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Efficient Resources Allocation and Energy Reduction with Virtual Machines for Cloud Computing

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Abstract: ***Cloud computing is an internet provisioned method for sharing the resources on demand by network management, storage, services, applications and the serves that necessitate management optimal effort. VMM (virtual machine migration) plays a major role in enhancing the resource utilization, application isolation, processing nodes, fault tolerance in VMs for enhancing nodes portability and for maximizing the efficiency of physical server. For balancing the clouds with resources for the enhanced performance, varied users are served with application deployment in the cloud environment is considered as the major task. The user can rent or request the resources when it becomes significant. The emphasis of this paper is on different energy VM energy efficient module as per machine learning methods. While allocating the VMs to the host machines, MBFD (Modified Best Fit Decreasing) is considered and the classification of host machine capability such as overloaded, normal loaded and underloaded is executed according to SVM (Support vector machine). SVM is utilized as a classifier for analyzing the MBFD algorithm and for the classification of the host as per the job properties. In this procedure, the numbers of jobs that are not allocated are examined via simulation which is computed by means of time consumption, energy consumption and a total number of migrations.***

Keywords: ***Cloud computing, Virtual machine, Resource allocation, VM allocation, MBFD, SVM, Time consumption, Energy consumption, Total number of migrations evaluation***

I. INTRODUCTION

Due to the less availability of the physical resource, allocation of resources has considered a complex task for cloud service providers. As cloud computing is a multi-tenant model, varied users request cloud resources. Therefore, the providers of cloud services should decide how many virtual resources to build according to the cloud user's request. The concern is about the "VM (Virtual machine)" that should be integrated with "PM (Physical machine)" so; VM-PM mapping technology must be considered [1]. The main objective of a cloud service provider is the enhancement of profits and resource utilization, while the aim of cloud users is to minimize payments by renting resources.

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Various parameters need to be considered when allocating resources. While allocating resources to cloud users, it should avoid over-supply and over-utilization (underutilization of resources due to insufficient supply (waste). Varied parameters considered in resource allocation are; response time, performance, availability, reliability, security, throughput, and so on [2]. The paper has been organized is into five parts. First part has already defined the context of the allocation of resources in cloud computing. Subsequently, the methods undertaken for the analysis of the concept are defined, viz. Green cloud computing, energy management in cloud, virtualization, and VMM. Later, the proposed architecture is defined which describes the flow of the work for execution in the form of a flowchart. Fourth part consists of results and discussion that defines the results being obtained after the simulation. In the end, the conclusion is defined following the references.

II. RELATED WORK

This section describes the research and the theories of VM by means of resource allocation and energy reduction to indicate to fill a perceptible hole in the existing hypothesis. The existing work is shown in tabular form in Table 1.

Table 1. Tabular Representation of Existing Work of Vm in Cloud Computing

Authors and year	Proposed work	Objective	Outcomes
Gai et al., [2016]	Dynamic energy aware cloudlet based MCC structure.	The main purpose of the study is to decrease the exact usage of energy and minimize latency delay.	The execution of the suggested work on the basis of energy utilization and total cost has been measured.
Chang et al., [2013]	MCC system for an efficient VM placement.	The aim of the study is to diminish the response time of the cloud service to a great extent as feasible so as to provide better quality. It is a noisy and less powerful experience for cloud users using Wireless networks.	The proposed VM allocation algorithm considers network features, especially network bandwidth and network latency while choosing a cloud to compute server to host a newly created VM. Simulation results show the effectiveness of the projected algorithms of VM placement on the basis of cloud service duration.

Magura walage et al., [2014]	Mobile cloud computing by utilizing a middle layer that comprises of cloudlets.	The aim is to design an offloading algorithm to generate a decision that when the cloudlet is to be offloaded.	The outcomes in terms of response time, as well as energy consumption, have been evaluated.
Liu et al., [2018]	An algorithm of ant colony optimization for resolving the problem of VM placement. ACO technique has been applied to solve the issues with variable sizes of VM in the cloud environment from homogeneous to heterogeneous servers.	In this research, to reduce the amount of active physical servers, evolutionary computing is practiced on VMP. It is done to save energy with the help of underutilized servers.	The proposed technique saves energy according to the number of resources.
Gupta et al., [2018]	Factor for resource usage to situate VM on the relevant PM to effectively use the resources. To achieve second objective authors have proposed the use of existing asset resources that can successfully understand the uneven use of resources in active PMs.	The initial purpose of this paper is to reduce the energy consumption of the IaaS cloud by decreasing the quantity of active PMs. The second purpose is to reduce uneven access among efficient PMs.	Performance in terms of power consumption, the number of the active physical machine, resource wastage and CPU utilization has been measured on the basis of the quantity of Amazon EC2 instances.
Yadav et a., [17, 2018]	Three dynamic models, named as gradient descent-based regression, maximize correlation percentage along with bandwidth-aware selection policy used for reducing energy utilization along with SLA violation.	The main purpose of this paper is to reduce energy utilization along with the SLA violation.	Minimize the utilization of energy along with maintenance of the requisite performance in the cloud data center via a CLOUDSIM simulator to approve the proposed algorithms.

III. MATERIALS AND METHODS

In this research, an improvement in energy consumption through VM migration for task allocation in cloud computing is considered. The methods/techniques considered to analyze the concept are defined below:

1.1 Green cloud computing

Green computing is an art that promotes the efficient use of computing resources. The main objective of green computing is the promotion of environmentally friendly products that are easy to recycle [3]. Green computing can skilfully use computing resources if it is used efficiently and used effectively, it will be a revolution. The goal is the same as green chemistry; it reduces the use of harmful substances and maximizes energy efficiency while the life of the product [4]. The corporate IT function is driving an exponential increase in energy demand, accompanied by corresponding increases in costs.

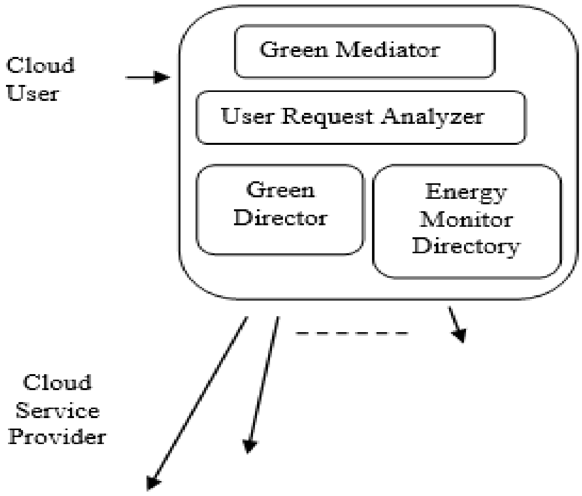

Figure.1 Green Cloud computing architecture

An architecture of green cloud computing is shown in Fig. 1. Green cloud computing is used for the reduction of the energy consumption of computing resources. With green computing, computer equipment could be effectively used in the environment to attain major goals like energy efficiency and to increase resource consumption [5]. In order to make cloud computing eco- friendly, varied methods, like, DVFS (Dynamic-Voltage-and-Frequency- Scaling-Technology), are considered to increase the speed of computing devices and different optimization and classification algorithms are used [6].

1.2 Energy management in cloud computing

Because of cloud computing, huge data centers with thousands of computing nodes consume an excess of electrical energy. The most significant reason for this immense energy consumption is not just because of more amount of computing resources in large-scale data centers and power inadequacy of these resources but more significantly, it is because of the inefficiency of resources usage [7].

As per data of around 5000 servers in six-months, the usage of servers is only 10-50% of the ability. Idle servers exhaust approximately 70% of the peak power.

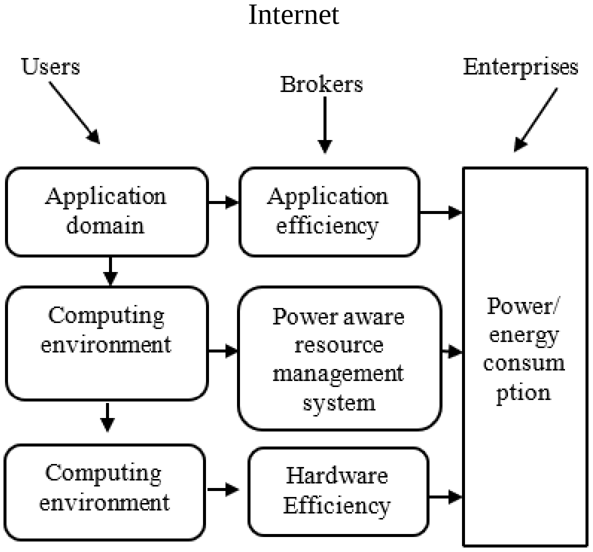

Figure.2 Energy Consumption at Different Levels in Computing Systems

In addition, to keep the server under-utilized is an effect from the energy consumption and over-utilized servers aspect for consuming a large amount of energy as compared to normal servers that may enhance SLA (Service level agreement) violations [8]. Virtualization is considered as the technique in cloud computing that can use resources effectively and extensively.Fig.2 depicts energy consumption at a different level in the cloud system.

1.3 Virtualization

Virtualization is a technology that allows a single physical instance of an application or hardware resource to be shared among multiple organizations or tenants (customers) [9]. Virtualization allows cloud providers to create multiple virtual machine instances on a single physical server. Control of hardware resources, allocation of resources, OS processing etc. are considered as the major VMM responsibilities [9]. The concept has been shown in the diagrammatical form in Fig. 3.

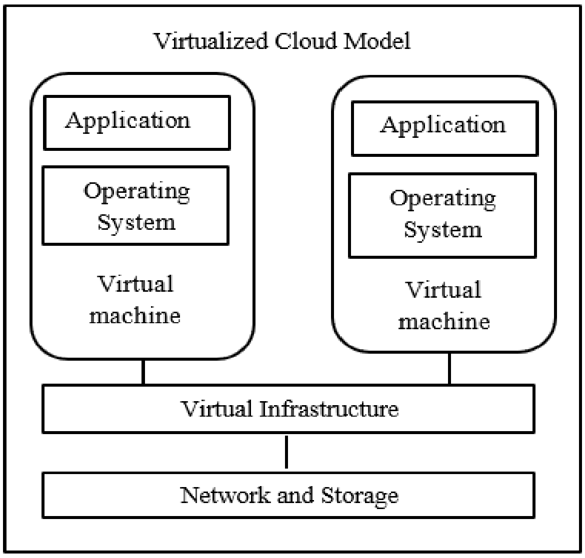

Figure.3 Virtualization in cloud

Virtualization is one of the effective solutions for minimizing power consumption, to reduce the hardware and IT cost while increasing the utilization of the hardware and maintaining energy efficiency. Xen, Oracle VirtualBox, VMware ESX with "Kernel-based Virtual Machine (KVM)" are extremely considered technologies on virtualization having common features [10].

1.4 VMM (Virtual machine migration) in cloud computing

In VM migration, a virtual machine is transferred from one server to another with no interruption for the applications being executing. VM migration technology assists for the achievement of resource management objectives; such as: Minimizing energy consumption, Load balancing, Fault tolerance, Resource sharing, Mobile computing, and System maintenance [11]. VMM is known as the technology for migrating different VMs with their connected jobs/applications from the primary machine to another primary machine in similar or different data centers [12]. VM Migration has been shown in Fig. 4.

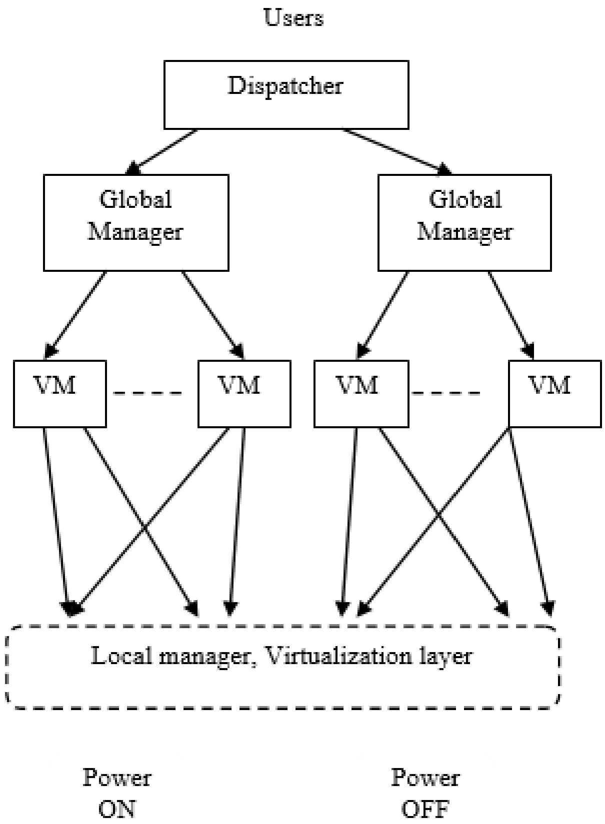

Figure.4 VM Migration Process

1.5 MBFD (Modified Best Fit Decreasing) algorithm

In MBFD, for every VM in the sorted list, if the host has adequate resources with VM that is if the hosts examine the demands of VMs, the approx power consumption would be VM configuration power consumption that could be added to the host execution power.

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Less power is already set that could be random or VMs utmost utilization [13]. The subsequent constraint defines that if the VM is allocated than less power consumption will be power computed at that definite iteration. MBFD algorithm is defined below:

Algorithm 1: Modified Best Fit Decreasing (MBFD)

Input:host_list, VM list
Output: Allotment of VMs
Vm_list.sort decreasing utilization ( )
For everyVm in VM list do
minPower← max
allocated host← $null$
for every host in host list do
if host consists of adequate resource for VM then
power←estimate power (host, Vm)
If power<manpower then
Allocate host←host
min power←power
if Allocated host≠null then
Assign VM towards the allocated host
Return Allocation

1.6 SVM (Support Vector machine)

SVM is a supervisory machine learning algorithm that can be utilized for classification or regression problems, data analysis, and pattern recognition. It uses kernel techniques to convert the data, and on the basis of these conversions; it finds the best boundary between possible outputs [14]. Fig.5 shows the diagrammatical representation of SVM. Classification data is considered as one of the major parts of machine learning. SVM creates a hyper-plane among data sets for indicating which class it is designated to [15]. The objective is to train the machine for understanding the structure from the data and map with the accurate class label. For enhanced results, hyper-plane is considered as the closest training data point for any class. When the amount of tags increases, then, it is considered as binary classification.

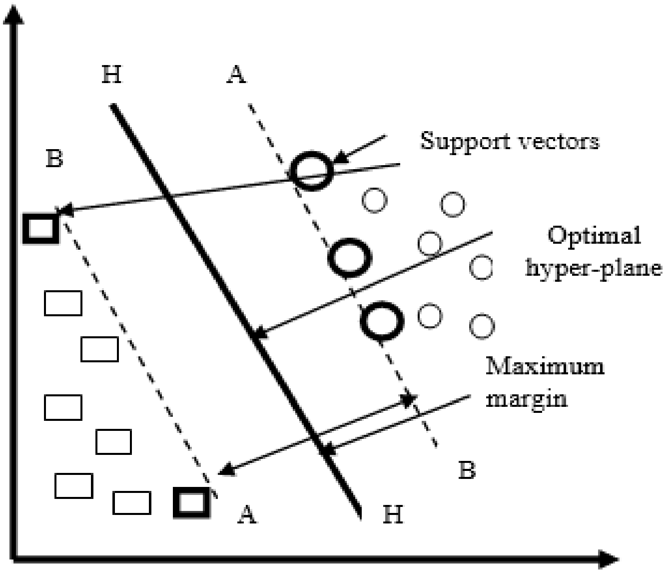

Figure.5 SVM Principles

When there are more than two categories, these problems are called multi-class classification. In this research work, SVM is used to migrate the VM to the specific PM with less energy consumption. As per the energy consumption parameter, SVM classifies between overloaded and under-loaded host machines. Thus, it helps to migrate VMs from over-utilized to underutilized hosts.

IV. PROPOSED ARCHITECTURE

In the proposed work, an energy optimization model is presented with the concept of VMM in cloud computing as shown in Fig. 6. When VMs are allocated to host machines during job scheduling process using MBFD technique, the host machines become overloaded, normal loaded or underloaded. In such a case, an allocation algorithm is required which can effectively migrate the virtual machines to exact physical machine in an efficient manner with low energy consumption. SVM technique is used to classify the hosts in overutilized plus under-utilized according to the energy consumption parameter. VMs are migrated from over-utilized hosts to underutilized host to maintain the energy consumption on host machines with SVM training and classification module. The steps taken to execute the concept are defined below:

Step 1: Input number of Virtual Machines and number of Hosts.

Step 2: Generate VM List and host List with their properties like CPU utilization, power, and resources. In this research work, virtual machine list varies rom 80 to 260 with the interval of 20, host list varies from 10 to 28 with an interval of 2 and CPU utilization varies from 0 to 5500.

Step 3: Apply the MBFD algorithm to sort vmList in descending order according to CPU utilization. For every VM, MBFD verifies two conditions (i) if hosts have enough resources for running the current VM then evaluate the generated power by the host for the current VM. (ii) If the available power is less than maximum power, the current VM is assigned to the recognize host.

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Step 4: Allocate VMs if host resources are available for VMs.
Step 5: Apply the SVM technique on the hosts and save training data. SVM is trained as per the energy consumption parameter.

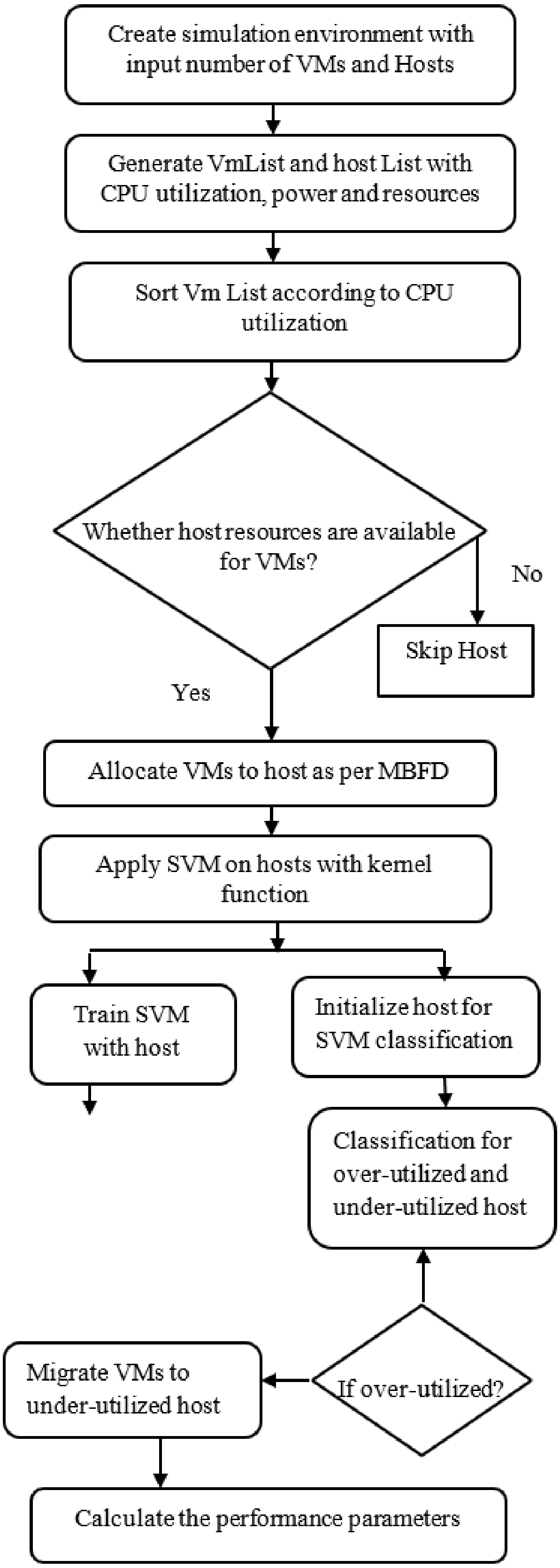

Figure.6. Proposed workflow

Step 6: SVM perform classification of over-utilized and underutilized hosts by using the kernel function of SVM.
Step 7: Migrate VM from over-utilized host to underutilized suitable host.
Step 8: When the energy consumption of the hosts gets balanced, then the performance parameters are calculated.

V. RESULT AND DISCUSSION

During the placement process of VMs, the allocation of VMs to their respective host according to the resources (CPU utilization, Memory) as per the MBFD algorithm is taken place. After that, VMs are migrated from over-utilized host towards under-utilized host; a number of migrations would be less by using SVM technique with kernel function. Below the results obtained after the evaluation are described:

Table 2. Time Consumption Evaluation

Number of iterations	Time consumption with optimization (msec)	Time consumption without optimization (msec)
1	12	19
2	15	20
3	11	17
4	16	15
5	13	16

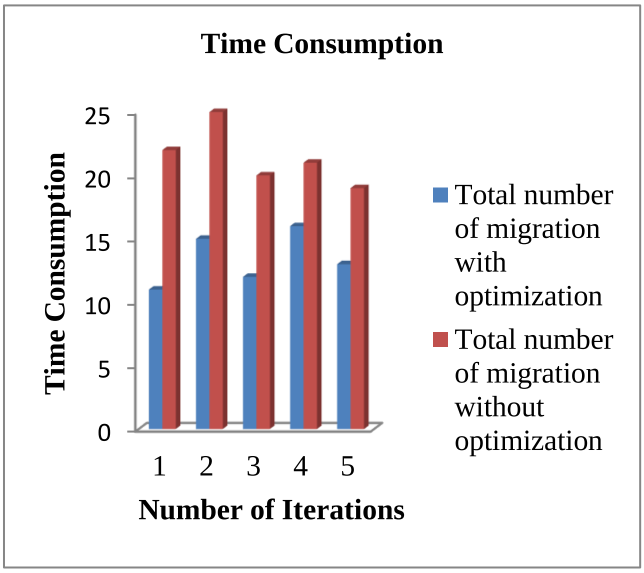

Figure.7 Time Consumption

Table 2 and Fig. 7 define the evaluation of time consumption. The analysis is conducted on the basis of proposed optimization algorithms that is SVM and MBFD and without optimization algorithms. As depicted in the figure, X-axis defines the number of iterations taken and Y-axis defines the obtained time consumption values.

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Red bar in the graph shows the results of time consumption with optimization and green bar depicts the results of time consumption without optimization.
The computation is in msec. The mean value for time consumption with optimization is 13.4 and the mean value of time consumption without optimization is 17.4.

Table 3. Energy consumption evaluation

Number of iterations	Energy consumption with optimization (mJ)	Energy consumption without optimization (mJ)
1	42	51
2	40	54
3	50	60
4	45	59
5	47	56

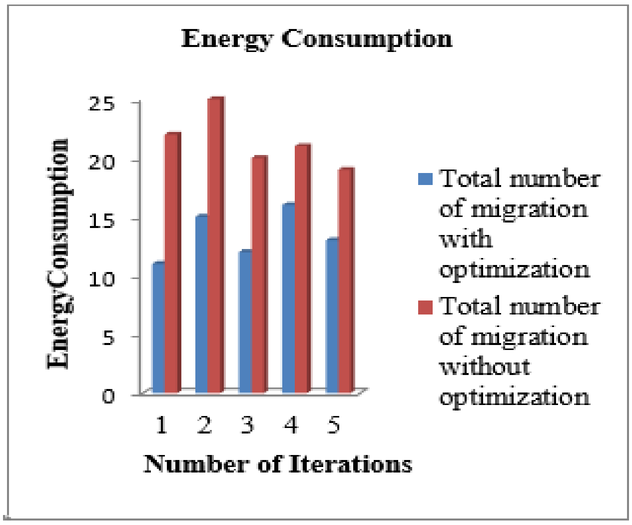

Figure 8: Energy Consumption

Table 3 and Fig. 9 define the evaluation of energy consumption in mJ. The analysis has been computed according to the proposed optimization algorithms; SVM and MBFD and without optimization algorithms.
As depicted in the figure, X-axis defines the number of iterations taken and Y-axis defines the obtained energy consumption values. Red bar in the graph shows the results of energy consumption with optimization and green bar depicts the results of energy consumption without optimization. The mean value of energy consumption with optimization is 44.8 and the mean value of energy consumption without optimization is 56.

Table 3. Total Number of Migrations Evaluation

Number of iterations	Total number of migration with optimization	Total number of migration without optimization
1	11	22
2	15	25
3	12	20
4	16	21
5	13	19

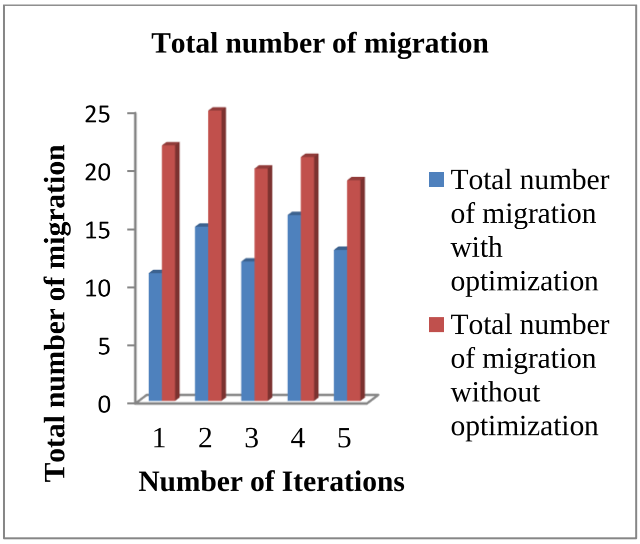

Figure. 9 Total Number of Migration

Above Table 4 and Fig. 9 defines the evaluation of a total number of migration. The analysis has been computed on proposed optimization algorithms that is SVM and MBFD and without optimization algorithms. As depicted in the figure, X-axis defines the number of iterations taken and Y-axis defines the obtained total number of migration values. Red bar in the graph depicts the results of the obtained total number of migration with optimization and green bar depicts the results of the obtained total number of migration without optimization. The mean value of the obtained total number of migration with optimization is 13.4 and the mean value of the obtained total number of migration without optimization is 21.4.

VI. CONCLUSION

This research has presented an energy-optimized model with VM allocation policy by MBFD and SVM algorithm. The allocated VMs are examined by the SVM algorithm. MBFD algorithm considers the power allocation scheme and therefore, updates about the less power allowed for migration or allocation of resources on VM. The simulation has been conducted on CLOUDSIM 2.0 tool integrated with Net Beans. The work has been analyzed with parameters like Time consumption, energy consumption and a total number of migrations. The mean value of time consumption with optimization is 13.4 and the mean value of time consumption without optimization is 17.4. So, it can be seen that by using SVM and MBFD, time consumption came out to be less. The mean value of energy consumption with optimization is 44.8 and the mean value of energy consumption without optimization is 56. The consumption of energy is less is reduced when the optimization algorithms are utilized.

The mean value obtained for total number of migration with optimization is 13.4 and the mean value obtained for a total number of migrations without optimization is 21.4. With the optimization algorithms, a total number of migrations came out to be less.

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That means, the system being proposed is more efficient in terms of migrations. It has been estimated that research has outperformed by utilizing optimization algorithms.

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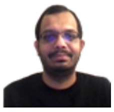

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