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A Hybrid Scheduling Algorithm for Reducing Average Waiting Time of Processes in Wireless Sensor Nodes

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ABSTRACT: Wireless networks generally contain a large number of sensors, which are arbitrarily and densely located. These networks find use in various applications such as process management, health care monitoring, traffic analysis, and industrial process monitoring. Scheduling is commonly a technique which is used for controlling the process order of a Computer CPU. In wireless sensor networks for reducing the sensor's energy consumption and terminal delays, scheduling plays an important role for a choice of data packets like real-time data packets and non-real time data packets. Scheduling algorithms for instance First Come First Serve, preemptive and non-preemptive priority algorithms puts large processing overhead and long terminal delays in data transmission. The development of packet scheduling algorithms can efficiently improve the delivery of packets between various wireless links in wireless networks. With the use of algorithms like packet scheduling, quality of service can be assured and transmission rate can be improved for wireless sensor networks. This paper fundamentally focuses on the wireless sensor network nodes as for each node the process execution requires the minimum reach to target. In this work the First Come First Serve Algorithm and Priority Scheduling algorithm has been applied for calculating the end-to-end delay. It can further be used for combining the coverage area for next processes. Shortest Job First (SJF) scheduling algorithm is then applied for finding the execution time on the basis of priority time reduction. Finally, a contrast of end-to-end delay with process execution time is done.

KEYWORDS: WSN, Delay, Matlab, Scheduling, FCFS, CPU, SJF.

1 INTRODUCTION

The process of scheduling users for communication, in a wireless communication system plays a significant job for improvement of performance. The scheduling is usually a part of common resource management; usually involves the allocation of communication resources, particularly for shared transmission resources of wireless medium, with user based on their priority sequence. Scheduling has utmost importance for several wireless applications that supports user-to-user communication services like IP Multimedia Subsystem (IMS). As an example the real-time node to node MTS (Multimedia Telephony Services) have a great importance for gratifying the needs of a choice of user services for improving their quality [1].

For multimedia service which is being used by a dense population of users concomitantly, there is a great need for efficient allocation of communication resources available. For this the prime requirement is the proficient approach and implementation for scheduled access of communication resources to the users. For efficient process scheduling, a round-robin approach commonly employ the time-sharing, providing each process a fixed time-slot (CPU time allocation) and giving an interrupt to a process until it is completed. The process will start again when time window is allocated to that particular process. In case of no timesharing or if the allocated time slot is large in comparison to the size of processes, a job which produces large processes will be preferential over other processes.

2 Scheduling Types

2.1 FCFS (First Come First Serve) Scheduling

FCFS scheduling algorithm is of non-preemptive type. For assigning priority to a process the First in – First out strategy is used in the order a request is made by a process. The process which requests the CPU at first is allotted the CPU at first. Other processes in the queue have to wait for CPU unless it is free. FCFS algorithm does not prove useful for scheduling of interactive users as it has a long average waiting time. First In First Out (FIFO), Run to Completion and Run Until Done are also known as the other types of FCFS [2].

2.2 SJF (Shortest Job First) Scheduling

In SJF scheduling technique the job which is shortest amongst the ready queue is executed first. The waiting time for the SJF is minimal. It is most appropriate for the bulk jobs that's run time are known in advance. Finding out which incoming process is shorter than other is the main disadvantage of this scheduling algorithm.

2.3 Round Robin Scheduling

The Round robin algorithm is specifically designed for the time shared systems. Round robin is similar to FCFS but it has the additional functionality of preemption to toggle between processes. Fixed time slots are assigned to each process in a rounded order for all processes regardless of their priority. Implementation of this algorithm is easy. It is also suitable for many other scheduling techniques like packet scheduling for computer networks [3].

3 Factors Affecting Scheduling

Scheduling is essentially a technique that defines the access provided to a user to transmit and to receive in each time slot. In Wireless Networks, scheduling reviews the difficulty on scheduled channel access with prominence on ad-hoc and wireless sensor networks contrasting to Wi-Fi, infrastructure-based, and cellular network [4]. It is focused to present pin-point of problems raised during allocation of shared resources within current and future wireless networks. A few factors affecting the scheduling are listed below:

3.1 Deadline

The scheduling techniques are divided based on deadline of coming of data packet at base station (BS), and are as:

- First Come First Serve (FCFS): In FCFS, data that arrives with a delay at the intermediate nodes of the network from the farthest nodes and requires a larger time for their delivery at base station (BS) whereas data from nearer neighbouring nodes requires lesser time for processing at intermediate nodes [5].
- Earliest Deadline First: Each packet has a defined deadline whenever it is available at the ready queue during which it will be sent to base station. Data packets with nearest deadline are first sent. The algorithm is very efficient pertaining to waiting time of packets and end delay [6].

3.2 Priority

The scheduling techniques are divided based upon priority of packets which the sensor senses at diverse sensor node.

- Non-preemptive: In this technique, If packet X start its execution, it keeps on running even if any packet Y arrive at the ready queue. Therefore packet Y has to wait until the execution of packet X is complete [7].
- Preemptive: In this packet scheduling, the packets with higher priority are first processed and can make wait the lower priority packets if they are running already [8].

4 PROPOSED ALGORITHM

Scheduling is essentially used for managing implementation of all the processes in a wireless sensor network nod. In a computer system CPU is the only important reserve which is scheduled before its use. Priority packet scheduling is first used for scheduling diverse data packets at nodes. Most scheduling techniques in sensor networks use FCFS and are associated long end delay problems in transmission of data, higher consumption of energy [9]. The denial of high priority data packets is also problematic in allocating packets for execution. In this research a combination of scheduling algorithms like priority is made considering the coverage area. By combining SJF all the priority related problems were reduced. Thus the execution time of processes is significantly reduced and better results are obtained than previous [10].

4.1 OBJECTIVES

- To implement a hybrid scheduling technique
- To minimize end-to-end delay
- To minimize the final execution time
- Comparison with other scheduling algorithms

5 RESEARCH METHODOLOGY

In this research process we have made a hybrid algorithm of scheduling in wireless networks that includes the following steps:

- Creation of a table of sensor nodes present in the wireless network for their burst time and priority
- Application of FCFS scheduling algorithm for calculating the average time
- Simultaneously, application of the priority algorithm to calculate the average waiting time.
- Choosing the appropriate algorithm among these two (FCFS & Priority) for making a hybrid algorithm along with coverage area.
- Determination of nodes in the coverage area and reduction of processing time based on their distance from the base station (BS).
- After application of priority algorithm for time reduction, SJF (shortest job first) algorithm is applied for calculating the new average process waiting time.
- Comparison of average delay and processing time of hybrid algorithm with the previous ones.

6 RESULT ANALYSIS

Matlab tool is used for this analysis. A certain number of processes (see Table 1) are taken which arrive at sensor node simultaneously in a given order. The scheduling techniques such as FCFS, Priority and Proposed scheduling techniques have been applied for the analysis of performance of processes at sensor node.

Table 1. Group of Processes at Sensor Node

Process Name	Burst Time (ms)	Priority Order
P1	15	2
P2	24	7
P3	18	1
P4	22	8
P5	36	4
P6	21	6
P7	46	3
P8	14	10
P9	16	5
P10	9	9

6.1 FCFS ALGORITHM IMPLEMENTATION

Gantt chart for group of processes as per FCFS is:

P1	P2	P3	P4	P5	P6	P7	P8	P9	P10

0 15 39 57 79 115 136 182 196 212 221

Average time = 1031/10

= 103.1000 ms

Turnaround time = burst time + waiting time

= 1031 + 221

= 1252 ms

Average turnaround time = 1252/10

= 125.2000 ms

Matlab results for FCFS algorithm:

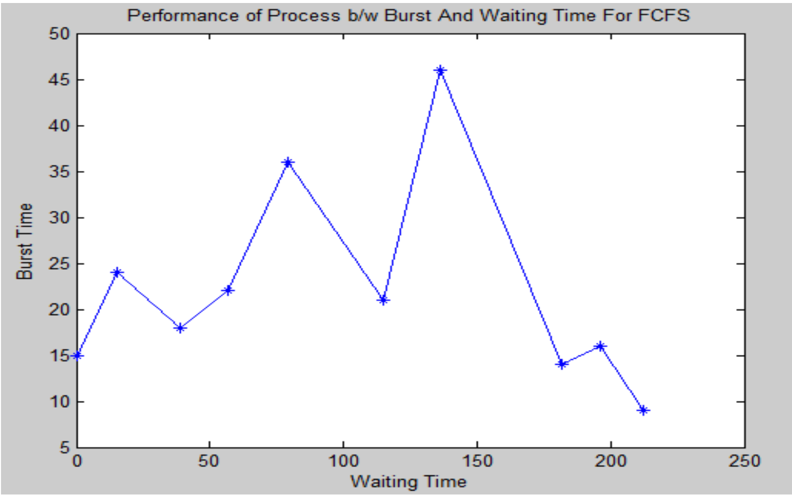

Fig. 1. Average waiting time for FCFS

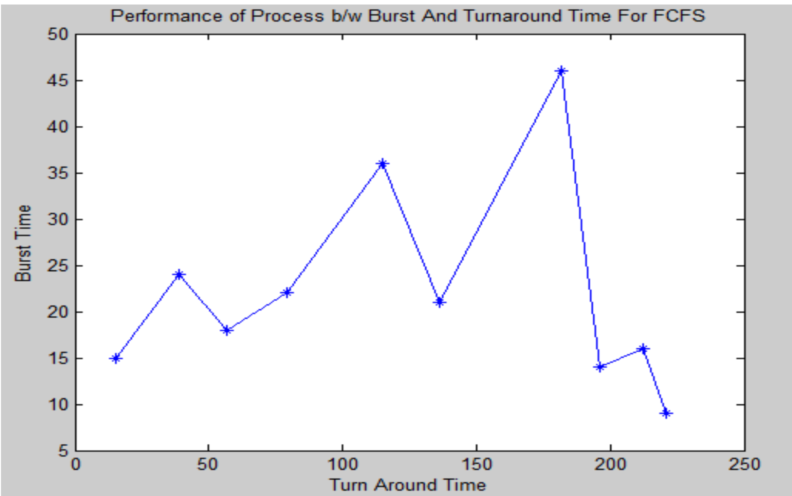

Fig. 2. Turnaround time for FCFS

6.2 PRIORITY ALGORITHM IMPLEMENTATION

Gantt chart for group of processes as per Priority Algorithm is:

P3	P1	P7	P5	P9	P6	P2	P4	P10	P8	
0	18	33	79	115	131	152	176	198	207	221

Average waiting time = 1109/10

= 110.9000 ms

Turnaround time = burst time + waiting time

= 1109 + 221

= 1330 ms

Average turnaround time = 1330/10

= 133 ms

Matlab results for Priority algorithm:

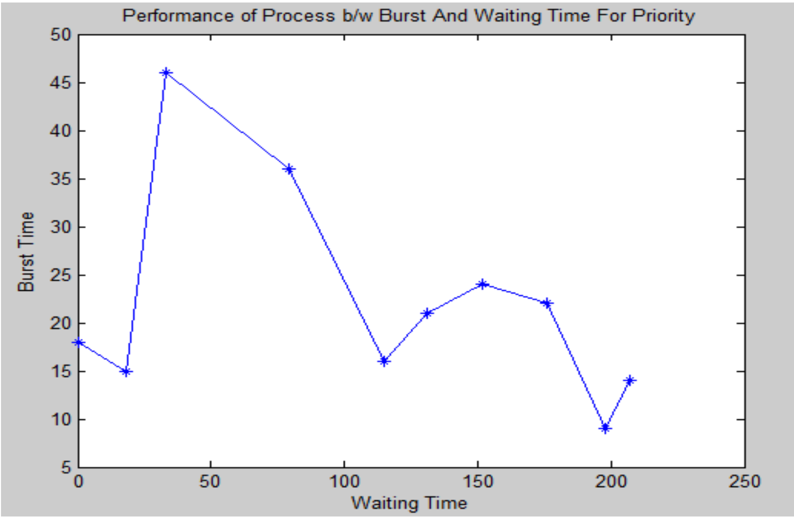

Fig. 3. Average waiting time for Priority Algorithm

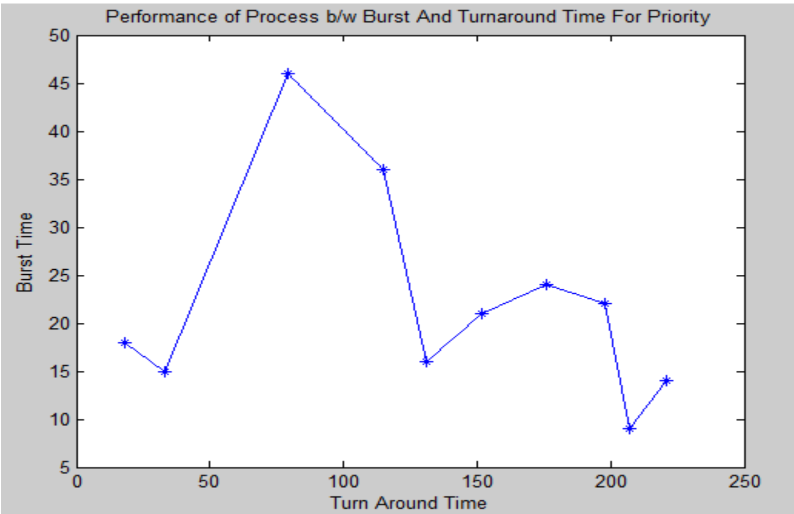

Fig. 4. Turnaround time for Priority Algorithm

6.3 HYBRID ALGORITHM IMPLEMENTATION

Gantt chart for group of processes as per Priority Algorithm is:

P10	P8	P1	P9	P3	P6	P4	P2	P5	P7	
0	7	16	27	39	54	73	94	117	149	194

Average waiting time = 576/10

= 57.6000 ms

Turnaround time = burst time + waiting time

= 576 + 194

= 770 ms

Average turnaround time = 770/10

= 77 ms

Matlab results for Proposed algorithm:

Final results are shown below obtained after applying hybrid scheduling technique for calculating average completing time and also a relative analysis is done with further techniques such as FCFS and Priority scheduling.

Table 2. Average Time Delay

FCFS	PRIORITY	PROPOSED
103.1000 ms	110.9000 ms	57.6000 ms

Table 3. Execution Time

FCFS	PRIORITY	PROPOSED
125.2000 ms	133 ms	77 ms

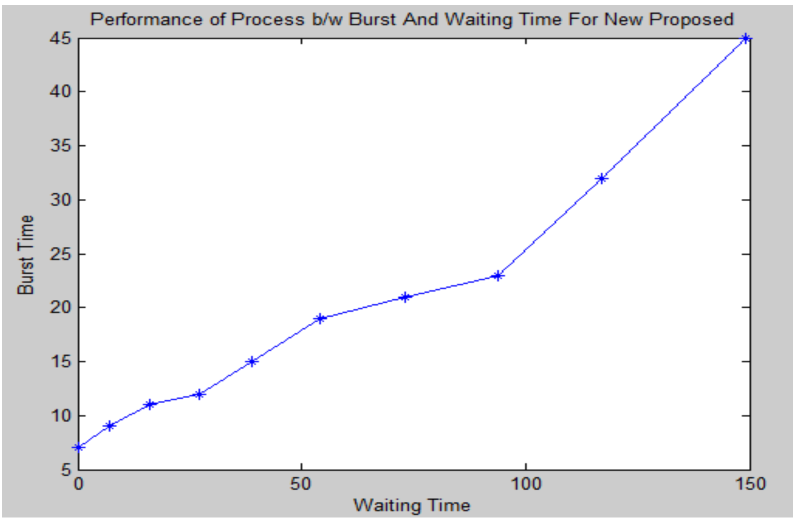

Fig. 5. Comparison between Burst and Waiting time

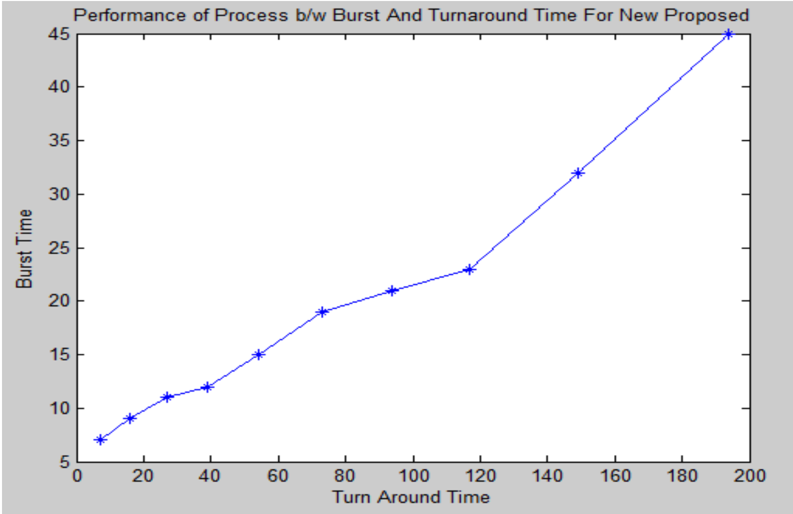

Fig. 6. Comparison between Burst and Turnaround

7 CONCLUSION

This experimentation shows the proposed hybrid scheduling algorithm yields improved performance as compared to old FCFS and Priority algorithms for average waiting time and delay time calculation. The higher priority data transmission is assured for end to end. The system degradation problem has been significantly reduced. The deadlock is reduced for real time processes and they don't need to wait for a longer time for execution. In this experimentation a hybrid algorithm for scheduling is proposed for reducing the process execution time in wireless sensor networks.

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