Particle Swarm Optimization Based Load Balancing in Cloud Computing

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***Abstract*— Cloud computing is a technology that facilitates tasks by allocating virtual machine (VM) dynamically. Users charge resources as they use based on their demands. There are so many challenges faced by cloud provider. One of the most challenges for him is load balancing. There are so many algorithms are available for proper load balancing but here we are focusing on particle swarm based algorithm that can balance the load in cloud computing so that resources are easily available for users. Our aim is to develop an efficient load balancing algorithm using particle swarm based to minimize performance paramaters like make span.**

Keywords—Cloud Computing, Load Balancing, Cloud Provider, Virtual Machine

I. INTRODUCTION

Cloud Computing is an on demand services in which resources, information and software are provided as per clients need. Now a days there are number of challenges faced by cloud computing and load balancing is one of the most issue in cloud. Number of users is increase and if proper load balancing is not done then performance of cloud computing is decrease. Load balancing is technique to equally distribute load among the resources. In this paper our main objective is to minimize make span using Particle swarm optimization (PSO) load balancing technique. The overall paper is arranged in a planned way as follows: section 2 provides the types of load balancing algorithm. Section 3 provides problem formulation. Section 4 gives particle swarm optimization algorithm. Section 5 gives particle swarm optimization load balancing algorithm. Section 6 describes simulation and result and Section 7 gives conclusion and Future work.

II. TYPES OF LOAD BALANCING ALGORITHMS

Load balancing is the technique to distributing workloads across multiple resources. Cloud load balancing minimize costs associated with document management systems and maximizes resources availability. Figure (1) represents different load balancing algorithms. [1]

Depending who initiated the process, load balancing algorithm can be classified into three categories.[2]

- Sender Initiated: - If the load balancing algorithm is initiated by server.
- Receiver Initiated: - If the load balancing algorithm is initiated by receiver.

Symmetric: - It is combination of both sender and receiver.

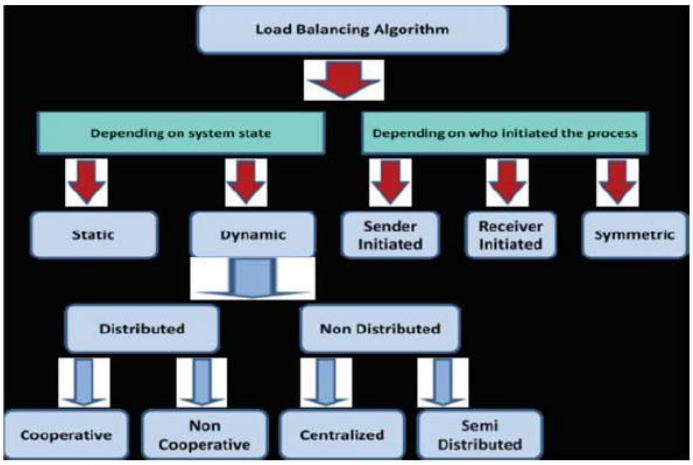


Figure (1) Types of Load Balancing Algorithm

Depending on the current state of system it can be classified into two types.

- Static Algorithm: - In this type the assign of task to processor is done before program execution is begin. It does depend on current state of system. Static algorithms are non preventive its main aim is to minimize the overall execution time.
- Dynamic Algorithm: - It is based on the redistribution of process among the processors during execution time. Its main aim to improve the performance of application to transfer task from heavily loaded processor to lightly loaded processor. No prior knowledge is needed. So it is better than static approach.

Policies of Load Balancing Algorithm:[3][4]
There are 4 policies:

- Transfer Policy: The part of the dynamic load balancing algorithm which selects a job for transferring from a local node to a remote node is referred to as Transfer policy or Transfer strategy.
- Selection Policy: It specifies the processors involved in the load exchange (processor matching)
- Location Policy: The part of the load balancing algorithm which selects a destination node for a transferred task is referred to as location policy or Location strategy.
- Information Policy: The part of the dynamic load balancing algorithm responsible for collecting information about the nodes in the system is referred to as Information policy or Information strategy.

Swarm Based Algorithms [5]

Swarm intelligence is the study of computational systems inspired by the 'collective intelligence'. Collective Intelligence emerges through the cooperation of large numbers of homogeneous agents in the environment. Examples include schools of fish, flocks of birds, and colonies of ants. Such intelligence is decentralized, self-organizing and distributed throughout an environment. In nature such systems are commonly used to solve problems such as effective foraging for food, prey evading, or colony re-location. The information is typically stored throughout the participating homogeneous agents, or is stored or communicated in the environment itself such as through the use of pheromones in ants, dancing in bees, and proximity in fish and birds.

Types of Swarm Based Algorithm for Load Balancing:

1) Genetic Algorithm
2) Particle Swarm Optimization
3) Ant Colony Optimization
4) Artificial Bee Colony

III. PROBLEM FORMULATION

Cloud computing is new technique to provide online resource dynamically when user demands for it. But when number of users is increase at that time load balancing is main issue for cloud computing. Load can be balance if we use proper scheduling management technique. Load balancing can be done at different levels of cloud computing. In this paper we are focusing on load balancing among VMs. Our main objective of this paper to minimize makes span time with the help of proper load balancing algorithm.

Let T={Task1,Task2,……,M}is a set of M task to be assign and process on different VMs. Here VM= {VM1,VM2,….K}is a set of K different VMs. We use non preemptive scheduling approach mean when one VM is processing one cloudlet until it will not complete its execution that VM is not assign to another cloudlet. [5].

IV. PARTICLE SWARM OPTIMIZATION ALGORITHM

Particle Swarm Optimization (PSO) is self adaptive global search based optimization introduced by Kennedy and Eberheart [6] algorithm. PSO is influenced by social behavior of animals like flock of birds finding food source. A Particle is analogue to bird flying through problem space. Each Particle contains velocity and solution. The performance of particle is measured by fitness value which is problem specific.

In this algorithm particles are initialized randomly. Each Particle contains fitness value which is calculated by fitness function. Each Particle knows its best position *pbest* and best position among entire group of particles *gbest.* In each generation velocity and position of each particle is updated using following equation (1) and (2).

v[] = v[] + c1 * rand() * (pbest[] - present[]) + c2 * rand() * (gbest[] - present[]) (1)

present[] = persent[] + v[] (2)

v[] is the particle velocity, persent[] is the current particle (solution). pbest[] and gbest[] are defined as stated before. rand () is a random number between (0,1). c1, c2 are learning factors. usually c1 = c2 = 2.

Detailed Pseudo code of the PSO Algorithm [7]

```
For each particle
   Initialize particle
END
Do
   For each particle
      Calculate fitness value
      If the fitness value is better than the best fitness value (pBest) in history
         set current value as the new pBest
   End
   Choose the particle with the best fitness value of all the particles as the gBest
   For each particle
      Calculate particle velocity according equation (a)
      Update particle position according equation (b)
   End
While maximum iterations or minimum error criteria is not attained
```

V. PSO BASED LOAD BALANCING ALGORITHM

In this algorithm position of particles are randomly initialized. Particles are the task to be assigned and dimension of particles is the number of tasks in workflow. Particle is nothing but the solution of the problem. It contains mapping of task to the available resources. The evolution of each particle is calculated using fitness function. Each particle knows its best position and best position among entire group [8].

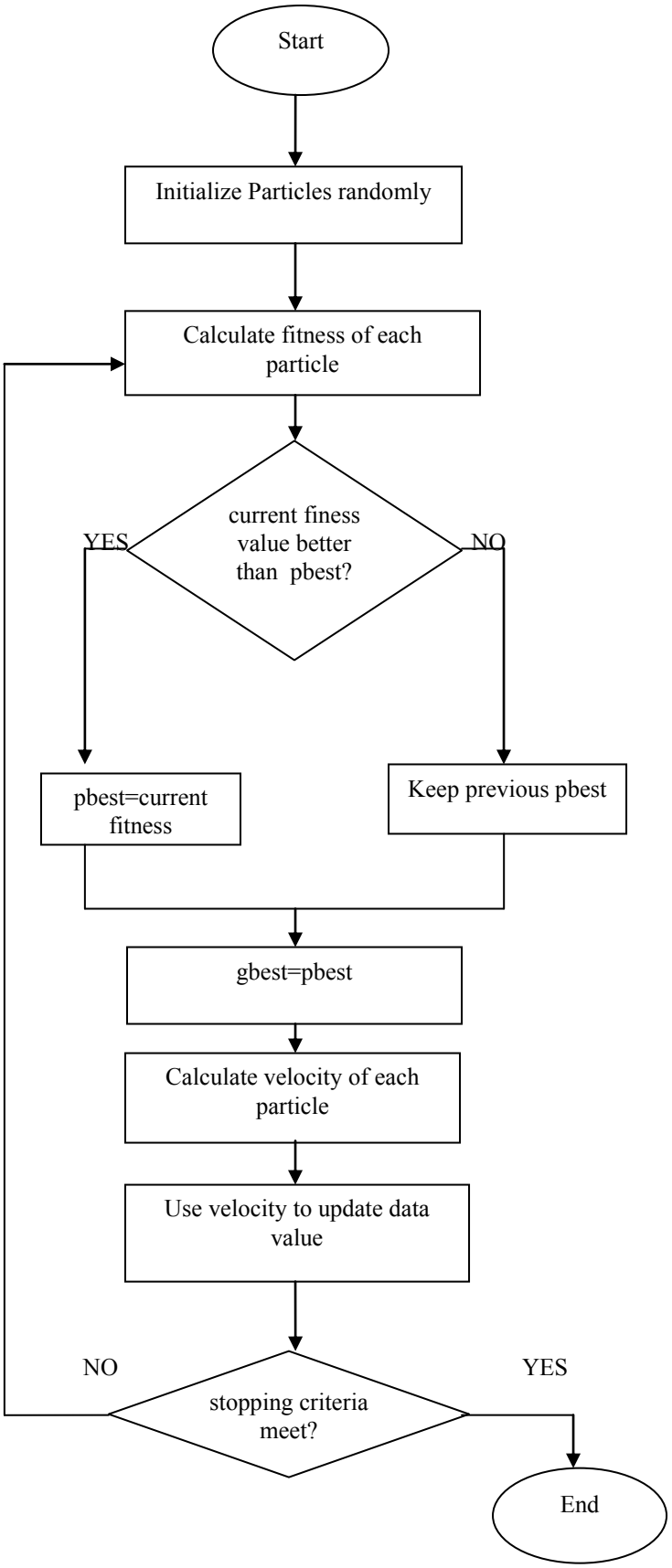


Figure 2. Flowchart of PSO Load Balancing Algorithm

VI. SIMULATION AND RESULT

A. Implementation Environment

The PSO algorithm is simulated using Cloudsim 3.0.2 Tool. Cloudsim3.0.3 is an open source simulator which has been developed by Gridbus project team and the grid Laboratory of the University of Melbourne in Australia. The Cloudsim can run on Linux and Windows systems [10]. The Experiments consists of different Parameters. Here we take only one data center and different task and VM, also we consider different number of iteration for getting better result. Based on different parameters in the Next section we will show the results.

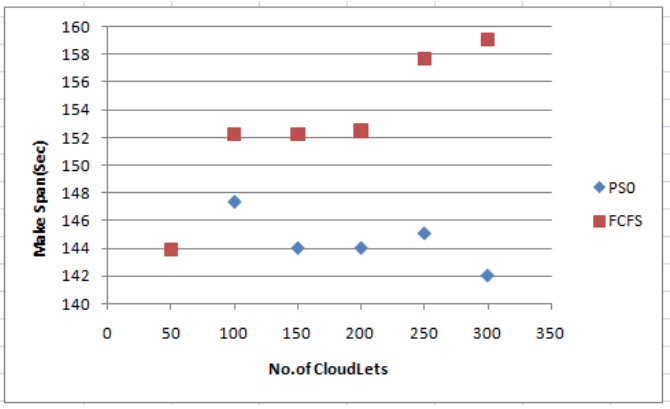
B. Parameters Setting

The Parameter setting of Cloudsim Simulator and PSO algorithm is shown below. Here we take different parameters and based on them we will get different results.

Configuration Variable	Value
Data Center	1
Host	1
VM	50
Cloudlet	Simulation Files/NASA-iPSC-1993-3.1-cln.swf(50-300)
Number of Particles	10

Table1 Parameter Setting of Cloudsim Simulator and PSO

C. Experiment Result



VII. CONCLUSION ANF FUTURE WORK

Load Balancing is greatest challenge in cloud Computing .The major objective of this algorithm is to minimize the make span

time. Here we use swarm based load balancing algorithm to achieve our Objective. Swarm based algorithm use nature inspired Optimization technique so we considering this in mind we have compared our algorithm with another FCFS algorithm .PSO algorithm gives better result as compared to FCFS. Comparison is based on minimum MAKESPAN time. In future we can design Preemptive Virtual Machine Scheduling which is able to perform load balancing and we can consider different parameter like throughput, average waiting time etc. to achieve our objective

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