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An Efficient Virtual Machine Migration Algorithm Based on Artificial intelligence

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Abstract: ***Cloud computing has brought a revolution in the domain of computing. Numerous algorithms are proposed to perform it more effectively. In cloud computing, Virtualization plays a significant role and entire performance of cloud depends on VM allocation and Migration. As many of energy are absorbed in this technology so different algorithms will be used to save energy and enhance the efficiency of proposed work known as Green algorithms. In this research work, a green algorithm for VM Migration is introduced using metaheuristic algorithm named as Genetic algorithm (GA). Every server has to perform different or same functions. A cloud computing infrastructure can be model as PM is a set of physical Servers/host PM1, PM2, PM3… PMn. The resources of cloud infrastructure can be used by the virtualization technology, which allows one to create several VMs on a physical server/host and therefore, reduces amount of hardware in use and improves the utilization of resources. The computing resource/node in cloud is used through the virtual machine. To address this problem, data centre resources need to be managed in resource -efficient manner to drive Green Cloud computing has been proposed in this work using Virtual machine concept with Genetic algorithm (GA). All the simulations have been carried out in CLOUDSIM environment and the parameters like SLA violations, Energy consumption and VM migrations along with their comparison with existing techniques will be performed.***

Keywords: Virtual machine, VM migrations, Green cloud computing, Genetic algorithm (GA)

1. INTRODUCTION

With virtualization, cloud computing can address the vast client base of heterogeneous computing need with the same type of physical infrastructure [1]. Resources of computer, storage resources and the different applications can dynamically provide charge as per use and later can be released if not needed. Such services are offered with an agreement i.e. SLA, which gives the user the desired Quality of service (QoS) [2].

Cloud computing is flexible and service based infrastructure with the support of multiple programming patterns. In order to fully understand the capabilities of cloud computing, cloud providers need to ensure that they can adapt to their virtual machine (VM) transport to meet different buyer prerequisites while keeping customers away from the basic data centre [3]. Virtualization applications dispense many comforts, including consolidation, migration. Cloud allows multiple services to be hosted on globally shared resource pools, where resources are allocated to on-demand services. It uses a virtualized environment to run the service, because there is no virtualized computing being inefficient and inflexible. In the past, many researchers have worked on energy-saving algorithms to reduce energy consumption [4]. Many algorithms have been implemented to conserve data centre power by shutting down or placing idle servers in the server's sleep mode. However, these technologies are not as effective as service performance degradation and inappropriate resource utilization. Some of the previous work includes the idea of developing energy-efficient algorithms for data centers and put forward a virtual machine placement algorithm for minimizing the migration (MM) by using host CPU utilization [5]. The algorithm outperforms other placement algorithms, but they do not take SLA parameters into account when selecting virtual machines for migration, which may be achieved by real-time migration. Most violations occur during real-time migration of virtual machines that affects SLA parameters such as availability, response time, throughput, network bandwidth, and so on. Therefore, it is necessary to develop a new method for SLA-aware energy-efficient algorithms for resource allocation in the data centre [6].

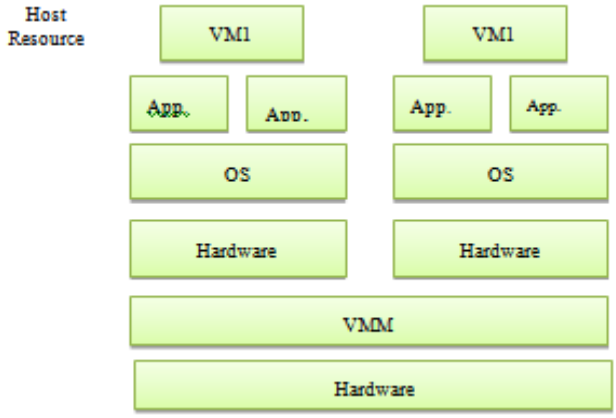

Figure 1 Virtual Machine Migration Architecture of two operating systems

Assuming that the data centre contains a number of physical servers with the resource capacity RC = {RC1, RC2, RC3…..RN} as the amount of capacity for each resource (CPU, memory, disk). There are a predefined set of VM types VT= {VT1, VT2, VT3, VT4…..VTN}. For

one period, the data centre receives Map Reduce jobs from multi users [7].

Given the set of VMs associated with each user along with their resource requirements, VM placement finds the most efficient packing recipes of these VMs on physical servers (PS) and is given by following:

$PS * \sum RC * \sum VT / \sum RC$

Resource allocation is one of the fundamental technologies of cloud-computing domain, which utilizes the computing resources like bandwidth, energy, and delay and so on, in the network to facilitate the execution of cumbersome tasks that require large-scale computation. Resource allocation is one of the challenges of cloud computing since end-users could easily access resources from anyplace and at any time [8]. In cloud computing paradigm, the main challenge is the allocation of several accessible resources between various end-users having varying requests of resources dependent upon their patterns of application usage [9].

VM placement and migration has always been a challenging task for the last couple of years. Whenever a physical machine is not able to fulfil the entire requirement of the virtual machine than there comes the requirements of the migration of the VMs or the borrowing spaces from other hosts [10]. In the same contrast, a lot of researchers have put their effort in order to minimize the SLA violation against different set of threshold values. Algorithms like Genetic; Particle Swarm Optimization has already being utilized in this scenario. The previous implemented algorithms are complex in nature and consumed a lot of time in order to find and allocate a physical machine due to which SLA (Service level agreement) is also violated [11]. As SLA violation increases, the time complexity also increases. Previous implemented algorithms has also not classified or verified the allocation process which again puts an add on in SLA violation.

The problem of the research work is to optimize the selection process of the physical machine for VM migration and to crosscheck the migration using ANN (Artificial Neural Network) [12]. The parameters of performance would be as follows:

i. SLA violation Vs Lower threshold
ii. Energy consumption Vs Lower threshold
iii. Number of migrations Vs Lower threshold

2. RELATED WORK

A lot of work has been done in the field of virtual machine migration by number of authors. Few of them are defined below:

Abdul Razaque et.al [2016], proposed a task scheduling algorithm using a non-linear programming model for separable task scheduling that assigns the correct number of tasks to each virtual machine. Based on this assignment, an algorithm for separable load scheduling is designed by considering the network bandwidth.

Dr. Amit Agarwal et.al [2014], proposed Generalized Priorities. The algorithm was used to effectively perform tasks and Comparison with FCFS and Round Robin Scheduling. The algorithm was simulated in the cloud Sim Toolkit and the results show that it provides better performance compared to other traditional scheduling algorithms. **Jichao Hu et.al [2015],** proposed resources in the cloud model and predicts the effect of the model time closer to the actual time. It could effectively limit the possibility of falling into the local convergence and shorten the time of the optimal solution of the objective function value, and more satisfy the user's needs. **Raja Manish Singh et.al [2014],** proposed different algorithms that were compared and studied Adaptability, feasibility, adaptability in the context of the cloudSim, after which the author is tried to propose a hybrid approach can be used to further strengthen the existing platform and so on. It can help cloud providers to provide better quality of the service. **FarhadSoleimanianGharehchopogh [2013]** talked about the security issues in cloud computing. According to the opinion, if the cloud computing services are going to be global, it should be taken care that they work in a better way everywhere like on mobile phones also as the mobile phones have applications to access everything. When the data is on a cloud platform, it is necessary to keep them in a safe way .The authors approach is only limited to keep the data on mobile devices which are related to cloud platform. **VahidAshktorab, Seyed Reza Taghizadeh [2012]** has discussed the advantages of the cloud platform and the security risks of keeping the data on a cloud server. In this research, authors have provided basic information about the security thefts of cloud server like SQL injection problem, DOS attacks and others. **Tao Lin et al. [2017]** proposed an iterative algorithm for solving the problem of multi-objective optimization. Authors adopted a Game Theoretical approach for managing the data traffic so that energy can be optimized. Authors worked with transport layer to form an energy efficient framework in cloud computing. **R. Singh and M. Agnihotri [2016]** discussed about the job allocation to number of virtual machines inside a cloud data center by using Map-K loop abbreviated as MKL which is a classical scheduling policy. By using the map, the jobs were assigned to the suitable Virtual Machines, and hence, generally job's waiting time and the response time get reduced. **Shi.J.H et.al [2011],** has studied cloud HPC resource planning. In this, author has proposed quArtificialitative application dependent instrumentation method to investigate multiple import artificial dimensions of a program's scalability. It has an ability to explore multi dimensions of a program. To demonstrate modelling and performance prediction processes, matrix multiplication application is used. **Gouzardi et.al [2010],** has solved resource allocation problem using SLA violations. In this, the upper bound of total profit is provided with the help of force-directed resource assignment (FRA) heuristic algorithm, in which initial solution is based on providing the better solution for profit upper bound problem. **Gaurav Dhiman et al [2009]** has focused on vGreen developed MPC balance algorithm that concentrates on CPU with the utilization of memory that decreases, amount of power save up to 15% to 20% of total power required. Power is directly propositional to energy so amount of energy also

got saved. In this, basically vGreen is used for energy efficient VM –management for linking it with VM scheduling and power management for higher performance.

3. SIMULATION MODEL

This work has dealt with the green cloud computing for energy reduction. Genetic algorithm has been applied for resource utilization on the basis of virtual migration. Different violations have been found out on the basis of neural network. Different parameters, like Task allocation, No. of jobs completed, accuracy and time consumption are used to check the performance of the proposed work. In the proposed work, the optimization during the Virtual Machine Migration process is achieved. For this purpose, the number of virtual machine migration, SLA Violation and Energy Consumption is measured. The Simulated environment is created for this process. In which Cloud sim environment is used. The number of Hosts and Virtual machines are Input from user. The various properties of Hosts and Virtual machines are measured like CPU utilization, Disk Allocation, Memory Allocation etc. Now start the process of Allocation of Virtual machines on Host. The Host that have more space, memory and disk are available for bidding the VMs. This allocation process is done through Neural Network Approach. According to this approach the different categories are created according to their properties and then allocate the VMs to Host that pass through those categories test. After that the load on each Host is calculated. If Host Load is exceeding from its original load capacity then migrate the Virtual Machines from that Host. For this purpose genetic algorithm is applied. During this process, the first step is to select the population for this purpose. Then Find the fitness function. If Host Load exceed from that Fitness value then apply crossover and mutation. At the end, Migrate Virtual Machine from that host has been calculated.

The methodology steps are defined below:
Step 1: Start and design the simulation work frame in CloudSim Environment with CPU, Memory and Disk Properties.
Step 2: Firstly, we Initialize VM and set their properties.
Step 3: After that, Initialize Hosts and define features for the Host
Step 4: For each VM in the allocation table at each host, Apply Neural Network Approach.
Step 5: To apply genetic Algorithm for Virtual Machine Migration if Load on Host exceed from its capacity.
Step 6: Evaluate the performance metrics.
Step 7: Stop

4. SIMULATION RESULTS

In this section various parameters and validation of the proposed work is evaluated to obtain the results and the comparison has been drawn with the existing approaches.

4.1 Simulated Parameters

The parameters that have been measured are named as SLA violation, number of migrations, energy consumption and are defined below:

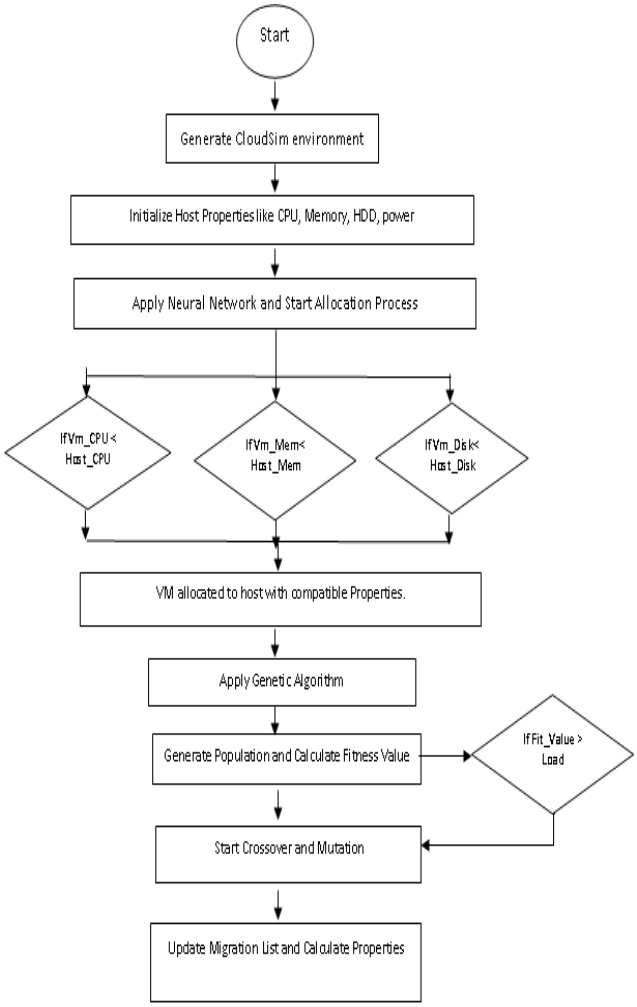

Figure 2 Proposed methodology flowchart

i. SLA violation
SLA stands for "Service Level Agreement". It is a commitment to service provider to the user. SLA can be called a violation for any reason, for example, if the job should be scheduled and it is non-scheduled.

ii. Number of migration
Live VM Migration comprises the Cost of RAM and Hard disk, so it is an expensive operation. It also comprises the CPU utilization, link bandwidth, downtime of services and total migration time, so one of our main objectives is to minimize the number of Migrations.

iii. Energy consumption
It is defined as the total energy consumed by each server within the system.

4.2 Scenario 1

The number of Host are Fixed to 10 and Virtual machines varies from 20 to 200. The results are calculated below:

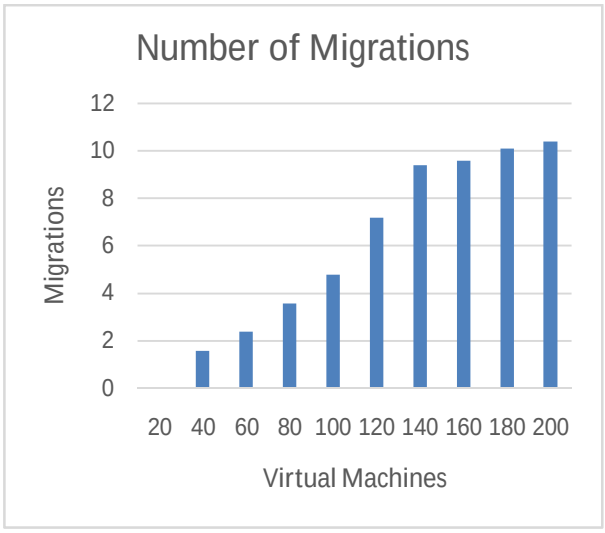

Figure 3 Number of migrations w.r.t VMs

The Average percentage of number of Migrations is increased as the number of Virtual machines as shown in fig above.

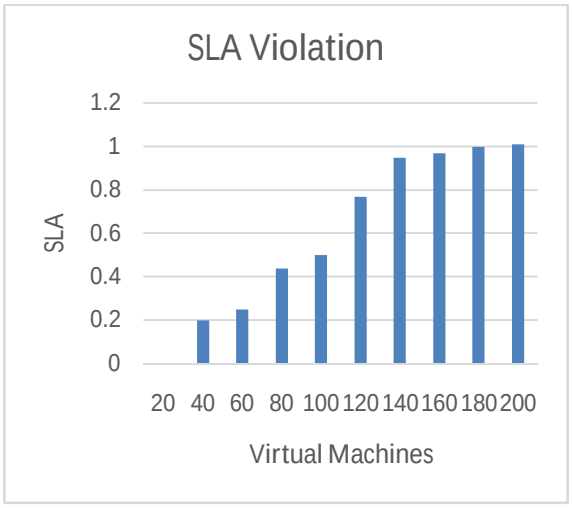

Figure 4 SLA violation wrt VMs

The SLA Violation is increased with increase in number of virtual machines as shown in figure above.

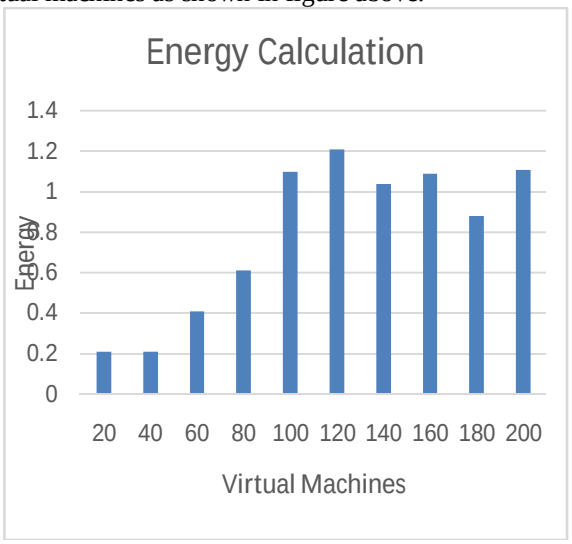

Figure 4 Energy consumption wrt VMs

The above fig. represents the Energy is violated with increase in number of migrations and virtual machines.

4.3 Scenario 2

In this scenario the Host are varies from 10 to 100 while the Virtual machines are fixed to 200. The results are shown below.

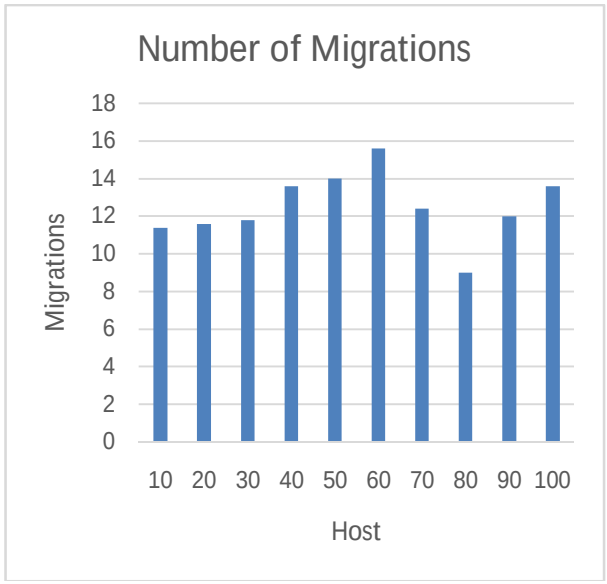

Figure 6 Migrations w.r.t Host

The above fig represents the Number of migrations with respect to Host. X-axis represents number of hosts and y axis represents number of migrations.

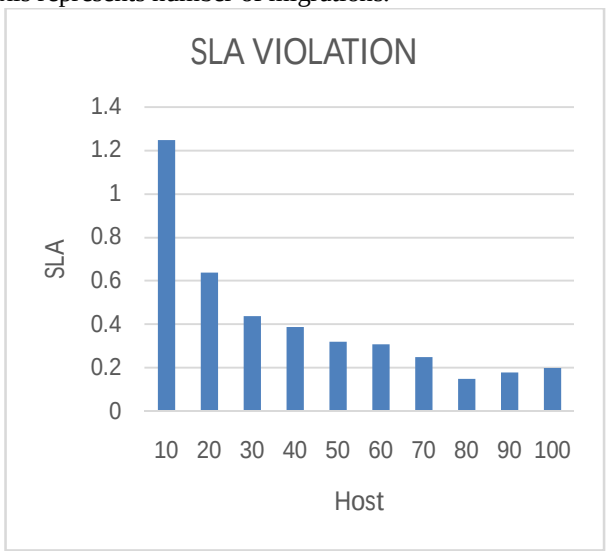

Figure 7 SLA violation w.r.t number of host

The above fig represents the SLA violation is decreased with increase in number of Host.

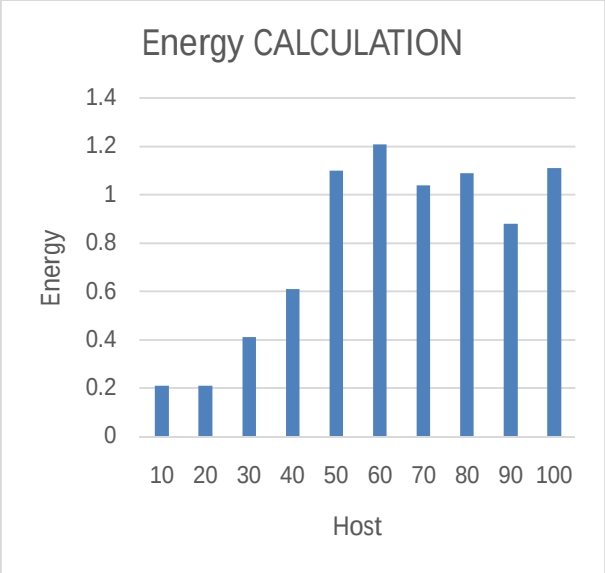

Figure 8 Energy calculation w.r.t host

The Energy is violated with Variation in number of Host in the given simulated environment is shown in above figure.

4.3 Comparison of Existing Work with Proposed Work

The Comparison of the proposed Work is with the firefly approach for optimization of virtual machine migration is shown in this work. The results prove that our proposed approach gives better results as compare to previous approach.

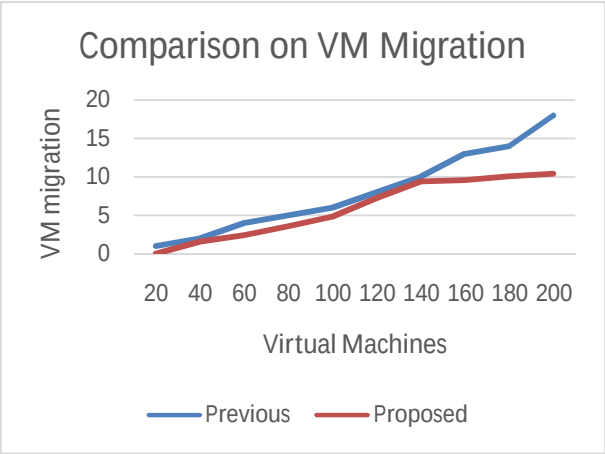

Figure 9 Comparison of VM migration for existing and proposed work

The above fig describes the proposed number of migrations are less as compare to previous one. Here blue line indicates the value of VM migration for existing work and red line indicates the value of VM migrations for proposed work.

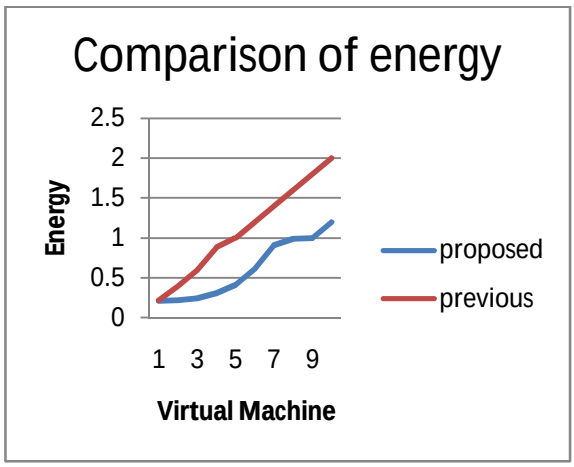

Figure 10 Comparison of energy with proposed and existing work

The Energy Calculation during this process is low in the proposed work as compare to previous approach as shown in above fig. It is clear from the above graph that the energy consumption of proposed algorithm is less than the previous algorithm.

5. CONCLUSION

In this research work, a Genetic Algorithm (GA) optimization technique is proposed along with artificial neural network for VM migrations in cloud computing.GA algorithm is used for selecting the number of possible physical machines and the selection of appropriate machine from the output of GA algorithm has been done. ANN has been used for allocating virtual machine. As explained in this research, VM Migration is an NP-Hard dilemma and this problem can be resolved in less time using some meta-heuristic algorithm. All such implementations can be adequately simulated using a tool named CLOUDSIM. And GA has several alternatives; multiple variants may be applied to VM migration problem. In this research work, Genetic algorithm (GA) is applied and Performance of all these metrics have been calculated in terms of No. of VM Migrations and Energy consumption. It is concluded that the proposed GA-VMM perform better. The load balancing problem is also solved in this approach by migrating number of virtual machines. The resulted parameters are calculated at the last to check the optimization.
In future to select the physical machines for VM migration different optimization algorithms like genetic algorithm along with particle swarm optimization (PSO) can be used in hybridization. The migrations can be checked by using SVM in conjunction with Fuzzy logic

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