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ORIGINAL RESEARCH

Load Balancing for Traffic Control in Cloud Computing Using Honeybee Optimization.

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Abstract – Load balancing involves distributing application tasks to different processors to decrease the execution time and improve cloud computing efficiency and user satisfaction. This is achieved by optimizing resource use, maximizing performance, and minimizing latency. An algorithm is proposed that improves load balancing by ensuring that no virtual machines remain idle and aims for a well-balanced load across all virtual machines for optimized solutions and reduced latency. This approach ensures that underloaded virtual machines are assigned tasks to maintain balance, rather than overloading fully loaded virtual machines. A comparison was made between the newly proposed algorithm and existing dynamic load balancing. Based on experimental results, it was found that the proposed methodology is more effective than the already existing algorithm with considerable decrease in the average processing time.

Index Terms – Load balancing, optimizing, virtual machines, overloading, cloud computing.

I. INTRODUCTION

Cloud computing is the on-demand availability of computing resources including tools and applications through the internet. it can provide both private and public cloud service for a fee. The cloud offers number of benefits to all sectors of companies which encompass the ability to make use of software from any device [1] .

Cloud computing offers shared processing resources and data without the need for users to buy servers or pay for power. It's also convenient for remote workers who can access their applications from anywhere [2]. However, as the users across cloud computing environment increase, so that demand for shared resources also grows, making load balancing a key challenge.

Load balancing involves distributing workloads and computing infrastructure among multiple users, and service providers to manage the workload demands. It helps avoid bottlenecks and achieves several benefits, such as equal task distribution, improved service quality, better system performance, reduce time to time, and optimal resource infrastructure [3]. The first aspect of load balancing is to equally balance the workload in hosts based on their processing speed, memory space, and also bandwidth.

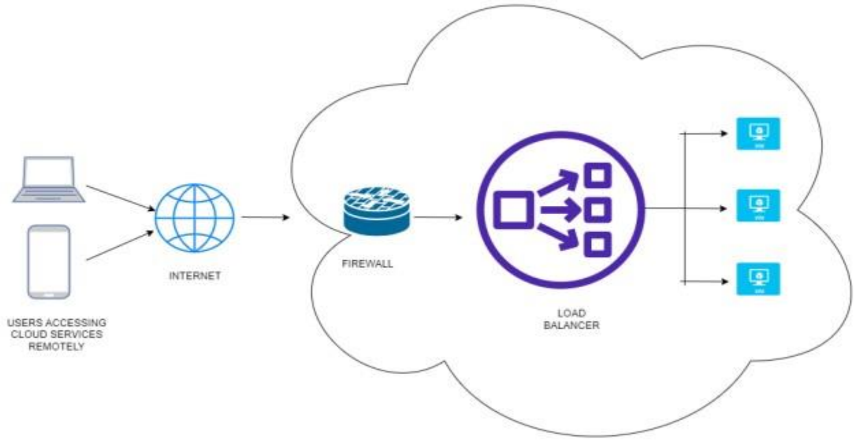

Fig 1: Architectural Design of Load balancing

Here, load balancer acts as a device that distributes the network traffic among the servers equally without Causing any traffic blocking.

Algorithms in load balancing are categorized into two types, namely static and dynamic. While static are less complex, they work best when the hosts have minimal fluctuations in their load. This is because they do not take current behavior while distributing the workload. On the other hand, dynamic algorithms are preferred for distributed systems like cloud computing [3]. An example of a static scheduling algorithm is Round Robin (RR), each turn it assign task to node without regard to the VM's resource capacity or the task's execution time. In contrast, a dynamic load balancing algorithm such as the Modified Throttled Algorithm equally distributes the task among the available VMs, but it does not consider resource utilization while allocating the task. Traditional load balancing algorithms face several limitations in the dynamic workload dynamics of cloud computing. To overcome the challenges, in recent years artificial bee colony and ant colony optimization have emerged. These algorithms have made significant strides in addressing the dynamic nature of cloud computing. Our proposed method suggests that load balancing is mimicking the foraging behavior in honeybees. Here this algorithm is based on a thorough analysis how honeybees search and collect food. In a beehive, scout bees search for food and communicate the location and quality of the food by performing a waggle dance. Forager bees follow scout bees to the food source and collect it. Then they return to the beehive and perform a waggle dance to inform other bees about the quantity of food remaining.

II. LITERATURE SURVEY

P Kumar and R. Kumar published a article “Issues and challenges of load balancing techniques in cloud computing” [1] discusses the challenges and issues associated with them. As it ensures that resources are distributed efficiently across multiple servers, thereby maximizing resource utilization, and minimizing response time.

The paper “A Comprehensive Study of LB Technique in Cloud Infrastructure” which is written by A. Ajil [2] and Kumar shows the technique used in load balancing for minimizing the load efficiently and provides the information of different parameters that are there in load balancing.

The authors Ali, Mrs Anooja, and D. P. Sumalatha for an article titled "A survey on Balancing the Load of Big Data for Preserving Privacy Access in Cloud" published in 2018, as it ensures that the resources are distributed evenly across multiple nodes or servers. The authors focus on the challenge of balancing the load of big data in a way that maintains privacy access, meaning that sensitive data is not accessible to unauthorized users [3].

A paper titled "Load Balancing of Nodes in Cloud Using Ant Colony Optimization" presented in 2012 written by Kumar Nishant, Pratik Sharma [4], and Vishal Krishna. This shows algorithms for cloud computing that uses ant colony optimization. ACO is a swarm intelligence-based algorithm that simulates the behavior of ants in nature to find the shortest path between a source and destination. The proposed algorithm aims to distribute workloads across multiple nodes or servers in cloud environment using the ACO algorithm.

"A review on dynamic load balancing algorithms" which is written by Shalu Rani, Sakshi Dhingra and Dharminder Kumar [5]. The paper provides a review of various dynamic load balancing algorithms used in distributed systems such as cloud computing, grid computing, and parallel computing. Dynamic load balancing refers to the process of equally distributing workloads across multiple nodes or servers in realtime based on current state of system.

This is a citation titled "Survey on Existing Load Balancing Algorithms in Cloud Environment" in 2021 which was written by Suman Sansanwal and Nitin Jain [6]. The paper provides a survey of existing algorithms that are used in cloud computing environments to distribute workloads across multiple servers or nodes in load balancing. The authors review different types of load balancing algorithms, including static and dynamic algorithms, and discuss their advantages and limitations and also shows a comparative analysis of different algorithms based on criteria such as performance, scalability, and fault tolerance.

This is a citation for an article titled "Load Balancing Algorithms for Cloud Computing Environment" published in May 2020. [7] it provides an overview among algorithms that are used to optimize the utilization of resources and minimize response time and compares their performance parameters.
A research paper titled "A Systematic Study of Load Balancing Approaches in the Fog Computing Environment" published in 2021 written by M. Kaur and R. Aron. [8] provides a systematic study to approach the fog computing environment. which extends cloud computing processing and storage to be located closer to the user or device. as it ensures that resources are distributed efficiently across multiple fog nodes or servers.

III. METHODOLOGY

Until recently, most research that are done on load balancing assumed stable nodes, which is often unrealistic in dynamic and heterogeneous cloud computing systems. As demand for resources or services fluctuates, new instances of the platform are launched, causing to increase the size and complexity of system [7]. Rule sets are imposed to manage the workload, but as the systems grow, these rules become unwieldy, and it becomes difficult for observation and response cycle. In summary, the meta systems is to manage efficiently organized load balancing strategy and agile sufficiently.

Therefore, a self-regulating load system is needed that can balance the load within the entities without any information about the system. This selforganized regulation can be distributed by distributed algorithms. To address this, we propose an implementation algorithm to manage the dynamic environment of virtual machine programming and requests in cloud computing. To balance the load in a cloud computing environment, tasks should be sent to the under loaded virtual machine, similar to how foraging bees send consecutive tasks to a flower patch until it is full. By taking inspiration from honeybee behavior, we can improve the overall efficiency of the system in load balancing. Prioritybased balancing focuses mainly on decreasing the time spends of task in a virtual machine's queue, similar to how honey bees prioritize certain flower patches to maximize efficiency. This approach reduces the response time of virtual machines.

Honeybee foraging behavior in Load Balancing

To achieve load balancing, it is recommended to allocate tasks to the less loaded virtual machine. This strategy is analogous to how foraging bees direct sequential tasks to a flower patch until it reaches capacity. By emulating the behavior of honeybees, the efficiency of the load balancing process can be improved. The priority-based balancing method concentrates on minimizing the duration that a task spends in the queue of a virtual machine, which is similar to how honeybees select particular flower patches to maximize productivity. By adopting this technique, the time of response in virtual machines can be reduced.

The algorithm of Artificial Bee Colony begins by pairing each bee with randomly selected food sources, without any bias. The bees then gather nectar from these sources and return to the hive, sharing their findings with other bees through dance. Next, a population of scout bees is established and randomly sent out to the food sources to calculate their fitness values.

Bees that are currently employed collect and store information about food sources in their vicinity. They then share this information through dance to other bees. Afterward, the employed bees revisit previously visited food sources and use the shared information to select new sources in the area. The scout bees based on nectar information they choose food which information is provided by the employed bees. The onlooker bees in the hive receive the information from the working bees about food source, and then choose one of the sources to visit. These bees wait for a dance performed by the employed bees to determine which food source to choose. The employed bees perform a specific type of dance, such as the waggle or tremble dance, to communicate about the quality, quantity, and distance of the food source from the hive. To find a food source scout bee conducts a random search, and when the bees no longer visit a particular source, the scout bee randomly selects a new source to investigate.

Algorithm: -

1.The user provides a list of available virtual resources in the data center (e.g., VM1, VM2… VMn.) and a list of tasks to be completed (T1, T2 … Tn.).

2.When a new request is received, the scheduler computes the computing capacity that is expected to be needed for the given tasks.

3.The average computing capacity for each task is determined using an equation - $PT_{host} = \frac{Total\ length\ of\ tasks\ submitted\ to\ host}{number\ of\ processors\ in\ host * processor\ speed\ of\ host}$

4.The load on each virtual machine (VM) is found - Load of each VM = $\frac{Number\ of\ tasks\ at\ time\ t\ on\ service\ queue\ of\ VM}{service\ rate\ of\ VMi\ at\ time\ t}$

5.The average system load is computed.

6.The load is checked against a probability value ranging from 0 to 1, and if the value is between 0 and 1, the VM is added to the underloaded list; otherwise, it is added to the overloaded list. if (0< P()<1):

Underloaded_list[]= VMi else:

Overloaded_list[]= VMi

7.The underloaded VMs are selected and compared to the expected computing power of the tasks. If the average computing capacity of the VM is greater than or equal to the expected computing power of the tasks, the VM is marked as the fittest and the tasks are allocated to it.

8.After the tasks are allocated, some VMs may remain underutilized, resulting in wasted processor time. Randomization is performed in the system on certain threshold value or less than to it. VMs with a system load greater than another threshold value is selected, and jobs are randomly allocated to VMs with a system load less than or equal to the first threshold value. The algorithm will make N-1/N attempts on average to reallocate jobs among the VMs.

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The flowchart shows that path how a task is being processed step by step uniformly. The flowchart consist of 4 sub parts i.e. workflow submission, taskin, task-out, delay

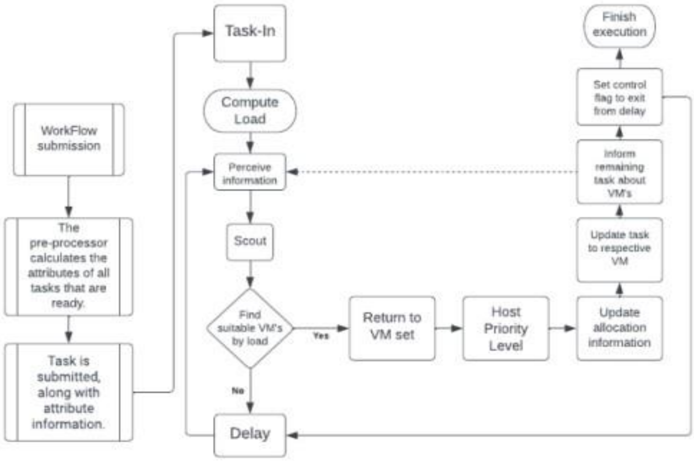

Fig 2: Flow diagram for the behavior of the proposed algorithm

IV. RESULTS

Cloud Analyst is used to stimulate task scheduling and model. The experimental evaluations are conducted using a simulation platform consisting of 50 VMs, Data centers and 100-1000 tasks. The tasks' length varies between 1000 to 2000million Instructions (MI) , while the speed of processer, memory size in VM, and bandwidth dictate the allowable load to each VM.

Table 1: Simulation Parameters

PARAMETERS	VALUES
Total no of tasks	100-1500
Length of task	2000-20000 bytes
No of VM's	50
Processor speed	500 - 10000
VM Memory size	256 - 2048 MB

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In order to customize the simulation outcomes, an examination was conducted on the impact of various parameters. These parameters include the average response time, the length of executable instructions, and the average frequency of user requests per hour.

Fig 3 presents the average response time of algorithm, varying the length of executable instructions for each task between 2000 and 20000 bytes, and testing at different numbers of tasks. The cumulative response time of task measures the duration between request submission and the initial response, in milli-seconds. Results show that, under all conditions, the average response time begins at approximately 51.67 seconds. However, this value slightly increases to 52.05 seconds when the executable instruction length for a task is 2000 bytes and increases to 52.89 seconds when it is 20000 bytes. This is attributed to the fact that an increase in the tasks and as well as the length of instruction will impact the load of system, resulting in increased response times.

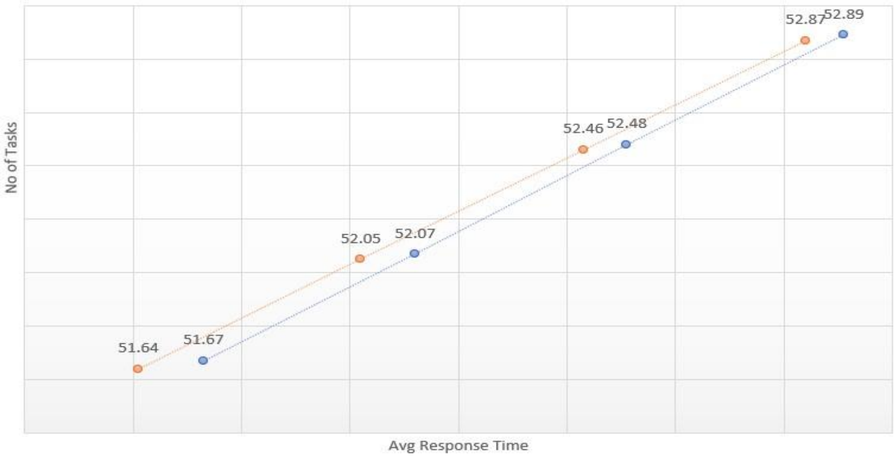

Fig 3: The study measures the Response time of Honey-Bee algorithm for different values of instruction length, while varying number of tasks

Comparison with swarm-based ant colony algorithm:

This compares simulation results of proposed algorithm with swarm-based ant colony algorithm. As noted in the previous section, the performance of the system is significantly impacted by the executable instruction size and no of tasks. Therefore, to demonstrate the impact of proposed algorithm a high default value for the tasks is chosen.

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Fig 4 represents the average response time in proposed honeybee algorithm with ant colony load balancing algorithm. The tasks are varied in between 100 to 1000. The instruction size for these tasks vary randomly between 2000 and 20000. It is shown that the proposed honeybee algorithm saves up overall response time compared to ant colony algorithm. This is because, when assigning tasks to VMs, the proposed algorithm considers factors such as the availability of VMs, least load including load variation on each VM.

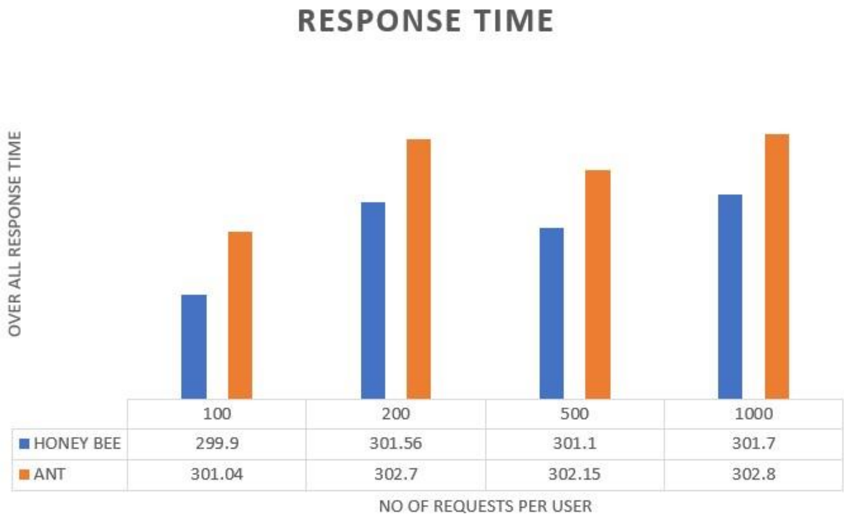

Fig 4: Average response time versus number of tasks

Fig 5 represents the average data processing time of proposed honeybee algorithm with ant colony algorithm. The tasks change from 100 to 1000. As it is shown that the proposed honeybee algorithm performs computation faster thereby reducing the vm cost the data transfer cost as well.

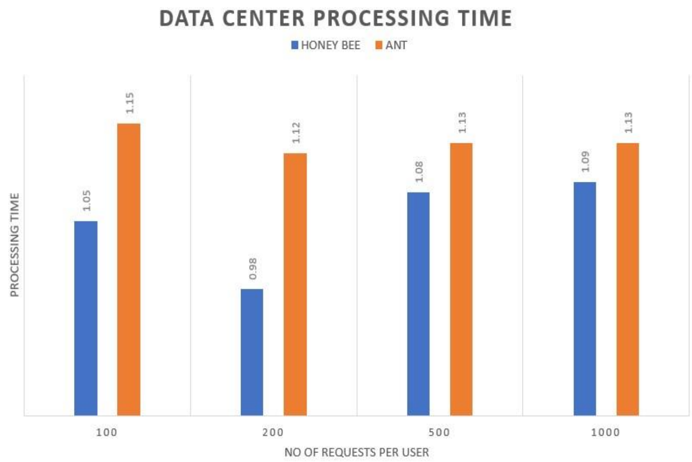

Fig 5: Data processing time verses no of tasks

V. CONCLUSION

The paper proposes a load balancing approach inspired by foraging strategy through behavior of honeybee in cloud system. The algorithm stabilizes the load by removing heavily loaded virtual machines while also considering the priorities of tasks. The honeybees are treated to be tasks to globally update the information. The algorithm also prioritizes tasks to improve the overall processing throughput and reduce the response time of VMs. When this proposed algorithm is set side by side to other existing techniques, and results show its efficiency without additional overheads. This technique is suitable for balancing independent tasks that are non-primitive and heterogeneous cloud computing systems.

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