An Improved Dynamic Round Robin CPU Scheduling Algorithm Using SJF Technique

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Abstract **CPU Scheduling is one of the fundamental concepts of operating system. There exists a number of CPU scheduling algorithms like first come f irst serve, shortest job first scheduling, round robin scheduling, priority scheduling etc. In these algorithms the round robin CPU scheduling is the preferred choice in time shared systems but it is not suitable for Real time systems ,because the existing RR CPU scheduling depends on the choice of static time quantum that decreases the performance of CPU and also have more number of context switches and longer waiting and response time.This in turn leads to low throughput of the system. In a real time systems the process having relatively larger CPU burst time it will leads to the problem of starvation.In this paper we have proposed a new algorithm that gives better CPU performance using the features of shortest job first and round robin scheduling with dynamic time quantum. This algorithm reduces the average waiting time, average turnaround time and number of context switches and also it gives high throughput. The proposed algorithm improves all the disadvantages of simple RR CPU Scheduling algorithm.**

Keywords— **CPU scheduling, SJF scheduling, RR scheduling , Burst time, Turnaround time, Waiting time.**

I. INTRODUCTION

The CPU scheduling also plays an important role in the real time operating system. Real t ime s ystems are the ones that are designed to provide results within a specific time.It must have well defined fixed and response time constraints and the processing must be done with in the defined deadlines or the system will damage.There are various CPU scheduling algorithms which have different properties. The main aim of the CPU scheduling algorithms is to minimize waiting time, turnaround time, response time and context switching and maximizing CPU utilization. There are different parameters which are measured in CPU Scheduling and using these parameters to say which algorithm is better as compare to other.

A. Scheduling Parameters

CPU utilization: It keeps the CPU as busy as possible.The Goal is to Maximize the Utilization of CPU. **Throughput:** The number of processes that complete their execution per unit of time. It must have maximum value. Throughput is less in round robin scheduling. Throughput and context switching are inversely proportional to each other.

Turnaround time: It is the amount of time to execute a particular process. It must have minimum value.

Waiting time: It is the amount of time a process has been waiting in the ready queue or in the waiting state. It must have minimum value.

Response time: It is the time from the submission of the request until the first response is produce.

Fairness: To avoid the process from starvation and all the processes must be given equal opportunity to execute.

B. CPU Scheduling Algorithms

CPU Scheduling is one of the fundamental concepts of Operating System. Sharing of computer resources between multiple processes is called scheduling . Basically the scheduling algorithms are divided into two categories as Pre-emptive and Non- pre- emptive scheduling algorithms. In non-pre-emptive, once the CPU has been allocated to a process, the process keeps the CPU until it releases the CPU either by terminating or switching to the waiting state.In pre-emptive, CPU allocated to a process is switched if another process of higher priority is scheduled. In this case, the currently running process is interrupted and moved to the ready state by the operating system.
The various CPU scheduling algorithms are:

First-Come- First- Serve (FCFS) Scheduling: It is a non-preemptive scheduling algorithm and simplest CPU scheduling algorithm. In this scheduling the process that request the CPU first is allocated to CPU first. Once a process has been submitted to the CPU, it runs into completion without being interrupted.

Shortest Job First (SJF) Scheduling : It is a preemptive or nonpreemptive scheduling algorithm. In this scheduling the process with the shortest CPU burst time is allocated to CPU first. If two process having the same CPU burst time FCFS is used to break up the tie. SJF reduces average waiting time of the processes as compared to FCFS. This prevents smaller processes from suffering behind larger processes in the ready queue for a longer time.

Priority based Scheduling : Priority scheduling can be either pre-emptive or non-pre-emptive. The priority is associated with each process and the CPU is allocated to the processes with the highest priority are executed first and lower priority processes are executed at the end. If multiple processes having the same priorities are ready to execute, they are scheduled with FCFS policy.

Round Robin (RR) Scheduling : It is a preemptive scheduling algorithm. RR scheduling is used in timesharing systems. It is same as FCFS scheduling with pre-emption is added to switch between processes. A static Time Quantum (TQ) is used in this CPU Scheduling.. When the time quantum expired, the CPU is switched to another process. Performance of Round Robin totally depends on the size of the time quantum.

C. CPU Scheduling Algorithms Comparision

The following table shows the comparison of various CPU scheduling algorithms on different parameter.

Parameter	FCFS	SJF	Priority	RR
Preemption	This FCFS scheduling algorithm is non-preemptive.	The SJF scheduling algorithm is preemptive or non-preemptive.	This priority scheduling algorithm is preemptive or non-preemptive.	This scheduling algorithm is also preemptive.
Complexity	It is simplest scheduling algorithm.	It is difficult to understand and code.	This algorithm is also difficult to understand.	RR scheduling algorithm, performance heavily depends upon the size of time quantum.
Allocation	It allocates the CPU in the order in which the process arrives.	In this, the CPU is allocated to the process with least CPU burst time.	It is based on the priority. The higher priority job can run first.	In RR, the CPU is allocated in the order in which the process arrives but for a fixed time slice.
Waiting Time	In FCFS, the average waiting time is large.	In SJF, the average waiting time is small as compared to FCFS scheduling algorithm.	In PR, the average waiting time is small as comparedto FCFS scheduling algorithm.	In RR, the average waiting time is large as compared to all the three scheduling algorithms.

II. PROPOSED ALGORITHM

Many research works has been done to improve the performance of the RR scheduling algorithm. The proposed CPU Scheduling algorithm is based on the small change in round - robin CPU scheduling algorithm using a dynamic time quantum. This proposed architecture eliminates the defects of implementing simple round robin architecture and which will helps to minimize a number of performance parameters such as context switches, the average turnaround time and the average waiting time.

This algorithm has following steps:

1. Processes are arranged in the ascending order of their CPU burst time and set the time quantum value is equal to the burst time of first process in the ready queue.

2. Select the first process from the ready queue and allocate CPU to that process for one time quantum.

3.After completion of one time quantum, to compare the time quantum value with the remaining CPU burst time, if it is less than or equal to time quantum value to allocate the same process again in the ready queue.

4.If the currently running process has finished their execution and the remaining CPU burst time zero, it is removed from the ready queue .otherwise remove the running process from the ready queue and placed it at the tail of the ready queue.

5. To continue this process until all the processes in the ready queue gets the CPU time interval up to one time quantum in the first cycle.

6. In the second cycle the processes are executed in shortest job first manner, i.e each process gets the control of the CPU until they completed their execution.

III. EXPERIMENTAL ANALYSIS

Consider five processes A, B, C, D and E with a given CPU Burst time in a random order. The processes arrival time is assumed zero and the burst time values are 15,26,8 ,10 and 5 respectively. The processes A, B, C, D and E are arranged in the ascending order of their burst time in the ready queue which gives the sequence E, C, D, A and B. The time quantum value is set to the burst time of first process in the ready queue .Now the CPU is allocated to first process i.e E for a time quantum of 5 milliseconds, then E has remaining CPU burst time is 0 ms , E has finished its execution and it will be removed from the ready queue. To select next process C in the ready queue to allocate CPU for a time interval of 5ms and then C has remaining CPU burst time is 3ms. It will be compared to time quantum , so it is less than or equal to specified time quantum value then C is allocated again. Next to select a process D with 10ms of CPU burst time and to allocate CPU for a time interval of 5ms. D has remaining CPU burst time is 5ms .so it is less than or equal to specified time quantum value then D is allocated again to CPU. Next shortest process is A with 15ms CPU burst time. CPU will be allocated to A for a time interval of 5ms. since the remaining CPU burst time of A is 10 i.e greater than the specified time quantum. so select process A and put it tail of the ready queue. To select next process B in the ready queue to allocate CPU for a time interval of 5ms and then B has remaining CPU burst time is 21ms.so it is greater than the specified time quantum to select that process and put it tail of the ready queue. After completion of first cycle only A and B process are available for second cycle. Next directly to apply the shortest job first procedure for the remaining process. The average waiting time is 16.8 ms and average turn arround time is 29.6 ms. The following examples are scheduled in round robin fashion and also according to the proposed algorithm. To compare the results of given examples.

Example :1

Table 1. Processes with burst time

Process Name	Burst Time
A	15
B	26
C	8
D	10
E	5

Simple RR CPU Scheduling Algorithm: Consider five processes A, B, C, D and E with a given CPU Burst time and the processes arrival time is assumed zero. The processes A, B, C, D and E are arranged in the simple round robin Procedure i.e

a) Time Quantum : 5

A	B	C	D	E	A	B	C	D	A	B	B	B	B			

0 5 10 15 20 25 30 35 38 43 48 53 58 63 64

Figure 1. Gantt chart representation of simple RR

Average Waiting time : 30.8 ms
Average Turn Arround time : 48.6 ms

b) Time Quantum : 10

A	B	C	D	E	A	B	B

0 10 20 28 38 43 48 58 64

Figure 2. Gantt chart representation of simple RR

Average Waiting time : 31.4 ms
Average Turn Arround time : 44.2 ms

Proposed RR CPU Scheduling Algorithm: Consider five processes A, B, C, D and E with a given CPU Burst time and the processes arrival time is assumed zero. The processes A, B, C, D and E are arranged in the ascending order of their burst time in the ready queue which gives the sequence E, C, D, A and B.

Table 2. Processes with burst time

Process Name	Burst Time
E	5
C	8
D	10
A	15
B	26

E	C	C	D	D	A	B	A	B

0 5 10 13 18 23 28 33 43 64

Figure 3. Gantt chart representation of proposed RR

Average Waiting time : 16.8 ms
Average Turn Arround time : 29.6 ms

Example :2

Table 3. Processes with burst time

Process Name	Burst Time
A	15
B	30
C	10
D	25
E	20

Simple RR CPU Scheduling Algorithm: Consider five processes A, B, C, D and E with a given CPU Burst time and the processes arrival time is assumed zero.

a) Time Quantum : 8

A	B	C	D	E	A	B	C	D	E	B	D	E	B	D			

0 8 16 24 32 40 47 55 57 65 73 81 89 93 99 100

Figure 4. Gantt chart representation of simple RR

Average Waiting time : 59.2 ms
Average Turn Arround time : 79.2 ms

b) Time Quantum : 10

0	10	20	30	40	50	55	65	75	85	95	100

Figure 5. Gantt chart representation of simple RR

Average Waiting time : 53 ms
Average Turn Arround time : 73 ms

Proposed RR CPU Scheduling Algorithm: The processes A, B, C, D and E are arranged in the ascending order of their burst time in the ready queue which gives the sequence C, A, E , D and B.

Table 4. Processes with burst time

Process Name	Burst Time
C	10
A	15
E	20
D	25
B	30

C	A	A	E	E	D	B	D	B

0 10 20 25 35 45 55 65 80 100

Figure 6. Gantt chart representation of proposed RR

Average Waiting time : 32 ms
Average Turn Arround time : 52 ms

IV. CONCLUSION

The proposed algorithm is the combination of the shortest job first and the round robin CPU scheduling algorithm with dynamic time quantum. The proposed Dynamic RR scheduling algorithm giving better performance than simple RR algorithm because the waiting time, turnaround time and context switches is reduced in this algorithm. so it is more efficient and it is useful for time sharing systems.

REFERENCES

[1] Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, ―Operating System Concepts‖, Sixth Edition.

[2] Ishwari Singh Rajput,‖ A Priority based Round Robin CPU Scheduling Algorithm for Real Time Systems‖.

[3] Sukanya Suranauwarat, ―A CPU Scheduling Algorithm Simulator‖, October 10-13, 2007, Milwaukee, WI 37th ASEE/IEEE Frontiers in Education Conference.

[4] Andrew S.Tanenbaum, Albert S. Woodhull, ―Operating Systems Design and Implementation‖, Second Edition.

[5] Rakesh Kumar Yadav, Abhishek K Mishra, Navin Prakash, Himanshu Sharma,‖ An Improved Round Robin Scheduling Algorithm for CPU Scheduling‖, (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 04, 1064-1066, 2010.

[6] Manish Kumar Mishra and Dr. Faizur Rashid, ―An Improved Round Robin CPU Scheduling Algorithm with varying Time Quantum ― International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.4, No.4, August 2014.

[7] P.Surendra Varma , ―A FINEST TIME QUANTUM FOR IMPROVING SHORTEST REMAINING BURST ROUND ROBIN (SRBRR) ALGORITHM" Journal of Global Research in Computer Science, 4 (3), March 2013, 10-15.

[8] Neeraj Kumar, Nirvikar ―Performance Improvement Using CPU Scheduling Algorithm-SRT‖International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)Volume 2, Issue 2, March – April 2013.

[9] Md. Mamunur Rashid and Md. Nasim Adhtar, ― A New Multilevel CPU Scheduling Algorithm‖, Journals of Applied Sciences 6 (9): 2036-2039,2009

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