REVIEW OF MOBILE AGENT BASED DATA GATHERING TECHNIQUES FOR WSN TO IMPROVE NETWORK LIFETIME

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Abstract: Wireless sensor network are characterized by the nodes operate by smaller batteries and in harsh environments. Once the nodes are dead, they have be replaced. Therefore, routing protocols always focus on increasing the node's lifetime in order to lessen the redeployment cost. Clustering is one of the technique focused on grouping the nodes, choosing a cluster head among them and then performing data aggregation at CH which eventually relays the data to the Base Station. It increases the network lifetime. Mobile agent is another technique used to gather data from the nodes and is focused at improving the network lifetime. This paper discusses the various mobile agent based schemes that aim at improving the life of the sensor network.

Keywords: Wireless sensor network, network lifetime, Mobile agent, Cluster head

I. INTRODUCTION

The emergence of wireless sensor networks (WSNs) has attracted much research interest and has become an active research area in a broad range of critical applications. WSN is the deployment of a vast number of sensor nodes, deployed in a field of interest to monitor physical or environmental conditions such as temperature, humidity, and velocity. Each sensor node consists of four main components: radio, a processor, sensors, and an energy source like a battery [1]. In any application, the primary purpose of these sensor nodes is to sense and transmit the data periodically to the base station (sink) and then send it to users located at a remote site. In WSNs, sensor nodes cannot transmit their data directly to the sink individually since some sensor nodes are located far away from the sink. If the data are directly transmitted by far nodes to the sink, these nodes will die much earlier in comparison to other sensor nodes that are closer to the sink due to limited energy. Therefore, each sensor node has to transmit its data to other neighbor nodes via multi-hop until it reaches the sink. This process of sampling the information and transmitting data from nodes to the sink is called data gathering [2], which is considered as one of the challenges in designing a WSN [3].

Many researchers have widely pursued data gathering to minimize the power consumption in WSNs. Over the years, protocols such as LEACH, PEGASIS, and PEDAP [4-6] have been proposed to minimize energy consumption and increase the lifetime of sensor nodes. However, balancing the amount of data among an enormous number of nodes has become a challenging issue which leads to data congestion, increased latency, and high energy consumption. This has proved that data transmission consumes much energy than data processing. Sending a single bit can consume the same energy as executing 1000 instructions at typical sensor node [7]. Therefore, it will be more energy efficient if the nodes keep its data in its memory and waits for an autonomous mobile computational code to gather the data. To mitigate such problems, researchers have proposed the use of mobile agent (MA) as an efficient approach for data gathering in WSNs to minimize energy consumption and to prolong the network lifetime [8-11].

This paper describes the concept of Mobile Agents in Section II. Section III explains the review of the papers that uses the mobile agents to achieve energy efficiency. Finally the conclusion is discussed in last chapter.

1.2 MOBILE AGENTS

A mobile agent is a special mobile node embedded with particular class of software or computer program that roams among the wireless sensor nodes of the disconnected WSN to perform the assignment autonomously and intelligently. Mobile agents can be classified into two types: mobile software agent and mobile hardware agent. Mobile software agent is a computer program that decides time and place for migration amid the wireless sensor nodes where it logically transfers its state and code to the destination and then restarts the process of migration. Mobile hardware agent can traverse the WSN to collect information from wireless sensor nodes. The hardware agents comprises of communication protocol, localization and energy harvesting algorithms. Here, communication protocol help in migration process, the localization help in identification of collection points and energy harvesting algorithm help in energy consumption and harvesting issues. While planning the path of MA, two steps are followed either by BS or by MA (autonomously): defining the set of sensor nodes to be visited by MA and determining the actual path sequence that helps to preserve bandwidth.

In WSNs, MA can be defined as a packet [11] that carries a computational code with an assigned itinerary (the route that the MA should follow). The sink dispatches the MA that visits the nodes one by one to do a particular task. In WSNs, MA has been used in various environments for different tasks such as data fusion [12] and data gathering [13].

The use of MA to perform data gathering in WSNs can be performed by two itinerary planning: single-agent itinerary planning (SIP) and multi-agent itinerary planning (MIP). In SIP, only one MA migrates to the network, while in MIP, multi-agents are dispatched to the network and work in parallel. Although MIP overcomes the weakness of SIP, it suffers from problems such as determining the optimal number of MAs and their optimal itineraries.

III. Literature Review

In this paper [14], the authors propose multi-mobile agent itinerary planning-based energy and fault aware data aggregation in wireless sensor networks (MAEF) to plan itineraries for MAs.

This can be achieved by grouping nodes in clusters and planning itineraries efficiently among cluster heads (CHs) only. What is more, an alternative itinerary is planned in case of node(s) failure. The simulation result clearly shows that the novel approach performs better than the existing ones.

In this proposal [15], the authors optimized the algorithm that based on iteratively partition in a directional sector zone, where the node will include in the method. In adaptive fashion by the Genetic algorithm schema we obtain the near optimal route. Through the angle of the direction, sector zone the length of method is controlled. The authors present Optimized Direction based grouping of source for multi-agent route planning (OPMIP). This is the enhanced version of DSGMIP. At the sink node, this operated centrally in the processing element. The major proposal of this algorithm is for the partition of the network area those center are sink node neighbor. When the MA travelled far from the base station of sink nodes the path of each MA's in a circle-trip naturally joins at the descend node while progressively expanding. The area covered by the typical route has shape like –sector.

In this article [16], the authors present a new algorithm named Optimal Multi-Agents Itinerary Planning (OMIP). The source nodes are grouped into clusters and the sink sends a mobile agent to the cluster head of every cluster; which migrates between source nodes, collects and aggregates data before returning to the sink. The results of the simulations testify the efficiency of the algorithm against the existing algorithms of multi-agent itinerary planning. The performance gain is evident in terms of energy consumption, accumulated hop count and end to end delay of the tasks in the network.

This article [17] presents eagilla, a middleware to support remote level multicasting wireless sensor networks. Eagilla organizes multicasting communication in different tuples, integrating mobile agents to the network for sensing data and to regulate the data to organize global communication. Eagilla model comes up with a hybrid multi-layered architecture to reduce the complexity and to support interoperability, heterogeneity in WSN. Eagilla provides non-functional requirements such as Qos, scalability, flexibility and reliability. The effectiveness of eagilla middleware is proved by conducting experiments in a professional environment.

In this proposed work [18] mobile agents are deployed at each cluster head. After fixed TDMA slot CH invokes associated agent and sent it for collection of data from its cluster members. Mobile agent follows hop to hop approach for data collection from member nodes. Each node transfers its data to mobile agent which shares this data with neighboring nodes so as to remove redundant data. Agents perform two types of operations one after another; firstly collects the data from member nodes and apply filters the data and then forwards the fresh copy of data to the CH. At each CH other MA called Head Mobile Agent (HMA) is there to filters the data aggregated from various CH within same network.

In this paper [19], the authors adopt a hybrid method called HM-ACOPSO which combines ant colony optimization (ACO) and particle swarm optimization (PSO) to schedule an efficient moving path for the mobile agent. In HM-ACOPSO, the sensor field is divided into clusters, and the mobile agent traverses the cluster heads (CHs) in a sequence ordered by ACO. The anchor node of each CHs is selected in the range of communication by the mobile agent using PSO based on the traverse sequence. The communication range adjusts dynamically, and the anchor nodes merge in a duplicated covering area for further performance improvement. Numerous simulation results prove that the presented method outperforms some similar works in terms of energy consumption and data gathering efficiency.

In this article [20], the authors propose a middleware architecture for mobile agent based WSN applications that is not only efficient for traditional tasks, but also capable of providing adequate security services. As a case study, they explore mobile agent based intrusion detection system, considering as an application, for our proposed middleware architecture. Comparative study and detailed analysis of proposed middleware architecture show a number of benefits.

In this paper [21], the authors present a cooperative data processing algorithm based on mobile agent (MA-CDP), and considers MA in multihop environments and can autonomously clone and migrate themselves in response to environmental changes. MA accounts for performing data processing and making data aggregation decisions at nodes rather than bringing data back to a central processor, and redundant sensory data will be eliminated. The results of the simulation show that MA-based cooperative data processing provides better performance than directed diffusion in terms of end-to-end delivery latency, packet delivery ratio, and energy consumption.

In this paper [22], the authors have proposed a dynamic mobile agent based data aggregation approach that takes into consideration energy efficiency, network lifetime, end to end delay and aggregation ration while making the decision for migration of agent in multihop sensor network. As their approach focuses on finding the most informative route by traversing comparatively less number of nodes consequently mobile agent takes less time to return to processing element, thus, exhibiting lower delay.

In this paper [23], a fuzzy-based MA migration approach (FuMAM) is proposed to determine appropriate itinerary for an MA by considering three parameters: distance, remaining energy, and a number of neighbors. Simulation experiments show that the FuMAM approach improves the rate of the successful MA round-trip and network lifetime. Moreover, the proposed FuMAM approach outperforms the compared algorithms in terms of energy distribution usage among nodes.

IV. CONCLUSION

This paper address the issues of energy efficiency in wireless sensor networks and presents the survey of previous studies that use the concept of mobile agents to augment the network lifetime.

One of such schemes uses the fuzzy rules to determine the itinerary of the mobile agent to collect data from the sensor nodes. Since network performance depends on the mobile agent's trip time and trip planning, the work can be done in future to further extend the network lifetime and its performance.

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