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An Optimization of Self Adaptive Sleep-Wake up Scheduling approach for Wireless Sensor Networks

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Abstract

Sleep/wake-up scheduling is one of the fundamental problems in wireless sensor networks, since the energy of sensor nodes is limited and they are usually rechargeable. Wireless Sensor Networks consisting of nodes with limited power are deployed to gather useful information from the field. In WSNs it is critical to collect the information in an efficient manner. It is applied in routing and difficult power supply area that cannot be reached and some temporary situations, which do not need fixed network supporting and it can fast deploy with strong anti-damage. In order to avoid the problem, we proposed a new technique called Bio-Inspired mechanism for routing. And ACO is one of the Bio-inspired mechanisms. ACO is a dynamic and reliable protocol. It provides energy-aware, data gathering routing structure in wireless sensor network. It can avoid network congestion and fast consumption of energy of individual node. Then it can prolong the life cycle of the whole network. ACO algorithm reduces the energy consumption.

Keywords: Self Adaptive; ACO; Sleep/Wake up

1. Introduction

By Due to recent technological advances, the manufacturing of small, low power, low cost and highly integrated sensors has become technically and economically feasible. These sensors are generally equipped with sensing, data processing and communication components. Such sensors can be used to measure conditions in the environment surrounding them and then transform these measurements into signals. The signals can be processed further to reveal properties about objects located in the vicinity of the sensors.

The sensors then send these data, usually via a radio transmitter, to a command centre (also known as a “sink” or a “base station”) either directly or via several relaying sensors [1]. A large number of these sensors can be networked in many applications that require unattended operation, hence producing a wireless sensor network (WSN). Currently, there are various applications of WSNs, including target tracking [2], health care [3], data collection [4], security surveillance [5], [6], and distributed computing [7], [8]. Typically, WSNs contain hundreds or thousands of sensors which have the ability to communicate with each other [9].

The energy of each sensor is limited and they are usually un-rechargeable, so energy consumption of each sensor has to be minimized to prolong the life time of WSNs. Major sources of energy waste are idle listening, collision, overhearing and control overhead [10]. Among these, idle listening is a dominant factor in most sensor network applications [11]. There are several ways to prolong the life time of WSNs, e.g., efficient deployment of sensors [12], optimization of WSN coverage [13], and sleep/wake-up scheduling [14]. In this paper, we focus on sleep/wake-up scheduling. Sleep/wakeup scheduling, which aims to minimize idle listening time, is one of the fundamental research problems in WSNs [15].

Specifically, research into sleep/wake-up scheduling studies how to adjust the ratio between sleeping time and awaking time of each sensor in each period. When a sensor is awake, it is in an idle listening state and it can receive and transmit packets. However, if no packets are received or transmitted during the idle listening time, the energy used during the idle listening time is wasted. Such waste should certainly be minimized by adjusting the awaking time of sensors, which is the aim of sleep/wake-up scheduling. Recently, many sleep/wake-up scheduling approaches have been developed. These approaches roughly fall into three categories:

- On-demand wake-up approaches;
- Synchronous wake-up approaches; and
- Asynchronous wake-up approaches.

A self-adaptive approach based reinforcement learning technique, enables each node to autonomously decide its own operation mode (sleep, listen, or transmission) in each time slot in a decentralized manner. [1].

2. Proposed Algorithm for ACO

ANT COLONY OPTIMIZATION (ACO) Swarm Intelligence (SI) is the neighbourhood cooperation of numerous straightforward specialists to accomplish a worldwide objective. The essential thought of the ant state enhancement (ACO) meta-heuristic is taken from the sustenance seeking conduct of genuine ants. Ant specialists can be separated into two segments: FANT (Forward Ants) and BANT (Backward Ants). The primary motivation behind this subdivision of these specialists is to enable the BANTs to use the helpful data accumulated by FANTs on their trek time from source to goal Based on this rule, no hub directing data updates are performed by FANT, whose just reason in life is to report n/w delay conditions to BANT [figure 1]. The different advances how these operators are passing steering data to one another are as per the following

1. Each network hub dispatches FANT to all goals at normal time interims.
2. Ants discover a way to goal haphazardly dependent on current steering tables.

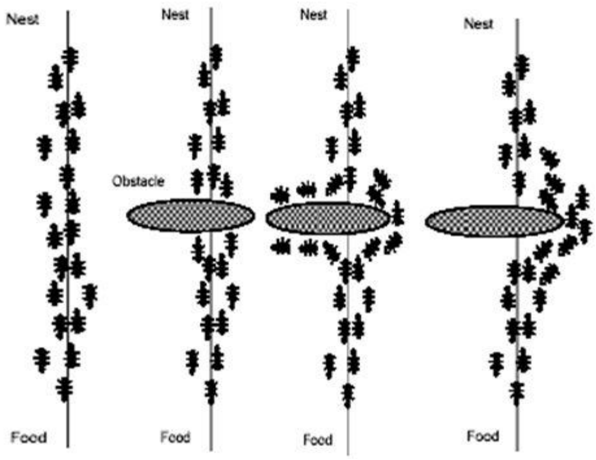

Figure 1: Movement of Ant in Ant System

Common conduct of an ant searching modes

- Search mode
- Return mode

To implement in a program

- Ants — Simple computer agents
- Move ant — Pick next component in the construction solution
- Trace — Pheromone, a global type of information
- Memory — MK or Tabu K
- Next move — Use probability to move ant

```
Loop
   Randomly position m artificial ants on n cities
   For city=1 to n
      For ant=1 to m
        {Each ant builds a solution by adding one city after
        the other}
         Select probabilistically the next city according to
                      exploration and exploitation mechanism
         Apply the local trail updating rule
      End for
   End for
   Apply the global trail updating rule using the best ant
Until End_condition
```

Figure 2: Algorithm for ACO

3. Simulation Results

The results are simulated on Network Simulator software NS2 version 2.33, NAM 1.13 and plotting of graphs on x-graph 12.1. The network is established in a grid manner, keeping 4 sources and 4 destinations; they are also marked on different energy levels. In figure 3, network simulator nam file is shown for node alignment. In figure 4, Packet Loss is represented graphically, which is least when used with ACO on self-adaptive system.

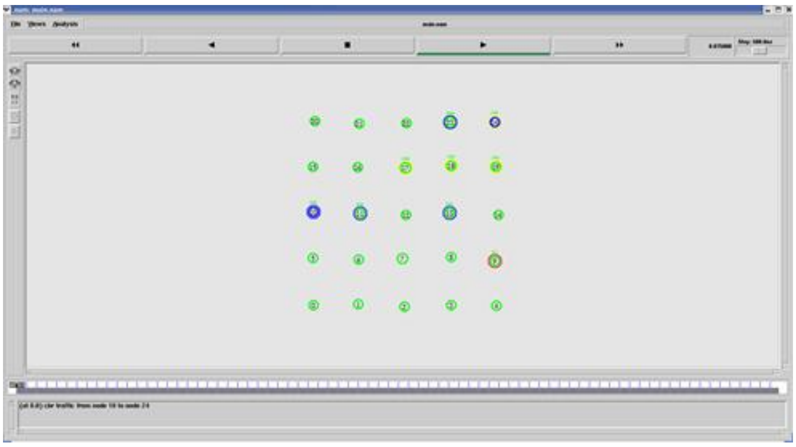

Figure 3: NAM for proposed model

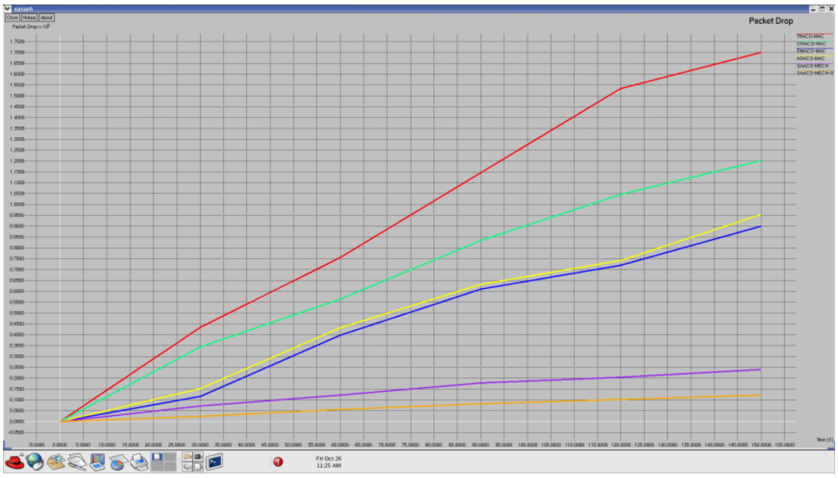

Figure 4: Packet Drop Calculation of the network (proposed)

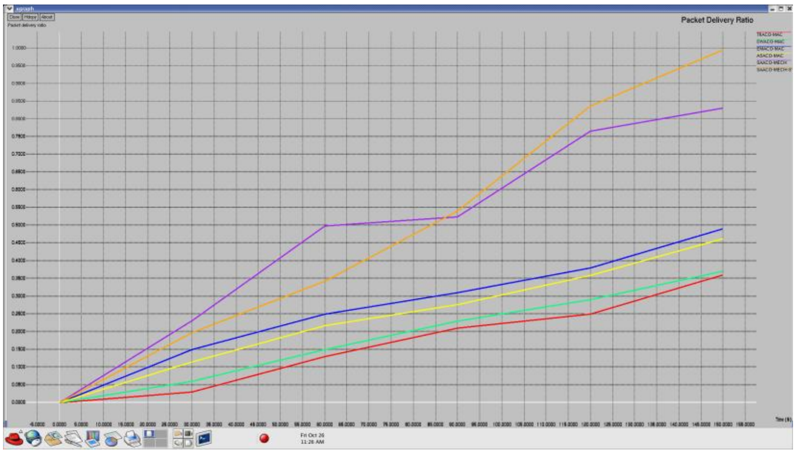

Figure 5: Packet Delivery Ratio Calculation of the network (proposed)

Figure 5 represent the PDR of the proposed system and Figure 6 and 7 are for throughput and routing overhead respectively.

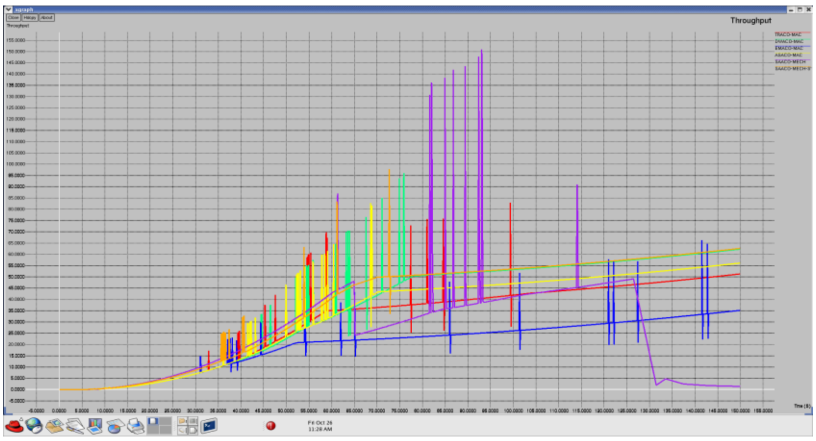

Figure 6: Throughput Calculation of the network (proposed)

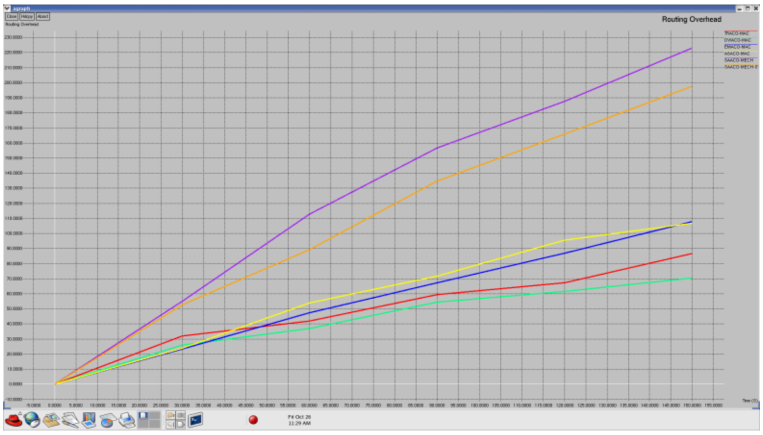

Figure 7: Routing Overhead Calculation of the network (proposed)

4. Conclusion

In This paper presented a self-adaptive sleep/wake-up planning approach based on ACO. This methodology does not utilize the procedure of duty cycling. By the use of this technique there is improvement in the Packet Delivery Ratio, Routing Overhead, Packet Loss and Throughput of the wireless network when compared with basic Sleep/Wake up Approach.

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