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A METAHEURISTIC APPROACH FOR SCHEDULING TASKS IN CLOUD ENVIRONMENT USING ACO

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Abstract—**In this era of internet cloud computing comes out to be a promising technique. Cloud computing provides easier access to the remote services. As it process huge amount of data so scheduling plays a vital role in cloud computing. Main goal of scheduling is to map the tasks to the resources so as to acquire the full advantage. On top of this load should be balanced on each and every virtual machine. Because scheduling without load balancing is not sufficient. There are various scheduling techniques exists to map the tasks with the machines. Some of them based on heuristic technique that provides an optimal or we can say nearer optimal solution. In this paper a new technique is proposed which is based on ACO. This technique is hybridization of improved ACO with the BCO technique. This technique is used to enhance the performance metrics of algorithm so that the tasks or we can say the cloudlets will be well scheduled with the balanced load on virtual machine. This approach will focus on the improvement of three main parameters overall response time, data center processing time and the total cost. The results of Proposed ACO will be compared with the existing technique.**

Keywords— **Cloud Computing, Scheduling, Ant Colony Optimization (ACO), Proposed ACO(P-ACO), Pheromones, Metaheuristic**

I. INTRODUCTION

Ant Colony is a metaheuristics technique which is based on population and probability. This approach is motivated from the behavior of ants. This technique is used to find out the optimized solution for the computational problems which are not able to compute by direct methods. ACO is capable enough to discover the shortest path between their colonies and food. Ants excrete chemical like substance called pheromones over the path while moving from colonies to their food source. The intensity of pheromones increases with the number of ants passing through the path and drops due to pheromone evaporation. Smaller the path larger will be the pheromones trail. And this pheromone trail helps to find the shortest distance path.. With the intention of being familiar with the ant colony optimization it is necessitate to completely understand the behavior of ants, where colonies refers to the social societies of the insects[3]. Ants' works in their colonies they do not work individually. Ant colony optimization technique best fit for different applications like scheduling, routing, subsets etc. In this paper a technique is proposed on the basis of Ant colony optimization, along with this BCO algorithm is hybridized with ACO so as to attain the best result.

The rest of the paper is organized as per follows: Section II provides the Literature survey. Section III deals with the Proposed Methodology. Section IV explains the Experiment & Result, finally section V concludes the paper and Section VI covers the future scope.

II. . LITERATURE SURVEY

"*A review of metaheuristic scheduling techniques in cloud computing*"

Mala Kalra et.al. (2015) [2] reviewed the metaheuristic techniques in the area of scheduling in cloud computing and grid computing. Metaheuristic based techniques have been proved to achieve near optimal solution within relative time for approximate problems like NP-Hard problem. A comparative analysis and an extensive survey for various scheduling algorithms techniques are included in this paper. They explain three popular metaheuristic techniques: ACO (Ant colony optimization), GA (Genetic Algorithm), PSO (Particle swarm optimization), and two novel techniques: LCA (League Championship Algorithm), The BAT algorithm.

"*Cloud Task Scheduling Based on Ant Colony Optimization*"

Medhat A. Tawfeek et.al. (2014) [4] described the most fundamental issues of cloud computing that is task scheduling. It is a NP hard optimization problem that can be solved by the approximate algorithm. Many metaheuristic algorithm have been proposed to get the nearer optimal solution of this large size problem. In this they proposed a task scheduling policy based on ACO is compared with the two different types of scheduling algorithm i.e. FCFS and RR. The main aim of this algorithm is to minimize the makespan of given tasks in order to get the profit and satisfy both consumer and producer. The result of the simulation is that the ACO algorithm performs better than other two algorithms and provides the better result.

"A Hybrid Bio-inspired Task Scheduling Algorithm in Cloud Environment"

Rakesh Madivi et.al. (2014) [5] described hybrid approach of task scheduling. As many scheduling algorithm has already approach so they propose a hybrid task scheduling algorithm that is based on combining the plus point of bio-inspired algorithms like ACO and Artificial Bee Algorithm. The proposed algorithm is then tested in the CloudSim Environment. They performed several experiments by incrementally increasing the number of cloudsets and VMs to observe the performance of the proposed algorithm over the existing algorithms like FCFS and traditional ACO. It was observed from the experiment that the proposed algorithm better than the existing algorithm.

"***Virtual Machine Scheduling Management on Cloud Computing Using Artificial Bee Colony"***

B.Kruekaew.et.al (2014) [6] described the Artificial Bee Colony algorithm for scheduling the virtual machines in cloud environment. In this paper different scheduling algorithms were analyzed and among them the combination of Proposed ABC algorithm and the Longest Job First scheduling technique performed better in the changing environment. It also balanced the load well and also reduced the makespan of data processing time.

"Load Balancing of Nodes in Cloud Using Ant Colony Optimization"

Kumar Nishant.et.al. (2012)[7] proposed an algorithm for balancing the workloads among nodes of a cloud by using Ant colony optimization technique. This is modified approach of ACO. It has been applied over cloud network systems in order to maintain the load over the nodes. This approach can detect the overloaded nodes as well as underloaded nodes. This can be identified by using a threshold value and then operations can be performed using the identified nodes. In this approach task depends on the type of first node that was encountered irrespective of their load.

III. . PROPOSED METHODOLOGY

This work mainly focus on the improvement of overall response time, data processing time and total cost of the task and schedule the task by using proposed technique in order to get the nearer optimal solution..

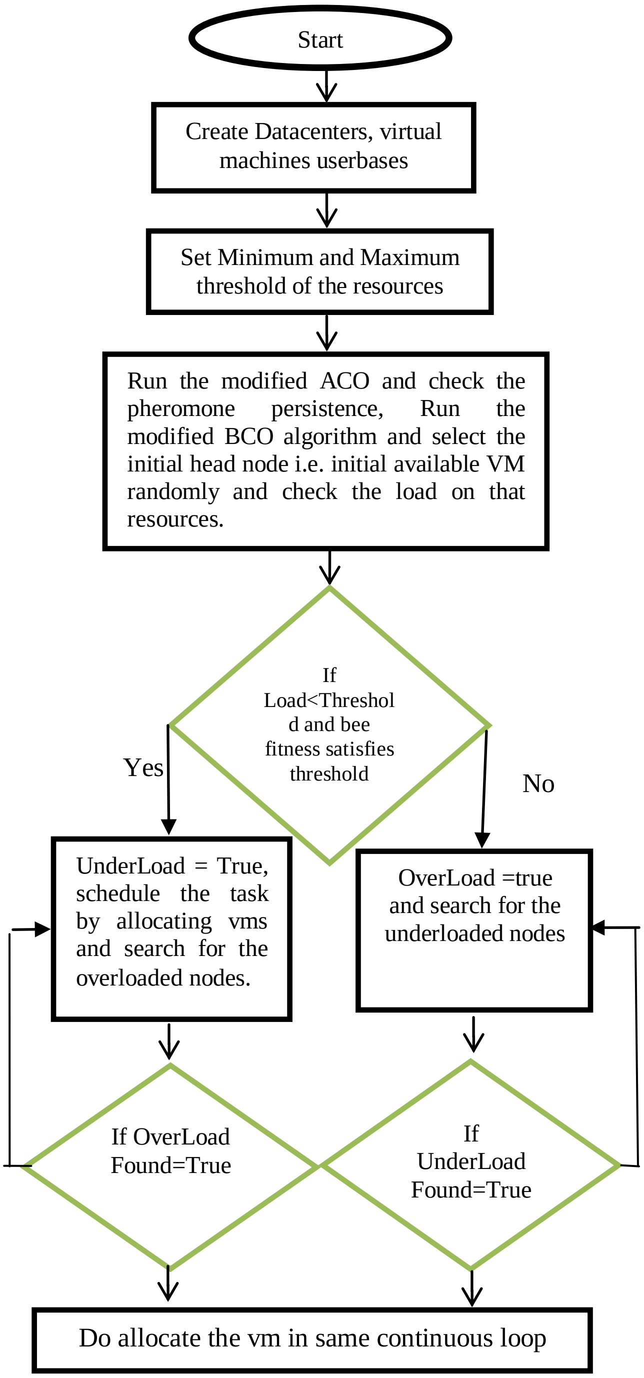

Fig. 1:Flowchart of Proposed Methodology

In this proposed work ACO is hybridized with Bee colony algorithm. Modified ACO and ABC algorithms will run to produce the output. On the completion of single iteration, the best common nodes with minimum load, maximum resources will be selected as optimized solutions to balance load. In this work Bee colony algorithm is used to check the fitness of the machines in order to enquire whether the machine is capable enough to handle the load or not. In this proposed ACO load balancing is done on the virtual machines along with the scheduling of tasks

Proposed Methodology:

Step 1: Use the P-ACO technique for scheduling User bases and Datacenter.

P-ACO:

Step I: Create the datacenters, virtual Machines and user bases.
Step II: Set minimum and maximum threshold of the resources.
Step III: Run the modified ACO and check the pheromone persistence, Run the modified BCO algorithm and select the initial head node i.e. initial available VM randomly and check the load on that resource.
Step IV: Check whether the load is less than the threshold value and fitness of bee satisfies the threshold or not.

- If yes then underload condition will be true, tasks will be scheduled by allocating virtual machines and search for the overloaded nodes.
- If no then overloaded condition will be true and search for the underloaded nodes.

Step V: Allocate the virtual machines in the same continuous loop.

Step 2: Check the parameters like overall response time, Data centre processing time and cost.

Step 3: Take the same number user bases and datacenters and apply the existing ACO algorithm.

Step 4: Compare the result of existing algorithms with the P-ACO.

In this proposed methodology ACO and BCO works in parallel. In this technique modified ACO and modified BCO are hybridized. ACO consist of a single result set which keep on modifies by the ants to form a complete solution. BCO is used to check the fitness value of the virtual machine, i.e. BCO is used to ensure that the virtual machine is perfect for the task. In this technique userbases are mapped with the datacenters in order to schedule the tasks with the virtual machines and along with this the workload over the nodes will be maintained and load will be equally distribute over the virtual machines so as to attain the improve performance results.

In this methodology data centers, virtual machines and userbases were created and then the minimum as well as maximum threshold value of the resources will be set. By using that threshold value load will be balanced. Then the tasks will be allocated to the virtual machines.

IV. EXPERIMENT & RESULTS

The simulation and performance analysis has been performed using the cloud analyst toolkit. Following are the statistical metrics derived as the output of the simulation in the cloud analyst version of the simulator:

- Overall response time of the system
- Total Data Center Processing time
- Total Cost

Fig.2. Layout of Cloud Analyst

Case I: The position of six user bases has been arranged in the same region. By considering the Image size, bandwidth we have taken three data centers DC1, DC2, DC3 in different regions region 0, region 1 and region 2 respectively to handle the requests of these users.

Table -1 Performance metrics of ACO(Case I)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**57.95**
Data Center Processing Time(ms)	**8.09**
Total Cost($)	**2.73**

This table 1 shows the performance metrics of ACO of test case I. It reveals the performance of ACO by showing the outputs of three parameters. Among three two parameters shows the average time which are overall response time and data center processing time. Last but not the least third parameter shows the total cost.

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Table-2 Performance metrics of P-ACO(Case I)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**56.34**
Data Center Processing Time(ms)	**7.13**
Total Cost($)	**1.69**

This table 2 shows the performance metrics of Proposed ACO of test case I. It shows the performance of P-ACO by showing the outputs of three parameters. Among three two parameters shows the average time which are overall response time and data center processing time. Last but not the least third parameter shows the total cost. The output of these parameters compare with the output of ACO. As a result P-ACO comes out to be a better approach then the existing one.

Using the defined configuration results has been calculated for the metrics like average response time, average processing time of the data center and total processing cost for the accomplishment of service request.

Average Response Time and Data Center (DC) Processing Time: The response time for six user bases and three data centers is being simulated and executed by cloud analyst for both ACO and Proposed ACO policies respectively, where average response time and data center processing time is calculated as:

$$\text{Response time} = (\text{Response}_{\text{Recieved}\,\Delta t} - \text{Request}_{\text{Sent}_t}) \quad (1)$$

$$\text{Response}_{\text{Recieved}\,\Delta t} = \sum \text{data\_size} \Big/ \sum_{c=1}^{c=k} \text{request} \quad (2)$$

Where $\sum_{c=1}^{c=k}$ requ is the total number of requests received by the virtual machine at time

$\text{Request}_{\text{Sent}_t}$ is the job request sent to the virtual machi at time t.

$\sum$ data_: is the total data processed.

$$\text{DC}_{\text{Processing}_{\text{Time}}} = \text{DC}_{\text{end}_{\text{time}}} - \text{DC}_{\text{start}_{\text{time}}} \quad (3)$$

Where start_time is the starting time when the data center is being started processing the task and is measured by gridsim_clock. end_time is the ending time when data center is finished the serving of the allotted task and is measured by gridsim_clock.

Case II: In this scenario, the position of five user bases has been arranged in the four regions i.e, UB1 and UB3 are in region 2, rest all are arranged in different regions. By considering the Image size, bandwidth we have taken three data centers DC1, DC2, DC3 in same region 0 in order to handle the requests of these users.

Table-3 Performance metrics of ACO(Case II)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**384.72**
Data Center Processing Time(ms)	**21.47**
Total Cost($)	**2.80**

Table-4 Performance metrics of ACO(Case I)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**368.98**
Data Center Processing Time(ms)	**10.39**
Total Cost($)	**1.83**

Case III: In this scenario, the position of ten user bases has been arranged in the five regions. We have taken five data centers DC1, DC2, DC3, DC4 and DC5 in same region 0 in order to handle the requests of these users.

Table-5 Performance metrics of ACO(Case III)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**248.33**
Data Center Processing Time(ms)	**2.31**
Total Cost($)	**5.94**

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Table-6 Performance metrics of P- ACO(Case III)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**244.58**
Data Center Processing Time(ms)	**1.91**
Total Cost($)	**2.94**

Case IV: In this scenario, the position of fifteen user bases has been arranged in the six regions. By considering the Image size, bandwidth we have taken five data centers DC1, DC2, DC3,DC4, DC5 in various regions in order to handle the requests of these users.

Table-7 Performance metrics of ACO(Case IV)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**140.86**
Data Center Processing Time(ms)	**2.38**
Total Cost($)	**8.95**

Table-8 Performance metrics of P-ACO(Case IV)

Performance Metrics	
Parameter	**Output**
Overall Response Time (ms)	**135.81**
Data Center Processing Time(ms)	**1.16**
Total Cost($)	**3.96**

It is clearly visible from the test cases that the performance of Proposed ACO is better than the performance of existing ACO technique.

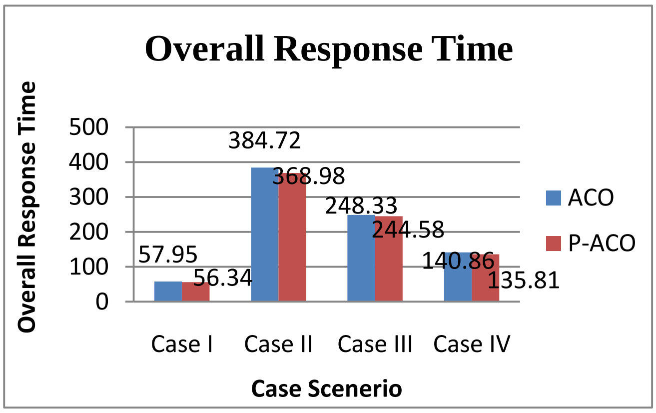

Fig. 3. It shows the comparison graph between ACO and Proposed ACO. It clearly shows that the Overall Response Time of P_ACO is better in comparison to existing ACO.

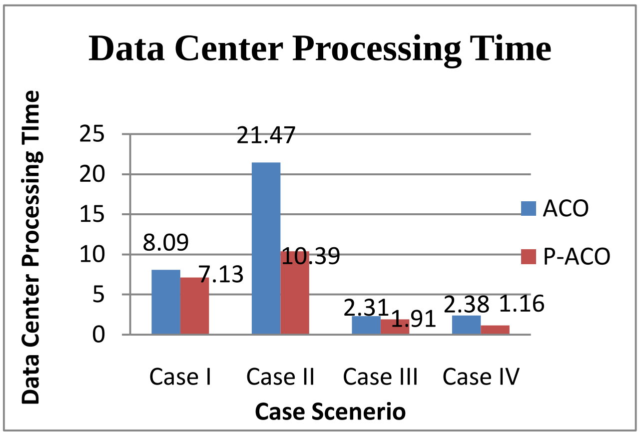

Fig. 4. It illustrates the comparison graph between ACO and P- ACO. It evidently shows that the Data Center Processing Time of P_ACO is better than the existing ACO.

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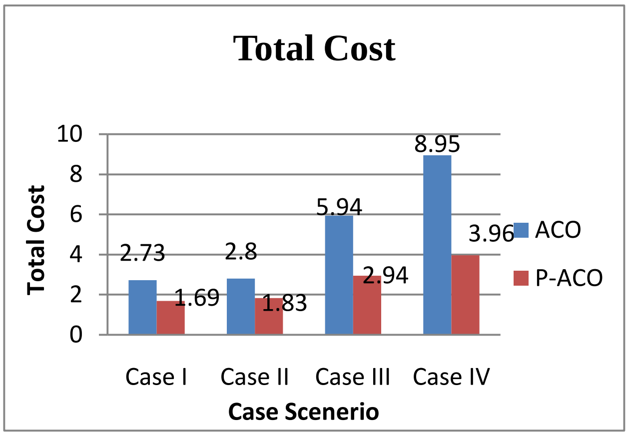

Fig. 5. It shows the total cost comparison between ACO and P-ACO.

V. Conclusion

Scheduling is becoming a major concern in cloud computing in which resources are to be shared over the network in a particular manner. If the resources are not scheduled properly the consumer will not get satisfaction. On the other hand it is also necessary to balance the load on virtual machines. The Ant colony optimization algorithm a metaheuristic technique used to find the nearer optimal solution within relative time. ACO is most popular technique and it is widely used in the cloud environment. Moreover it is also used with combination of other metaheuristic technique as a hybrid. In this dissertation part the main focus is to improve three parameters Overall Response Time, Data Center Processing Time and cost. Here, A technique is proposed P-ACO in order to minimize these three parameters so as to attain the user satisfaction. In this approach ACO is hybrid with the Bee colony algorithm in order to improve the performance metrics. So, It shows that Proposed ACO technique is better than existing ACO.

VI. Future Scope

Ant colony optimization is very efficient research direction which can be further explored. Time and cost can be further improved by hybridization of different approaches with ACO.

1. It can be improve by hybridization of ACO with Genetic Algorithm.
2. It can be further improve by improving the pheromones trails.
3. It can also be improve by enhancing the fitness value of bee colony algorithm.

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