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A New Method of Scheduling Tasks in Cloud Computing

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Abstract

Task scheduling and energy efficiency seem to be the necessary design requirements for current computing systems in recent years. It extends from single servers to data centers and clouds, as they consume large amounts of electrical power. For this reason, an effective energy management for cloud data centers is essential. At present, many researchers have focused and implemented biologically-based calculations as a desirable paradigm for addressing heterogeneity and the growth of energy crisis with skill and no added complications. Similarly, for our work, we selected biological behavior of Korean insects and chosen FFO-based migration method. The benchmark for choosing it is the rapid convergence and global optimization.

In addition, the notion of limiting the overall increase in power increases with respect to new VM migration and never before used for the VM migration method. In the energy consumption scenario by VM migration, a FFO-based linear model is formulated that executes an FFO algorithm that is able to solve the power consumption problem with the firefly attraction feature. In other words, this paper proposes a virtual energy virtualization migration technique that emits live VMs from an active node to another active node. The proposed technique uses the biography-inspired worn-out optimization technique to find the best node for over-migrating VMs to achieve energy efficiency in cloud data centers. This optimizes energy efficiency through the optimal migration of VMs, thereby improving the level of resource utilization.

Keywords: Virtual Machine, Scheduling, Cloud Computing, Energy Consumption

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1. Introduction

An architecture is presented for managing cloud energy consumption, as well as several resource allocation policies and scheduling algorithms. To determine the optimality of resources, a high limit of optimality and a low optimal limit are usually determined. If the use of a resource is so high that the optimal resource passes through the high level of efficiency, then the source is out of optimal mode and it is possible that the source is not responding to requests or the response time to requests is increased. In research, heuristic methods have been compared to work scheduling in the cloud environment. These methods [1]are PSO algorithms, genetic algorithms and modified PSO algorithms for efficient timing. In all of these three algorithms, the goal is to produce an optimal timetable in order to minimize the completion time of the work. [1-3]

A load balancing strategy is also proposed using genetic algorithm. This algorithm improves load balancing in cloud infrastructure while attempting to minimize the length of tasks given. The simulation results for a typical sample application indicate that the proposed algorithm performs better than existing methods. In the paper, Optimal Source Rendering Algorithm (RPOA) is an algorithm based on the PSO and implemented to find an optimal solution for allocating resources with minimizing the time of the results and showing that using the PSO, the distribution map is better provided, because the number of replicates that reaches the nearest best desirable value is reduced. Data centers are not only cost-effective for maintenance, but also harmful to the environment. [4-9]

Cloud service providers have found that their profits have dropped dramatically with rising energy costs. The increasing pressure from governments in the world to reduce carbon emissions, which has a huge impact on environmental pollution, is also due to the cause. For example, the Japanese government has created a council to address the need to increase the energy supply of data centers. In this regard, processing service providers, a global green network consortium, have been developing energy efficiency in data centers and minimizing its environmental impacts, as energy costs increase, the amount of access to it is also reduced Finds. Therefore, it is necessary to shift focus from efficiency to focus on optimizing energy consumption, where the performance level is acceptable.

Despite the many studies carried out in this area, there is still scope for a study of the research done in this regard and finding their shortcomings or better methods, and thus better and more accurate results can be obtained. Found. [10-12] The application of cloud computing in the field of energy improves the environmental impact of energy activities. The environmental benefits of the cloud can also be applied in processes such as hydrofracking, which complies with the company's environmental processes in terms of ensuring the quality of drinking water

[1] This is a global minimization method which can be used to solve problems with a point or surface in a n-dimensional space.

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and the non-release of polluted gases and air. Industry activists use cloud technologies to improve the speed and accountability of managing major engineering operations.

This commitment often involves the use of a combination of cloud and mobile technologies to help improve the functionality of remote equipment and better manage corporate assets and reduce waste of resources. [13] In addition to all of these benefits, cloud computing helps companies reduce the environmental outcomes and reduce energy consumption. These efforts include the realization of virtualization and consolidation of infrastructure and the provision of applications and processes in the form of various services in order to reduce energy consumption, costs and increase job opportunities.

As mentioned, reducing energy consumption is one of the major challenges in cloud computing. So cloud service providers are heavily under pressure to reduce energy consumption. It should be noted that the goal is not only to reduce energy consumption. Instead, it is necessary to take into account environmental regulations and conventions between users and service providers. Therefore, the design of data centers has recently been considered with this approach. This issue can be examined in different ways. Energy consumption is not the only problem, but the huge amount of carbon it enters into the environment has added to the problems. Meanwhile, this increase in energy consumption has a direct impact on the cost of users.

Meanwhile, as one of our assumptions in this report, we focus solely on the power consumption of the processor for ease of use. Because among cloud computing such as processor, RAM, storage, storage and ..., the most energy consumed by the processor.

2. Conducted Works

Hien Nguyen et al., In 2009, began to manage virtual resources on cloud infrastructure to manage automated resources and control virtual environments, which separated resources from dynamic location of virtual machines. In fact, this global optimization manager optimizes the degree of SLA4 and operational costs, and uses a tight programming to solve the optimization problem. [14]

Yang Hu et al. (2009) provided resource-efficient cloud computing with efficient interactive performance evolutionary classes to determine the minimum number of servers required for SLAs. For both classes, the probability of a response time smaller than x is considered to be y. Two server allocation strategies are used, one is shared allocation and the other is an exclusive allocation. The FCFS scheduler determined an allocation strategy for distributing response time to develop an innovative algorithm that required the least number of servers. This algorithm was used in operational conditions and yielded favorable results [15].

Guiyi Wei et al. (2010) presented a game theory approach for allocating resources to cloud computing services. The purpose of this research is to solve the quality of service problem by

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allocating limited resources. Service applicants will be asked to provide their required parallel resources to solve their complex parallel computing problem. In this research, game theory has been used to solve the resource allocation problem and an appropriate two-step solution has been proposed. First, each client independently solves its problem without considering the allocation of resources. An appropriate binary programming method is proposed for independent optimal solution. Second, an evolutionary mechanism has been designed that changes the strategy of sharing the initial solutions of different customers. The overall result is that a suitable solution can always be found. [16]

Onat Yazır et al., In 2010, allocated dynamic resources for cloud computing using multi-criteria distributed analysis. In this research, a method for managing autonomous resources in cloud computing is proposed, and contains two-stage. First, a distributed resource management architecture divides into independent tasks, each of which is executed by agent nodes that are physically connected to the data center. Second, automatic agent nodes are configured using several methods of decision analysis using the PROMETHEE method. The simulation results show that the proposed method is flexible. [17]

Linellin et al in 2011 allocated resources to provide services in cloud computing environments. These resource allocation algorithms for SaaS1 provide the infrastructure cost to be minimized. Designed algorithms are a surefire way that enables SaaS providers to manage client changes, map client requests to infrastructure layer parameters, and run virtual machines. This research analyzes and validates the algorithms for minimizing the costs of SaaS providers in the cloud computing environment. [18]

Arfeen et al. (2011) presented a framework for resource allocation strategies in the cloud computing environment, and a method for evaluating network resource allocation strategies in the cloud computing environment is proposed and attempts to optimize awareness and consistency Network resource allocation strategies focus. A framework for allocating network resources in cloud computing is based on active metrics. Network topology, taking into account traffic and changing the optimal criterion in accordance with the user's dynamic needs (plays a major role in determining the Internet architectures and protocols and shaping resource allocation management strategies in cloud computing) The most important results of the research. [19]

Abirami introduced a linear timing strategy for allocating resources in the cloud in 2012. The timing of resources and tasks are separately answered, including waiting time and time. In this research, a linear scheduling algorithm for scheduling tasks and resources, called LSTR, is designed that performs task scheduling and resources in a timely manner. Here is a combination of Nimbus and Cumulus services to create a service provider. IaaS Cloud environments and KVM / Xen virtualization have been used along with LSTR timing to allocate resources and maximize operational capability and resource utilization. [20]

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In 2013, Xiao et al. Assumed the allocation of dynamic resources using virtual machines for cloud computing environments. In this research, a system that uses virtualization technology to allocate dynamic data center resources based on application demands and service resource optimization. In this research, the concept of Skewness is introduced as a negligible measure in exploiting multidimensional resources in the service. In this research, a set of innovations to prevent overhead in the system has been effectively developed to be used in energy storage. The experimental results show that the proposed algorithm has reached optimal performance [21].

In 2014, Maguluri et al. Reviewed optimal allocation algorithms in cloud computing clusters and provided a possible model for tasks (requests like CPU, memory and storage space) in cloud computing. The proposed model can split the source allocation problem into two balancing and scheduling problems and examine the join-the-shortest-queue and power-of-two-choice algorithms with maxweight scheduling algorithms. This research shows that the algorithms optimize the operational capability and limit the optimal queue length in heavy traffic [22]

Wenhong Tian in 2016 presented a tool for modeling and simulating the real-time allocation of virtual machines in a cloud data center. An innovative method for dynamically scheduling resources in a cloud data center that has runtime limitations on RMs and PMs was applied. This method focuses on timing simulation in the 1IaaS layer. Simulations indicate that the multidimensional information source of real-time design and implementation has been shown to improve the results compared to the previous methods. [23, 25, 28]

Stefano Marrone et al., In 2017, dedicated automatic resource allocations to high-availability cloud services and devised a method to support cloud agents for an optimal configuration of dependency on cloud-based applications that require high security. This method uses the principles of the UML axis model and the networks of the city to store, analyze and optimize the configuration in the cloud space. [24 , 26, 27]

2- The Proposed Method

Primary Population:

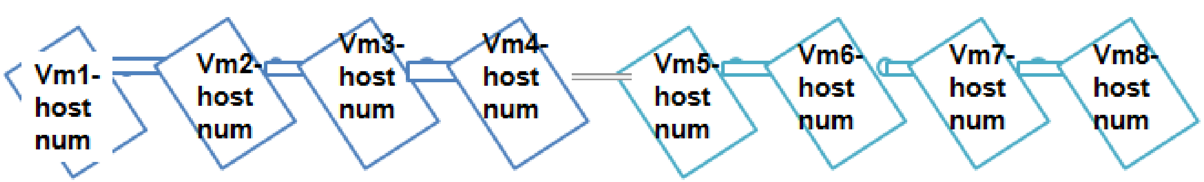

Figure 1: Proposed Chromosome String

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The above figure is an instance of a population group or the same chromosome. It produces 200 chromosomes that randomly adjusts the location of the vm onto hosts. Each chromosome is a solution that randomly assigns virtual machines to servers.

Accordingly, we generate a population of 200 strands (chromosomes) that randomly assign each virtual machine site (vm) to host (hosts). We select each chromosome with a length of 1052. 1052 is the number of virtual machines we have to offer to 800 hosts. Each gene takes up one of 800 servers in a way that minimizes energy consumption. So, we consider each chromosome as a single-row array of 1052 columns. Each node specifies which machine is deployed on which host. So any gene or gene in the genetic expression is the physical machine number. For example, in the first layer, if the value is 275, it means that the first virtual machine is located on the 275M server. Each virtual machine can only be on one host at a time. On the other hand, each host has a limited capacity.

We apply these conditions to the production of primary populations so that our population is well placed.

We repeatedly changed the number of repetitions and the best result was repeated to 1000. Therefore, each 200 chromosomes will be updated 1000 times and will be optimized during the steps of the genetic algorithm (evaluation-combination-mutation).

Evaluation function: Σ Power (cromosome), first, the host energy is evaluated and then the total energy of the hosts of a string is calculated. At the end, the energy of the strings is compared to the minimum energy strand.

In this algorithm, using a table in the paper, we evaluated two of the cloud computing pioneers, namely Buyya and Belaglazov, to select the function. In the table below, given the two types of processors used in cloud data centers and used in simulations of this model, in the first line, the load on the server is expressed in percentages, and in the row The second and third consecutive energy consumption of these processors is expressed in terms of workload.

Server	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
HP ProLiant G4	86	89.4	92.6	96	99.5	102	106	108	112	114	117
HP ProLiant G5	93.7	97	101	105	110	116	121	125	129	133	135

Table 1: Power consumption of processors according to workload

The specifications of the two processors are as follows:

HP ProLiant ML110 G4 (Intel Xeon 3040, 2 cores _ 1860 MHz, 4 GB),
HP ProLiant ML110 G5 (Intel Xeon 3075, (2 cores _ 2660 MHz, 4 GB)

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So with these numbers, when the first type server is clear, but no program is running on it, its power consumption is 86 watts, and as 10 percent of the processor's capacity is loaded, the power consumption is 89.4 watts per hour. The rest are similarly achieved, and at the end we observe that when the processor is 100 percent, its power consumption is 117 watts per hour.

On the second type processor, the power consumption is 93.7 watts per hour when the server is 100 percent and the power consumption is 135 watts.

Since both types of these servers are dual-core, we consider the full dual-processor capacity.

With regard to the energy consumed, a linear function is obtained for each workload of the server. Because each type of processor has a steady slope, the power consumption is higher.

If the program goes to the first type processor, we calculate 86 + 31 * percent of the workload in the host.

This is the energy used to turn on the device, plus the difference between completeness and the empty server multiplied by the percentage of the server's first type.

If the program goes to the second type processor, we calculate 93.7 + 46.3 * percent of the workload in the host.

This is the energy used to turn on the device plus the difference of completeness and the empty server multiplied by the percentage of the server's second type.

By doing so, we will determine whether the workload has been reached by the host to the designated critical point.

If the host's workload is less than 10%, it can transfer virtual machines from it to other hosts, provided that the destination server does not reach this critical point.

Also, if the host load exceeds 90% of its capacity, we will ship several virtual machines from this host to other servers to achieve a normal percentage load.

Selection

In this section, check the chromosome evaluation function. The population in each replication is 100, and each chromosome is evaluated, we select five to the least of the parents and we consider straightforward as a child. 95 others are in the process of combining and jumping operators. In fact, each population consists of five parents with the lowest value and 95 genes obtained from the genetic algorithm.

Cross over

For the composition process in this algorithm we use a one-point and two-point routine.

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Single Point Procedure:

This method is the most common combination method. In this method, a point is selected randomly in parent chromosomes and combined with each other. It inherits from the beginning of the first parent to that point the genes of parent-one and from that point to the end of the second inheritance.

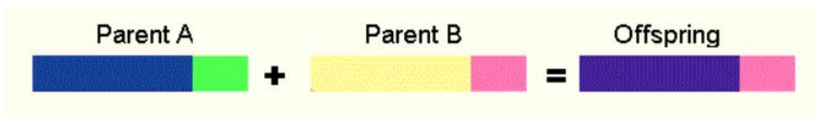

Figure 2: Cross Over - Single Point Procedure

The following example is an example of this method:

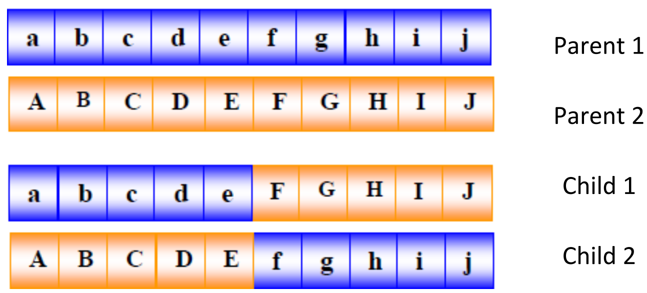

Figure 3 - Example – Cross over - Single Point Procedure

Two- Point Procedure

In this method, two points are randomly selected in the parent chromosomes, and then the genes between the points selected are changed one by one with each other. It inherits from the beginning of the first parent to the first point and from the second to the end of the first parent and inherits between the points from the second parent.

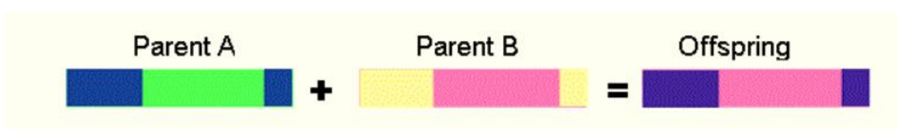

Figure 4: Cross Over - Two-Point Procedure

The following example shows an example of this method.

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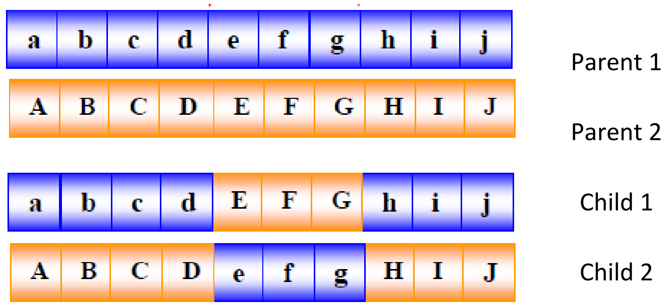

Figure 5: Example – Cross over - Two-point Procedure

Uniform Procedure

In this routine, parts of the child are randomly selected from the first parent and parts of the second parent are selected. In fact, we can say that the n-point of the combined operator is applied.

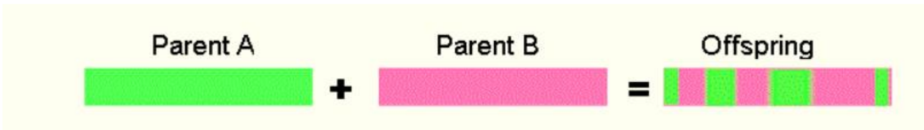

Figure 6: Cross over - Uniform Procedure

Cross over rate

In practice, we combine a possible rate. For example, we suggest a seventy percent rate based on experience. On the other hand, in each repetition, a random number is generated between one and one hundred. If the replication number is between one and seventy, then the cross over is applied to that string, otherwise it goes to the next step of the algorithm where the mutation operator is applied.

Mutation

We use the bitwise method for the mutation process. This method randomly changes one bit in the string.

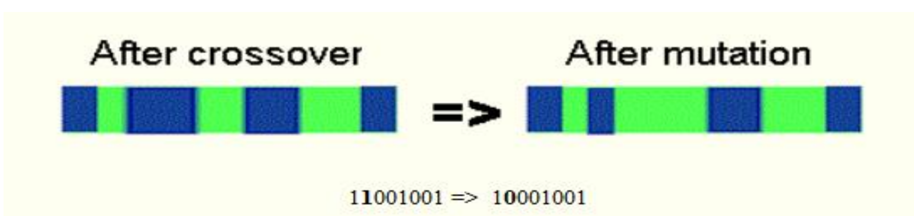

Figure 7: Mutation-Bit

In this process, we use a 0.05 mutation rate. This means that a random number is generated between one and a hundred. If this number is between one and five, the mutation action occurs

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or else we go to the next step. This is due to the fact that the jump should happen very little so that there is not much change in our fields. On the other hand, the mutation is used, so that if the optimal global point was outside the current search range, it would enable the algorithm to scan those points. If the value obtained from the jump routine is better than the current search points, the algorithm moves to that range and otherwise it continues to search in the same range.

In the next step, we will examine the overload and underload on each chromosome.

If the use of the host CPU exceeds ninety percent of its capacity, overload or overflow has occurred.

And if the use of host CPUs is less than 10% of its capacity, then underload or workload has occurred at least.

During excessive overload, large amounts of power and power are consumed, and this lack of energy directly affects the cost of paying customers to use cloud services and reduce the quality of service, and has caused problems such as reduced availability and reduced lifetime of the device. It also reduces the reliability of the system. For this reason, it is decided to migrate a number of virtual machines from this host to other hosts based on the machine selection algorithm for migrating mmt to return the host state to normal.

During underload, because there is a small number of virtual machines or programs on a host that is running at high cost and power, it is decided that the host is shut down and resting and the virtual machines on the host also other active hosts migrate.

In this section, our fields have reached their final status after passing through the stages of combination, mutation and migration. Here, we evaluate the strings using the objective function. The string that consumes the least amount of energy is sent to the output for a graceful string.

3. Simulation Results

We used different methods of checking the load and selecting the virtual machine for migrating to integrate into the proposed scheduling algorithm. We also use the one-point, two-point and dispersed method, and ... for the scheduling phase combination, using bitwise methods, etc. for the stage of mutation scheduler.

Finally, the best results were obtained after frequent changes in the variables with respect to the change of the cross over operator and the number of repetitions. Here are some charts that respond to the graph and change the other variables:

In repetition of 100, a single-point combine operator and a bit-mutation and selection operator are presented and with the population of 100 each repetition the result is obtained.

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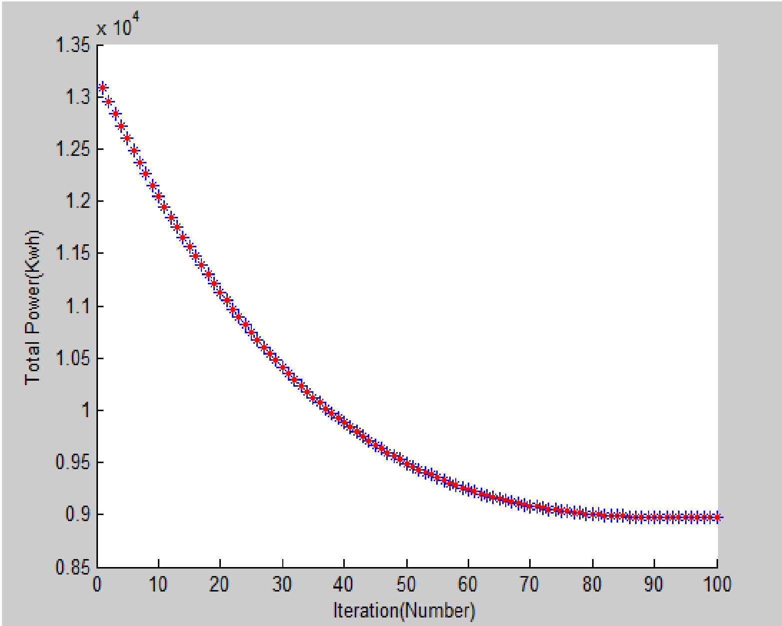
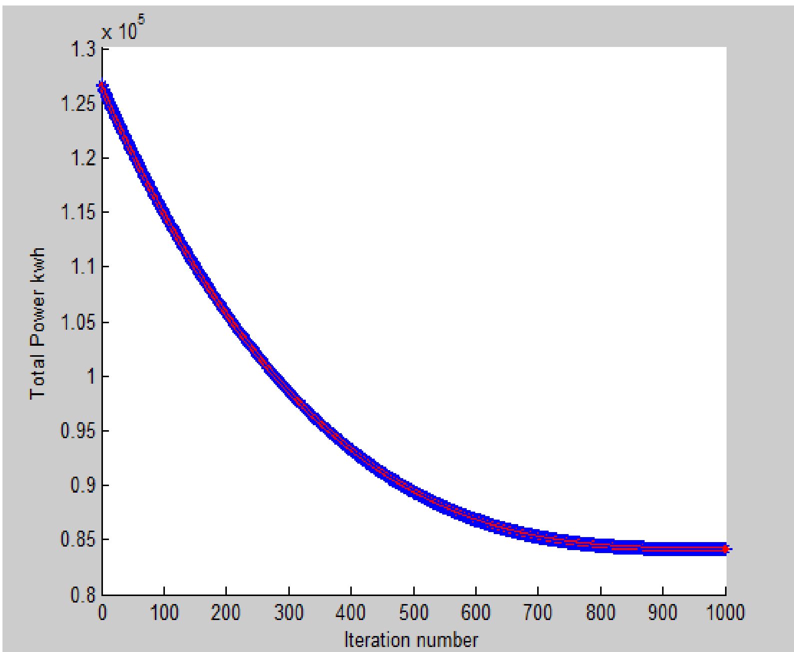


Figure 8- the scheduler with a repeat number of 100 and a single point operator

As you can see, energy consumption in this way has reached about 90 kWh.

Then we chose the Scatter function operator, which determines the number of points with the probability number it generates, and then the combination is made. In fact, it can be called the infinite point combination.

With a repeat change to a thousand and dispersed combinative operators, the result was improved and the minimum energy consumption was 84.40 kilowatt hours.



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Graph 9- the scheduler with a number of repetitions of 1000 and dispersed cross over operators

Compared to the other proposed methods, the proposed method shows an improvement in energy consumption.

Policy	*Energy kwh*
NPA	2419.2
DVFS	613.6
THR-MMT-1.0	95.36
THR-MMT-0.8	89.92
IQR-MMT-1.5	90.13
MAD-MMT-2.5	87.67
LRR-MMT-1.2	87.93
LR-MMT-1.2	88.17
Suggested Algorithm	84.40

Table 2: Comparison of Different Algorithms Based on Energy Consumption of Servers (Kwh)

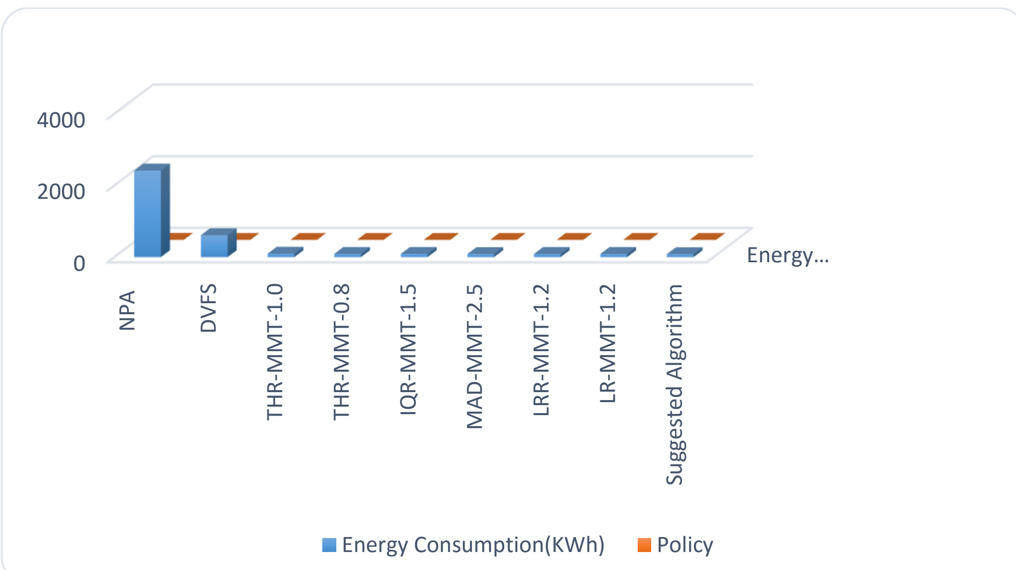

Chart 10: Comparison of Different Algorithms Based on Energy Consumption Servers (Kwh)

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The NPA algorithm is actually an algorithm that does not attempt to optimize the energy consumption of the data centers, and considers other factors such as the quality of the work. We plotted this algorithm to provide a general comparison between energy consumption based on energy-oriented algorithms and other algorithms.

In the diagram below, we compare only the energy-oriented algorithm. See the most detailed optimizations.

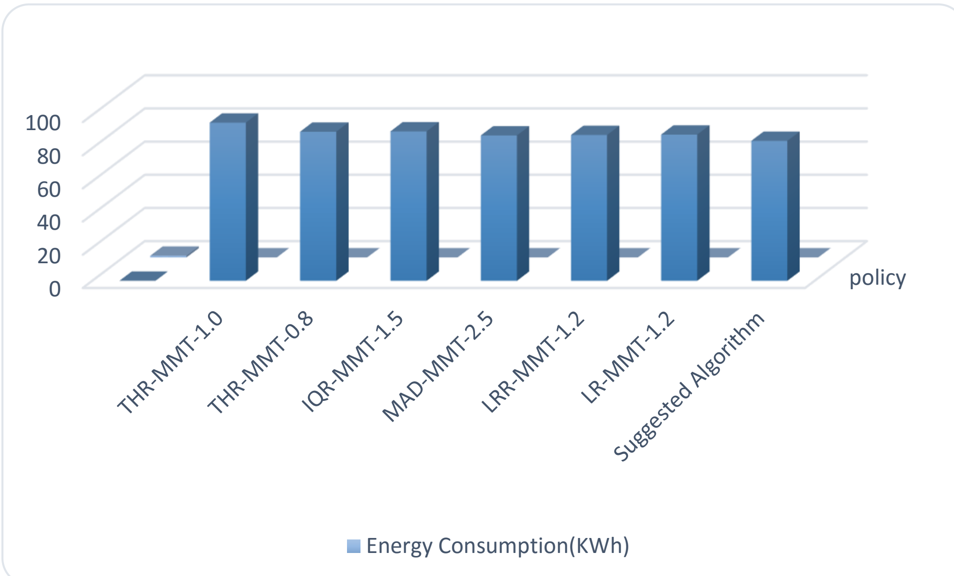

Chart 11 Comparison of energy-conscious energy sources based on energy consumption of servers (Kwh)

As you can see, the proposed algorithm reaches a minimum of 84.40, which is a very good result among the previous algorithms. As can be seen, this algorithm has worked well even with the LR-MMT algorithm, which worked on the critical point survey with the LR algorithm and the allocation of additional resources to the MMT algorithm, and is well-suited to comparing the rectangular charts below. Obviously, the algorithm presented on the basis of the genetic algorithm improves the energy consumption of cloud data centers than previous ones. The energy consumed (CE), the number of hosts hosted and the number of dropped immigrants have been calculated through the proposed FFO EVMM method. Energy consumption is also calculated using the threshold of using different nodes.

The results are compared with the ACO and FFD-based techniques. (Figure 12)

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Chart 12 provides a comparison of the three techniques, FFD, ACO, and FFO EVMM, based on the number of active host required by the number of virtual machines as an independent axis.

It is important to keep the number of hosts operating in the system to prevent situations where the hosts are more likely to be idle and unnecessary power consumption, which violates minimum energy requirements. After identifying the idle hosts, they are set to sleep. Based on the analysis of the results, it is evident that the FFO EVMM technique performs fewer active hosts than two other techniques.

This is because the FFO EVMM runs a firefighting algorithm that selects the exact nodes for VM assignment by reducing the discovery time, and as a result, optimal use of host nodes, this global optimization with sync speed and faster results are obtained,

Improvement at the resource level reduces the number of VM migrations, thereby eliminating energy costs.

Figure 12 shows the number of VM migrations by the three techniques. As shown in Figures 12 and 13, the FFO EVMM technique uses less number of hosts and fewer VM migrations compared to FFD and ACO. The FFO EVMM functionality is needed to identify the best node for VM allocation without compromising energy consumption on future migration decisions and the number of VM migrations required for allocating energy without compromise on future migration decisions and the number of VM migrations. In this way, the need for more and more VM migration is low, while load allocations are more likely to be energy constraints.

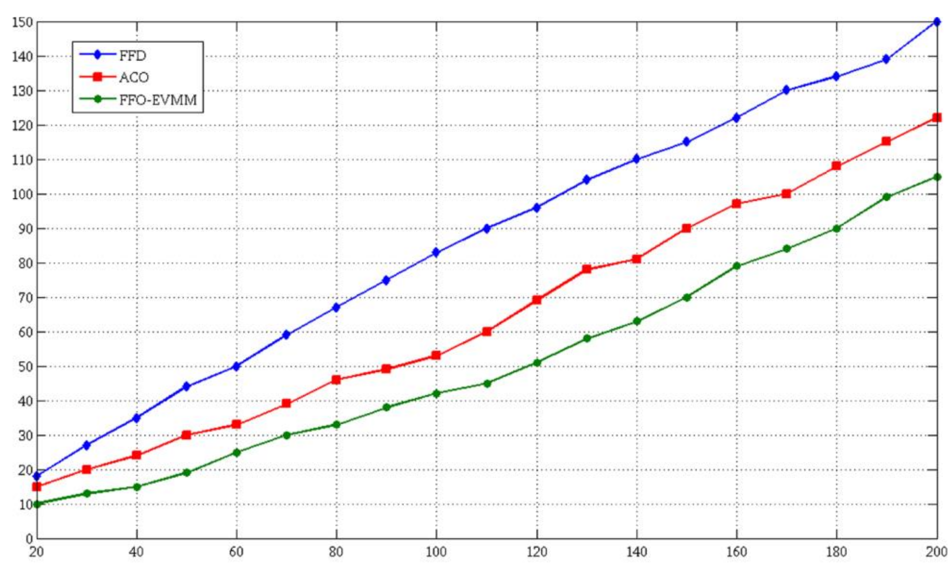

Chart 12. Host and VMs

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With fewer hosts and VM migration, the FFO EVMM offers less energy. Energy consumption by FFO EVMM is low compared to FFD and ACO, as shown in Fig. 14. The desire to detect and reduce the number of active but unemployed hosts reduces energy demand. It connects it to the useful levels of sources of resources affecting the number of VM migrations.

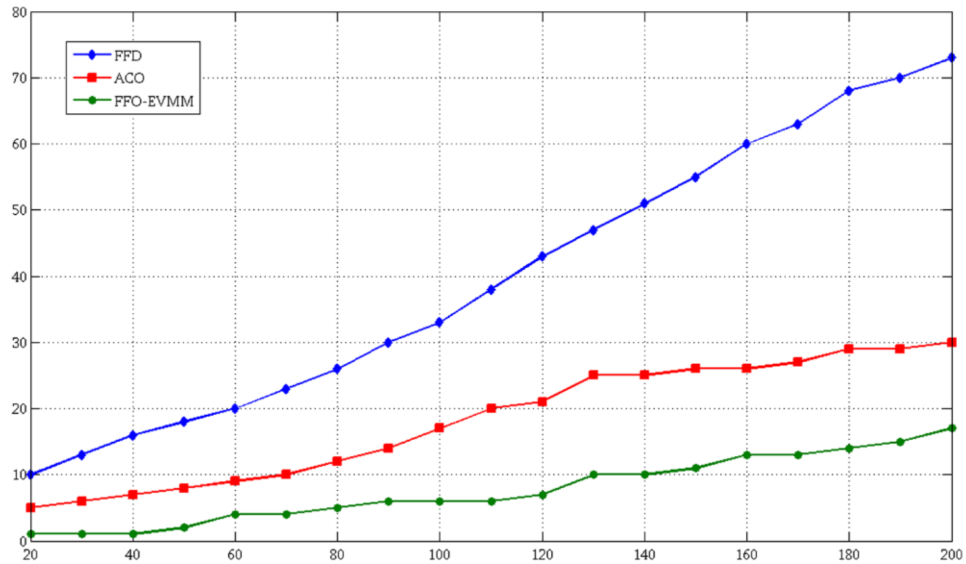

Chart 13: Number of Immigration and VMs

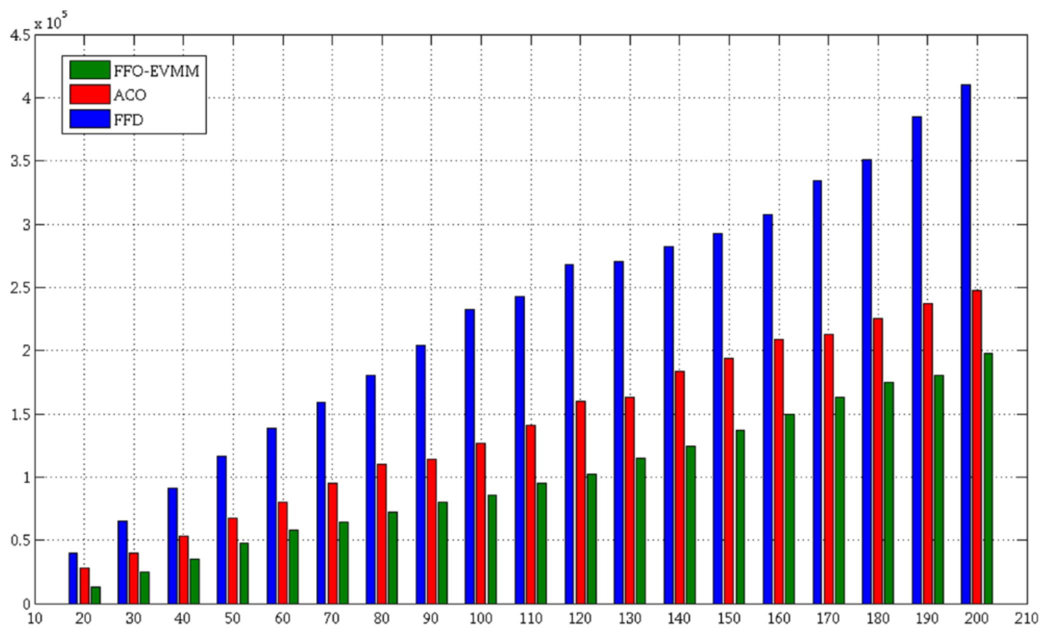

Chart 14: Energy Consumption and VMs

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Reducing the number of VM migrations, reducing energy consumption reduces the number of migrations, otherwise, when the VMs migrate it is wasted, resulting in reduced operational energy and energy consumption.

After simulation, it is concluded that in different threshold values, in FFD and ACO-based techniques, energy fluctuations are measured by FFD and ACO. The energy consumed by FFD and ACO compared to our proposed method is irregular behavior, which means that energy consumption continues to increase or decrease for different threshold values. The ratio of energy consumption in the FFO EVMM method is constantly reduced with different thresholds. The FFO EVMM's declining energy consumption trend is due to improvements in host levels due to VM's energy allocation decisions.

4. Conclusion

As you can see in the results section, we measured the effectiveness of our method by performing several experiments and in order to better identify this performance. We compared these results with the results obtained from different methods. The results of the comparison showed that our proposed method reduces energy consumption of cloud data centers while guaranteeing the quality of user services and using the live migration method used in this algorithm without any disruption even during the migration runs user programs.

Therefore, cloud computing from the perspective of the infrastructure, in the form of distributed and parallel systems, includes a set of virtual computers that are connected to each other. These computers are dynamically delivered and are offered as one or more integrated computing resources based on service level agreements. These agreements are being put into place during negotiations between service providers and consumers. Cloud computing is trying to provide a new generation of data centers by dynamically providing virtualized network services and services so that application service providers can tailor services and applications flexibly and provide more ease-of-use, and users can access apps from anywhere in the world.

As we have seen in this article, we are focusing on one of the most important and critical issues in cloud computing networks, which today is the study of many cloud-based researchers, namely the optimization of energy consumption in cloud data centers and task scheduling. have paid. In this work, we used the virtualization method to store data centers energy, which, by integrating multiple systems in a virtual system, simultaneously runs parallel operations in parallel, and with this technique, the percentage of use and turning on of servers significantly decreases. By virtue of virtualization, we introduced and improved the migration algorithm of virtual machines based on the genetic algorithm. In this way, we added two functions of checking the workload and migration after the functions of choice and combining and mutating the genetic algorithm.

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By doing so, the proposed algorithm could save more energy than other existing algorithms and guarantee the quality of work. In this algorithm, due to the extinction of idle devices based on the migration function, the power consumption is reduced and the production of carbon from the cooling of the devices is reduced and this reduces the production of bio-contaminants that has become a source of concern in recent years. In the future, we can improve our proposed method in different ways. For example, if the proposed method uses new algorithms for critical point and resource allocation. Also, due to the server's production temperature, which causes them to crash and lower the quality of the users' work, the server temperatures can also be considered in the future. Because as the work on server’s increases, the temperature of the device goes up and for data centers with such a large number of servers becomes problematic.

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