Enhance the Performance of Public Cloud Computing using Hybrid Swarm Intelligence Algorithms.

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Abstract

Load balancing is an important factor in public cloud computing. The process of load balancing increases the utilisation of dedicated resources in public cloud computing. Load balancing is approached in two ways: static and dynamic. Dynamic load balancing applies swarm intelligence-based algorithms to the job scheduling process. instead of conventional load balancing approaches such as FCFS, SJF, and partition of load. This paper proposes a hybrid load balancing algorithm for public cloud computing. The hybrid algorithm is a combination of two swarm intelligence algorithms. The algorithms of swarm intelligence are ant colony optimization and genetic algorithms. The diversity of ant colony optimization and the guided approach of genetic algorithms control virtual machine allocation and make the best use of a dedicated system's resources. The proposed algorithm was tested on the cloud-Sim simulator and applied to different sets of user groups and data centres. The experimental analysis of the results suggests that the proposed algorithm is efficient in place of other load balancing algorithms such as GA and ACO.

Keyword's: - Cloud Computing, Load Balancing, Swarm intelligence, ACO, GA, Cloud-Sim

Introduction

The load balancing technique provides the great utility of cloud computing over the sharing of resources and allocation of jobs. The cloud-based services include hardware infrastructure and resource pooling such as platform as a service and software as a service. In all service applications, cloud computing enforces the process of virtual machines and data centres [1,2,3]. Cloud computing requires job scheduling and load balancing for the maximum utilisation of virtual machines and data centres. Job scheduling and load balancing are very critical issues in a cloud computing environment. The distribution of load on cloud computing is basically a principle of the distribution of tasks and jobs on dedicated resources such as datacentres and virtual machines. The datacentre and virtual machines are very important components of cloud computing. The proper utilisation of resources and network cloud computing processes requires the load balancing technique. In cloud computing, the load is distributed in the manner of distributed computing [4,5,6]. The process of distributed computing allows the concepts of load sharing and job sharing during the processing of tasks. The dynamic load balancing policy uses the concept of swarm intelligence. The family of swarm intelligence includes a variety of algorithms such as genetic algorithms, ant colony optimization, and particle swarm optimization. The swarm family optimization algorithms work very well and suffer from a problem in search space mode. The limited search space reduces the better allocation of jobs according to their resources. The main idea comes from the nature of the diversity of swarm intelligence. The intelligence of swarms basically improved the performance of various complex problems. Here we used the ant colony optimization and genetic algorithm techniques. Ant colony optimization techniques are basically based on the concept of biological ants [7,8,9]. The intelligence of the ants maintains the distance between difference points for the process of job and location selection over the earth. The applicability and utilities of cloud computing have improved the capacity of the middle-level IT industry [10]. The middle level IT industry creates an overload situation for the cloud service providers. In this case, we use the hybrid algorithm technique to improve the load ratio in terms of underload and overload. The improvement of job scheduling and allocation of jobs required the load balancing technique. Initially, cloud load balancing technique is divided into two sections: one is static load balancing technique and the other is dynamic load balancing technique [11,12]. The static load balancing technique uses CPU scheduling such as round robin, first come, first served and other static algorithms. Nowadays, dynamic algorithms such as genetic algorithms, ant colony optimization, and many more are based on heuristic functions. The rest of the paper describes, as in Section II, related work in load balancing, in Section III, the proposed methodology, in Section IV, the experimental analysis, and in Section V, conclusion and future work.

II. Related Work

The continuous efforts of algorithms in the development of load balancing and task scheduling algorithms for public cloud computing enhance the performance of networks and data centres. These swarm intelligence-based algorithms increase the capacity and utilisation of public cloud networks. The major contributions of different authors are described here. Matte Sommer et al. [1]: The contribution of this research is as follows: First, we show our time series forecast module for VM usage in the future. Second, we show how CPU utilisation estimates might be useful in cloud computing scenarios. We came up with a new policy for the live migration of virtual machines in heterogeneous cloud environments by using a predictive method to find hosts that are too busy. This encourages us to use ensemble-based hydrologic forecasts as inputs in our analysis of the reservoir's real-time operating risk. This study examines the real-time operational risk of reservoirs using ensemble-based hydrologic forecasting inputs. The following conclusion could be reached from a case study of the Three Gorges Reservoir (TGR) during the 2010 flood: Among them is Shyam Singh Rajput. ([3] In order to reduce the make span and improve resource usage, we presented an improved load-balanced min-min (ILBMM) approach using genetic algorithms (GA) in this study. The suggested algorithm reduces the make-up time and improves resource consumption. Here, we use a genetic algorithm with crossover, mutation, and fitness functions to figure out the MI of the job and the MIPS of the VM. Among others, Aminu Abdulkadir Mahmoud [4], there are two main steps to the algorithm. The first phase measures the quickest job completion time using the results of three different techniques: min-min, max-min, and suffrage. His integration results in the suggested method (RMK), which is executed in three phases. Stack table with the times at which jobs were executed when mapped to the centre. In this paper, we seek to offer a detailed and organised summary of the research on load balancing methods in cloud computing. This study examines the most advanced load balancing tools and methods from 2004 to 2015. We put together current methods that seek to provide load balancing fairly. An important part of this research is comparing different algorithms, taking into account things like fairness, throughput, fault tolerance, overhead, performance, response time, and use of resources. In this paper, we cover load balancing, various proposed algorithms for spreading the load among the nodes, as well as the factors that are taken into consideration when determining the optimum algorithm to balance the load. The load balancing of a cloud involves several different aspects. The issue we have with the load balancing algorithms that are currently in use is that they are not able to provide load balancing in all of the locations where load balancing is necessary. In the study by Mubarak Haldu and others [7], various job scheduling algorithms are examined, and an enhanced Min-Min method is created. The method avoids the disadvantages of Min-min while utilising its benefits. The overall completion time (Make span) and resource utilisation are two factors that the Enhanced Min-Min Task Scheduling algorithm considers. The experiment was carried out using the simulation programme Cloudsim. [9] Geetinder Kaur and colleagues in order to schedule cloudlets and resources more efficiently, this study uses a hyper-heuristic scheduling approach that accounts for both computation time and transmission costs while using two detection operators. The Improved Hyper-Heuristic Scheduling algorithm gets the job done when compared to the Hyper-Heuristic Scheduling algorithm. Garima Rastogi and co-workers [10] In this essay, we'll talk about load balancing in cloud computing: why it's important, how to do it, commonly used performance measures for load balancing, and an in-depth review of the algorithms used in the literature. All researchers who are looking for a load balancing method for cloud computing with all the necessary information will benefit from this study. It will also make it easier for them to present fresh ideas for additional improvements in the cloud area. Nada Ahmed and others [11]. One of the most popular technologies in the IT industry is cloud computing. It offers computational resources as general utilities that customers can rent and release as needed. To build a model to forecast the risk level in a cloud computing environment, we suggested an ensemble of adaptive neuro-fuzzy inference systems (En-ANFIS). Based on the results of experiments, an ensemble of ANFIS models works much better than a single ANFIS model while still being able to be used effectively. One such example is Diptanshu Pandya [12]. When nodes are overwhelmed with work, load balancing is the process of dispersing the load among the many nodes, which results in good resource usage. Load balancing is necessary to manage the load when one node is overwhelmed. A survey of load balancing techniques is proposed in this study. Load balancing is one of the major problems in cloud computing. The client should have access to the service when they request it. In their publication, Zhijia Chen et al. [13] propose the subtractive-fuzzy clustering algorithm, which combines fuzzy c-means and subtractive clustering. Finally, we use a variety of criteria to assess the suggested approach. The outcomes of the experiment demonstrate how precise and successful the method is in forecasting resource demands. The fuzzy-subtractive clustering approach is suggested to enhance the FNN's convergence performance. The fuzzy-subtractive algorithm combines the subtractive clustering algorithm with the fuzzy c-means clustering algorithm. Neeraj Kumar Pandey and colleagues [14] Real-time resource allocation is a difficult problem in this scenario. To meet customer needs, cloud services are efficiently and optimally allocated. In the paper, researchers look closely at a number of cloud resource allocation techniques and the results they suggest. Nikhil S. Band, Ph.D., and others [15]. The study and analysis of various load balancing algorithms used in the cloud computing environment, as well as their accompanying benefits and drawbacks, are described in detail in this paper. We have talked about the existing algorithms that different scholars have developed. Here, multiple load balancing algorithms are also contrasted based on various parameter kinds. Kavita and others This work suggests a multi-objective scheduling technique that takes into account a wide range of cloud environment parameters. The purpose of the study is to reduce the burden on a virtual machine (VM) using the load balancing method in order to enhance the performance of CPU, memory, and network operations. No dominated sorting is used to complete the task of sorting. Also, the article wants to use RASA to spread out the work of VMs and make better use of resources. Indra yak Shinde and others [17] This paper describes and evaluates various algorithms in order to give a general overview of the current methodologies targeted at providing load balancing to improve the overall performance of the cloud in an equitable manner. The suggested approach uses pre-emptive task scheduling and loads jobs onto virtual machines in a manner similar to honey bees' foraging activity. The Pareto dominance idea is also used to choose the best virtual machine (VM) and decide which tasks are most important. Poonam and others [18]: the provided algorithms are used in this paper to implement the execution time. Our goal is to create an algorithm for load balancing using ant colony-based algorithms (ACO). In ant colony algorithms, the author says that ants use both specific knowledge in the form of heuristics and information stored in the pheromone trail to figure out what to do.

III. Proposed Methodology

The proposed algorithm improves the load balancing approach of public cloud computing environments. The load balancing algorithm encapsulates the genetic algorithm and ant colony optimization. The ACO algorithms reduce the maximum load of jobs based on the nature of similarity. The Genetic algorithm allocates the resource for the execution of jobs. The processing of ant and GA as the global and local optimal solution for the processing of cloud job[13,14,15].

The processing of hybrid algorithm process the different jobs as j1,j2,……………..,jn. The W is weight factor of all job assign for the cloud environments. τ is the value of pheromones of ants. The allocation process of job describe here.

Begin 1 define the value of job set J={ j1,j2,…………..,jn} in GA population

a. Define the value of w=0
b. Selection of jobs as ants of given constraints function

$$F(T) = \frac{(FLt-FGt)}{LtX\ Gt}, W i \epsilon T(t1, t2 \ldots.. tn) \ldots \ldots \ldots \ldots..(1)$$

Here Lt is local job and Gt is global job of set of define job matrix of job

The selected jobs assign as the ants of ACO algorithm TA={at1,at2,……….,atn} the local optimal estimation function as

$$Pbest = \begin{cases} \frac{(\tau_i)^\alpha \left(LI_i^{S_j}\right)^\beta}{\sum_{g \notin S_j} (\tau_g)^\alpha \left(LI_g^{S_j}\right)^\beta} & if \quad i \notin S_j \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2) \\ 0 & otherwise \end{cases}$$

Here τ_i is phenomenon value of ants and LI is value of least interface of ants.

Begin 2. Exchange the local best to global best allocation

Put the local best job matrix for the processing of resource allocation.

1. Estimate difference of jobs as relative difference
   $RT = \frac{TSI}{Wd}$ Here Tsi is interference value of ants and Wd is sum value of PSO space.
2. The GA space creates the allocation states of resources
   $$Allocation = \begin{cases} \frac{\max\ (RF)\ -F(s)}{\max_{h=1:}(WS)} & if\ \ T_i \in RT_j \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3) \\ 0 \quad otherwise \end{cases}$$
3. Measure relative distance of jobs as
   $$Rd = \sum_{fd=1}^{n} \sum_{pf=1}^{m} (Ti - Tr) \ldots \ldots \ldots \ldots \ldots \ldots..(4)$$
4. The value of Rd is zero resource is allocated to dedicated jobs.
5. Else the process of allocation goes into steps 2

IV. Experimental Analysis

To validate the proposed hybrid algorithm for load balancing in the cloud-sim simulator. The cloud-sim simulator is a Java programming-based simulator and encapsulates job allocation policy and different networks of clouds. The cloudlet and mapping of virtual machine library files correspond with genetic algorithms, ant colony optimization algorithms, and hybrid algorithms. The performance of algorithms is evaluated in terms of the processing time of data as maximum, minimum, and average time[17,18].

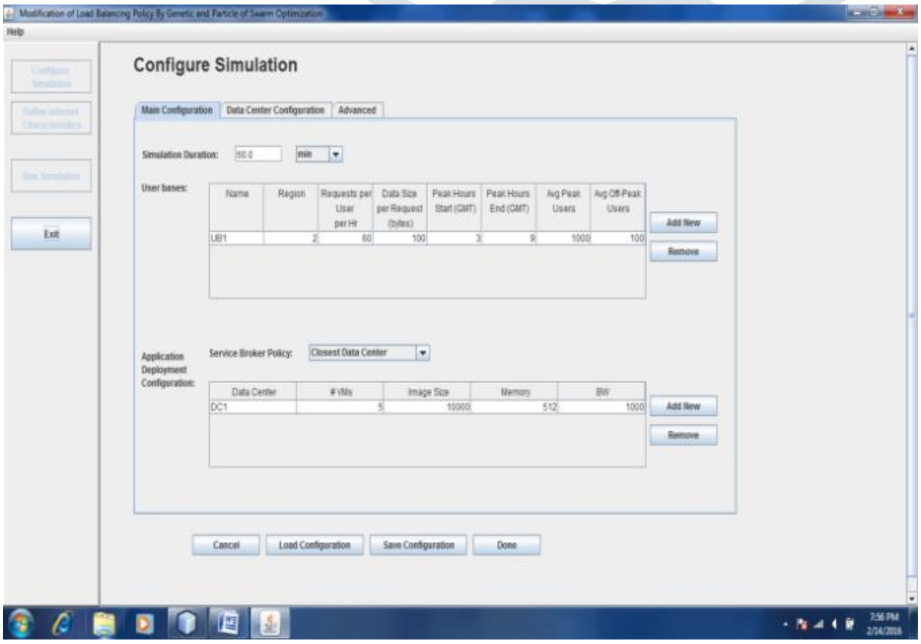

Figure 1: Shows that the main Simulation window for cloud computing analyst.

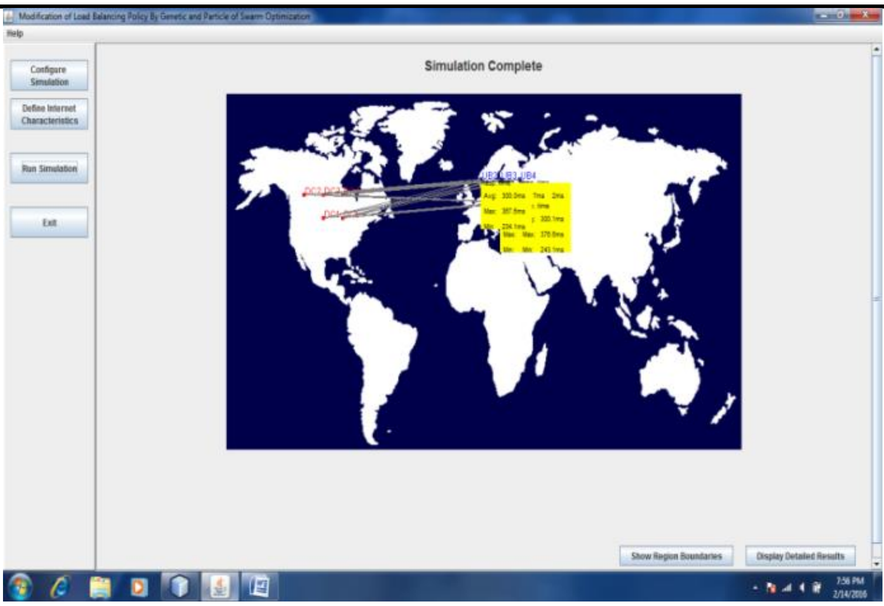

Figure 2: Shows that the result window for cloud computing Data centre connection using genetic algorithm method with datacentres is 5.

Table 1: Comparative performance evaluation using Round Robin, Genetic Algorithm and particle of Swarm Optimization methods with the input value is 5.

Number of Input	Method Name	Average Time	Minimum Time	Maximum Time
	GA	0.31	0.02	0.62
5	ACO	0.22	0.01	0.44
	Hybrid	0.16	0.01	0.31

Table 2: Comparative performance evaluation using Round Robin, Genetic Algorithm and particle of Swarm Optimization methods with the input value is 10.

Number of Input	Method Name	Average Time	Minimum Time	Maximum Time
	GA	0.36	0.02	0.69
10	ACO	0.24	0.01	0.43
	Hybrid	0.18	0.01	0.34

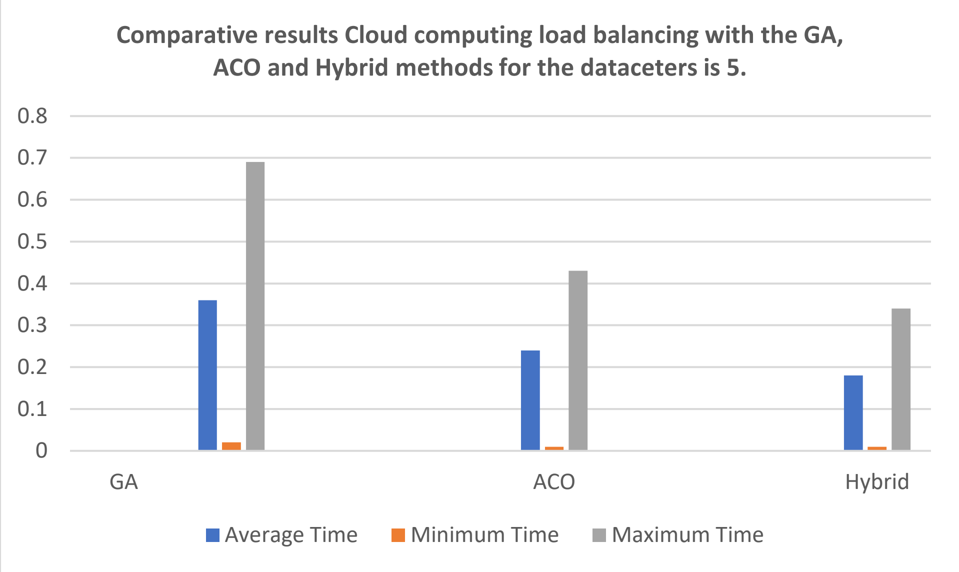

Figure 3: Shows that the comparative performance evaluation for the cloud computing load for each different number of datacentres here the input datacentres is 5.

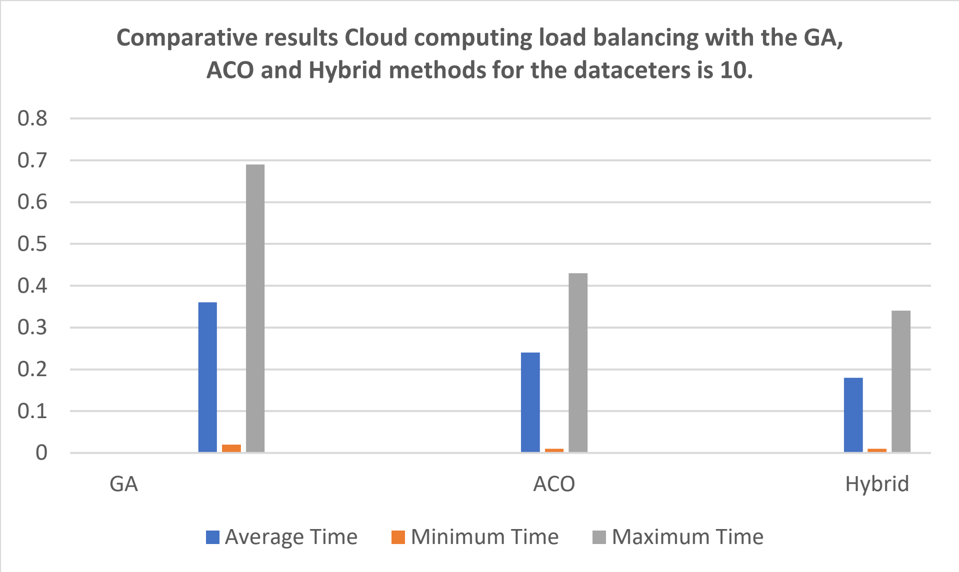

Figure 4: Shows that the comparative performance evaluation for the cloud computing load for each different number of datacentres here the input datacentres is 10.

V. Conclusion & Future Work

In this paper, we propose a hybrid algorithm for load balancing policy in cloud environments. The hybrid algorithm sets the diverse properties of a virtual machine and requests a job. The define fitness constraints function partially allocates jobs for a dedicated machine and the distribution of jobs according to the process job scheduler. For the evaluation of performance, we used cloud simulator software, which is called Cloud Analyst. The cloud analysis software is composed of the cloud environment and load balancing policy. The hybrid algorithm-based policy reduces the load effect by approximately 10–12% in compression of genetic algorithms and ant colony optimization. The partial allocation of job allocation policy faced the problem of a minimum time span. The minimum time span factor affects the efficiency factor of hybrid policies.

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