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A Novel Nature Instilled Moving Sink Architecture for Data Gathering in Wireless Sensor Networks

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ABSTRACT

Wireless sensor networks are commonly used to monitor certain regions and to collect data for several application domains. Generally, in wireless sensor networks, data are routed in a multi-hop fashion towards a static sink. In this scenario, the nodes closer to the sink become heavily involved in packet forwarding, and their battery power is exhausted rapidly. This article proposes that a special node (i.e., mobile sink) will move in the specified region and collect the data from the sensors and transmit it to the base station such that the communication distance of the sensors will be reduced. The aim is to provide a track for the sink such that it covers maximum sensor nodes. Here, the authors compared two tracks theoretically and in the future will try to simulate the two tracks for the sink movement so as to identify the better one.

KEYWORDS

Archimedean Spiral, Half-Circle Spiral, Hexagonal Packing, Hyperbolic Spiral, Hyperbolic Spiral Track, Logarithmic Spiral, Sink, Wireless Sensor Network

1. INTRODUCTION

A sensor network is basically an infrastructure comprising of sensing (measuring), computing, as well as communication components that affords an administrator the capability to instrument, speculate, and respond to various events and phenomena in a specific environmental setup. The environment can be the real-life physical world, or a biological system, or an information technology (IT) framework. Sensors are employed in many days to day objects like touch-sensitive elevator buttons as well as lamps that either dim or brighten through touching the base, besides numerous application domains of which most people are never aware. With advancement in micro machinery as well as microcontroller platforms, the usage of sensors have expanded beyond the traditional fields of temperature, pressure or flow measurement. Moreover, analog sensors such as potentiometers and force-sensing resistors are still widely deployed. Many applications include: cars, medicine, robotics, manufacturing machinery, airplanes and aerospace, and many other applications in our day-to-day life. Sensor network comprises of a large number of sensors that are deployed either inside the phenomenon or very closer towards it. Further, the location of sensor nodes need not be predetermined. The sensor nodes are normally scattered in a sensor field. Besides, each of the scattered sensors is capable of collecting as well as

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routing data back to the sink (Akyildiz et al., 2002). Further, data are routed back to the sink by multi hop. There are diversified application domains of wireless sensor network to tackle several difficult real-life circumstances viz. flood situations, military applications, forest fire, vehicle tracking etc.

Basically, Wireless sensor networks (WSN) consist of spatially distributed autonomous sensors for trapping the physical or environmental parameters like: temperature, sound, pressure, etc. for cooperatively passing their data through the network to a main location. In recent days, the networks are bi-directional, that enables the *control* of sensor activity. The advancement of WSN was motivated by various military applications like: battlefield surveillance etc. Recently, such networks are deployed in various industrial as well as consumer application domains, such as industrial process tracking and control, machine health monitoring etc. The WSNs consist of nodes – from a few to several hundreds or thousands and every node is connected to one or more number of sensors. Every node consists of many parts such as: a radio transceiver with an internal antenna or connection to a special external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. Moreover, a sensor node may vary in size from that of a shoebox down to the size of a grain of dust. In like manner, the cost of sensor nodes is variable, ranging from a few to hundreds of dollars, depending on the complexity of the sensor nodes. Size and cost constraints on sensor nodes give rise to corresponding restrictions on resources like: energy, memory, computational speed as well as communications bandwidth. Further, the topology of the WSNs can vary from a simple star network to an modern multi-hop wireless mesh network. In recent trends of computer science as well as telecommunications WSNs are active research fields with thousands of workshops and conferences organized each year etc.

The primary goal of Wireless Sensor Network (WSN) is to sense and send the sensed data to the destined user. However, the requirement is to prolong the longevity of the network. Basically, the lifetime of a network is the amount of time that a WSN would be fully in operational mode. In other words, it is the time at which the first network node runs out of energy for sending a packet for losing a node could mean that the network would loss various functionalities. On the contrary, it is also feasible to use a separate definition, where some of the nodes may die or run out of battery power, when the other network nodes would be deployed to trap the desired information or for routing the desired messages to their intended destined destination. Since the devices are having limited amount of battery power, the energy management is highly necessary.

Energy management incorporates the planning as well as operation of energy production as well as energy expenditure. The objectives include various resource conservation strategies, protecting the desired climate and saving the cpsts, while the users have permanent access to the energy they necessitate. Basically, It is concerned very closely to the destined environment management, production management, logistics as well as various other desirable business functions. Generally, the “Energy management” is the proactive, organized as well as the systematic coordination of conversion, procurement, distribution and usage of energy to meet the necessities while considering the environmental as well as economic goals. From several experimental studies, it is quite clear that transmission of data takes heavy block of energy. Hence, effective data gathering as well as transmission reduces significant amount of energy expenditure. There are different energy efficient data gathering methodologies available such as cluster-based data gathering, chain-based data gathering etc. In case of cluster-based method, a group of nodes manifest a cluster. Subsequently, one of the nodes from each of the cluster becomes the cluster head (Heinzelman et al., 2000). Further, all the nodes in the cluster send the data to the concerned cluster head. Afterwards, the cluster head communicates it to the sink. In each round a different node becomes the cluster head. Therefore, the communication distance becomes variable and the sensors expend greater amount of energy. In case of chain-based approach, the nodes send data to the neighboring node and in like manner it forms a chain. Then a chain leader (Lindsey & Raghavendra 2002) sends the data to the base station. This chain leader is chosen randomly. But the problem is that the communication distance becomes more and variable for sparsely deployed network, hence energy consumption becomes more.