Intelligent Cluster Routing Protocol for Wireless Sensor Network based on G.A.

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Abstract

Interconnection of sensor nodes forming a network called wireless sensor network (WSN). The difference between the WSN and traditional wireless networks is that sensors are extremely sensitive to energy consumption. Energy saving is the crucial issue in designing the wireless sensor networks. By considering its application areas WSN can be argued as a traditional wired or wireless network. But in reality, these networks are comprised of battery operated tiny nodes with limitations in their computation capabilities, memory, bandwidth, and hardware resulting in resource constrained WSN. In this paper we work on a Intelligent Cluster Routing technique based on GA to achieve high energy efficiency.

Keywords: Energy aware, Energy efficiency, GA, Intelligent protocol, WSN.

I. INTRODUCTION

Wireless communications have been successful in linking people together. The cellular networks enable people to be connected at any place any time. Besides connecting people wireless communications also extend its applications into connecting environment or machines with people or machines with machines. In this paper we investigate into one of enabling technologies of such application, Wireless Sensor Network (WSN).

Recent technological advancements in micro electronics and wireless communication technologies have enabled manufacturing of small, low cost, battery operated and multifunctional sensor nodes. These sensor nodes measure ambient condition in the surrounding environment that can be processed to reveal the characteristics of the phenomena occurring at the location where the sensor nodes are deployed. A large number of these sensor nodes are either placed carefully or randomly deployed over a geographical area and networked through wireless links to form a WSN.

Routing methods in WSNs have to deal with a number of challenges and design issues. Despite advancement in technology, sensor nodes in WSNs still have restrictions such as limited battery power, bandwidth constraint, limited computing power and limited memory. It creates the need for routing protocols to be highly adaptive and resource aware. Some of the challenges of routing protocols are:

(1) Node deployment in either random or pre-determined manner.
(2) Data reporting method which can be a time-driven, event-driven, query-driven or a hybrid of all of these methods.
(3) Trade-off between energy consumption and accuracy of data gathered.
(4) Node failure tolerance of the network.
(5) Scalability, where routing method should be able to work with large networks.
(6) Routing method should be adaptive for mobile sensor nodes.
(7) Should support data aggregation to reduce redundant data.

Although sensor nodes are identical devices but their characteristics varies with the network structures. Sensor deployment, coverage, transmission power, computation, reporting, addressing and communication pattern greatly affects the routing protocol operation both at nodes and at base stations discussed in chapter (2). Routing protocol used for WSN communication support unicast (one-to-one), multicast (one-to-many) and reverse-multicast (many-to-one) in the following ways [11].

A. Node-to-Node

In a multihop communication data needs to be passed by intermediate nodes in order to reach to destination. Node to node communications is used to pass data from one node to other till the destination. Generally, this type of communication is not required in WSN communication.

B. Node-to-Base Station

When sensors node want to send responses back to base station, this communication pattern is used. This is a reverse-multi path communication which means that more than one node can communicate to base station directly or indirectly. This communication pattern can also be unicast if there are multiple base stations or there is a special node (group leader), who is responsible to gather sensed information and transmit it to base station [11].

C. Base Station-to-Node

This type of communication is required when base station wants to request data from nodes. Typically, the mode for communication is any cast (one-to-many) which means any sensor node having the requested date can respond to the base station. This pattern of communication can also be multicast or unicast if the identification of nodes is unique by their IDs or locations etc.

II. PROBLEM FORMULATION

Wireless sensor networks are finding its way in many real time applications. This prevalence requires that the network to be efficient in handling data as well as being able to act on the information by either directing it to the correct location or acting appropriately. The types of routing protocols currently used each have their benefits as well as their problems. One of the problems in WSNs is that they are still relatively new to the community and common standard protocols that can satisfy all the multitude of tasks does not exist at present. The TCP/IP suite of protocols would be an example of a standard that almost all computers use, especially when communicating on the Internet. A similar WSN protocol that can be used widely and efficiently would allow greater flexibility in the wireless sensor environment.

The problem addressed in this proposal is to design and develop a routing protocol that has as many of the advantages and as few of the disadvantages of the current protocols and to implement these changes into a single protocol. Most protocols written for a WSN only allow for fixed sensors but a WSN would most likely contain a limited number, if not consist only of mobile nodes. If a sensor is mobile, attached to a person for instance, the static network would be constantly trying to reorganize the network routing structure. Thus further investigation should be conducted to allow for a more flexible routing protocol that can adapt mobility into its environment as effectively as possible.

Wireless sensor nodes themselves are often only provided with a limited power supply. Making efficient use of this available power supply requires all the layers of the device to work in harmony to maximize the lifetime of the node, which in turn increases the lifetime of the network as a whole. This concept is termed as using a cross-layer design.

III. RESEARCH OBJECTIVES

The scope and objective of this proposed research is the design and development a WSN routing protocol that can be implemented on existing WSN infrastructures and which exhibits the following criteria:

- The protocol should function effectively for networks of any size keeping scalability in focus.
- The protocol's computational complexity has to minimize for the nodes, which results in extending the lifetime of the network.
- The protocol must keep in view of hardware capabilities of the nodes.
- The protocol must limit the number of transmissions required to function it properly.
- The protocol must allow mobile nodes to keep information about the network.

The above objectives can be summarized in protocol's scalability, energy efficiency, simplicity and mobility. To achieve these objectives, a number of sub-objectives needed to be achieved.

Examine the current status of WSNs and the possible future that they may provide. Any

- Investigate different aspects of routing protocols that are available.
- Identify routing architecture's advantages and disadvantages being employed.
- Investigate the scope and credibility of research to date.
- Propose and test a new protocol which uses the GA to improve its performance.
- GA is utilized to test the fitness of a node to become cluster head
- During the selection process of cluster head the energy factor is utilized to make it energy aware.

IV. RESULTS & ANALYSIS

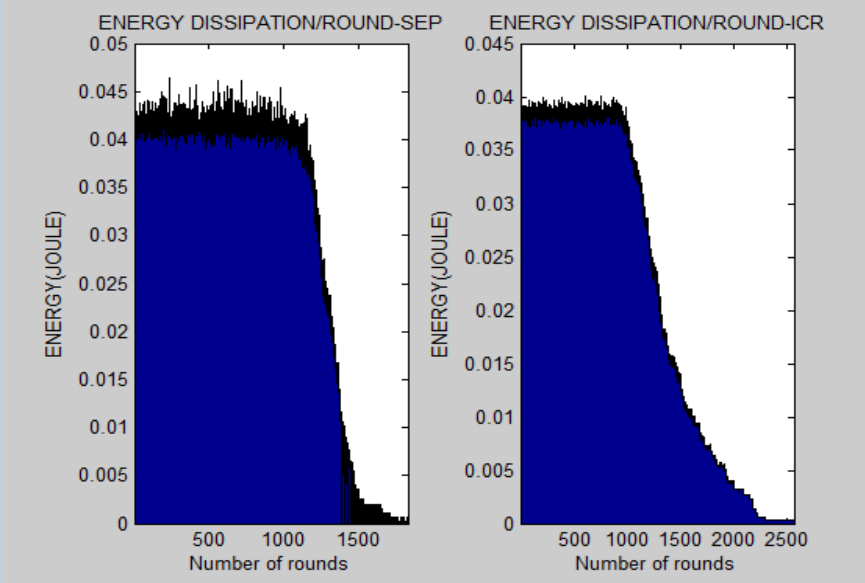

Fig. 1: Energy dissipation per round

Energy dissipation is an important factor in determining the performances of both the protocols. In SEP the energy dissipation takes place at a rate of near about 0.045Joule per round whereas ICR(Intelligent Cluster Routing) do not allow the energy dissipation at a higher rate and decrease this level to 0.04 per round.

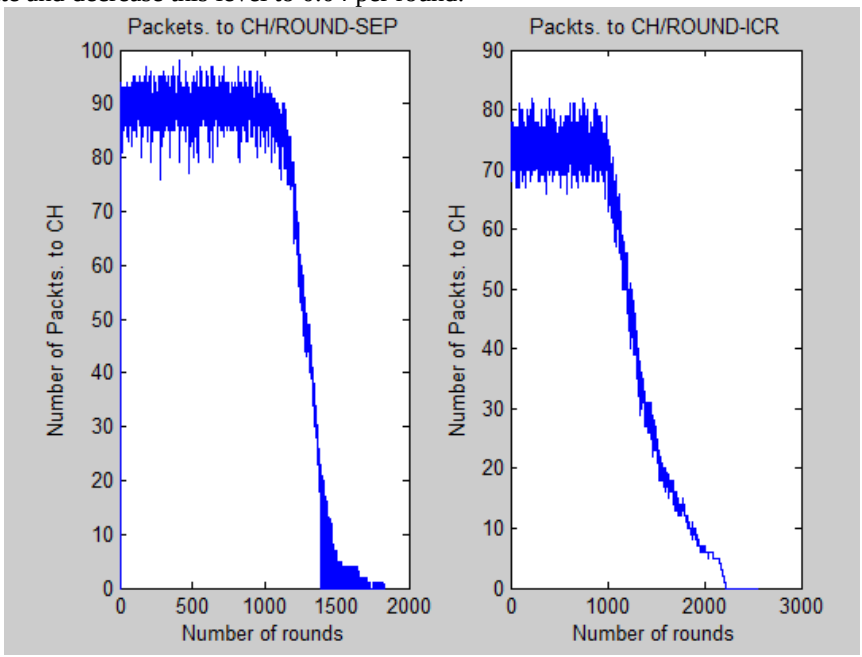

Fig. 2: Packets transmitted in given rounds

Figure 2 shows the Packets that are coming to Cluster head in SEP & ICR Protocol during the lifetime of the protocol. It provides the throughput analysis from 0 rounds to 2000 rounds as 1800 is the overall lifetime of SEP in our experiment. Here Y axis shows the amount of packets sent during active network. It shows the effect of the stability period for wireless sensor network. The progress in terms of network life time is clearly visible from the results.

Figure 3 shows the Packets that are sent to Cluster head in SEP & ICR Protocol during the lifetime of the protocol. It illustrates the throughput from 0 to 3000 rounds. Here y axis shows the amount of packets to BS during running time. The number of packets per round varies initially 12 to 24 packets per round and in the last 500 rounds it lies in between 5 and 0 per round in case of SEP while this packet variation is from 34 packets per round to 1 packet per round in case of ICR.

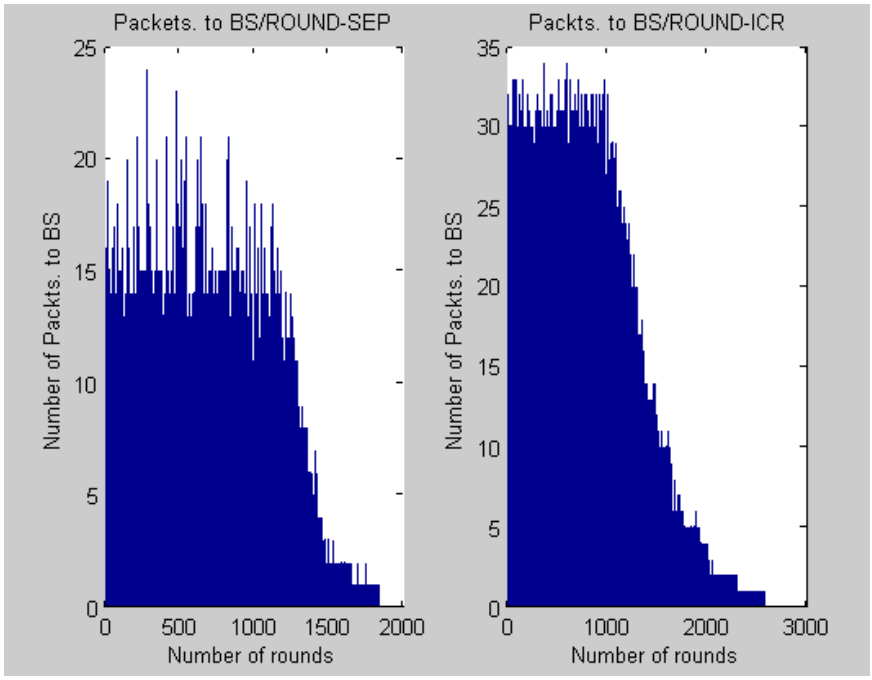

Fig. 3: Packets sent to Base Station

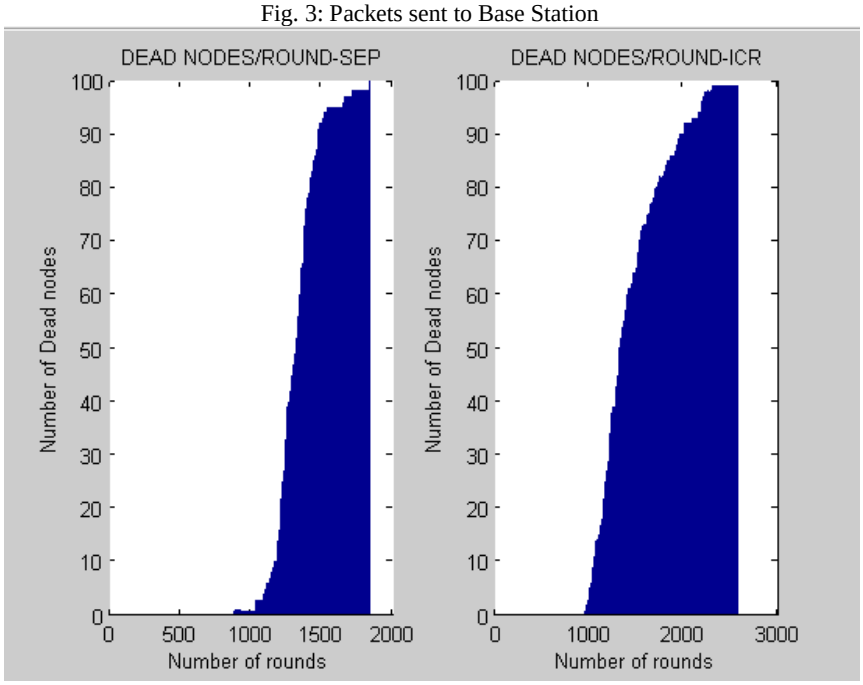

Fig. 4: Total number of Dead nodes

Above figure provides the graph statistics of Dead node with same number of initial nodes.. In our proposed algorithm all the 100 nodes are alive till 1000 rounds and start dying thereafter. All the nodes completely die after 2500 rounds. While in SEP all the 100 nodes are alive till 900 rounds and start dying thereafter. All the nodes completely die after 1800 rounds. It shows the improvement in lifetime of network by increase in number of rounds for which the network works, in our proposed algorithm.

V. CONCLUSION

The proposed algorithm has shown a significant improvement over SEP. The difference among existing protocols and proposed algorithm include proposed algorithm selects a node as cluster head after application of GA i.e the fittest node is chosen as cluster head where fitness is considered more only if it has comparatively higher energy among other nodes in cluster area during run time. The proposed algorithm makes the full utilization of heterogeneous environment WSN nodes.

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