

Chapter 20

Improved Energy-Efficient Ant-Based Routing Algorithm in Wireless Sensor Networks

Adamu Murtala Zungeru

University of Nottingham-Malaysia Campus, Malaysia

Li-Minn Ang

University of Nottingham-Malaysia Campus, Malaysia

SRS. Prabaharan

University of Nottingham-Malaysia Campus, Malaysia

Kah Phooi Seng

Sunway University, Malaysia

ABSTRACT

High efficient routing is an important issue in the design of limited energy resource wireless sensor networks (WSNs). This chapter presents an Improved Energy-Efficient Ant-Based Routing Algorithm (IEEABR) in wireless sensor networks. Compared to traditional Basic Ant-Based Routing (BABR), Improved Ant-Based Routing (IABR), and Energy-Efficient Ant-Based Routing (EEABR) approaches, the proposed IEEABR approach has advantages of reduced energy usage and achieves a dynamic and adaptive routing that can effectively balance the WSN node power consumption and increase the network lifetime. This chapter covers applications and routing in WSNs, different methods for routing using ant colony optimization (ACO), a summary of routing algorithms based on ant systems, and the Improved Energy-Efficient Ant-Based Routing Algorithm approach. Simulations results were analyzed while also looking at open research problems and future work to be done. The chapter concludes with a comparative summary of results with IABR and EEABR.

1 INTRODUCTION

The advancement in technology has produced the availability of small and low cost sensor nodes with capability of sensing types of physical, environmental conditions, data processing, and wireless communication (Akyildiz et al., 2002; Katz et al., 1999; Min et al., 2001; Rabaey et al., 2000; Sohrabi et al., 2000). The sensing circuitry measures ambient conditions related to the environment surrounding the sensor, which transforms them into an electric signal. Processing such a signal, reveals some properties about objects located and/or events happening in the vicinity of the sensor. The sensor sends such collected data, usually via radio transmitter, to a command center (sink) either directly or through a data concentration center (a gateway). The decrease in the size and cost of sensors, resulting from such technological advances, has fueled interest in the possible use of large set of disposable unattended sensors. Such interest has motivated intensive research in the past few years addressing the potential of collaboration among sensors in data gathering and processing and the coordination and management of the sensing activity and data flow to the sink. A natural architecture for such collaborative distributed sensors is a network with wireless links that can be formed among the sensors in an ad hoc manner.

The main goal of our study is to maintain network lifetime at a maximum, while reducing Energy usage by the nodes and discover the shortest paths from the source nodes to the base node (sink) using a Improved Energy-Efficient Ant-Based Routing Algorithm (IEEABR).

The chapter is organized in the following format: The introductory part of the chapter provided in section 1, covers a general perspective and the objective of the chapter. Section 2 the WSNs and previous work on routing, deals with wireless sensor networks while looking at its applications and routing algorithms, different methods of routing using the popular ACO and

generally comparing the different methods of routing. Section 3 gives detailed explanation of our proposed algorithm, the IEEABR. Section 4 looks in to analyze simulation results while also looking at the simulation environment and the trace files. Finally, section 5 concludes the chapter with an open research problems and future work to be done, and a comparative summary of our results with the IABR and EEABR. At the end of the section were provision for References and Additional readings for detail of some routing Algorithms.

2 PREVIOUS WORK ON ROUTING IN WSNs

2.1 Wireless Sensor Networks; Applications and Constraints

WSNs are collections of compact-size, relatively inexpensive computational nodes that measure local environmental conditions, or other parameters and forward such information to a central point for appropriate processing. WSN nodes can sense the environment, communicate with neighboring nodes, and in many cases perform basic computations on the data being collected. The environment can be the physical world, a biological system, or an information technology (IT) framework. However, the characteristic of wireless sensor network (WSN) require more effective methods of data forwarding and processing. Though, WSN is used in many applications such as; radiation and nuclear-threat detection systems, weapon sensors for ships, toxins and to trace the source of the contamination in public-assembly locations, structural faults (e.g., fatigue-induced cracks) in ships, Volcanic eruption, earthquake detection, aircraft, and buildings, biomedical applications, habitat sensing, and seismic monitoring. More recently, interest has focused on networked biological and chemical sensors for national security applications, physical security, air traffic

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