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# JOB SCHEDULING AND RESOURCE PLANNING IN WIRELESS SENSOR NETWORK

## Istiaque Ahmed, Farzana Morium, G.M.Farhad Hossain

Guest Lecturer, National Academy for Computer Training And Research, Bangladesh, E-mail: isti.ru.cse@gmail.com Dept. of Computer Science and Engineering, Pundra University of Science and Technology, Bangladesh, E-mail: morium.pub.cse@gmail.com Dept. of Computer Science and Engineering, American International University-Bangladesh, Bangladesh, E-mail: farhadhossain.cse.aiub@gmail.com

## Keywords

Job Scheduling, IoT, Wireless Sensor Network, Resource Planning

## Abstract

Devices in Internet of Things (IoT) network are connected in a systematic way to transfer data over the network. In automation it is required to process and schedule response without human or high processing power computer assistance. Devices in IoT network have unique identification (UID) and they are compact with other objects, people or animal. Wireless Sensor Network (WSN) supports the topology and transfer of information. Nodes are connected to the gateway and some cases there are same type nodes to perform same type functionality. In some automation there are huge tasks in same domain. Scheduling of tasks and response from the right node ensure performance of the network. Group of selecting sensors can participate for censing to produce better throughput. Using optimal resource in wireless sensor network is also a challenge. In this paper we propose combination Ant Colony Optimization (ACO) and priority scheduling algorithm optimal resource planning and job scheduling in wireless sensor network.

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#### Introduction

In WSN multiple devices are connected to each other by passing information. Gateway help for communication and processing of information. Protocols are very important to schedule job in the case multiple jobs are ready to be processed. In ToT network it is a challenge to schedule job with low processing capabilities of processing unit. An efficient scheduling approach can help IoT agents collaborate the functionality of the network and improve performance. Scheduling and selecting of data collecting units play a vital role to the performance. Protocol should be suitable of dynamically added agent of the network. WSN are the combination of smart devices and control applications [1]. Radio frequency identification (RFID) is used ensure reliability and robust processing capability. Data collection is the main challenges of IoT networks depend on scheduling the data transmission of large number of IoT nodes. It is very crucial in IoT event-driven applications to send data with low latency, so that accurate action can be initiated. The design for IoT network based on WSN's to minimize the data collection delay and energy consumption [2]. Designing an optimal scheduling algorithm should increase the CPU utilization and performance and minimize the delay and power consumption [3] [4] in IoT. Applications have repeated jobs executed in different sensor nodes which result in higher sensing cost and reduced lifetime of network. Assigning the similar tasks within a specific region to a single system is solution for this issue. But selecting that single system for execution is challenging. Efficient scheduling helps to avoid repeated execution of unnecessary job in same domain. Scheduling the duty cycle is also an issue in many IoT network. Strategy of keeping the nodes sleep is taken in some research [5]. Node's life time (least residual energy) in the energy efficient scheduling [6] considers for deciding the active set of nodes. Optimal duty-cycle scheduling technique [7] and DeTAS [8] consider traffic load of devices in terms of queue size to determine the duty-cycle length. Interference aware scheduling discussed in [9] and [7]. These approaches to satisfy the varying quality of service demands of multiple applications and their demands [5]. Scheduling jobs and optimal use of resources in desired in every IoT automation.

#### **Related Work**

In IoT job scheduling offers challenges and scheduling should reduce the resource usage especially sensors and RFIDs are used. Approach followed should increase lifetime of the network and reduce communication cost between nodes. Energy efficient framework is proposed to provide better Quality of Information(QoI) in sensor network[10]. A new concept of Quality of information (QoI) is discussed in this [10] research and a new concept of "critical covering set" for any task to select sensors to carry out a task over time. Dynamically energy management is performed during run time that provides optimum traffic statistics. Another research [11] proposed a multi-objective job based scheduling technique. This method mapped tasks to virtual machines to improve the throughput of datacenter. An algorithm provides optimal scheduling methods and tasks are scheduled based on execution time. This algorithm provided better performance and throughput on simulation. Heuristic techniques [12] based on genetic algorithm to provide optimal solutions in polynomial time based on the constraints that might be present. In paper [13] Ant colony optimization (ACO) heuristics is used to solve the constraint task allocation problem(CTAP). Compared to other heuristics based algorithm ACO shows better throughput. A powerful and improved genetic algorithm [14] is proposed to optimize job scheduling solutions. This algorithm uses the features of evolutionary genetic algorithm with heuristics and execution time was improved by using this method. Hybrid algorithm of genetic and variable neighborhood search [15] to reduce the cost of executions of job in a grid scenario. This algorithm can schedule independent jobs in a grid environment. A new algorithm[16] for task graph scheduling was proposed which is based on Ant Colony List scheduling (ANTLS) and task graph to propose a task schedule. In this method the main problem is that it requires huge memory and register allotment which is very expensive in large task scenario. Combination of ACO and Cuckoo algorithm [17] try to solve job scheduling issue. They combine the merits of ACO and Cuckoo algorithm for better results than when then they are applied individually.

#### **Proposed Approach**

The proposed approach is a hybrid cognitive algorithm involves hybrid priority of non-preemptive priority scheduling algorithm and ACO. Preprocessing of jobs is performed by the gateway. In IoT some jobs need response from a particular location that types of jobs is called spatial jobs and dome task need response in time those are called spatial job. Time is related to temporal jobs and they are not negligible but spatial jobs have opposite scenario. Gateway distinguish the job is spatial or temporal. Temporal jobs are given priority to execution and spatial job are placed into the job pool. In this priority based scheduling approach priority of a job is define at setup time and dynamically added nodes priority is assigned based on registration category. Category denotes the batch and execute in higher priority approach.

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 $P_j$  is the priority of job  $j \in \{0, 1, 2, 3, \dots, n\}$ .  $A_j$  is the arrival time of job j. Based in the execution time  $E_j$  service time  $S_j$  and waiting time  $w_j$  is calculated.

*IF*  $A_j = 0$  execute the job first.

System continuous monitor arrival of higher priority job. At the execution of  $j_0$ ,  $j_1$  and  $j_2$  has come and  $P_{j_2} > P_{j_1}$  then  $j_2$  will execute before  $j_1$ .

In ACO nodes are chosen randomly to find the shortest path. The problem is that congestion happen in this shortest path and repeated random chosen of visited node may lead an infinity loop. In the modification of ACO we keep a record of visited node to avoid repeated selection of visited nodes to avoid infinity loops.

The weight of an edge  $w_{ij}$  is calculated as  $w_i = \frac{c}{s}$ , where C is a content adjusted according to experimental condition. And S is total path length of ant.

Weight is the information to rest of the nodes and a feedback related to that, depending the feedback a path is suitable or need to be improved is decided.

The probability of selecting node *i* from node *j* is calculated as follows

$$p_{ij} = \frac{w_{ij}^{\alpha} n_{ij}^{\beta}}{\sum w_{ij}^{\alpha} n_{ij}^{\beta}}$$

The traveling weight  $w_{ij}$  is updated as follows

 $w_{ij} = (1 - \rho) \cdot w_{ij} + \sum_{i=1}^{m} \Delta w_{ij}^{k}$ 

In Above equation  $\rho$  is the evaporation rate, m is total number successful packets,  $\Delta w_{ij}^k$  is the quantity of weight on the edge by packet k.

In simulation the performance of ACO and proposed modification give throughput as follows.

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Fig.1: Comparing ACO and Proposed approach considering average waiting time

# Conclusion

In this paper we review literature on IoT, ACO and Job scheduling. We consider number of jobs and available resources in WSN. To get better performance we use a hybrid approach, ACO is used to places the devices in a network following as shortest path as possible as well as minimize the number of devices. The priority is set to jobs and a non-preemptive algorithm is used with ACO to schedule. Experimental result shows that the combination of ACO and job scheduling contribute to overall performance in IoT. In the future, we will extend our work by considering different applications in IoT domain, arising issues and different types of devices will be taken into account for better performance of IoT agents in WSN.

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