UNIVERSITI TEKNOLOGI MARA

CLUSTER HEAD SELECTION ALGORITHM USING FUZZY LOGIC IN MULTI-TIER WIRELESS SENSOR NETWORK FOR ENERGY EFFICIENCY

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ABSTRACT

Energy deficiency is one of the most critical aspects of Wireless Sensor Network (WSN). The network performance can be affected when a small network grows larger, and this is related to the energy deficiency of WSN. Therefore, it is essential to manage sensor node energy efficiently, so as to ensure that it would be sufficient to complete WSN applications. Clustering is an established approach which emphasized on cluster head to prolong the lifetime of WSN. However, there is still a lack of effective techniques to determine and select the cluster head. Currently, the selection of cluster head is based on residual energy and several parameters. The data routing to the based station is solely relying on cluster head. These have resulted ineffective of energy usage of sensor node which causes restrict on a lifetime of the sensor network. Hence, this study proposes a new algorithm called Multi-Tier Protocol (MAP). MAP introduced clustering scheme to reduce the energy consumption of wireless sensor network in which, Fuzzy Logic used as tools to select the cluster head and multi-hop communication is used to route the data from the cluster head to the base station. Initially, the combinations of parameters which are residual energy, centrality and communication cost are determined for cluster head selection and utilized in MAP. Also, two types of principle nodes applied which called cluster head and primary node. The cluster head (CH) is responsible to gathered and compressed the data send by the sensor node, while primary node acts as a relay node for the respective cluster head at each tier to execute the routing process and sent the data to the base station. Two simulations based on 100 sensor nodes with 1 Joule and random energy are carried out. Simulation based on 200 sensor nodes with 1 Joule energy deployed for testing the reliability of MAP. The performances of MAP are evaluated through comparing its energy usage for data transmission against Low Energy Adaptive Clustering Hierarchy (LEACH) and Stable Election Protocol (SEP). It found that the three parameters' combination gave the most promising results in improving the lifetime of a network. The results indicated that MAP significantly extends the lifetime of wireless sensor network 48.25% longer than LEACH and SEP. This thesis concludes that the proposed protocol MAP with effective combinations of parameters for selecting cluster heads and cluster primary nodes as a relay node for data routing can effectively improve the efficiency of WSN network.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Wireless Sensor Network (WSN) defined as a network of devices indicated by nodes that can sense and communicate the gathered data from the monitored field through wireless link [1–4]. A sensor node commonly equipped with a radio transceiver for communication, a tiny microcontroller, and an energy supply [5, 6]. The cost of sensor node depends on the size of the sensor network and the complexity required for individual sensor node [6]. Since wireless sensor networks are constraints on the size and cost of the sensor nodes, there have been limitations on other resources such as low power, limited computational memory, speed and bandwidth [7–9]. A sensor node has the capability to sense, process and transmits data back to the base station. This sensor node enables the WSN to monitor or records a physical situation such as motion, pressure, humidity, temperature and radiation [10–12]. This physical situation is related to WSN's applications such as environmental monitoring [13], health care monitoring [14], surveillance, fire detection [15] and resources monitoring for offices and homes [16]. The reduction of production cost in computation and communication devices has allowed this technology to be used widely such as in civilian and military applications [17, 18].

In WSN, the most important part that uses an enormous amount of energy is its communication unit [19]. This communication unit closely related to transmitting and receiving the data, processing and forwarding query requests or data to the neighboring nodes [20]. Apart from that, the energy is also consumed while idly listening to the media, retransmitting due to packet collision, overhearing and /handling control packets. Thus, it may cause the energy in the sensor node deplete easily. Due to that, efficient deployment of energy is a vital design factor because of the remaining energy of each sensor node is directly related to the lifetime of the WSN [21]. In most cases, battery recharging is inconvenient or impossible. The energy cannot replenish, and the resource limitation makes it essential for the sensor nodes to conserve energy to increase the lifetime of the sensor network [22]. The