

# A New Proposed Dynamic Quantum for Priority Based Round Robin Scheduling Algorithm

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**Abstract** - : The main objective of this paper is to develop a new approach for round robin CPU scheduling algorithm which improves the performance of CPU using the priority factor in real time operating system. The proposed Priority based Round-Robin CPU Scheduling algorithm is based on the integration of round-robin and priority scheduling algorithm. It retains the advantage of round robin in reducing starvation and also integrates the advantage of priority scheduling. The proposed algorithm also implements the concept of dynamic time quantum to the processes. Existing round robin CPU scheduling algorithm cannot be implemented in real time operating system due to their high context switch rates, large waiting time, large response time, turnaround time and less throughput. The proposed algorithm improves all the drawbacks of round robin CPU scheduling algorithm. The paper also presents the comparative analysis of proposed algorithm with existing round robin scheduling algorithm on the basis of average waiting time, average turnaround time and number of context switches.

**Key Words:** CPU scheduling, Round Robin CPU scheduling algorithm, Turnaround time, Waiting time, Response time, Context switching, Gantt chart.

## 1. INTRODUCTION

Multiprogramming and time sharing are two important requirements of Operating System. The objective of multiprogramming is to have some process running at all times to maximize CPU utilization. The objective of time sharing is to switch the CPU among processes so frequently that users can interact with each program while it is running. To meet these objectives, scheduling is required, in which the process scheduler selects an available process for program execution on the CPU. A process is executed until it must wait, typically for the completion of some I/O request. Whenever one process has to wait, the Operating System takes the CPU away from that process and the scheduler selects next process and allocates CPU to it. This process continues till the system request for termination of execution and then the last CPU burst ends up with it.

## 1.1 SCHEDULING ALGORITHMS

There exists a number of CPU scheduling algorithms such as First Come First Serve (FCFS), Shortest Job First (SJF), priority etc. With FCFS, the process that arrives first in the

ready queue is allocated the CPU first in a FIFO policy. In SJF, the process that has the smallest next CPU burst is assigned next, when the CPU is available. If two processes having same burst time and arrive simultaneously, then FCFS procedure is applied to break the tie. In priority scheduling algorithm, a priority can be provided to each process internally or externally and the process having highest priority is executed first and so on. The Round Robin (RR) scheduling which is the main concern of this research is designed especially for time-sharing systems. RR scheduling is similar to FCFS scheduling, but preemption is added to switch between processes. In this a fixed time unit called time quantum is assigned per process usually 10-100 milliseconds by the scheduler and cycles through them.

## 1.2 SCHEDULING OBJECTIVES

The objectives of the scheduling algorithm is to:

1. Maximize throughput: A scheduling algorithm should be capable of servicing the maximum number of processes per unit of time.
2. Avoid indefinite blocking or starvation: A process should not wait for unbounded time before or at the time of process execution.
3. Minimize overhead: Overhead causes wastage of resources. But when we use system resources effectively, then overall system performance improves greatly.
5. Enforcement of priorities: if system assigns priorities to processes, the scheduling mechanism should favour the higher-priority processes.
6. Achieve balance between response and utilization: The scheduling mechanism should keep resources of system busy.
7. Favour processes exhibits desirable behaviour.
8. Degrade gracefully under heavy load.

A system can accomplish these goals in several ways. The scheduler can prevent indefinite blocking of processes through the concept of aging. The scheduler can increase throughput by favouring processes whose requests can be satisfied quickly, or whose completion cause other processes to run.

### 1.3. SCHEDULING CRITERIA

Schedulers use different scheduling criteria to enhance the performance of CPU.

**Utilization/Efficiency:** CPU should be best utilized by allocating the significant tasks; so that it should not be ideal.

**Throughput:** It is the number of completed (finished) jobs in a specific time period. To increase the number of processed jobs per hour throughput should be increased.

**Turnaround time:** It is total time taken from submission of the process till the completion. Turnaround time should minimize the time of users who wait for the output.

**Waiting time:** It is the total time spent in ready queue. Waiting time of a process should be minimised.

**Response Time:** It is the duration after submission of the process till the first response. It should be minimal in case of interactive users.

**Fairness:** CPU should be unbiased and every process should get its fair time to execute.

## 2. Organization of paper

Section 3 represents literature survey. In section 4 efficiency of the existing approaches are illustrated. Section 5 presents the illustration of my proposed algorithm. Section 6, contains the conclusion with the future scope in section 7.

## 3. Literature survey

A number of CPU scheduling mechanisms have been developed for scheduling allocation of processor in the last few days. Depending on these factors the research area is also very wide.

**Himanshi Saxena**[1] enhance the concept of Round Robin algorithm (RR) which include priority of a process. They calculated the factor of precedence 'FP' for each process that determines the order of execution of processes, intelligent service time 'IST' for each process which determines time of execution of process in a single round and execute the processes in RR fashion.

**K.N. Rout** [3] and **etal.** As per the new calculated time quantum it executes the processes and using median and highest burst time it calculate the time quantum.

**Lalit Kishore** [4] **etal.** proposed a Median based time quantum scheduling algorithm. It is a combination of SJF & RR. In this algorithm all the jobs in the queue are first ordered as per their burst time in ascending order and then to improve the CPU performance Round robin is applied.

**Rami J. Matarneh**[5] proposed that an optimal time quantum can be calculated by the median of burst times for processes in the ready queue. If this median is less than 25ms, then in that case, the quantum value is modified to 25ms to avoid the overhead of context switch time.

**Zena Hussain Khalil**[6] and **etal.** have improved RR by proposing a new algorithm which uses the concept of Dynamic quantum time in RR, to select the next process from ready queue it takes the Highest Response Ratio Next (HRRN) for each process in each round In their proposed algorithm, Intelligent Time Slice (ITS) is calculated to give a different time quantum to each process based on the difference between CPU burst time, context switch avoidance time and priority.

**P.Surendra Varma**[7] and **etal.** showed that by taking mean average of burst times as time quantum performance of the RR can be improved, they proposed a novel scheduling algorithm in which to find the order of execution of processes it uses mean average as a time quantum and also uses the balanced factor (BF) of precedence rather than arrival time.

**Mohammed Abdullah Hassan Al-Hagery**[13] proposed a method that takes into account the basics of RR algorithm. The proposed method is called Selective-Round-Robin Quantum of Time (SRRQT). Perfect results to the challenge of RR by using selective time quantum instead of a fixed value is one of the researches that provide best solution in SRRQT.

**Rakesh Mohanty**[14] and **etal.** proposed a new algorithm, known as Priority Based Dynamic Round Robin Algorithm (PBDRR). This approach calculates intelligent time slice for individual processes and changes after every round of execution. By taking dynamic time quantum concept into account the proposed scheduling algorithm is developed. To finish the execution of shorter process earlier more time quantum is given to that process and their algorithm is the combination of SJF and RR algorithm with dynamic time quantum.

**Reena Kumari Naik**[15] and **etal.** Proposed a new hybridized multilevel feedback queue (MLFQ) with intelligent time slice (ITS). They proposed that the processes that are entering into the system are assigned to the first ready queue according to their priority which is decided by using HRRN algorithm and then gradually shifted to the next lower level queues upon expiration of their time slice.

**H. S. Behera**[19] proposed a new variant of Round Robin scheduling algorithm, known as Precedence based Round Robin with Dynamic Time Quantum (PRRDTQ). According to their priority and burst time the algorithm gives precedence to all processes, then applies the Round Robin algorithm on it.

**Deepali Maste**[20] proposed a new variant of MLFQ algorithm, in which time slice is assigned to each queue for MLFQ scheduling such that it changes with each round of execution dynamically and neural network is used to adjust this time slice again to optimize turnaround time. They carried out a smoothed competitive analysis which is applied to multilevel feedback algorithm in Basney research paper.

#### 4. EFFICIENCY OF EXISTING APPROACHES

The algorithm which schedules the processes in a fair manner and also produces results in minimum average waiting time and turnaround time is known as efficient algorithm and it was clear from the above discussion. In various research papers it has been discussed that time quantum and priority decision is the bottleneck in various CPU scheduling algorithm. To answer what should be the optimal time quantum in round robin algorithm is a difficult question. How a relationship between dynamic priorities in conjunction with other algorithms is another aspect to be considered. To determine the meaning of dynamicity in CPU scheduling algorithms is not an easy task. As there are various no of questions, the solution set must satisfy most of the performance criteria and it should be accepted by most of the operating system. Few researchers paid attention towards deciding dynamic time quantum, some talk about dynamic priority calculation and some paid attention towards the combination of two. According to some research the response time must be the first criteria to be looked upon. To determine dynamic time quantum or priority some researches use artificial intelligence.

According to researches a lot of efforts in this field have been done, and most of the work is done on the basis of calculating dynamic time quantum using measures of central tendency (mean, median). But since these measures suffers from the effect of outliers in the set, so such solutions failed to give optimum result for the set of processes having CPU burst time in which outliers are present. An outlier is generally considered to be a data point that is far outside the norm for a variable. Outliers can have deleterious effects on central tendency measurement. If the outlier is higher, it will lower the mean. If the outlier is lower, it will raise the mean. Without the outlier value, the mean would get more accurate. This is why they're sometimes removed and also it is a known fact that the CPU always tries to keep a mix of CPU bound and I/O bound processes, so chances of presence of outliers is not an exception in the list. Removing the outlier makes the data more accurate while determining mean or median value for determining time quantum. So the proposed approach addresses this issue in CPU scheduling algorithm.

#### 5. PROPOSED ALGORITHM (DQPRR)

##### A. Approach

From the above review of the CPU scheduling algorithms, we can easily figure out that there are three major factors in each process namely arrival time, burst time and the priority. So in the proposed approach, a new factor WF (weight factor) has been added with each submitted process. It is the combination of effect of all the three basic factors (priority, CPU burst time and arrival time). The equation can be written as:

$$WF = (PR*0.8) + (BT*0.7) + (ATT * 0.2) \dots\dots\dots(1)$$

Where,

BT=number assigned to the process on the basis of burst time

ATT= number assigned to the process on the basis of arrival time

PR=Priority

Normally we give importance to the priority factor rather than arrival time or burst time in a real time environment and the CPU burst time can be considered as the more important factor than the arrival time. So in this equation more weight is given to priority (80%). Also, the thumb rule is that 80 percent of the CPU bursts should be shorter than the time quantum [1]. So to reach the target of 70%, 0.7 weight is assigned to the Burst time. This algorithm is mainly based on the combination of two techniques of scheduling namely Priority (PS) & Round Robin (RR). A weight factor WF as mentioned in equation (1) is assigned to each process depending on the priority and arrival time of process. It is also important that performance of RR algorithm mainly depends upon the size of time quantum. The number of context switch depends upon the size of time quantum and the algorithm degenerates to FCFS if the time quantum is very large. So proposed algorithm solves this problem by taking a dynamic time quantum where the time quantum is repeatedly adjusted according to the remaining burst time of currently running processes. The optimal time quantum can be calculated as

$$TQ = \sum_{i=1}^n \frac{\text{remaining CPU burst}}{\text{no. of process}}$$

If the remaining burst time is less than the one time quantum then give it to the CPU.

##### B. Algorithm

Since this algorithm is designed around multiple parameters of CPU scheduling algorithm, so

Input: CPU Burst time (BT), Priority (PR) and arrival time (ATT) of each process.

- 1) Start
- 2) For each process present in ready queue
  - a. Number in each process with their decreasing bust time
  - b. Numbering to each process with their decreasing arrival time
- 3) For each process  $P_i$  calculate

$$WF_i = 0.8 * PR_i + 0.7 * BT_i + 0.2 * ATT_i$$

- 4) Arrange processes in decreasing order wrt their WF. When two processes having same WF consider priority for arranging.

$$TQ = \sum_{i=1}^n \frac{\text{remaining CPU burst}}{\text{no. of process}}$$

- 5) Assign TQ to process  
Pi ->TQ
- 6) If (i<n) then go to step 5
- 7) If a new process is arrived,  
Update the counter n and go to step2  
End of while
- 8) Average waiting time, average turnaround time and no. of context switches are calculated
- 9) Stop

- 3) Employing different performance criteria for comparison such as the turnaround time and response time.

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## 6. CONCLUSION

In CPU Scheduling algorithm it has been found that for any kind of simulation it has limited accuracy. To design a CPU scheduling algorithm it requires a lot of research work which guarantees fairness and avoids starvation during allocation of CPU to the processes.

This study shows that

- 1) To avoid starvation during allocation of CPU to the processes careful attention is required to assure the fairness.
- 2) CPU must be allocated for that time quantum for which minimum average waiting time and turnaround time is achieved. To find the best results it includes dynamicity in the CPU scheduling algorithms.
- 3) To improve the RR algorithm a new method is proposed in this paper and thereby propose a new algorithm which computes the dynamic time quantum on the set of available processes.
- 4) The processes which have higher priority and lower burst time and arrival time are given precedence in this algorithm.

## 7. FUTURE SCOPE

This paper can be enhanced in many directions like:

- 1) Studying performance in real time applications where tasks have priorities and deadline constraints.
- 2) Applying scheduling technique on distributed systems.

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