Evaluation of Various AD HOC Networking Algorithms

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Abstract — As a wireless sensor network (WSN) monitors environmental or physical factors such as temperature, sound, pressure, etc., its spatially distributed autonomous sensors cooperate to convey their data to a central location. The bi-directional nature of the more modern networks also enables control of sensor activity. Wireless sensor networks, which are currently used in many consumer and commercial applications, such as machine health monitoring, industrial process monitoring and control, and more, were developed in response to military uses like battlefield surveillance. The WSN is composed of "nodes" that are connected to one or more sensors. These "nodes" might be as few as a handful, hundreds, or even thousands. Each of these sensor network nodes typically consists of a radio transceiver with an internal antenna or a connection to an external antenna, a microcontroller, an electrical circuit for communicating with the sensors, and an energy source, either an embedded energy harvesting device or a battery. While there are yet no working "motes" of such small size, a sensor node can be as small as a shoebox or as little as a dust particle. The cost of sensor nodes can range from a few to hundreds of dollars, depending on how complicated each one is. Similar restrictions on energy, memory, processing performance, and communications capacity result from sensor node size and cost constraints. Basic star networks and complex multi-hop wireless mesh networks are examples of WSN topologies. To solve the problems with wireless sensor networks (WSNs), we will develop an energy-efficient algorithm using a layered chain approach. These networks ought not to be diversified or mobile.

Keywords: Wireless Sensor Networks (WSNs), Sensor Nodes, Environmental Monitoring, Energy-Efficient Algorithms, Layered Chain Approach, Multi-hop Mesh Networks, Sensor Network Topologies, Embedded Systems, Energy Harvesting, Microcontroller-Based Sensing, AD HOC Networking

I. INTRODUCTION

A wireless sensor network (WSN) is made up of spatially dispersed autonomous sensors that work together to transmit their data to a central location in order to monitor environmental or physical parameters like temperature, sound, pressure, etc. Controlling sensor activity is made possible by the bi-directional nature of the most recent networks. Military uses like battlefield surveillance gave rise to wireless sensor networks, which are now employed in many consumer and business applications like machine health monitoring, industrial process monitoring and management, and more.

One or more sensors are connected to each of the "nodes" that comprise the WSN, which might number anywhere from a few to hundreds or even thousands. Each such sensor network node typically consists of a radio transceiver with an internal antenna or a connection to an external antenna, a microprocessor, an electrical circuit for communicating with the sensors, and an energy source, either an embedded energy harvesting device or a battery. Despite the lack of working "motes" with incredibly small dimensions, a sensor node can be as small as a shoebox or as large as a dust particle. Sensor node prices can range from a few to hundreds of dollars, depending on how complicated each one is. Energy, memory, processing performance, and communications capacity are all similarly limited by sensor node size and cost constraints. WSN topologies vary from simple star networks to complex wireless mesh networks with several hops.

II. LITERATURE SURVEY

A. *Research Paper on EASPRP (2012)*

Wireless sensor networks, or WSNs, are composed of several widely distributed sensors to collect the necessary data. They have limited access to a wide range of resources, such as memory, computation speed, electricity, and communications bandwidth. The two primary issues in WSNs are energy and power. To use the judiciary's available power fairly, it is necessary to address many paths in a load-balancing manner and multiple events concurrently in either direction. The new approach that we are proposing here is based on Prim's approach. EASPRP, a novel routing system for wireless environments, was developed and proposed based on the shortest path using Prim's algorithm.

Prim's technique outperforms Dijkstra's when the complexity drops to O((n+e) log n). In the subject of wireless sensor networks, loop-free routing has been examined for issues including energy level status and unintentional or significant node damage. The proposed approach includes a workaround for these situations.

1) *Shortest Path Algorithm*

The shortest route between the source and the sink is determined using Prim's algorithm.

B. *EASPRP Packet Format (4 Bytes)*

EASPRP uses hop counts and energy-status single-bit information to create local routing decisions. The 4-byte packet format used by the EASPRP is displayed below:

Prim (G: weighted connected graph with n vertices)
T:= 0 minimum- weight edge
for i = 1 to n-2
begin
e:= an edge of minimum weight incident to a vertex in T and not forming a circuit in T
if added to T
T:= T with e added end return (T)

C. *An Investigation into Cost-Effective Routing*

This research proposes a mobile sensor network approach to track a moving target with low energy consumption. It is believed that the primary drivers of the energy consumption of the network's sensors are mobility, sensing, and communication. In order to determine near-optimal locations for the sensors at different time instants, the target region is first divided into a grid of sufficiently small rectangular cells. Next, the grid is transformed into a graph with edges that are suitably weighted. A shortest path method is then used by a number of sensors to route data from the target to the destination.

III. PROBLEM STATEMENT

Consider a group of n mobile sensors, S1,..., that are intended to track an object in motion. Dispersed across an area where the target moves, the sensors aim to maintain communication between the target and destination (a fixed position). The difficulty of identifying the optimal path and sensor placements for an energy-efficient tracking system is tackled using the well-known shortest path problem. This is accomplished by dividing the field into Voronoi polygons and analyzing different network design scenarios. Simulations demonstrate the efficacy of the proposed tracking strategy.

A. Research Paper on EESPRP

The usage of wireless sensor networks, or WSNs, is one of the most recent innovations in modern communication systems. Since conventional IP-based routing is inadequate, routing is crucial to WSN design. Security, energy consciousness, and QoS needs are just a few of the crucial elements that go into designing a routing protocol. One of the most crucial elements is energy awareness because sensor nodes' batteries cannot be regularly recharged. Many energy-conscious protocols were published in the literature. In this study, we propose a new Energy Efficient Shortest Path (EESP) algorithm for WSNs, which differs from the traditional shortest path routing method. By distributing the load evenly throughout the paths, this method improves network performance.

1) Energy Model:

The suggested method uses the radio model as its energy model.

ET (d) = Ect+ ε dn (1) provides the energy needed to transmit a packet over a distance of d. Here, Ect is the energy used by the transmitter's circuitry, ε is the energy lost in the transmitter amplifier, and n is a design parameter that can be either 2 or 4.

Additionally, ER (d)= Ecr (2), where Ecr is the energy used by the receiver's electronics, provides the power used during reception. The energy used by intermediate nodes will be the total of the expressions (1) and (2) since they must receive and forward the packets.

B. Research Paper on Scalable EESR in WSN

Scalability, low latency, and energy efficiency are important requirements for wireless sensor networks. Scalability is essential in wireless sensor networks, particularly as sensor nodes frequently run on batteries and have constrained resources. This necessitates a low-latency, energy-efficient sensor routing technique. In this study, we propose a sensor routing technique, EESR (Energy-Efficient Sensor Routing), that enables energy-efficient data transfer from sensors to the base station. Each of the sectors that comprise the region has a management node according to the proposed strategy. After receiving the data from sensor devices in its sector, the manager node sends it to the base station via the shortest path of the 2-dimensional (x, y) coordinates. In this process, we use relative direction-based routing in the two-dimensional (x, y) coordinates of wireless sensor networks. We show through analysis and simulation that the proposed scheme provides significant energy savings and outperforms idealized transitional systems (e.g., broadcasting, directed diffusion, and clustering) in the investigated circumstances.

C. Energy Efficient Sensor Routing

A sensor node that senses an event first searches the EESR database for the sector IDs of all neighbor nodes within a 1-hop before selecting the next node to transmit the event. If the event is within one hop, the management node is selected as the subsequent node to deliver it. If they are within one hop, another node in the same sector is randomly selected to be the next node. Otherwise, the next node is a neighbor node with the lowest sector number and the closest proximity to the base station. If several nodes have the same smallest sector number, nodes in the same quadrant are selected to prevent the event from propagating far to the other region. Once the event node has selected one of the neighbors within a one hop radius, the event is only sent to the selected sensor node.

D. Research Paper on SPRP for Data Centric WSN

Wireless sensor networks, or WSNs, are composed of many sensors spaced widely or sparsely to collect the necessary data. Energy, memory, communications bandwidth, and processor speed are among the resources that are limited. Since power is a major issue in WSNs, the primary focus has been on lowering the number of transmissions to extend the network's sensor service time and allow for the simultaneous identification of many channels and events in any direction. Based on the best cable protocol, TCPIIP, we are introducing a new technique named "Shortest Path Routing Protocol for Highly Data Centric Wireless Sensor Networks (SPRP)".

SPRP is a novel routing mechanism for wireless environments that draws inspiration from various routing strategies including RIP, OSPF, and a shortest path using Dijkstra's algorithm. The proposed approach includes a remedy for some unexpected scenarios in wireless sensor networks, like energy level status and unintentional or deliberate node damage.

IV. THE SPRP PROTOCOL:

The SPRP has been influenced by Dijkstra's method [9] for shortest path discovery, the ease of offloading, and the enhanced efficiency of the routing table in the TCP/IP architecture. SPRP makes local routing decisions based on energy-status single-bit information and hopcounts. The SPRP uses a 4-byte packet format.

– Originating node id: a 10-bit unique id that supports 210 nodes in the network;
– .Energy threshold bit: 1 bit 1/0 to indicate if the energy of the originating node is below or over the threshold.
– 4 bit TOS
– Hop count to Sink: 16 bits, which begins at 0 and rises by 1 with each hop or transmission Examples of service

kinds include control packets, data packets, and out-of-service packets.

A. Research Paper on SPRP for Mobile WSN

A mobile wireless sensor network composed of numerous small, low-power sensors is an effective way to gather data in various environments. A single processing center receives the input from each sensor and uses it to identify environmental features. Large-scale sensors that are positioned in different places can move with the water and wind. By specifying different sensor nodes and routing protocols, we reduce sensor complexity, minimize network expenses, and update network topology with low energy consumption. In this paper, we construct a three-layer mobile node architecture to organize all the sensors in mobile wireless sensor networks. To adapt sensors and update the network topology in accordance with the new architecture, we propose the SP (Shortest Path) routing protocol. Simulations show that SP performs similarly in small-scale wireless sensor networks but better than LEACH in large-scale ones. Additionally, in the multi-layer mobile wireless sensor networks that we modeled, SP provides an advanced method for managing node movement. We have developed a three-layer mobile node architecture to reduce the complexity of sensors and the cost of constructing wireless sensor networks. Based on the new design, we have proposed a shortest path routing method to save node energy.

B. Layered Chain-Based Energy-Aware Routing Algorithm for Wireless Sensor Networks

To adapt sensors and update the network topology in accordance with the new architecture, we propose the SP (Shortest Path) routing protocol. Simulations show that SP performs similarly in small-scale wireless sensor networks but better than LEACH in large-scale ones. Additionally, in the multi-layer mobile wireless sensor networks that we modeled, SP provides an advanced method for managing node movement. We have developed a three-layer mobile node architecture to reduce the complexity of sensors and the cost of constructing wireless sensor networks. Based on the new design, we have proposed a shortest path routing method to save node energy. By preventing the formation of Long Links (LL) between neighboring nodes, the proposed approach outperforms the existing chain construction algorithm protocols. Furthermore, LBEERA selects the super leader for each higher chain based on the leader's residual energy and the distance between the leader and the BS, and it chooses the leader for each lower chain based on the nodes' remaining energy. To reduce the overhead of reelecting the leader and super leader, we would prefer to select them every few rounds rather than every round. Following that, a super leader will be chosen depending on the leader's remaining energy as well as the distance between the leader and the BS.

C. A Cluster-Chain-Based Routing Technique That Uses Less Energy for Time-Sensitive Wireless Sensor Network Applications

This study suggests an Energy Efficient Cluster-Chain based Protocol for Time Critical applications (ECCPTC) in wireless sensor networks to maximize network lifetime and minimize energy consumption and transmission delays of time-sensitive data. ECCPTC prioritizes time-sensitive data over non-time-critical data to guarantee that time-sensitive data is transmitted to the base station immediately. ECCPTC uses a threshold value to reduce transmission delays for time-sensitive data. ECCPTC organizes sensor nodes into clusters and builds a chain across the sensor nodes inside the cluster so that each sensor node can broadcast to a following neighbor and receive from a previous neighbor.

Depending on the number of neighbors, the distance between nodes, and the remaining energy of the nodes, cluster heads are selected. A chain-based data transmission method is also used by ECCPTC to send data packets from the clusterheads to the base station. We show through simulation that our proposed protocol can beat previous studies in terms of network lifetime, stability period, energy consumption, total data received at the base station, transmission delay of time-critical data, and communication overheads. The radio energy dissipation model is used to select a cluster's head.

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