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Performance generation of routing protocol for WSN

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Abstract
WSN is an application specific network. It depends upon application, resource availability. Structural Health Monitoring (SHM) using wireless sensor networks has concentrate most attention recently. It is an area of research that can proactively assess the structural integrity of bridges, tunnels, turbines, buildings and nuclear reactors etc. using Wireless Sensor Network.

Basically every node works on battery. Generally these batteries are non-rechargeable and due to diverse geographical localities of sensors it is not always possible to replace nodes always. So, it is important to check the energy consumption of node and try to reduce it.

When we transmit it through a series of intermediate nodes there can be more than one path through which data can be transmitted. Among these different paths we have to choose most efficient path in terms of consumed energy, proper transfer of data from source to destination etc. Energy can be conserved at every layer of WSN. We focus on the network layer whose function is the routing and topology control. Here we have developed a novel energy efficient routing algorithm whose performance is better than the existing ones. The aim of the paper is to develop the multi parameters mathematical model to optimize the routing parameters particularly network lifetime w.r.t energy consumption considering network design model parameters for SHM of bridges, which affects the routing layer. Also it is to develop a novel energy efficient routing algorithm for improving the network lifetime without compromising the energy consumption.

Keywords: Performance generation, WSN, SHM

Introduction

Wireless Sensor Network is the wireless network which is the combination of autonomous sensors or control environment conditions. Information that are to be collected or sensed are temperature, pressure, humidity, motion, heat, sound, light, electromagnetic field, vibration, images, pollutants etc. [1, 2, 3, 4]. The popularity of WSN has increased due to growth in Micro-Electro-Mechanical Systems (MEMS) technology. The concept of wireless sensor networks is based on a simple expression: Sensing + CPU + Radio = Thousands of potential applications [5]. The sensor node has limited resources like energy, size, memory, computational power, communication range, bandwidth, so a large no of sensor nodes are distributed over an area of interest for collecting the information. So these nodes communicate with each other either directly or through intermediate nodes and thus form a network, so each node work as a router. There is no general solution for WSN problems. It depends upon usage, budget & resource availability. Wireless Sensors Network term can be sensed as devices range from PDAs, laptops or mobile phones to tiny and simple sensing devices. At present, most available wireless sensor devices are considerably constrained in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons [1, 2, 3]. Most of the research on WSNs has focused on the design of energy and computationally efficient algo. and protocols, and the application domain has been confined to simple data-oriented monitoring and reporting applications. WSNs nodes are stored battery powered which are ready to perform a specific task for a long period of time, even years. If WSNs nodes are more powerful or mains-powered devices in the vicinity, it is beneficial to utilize their computation and communication resources for complex algorithms and as gateways to other networks. New network architectures with mixed devices and expected advances in technology square measure eliminating current limitations and increasing the spectrum of do able applications for WSNs significantly.

Literature review

Nikolaos A. Pantazis, Stefanos A. Nikolidakis and Dimitrios D. Vergados, “Energy-Efficient

Routing Protocols in Wireless Sensor Networks: A Survey" (2013) In this paper authors have discussed, depending upon the different applications, architectures and design constraints a various types of routing protocols. Also the performance of routing protocols related to the architectural model has been considered. In this paper three main categories like data centric, hierarchical and location based have been discussed. Each protocol is described and discussed under appropriate category and paper classification has been done. In data centric protocols, Flooding and Gossiping, SPIN, Directed Diffusion, Energy aware routing (EAR), rumor routing, Gradient- based routing (GBR), constrained anisotropic diffusion routing (CADR), Cougar, Acquire have been discussed. In hierarchical protocols Leach, Pegasis & Hierarchical Pegasis, Teen & Apteen, energy aware routing for cluster based sensor networks, self-organizing protocols have been considered. In location based protocols, minimum energy communication network (SMECN), Geographic Adaptive Fidelity (GAF), Geographic and energy aware routing (GEAR) have been described. In network flow and QoS aware protocols, Maximum lifetime energy routing (MLDR), maximum lifetime data gathering (MLDA), minimum cost forwarding, Sequential Assignment Routing (SAR), Energy aware QoS routing protocols, SPEED, Stateless Geographic Non-Deterministic forwarding (SNFG) have been presented [10].

W. Heinzelman, A. Chandrakasan and H. Balakrishnan "Energy-Efficient Communication Protocol for Wireless Microsensor Networks" (2000) Some important design issues of routing protocols for sensor network have been identified in research paper [2]. Also some routing protocols like Spin, DD, RR, GBR, CADR, Cougour, Acquire, Leach, Teen, Apteen, Pegasis, VGA, SoP, GAF, Span, Gear, SAR, Speed are compared and contrasted in terms of power usage, Data aggregation, scalability, query based, overhead, data delivery model and QoS. Besides this routing protocol selection for a particular application in WSN like habitat monitoring, environment monitoring, health monitoring, military, home/office, production, commercial in terms of node deployment, topology, size have been done. The conclusion of this paper indicates that it is not possible to design a common routing protocol and algorithm which have a good performance under all applications and scenarios of WSN. Here it is not possible to design a general routing protocol which can be used for a mostly applications. So we have to choose an application first, then according to it we have to choose an application specific routing protocol [2].

I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless Sensor Networks: A survey" (2002) In this article current state of art of sensor network has been discussed according to the different protocol layer structure. Here different technical issues are dissolved for different application areas. Also this paper points out that the research and design issues related to the protocols. Mainly in this article survey of algorithms and protocols are proposed for the sensor network. The factor that affects the network design has also been discussed. This paper provides a detailed investigation about the current proposals in the physical layer, data link layer, network layer, transport and application layer. Design factors on the basis of fault tolerance, scalability, production cost, sensor network topology, hardware constraints, environment and power consumption have been summarized with a great deal. The sensor network protocol stack along with design issues of physical layer, data link layer, network layer, transport and application layer has been discussed. In the network layer SMECN, Flooding & Gossiping, SPIN, SAR, LEACH, Directed Diffusion has described. A list of current sensor network projects along with current research projects is given. Here different projects like Sensor Net, WINS, SPINS, SINA, mAMPs, LEACH, Smart Dust, SCADDS, PICO RADIO, PACMAN, Dynamic Sensor Networks Aware Home, COUGAR Device, Data base Project, Data space have been printed out [6].

Barati, Hamid "A review of coverage and routing for wireless sensor networks" (2008)

Special constraints of sensor networks impose a number of technical challenges for employing them. In this review, there is study of the issues and existing protocols in three areas: coverage and routing. In this paper authors present two types of coverage problems: to determine the minimum number of sensor nodes that need to perform active sensing in order to monitor a specific area and to decide the quality of service that can be provided by a given sensor network. Meanwhile most routing protocols in sensor networks are data-centric, there are other types of routing protocols as well, such as hierarchical, location-based, and QoS-aware. Authors describe and compare several protocols in each group and present several multipath routing protocols and single-path with local repair routing protocols, which are proposed for recovering from sensor node crashes. Some transport layer schemes have also been discussed for reliable data transmission in lossy wireless channels [8].

WSN Node Architecture

Sensing Unit: Sensing units are usually composed of two subunits: sensors and analog to digital converters (ADCs). Sensor could be a device that is employed to translate physical phenomena to electrical signals. Sensors is classified as either analog or digital devices. There exists a range of sensors that live environmental parameters like temperature, candlepower, sound, magnetic fields, image, etc. The analog signals produced by the sensors based on the observed phenomenon are converted to digital signals by the ADC and then fed into the processing unit [9].

Processing Unit: The process unit in the main provides intelligence to the sensing element node. The process unit consists of a microchip, which is responsible for control of the sensors, execution of communication protocols and signal processing algorithms on the gathered sensor data. Commonly used microchips square measure Intel's robust ARM microprocessor, Atmel's AVR microcontroller and Texas Instruments' MP430 microprocessor. For example, the processing unit of a smart dust mote prototype is a 4 MHz Atmel AVR8535 micro-controller with 8 KB instruction flash memory, 512 bytes RAM and 512 bytes EEPROM. Tiny OS operating system is used on this processor, which has 3500 bytes OS code space and 4500 bytes available code space. The process unit of μAMPS wireless device node paradigm incorporates a 59–206 megacycle SA-1110 micro-processor. In general, four main processor states is known in an exceedingly microprocessor: off, sleep, idle and active. In sleep mode, the hardware and most internal peripherals square measure turned on, and may solely be activated by associate degree external event (interrupt). In idle mode, the CPU is still inactive, but other peripherals are active [9].

Transceiver Unit: The radio allows wireless communication with neighboring nodes and therefore the outside world. It consists of a brief vary radio that sometimes has single channel at low rate and operates at unlicenced bands of 868-870 megacycle (Europe), 902-928 megacycle (USA) or near 2.4 GHz (global ISM band). For example, the TR1000 family from RF Monolithic works in the 800– 900 MHz range can dynamically change its transmission power up to 1.4 mW and transmit up to 115.2 Kbps. The Chipcon‘s CC2420 is included in the MICAZ mote that was built to comply with the IEEE 802.15.4 standard for low data rate and low cost wireless personal area networks.
There square measure many factors that have an effect on the ability consumption characteristics of a radio, which incorporates the sort of modulation theme used, data rate, transmit power and the operational duty cycle. At transmitted power levels of -10dBm and below, a majority of the transmit mode power is dissipated in the circuitry and not radiated from the antenna [9].

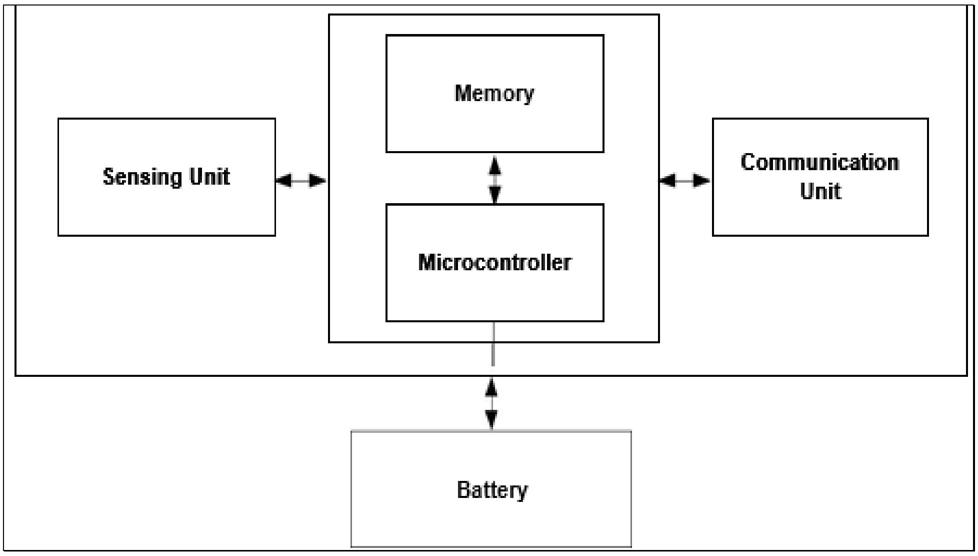

Fig 1: WSN Node Architecture

Battery: The battery provides power to the whole device node. It plays a significant role in crucial device node lifespan. The amount of power drawn from battery ought to be fastidiously monitored. Sensor nodes square measure typically tiny, light and cheap, the size of the battery is limited. A battery normally stores 2.2 to 2.5 Ah at 1.5 V. However, these numbers vary betting on the technology utilised. For example, Zinc–air-based batteries have higher capability in Joules/cm3 than metallic element batteries. Alkaline batteries have the littlest capability, normally around 1200 J/cm3. Furthermore, sensors should have a lifespan of months to years, since battery replacement isn't associate possibility for networks with thousands of physically embedded nodes. This causes energy consumption to be the most important factor in determining sensor node lifetime [9].

WSN Applications

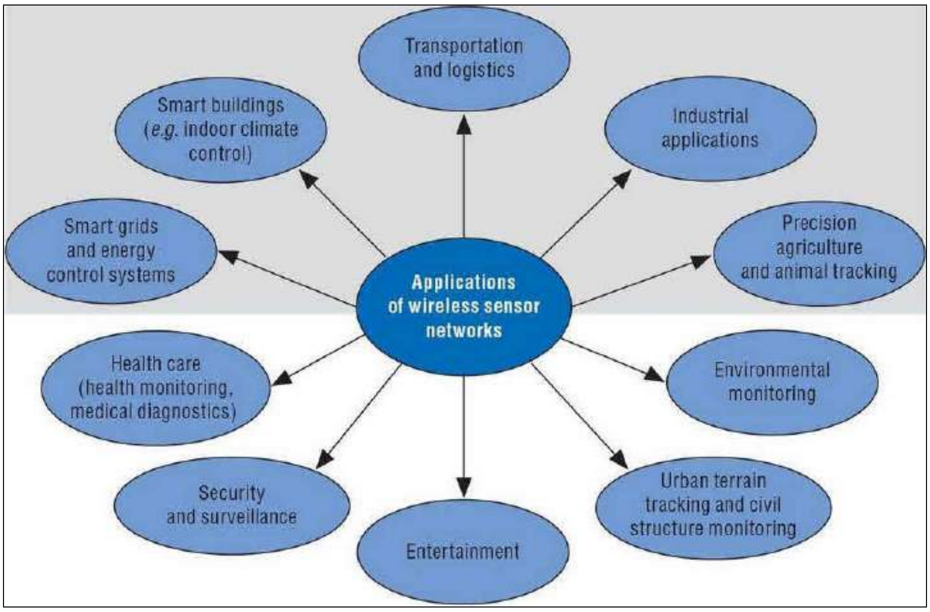

Fig 3: WSN Applications

WSN suits the applying desires as compared with wired sensing systems, since it's merely deployable associated reconfigurable even in associate degree inaccessible areas and reduces the system installation and condition observance value normally. Wireless device network allows inexpensive sensing of atmosphere. Wireless device networks ar compatible for the structural health observance for buildings [6], wind turbines [7], coal mines [8], tunnels [9] and bridges [10]. To monitor a structure, we measure behavior (e.g. vibration, displacement) of structure, and analyze health of the structure supported measured knowledge.

Advantages and Disadvantages of WSN

Recent developments at intervals the area of micro-sensor devices have accelerated advances at intervals the device networks field leading to many new protocols specifically designed for wireless device networks (WSNs). Wireless sensor networks, sensor nodes can gather information from an unattended location and transmit the gathered data to a particular user, depending on the application. These device nodes have some constraints thanks to their restricted energy, storage capacity and computing power. Data are transferred from one node to other node using different routing protocols. The area unit variety of routing protocols for wireless device networks. In case of wireless device networks dynamic routing is used as a result of nodes might of times amendment their position and die at any moment. The advantages and drawbacks of wireless device networks may be summarized as follows:

Advantages

1. Network setups could be done without static infrastructure.
2. Ideal for the remote area such as across the sea, mountains, rural areas or deep forests.
3. Feasible if there is ad hoc situation when extra workstation is required.
4. Implementation cost is cheap.

Disadvantages

1. Less secure as hackers can enter the access point and gather all the information.
2. Lower speed compared to a wired network.
3. Complex to configure than a wired network.

Motivation of the Research Work

Basically every node works on battery. Generally these batteries are non-rechargeable and due to diverse geographical localities of sensors it is not always possible to replace nodes always. So, it is important to check the energy consumption of node and try to reduce it. Suppose if we want to transmit data from one node to another node which is at a very far distance, It may not be possible to do this data transmission directly as the radio waves which are generated at first node mayn't have that much transmission power. So, we can keep many nodes in between these two nodes. This way data can be transmitted between these nodes through a series of intermediate nodes and we can use each node for a longer time i.e., whole network last longer than previous case of direct transmission between source and destination.

When we transmit it through a series of intermediate nodes there can be more than one path through which data can be transmitted. Among these different paths we have to choose most efficient path in terms of consumed energy, proper transfer of data from source to destination etc.

Energy can be conserved at every layer of WSN. The focus of the research work is the network layer whose main function is routing and topology control. So it is to develop a novel energy efficient routing algorithm whose performance is better than the existing ones.

Hence, due to the limited energy resources of each node, the objective of the research work is to optimize the energy consumption at routing layer of WSN.

Conclusion

WSN is an application specific network. There is no such optimized solution for WSN problems. It depends upon application, resource availability. Structural H. monitoring (SHM) using wireless sensor networks has concentrate considerable attention in recent years. It is an area of research that can proactively assess the structural integrity of bridges, tunnels, turbines, buildings and nuclear reactors etc. using Wireless Sensor Network.

This thesis basically focuses on application dependent parameters that effect algorithms for SHM applications. In this research work it has been considering 100 meter Bridge test as an application of SHM.

The problem of the thesis is to develop the multi parameters mathematical model to optimize the routing parameters. Particularly Network lifetime w.r.t Energy Consumption considering network design model parameters for SHM of bridges, which affects the Routing layer. The combinations of various Routing as well as MAC algorithms have been analyzed with the developed mathematical model to bring out the most efficient energy consumption without compromising the network lifetime for SHM applications.

The other important contribution of this dissertation is to develop a novel energy efficient routing algorithm to improve the network lifetime without compromising the energy consumption. Our proposed algorithm shows that network lifetime has been increased

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