Chapter 35

Balanced Energy Consumption Approach Based on Ant Colony in Wireless Sensor Networks

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ABSTRACT

Nowadays Wireless Sensor Networks (WSNs) have grown rapidly due to advancement of information technology. Sensor nodes are deployed over the field for collecting useful information. Sensor nodes have limited battery power and bandwidth. As a result it is critical for planning energy efficient protocols in WSNs. It is necessary to transfer and gather information in optimized way to reduce the energy dissipation. Ant Colony Optimization (ACO) is already proved to be better technique to optimize the network routing protocols in WSNs. Ant based routing can have significant role to extend the network life time and balance energy consumption in WSNs. In this chapter wireless sensor network architecture, routing factors of wireless sensor networks, computational intelligence technique, ant colony algorithm and ant colony based balanced energy consumption approaches in wireless sensor network have been discussed.

INTRODUCTION

The Wireless Sensor Network (WSN) consists of inexpensive, little-power as well as tiny size motes. In WSN environment, all motes work collectively to feel the surroundings, accomplish easy data processing as well as exchange wirelessly over a small range (Zhao et al., 2004). Sensor nodes can link straight to the sink to design a local area networks model in WSNs. The sensor node consists of transceiver, battery, sensors and the processor. The processor converts the analog sensed information in to digital format (Yick et al., 2008). The sensor can perform simple calculations and communicate locally over a small area. Wireless sensor nodes transfer data within short distances. WSN depends on IEEE 802.15.4 standard. WSNs are extensively operated in the surroundings monitoring like disasters area, battleground,
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Energy is limited in sensor node because power is supplied by the battery. It is extremely complicated to replace batteries in coarse or far-flung fields. So, this is real challenge to maintain the power consumption to preserve power along with long lived. The core issue in sensor network research is to increase the life span of network. The major research issue in wireless sensor network is routing. The main challenge in WSN is to designing routing protocols and implement in common as well as compromising platforms that can be employed for different activities. There are several routing protocols have been constructed as well as evolved for WSNs as the routing in WSNs is different from various networks because it is impossible to construct a global addressing method due to enormous number of sensor nodes, nodes are strongly power constrained as well as storage spaces, node failure rate and probability of redundant data (Hui et al., 2009). Biologically inspirations (BIs) based techniques have been adopted to cope with these challenges (Saleem et al., 2011). Swarm intelligence (SI) technique is widely used to solve computational problems. Ant colony is highly attracted the interest of researchers for long time (Kate & Das, 2014). The basic idea of BIs is to be accustomed to be developing novel protocols for managing as well as optimizing in WSNs (M Shamsan Saleh et al., 2012). The insects such as ants, bees act as a cooperative element to solve routing challenges. The ants go away for establishing and discovering routes as well as effectively relocate frontward and toward the back from the den to the destination food (Stutzle & Dorigo, 2004). These ants find routes from the collaborate relations of the several ants throughout the route patterns. Ant Colony Optimization (ACO) is characterized by computing smooth, robustness, extensibility along with appropriate for constructing routing techniques in WSNs. ACO algorithms are helpful to resolve combinatorial optimization problems by observations of the foraging nature of ants (Dorigo & Gambardella, 1997; Bonabeau, Dorigo, & Therault, 2000) in determining the optimal path from the den to the food resource. The cluster analysis algorithms based on ACO follow either of the two fundamental natures of real ants: ants foraging behavior for determining the food source and imitate the ant’s behavior of grouping dead bodies. ACO is very much popular in network routing. The ACO technique not only detects the most favorable smallest path within the nodes but also calculates the node energy which balances the energy consumption of WSN’s nodes as well as prolongs the network life span (Mahale, R, & Chavan, 2014). ACO algorithms have high degree of self organizational and global optimization characteristics, reasonable combination similar with low energy consumption, self-organizing WSNs in large scale network routing and contribute to the data centric aggregation routing (Liu, 2014, pp. 526-533).

WIRELESS SENSOR NETWORK ARCHITECTURE

The WSN comprises of tiny sensor nodes, sink nodes, infrastructure network as well as a sensor network management. The nodes within communication range exchange data with their neighbors but multi-hop routing is employed to access the communication outside the range of node (Xiang & Yun, 2012) in WSNs. Most nodes can establish a wireless link with the gateway node. In whole area i.e. sink node with internet or satellite communication, data is communicated to the far-flung monitoring center for centralized treatment. Figure 1 shows user collects the monitoring data through the management node of WSN configuration as well as management.

Routing design in WSN is very much linked to the network system design mode. There are many challenging factors (Chong & Kumar, 2003) for designing routing protocols in WSNs are discussed below.
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