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IACO-LB: A Navel Technique for Load Balancing in Cloud Computing

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ABSTRACT: Cloud computing is an emerging technology. It process huge amount of data so scheduling mechanism works as a vital role in the cloud computing. It provides on-demand access to shared pool of resources over Internet. Load balancing is required to distribute the workload equally among all nodes so that no node is overloaded .In this paper we are using ACO in combination levy flight in one of the step to generate the population to obtain better solutions. This paper mainly focuses on reducing the makespan and increasing the average resource utilization. The simulations have been carried out using cloudsim toolkit. In the conclusion we observed that M-ACO is better than ACO.

KEYWORDS: Cloud Computing; ACO; Levy flight; Makespan; Average Resource Utilization.

I. INTRODUCTION

Cloud computing is a newly progressing technique which offers online computing resources, storage and permits users to organize applications with enhanced scalability, availability and fault tolerance. Cloud computing is about storing the stuff on remote servers instead of on own computers or other devices. This information can be retrieved using the internet with any device, everywhere in the world as long as that device can support cloud computing systems. Its characteristics describe a cloud computing system: on-need self-service, pooling of resources, access to the internet.

The goal of scheduling is to map tasks to appropriate resources that optimize one or more objectives. Scheduling in cloud computing belongs to a category of problems known as NP-hard problem due to large solution space and thus it takes a long time to find an optimal solution. There are no algorithms which may produce optimal solution within polynomial time to solve these problems. In cloud environment, it is preferable to find suboptimal solution, but in short period of time. Meta heuristic based techniques have been proved to achieve near optimal solutions within reason-able time for such problems. In this paper, we provide an extensive survey and analysis meta-heuristic techniques: Ant Colony Optimization (ACO

Ant Colony Optimization (ACO) is a meta heuristic technique that is inspired by the behavior of real ants finding the shortest path between their colonies and a source of food. This novel approach was introduced by Dorigo While walking amid their colony and the food source, ants leave pheromones on the ways they move. The pheromone intensity on the passages increases with the number of ants passing through and drops with the evaporation of pheromone. As the time goes on, smaller paths draw more pheromone and thus, pheromone intensity helps ants to recognize smaller paths to the food source .In this dissertation we are applying levy flight in one of the steps in ACO to reduce the makespan, and increase the average resource utilization of resources

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II. RELATED WORK

Ant Colony Optimization (ACO) Meta heuristic is inspired by the behavior of real ants finding the shortest path between their colonies and a source of food. This novel approach was introduced by Dorigo in 1992 in his Ph.D. thesis and was originally called ant system. While walking amid their colony and the food source, ants leave pheromones on the ways they move. The pheromone intensity on the passages increases with the number of ants passing through and

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drops with the evaporation of pheromone. As the time goes on, smaller paths draw more pheromone and thus, pheromone intensity helps ants to recognize smaller paths to the food source. In[1] the author presents a cloud task scheduling strategy by Load Balancing Ant Colony Optimization algorithm. The core motive of the work was to balance the whole system load while trying to minimize the make span of a given task set. In[3] author gives a new method for load balancing in Cloud Computing. Here they have focused only on accessing different web services In[4] the author presents Proposed technique based on the ACO where redistribution of overloaded nodes is done based on the threshold value. If the load on current node is less than the threshold ant will then search for overloaded node among the neighboring nodes of the current node and move to the underloaded node by checking its Foraging Pheromone value. Here ants move only in one direction at a time. In[5] author's discussed the various goals, issues, components, classification, different techniques and metrics for load balancing. Load balancing is one of the major concern in cloud computing, and the main purpose of it is to satisfy the requirements of users by distributing the load evenly among all servers in the cloud to maximize the utilization of resources, to increase throughput, to provide good response time and to reduce energy consumption.

III. PROPOSED ALGORITHM

ACO technique is inspired by the behaviour of the ants leaving a chemical substance pheromone. As the time goes some of the pheromone evaporates as a result some of the solutions cannot be finded so levy flight technique is used in one of the step to update the pheromone. The algorithm uses the levy flight technique for generating the better solutions than that of basic ACO as levy flight gives the better convergence rate.
For improving the performance of ACO, LF-ACO is used to change the pheromone volatilization coefficient ρ using Levy distribution while ρ is a constant in ACO, so we propose a new improved ACO algorithm based on Levy Flight (LFACO) in which each movement of each ant individual obey the levy distribution. In LFACO, we get the equation (1) for updating the location of each ant individual:

$$\tau_{ij}(t+1) = (1 - p_{i,j}) * \tau_{ij}(t) + \Delta\tau_{ij}(t) \qquad \text{eq. (1)}$$

In the eq(1), $p_{i,j} \sim levy(\beta)$, $levy(\beta) \sim u/|v|^{1/\beta}(\tau_{ij}(t+1) - \tau_{ij}(t))$ and $u \sim N(0,\sigma_u^2)$, $v \sim N(0,1)$

$$\sigma_u = \frac{\Gamma(1+\beta)\sin(\beta\pi/2)^{1/\beta}}{\Gamma((1+\beta)/2)\,\beta\,2^{(\beta-1)/2}}$$

IV. PSEUDO CODE

Procedure MACO:

1. **Initialisation**:
   - i. Initialise the pheromone value to a positive constant for each path between task and resources.
   - ii. Optimal Solution=null
   - iii. Place the m ants on random resources

2. **Solution construction for each ant:**
   Repeat for each ant
   - i. Put the starting resource in tabu list of this ant (for the first task)
   - ii. For all remaining tasks
     - a) Choose the next resource r_j for the next task t_j by applying following transition rule

$$P_{ij} = \frac{(\tau_{ij})^{\alpha}(\eta_{ij})^{\beta}}{\Sigma_{k\text{Ɛ}allowed}(\tau_{ik})^{\alpha}(\eta_{ik})^{\beta}} \quad \text{if } j \text{ Ɛ allowed, allowed means not in tabu list}$$

     Else 0
     - b) Put the selected resource in previous step

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End for
Until each ant build its solution

3. **Fitness:** Compute the fitness value of the solution of each ant
4. **Replacement**: Replace the optimal solution with the ant solution having best fitness value if its fitness value is better than optimal Solution.
5. **Pheromone Updation:**
   i) Update local pheromone for each edge using levy flight eq.(1)
   ii) Update global pheromone
6. Empty tabu lists of all ants
7. Repeat step 2 to 6 until stopping condition is met. Stopping condition may be the maximum number of iterations or no change in fitness value of ant solutions in consecutive iterations.
8. **Output:** Print Optimal Solution

End Procedure

V. SIMULATION RESULTS

The proposed algorithm is implemented with Cloudsim. Proposed algorithm gives the modified ACO by applying levy flight technique in one of the steps of ACO for generating the better solutions. Our results shows that the Makespan, Resource Allocation of proposed algorithm gives better results as compared to ACO

Table 1.comparision of ACO and M-ACO in terms of makespan, average resource utilization and load balance Rate

Algorithm	Makespan	Average Resource Utilization	LBR
ACO	6.922	71.116	64.88
M-ACO	**6.006**	**76.996**	**69.916**

Makespan

It is defined as the maximum completion time of application tasks executed Makespan is a measure of the time of the heterogeneous cloud system. Lesser is the makespan of a scheduling algorithm better it works. Fig 2 shows that the makespan of M-ACO is less as compared to that of ACO.

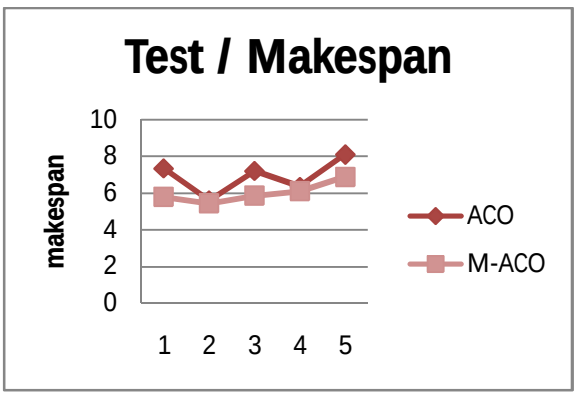

Fig 2.Sample wise Makespan

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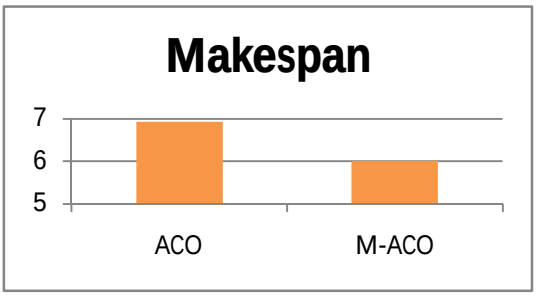

Fig 3. Average Makespan of ACO and M-ACO after running code 5 times

Average Resource Utilization (AvgRu)

AvgRU can be defined as the percentage of resources or VMs used by the cloudlets. More is its percentage, better the algo is. As, proposed algo has the highest value of it so, it is better than others. The resource's utilization (RU**)** is defined as the amount of time a resource is busy in executing tasks. In Fig 4 we can see that average resource utilization of M-ACO is high than that of ACO so it is better.

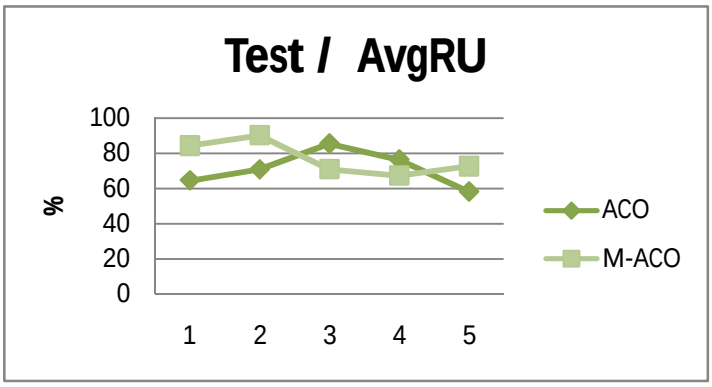

Fig 4. Sample wise AvgRU

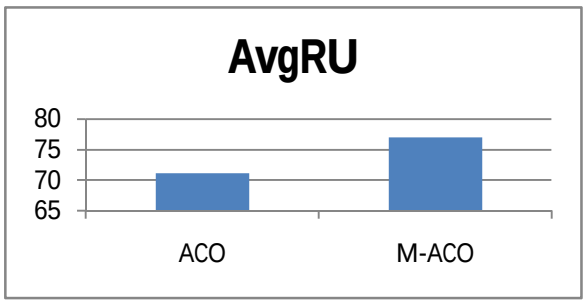

Fig 5.AvgRU of ACO and M-ACO after running code 5 times

Load balance Rate

Cloud Load Balancing is the Process of equally Distribution of Work Load across multiple computing Resources.LBR is the percentage of equally distribution of load on resources. Our proposed algorithm has high load balance rate .In Fig 6 it has been shown that MACO has better load balance rate than that of ACO.

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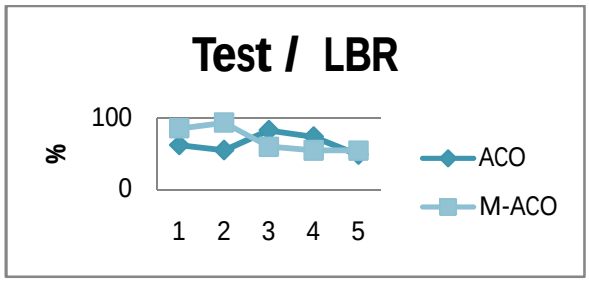

Fig 6. Sample wise load balance rate

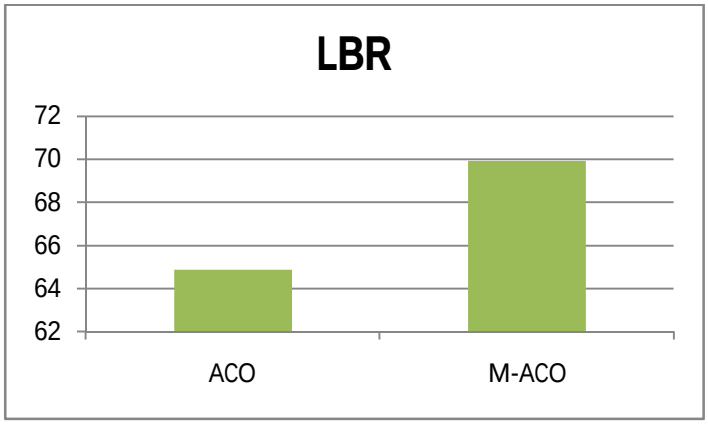

Fig 7.Comparison of load balance rate of ACO and M-ACO

VI. CONCLUSION AND FUTURE WORK

In this paper we modified ACO by using the levy flight (random walk) technique in one of the step to obtain better results than ACO.As a result makespan is reduced, average resource utilization and load balance rate is increased as well. Further we can apply different algorithms like firefly, cuckoo search, bat algorithm in modified ACO to obtain better results.

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