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Energy Efficient Cooperative Routing Scheme For Heterogeneous Wireless Sensor Network

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Abstract: *Advancement in wireless communication and electronics over the years has led to the development of wireless sensor networks (WSNs). WSNs are formed by sets of distributed autonomous devices with several distinct characteristics to sense, process, transmit and receive observed or measured condition. Its deployment has been enhanced by its small, inexpensive and smart sensor which is easily deployable. In its simplest form, the sensor node is made up of a sensor component that measures the condition of the observed situation or physical surrounding of interest while the microprocessor component of the node ensures the information obtained are intelligently computed. The wireless radio embedded in the nodes allows communication between the neighbouring nodes. A considerable number of these sensors are used to cover the area of interest since a single sensor node can only provide limited information.*

I. INTRODUCTION

Wireless sensor network (WSN) has been widely deployed for various purposes, such as remote environment monitoring, health-care, and air quality monitoring. By employing a large number of low-power sensors, WSN collects desired information in a distributed and self-organized manner. Such feature has made WSN a key enabler to realize the Internet-of-Things (IoT) and green communication era. One well-known concern in WSNs is that the network lifetime is greatly restrained by the battery capacity of sensor nodes. To address this issue, many efforts have been made in recent years, focusing on either exploiting sustainable energy to diversify the energy supply or greening network to reduce energy expenditure. Among these, energy harvesting has received considerable attention owing to its ability in extending the lifetime of WSNs. By utilizing the energy harvesting unit and the energy buffer, each sensor node of WSN can harvest energy (e.g., solar and wind power) from environments, thereby ensuring an unlimited energy supply to each node. This type of network is referred to as the energy harvesting WSN (EH-WSN). Sustainable energy supply techniques have also been suggested in hyper cellular networks. Further applications can be found in wireless energy transfer and energy cooperation.

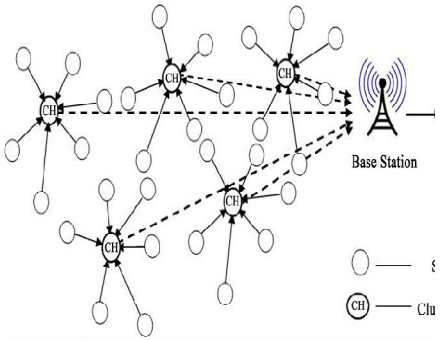

Figure 1.2: WSN Cluster Formations

A **wireless sensor network** (WSN) is a computer network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration,

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pressure, motion or pollutants, at different locations. The development of wireless sensor networks was originally motivated by military applications such as battlefield surveillance. However, wireless sensor networks are now used in many civilian application areas, including environment and habitat monitoring, healthcare applications, home automation, and traffic control.

In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. The size a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust. The cost of sensor nodes is similarly variable, ranging from hundreds of dollars to a few cents, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth. In computer science, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year.

1.1 Applications

The applications for WSNs are many and varied. They are used in commercial and industrial applications to monitor data that would be difficult or expensive to monitor using wired sensors. They could be deployed in wilderness areas, where they would remain for many years (monitoring some environmental variable) without the need to recharge/replace their power supplies. They could form a perimeter about a property and monitor the progression of intruders (passing information from one node to the next). There are a many uses for WSNs. Typical applications of WSNs include monitoring, tracking, and controlling. Some of the specific applications are habitat monitoring, object tracking, nuclear reactor controlling, fire detection, traffic monitoring, etc. In a typical application, a WSN is scattered in a region where it is meant to collect data through its sensor nodes..

II. RELEVANT WORK

1. Title: Integration and Exploitation of Sensor Data in Smart Cities through Event-Driven Applications, Authors: Garcia Alvarez, Manuel, Javier Morales, and Menno-Jan Kraak.

Propose a generic approach to enabling spatiotemporal capabilities in information services for smart cities. We adopted a multidisciplinary approach to achieving data integration and real-time processing, and developed reference architecture for the development of event-driven applications. This type of applications seamlessly integrates IoT sensing devices, complex event processing, and spatiotemporal analytics through a processing workflow for the detection of geographic events. The purpose of addressing the design aspects of smart city applications is to provide a generic approach to the development of applications that support real-time decision making in smart cities. By generic, we mean that the approach is not limited to applications in a specific domain, e.g., traffic management, environmental monitoring, etc. Rather, we describe an approach that can be applied to a range of application domains and cases. The approach relies on sensors as the main sources of data, while CEP is adopted as a suitable technology to achieve real-time processing and to detect geographic events. Event-driven applications detect the occurrence of relevant geographic events to support decision making. The general purpose of an event-driven application is to provide users with information of geographic events and support real-time decision making. Real-time decision making means that users take decisions about the most relevant problem at hand considering the most recent information available.

Merit:
It support scalable and reliable applications.

Demerit:
Take more time for composite geographic events detection.

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2 Title: Ant Based Cluster Head Election Algorithm in Wireless Sensor Network to Avoid Redundancy, Authors: Sharma, Tripti, Bijesh Kumar, Karan Berry, AkankshaDhawan, Rahul Singh Rathore, and Vishalakshi Gupta.

Propose a novel routing approach based on ACO algorithm in Wireless Sensor Networks on which LEACH protocol is applied, to route the data packets in sensor networks to maximize energy efficiency and to increase the network lifetime. ACO algorithms have been applied in solving various optimization problems effectively. In this paper we apply ACO in WSN routing. In ACO algorithm Ant agents are placed on the source node which iteratively produces the solution by using probabilistic approach and the pheromone value (which defines the goodness of path) of optimum path from source to sink. This process continues until the final termination condition is achieved, i.e. all the nodes are dead in the system.

Randomly cluster heads are selected among the alive sensor nodes and clusters are built around these cluster heads which comprises of their associated nodes. A radius for the cluster is chosen in such a way so that nodes having redundant information will stay within the range of the chosen radius. Experimental setup shows that taking 5 as radius gives the optimum result. Of all the nodes lying within the radius only one node is allowed to send the data packet to the cluster head as all the nodes lying within that area would send similar data or redundant data. This routing algorithm follows the probabilistic approach for constructing the solution, i.e. selecting the suitable path for transmission. This probabilistic selection uses pheromone information and the heuristic information, which is updated continuously.

Merit:
Proposed algorithm is able to give random cluster head selection approach.

Demerit:
Need to optimize the procedure of present cluster head selection

III. Problem Statement

3.1 Existing System

Routing paths of different WSNs are mutually independent, meaning that different WSNs route their own packets through their own routing paths and sensors. On receiving a packet belonging to other WSN, a sensor drops this packet without relaying it to the corresponding sink. In fact, if sensors can forward receiving packets for other WSNs, basically, the routing efficiency will improve since many more sensors can relay packets in this heterogeneous WSN, thus shortening the distance between two neighbor sensors and then increasing the sensor density of this monitoring environment.

For heterogeneous wireless sensor networks, proposed cluster-based routing protocols (CBRP) for balancing energy consumption among sensors. Sensors of a cluster elect their head to cooperate packet collection and delivery. EERH, the time line of a sensor is logically divided into rounds, also called time slots. A round consists of a detection period and a listening period. In the former, sensors detect events; while in the latter, sensors listen to its neighbors for receiving packets that will be relayed to sinks. The lengths of different rounds are the same. The detection periods (listening periods) in different rounds are of the same length.

Also an efficient routing protocol implemented to resolve the issue of load balancing in a WSN. The proposed DCRP routing protocol addresses this issue of load balancing in a WSN with minimum communication and computational costs. In the presence of our proposed DCRP routing protocol, the selected CH nodes act as CH for designated clusters for the defined interval of time.

3.2 Advantages

- Events are detected periodically and event packets are transmitted dynamically.
- Improves the lifetime of the deployed WSNs with better end-to-end delay.
- Reduce load balancing in a WSN with minimum communication and computational costs.

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3.3 Disadvantages

- In CBRP, an election consumes lots of energy and a packet may pass through many more hops before arriving at the sink.
- In TSCR, their focuses are not energy efficiency and lifetime of a heterogeneous WSN.
- When the residual time is quite short, the event announcement may fail due to packet collision.

IV. METHODOLOGY

4.1 Proposed System

Propose an energy saving routing mechanism, named Energy-Efficient Cooperative Routing Mechanism for Heterogeneous Wireless Sensor Networks (EERH for short), in which WSNs deployed in the same geographical environment form a heterogeneous sensor network and sensors relay packets generated by its own WSN and other WSNs. The routes for packet delivery are determined dynamically according to

V. SYSTEM ARCHITECTURE

System architecture involves the high level structure of software system abstraction, by using decomposition and composition, with architectural style and quality attributes. A software architecture design must conform to the major functionality and performance requirements of the system, as well as satisfy the non-functional requirements such as reliability, scalability, portability, and availability.

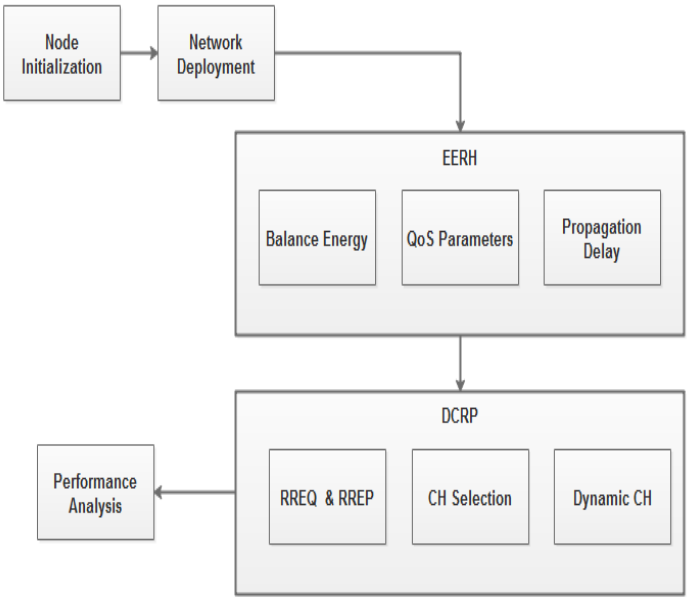

Figure: System Architecture

VI. SYSTEM TESTING

6.1 Unit Testing

The first test in the development process is the unit test. The source code is normally divided into modules, which in turn are divided into smaller units called units. These units have specific behavior. The test done on these units of code is called unit test. Unit test depends upon the language on which the project is developed. Unit tests ensure that each unique path of the project performs accurately to the documented specifications and contains clearly defined inputs and expected results. Unit testing producing tests for the behavior of components (nodes and vertices) of a product to ensure their correct behavior prior to system integration.

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6.2 Functional Testing

Functional test can be defined as testing two or more modules together with the intent of finding defects, demonstrating that defects are not present, verifying that the module performs its intended functions as stated in the specification and establishing confidence that a program does what it is supposed to do

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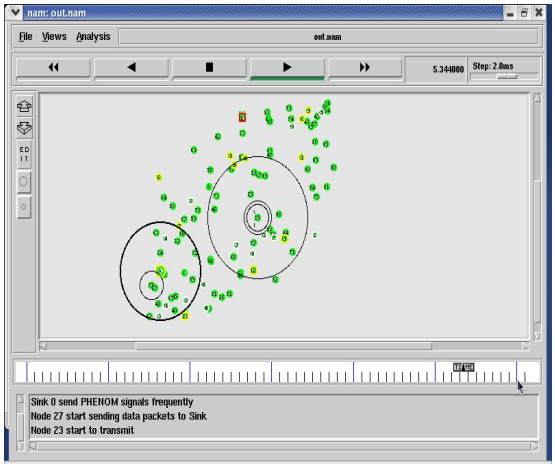
VII. OUTPUT



VIII. CONCLUSION

Wireless communications globally is something that people can expect as technology advances. Wireless communications has a lot of benefits and can make the world a lot more efficient. It does have concerns though as with every other new advancement that is made in today's world. The issues with security regarding access to a person's personal information or the negative impact that it may seem to have on society are a few things that are holding back the progress that wireless technology could be making. With more research and experiments conducted, the problems associated with wireless communications can be reduced and make it a more significant part of the world. Wireless technology will be very important in the near future where the need for wires connecting individual devices seems to be coming to an end.

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