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Parallel Genetic Load Balancing with Competency Rank in Computational Grid Environment

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Abstract:-

Computational grid is an aggregation of geographically distributed network of computing nodes specially de-signed for compute intensive applications. The maximized utilization of the resources in the computational grid has helped to support all jobs: fine grain and coarse grain. There has been degradation in the performance over a period of time due to the imbalance in the load of heavy jobs though it has been scheduled optimally. Hence most of the complex optimization problems can be solved using an evolutionary computation technique, Genetic Algorithm. This paper presents a new method by which the resources are placed in different sites depending on their processing power. The fitness value and maximum utilization is calculated using genetic algorithm so that the jobs are allocated to the appropriate processor and thereby reducing the idleness of the processors.

I. Introduction:

Distributed heterogeneous computing is being widely applied to a variety of large size computational problems. These computational environments consist of multiple heterogeneous computing modules interacting with each other. In a Heterogeneous distributed computing system (HDCS), processing loads arrive from many users at random time instants. A proper scheduling policy attempts to assign these loads to available computing nodes so as to complete the processing of all loads in the shortest possible time.

The resource manager schedules the processes in a distributed system to make use of the system resources in such a manner that resource usage, response time, network congestion, and scheduling overhead are optimized. There are number of techniques and methodologies for scheduling processes of a distributed system. These are task assignment, load-balancing, load-sharing approaches. Due to heterogeneity of computing nodes, jobs encounter different execution times on different processors. Therefore, research should address scheduling in heterogeneous environment. In task assignment approach, each process submitted by a user for processing is viewed as a collection of related tasks and these tasks are scheduled to suitable nodes so as to improve performance. In load sharing approach simply attempts to conserve the ability of the system to perform work by assuring that no node is idle while processes wait for being processed. In load balancing approach, processes
submitted by the users are distributed among the nodes of the system so as to equalize the workload among the nodes at any point of time. Processes might have to be migrated from one machine to another even in the middle of execution to ensure equal workload. Load balancing strategies may be static or dynamic . To improve the utilization of the processors, parallel computations require that processes be distributed to processors in such a way that the computational load is spread among the processors. Dynamic load distribution (also called load balancing, load sharing, or load migration) can be applied to restore balance [7]. In general, loadbalancing algorithms can be broadly categorized as centralized or decentralized, dynamic or static, periodic or non-periodic, and those with thresholds or without threshold. We have used a centralized load balancing algorithm framework as it imposes fewer overheads on the system than the decentralized algorithm.

Related Work:-

The intelligent ants method of load balancing discusses about how the meta-heuristic technique has been implemented for grid load balancing [5]. This concept shows that the ants can be born new or either dies because of the environmental conditions in the scenario. The ants being an intelligent agent can create a new one when they find themselves to be overloaded [6]. Also, they can take decisions based upon the memory allocation to them and the decision making algorithms.

The adoptive method of load balancing approach provides a solution to the most important challenge faced in the field of grid computing. The critical feature of grid is that the submitted resources can be withdrawn at any time [10].Hence, this technique varies the number of processors during the run time and thereby the low – power, high – performance parallel systems get benefited.

The new hybrid technique method combines both the static and dynamic load balancing for addressing the problem of resource allocation. They use the metric of update interval for reducing the

delay and deadlock. The main advantage is that they reduce the waiting time of the jobs thereby providing them with priority, leading to the reduction of execution time [9].

The task load balancing method comes up with the dynamic tree based model for managing the workload. Secondly, by using the neighborhood property hierarchical load balancing is achieved. The main advantage of this work is that it will decrease the amount of exchange messages in the grid environment and thereby lead to the decrease in communication overhead [3]. The capacity based load balancing technique provides a two-level load balancing in a multi-cluster grid environment with each of the clusters located in different LANs [1]. Minimization of overall response time and maximization of system utilization and throughput has been achieved though the consideration of the processing element's capacity and hence achieve an appropriate load balance.

The branch and bound parallelization technique works with the construction of search tree and exploring them to tackle the problem. The crucial issue faced in this method is how efficiently the irregular tree's node can be allocated to heterogeneous processors. The exploration is done through depth first search. This B&B technique is depicted through the farmer-worker model [2]. The main advantage of this method is that the execution time can be improved through parallelization. But, when the workload increases there will be degradation in the performance.

The reliability method of load balancing in grid environment is dynamic in nature, it is difficult to choose a target (i.e.) the resource and transform the load from heavily loaded resources to lightly load. But, the cost of transmission and overhead in load balancing is unacceptable. This approach [14] balances the load based on the trustworthiness of the resource that is to check whether they are reliable or unreliable. The reliability of the resource is based on the threshold value that will be calculated based on the fuzzy sets.

The competency rank based approach comes with the improvisation of the branch & bound technique. This method works with the farmer worker model where the jobs are allocated based on the capability of the worker. Hence in the computational environment, the jobs will be prioritized into high, medium and low and they will be assigned a rank [11]. Competency Rank will be calculated based on the movement of ants (i.e. the requests and responses).Then the jobs have to be allocated to the resource matching their competency rank. When they do not match, they enter into the transitional phase. Careful attention has to be paid since the change between the two phases may increase the overhead cost. The performance measures show that the makespan, tardiness and computational cost are reduced to the most. But when the workload increases they suffer from serious disadvantages and hence another method has to be adopted.

Proposed Algorithm:-

```
Competency rank based genetic load balancing technique()
{
Assign_job_priority
Provide_job_service(job)
Generate population solution
Calculate fitness value of individual
Sort jobs based on fitness value
Sent specification of resource
Check the control word
Direct new population to old population

For (i=1;i<=no.of jobs;i++)
{
Crossover performance evaluation
Mutation of offspring
Store new population
Compare the fitness value
When(Resource :=Job)
Allocation of resources with job
Store the load distribution value
}
```

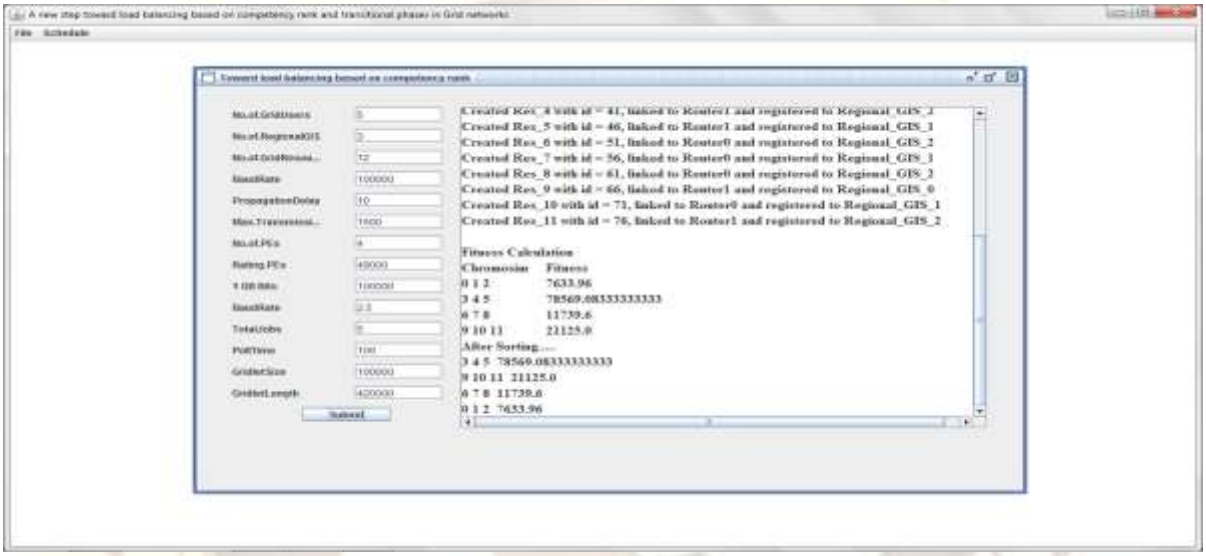
Load Balancing has been done through the following steps. It combines both the method of tree model and the genetic algorithm. The ant colony algorithm has been used since they include the subtraction of the forward and backward ants. The competency rank is calculated. Then the jobs are placed in different sites based on their fitness value calculated. Depending on the arrival of the jobs they will be send to the sites and the allocation of the jobs will happen. Control word can also be calculated for the calculation of the available resources.

II. Results and Discussions:

Our demonstration has been carried out in gridsim and the scenario is depicted as follows:

When each job eneters into the environment to get service they will be calculated the fitness value using the genetic algorithm and then they will be allocated to the particular resource.This will be served based on the tree model and it has better results even for higher no. of jobs.

The scenario is set as shown in the following figure



Then the fitness value will be calculated and then the allocation of the jobs is done as follows. Then depending on the arrival the router will be assigned to the specific network and then they will be allocated to the resources. The resources have to be allocated in the different sites based on their competency rank.

The control word will also be send to them based on the following method. The figure below shows the calculation of the fitness value and the chromosim and the allocation of the resource to the particular resource as shown in the following figure. The number of existing resources and the jobs entered to the environment is also increased. Also the jobs can be devoted to the existing resources in the form of grouping. Using the genetic algorithm is also one of the cases that can be exerted on the proposed algorithm and investigated the execution and tardiness as shown below.

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