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Anaysis of Different Energy Efficiency Algorithms in Cloud Computing

Neha Dutta, Pardeep Cheema

Abstract: ***Cloud computing is internet computing that offers metering-based services to customers. 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 (CO2) 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].***

Keyword**:** ***The efficient use of resources and operational efficiencies are the keys to increasing effectiveness balancing the loads and optimizing energy.***

I. 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.

II. 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[SiYuan, 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.

A. 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 [SiYuan, 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:

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* Correspondence Author
Neha Dutta*, Research Scholar, Akal College of Engineering and Technology Baru sahib (Himachal Pradesh), India.
Pardeep Cheema, Professor, Akal College of Engineering and Technology Baru sahib (Himachal Pradesh), India.

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.

B. 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 Ii 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 (Ij > Ii)
5: Move firefly i towards j in d-dimension;
6: end if
7: Attractiveness varies with distance r via exp[−γr]
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

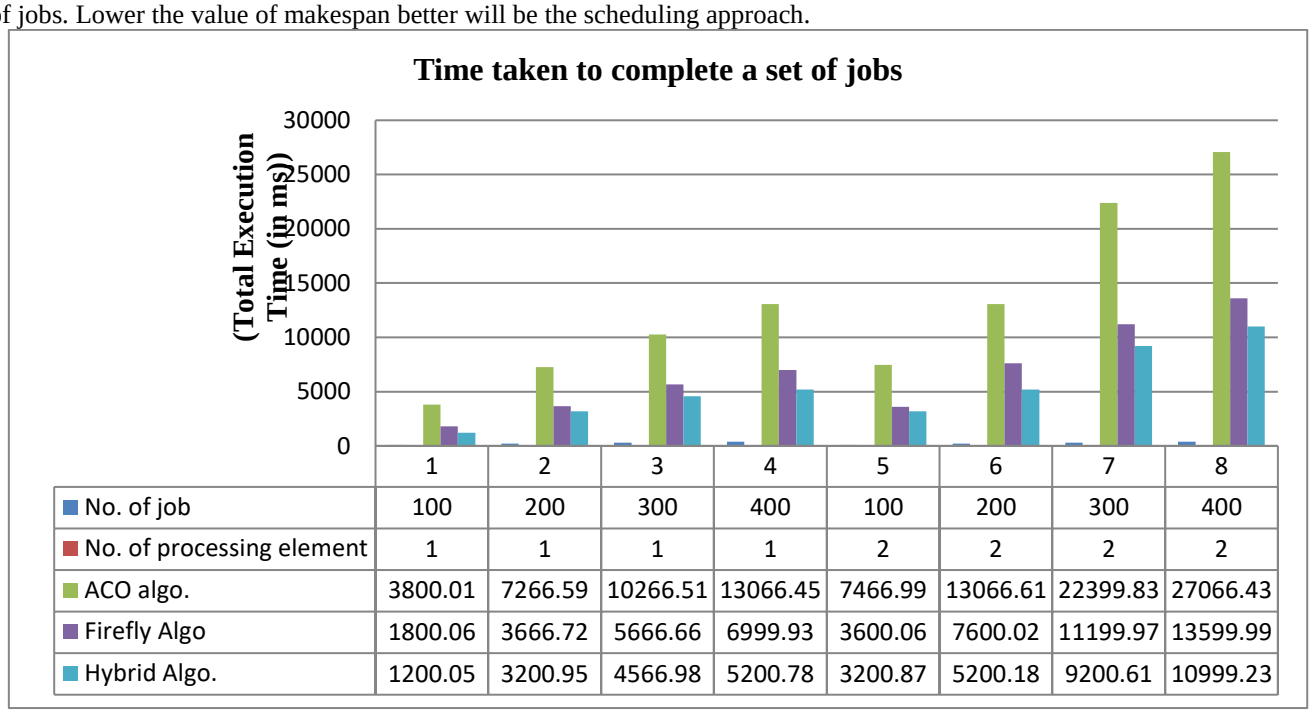
Step 9: If current_jobs ≥ n jobs then

n jobs ++ and go to step 2

else

Step 10: Return value

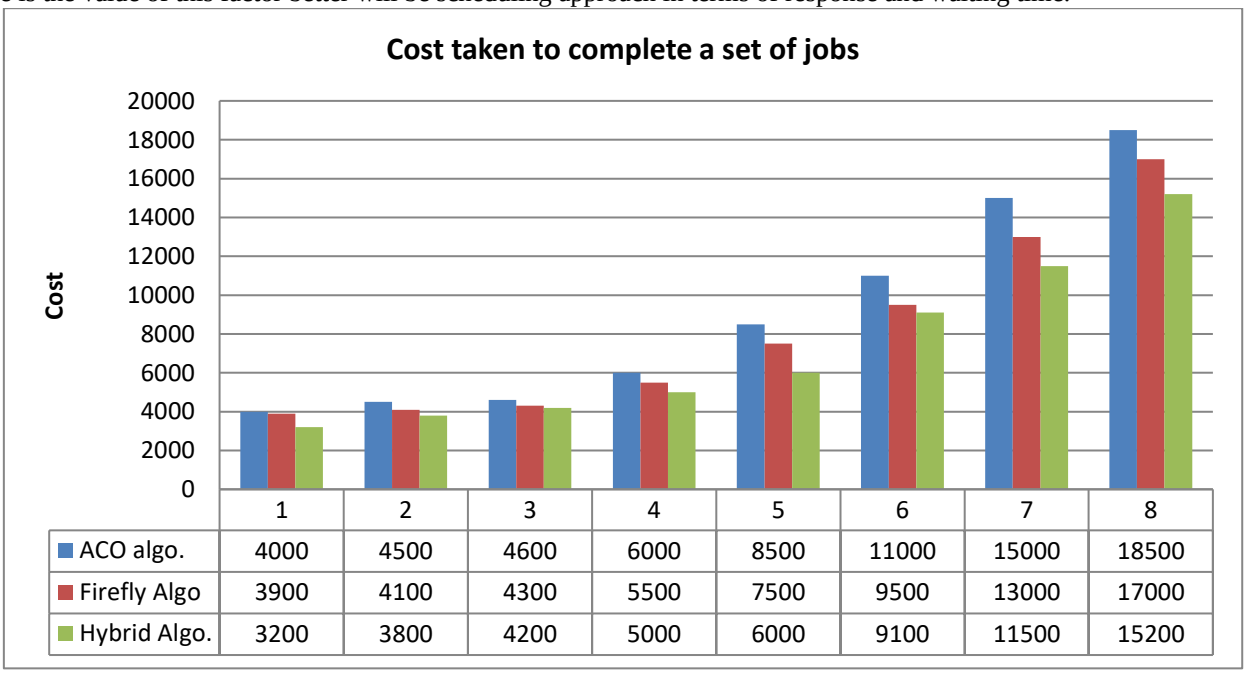
Disadvantage:- In a cloud computing lab, the processing time of the Hybrid controller is evaluated to the ACO algorithm. As the number of jobs grows, the time required by the Hybrid method decreases. Utilizing the Hybrid algorithm reduces the amount of energy used for task scheduling. This is only feasible 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, makespan, average resource utilization, and load balancing level has been considered. Makespan is an indicator of the total time taken to complete a set of jobs. Lower the value of makespan better will be the scheduling approach.



	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

Figure 1. Comparison of energy efficiency algorithms based on makespan

Figure 1 shows the comparison of three algorithms on the scale of makespan. 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 makespan. 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.



	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

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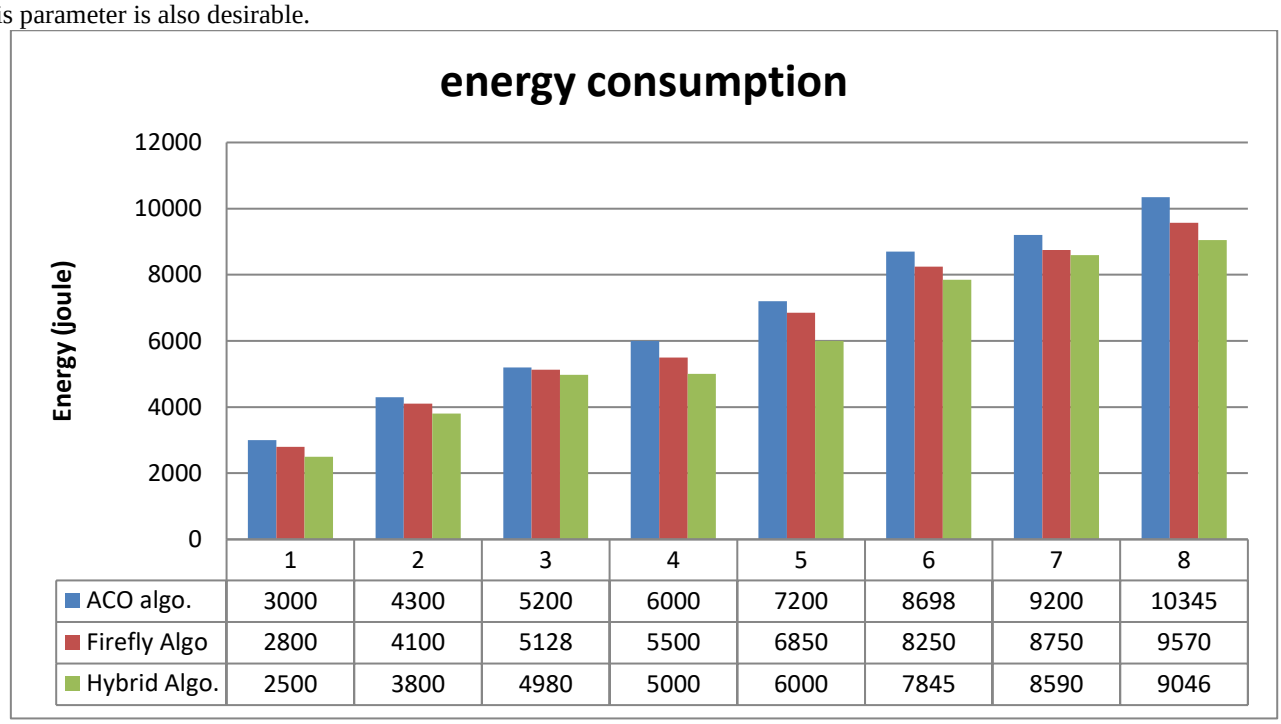
Figure 2 shows the comparison of three approaches on the scale of resource utilization. It has been found that the hybrid approach is showing better performance relative to the Firefly algo. and ACO approach on the scale of average resource utilization. Even distribution of tasks among all resources will result in better response and waiting time. So higher value of this parameter is also desirable.



	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.

III. 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.

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AUTHOR PROFILE

Er. Neha Dutta
Email- duttan90@yahoo.co.in
Educational Qualification

- P.hd (Persuing), from Eternal University Baru Sahib(H.P.).
- M. Tech. in CSE (2007-2010) from Lovely Professional University, Phagwara.
- M.Sc. in Computer Sci. (2004-06) from Guru Nanak Dev University Amritsar.
- B.C.A. (2001-04) from Guru Nanak Dev University Amritsar.
- 10+2 in Non-Medical (2001) from Shanti Devi College, affiliated to PSEB.
- Metric in (1999) from Ch.J.M.M.G.G.S.S. School Dinanagar, affiliated to PSEB.

Publications:
Total No of papers published in National and International Conferences= 16
Total No of Short Term Course=1
Total No. of books published= 3
Total No. of Workshops attended=1
Total No of Learning Teacher Training Program=1

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- Neha Dutta, “Internet & Web Designing” by KATSON Publication House, New Delhi.
- Neha Dutta, “Periphral & Interfacing” by KATSON Publication House, New Delhi

Dr. Pardeep Singh Cheema, Principal/Director/Administrative Head, Akal Collage of Engineering & Technology, Eternal University Baru Sahib-173101,
Teaching Experience:16 Years in Central Funded Deemed University Punjab.
3 Years (2010-2013)- Worked as Senior Associate Professor in Jazan University UAE
2013-2014-Worked as Director-principal Engineering Desh Bhagat University
Presently working as Director Technical education in Kalgidhar Trust & presently on deputation working as Dean Akal Collage of Engineering & Technology Eternal University Baru Sahib.
PhD Guided: One (1) From Punjab Technical University Jalandhar Mr Kulwinder Singh
Maan Title: “Information Modelling Using Decision Support Systems for Strengthening Rural Health Issues”

Presently PhD students: (02) Pooja Chopra D/o Mohinder Pal
Discipline: Computer Science (Cloud Computing) From: Punjab Technical University Jalandhar
Er Gurpreet Singh **Discipline:** Computer Science (Cloud Computing) From: Punjab Technical University Jalandhar

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