



A REVIEW ON A HYBRID APPROACH USING MOBILE SINK AND FUZZY LOGIC FOR REGION BASED CLUSTERING IN WSN

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ABSTRACT

A Wireless Sensor Network or WSN is supposed to be made up of a large number of sensors and at least one base station. The sensors are autonomous small devices with several constraints like the battery power, computation capacity, communication range and memory. They also are supplied with transceivers to gather information from its environment and pass it on up to a certain base station, where the measured parameters can be stored and available for the end user. In most cases, the sensors forming these networks are deployed randomly and left unattended to and are expected to perform their mission properly and efficiently. As a result of this random deployment, the WSN has usually varying degrees of node density along its area. Sensor networks are also energy constrained since the individual sensors, which the network is formed with, are extremely energy-constrained as well. Wireless sensor networks have become increasingly popular due to their wide range of application. Clustering sensor nodes organizing them hierarchically have proven to be an effective method to provide better data aggregation and scalability for the sensor network while conserving limited energy. Minimizing the energy consumption of a wireless sensor network application is crucial for effective realization of the intended application in terms of cost, lifetime, and functionality. However, the minimizing task is hardly possible as no overall energy cost function is available for optimization.

Keywords

Wireless, Sensor Networks, Protocol, Cluster Head, WSN, Fuzzy Logic.

INTRODUCTION

The wireless network is basically a network, in which computers are connected and communicate with each other not by a visible medium, but by emissions of electromagnetic energy in the air. Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. In telecommunications, the most widely used transmission support is radio waves, which use some form of energy to transfer information without the use of wires. Information is transferred in this manner over both short and long distances between computer devices. These devices cover printers, laptops, mobile phones and servers. Due to recent technological advances, the manufacturing of small and low cost sensors became technically and economically feasible. The sensing electronics measure ambient conditions related to the environment surrounding the sensor and transforms them into an electric signal. Processing such a signal reveals some properties about objects located and/or events happening in the vicinity of the sensor. A large number of these disposable sensors can be networked in many applications that require unattended operations. A Wireless Sensor Network (WSN) contain hundreds or thousands of these sensor nodes. These sensors have the ability to communicate either among each other or directly to an external base-station (BS). Wireless Sensor Network (WSN) is a type of wireless Ad-Hoc network in which large numbers of sensor nodes are deployed in the application field [1]. Sensor nodes are inexpensive and low power devices. Each node consists of four main units: Sensing Unit, Processing Unit, Communicating Unit and Power Unit. In sensing unit one or more sensors are placed to sense different environment parameters like sound, temperature, vibration, pressure, motion and etc., based on application requirement. Sensed data's (analog or digital) are processed and aggregated in the processing unit. The communication across a wireless network is a two-way radio communication. The procedure is that the wireless adapter of computer translates data into a radio signal and transmits it using different models of antenna and then wireless router receives the signal and decodes it. The router then sends this information to the internet using a physical, wired Ethernet connection. This is a reversible process, with the router receiving information from the Internet, translating it into a radio signal and sending it to the computer's wireless adapter.

The need for energy-efficient infrastructures for sensor networks is becoming increasingly important. Wireless sensor networks are networks consisting of many sensor nodes that communicate over a wireless media. A sensor node is equipped with a sensor module, a processor, a radio module and a battery. Since the battery limits the lifetime of the sensor nodes it also limits the lifetime of the sensor network, thus energy efficiency is a major issue for sensor networks.

An important goal in many sensor networks is to monitor an area as long time as possible. Hence, it is important to distribute energy consumption evenly across the network. When the energy consumption is evenly distributed, the major part of the sensor nodes will stay alive approximately equally long time. This enables continued information gathering throughout the whole network area during the lifetime of the network. The most power-consuming activity of a sensor node is typically radio communication [2]. Hence, radio communication must be kept to an absolute minimum. This means that the amount of network traffic should be minimized. In order to reduce the amount of traffic in the network, we build clusters of sensor nodes as proposed in e.g. [3, 5]. Some sensor nodes become cluster heads and collect all traffic from their respective cluster. The cluster head aggregates the collected data and then sends it to its base station. When using clustering, the workload on the cluster head is thus larger than for non-cluster heads. The cluster heads should therefore



be changed several times during the lifetime of the sensor network in order to distribute the extra workload and energy consumption evenly.

Networking unattended sensor nodes may have profound effect on the efficiency of many military and civil applications such as target field imaging, intrusion detection, weather monitoring, security and tactical surveillance, distributed computing, detecting ambient conditions such as temperature, movement, sound, light, or the presence of certain objects, inventory control, and disaster management. Deployment of a sensor network in these applications can be in random fashion (e.g., dropped from an airplane) or can be planted manually (e.g., fire alarm sensors in a facility). For example, in a disaster management application, a large number of sensors can be dropped from a helicopter. Networking these sensors can assist rescue operations by locating survivors, identifying risky areas, and making the rescue team more aware of the overall situation in the disaster area. In the past few years, an intensive research that addresses the potential of collaboration among sensors in data gathering and processing and in the coordination and management of the sensing activity were conducted. However, sensor nodes are constrained in energy supply and bandwidth. Thus, innovative techniques that eliminate energy inefficiencies that would shorten the lifetime of the network are highly required. Such constraints combined with a typical deployment of large number of sensor nodes pose many challenges to the design and management of WSNs and necessitate energy-awareness at all layers of the networking protocol stack

SENSOR NETWORKS APPLICATIONS

Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions that include the following [23]:

- Temperature,
- Humidity,
- Vehicular movement,
- Lightning condition,
- Pressure,
- Soil makeup,
- Noise levels,
- The presence or absence of certain kinds of objects,
- Mechanical stress levels on attached objects, and
- The current characteristics such as speed, direction, and size of an object.

Sensor nodes can be used for continuous sensing, event detection, event ID, location sensing, and local control of actuators. The concept of micro-sensing and wireless connection of these nodes promise many new application areas. We categorize the applications into military, environment, health, home and other commercial areas. It is possible to expand this classification with more categories such as space exploration, chemical processing and disaster relief.

ARCHITECTURE OF WSN

The architecture of protocol stack used by the sink and sensor nodes is shown in Figure 1. This protocol stack integrates power and routing awareness (i.e., energy-aware routing), integrates data with networking protocols (i.e., data aggregation), communicates power efficiently through the wireless medium, and promotes cooperative efforts of sensor nodes (i.e., task management plane). Sensor network have five different layers through which the communication is establish. The Layer is: Application layer, Transport layer, Network layer, Data-link layer and Physical layer in addition it contains power management plane, mobility management plane, and task management plane. The physical layer addresses the needs of a robust modulation, transmission and receiving techniques. The network layer takes care of routing the data supplied by the transport layer. The transport layer helps to maintain the flow of data if the wireless sensor network application requires it. Depending on the sensing tasks, different types of application software can be set up and used on the application layer.

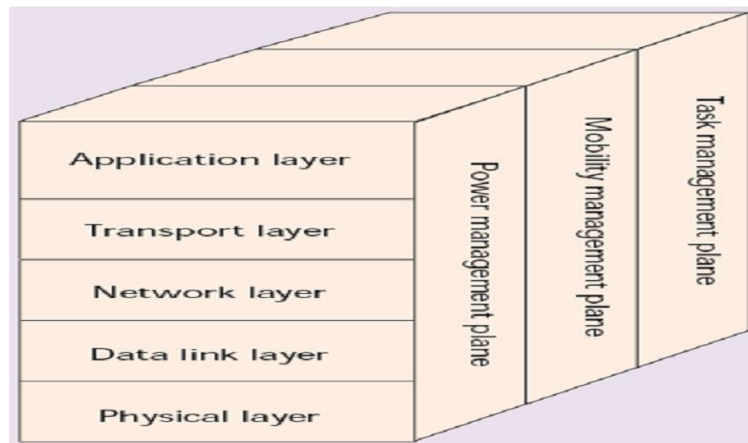


Figure 1. Layers of WSN Architecture

The power management plane manages how a sensor node uses its power and manages its power consumption among the three operations (sensing, computation, and wireless communications). For instance, to avoid getting duplicated messages, a sensor node may turn off its receiver after receiving a message from one of its neighbors. Also, a sensor node broadcasts to its neighbors that it is low in power and cannot take part in routing messages. The remaining power is reserved for sensing and detecting tasks. The mobility management plane detects and registers the movement mobility of sensor nodes as a network control primitive. Hence; a route back to the user is always kept, and sensor nodes can keep track of who their neighbors of other sensor nodes are. Therefore, the nodes can balance their power and task usage by knowing this situation. The task management plane schedules and balances the sensing tasks given to a specific region. Based on the power level, not all sensor nodes in a region are needed to perform the sensing task at the same time. This management plane is required because sensor nodes can work together in a power efficient way, route data in a mobile sensor network, and share resources between sensor nodes.

ROUTING CHALLENGES AND DESIGN ISSUES IN WSNS

Despite the innumerable applications of WSNs, these networks have several restrictions, e.g., limited energy supply, limited computing power, and limited bandwidth of the wireless links connecting sensor nodes. One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques. The design of routing protocols in WSNs is influenced by many challenging factors. These factors must be overcome before efficient communication can be achieved in WSNs. In the following, we summarize some of the routing challenges and design issues that affect routing process in WSNs.

Node deployment: Node deployment in WSNs is application dependent and affects the performance of the routing protocol. The deployment can be either deterministic or randomized. In deterministic deployment, the sensors are manually placed and data is routed through pre-determined paths.

Energy consumption without losing accuracy: sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment. As such, energyconserving forms of communication and computation are essential. Sensor node lifetime shows a strong dependence on the battery lifetime [1].

Data Reporting Model: Data sensing and reporting in WSNs is dependent on the application and the time criticality of the data reporting. Data reporting can be categorized as either time-driven (continuous), event-driven, query-driven, and hybrid [13].

Node/Link Heterogeneity: In many studies, all sensor nodes were assumed to be homogeneous, i.e., having equal capacity in terms of computation, communication, and power. However, depending on the application a sensor node can have different role or capability. The existence of heterogeneous set of sensors raises many technical issues related to data routing.

Fault Tolerance: Some sensor nodes may fail or be blocked due to lack of power, physical damage, or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network. If many nodes fail, MAC and routing protocols must accommodate formation of new links and routes to the data collection base stations.

Scalability: The number of sensor nodes deployed in the sensing area may be in the order of hundreds or thousands, or more. Any routing scheme must be able to work with this huge number of sensor nodes

Network Dynamics: Most of the network architectures assume that sensor nodes are stationary. However, mobility of both BS's and sensor nodes is sometimes necessary in many applications [9].

RELATED WORK

Alduais et al (2016) specifies that WSN has become an enabler technology for the IOT applications which extend the physical reach of the monitoring capability. WSN as it is, possess several constraints such as limited energy availability,



low memory size, and low processing speed, which are the principal obstacles to designing efficient management protocols for WSNs, what more if it concerns WSN-IOT integration.

Bengherbia et al (2016) states that the wireless sensor network (WSN) represent fertile area for research and exploration, especially with enormous development in modern electronic systems, where it becomes an alternative to traditional wired systems. The wireless stems are less energy-consumptive and inexpensive, in addition it helps to reduce the complexity of wiring. Wireless sensor networks require the design of high density computing, an energy- efficient and a flexible node architecture.

Bera et al (2016) proposes a software-defined wireless sensor network architecture (Soft- WSN)—an effort to support application-aware service provisioning in Internet of Things (IoT). Detailed architecture of the proposed system is presented involving the application, control, and infrastructure layers to enable software-defined networking (SDN) in IoT.

Cueva et al (2016) presents a study in order to identify the value range of the main parameters within Carrier Sense Multiple Access (CSMA) defined in IEEE 802.15.4 that guarantee a satisfactory Wireless Sensor Networks (WSN) performance for a possible volcano monitoring application. Moreover, this study performs the comparison between test-bed in outdoor scenarios with the purpose of distinguishing the optimal number of nodes or each gateway according the main constrains given by an existing sensor network for real-time (RT) volcano monitoring system such as sampling time, packet loss, and delay.

Dayem & Rizk (2016) introduces an authentication protocol and simple key distributed scheme between sensor nodes. Node mobility has been taken into consideration and the work proposes a re-authentication protocol that is very efficient than the initial protocol. A wireless sensor network (WSN) consists of thousands of sensors and one base station. Sensors are deployed in the network to monitor target area and sense information according to the applied application then send this information to the base station.

Gupta & Shekocar (2016) presents a novel scheme to improve the lifetime of a sensor node by optimizing the size of the packet such that there is no loss of data along with providing an increased lifetime for the nodes. Wireless sensor network is a rapid developing area with diverse applications. Smartness and interoperability of network keeps it in high demand and hence comes need for the efficiency of the system. The most important limitation on sensor node is the low power consumption. Sensor nodes carry inadequate, generally irreplaceable power sources. Therefore, while traditional networks aim to achieve high quality of service (QoS), wireless sensor network protocols must emphasis predominantly on power conservation.

Hadi & Wahidah (2016) studied effectiveness in using Compressive Sensing (CS) algorithm in order to reduce measuring in IEEE 802.15.4 Standard Wireless Sensor Network (WSN). As well known, in common WSN work system, Base Station (BS) gather some information from available nodes, which the process itself consumes a lot of energy from each node.

Kaschel & Ortega (2016) describes the mechanisms to achieve energy efficiency in a WSN, focusing particularly on routing protocols. Based on the state of the art, is presented a complete taxonomy of routing protocols used in WSN exposing their level of energy efficiency.

Kaur, Deepali, Kalra (2016) decreases the passive attack on sink node by decreasing the traffic on sink node. The simulation results demonstrate the proposed method can each node will compress their data before sending to cluster head. After compressing, the packet size of node will decrease. This will decrease the traffic overload.

Kumari & Nand (2016) analyzes the performance of the various routing protocols of the wireless network in the WBAN and WSN. Moreover, the paper also compares their performance in the same network and in different network using different parameters i.e. PDR, latency and throughput etc. The research signifies that the wireless protocols needs updating to perform well in the WBAN.

Shahabuddin, Hasbullah, Aziz (2016) proposes fundamental modelling of topology control algorithm to conserve individual WSN node's energy, and at the same time preserving the graph connectivity. The proposed topology control algorithm consists of three phases: 1. Identifying connecting nodes at maximum transmission, 2. pairing nodes with shortest algorithm/minimum energy level, 3. Calculating/setting minimum power transmission per-node for energy conservation. The algorithm works-out locally and dispenses full graph connectivity, and theoretically would be able to reduce WSN control overhead.

Singh, Rishiwal, Yadav (2016) compares three well accepted WSN routing protocols namely LEACH, FAIR and SEP for their energy pattern in heterogeneous scenario. Heterogeneity is introduced in terms of initial random energy values given to the sensor nodes. All simulations are done in MATLAB. Different parameters are used for checking the efficacy of the considered routing protocol for H-WSN.

Wu, Liu, Min (2016) proposes a new model to efficiently control cluster-heads using heterogeneous sensors in real-time. It also proposes a generic software framework to feasibly and efficiently meet the needs of the users and applications (e.g., reliability, energy efficiency). The proposed model and its method have been implemented and evaluated in MATLAB, comparing its performance with known protocols for WSNs. The proposed model is suitable for common use because it is superior to other methods by energy efficiency.

Xiuwu et al (2016) proposes a routing protocol that is based on monitoring area partition clustering for energy-balanced (EBPC). They divided monitoring area into several virtual partitions, controlled the number of common nodes and clusters by data fusion rate, and forwarded cluster heads data to the next partitions with minimum path selection coefficient.



RESEARCH MOTIVATION

Due to the deployment of WSNs in unattended harsh environment conditions, it gets to be unrealistic to charge or replace their batteries. Accordingly, the energy efficient operation of wireless sensors is very important to prolong the lifetime of overall wireless sensor networks. Furthermore, in WSN, there is wireless communication among all the nodes. Moreover, the energy consumed to transmit a message is exceptionally more than the energy needed to receive the same message. Besides all this, the route of each message destined to the base station too decides the network lifetime; for example, any node with depleted battery in short routes to the base station may lead to decreased network lifetime. While, using a long route composed of many sensor nodes can significantly increase the network delay.

- Cluster head election is entirely based on the residual/remaining energy and distance to base station.
- If the CH will send the data directly to the BS, then there will be much loss of energy for the CH which is far from the BS.
- If CH chooses the multi-hop node (relay node) for data transmission, then the node which is connected to BS will be overloaded with data of all the regions.
- More parameters like number of neighbors, average energy consumption should also be considered before electing the node as cluster head.

The objective is to find out best energy efficient algorithm that will lead to the maximization of system lifetime.

CONCLUSION

Recent technological improvements have made the deployment of small, inexpensive, low-power, distributed devices, which are capable of local processing and wireless communication, a reality. Such nodes are called as sensor nodes. Each sensor node is capable of only a limited amount of processing. But when coordinated with the information from a large number of other nodes, they have the ability to measure a given physical environment in great detail. Thus, a sensor network can be described as a collection of sensor nodes which co-ordinate to perform some specific action. Unlike traditional networks, sensor networks depend on dense deployment and co-ordination to carry out their tasks. Previously, sensor networks consisted of small number of sensor nodes that were wired to a central processing station. In this paper, we presented a new approach for minimizing the total energy consumption of wireless sensor network applications for improving the overall network lifetime. We will implementing the above said algorithm in matlab environment

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