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EFFICIENT AND SECURE DATA TRANSMISSION IN WIRELESS SENSOR NETWORKS

Roop Shikha[1] Komal Dhiman[2,]

[1]Assistant Professor, Department of Electronics & Communication Engineering, Swami Vivekanand Institute of Engineering & Technology, Banur, Punjab-140601

[2]Assistant Professor, Department of Electronics & Communication Engineering, Swami Vivekanand Institute of Engineering & Technology, Banur, Punjab-140601

Abstract:
Communication based on wireless sensor networks happens across a wireless channel. There are numerous users in a large area, for instance, mobile users. Numerous towers in the local vicinity serve as nodes, or sensors, in wireless sensor networks. Thus, communication takes place between nodes without the need for a physical connection. In other words, data is transmitted from a transmitter node to a sink node, which connects to an external base station or to each other via a large number of intermediary nodes. Numerous nodes make up a network, with one serving as a source node and one or more serving as a destination node. Wireless sensor networks have the benefit of operating unattended in severe environments, where manual human monitoring methods are unsafe and ineffective.
Keywords: Wireless sensor network; Sensor; Bacteria Foraging Optimization; Routing; Nodes

1. INTRODUCTION TO WIRELESS SENSOR NETWORK

Thousands of sensor nodes make up a wireless sensor network (WSN), which is able to sense and analyse events in wireless communication systems. By detecting electronic circumstances relevant to the environment around the sensor and converting them into electrical signals, these nodes or sensors process events occurring nearby. From the transmitting node to the sink node, data is transmitted, which interact with one another either directly to an external base station or through a large number of intermediary nodes. The cluster will cover a larger geographic area if there are more nodes installed. A sensor that detects changes in the environment routes data packets to a destination sensor that is present in the sensor field. This procedure is shown in Figure 1.1, where the source and destination nodes are denoted by red dots. To guide the path until the destination or sink node was reached, these sensors talked with intermediate nodes. Low cost, multipurpose wireless sensor nodes are used to gather data from an area of interest and relay it to a sink node.

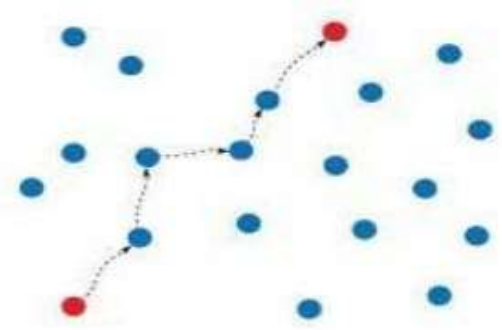

Figure 1.1: Deployment of sensors in environment [2]

1.1 Operating Stages of WSN Network

The five primary stages of a typical wireless sensor network are the cogitate stage, node establishment, post establishment stage, working stage, and post working stage. Typical sensor networks are run in a way that allows for real-time communication, is energy-efficient to extend network life, and provides data accessibility when it is needed.

a) In cogitate stage survey is done regarding deployment environment and its condition to select a suitable mechanism to establish the nodes in selected site.

b) In establishment stage, nodes are deployed in site region; which can be either done randomly or planted manually.

c) In post establishment work, sensor network operators need to identify or estimate the location of sensors to access coverage

d) Working stage involves sensing and monitoring the environment to generate data.

e) Post working stage involves shutting down and preserving the sensor for future work.

1.2 Components of WSN/Architecture of WSN based System

Devices with built-in sensors form the basis of wireless sensor networks. Nodes are what we name such gadgets. As a foundational standard, the IEEE 802.15.4 standard is used to network these nodes. The environment field known as the sensor field is where nodes are put. Deployment of nodes, which can be done manually or at random, refers to the process of installing nodes in sensor fields.

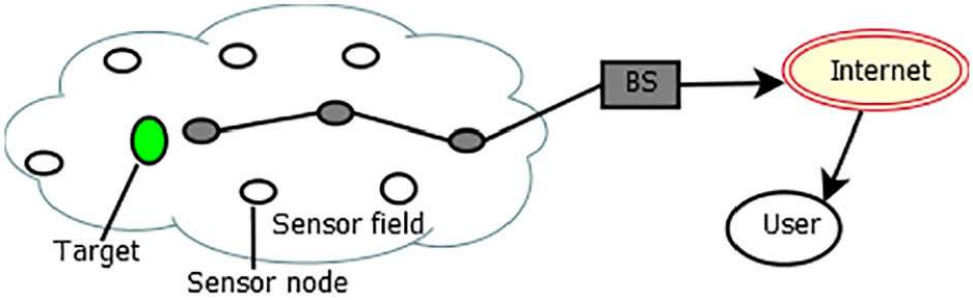

Figure 1.2: Basic Structure of WSN Based System

A base station can be thought of as a node that connects a sensor field to an existing communication infrastructure, such as the internet, in order to broadcast information to users in distant locations. Base stations can be fixed or mobile.

1.3 Advantages of Wireless Sensor Networks

- **Low Power Consumption**

The majority of wireless sensor nodes run on batteries and is built with minimal battery power consumption in mind. For instance, a typical 4 AA battery may power a node for up to three years. Additionally, they are capable of drawing electricity from the environment through a variety of internal transducers, including solar cells and piezoelectric generators.

- **Cost Reduction**

Due to its dispersed nature and embedded design, wireless sensing technology is far superior to conventional technology. Microcontrollers and transreceivers with low power consumption are used. In the W.S.N system, a sensor node doesn't even cost $100.

- **Efficiency Enhancement**

The efficiency of measuring systems is increased by the use of wireless sensor networks, which may access data practically anywhere and at any time. It also cuts down on downtime.

- **Mesh Technology**

Mesh topology data transmission uses less power than direct data transmission between the transmitting and sensing nodes. The majorities of sensor networks are scalable and can adjust their structure and node density without losing functionality. Nodes in the WSN network are able to react to unique events that the network needs to monitor.

- **Better Coverage**

Systems using wireless sensor networks provide more coverage than those using other types of sensors. Organisations can deploy more sensors in an environmental field, improving the s/n ratio of the system and increasing the amount of usable data, due to the cost advantage and employment of mesh technology.

2.Literature Survey

The earlier research on wireless sensor networks is explained in this section. The term "done" is used in this section to refer to a literature review illustrative of previous research in the field of wireless sensor networks, including various routing protocols for lifetime enhancement, throughput paths, best routing, and wireless sensor network security.

In 2011, M. Saleem et al [2] revealed their research. He has provided a rather thorough overview of various SI-based routing algorithms for WSNs in his work. Additionally, they identified some methodological errors in the way these algorithms are typically presented and empirically evaluated. The definition of scientifically valid studies and performance evaluation had finally been specified. The field of SI-based WSN routing lacks contributions in the two diametrically opposed domains of mathematical modelling and real-world implementations, aside from the methodological issues that have been identified.On the one hand, mathematical models that support fair comparisons across algorithms and enable the study of very large systems and generic algorithm features should be added to simulation-based investigations. However, simulation should only be the first phase of hardware implementations. Real-world testbed experiments present the experimenter with a variety of issues and difficulties that are difficult to recreate in simulation. They firmly believe that once SI researchers dedicate themselves to the application of reliable experimental procedures and conduct out studies integrating mathematical modelling, simulation, and real-world testing, they will see a significant diffusion of SI-based solutions for real-world WSNs. They are adamant that they will observe a large dissemination of SI-based solutions for actual WSNs once SI researchers commit themselves to the use of dependable experimental methodologies and carry out studies integrating mathematical modelling, simulation, and real-world testing.

Dynamic source routing (DSR), a routing protocol created by the author, incorporates the two aforementioned ideas. His research has the potential to speed up protocol adaptation to changes in routing during periods of high node movement while requiring little to no overhead during periods of low node movement. Through performance data gathered from a full-scale 8 node test bed, the work demonstrates numerous approaches for experimenting with protocols and applications in an ad hoc network environment, including the emulation of ad hoc networks. It also proves the viability of the DSR protocol.

Shaik Sahil Babu et al [3] introduced a new algorithm in their article in august, 2011 for the formation of trustworthy route from source node to sink node for secure routing of messages in wireless sensor networks. This algorithm process the information given by the Trust dependent Link State Routing. Direct Trust dependent Link State Routing Protocol based on Geometric Mean (GM) of the QoS characteristics, which allow the trusted nodes only to participate in the routing. By filtering the untrusted nodes according on degrees of trust metrics, the execution of this algorithm at any node provides the BS with a variety of trusted routes with varying route trusts. Based on the trust levels of the neighbour nodes and the trust levels of the many routes they have provided, the source node chooses the most reliable route out of several reliable routes that the

neighbour nodes have provided. Without taking into account the malicious nodes, the newly established trustworthy route from source node to sink will be the optimal trustworthy route.

In March 2012, S. Manju Priya and Dr. S. Karthikeyan [4] published a research paper in an international journal with the primary goal of proposing a revolutionary method for extending the lifespan of sensor networks utilising clustered multipath routing. The authors view lifetime maximisation and energy conservation as two major challenges in the development of wireless sensor networks. Energy routing method implementation is required to enhance the energy of the nodes.

A summary of the most recent routing methods used in WSNs was offered by Jamal N. Al-Karaki et al. in their publication [5]. In December 2004, they put forth a research paper that explains the difficulties in designing routing protocols for WSNs and then offers a thorough analysis of several routing strategies. In the energy routing paradigm, the author examines the design trade-off between energy and communication overhead savings. The benefits and performance difficulties of each routing approach are also explained by the authors.

On February 20–22, 2006, Al-Sakib Khan Pathan et al. [6] proposed a study to investigate the security-related problems and difficulties in wireless sensor networks. They analyse suggested security measures for wireless sensor networks and identify security concerns. They also talked about how wireless sensor networks perceive security as a whole. A significant area of research is ensuring comprehensive security in wireless sensor networks. Many of the security plans that are being suggested today are based on particular security concepts. Though security mechanisms for each layer will eventually be well-established, merging all the mechanisms to have them cooperate with one another will be a difficult research task.

Tanveer Zia and Albert Zomaya [7] suggested a research article to list all the security flaws in wireless sensor networks that are currently known, as well as the research direction for developing defences against the dangers that these flaws present. The majority of the current research in sensor network security is based on a trusted environment, but there are still many research questions that need to be resolved. The authors of this research explored threat models and particular security problems that wireless sensor networks face. They support the necessity for a security architecture to offer defences against attacks in wireless sensor networks based on their observations.

According to Garg et al. [9], routing disciplines have put a lot of effort into determining the best routes for successful, on-time information packet delivery. Prior research has concentrated on energy and distance characteristics to determine the optimum pathways, but latency and other parameters also influence performance. The optimum path is also chosen using the optimisation techniques. These algorithms for route optimisation created a set of potential paths for data transmission from source to destination, and the optimal path from the set is chosen as the routing path while taking the same factors into account.The calculations for the performance metrics stop once the path is decided. Now, if the chosen path is discovered to have been attacked, it is deemed to be faulty, and the entire process is redone to identify the path that is fault-free. As a result, these

routing procedures take longer and cause convergence delay. As a result, the author suggests a novel method for determining the best pathways that takes into account not only the energy and distance factors but also the latency or convergence delay characteristics.

3. Routing in WSN

Wireless sensor networks are a type of network made up of autonomous, spatially dispersed devices that use sensors to keep tabs on the physical or environmental variables. Wireless Sensor Networks are, to put it simply, networks in which communication occurs over a wireless channel. These networks, which are made up of many little wireless nodes and are widely dispersed, monitor the surroundings of a system by taking physical measurements like pressure and temperature. Numerous nodes make up a network, with one serving as a source and one as a destination. The number of nodes in a large area is not given.

Routing is the process of deciding which paths to send organised movement along inside a network [11]. In order for routers [10] to pick the best route between any two nodes on a computer network, they must communicate with one another according to a routing protocol. Routing algorithms make the specific route choices. Every router has systems that were directly added to it from earlier learning. This information is distributed through a routing system initially among close neighbours and then throughout the entire network.

Here, the focus is on distribution rather than routing or transmission, which implies to distribute strategically or methodically. This sort of setup is known as a "sensor take battle station" in wireless sensor networks.

These wireless sensor network's faces numbers of following problems at the time of communication.

- Issue regarding deployment
- Issue regarding distance
- Issue regarding energy consumption
- Issue regarding coverage area

3.1 Bacteria Foraging Optimization (BFO) in Wireless Sensor Networks

Stochastic search techniques called evolutionary algorithms imitate the idea of organic biological evolution. In order to create better and better approximations to a solution, evolutionary algorithms operate on a population of potential solutions using the survival of the fittest. By selecting individuals based on their level of fitness in the issue domain and breeding them together using natural genetics-inspired operators, a new set of approximations is produced at each generation. Similar to natural adaptation, this process results in the emergence of populations of people who are more adapted to their environment than the people they were formed from [8].

4.2 Principle of Evolutionary Algorithms

Natural processes including selection, recombination, mutation, migration, location, and neighborhood are modelled by evolutionary algorithms. Instead of using a single solution, evolutionary algorithms operate on populations of individuals. The search is carried out in parallel in this fashion. A population of individuals is randomly initialised at the start of the computation. The goal function for these people is then assessed. The original or first generation is created. A new generation is started if the optimisation conditions are not met. People are chosen based on how well they are able to produce progeny. Offspring are created by recombining the parents. A certain probability dictates that all children will be modified. Next, the fitness of the progeny is calculated. A new generation is created when the kids are introduced into the population in place of the parents. Up till the optimisation conditions are met, this cycle is repeated. Such an evolutionary algorithm with a single population is strong and effective for a range of situations. Multiple subpopulations can be introduced to provide better outcomes, but [8]. Before one or more individuals are swapped between subpopulations, each subpopulation goes through a few generations of isolated evolution (similar to the single population evolutionary algorithm). Compared to the single population evolutionary algorithm, the multi-population evolutionary algorithm more accurately simulates the evolution of a species.

Conclusion:

Despite the fact that sensor networks offer many useful applications and satisfy all of the needs of current network technology, there are still several challenges that contemporary sensor technology must address. The first section introduces wireless sensor network fundamentals, including its features, benefits, and applications. The second conclusion relates to past research in the area. We should concentrate our study on wireless sensor networks on the optimum route distance between nodes and sensors, as well as on increasing sensor coverage and total energy dissipation.

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