are used to minimize the energy consumption of sensor nodes. At network-level reconfiguration, intelligent node activation determines node activity to minimize redundant energy usage within the network. The utilization of all reconfiguration techniques have to consider dynamic factors, such as changes in user requirements, variations in communication channel quality, application changes, addition of new nodes, and node failure. This increases the complexity of using dynamic reconfiguration in WSNs (shown in fig 2) [10].

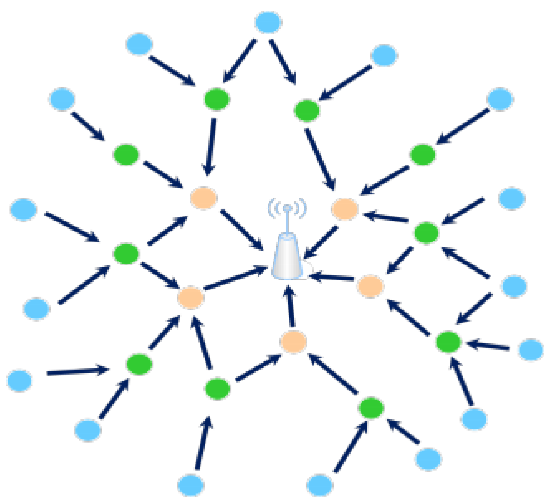

Fig 2: Node Traffic in WSN [3]

A. Node Level Reconfiguration
The dynamic reconfiguration at node level sought to minimize energy consumption by dynamically adjusting hardware platforms of sensor nodes. We addressed two promising reconfiguration hardware techniques, DVS and DMS, since they have already been separately used on computation and communication systems to reduce the energy consumption. A dynamic time allocation was developed, which considered DVS and DMS simultaneously to fully utilize the energy-aware capability of sensor nodes. In the following sub-sections, the two energy-aware techniques are first introduced, and then the dynamic time allocation is analyzed on a single-node scenario and is extended to multi-node scenario.

B. Dynamic Time Allocation
Since both DVS and DMS techniques traded energy savings against the computation and communication time, respectively. When only limited time was available for the sensor node, it became critical to allocate the time resource for minimizing the total energy consumption. Such an allocation mechanism was called Dynamic Time Allocation (DTA), which determined the optimal share of computation time and transmission time subject to the time constraint.

C. Centralized Reconfiguration
From Literature, Some authors detect the need for reconfiguration of a WSN by creating a global model based on information coming from sensor nodes at run-time. Next, a design space search is performed in order to come up with a suitable new configuration, which is subsequently transferred on to the sensor nodes. However, because the tool chain of the dominant WSN operating system, Tiny OS, compiles software components to a static image, this requires replacing the entire code image after deployment. This uses much bandwidth and energy. Some provides a method for creating virtual machines for sensor nodes that execute small script-like programs [12]. These scripts can be sent to a node and loaded and unloaded at run-time. Although this approach is more efficient than reprogramming, a disadvantage is that applications are required to be expressed as a list of generic operations, with little room for specialized functionality.

They do not exactly qualify as middleware, as they mainly alter the Tiny OS compilation process to allow for linking software components on the node after deployment. This way, nodes can be reconfigured by uploading new individual software components to the nodes and deleting unused parts. Because in some cases this still requires a restart of individual nodes, it is not considered run-time adaptation. However, the reconfiguration does occur after deployment and if the state of a node can be restored after reconfiguration, the WSN can continue its operation. Also, determining when to change which component is done manually in these solutions. The biggest concern for these solutions is that the reasoning over reconfiguration is done centrally and requires a global view of the WSN. This is not feasible for most actual deployments, because centralized algorithms scale poorly.

D. Distributed Reconfiguration
A solution, in which nodes reconfigure themselves without a centralized algorithm, is Impala [5]. Each node contains an application adapter and update component. These respond to certain events in the network and periodically check system and application parameters. Software components are modelled by a finite state machine. If specific preconditions are satisfied, the application is transferred to a different state. A downside of this approach is its granularity: an application can only have a limited number of states, and even small changes take up a complete state. Also, little attention is paid to the reasoning on reconfiguration, and the authors have not yet succeeded in implementing it on a sensor node platform.

Here, nodes publish their functionality as a service to which other nodes can subscribe. When an event in the network or the context decreases the functionality that a specific node offers, the subscribed nodes try to find other nodes with a better service level for the required functionality. However, in sparse networks where there are few alternative nodes with certain functionality, the application can still fail, since these solutions do not consider changing the nodes themselves, but only the relations between them.

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In ASCENT, reconfiguration is modelled as a coverage problem [13]. Nodes either actively contribute to some network functionality or remain passive to save energy, depending on the number of active nodes in their neighbourhood. This ensures specific functionality is available for each area in the network. However, this can only be achieved in a sufficiently dense network. As with service-oriented sensor networks, ASCENT cannot prevent an application from failing in case a node fails while there are no alternative nodes with similar functionality. Distributed reconfiguration promises a more scalable approach for WSNs, but the available solutions generally assume dense networks, place a heavy burden on system resources or are not generally applicable to multiple WSN applications.

E. Clustering Approach

Clustering has become an emerging technology for building scalable and energy balanced applications for WSNs. Some derive an efficient failure detection solution using a cluster-based communication hierarchy to achieve scalability, completeness, and accuracy simultaneously. They split the entire network into different clusters and subsequently distribute fault management into each individual region. Intra-cluster heartbeat diffusion is adopted to identify failed nodes in each cluster.

IV. PROPOSED RECONFIGURATION SCHEME

The topic of WSN continues to grow as a fertile research area. Efforts continually seek to overcome the complications of reliable, or even fault-tolerant, communications in large wireless networks. Specific to the context of wireless network routing, a number of protocols have been developed to address the issue of dependable communications within WSN. From the survey, it can be obtained that a routing protocol designed for WSN should have the ability of adapting to different applications and different network conditions. If we can change the routing protocol remotely according to the applications' requirement and the network conditions, we can achieve this goal. Currently, it is very difficult, if not impossible, to change a routing service in a large scale sensor network because the service is statically pre-configured into each node, which is often unattended. So, it proposes a mobility based network reconfiguration system in WSN which can be dynamically reconfigured. Then we present the mechanism of dynamic reconfiguration. The dynamic reconfiguration at node level sought to minimize energy consumption by dynamically adjusting hardware platforms of sensor nodes. The utilization of reconfiguration technique have to consider dynamic factors, such as changes in user requirements, variations in communication channel quality, application changes etc.

The main objective of this work is to design mobility based self network reconfiguration system in WSN. The next objective is to use dynamically reconfigurable routing protocol with shortest path for routing in network (shown in fig 3). Environmental observation and forecasting may include volcanic studies and eruption warning system, flood detection, meteorological observation, earthquake

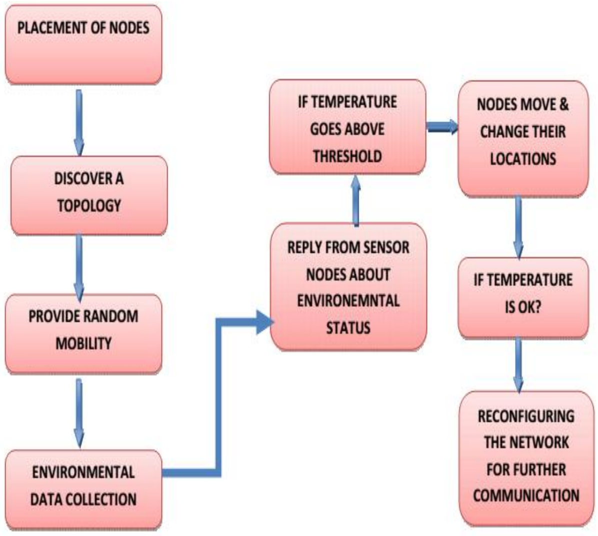

Fig 3: Proposed System Model

studies and warning system, cyclone and tsunami warning system, water quality monitoring etc. A good warning system can help to avoid the damages caused by natural disasters. Sensor nodes can be used to monitor the conditions of plants and animals in wild habitat, as well as the environmental parameters of the habitat. Sensor can be deployed under water or on the ground to monitor the quality of air and water. Air quality monitoring can be used for air pollution control and water quality monitoring can be used in biochemistry field. Sensors can also be deployed to detect natural or non-natural disasters. For example, sensor nodes deployed in a forest can also detect the exact origin of the fire before the fire is spread uncontrollable. Seismic sensors can be used to detect the direction and magnitude of earthquakes.

In above figure, the first step describes the sensors are being deployed in a disaster area. Sensors are randomly spread over the area. Each sensor has a sensor ID shown along with it. It will be used to address any sensor throughout the process. Here we take large number of sensors so that proposed scheme will evaluate easily. No two nodes overlap each other. In typical usage scenario, the nodes will be evenly distributed over an outdoor environment. This distance between adjacent nodes will be minimal yet the distance across the entire network will be significant. Then provide random mobility in nodes to show that all nodes are dynamic in nature. All nodes are communicating with each other on the basis of shortest path calculated.

After the deployment of the sensor nodes, there is a Head node selection by polling method. In a sensor network, the basic sensors are simple and perform the sensing task, while some other nodes, often called the heads, are more powerful and focus on communications and computations. Then head check the status of each node and collects the environmental data from sensor nodes. For this, there is a direct communication between head & nodes. Head asks the nodes about environment conditions, then reply back to head about status. Now if temperature goes above threshold due to any disaster effect, the nodes sense data

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and tells to the head and starts moving from their locations. Then they collect to any other location and when the disaster under control then head orders the nodes to repositioning or reconfigure their locations within minimum time.

V. CONCLUSION

How to design a routing protocol, which can meet the need of different applications and different network conditions, is an extremely challenging problem. This work presents an approach for dynamic reconfiguration in sensor networks with minimization of localization error. It works on different scenarios of the dynamic reconfiguration infrastructure. In this work, all nodes will be communicating with each other. A Base station is provided for giving the instructions to all nodes. The need for reconfiguration architecture for sensor network applications is apparent from the results of even a simple environmental monitoring algorithm. In this, it takes the scenario of disaster in forests. Before disaster occurred, all nodes will change their location for security. As disaster under control, there may get back to their locations. Due to this, they will provide safety and also minimum location error.

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