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Enhancement of Dynamic Load Balancing Using Particle Swarm Algorithm in Cloud Environment

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Abstract:-- **Dynamic load balancing with decentralized load balancer using PSO technique: Cloud consists of multiple resources and various clients request to the cloud for allocation of shared resources. Each request will be allotted to the virtual machines. In different situation different machines get different load. So to balance the load amongst different virtual machines decentralized load balancer is enhanced using particle swarm algorithm. The main objective is reducing the energy and increasing the throughput in comparison to centralized and simple decentralized load balancer using particle swarm optimization.**

Keywords:-- **Centralized, Decentralized, Energy, PSO, Throughput**

I. INTRODUCTION

With high flexibility and great retrieval of data as per users' requirements, cloud computing provides numerous services. To handle a very large amount of data several techniques to optimize load and streamline operations are needed to achieve desired performance level for the users. The workload of a processor can be defined as the total time required by the processor to execute all the assigned processes. Load balancing is to ensure that every processor in the system does approximately the same amount of work at any point of time [11]. Load balancing is required so that time of total resource finding can be minimized. As well as rather than having load on all the machines load can be given on all the machines evenly.

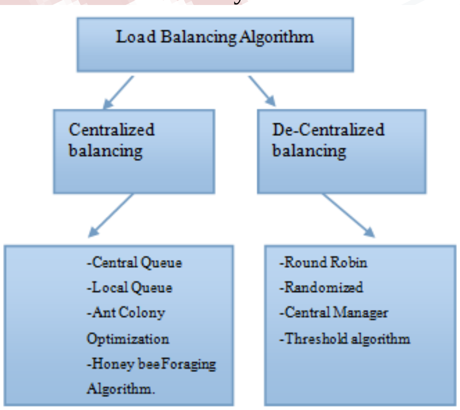

Figure1. Type of load balancing

1.1 Centralized load balancing algorithm:

The work load is distributed among the processor at runtime. In this mechanism, master assigns new processes to the slaves based on the new information collected.

Work is central. In non distributed manner one node execute the load balancing algorithm and task of load is shared among them.

Nodes interact in two ways: cooperative and non-cooperative [2].

The main advantage here is, the total load balancing process will get affected, if, one or more node stop working it will just affect the overall performance of system in a certain manner.

In central type, the task of load balancing is done by either single node or group node.

Central load balancing takes two forms: centralized and semi-distributed. In centralized form one node is solely responsible for load balancing of the whole system and other nodes simply interact with the central node.

1.2 Decentralized load balancing algorithm:

It depends on a priori information of the applications and static information about the load of the node.

They do not consider the existing state of system; rather they consider processing power, memory and storage capacity and recently known communication performance. Distributed algorithms are basically suitable for homogeneous and steady environments. Distributed algorithms always work in master – slave manner, where the performance of any processor is determined before starting the actual execution [3][4][5].

1.3 Particle swarm algorithm (PSO): PSO is a swarm based heuristic optimization technique. It is used for identifying the optimal path of solution space. While putting up the load on specific virtual machine for processing of the resources, it moves along all the virtual machines and identifies the optimal machine to put the load. It is one of the mechanisms to identify the optimal V.M, which is load less, available and task map. So the relative energy and time utilization to process the node can be reduced.

Basic Steps for PSO:

1. Initialize population of particles with random position and velocities.
2. Calculate the fitness function value for each and every particle.
3. Compare current particle's fitness value with each particle's fitness value and find Pbest value.

II. LITERATURE SURVEY

In [14], Dr. M.Sridhar et al. defined scheduling is a task performed to get maximum profit to increase cloud computing work load efficiency. For this, resource utilization and managing of load between resources with minimum execution time becomes the main objective. Optimization is the selection of best element (pertaining to specified criteria) from available variable alternatives with the goal to i.e. to accomplish – "maximal output with minimal input". So, a hybrid Particle Swarm Optimization (PSO) is proposed which performs better in execution ratio and average schedule length when it is compared with Max-min scheduling and minimum execution time.

Author Madhurima Rana et al. in [6] discussed Load balancing that ensures no single node will be overloaded and used to distribute workload among multiple nodes improving the system performance and ensuring proper utilization of resources. It also minimizes the time and cost involved in big computing models. To overcome load balancing problem a summary is provided of evolutionary and swarm based algorithms in different environment of cloud. Various soft computing approaches to optimize the load are discussed like Genetic algorithm, Particle swarm optimization, Ant colony optimization, artificial bee colony and other various algorithms. The issues involved in these techniques are listed in a tabular form comparing each other.

The chaos cloud particle swarm optimization algorithm based on the golden section evaluation criteria is presented by Xi Song et al in [4]. Particle swarm is divided into standard particle, chaos-cloud particle and cloud particle using the judge principles based on golden section according to the fitness value. Each population is operated by the different algorithm. An optimal power flow model for Available Transfer Capability (ATC) under the static security constraints is established. The algorithm proposed solves the problems of easily falling into local optimum in basic PSO and the drawback of repeatedly search part of solutions in chaos optimization. It has high accuracy in ATC calculation and can make full use of power resources. Gulshan Soni et al. discussed the biggest challenge for cloud data centers i.e. how to handle and service the millions of requests that are arriving very frequently from end users efficiently and correctly in [2]. In cloud computing, load balancing is required to distribute the dynamic workload evenly across all the nodes. Load balancing helps to achieve a high user satisfaction and resource utilization ratio by ensuring an efficient and fair allocation of every computing resource. Proper load balancing aids in minimizing resource consumption, implementing fail-over, enabling scalability, avoiding bottlenecks and over-provisioning etc. "Central Load Balancer" is a load balancing algorithm to balance the load among virtual machines in cloud data center. Results showed that the algorithm can achieve better load balancing in a large-scale cloud computing environment as compared to previous load balancing algorithms.

In [1], Michael Pantazoglou et al. Discussed decentralized approach towards scalable and energy-efficient management of virtual machine (VM) instances that are provisioned by large enterprise clouds. Also, the computation resources of the data center are effectively organized into a hypercube structure. The hypercube seamlessly scales up and down as resources are either added or removed in response to changes in the number of provisioned VM instances. Without supervision from any central components, each compute node operates autonomously and manages its own workload by applying a set of distributed load balancing rules and algorithms. On one hand, underutilized nodes attempt to shift their workload to their hypercube neighbors and switch off. On the other, over utilized nodes attempt to migrate a subset of their VM instances so as to reduce their power consumption and prevent degradation of their own resources, which in turn may lead to SLA violations. In both cases, the compute nodes in our approach do not overload their counterparts in order to improve their own energy footprint. An evaluation and comparative study of the proposed approach provides evidence of its merits in terms of elasticity, energy efficiency, and scalability, as well as of its feasibility in the presence of high workload rates.

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Enhancement of the make span of particle swarm optimization based dynamic scheduling in cloud environment is done in [17] by Azade Khalili et.al. Mapping and scheduling the tasks is assigning task to run on the existing resources that helps to maximize utilization and minimize make span. The objective was to optimize task scheduling that uses PSO algo to minimize make span by using different inertia weights. The linear descending inertia weight(LDIW) with an average 22.7% reduction in make span shows best performance.

Jun Zhang et al. proposed a Set-Based PSO approach. It tackles a cloud workflow scheduling problem which enables users to define various Qos constraints like deadline constraint, budget constraint and reliability constraint in [9]. It enables users to specify one preferred Qos parameter as the optimization objective. Defined penalty based fitness functions to address multiple Qos constraints and integrate S-PSO with seven heuristics. A discrete version of Comprehensive Learning PSO algorithm based on S-PSO is implemented.

Geng Yushui et al. in [24] defined data migration which is the key technology to realize the nodes dynamically extensible and elastic load balancing. To reduce migration cost of time is the problem that cloud service providers need to solve.

In [18], Hongwei Zhao et al. designed PSO algorithm in order to implement the balanced distribution in Cloud Computing system and to improve the utilization ratio of the resource as well as handling up rate of the system. The system of dynamic dispatching system based on Particle swarm optimization (PSO) for Cloud Computing Environment has been s and implemented after the study on the Cloud Computing.

III. RESULTS AND DISCUSSIONS

Over lead and under load:

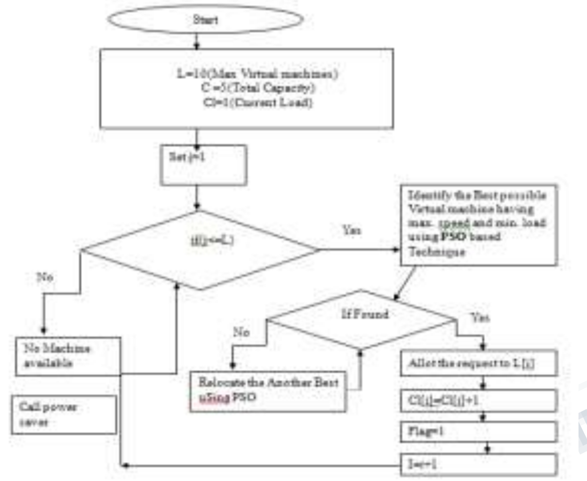
Each virtual machine has capacity to take up the load and also max. capacity to buffer the queue. Once this queue will be filled and on each subsequent addition of the request will overload the virtual machine. Under load is the situation when the virtual machine has load less than the max. Capacity that machine can undertake.

V.M. Migration:

It is the process of migration of request from one machine to other, so that two objectives can be achieved.

1. Saving the system from overloading on few virtual machines. Ie it should be evenly distributed.
2. Saving the power consumption by shifting the load of two or more virtual machines to one or more machines/ so that few machines power can be shut off. In result power will be saved.

Flow Chart of Proposed Algorithm



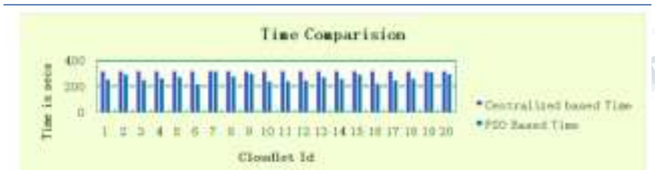
Parameter improved:

1. Reduction in time required for execution of request due to less waiting time.
2. Total power consumption for cloud ie energy reduction by request completion.

IV. EXPERIMENTAL RESULTS

Time Comparison:

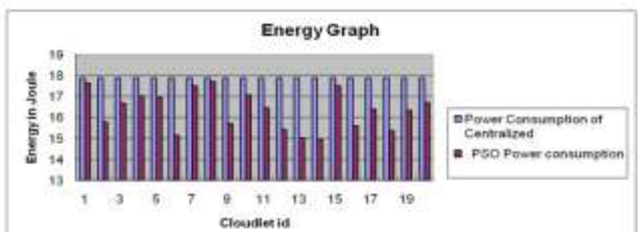
	Time Comparison	
Cloudlet ID	Centralized based Time	PSO Based Time
0	320	259
5	320	296
1	320	254
6	320	265
2	320	274
7	320	222
3	320	320
8	320	281
4	320	302
9	320	242
100	320	244
105	320	246
102	320	274
107	320	262
104	320	295
109	320	226
101	320	248
106	320	261
103	320	314
108	320	297



In first table there is the comparison of time taken by previous technique and current technique. In this table this time denotes the time taken for load balancing. Such that overloading of the machines can be avoided. In current PSO based technique is a improvement in time. As this improvement is around 20% to 21%. Such that centralized technique requires more time for load balancing.

Energy Comparison

	Energy Graph	
Cloudlet ID	Power Consumption of Centralized	PSO Power consumption
0	17.888544	17.66352
5	17.888544	15.779734
1	17.888544	16.673332
6	17.888544	17.029387
2	17.888544	17
7	17.888544	15.132746
3	17.888544	17.521416
8	17.888544	17.720045
4	17.888544	15.716233
9	17.888544	17.088007
100	17.888544	16.462078
105	17.888544	15.427249
102	17.888544	15.033297
107	17.888544	14.933185
104	17.888544	17.521416
109	17.888544	15.588457
101	17.888544	16.40122
106	17.888544	15.362291
103	17.888544	16.340136
108	17.888544	16.703293



In energy comparison of both the techniques there is PSO based technique shows that less energy is required for load balancing in comparison to the centralized technique. There is a improvement around 18%.

V. CONCLUSION AND FUTURE WORK

In this paper extensive load balancing is done based on PSO using decentralized load balancing technique. On taking up the decentralized load balancing by PSO technique the aim is achieved. Previously load balancing in existing research paper is based on decentralized load balancer. In our current work we will be improving the technique by using PSO and also enhancement of the parameters is done. Main goal is to have load balancing and distributing the load on each machine for better utilization of the resources.

Current research work is based on PSO. Ie particle swarn algorithm. In which best possible solution is being identified . this PSO based technique imparts better results in comparison to centralized technique. As future work it can be compared to ABC and SMO techniques.

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