SIMULATION OF WIRELESS SENSOR NETWORK FORENERGY MANAGEMENT IN IOT ENVIRONMENTS

Abstract

The term "Internet of Things" (IoT) refers to the idea that physical devices, sensors, and controllers can communicate via the Internet [1]. Most IoT nodes are known to be energy-constrained, particularly in wireless networks. In this paper, a simulation model for wireless networks in an IoT environment is proposed. Heterogeneous nodes are used in the simulation. The simulation proposed in this study involves three techniques.The initial strategy seeks to minimise data transmission in the IoT context. The second approach plans out the duties of necessary IoT nodes. The third method, which is the final one, provides fault tolerance for probable energy-related problems in IoT nodes. Together by implementing these strategies in IoT environment, significant amount of energy consumption can be reduced. NS2 network simulator is used to test the suggested simulation. The simulation results demonstrate that, in terms of throughput, energy consumption rate, packet loss, and network lifetime, the suggested method is superior to the established IoT system.

Keywords: Scheduling, Fault Tolerance, WSN, IoT nodes, NS2, Energy management.

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I. INTRODUCTION

The Internet of Things (IoT), to put it simply, is a network of physical objects, including gadgets, cars, buildings, and other similar things, that are equipped with electronics, software, sensors, and network connectivity tools. This allows us to gather and exchange data between these entities, also known as objects or things. In recent years wireless gadgets and devices have become the most preferred form of communication. Since the majority of these wireless devices are energy-constrained, administering the wireless Internet of Things network has grown challenging as a result of the demand. [2]. A Wireless Sensor Network (WSN) is made up of a variety of inexpensive nodes that can be randomly placed or set in place to monitor the surroundings. WSNs, which have been popular in recent years, entail the deployment of a great deal of small nodes. The nodes then sense environmental changes and report them to other nodes over flexible network architecture. Sensor nodes are great for deployment in hostile environments or over large geographical areas. Many advances and researches are being conducted in this field in order to meet the current demands. Each sensor node has a separate sensing, processing, storage and communication unit. The position of sensor nodes need not be predetermined. Sensor nodes possess limited power and a restricted range, hence necessitating collaborative efforts in multihop wireless communication architectures to enable the transmission of the data they sense and gather to the nearest base station [3]. Because wireless networks use a broadcast transmission method, they are susceptible to security assaults. A IoT network needs to operate without human intervention for a continued period of time without any system breakdown. Any WSN has four fundamental parts: (1) a collection of dispersed sensor nodes; (2) a wireless network connecting the sensor nodes; (3) an information-gathering base station (Sink); (4) a collection of computing devices at the base station (or elsewhere) to interpret and analyse the data received from the nodes; the computing may occasionally be carried out by the network itself. The simulation proposed in this study involves three techniques. The initial strategy seeks to minimise data transmission in the IoT context. The second approach plans out the duties of necessary IoT nodes. The third method, which is the final one, provides fault tolerance for probable energy-related problems in IoT nodes. lowering the energy usage of IoT nodes after developing a simulation model for these nodes. This can be accomplished by simulating the intended model using an appropriate network simulator prior to the model's actual implementation. The suggested model is simulated using a network simulator named NS2, where various network characteristics are shown against conventional values and different protocols are used for different nodes.

II. SOFTWARE REQUIREMENT

Network Simulator 2

NS2 (Network Simulator-2) is a simulation tool used to replicate networks, including those in MANETs [4]. Its second version is commonly referred to as NS2, and it operates on Fedora LinuxThe basic architecture of NS2, an object-oriented, discrete event-driven simulator written in C++ and Otcl/Tcl, is shown in Figure 1. TCP and UDP network protocols, as well as traffic patterns like FTP, Telnet, and web protocols, can all be executed by NS2. The network and packet traces are graphically represented using the animation tool known as Nam (Network Animator), and NAM is also used to display the results.

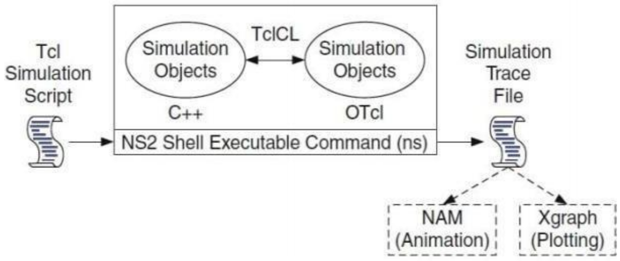

Figure 1: Basic Architecture of NS2 Simulator.

III. EXISTING SYSTEMS

1. **Related Works:** Define The related work in this field have multiple ideas being presented by various authors which can be implemented. G. Jianliang et al. proposes a methodology to avoid incorrect decisions when there is fault in the sensor networks (WSNs). Therefore, a distributed online approach is developed to find these flaws. A flawed sensor can self-correct depending on spatial and temporal information provided by the nearby sensors thanks to spatial correlations in WSNs. The suggested approach is quite effective at identifying malfunctioning sensors.[5]. B. Zhang et al. proposed an idea to improve the network throughput and communication performance, Multiple-Input It makes use of multiple-output (MIMO) technology. Both base stations and nodes are equipped with MIMO technology. The effect of fading between a node antenna and a base station antenna is found to be reduced by MIMO. For slow fading channels, the outrage throughput capacity is examined [6]. For fast fading channels, the ergodic throughput capacity is also discovered in both low and high SNR cases. X. Ding introduced an idea where there are many devices, complex associations and energy constraints in an IoT environment. For communication, the process of scheduling needs large amount of energy. As a result, a multi-objective fuzzy algorithm-based scheduling solution for energy loss optimisation is employed [7]. The algorithm searches for the device's idle time, and the energy consumption model is optimised to lower the device's energy consumption, resulting in high precision and energy savings.

2. **Existing Systems:** Previous methods were centred around the balance resource consumption model, which took into account various network performance parameters like energy consumption, flow control, and maximum link capacity, but neglected guaranteed lifetime [8]. In addition to the adaptation problem, a more efficient and rapid technique for network management is favoured even if it requires additional overhead for data collection and distribution. This indicates the possibility of a centralized strategy as opposed to a distributed one, which takes a long time to calculate and stabilize using local information. As a result, it is more suitable to use a centralized system that has a global perspective of the entire network and full access to the required information for network deployment. The disadvantages of these systems include

   - No self adaptation for efficient network management
   - Increase in network overhead
   - Computation takes long time

3. **Proposed System:** The essential problem of ensuring the IoT network lifetime under limits on coverage and connection is the main emphasis of the proposed technology. The suggested system has been created specifically for an IoT context [9]. The primary goal of the EMS is to take into account the energy issue for completely heterogeneous energy-based nodes in the Internet of Things environment. The scheme's fundamental idea is built on the use of three separate tactics. The first tactic limited the amount of data that could be communicated via the IoT system. The second scheduling approach changed the status of each energy-based node in the IoT system based on a number of factors, such as the importance of the energy level, in order to conserve node energy. The third method handled the problem of finding replacement nodes for those that failed due to energy loss. The advantages of the proposed scheme include balanced energy among nodes and increased networklifetime.

4. **Clustering in WSN:** The concept of clustering sensor nodes has been extensively studied by researchers to achieve network scalability goals. A leader, referred to as a cluster-head (CH), must be appointed in order for clusters to form. Although many different clustering methods have been proposed for ad-hoc networks in the past, their main focus has been on creating stable clusters in environments with mobile nodes. Instead of focusing on the crucial design objectives of WSNs, like network lifetime and coverage, these methodologies largely concentrated on node reachability and route stability. The cluster of sensors may elect the CH, or the network designer may pre-assign one. The CH could either be a node with extra resources or one of the sensors [10]. There are two types of cluster membership: fixed and changeable. The CHs might create a secondary network or distribute data to interested parties like a base station or a command center.

IV. SYSTEM DESIGN

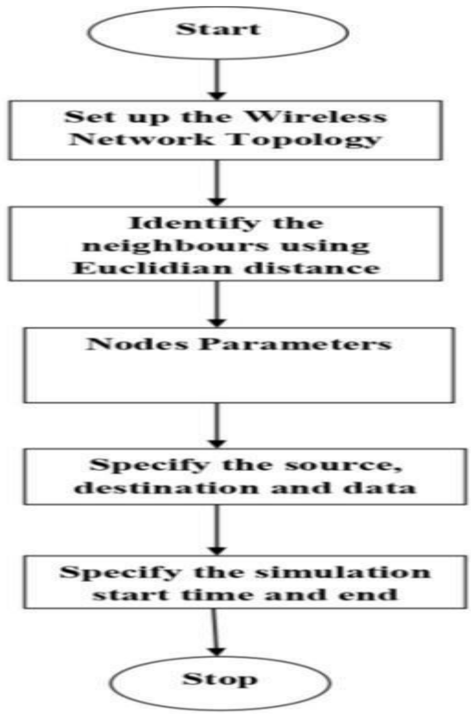

Figure 2: Flowchart of the topology.

In this section, we will describe the functions of the scripts utilized for constructing the topology. This module is responsible for creating a Wireless Network topology that comprises of mobile nodes, with each node operating on multiple channels as illustrated in Figure 2. This encompasses the configuration of the Wireless Network Topology, including environmental settings, node configuration, andtopology creation. We will set the bandwidth and threshold value, identify the neighbours, and specify the source, destination, data and Specifying the simulation start time andend time. The first stage is node deployment which is responsible for deploying mobile nodes in the IoT environments [11]. A group of nodes within one hop distance are formed into a cluster. Based on the clustering algorithm a clustering head is selected for data communication. After selecting the cluster head the energy management strategies like Data minimization, Scheduling, and Fault tolerance are applied at the respective intervals.

V. IMPLEMENTATION

1. **Data Minimization, First:** Headings Energy use and data processing are intimately related in the IoT context. Data is one of the key elements determining energy consumption because it is mainly utilised during data collection, processing, and transmission. Reduced data volume in the IoT environment can significantly reduce energy consumption [12]. Data reduction is implemented differently depending on the node class, though. Data prioritisation is required when an IoT network is congested. Data in the EMS are separated into 'n' classes and processed in various queues according to the queuing theory. Data flow across the IoT network may decrease if data is prioritised into more than two classes since a greater data size may be neglected or delayed. Data fitting is another technique for data minimization employed by energy-based nodes, such as sensors. This approach reduces the amount of the data before sending it to the target. Finding connections between IoT data requires the abstraction process, which entails sending additional parameters to the destination to aid in the extraction of the original data.destination.

2. **Planning:** Scheduling is the second method to reduce energy consumption rates. Packet transmission from any node to sink is achieved through the process of scheduling the data transmission [13]. After the selection of cluster heads(CH) for each cluster, the process of packet transmission is initiated. Nodes are checked if they are ready with data that needs to be transmitted. In case of multiple nodes competing with each other to transmit the packet fight, the packets are queued using FIFO methodology to avoid traffic and data loss. The Routing algorithm used in this case is AODV (Ad-hoc On demand Distance Vector) algorithm [14].

3. **Failure Tolerance:** Fault tolerance is the third approach employed by the EMS[15]. Applying this tactic may come before or after the first two tactics. If a node's energy fails, another node or nodes should take its place, as depicted in 8.3. This tactic is viewed as an addition to EMS's efforts to keep all data and tasks in the IoT ecosystem. The fault tolerance approach is dependent on the levelling of IoT nodes according to the importance of the task. If the task of the node is more important, then that node is covered withmore alternate nodes clustered closely together so that the important data is not lost.

VI. CONCLUSION

The proposed scheme is effective for managing the heterogeneous types of wireless sensor nodes such as MANETs, RFID's, and other networks. When the results of the proposed scheme were compared to the conventional values, it was discovered that throughput was enhanced, energy consumption was decreased, and that the quantity of dropped packets also decreased with time. The drawbacks of this proposed scheme is that it slightly increases the overhead time.

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