Survey For Energy Efficiency Algorithms In Cloud Computing

Neha Dutta Research ScholarACET eternal university Baru sahib (H.P.)

Dr. Pardeep Cheema Proffesor ACET eternal university Baru sahib (H.P.)

Abstract

Cloud computing provides the services on demand bases. It is internet computing that offers metering-based services to customers. User only pays as per use. It implies accessing data from a consolidated pool of computer resources that may be requested and consumed on-demand. It also offers computer resources via virtualized over the internet. The data center is the most essential in cloud computing which includes a group of servers on which Business records are kept and applications operate. The data center which contains servers, cables, air conditioning units, networks, etc. uses more electricity and emits a large quantity of Carbon-di-oxide (CO_2) to the atmosphere. One of the most significant problems encountered in cloud technology is the optimizing of Energy Usage. Hence the idea of cloud computing originated. It is a concept for allowing all over, on-demand access to a shared pool of customizable computer resources[Wanneng Shu et. A.,2014].
The efficient use of resources and operational efficiencies are the keys to increasing effectiveness balancing the loads and optimizing energy.

Introduction

Cloud computing executes computation via the internet on-demand basis as per the need of the customers. It is a concept for allowing all over, on-demand demand access to a shared of customizable computer resources[Blum, C. 2005]. Cloud computing offers a few attractive benefits for businesses and end customers. In recent times, the cloud offers various kinds of services via the Internet likes online functions, processing power, space, technology, etc.
The efficient use of resources and cost control are the keys to increasing effectiveness in balancing the load and optimizing energy. It is also noticed that, since nearly all Industries and Institutes required strong Cloud Services for their business needs and development, the Data Centre Network is greatly studied and enhanced concerning energy.
The main aim of the article is to compare the current energy optimization methods and different ideas connected to energy in a cloud environment [Losup, Alexandru, 2011]. There are many factors under the expression of cloud which are described below:

✓ **Datacenter:** Hardware strategy plans consisting of a collection of hosts related to maintaining VM throughout their life cycle.
✓ **Datacenter Broker:** Software as a Solutions and Cloud services are unilaterally brokered by Datacenter Broker.
✓ **Host:** Host represented physical server.
✓ **Virtual machine**: Virtual machine is operated on a Cloud host to interact with the cloudlet.

ENERGY OPTIMIZATION EVOLUTION:-

Cloud computing experts are seeking to enhance the energy and they are confronting various difficulties like virtualized, migrations, and scheduling. It's been more than a decade since virtualization became popular. It's the process of creating a logical number of VM's on the same physical system [Si Yuan, Jing, 2013]. It is the core of the cloud computing business and plays a critical function in the virtual environment.

- **Virtualization** technology to accomplish the most effective and efficient use of resources storage, and allows data centers to deploy innovative data analysis strategies to achieve cloud services via the most effective use of data center resources. The virtual machine was created to allow many tasks to be completed on a single host, each VM functions as a single physical server. The following are some of the advantages of establishing virtual machines in cloud services.
  1. Reduce the cost of infrastructure.
  2. Conserve energy.
  3. Provisioning of servers is faster.
  4. Boost your recuperation.
  5. Isolate apps.
  6. Flexibility
  7. Reliability
  8. Testing and development phases are simple.

- **Virtual Machine Migration**:-

Cloud services resources must be managed dynamically, which is why virtual machine migration is becoming more popular. The movement of a virtual machine from one physical server to another allows for load balancing, hardware maintenance, highly available services, and centralized administration [Si Yuan, Jing, 2013].
The following are the main benefits of utilizing a live VM migration: -
1- To have a term asset that enables virtual machine maintenance or upgrades to be performed without closing down the entire system.

2- Maintain the data center's load balancing. When utilizing VM Migration in the data center, we may switch down hosts to improve energy efficiency by consolidating servers. Two important issues may arise throughout every VM migration process:

Q1. Which VM should I transfer from an overburdened server?

Q2. Which server should I use to choose a destination? The answers to these questions are typically determined by the data center's processing policies and the needs of the users.

- **Scheduling Methodologies** Since the demand for cloud-based users is growing [Sumathi, Surekha, 2010.], the academic community has been looking at energy consumption. The adoption of a proper scheduling strategy is one of the greatest strategies to reduce energy usage inside the data center. A scheduling algorithm is a method of monitoring and regulating the process of allocating incoming jobs to servers in response to the needs of cloud users.

The standard Firefly algorithm is as follows:

1) The firefly's behavior There are around 2,000 species of firefly, which are mostly found in warm and humid climates. The majority of firefly species emit distinct, brief, and repetitive flashes. The mechanism that causes light to flash is known as phosphorescence. These lights are used to target potential prey and mating partners. The pace of flashes and the length of time between these rhythmic flashes vary from one another [Kumar, V., & Kumar, D. (2021)]. Females react to a male's distinctive flashing pattern, which creates a signaling system that brings both sexes together. The inverse square rule applies when a light source produces an intensity of light from a certain distance. Because air absorbs light, it becomes weaker as the distance between them grows. The flashing light is designed in a way that it may be linked to the optimization problem that has to be improved, allowing for the creation of novel optimization methods [Fister, I., et. Al., (2014).].

```
Algorithm 1 Pseudo-code for FA main steps
```
Objective function $f(y)$, $y = (y_1, ..., y_n)^T$

Generate initial population of fireflies y_i ($i = 1, 2, ..., m$)

Light intensity I_i at y_i is determined by $f(y_i)$

 Define light absorption coefficient γ

1: while ($t <$ Max Generation)

2. for $i = 1 : m$ all m fireflies

 3: for $j = 1 : i$ all m fireflies

4: if ($I_j > I_i$)

5: Move firefly i towards j in d-dimension;

6: end if

7: Attractiveness varies with distance r via $\exp[-\gamma r]$

8: Evaluate new solutions and update light intensity

9: end for j

 10: end for i

11: Rank the fireflies and find the current best

12: end while

Postprocess results and visualization.

Disadvantage:- However, since they are global optimization algorithms, one of their major drawbacks is the high likelihood of getting stuck in local optima.

2. **Ant colony optimization:-** For addressing computational problems ACO method may be utilized because of the dynamic behavior, ant colony optimization is used to find an optimal route across graphs, depending on the activity of ants searching for a path among their colony in search of food source. This concept has been utilized to solve different numerical issues; many challenges have come up based on various unique characteristics of ant behavior. Explanations: ant travels in various motions in search of natural diet around the colony, once the food source has been found by ant it could come straight to nest, leaving a trail of pheromone in route. Since pheromone is attractive by its nature the remainder of ants prefer to follow straight along that route[Hu, Xia-Min, Zhaet. Al.,2010]. Once going back to their colony they further leave a trail of pheromone in the way, which will, in turn, reinforce the route. If there exists more than one mode of transportation an equal food source, the shorter path will be taken by several ants, than

different pathways because pheromones placed in the long road will be evaporated for a specific instant of time. This is owing to the volatile nature of pheromones, eventually, all ants chose to travel the shortest route. Generally, surroundings are utilized as a shared platform by ants, for the flow of opinions among ants and it took place with the aid of pheromone that has been placed. The extent of information transmission is limited, those colonies where ant found pheromones left have a conviction for them[Sumathi, Surekha, 2010.].

Ant Colony Optimization Algorithm

1. Compute a (linear) lower bound LB to the problem

Initialize $\tau_{t\Psi}$ ($\forall_{t}, \Psi$) with the primal variable values

2. For k=1,m (m= number of ants) do

repeat

      2.1 compute $\eta_{t\Psi} \forall(t\Psi)$

      2.2 choose in probability the state to move into

      2.3 append the chosen move to the k-th ant's tabu list

until ant k has completed its solution

      2.4 carry the solution to its local optimum

end for

3. For each ant move $(t\Psi)$,

compute $\Delta\tau_{t\Psi}$ and update trails

4. If not(end_test) goto step 2.

Disadvantage:- Convergence is assured, but the time to convergence is unknown. Coding is not easy.

3. Hybrid algorithm: a combination of ACO and cuckoo search

Hybrid algorithm for energy efficiency

Step 1: Initialization of parameters

         Set the beginning of pheromone trail, heuristic information (h_{if}), random nests (r_{ns})

Step 2: Get Input jobs from 1 to n jobs

Step 3: Apply transition rules

Step 4: for each jobs j_i to j_n do

         for each virtual machine vm_1 to vm_m do;   Assign jobs to vm; Vm = job j_i

         end for ; end for

Step 5: random walk by cuckoo search from $Z_{t+1}=(Z_t+sE_t)$

Step 6: Pheromone updation

         for each pheromone p_m to p_n do

Step 7: evaluate $P^k_{mn;}$ end for

Step 8: pheromone trails updation

         for pheromone dumped β_m to β_n do ;   evaluate $\beta_{mn;}$ end for

Step 9: If current_jobs $\geq$ n jobs then

         n jobs ++ and go to step 2

            else

Step 10: Return value

Dis Advantage:- In a cloud computing lab, the processing time of the Hybrid controller is evaluated to the ACO algorithm. As the number of jobs grows, the time required by the Hybrid method decreases. Utilizing the Hybrid algorithm reduces the amount of energy used for task scheduling. This is only feasible if the job's turnaround time is reduced. The energy usage depending on the number of processing is also looked at, and it shows that as the number of processors grows, the amount of energy used decreases.

To analyze the performance of discussed approaches in section 3, makes pan, average resource utilization, and load balancing level has been considered. Makes pan is an indicator of the total time taken to complete a set of jobs. Lower the value of makes pan better will be the scheduling approach.

Time taken to complete a set of jobs

	1	2	3	4	5	6	7	8
■ No. of job	100	200	300	400	100	200	300	400
■ No. of processing element	1	1	1	1	2	2	2	2
■ ACO algo.	3800.01	7266.59	10266.51	13066.45	7466.99	13066.61	22399.83	27066.43
■ Firefly Algo	1800.06	3666.72	5666.66	6999.93	3600.06	7600.02	11199.97	13599.99
■ Hybrid Algo.	1200.05	3200.95	4566.98	5200.78	3200.87	5200.18	9200.61	10999.23

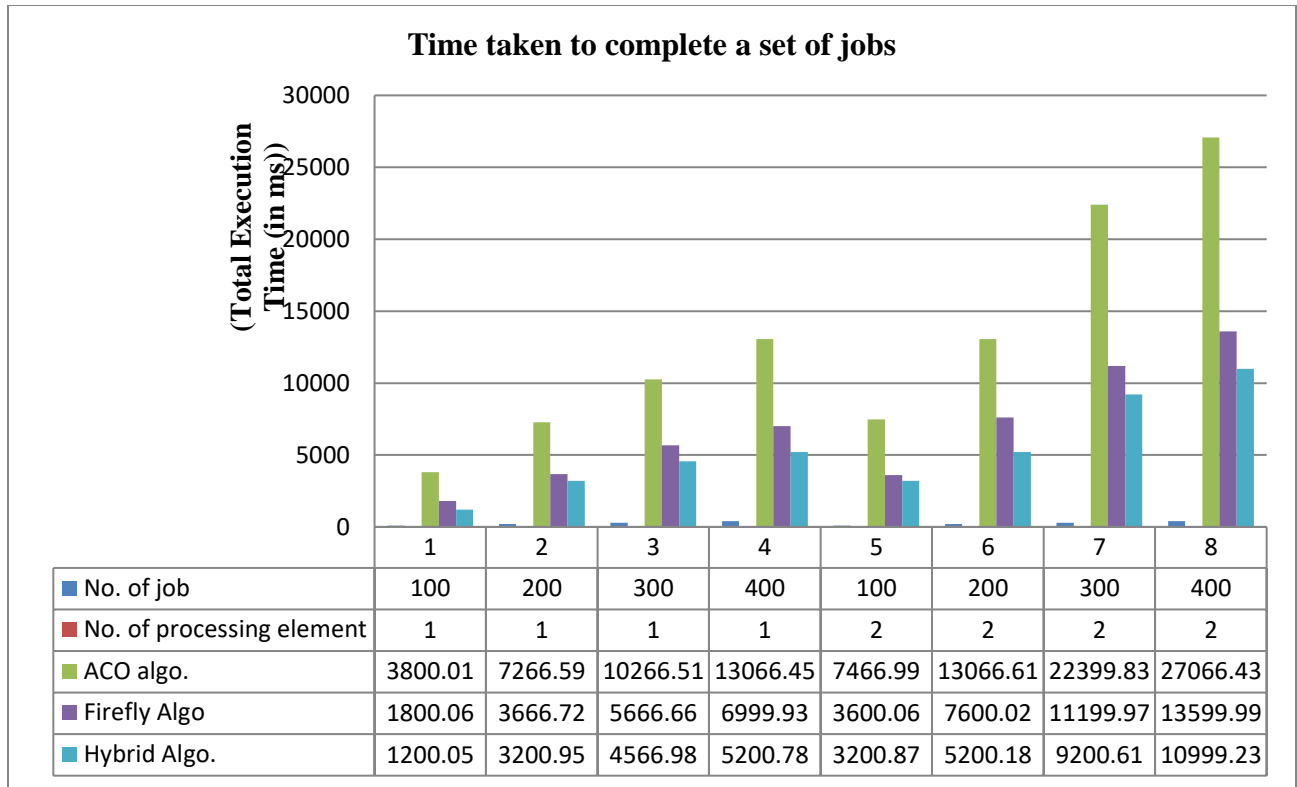Y-axis: (Total Execution Time (in ms))

Figure 1.   **Comparison of energy efficiency algorithms based on makes pan**

Figure 1 shows the comparison of three algorithms on the scale of makes pan. It has been found that the hybrid algorithm is showing better performance as compare to ACO and firefly algorithm relative to min-min and max-min approach on the scale of makes pan. Resource utilization is another parameter used to judge the performance of the scheduling approach. More is the value of this factor better will be scheduling approach in terms of response and waiting time.

Cost taken to complete a set of jobs

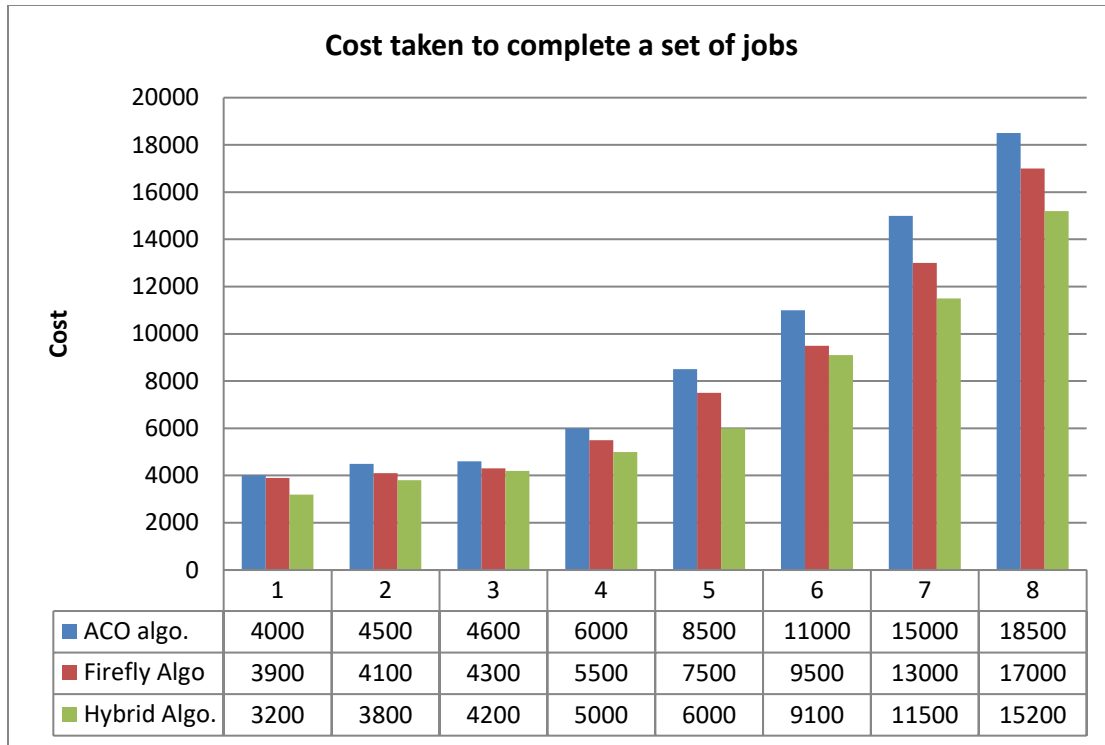|	1	2	3	4	5	6	7	8
ACO algo.	4000	4500	4600	6000	8500	11000	15000	18500
Firefly Algo	3900	4100	4300	5500	7500	9500	13000	17000
Hybrid Algo.	3200	3800	4200	5000	6000	9100	11500	15200

Figure 2. **Comparison of a heuristic approach based on resource utilization**

Figure 2 shows the comparison of three approaches on the scale of resource utilization. It has been found that the hybrid approach is showing better performance relative to the Firefly algo. and ACO approach on the scale of average resource utilization.

Even distribution of tasks among all resources will result in better response and waiting time. So higher value of this parameter is also desirable.

energy consumption

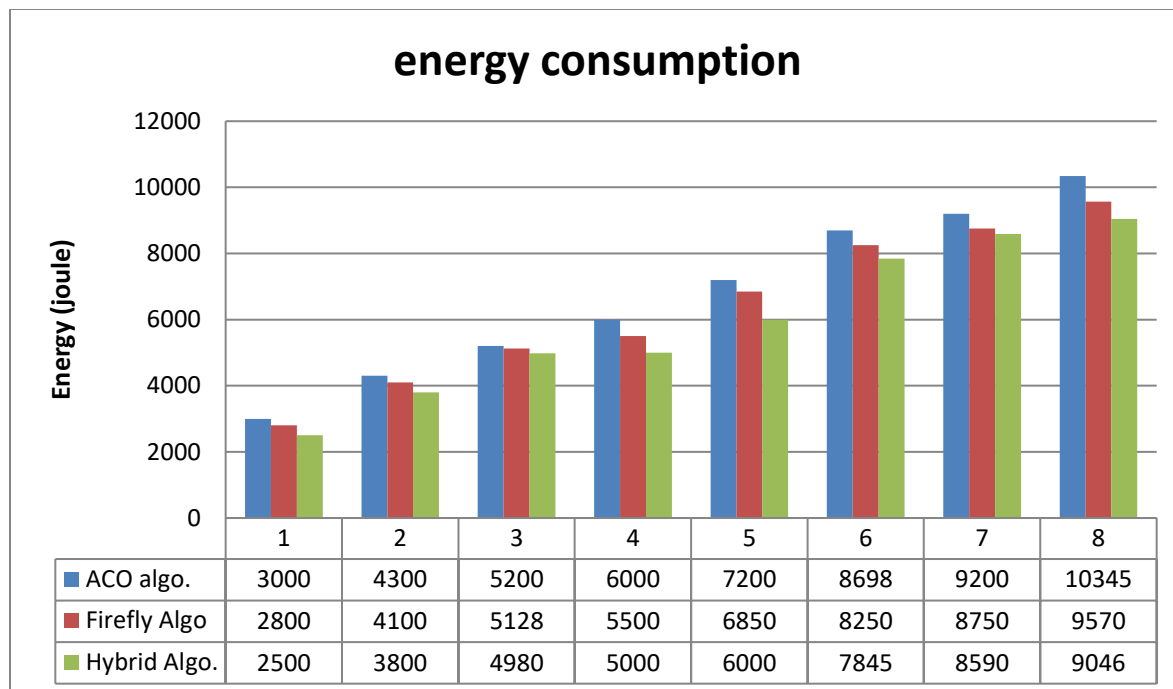|	1	2	3	4	5	6	7	8
ACO algo.	3000	4300	5200	6000	7200	8698	9200	10345
Firefly Algo	2800	4100	5128	5500	6850	8250	8750	9570
Hybrid Algo.	2500	3800	4980	5000	6000	7845	8590	9046

Figure 3.   **Comparison of a heuristic approach based on Energy consumption**

Figure 3 shows the comparison of three approaches on the scale of load distribution. It has been found that the Hybrid approach scheduling approach is showing better performance relative to the firefly and ACO on the scale of energy consumption. After the combined analysis of Figures 1,2 and 3, it can be concluded that the Hybrid approach is the best-suited energy consumptions in cloud environments among firefly and ACO.

Conclusion:

In this papers authors reviewed different energy efficiency algorithms for task scheduling based on cloud computing. Authors analyses these algorithms in details. Cloud Sim simulator is used for its analysis purpose. In this paper Authors have analyses ACO, Firefly and Hybrid Algorithms. The result of this analyses is that Hybrid is best among these three.

References:

1   Kumar, V., & Kumar, D. (2021). A systematic review on firefly algorithm: past, present, and future. Archives of Computational Methods in Engineering, 28(4), 3269-3291.
2   Fister, I., Yang, X. S., & Fister, D. (2014). Firefly algorithm: a brief review of the expanding literature. Cuckoo Search and Firefly Algorithm, 347-360.
3   Blum, C. (2005). Ant colony optimization: Introduction and recent trends. Physics of Life Reviews, 2(4), 353-373.

4   Dorigo, M., & Blum, C. (2005). Ant colony optimization theory: A survey. Theoretical computer science, 344(2-3), 243-278.
5   Dorigo, M., & Stützle, T. (2019). Ant colony optimization: overview and recent advances. Handbook of metaheuristics, 311-351.
6   Wanneng Shu, Wei Wang, Yunji Wang, "A Novel Energy-Efficient Resource Allocation Algorithm Based on Immune Clonal Optimization for Green Cloud Computing," EURASIP Journal on Wireless Communications and Networking, Springer, 2014.
7   Hu, Xia-Min, Zhang, Jun, Chung, H.S., Li, Yun, 2010. Sam ACO: variable sampling ant colony optimization algorithm for continuous optimization. IEEE Trans. Syst. Man Cybern. B Cybern. 40 (6), 1555–1566.
8   Losup, Alexandru, 2011. Performance analysis of cloud computing services for many-tasks scientific computing. IEEE Trans. Parallel Distrib. Syst. 22 (6), 931–945.
9   SiYuan, Jing, 2013. A novel energy-efficient algorithm for cloud resource management. Int. J. Knowl. Lang. Process. 4 (2),12–22.
10 Sumathi, Surekha, 2010. PSO and ACO-based approach for solving combinatorial Fuzzy Job Shop Scheduling. Int. J. Compt. Technol. Appl. 2 (1), 112–120.