Performance Evaluations of the Round Robin Load Balancing Algorithm Using Nine Qualitative Metrics

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ABSTRACT
Round robins (RR) commonly serve as a load balancing in computing cloud as a result of its simplicity and fairness, quality. RR is effectual for distributing tasks uniformly. The Round Robin algorithm cycles through processes, allotting each a fixed time quantum; if a process is not completed, it is placed at the end of the queue. This ensures uniformity but can lead to inefficiencies if the quantum is not properly chosen. Performance Evaluations of the Round Robin Load Balancing Algorithm Using Nine Qualitative Metrics was evaluated generated from the developed application. The evaluation of the performance of round robin algorithm when based on nine qualitative parameters yielded 98.64% efficiency. This research is significant in improving communication and the quality of relationship within groups. The Round Robin system is more robust and efficient to handle load balancing in cloud computing environment.

INTRODUCTION

Load balancing is a major content in computing cloud, as it is crucial for a uniform and effective distribution of load among the nodes in private and public clouds (Bhargvi, 2025). In distributed systems load balancing is defined as the process of distributing load among various nodes to enhance general resource utilization and job response time (Ajay *et al*., 2022)

The platform of this algorithm is the principle of time distribution (Gao and Wu, 2022). The Scheduler maintains a list of available virtual machines in a table known as VM allocation Table. It designate the tasks received through the datacenter controller to a list of virtual machines on rotation basis

Round Robin is one of the fundamental loads balancing method for sharing workloads across in a cloud computing environment (Joshi and Gupta, 2024). This technique functions by going down the list of servers in the data center and forwards a client request to each server in turn, it send request to the server as they are listed on the data centre. When it reaches the last server, goes back the first server. In the Round Robin scheduling, loads are uniformly distributed but are given a limited amount of CPU time called a time-slice or quantum. If a process is completed before its time slice expires, the CPU is pre-empted and given to the next process waiting in a queue.

The preempted process is then placed at the back of the ready list. One of the fundamental advantage of the Round Robin load balancing algorithm is its simplicity and uniformity in load distribution. However, it does not take into account parameters such as transaction time for each load, unequal server capacities, or network congestion, which may hinder general system performance system performance (Singh et al., **2022**).

MATERIALS AND METHODS

The techniques adopted in this work focuses on the concepts of Object-Oriented Analysis and Design (OOADM). The object-oriented analysis is based on the definition of classes and the manner in which they are used with one another to effect customer requirements Unified Modeling Language (UML) and the Unified Process are predominant features of object-oriented analysis Object-Oriented Analysis and Design (OOADM) was used because the model being proposed was deployed using a Java platform–independent, class-based system and OOADM is most appropriate for developing models that are either desktop-based **or** web-based applications. The application to test the proposed model focused on cloud computing load balancing technique, where CPU resources are required for utilization and

this can be best described using use-case and sequence diagrams which can depict the process easily.   The **Object-** described using use-case and sequence diagrams **Oriented Design Analysis (OODA)** concept that originated from two different areas. Which encompass the logic frame work and the physical frame work of the system. OODA lead to different procedures that are useful for doing two important jobs. Based on this research work the methodology was narrowed down to the Central Processing Unit (CPU) resource utilization and allocation policy of the broker or task in cloud computing technique or metrics.

Cloud Computing Quantitative Load Balancing Process

Some of the step used for evaluating a cloud computing virtual machine learning involves:

- **CPU Utilization:** The overall percentage of time for which central processing unit was utilized **Throughput:** Total no. of tasks executed (or requests served) per unit time.

- **Response Time:** The time utilized by a request in the waiting queue till it gets the first time to use the central processing unit.

- **Waiting Time:** The overall period utilized by the request waiting in the ready queue after the first response from CPU.

- **Turnaround Time:** The overall period used by a request to get completely served, including its response time, waiting time and service time.

- **Fairness:** The principle is based on uniformity of load balancing and central processing time

- **Resource Cost:** The overall cost of the resource utilized for the servicing of requests by various cloud users

Cloud simulation tools and software
The cloud simulation tool used for the analysis of Round Robin algorithm was CloudSim, this allows for the evaluation of Round Robin   in cloud environments by simulating tasks and resource allocations. The cloud produced by GRIDS Laboratory of University of Melbourne. The software used are Jave, Java swing, Cloudsim, and Sim Java (Bhathiya, 2009).

Algorithm Design
Step1: *Let initialize Data center Broker.*
The status table of the virtual machine and the state of the existing clouds resources and cloud qualitative metrics. At the time of initialization no virtual machines were allocated to the Cloudlet.

Step2: *When there is a request to distribute new virtual machine come Data center Broker,*
Data Center Broker analyzes the status table. Then, calculate the total execution time of all existing cloud lets in the queue (of each virtual machine) and the expected completion time of the new cloud let being prepared for processing.

If the virtual machine has the shortest expected processing time that machine is chosen to submit the next Cloudlet. If there is more than one, the first virtual machine is selected.

Step 3: *Send the selected virtual machine ID to the Data center Broker then, Data Center Broker sends the cloudlet to the virtual machine allocated by that ID.*

Step 4: *Data broker notifies about new allocation and updates to virtual machine and cloudlet status tables.*

Step 5: *When the virtual machine completes the processing request and Data Center Broker receives the Cloudlet response, it will update the Cloudlet's status table as completed and reduce a Cloudlet in the status table.*
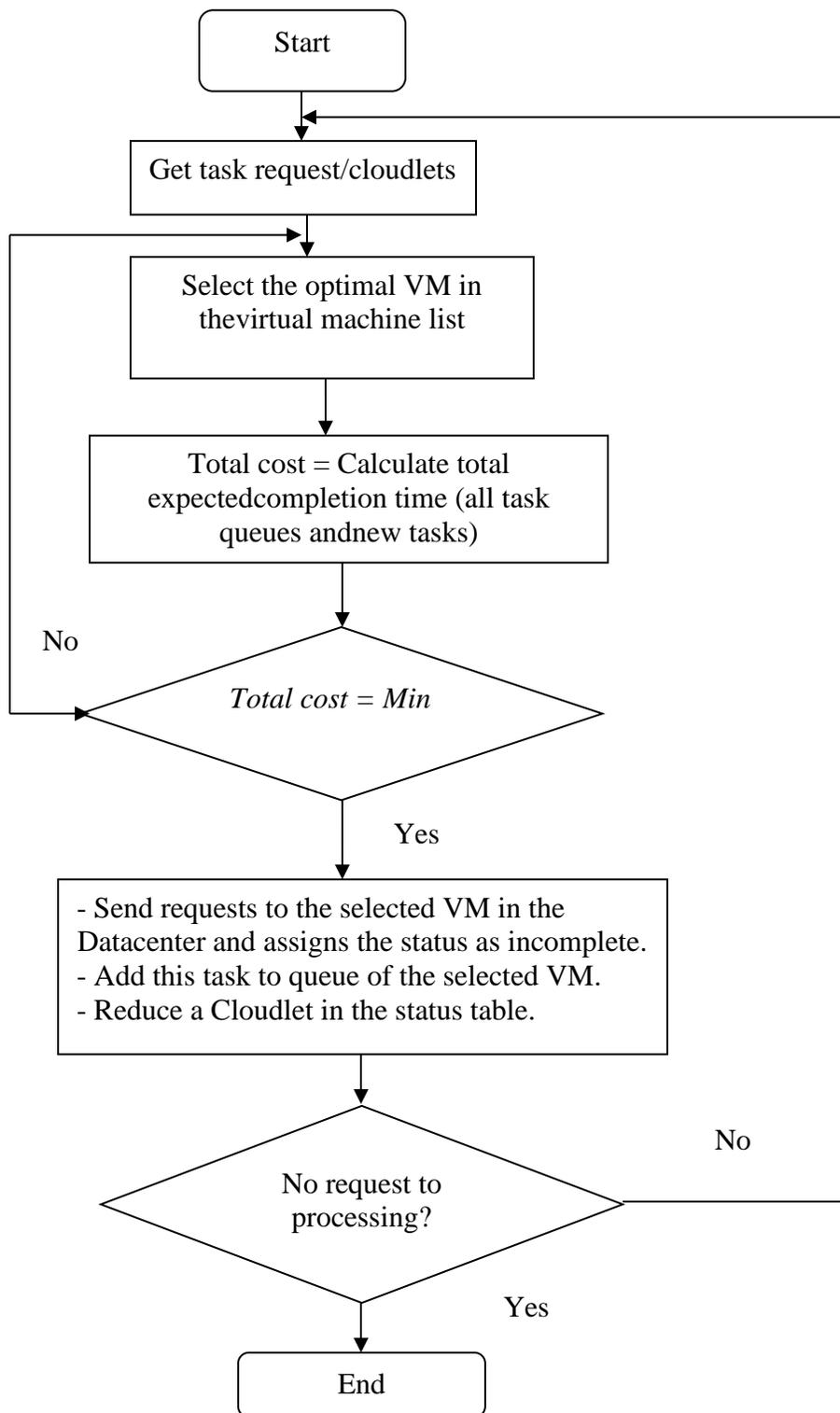
Step 6: *Go back to Step 2.*

```
                          ┌──────────────┐
                          │    Start     │
                          └──────┬───────┘
                                 │
                  ┌──────────────▼──────────────┐
                  │  Get task request/cloudlets │
                  └──────────────┬──────────────┘
                                 │
                  ┌──────────────▼──────────────┐
                  │   Select the optimal VM in  │
                  │    thevirtual machine list  │
                  └──────────────┬──────────────┘
                                 │
                  ┌──────────────▼──────────────┐
                  │  Total cost = Calculate total│
                  │  expectedcompletion time (all task│
                  │    queues andnew tasks)     │
                  └──────────────┬──────────────┘
                                 │
      No              ◇──────────▼──────────◇
                      ◇    Total cost = Min  ◇
                      ◇──────────┬──────────◇
                                 │  Yes
                  ┌──────────────▼──────────────┐
                  │ - Send requests to the selected VM in the│
                  │ Datacenter and assigns the status as incomplete.│
                  │ - Add this task to queue of the selected VM.│
                  │ - Reduce a Cloudlet in the status table.│
                  └──────────────┬──────────────┘
                                 │
                      ◇──────────▼──────────◇   No
                      ◇   No request to      ◇────►
                      ◇   processing?        ◇
                      ◇──────────┬──────────◇
                                 │  Yes
                          ┌──────▼───────┐
                          │     End      │
                          └──────────────┘
```

Figure 1: System Flow chat

RESULTS AND DISCUSSION

A Comparative study of round robin and power aware load balancing Algorithms
A Qualitative Metrics for Round Robin

This metric was used to compute the nine qualitative metrics of cloud computing for evaluate the performance of Round Robin load balancing algorithm. The analysis shows that Round Robin utilized 98.64% performance accuracy of evaluation with respect to cloud resource allocation efficiency factor of Round Robin technique. Below is module that controls the Round Robin qualitative metrics module that control round robin qualitative metrics
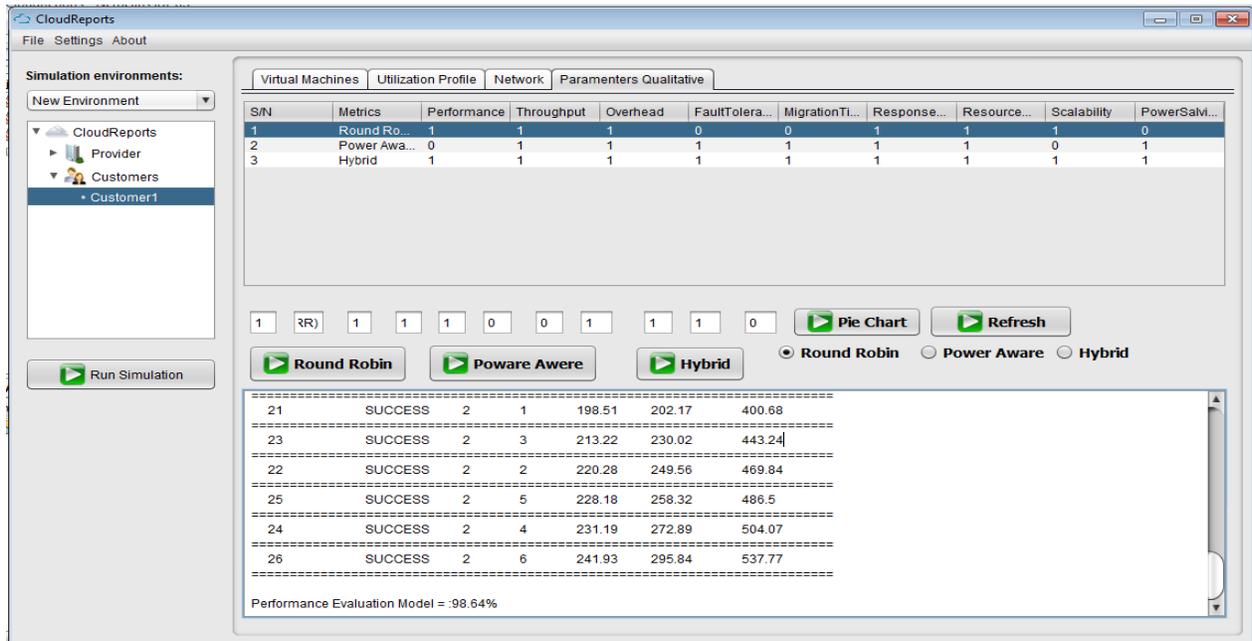
Figure 2: Qualitative Metric for Round Robin

Figure 2, Shows the evaluation of the performance of round robin algorithm when applying it to nine parameters of qualitative metrics. Based on this concept we were able **develop a model for load balancing in a cloud computing system using** proposed technique used for this work.
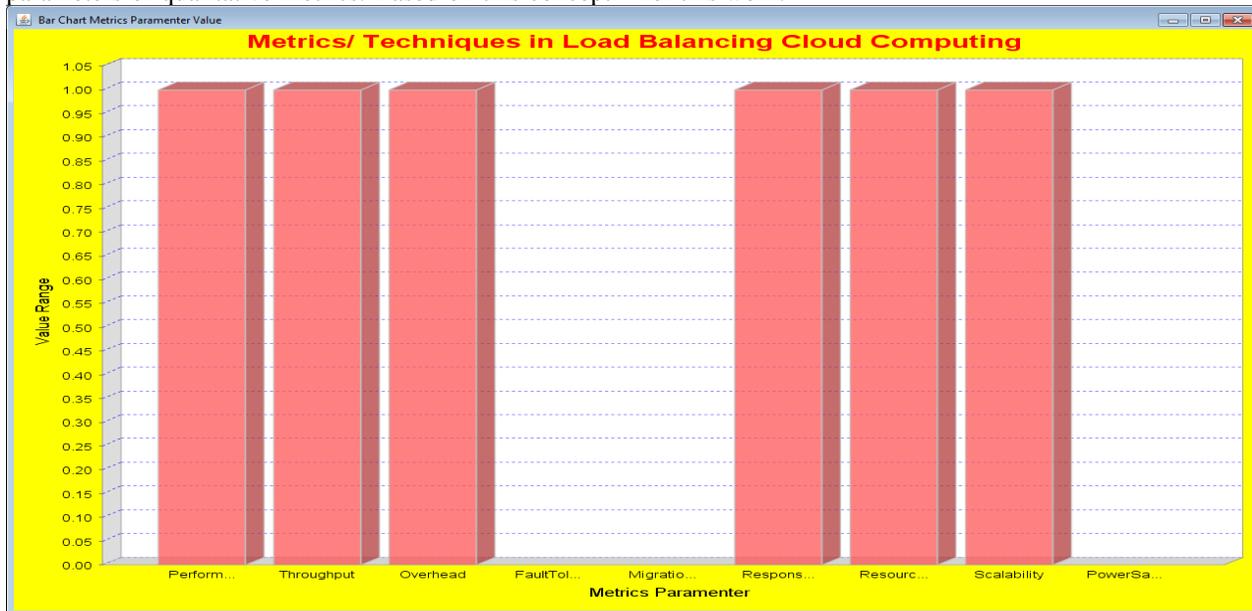

Figure 3. Qualitative metrics for Round Robin

Qualitative metrics for round robin in **Figure 3** show that fault tolerance, migration, and power-saving features are absent**,** respectively

CONCLUSION

Round Robin load balancing is a widely used, straightforward algorithm that distributes incoming requests evenly across a pool of servers. It is most effective in environments where servers have similar capacities and workloads are relatively uniform. The Round Robin system is more robust and efficient to handle load balancing in cloud computing environment. From this research it is concluded that the Round Robin load balancing algorithm shows a very high performance of **98.64%** when applied to nine qualitative performance metrics**.** The Round Robin system is more robust and efficient to handle load balancing in cloud computing environment. An extensive evaluation of these tasks scheduling algorithm should be conducted by focusing on the energy consumption

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