Mapping of Tasks to Resources Maintaining Fairness Using Swarm Optimization in Cloud Environment

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Abstract: Cloud computing gets its standard all over the world due to the necessity for delivering IT services, in excess with internet. It consist of pooled computing resources like network, applications, servers consist of parallel and distributed system based on the SLA. It has been perceived from the past decade that in a cloud environment task scheduling became concerned issue. In this paper our aim is to get better optimized results for which we do mapping of tasks to resources maintaining fairness using the PSO scheduling algorithm. The platform used for the experiment is CloudSim via which we attain more efficiency.

Index Terms – Computing cloud, Particle Swarm Optimization, Task Scheduling, QoS, Cloudlet, and CloudSim.

I. Introduction

One of the concerned matters of the existing combinatorial optimization problem is task scheduling in a cloud environment. This topic has drawn attention of many researchers towards it and there has many algorithms developed to reign over the restrictions on the enumerated method and provide more satisfaction to the consumers [5]. In In order to make reduction in time and cost we are taking tasks as an input factor from the workflow using the PSO algorithm further it will gain a good utilization and result in an increase in efficiency. The next part of paper is planned as follows: Related Work is in Section II has related work. Background knowledge is presented in Section III. Section IV.

II. Related Work

This part discusses about job scheduling problems. In this problem scheduling of tasks is very significant and challenging too. The job scheduling problems are mainly formulated when there is no perfect mapping between the resources and the user's need of requirement (QoS). In some cases jobs take much time to complete the work because of busy traffic route or may not get the access of that particular service required by the user.
Now think the JSPs consist of N jobs (no of jobs) with M machines. All the jobs are being processed in the same manner as allotted to their respective machines and it cannot be intermittent until it comes to an end. The chief purpose of JSPs is to set up a schedule that can minimize the maximum completion time of a particular job. In [1] authors have discussed in the paper about better understanding of the intend disputes of cloud computing. After having analysis on cloud computing they have shown all its interest in virtualization one of its key-concept. In [2] authors have proposed a latest approach in which an element is motivated from the new chain by applying a scheduling algorithm (PSO) for the flow shop scheduling, but it requires more computation times to optimize the result In [3] authors have proposed MIPSO algorithm, a combination of both PSO and enhancement of Multi-type individual scheme. Generally MIPSO algorithm gave better results than an existing algorithm to resolve problem like task scheduling, but it has limitation of increase in the computational load. In. [4] Authors deal with the problem of parallel machines scheduling. So, to minimize make span i.e. maximum expectation time they have proposed a combination of PSO discrete PSO algorithm (DPSO). Further for multiple objective parallel machines this proposed algorithm doesn't work accurately. In [5] authors have taken account for executing both optimize time and cost as well, which result, less cost is attained by applying PSO. In [6] authors keen interest is to maintain control over the operating cost of data transfer and to obtain the required result, they have revised the discrete PSO algorithm and named it as (RDPSO) in a cloud environment. In [7] authors have measured increase in requirement of both QoS and budget over cloud environment result in expansion of cloud scale. Hence the PSO algorithm is being adopted because workflow scheduling is not feasible here. In [8] authors have proposed an algorithm for the first time in cloud environment based on the Berger model for task scheduling. The execution of tasks by the proposed algorithm can successfully make fairness free from injustice. In this paper author have aimed to provide more satisfaction to user's by the judgement of the simulation results with the time shared algorithm. In [9] authors have proposed a PSO algorithm to run on a grid environment to solve task scheduling problem which are mainly arises in heterogeneous resources when giving users a free computational resource for scheduling tasks. In [10] authors have suggested a new model and techniques to remove the constraints from the

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heterogeneous and grid system by applying PSO to attain more satisfaction to user and provide better results. In [11] authors intended to get better efficiency and in order to get more efficiency the developed PSO algorithm has been compared with mutation, local search algorithm and crossover. By applying the PSO algorithm Cost factor for task scheduling may get reduced. In [12] the authors have done mapping b/w the allocated tasks to the appropriate resource, but before that first author's work out for every dimensional parameters weight. Thus, multi-dimension QoS is set forward to support cloud simulation scheduling algorithm. In [13] the authors have aimed to propose an improved PSO with the help of a simulation annealing technique to solve that challenging issue. At last the obtained result lifts the accessibility of resources with reduction in time. In [14] the authors have simulated the three task algorithm by using CloudSim to make balance between three constraints: priority fairness & efficiency. In [16] authors have discussed about an approach to have main attention on network awareness & manage the optimization of resource distribution. The main aim was to develop a framework for cloud computing, based on user requirement along with active measurement. In [17] authors run PSO on CloudSim by means of comparison analysis commencing different simulators. Load-balancing & workflow scheduling are also being used to perform efficient result.

III. Background awareness of PSO-Algorithm

Cloud computing services are used by many IT industries to have their growth in market oriented business [1]. Task scheduling is the concerned issue arising in the field cloud computing. This area of interest attracts many researcher attention to itself, where many algorithms are used by them to get rid out of the problem but even after getting better result from the existing algorithm, there might be some constraint left. So, PSO algorithm is being proposed by Eberhard & Kennedy in 1955 encouraged by observing a group of birds or fish school. The main function which motivates PSO be to achieve the best possible path b/w individual member and their surrounding neighborhoods.

Some scientist gives their view that there is a mutual behavior of insect-colonies, a group of birds, fish-school and other animal societies where they each look for their food and observed their social behavior. Each particle in PSO represents a candidate's position and improves the condition of the global best (overall best) solution at the same time as the swarm iterates. Then particle iteratively estimates the suitability of candidate solution [13, 14].
In each generation, a better route is being chosen via selecting best value from local maxima (local rate) & global maxima (global route) to find the optimal solution. PSO is self–adopted global search based technique motivated from the simulation of social behavior and therefore it resolves many resource scheduling problems in a cloud environment. In the next section of the paper the brief introduction to proposed PSO algorithm is being explained.

IV. Gap Analysis

There are following points measured in the gap analysis:

Optimization- More optimization gives better result by applying PSO scheduling algorithm.

Time complexity- After the proper utilization of machines time complexity is less as compared with simulation results.
Less cost- less cost is attained when performing the experiment in simulation platform as compared to real infrastructure.
Hybrid Technique- applied in PSO only.

V. Proposed PSO Algorithm

This section illustrates the population- based optimization technique that can find very good solution in reducing the maximum time taken to complete the process. The central idea of using the PSO algorithm is, renew the population of individuals pertain some sort of operators, according to fitness information attain from the environment. The velocity of a particle means the rate of position change is vigorously attuned by its individual flying ability and neighborhood flying experience. The result attained by comparing the algorithm, in this paper is effectual and show better result than time-share simulation scheduling.
The simple description of PSO algorithm is given below

```
Initialize parameters
Randomly initialize the population randomly
Initialize each particle vector and velocity vector
Do {
Update each particle velocity & position;
Find the minimum time, according to the updated
Each particle position;
Evaluate each particle & update the personal
 best and global best;
Apply the local search;
      }
while (! Stop criterion).
```

Large number of jobs are submitted from different users and the user tasks are classified based on different parameter such as bandwidth, memory, completion time. This technique of classifying the tasks on the basis of their parameter are known to be Task Parameterization.

VI. Proposed Methodology

PSO evaluates a problem by having a number of candidate solutions, which are known as particles, and moving these particles around in the search-space fitting to simple mathematical formulae over the particle's position and velocity. The movement of each particle is affected by its local best known position and is also guided as to the best known positions in the search-space, these are updated as better positions and then they are found by other particles. This is expected to move the best particle termed as swarm toward the best solutions. At each generation, each particle in PSO can select best particle out of local maxima and global maxima based on the optimal completion time and that's because it is self–adopted global search based technique motivated by their own performance and their neighbor best result. It can search for an extremely large search space of candidate solutions without making any assumptions or very few assumptions about the optimization of the problem. Through the whole process goes out it will depend upon minimum iteration to find the optimal solution, if the solution is optimal then the process stops or else it will further process the next iteration for updating.

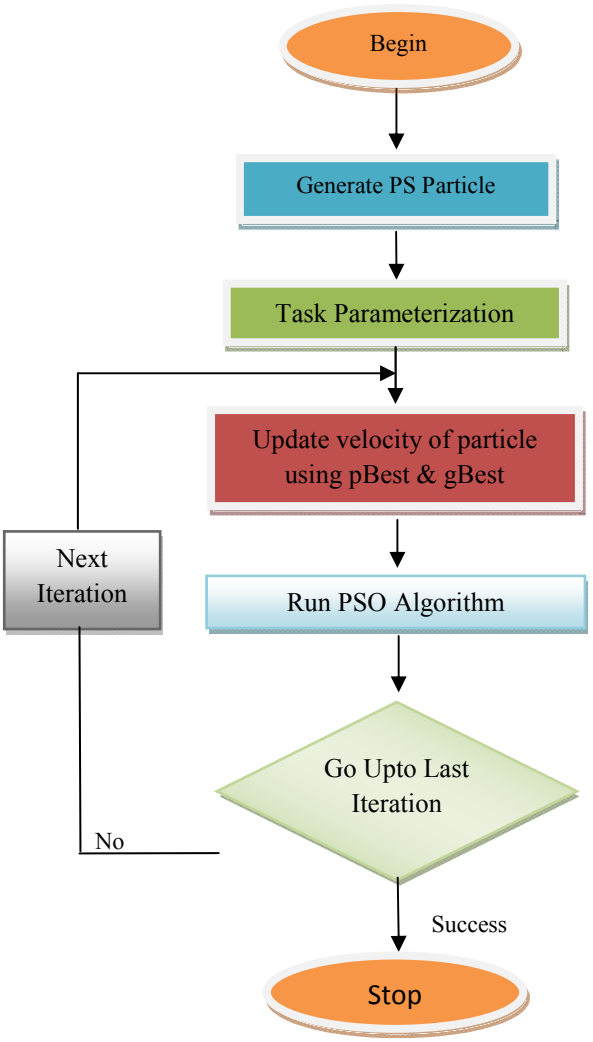

Fig.1 Flow Diagram of mapping of resources using the PSO algorithm

VI. Experiment Result

CloudSim is simulation software of cloud computing and experiment, part of this paper is done on the CloudSim platform [15]. CloudSim is publicized by the Gridbus project in April 2009.

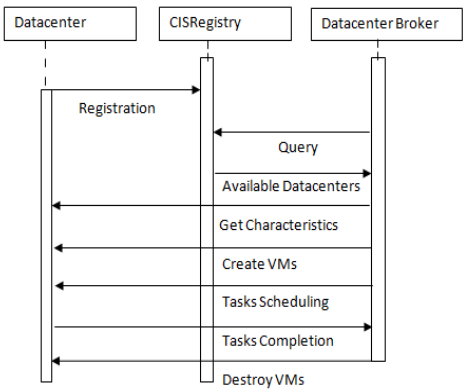

Fig.2 [29]: State Diagram of CloudSim

VII. Experiment Analysis

The result below shows how much time is taken by an individual particle on a particular machine to complete its work and its utilization during the whole job.

Tasks	T1	T2	T3	T4
Value of Processing times	13	18	24	22

Tasks	T5	T6	T7	T8	T9
Value of Processing times	28	15	19	24	27

Table VII (a): Represent starting utilization of scheduling

In this table, we have taken the initial value of processing times and the value is obtained by applying time-sharing algorithm.

Test 1

Iterations	Local maxima	global maxima	d(Cmax)
1	50	50	50
2	52	52	52
3	52	52	52
4	49	49	49
5	51	51	51
6	49	49	49
7	51	51	51
8	50	50	50
9	50	50	50
10	51	51	51
11	52	52	52
12	51	51	51
13	51	51	51
14	50	50	50
15	52	52	52
16	52	52	52
17	52	52	52
18	51	51	51
19	49	49	49
20	51	51	51
21	50	50	50
22	52	52	52
23	50	50	50
24	51	51	51
25	51	51	51

Iterations	Local maxima	global maxima	d(Cmax)
26	50	50	50
27	49	49	49
28	52	52	52
29	51	51	51
30	51	51	51
31	50	50	50
32	49	49	49
33	52	52	52
34	49	49	49
35	51	51	51
36	52	52	52
37	52	52	52
38	50	50	50
39	51	51	51
40	50	50	50
41	49	49	49
42	51	51	51
43	50	50	50
44	52	52	52
45	51	51	51
46	51	51	51
47	52	52	52
48	52	52	52
49	50	50	50
50	51	51	51

Table VII (b): Reveals the selection of local maxima & global maxima

The results comes show that the proposed PSO approach yields good results efficiently. An examination of Table1 reveals that the selection between local maxima & global maxima to find the optimal solution. In addition, the optimal solution is reached several times in one run.

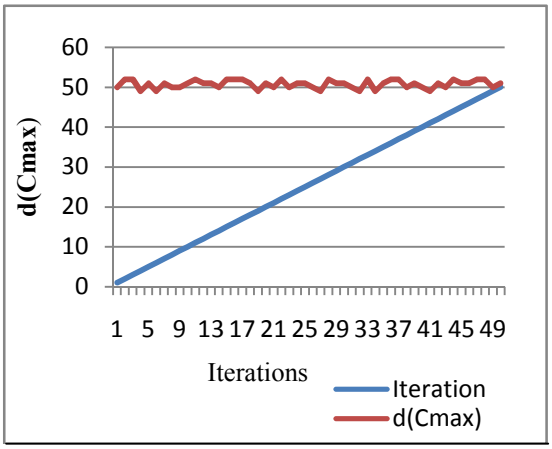

Fig. VII (a): Optimum value attained depends upon no. of iteration

The above graph shows the result comes from the selection between local & global maxima. The maximum value selects out from both of them that gives the optimum result.

Machine	Scheduled Jobs			*Ci*
M1	Task1	Task3		48
M2	Task5	Task9		47
M3	Task4	Task7		49
M4	Task2	Task5	Task6	46

Table VII (c): Reach to best Optimization tasks after PSO

The results show the optimal value achieved by each task after applying the proposed PSO algorithm. Task 1 and Task 3 attain value is 48 performed on Machine1. The best attained value by Task 5 & Task 6 is same i.e. 47 performed on Machine2. On Machine3 Task 4 & Task 7 gain value 49 yields good results efficiently. At last, three tasks Task 2, Task 5 and Task 6 reach to the value 46 performed on Machine 4. three tasks Task 2, Task 5

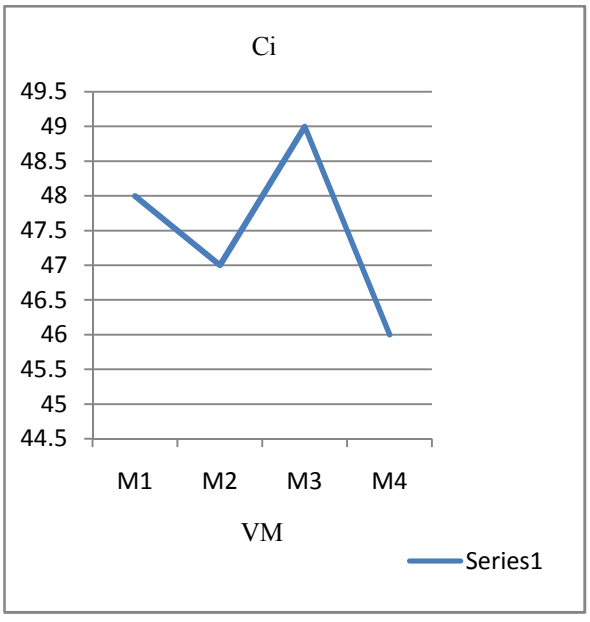

Fig. VII (b): Max. Utilization of Machines

Above graph represents the best optimal value achieved after applying PSO and the values come after no. of iterations being processed.

Test 2

Iterations	Local maxima	global maxima	d(Cmax)
1	50	50	50
2	52	52	52
3	52	52	52
4	49	49	49
5	51	51	51
6	49	49	49
7	51	51	51
8	50	50	50
9	50	50	50
10	51	51	51
11	52	52	52
12	51	51	51
13	51	51	51
14	50	50	50
15	52	52	52
16	52	52	52
17	52	52	52
18	51	51	51
19	49	49	49
20	51	51	51
21	50	50	50
22	52	52	52
23	50	50	50
24	51	51	51
25	51	51	51

Iterations	Local maxima	global maxima	d(Cmax)
26	50	50	50
27	49	49	49
28	52	52	52
29	51	51	51
30	51	51	51
31	50	50	50
32	49	49	49
33	52	52	52
34	49	49	49
35	51	51	51
36	52	52	52
37	52	52	52
38	50	50	50
39	51	51	51
40	50	50	50
41	49	49	49
42	51	51	51
43	50	50	50
44	52	52	52
45	51	51	51
46	51	51	51
47	52	52	52
48	52	52	52
49	50	50	50
50	51	51	51

Table VII (d): Reveals another set of selection to find an optimal result between local maxima & global maxima

From the above results it has been calculated that the proposed PSO approach acquire good results efficiently. An examination of Table VI (d) reveals that the selection between local maxima & global maxima to find the optimal solution.

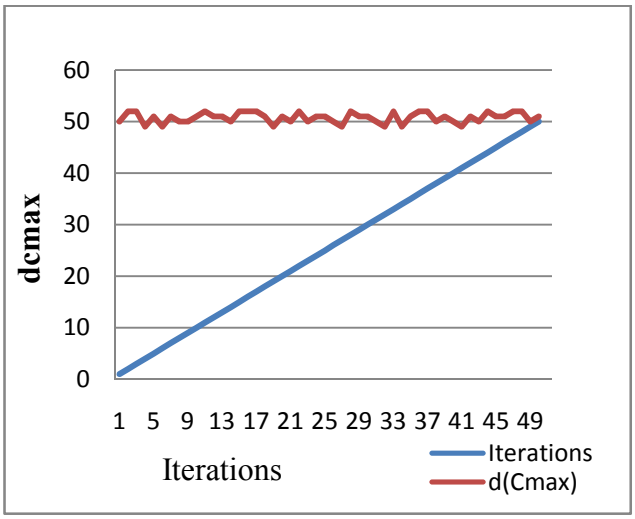

Fig. VII (c): Represents optimal values achieved after applying PSO.

The above graph shows the result comes from the selection between local & global maxima. The maximum value selects out from both of them that gives the optimum result.

Machine	Scheduled Jobs			*Ci*
M1	Task 8	Task 3		48
M2	Task4	Task9		49
M3	Task1	Task 7	Task 6	47
M4	Task2	Task 5		46

Table VII (e): Represents Optimization tasks after PSO

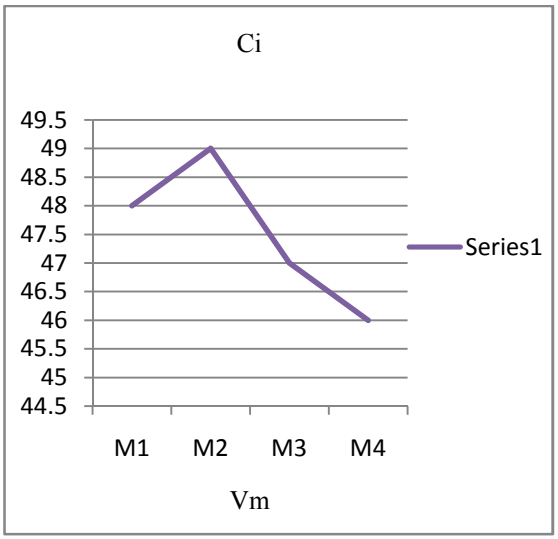

Fig. VII (d): Utilization of Machines

VII. Conclusion and Future Work

Each user in Cloud computing has their on-demand network access from where they can use a shared pool of configurable resources conveniently. After surveying from literature it is concluded that a lot of existing work required in this area of task scheduling. PSO is used mostly for the existing work and always show different weights to cost minimization. For scheduling task PSO is used for first time. Therefore we should build up our main approach run a PSO algorithm on cloud platform for optimal completion time. By comparing Time-sharing simulation result with the PSO algorithm it reveals that optimal result i.e. minimum completion time will be achieved.

Future Scope: We have attained better result using CloudSim platform in our research now other simulation tool may be selected to gain some better result as compared to this. We may also use Ant Colony Optimization algorithm for task scheduling

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