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Bio-Inspired Techniques for the Efficient Migration of Virtual Machine for Load Balancing In Cloud Computing

Jiregna Abdissa Olana[1], Hrudaya Kumar Tripathy[2],
School of Computer Engineering ,
KIIT University
Bhubaneswar, India. 751024 cc2017j@gmail.com
hktripathyfcs@kiit.ac.in

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Abstract

The cloud is the architecture in which virtual machines, data centers, hosts and brokers are involved in the communication. The broker search most reliable virtual machine for the cloudlet execution. In the network uncertainty may happen due to which system get overloaded. In this research, paper technique is proposed to increase fault tolerance of the system. The proposed improvement is based on the Ant Colony Optimization (ACO) algorithm which can select the best virtual machine on which cloudlet will be migrated. The performance of the proposed algorithm is testing on cloudsim in terms of execution time, energy consumption. The simulation results demonstrated that execution time and energy consumption of Ant Colony Optimization (ACO) algorithm is least as compared to Three-threshold energy-saving algorithm (TESA) Algorithm. The proposed algorithm can be used for the load balancing in cloud computing.

***Key Words*:**Cloudlet, Virtual Machine, Migration, Virtualization, Ant Colony Optimization (ACO).

1 Introduction

A system that provides a shared pool of numerous resources such as networks, servers and storage devices to the users as per their demand is known as a cloud computing system. This system ensures that there is very less management effort put by the user and there is a simple way followed for providing such services to the users [1]. There is an on-demand and easy to access network environment present for the users within the cloud computing systems. The demands required by the user are fulfilled by the cloud computing. These demands include both hardware and software resources which are present on the internet. The users subscribe as per their requirements and access the resources until they want to [2]. In order to successful utilization of resources and to increase response time load balancing is utilized. It is a procedure in which the every node is reassigned with the total load of the network. This algorithm depends up on the current conditions of nature and avoids the use of previous natural conditions. Whole system is working even if one part of the system is fails due to used methodology of the fault tolerance. It allows system to continuous functioning. In the condition of breakdown of programming or equipment this technique responds immediately to the system. Still after breakdown if its not working properly fault tolerance remain the systems active by reducing its operating limit instead of shutting down it completely. Virtualization is the technique which helps in providing various services and also in reducing the cost of implementation along with the addition of hardware parts which will help in meeting the requirements of the user. Numerous operating systems can be made to run simultaneously on a single physical host with the help of virtualization method. The advantages of various techniques such as fault tolerance, portability, resource sharing, etc. provide a base to this technique which is further mainly utilized within the data centers. [3], [4].

The physical resources used to initialize a virtual machine are provided with the help of a virtualized view within the virtualization method. The abstraction from physical resources is provided with the help of middleware through the hypervisor.

The various tasks that are not evaluated by the host environment can be executed by the virtual machine [5]. With the help of hardware virtualization or the software emulation methods, the virtual machines can be generated. Numerous virtual machines can be generated and manages with the help of virtualization software on a single physical host only. There is an individual RAM, CPU, and NIC as well as hardware disk of its own with the VM and is considered to be as an individual physical computer. The shutting down of VM was mandatory in the earlier technology if one requires moving a VM amongst two physical hosts [6]. Further, the required resources were allocated to the new physical host, the VM files were moved and within the new host, the VM was initialized. Avoiding the downtime, the VMs are migrated now within the live migration technique. The actual meaning of transfer of VM is the transfer of its state which involves the memory, internal state of devices and the virtual CPU. The transferring of memory consumes the most of the time amongst all the other states. There are two important parameters to be taken care of while running the live VM-migration. First is the downtime which is the duration in which there is no VM service available. [7].

Bio-Inspired Techniques is used within all the engineering fields, the optimization is a major issue that arises while making computations. The best possible solution is identified by the optimization process amongst the different solutions available. There are large numbers of issues being faced in the areas which can be solved with the help of these methods. There can be either deterministic or stochastic types of optimization algorithms available. There is a need of various computational efforts in order to solve the optimization issues as there is an increase in issues with time. Within the deterministic approach, the application of bio inspired stochastic optimization algorithms is proposed by various researchers in order to solve such issues. These algorithms are solely based and inspired from the nature and the complex relationships are resolved here in very simple manners.

2 LITERATURE REVIEW

The authors proposed a study of the used application for the minimization of the Directed Acyclic Graph. For this purpose author proposed an algorithm for Dynamic Voltage Scaling. They are placed in the active environment as these applications are based on the distributed and parallel machines. The greedy method is improved by this system for improvement in requirements of energy. It also improves the deadline constraints. The authors discussed that the resource utilization is increased which in turn reduces the energy consumption in task consolidation. The reduction of energy consumption is affected in ways by the task consolidation. Without degrading the performance of a particular task, the task is assigned to the resource which has minimum energy consumption. The results prove that the energy-saving capability is better in these proposed heuristics. [8], [9]. The tradition of using portable and handheld devices for the consumption of power. This power management restricted their applications therefore author in this paper proposed a method to handle more power in the web servers. Traditional way of storage was broken in this paper. They measured all the aspects of energy consumption included, energy consumed by the "typical" web server. Author provided a method that is used for the estimation of CPU consumption of energy by a power simulator for web server. A technique that is used to provide on-demand capacities. This scheme is multi-tiered resource scheduling. It is used for the resources that flow through virtual machine an on demand capacity to the hosted services. The proposed algorithm enhances the performance rate of critical services by degrading other services. Author compared it with other algorithms and concluded that it improve the critical services to 9%. And show 39% less degradation to the services that are low in priority. [10], [11].

Interconnecting the DVM utility based manager and DVM placement manger, the resource management framework is obtained. These are the issues that are considered as the constraint satisfaction problems. The applications of heterogeneous can be validated by the resource arbitrations. This

technique also provides the information to balance the QoS and its computational cost. This can be completed by characterizing the application of the priority factors and the reduction in their electricity cost. A virtual machine (VM) deployment algorithm called three-threshold energy saving algorithm (TESA). The main objective of this algorithm is to improve the productivity of energy in data center at very large scale. The experimental results demonstrate that, as compared to different algorithms, MIMT altogether shows the improvement of energy efficiency in the datacenter. They are used for the practical purpose by utilizing this on the cloud-based systems for the practical applications. There applications have been used to improve the energy efficiency in the datacenter and for the reduction of the energy consumption cost. [12], 13].

3 PROPOSED METHODOLOGY

The Ant colony optimization is the nature inspired optimization algorithm. In the cloud computing, the virtual machines are responsible to execute the cloudlets which are assigned by the brokers. The brokers search most optimal virtual machines on the basis of their reliability. The virtual machines which are maximum reliable will be responsible to execute the desired cloudlets. In some cases, the virtual machines get overloaded due to which execution time and energy consumption of the network increased at steady rate. The ACO algorithm is been implemented which migrate the task from one virtual machine to other in case of machine overloading. The ACO algorithm works in the three phases which are described below:-

a) Define Initial Population: - The initial population is given as input which is the execution time and failure rate of each machine. The initial population is used to select most reliable machine for the cloudlet execution.

b) Update pheromone: - In this algorithm, the probability of failure of each machine is calculated on the basis of initial population. To calculate the probability the below equation

applied.

$$\rho\,(i,j) = \frac{(\tau_{i,j}^{\infty})(\eta_{i,j}^{\beta})}{\sum(\tau_{i,j}^{\infty})(\eta_{i,j}^{\beta})} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, the amount of pheromone on edge i, j isτ_{ij}. To control the influence of τ_{ij} used parameter is α. The desirability of edge i, j (typically $1/\mathrm{d}_{(}i,j)$) is $\eta_{(}i,j)$. To control the influence of $\eta_{(}i,j)$ used parameter is β.

c) Select best pheromone: - The machine consider as the optimal machine for task migration if its failure probability is least at the last stage. Given below equation is used to select the best machine. To select the best machine equation below is applied.

$$\tau_{i,j} = (1-\rho)\,\tau_{i,j} + \Delta\tau_{i,j} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where the amount of pheromone on edge i, j is $\tau_{i,j}$. The rate of pheromone evaporation is given by ρ. The amount of deposited pheromone is given by $\Delta\tau_{i,j}$.

$$\Delta_{i,j}^{k} = \begin{cases} \frac{1}{L_k} & \text{if ant k is the chances of failure} \\ 0 & Otherwise \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where L_k is the cost of the k^{th} ants tour (typically length). In this paper, the ACO algorithm is used because which has least complexity and least execution time. For the virtual machine migration, we use the algorithm which can migrate the task in which least amount of time that why we have used ACO instead of any other algorithm.

A. Pseudo Code of proposed Algorithm

Begin

Step 1: Get list of all VMs working on all hosts.

Step 2: Get resource utilization, failure rate, and execution time of all VMs.

Step 3: Get the list of over utilized hosts.

Step 4: Call MIMT algorithm to find the best VMs to migrate from the over utilized hosts.

Step 5: Get the List of best VMs for migration from each overloaded hosts.

Step 6: Built transition matrix for hosts available for migration and VMs needs migration.

Step 7: Repeat until all VMs on over utilized hosts are migrated.

7.1: Get the current resource utilization of particular VMs that needs migration .i.e. initialize the pheromone.
7.2. Consider the current utilization of the machine will be initial pheromone.
7.3: Find probability of overutilization of each host where machine has to migrate.
7.4: Compare probability of overutilization of every host with all the other hosts to update the pheromone for next iteration.
7.5 Update pheromones until best machine is searched for the task execution.
7.6: Select host with less probability of overutilization for migration i.e. updating the pheromone.
Step 8: return migration List.
Step 9: If CPU utilization of any host exceeds upper threshold limit go to step 5.
End

4 RESULTS AND DISCUSSION

The ACO is the algorithm which is applied for the task migration in cloud computing. The ACO works in the three phases for the selection of optimal machine to perform task migration. Proposed algorithm is tested in cloudsim that provide its performance described in Table 1.

TABLE 1: PARAMETERS USED FOR SIMULATION

Number of Hosts	**299**
Number of applications	**99**
Virtual machine size	**2500 Mb**
Host size	**16 Gb**
Host Processor	**Xenon**
Number of Data Centre	**5**

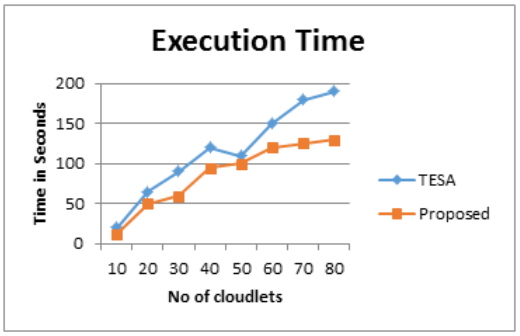

Figure 1 Execution Time

As shown in figure 1, the execution time of the proposed and existing algorithm is shown graphically. The graph shows the variation in the execution time correspond to different number of cloudlets. The execution time of the proposed algorithm is smaller than the existing one. This indicates the proposed ACO algorithm executes the cloudlets with in less time compared to the existing Three-threshold energy-saving (TESA) algorithm.

As shown in the figure 2 below, the energy consumption of proposed and existing (TESA) algorithm is compared graphically. To validate the results the cloudlets are varied in both algorithms.

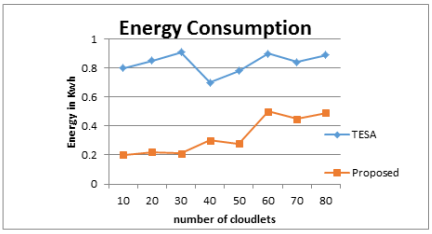

Figure 2 Energy Consumption

The Table 2, in the given below table the comparison between the existing algorithm and proposed algorithm has been done on the basis of its execution time and consumed energy. In the existing algorithm due to overloading, there is steadily increasing in the processing time and consumed energy.

TABLE 2 : COMPARISON TABLE

No of Cloudlets	Execution Time		Energy Consumption	
	TESA	Proposed	TESA	Proposed
10	20	12	0.8	0.2
20	65	50	0.85	0.22
30	90	60	0.91	0.21
40	120	95	0.7	0.3
50	110	100	0.78	0.28
60	150	120	0.9	0.5
70	180	100	0.84	0.45
80	150	100	0.89	0.49

5 CONCLUSION AND FUTURE WORK

In this paper virtual machine migration technique of reducing the energy consumption and CO_2 emission of datacenter along with virtualization are discussed for supporting green computing. We propose VMM technique in order to achieve maximum efficiency of data center and increase the revenue. The virtual machine migration is the technique which is applied to migrate the cloudlets of one virtual machine to another. In this paper, it is been concluded that due to virtual machine overloading execution time and space utilization is increased at a steady rate. The ACO algorithm is applied in this work, which will migrate the task of the virtual machine which gets overloaded to another virtual machine for the efficient execution. The performance of proposed algorithm is tested in CloudSim and it is been analyzed that execution time and space utilization is reduced after virtual machine migration. For the future we will find out to achieve better utilization of resources from a cloud with minimal energy consumption in data center resulting green solution and we will also consider the security of the cloud system.

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