Improving Performance in Load Balancing Problem on the Grid Computing System

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ABSTRACT
Load Balancing is a technique to improve resources, utilizing parallelism, exploiting throughput managing and to reduce response time through proper distribution of the application. Load balancing strategies is always used for the emergence of Distributed systems. Generally there are three type of phases related to Load balancing i.e. Information Collection, Decision Making, Data Migration.

Grid computing is a replica of distributed computing that uses geographically and disperses resources. To increase performance and efficiency, the Grid system needs competent load balancing algorithms for the distribution of tasks. Load balancing algorithms is of two types, static and dynamic. Our projected algorithm is based on dynamic strategies.

Keywords
Information Gathering Policy, Firing Triggering Policy, Hitting Selection Policy

1. INTRODUCTION
Grid computing is a type of parallel and distributed system that enables the distribution, selection and aggregation of geologically resources dynamically at run time depending on their availability, capability, performance, cost, user quality-of –self-service requirement [1].Grid computing, individual users can retrieve computers and data, transparently, without taking into account the location, operating system, account administration, and other details. In Grid computing, the details are abstracted, and the resources are virtualized. Grid Computing should enable the job in question to be run on an idle machine elsewhere on the network [2]. Grids functionally bring together globally distributed computers and information systems for creating a universal source of computing power and information [3]. A key characteristic of Grids is that resources (e.g., CPU cycles and network capacities) are shared among various applications, and therefore, the amount of resources available to any given application highly fluctuates over time. Load balancing is a technique to enhance resources, utilizing parallelism, exploiting throughput improvisation, and to reduce response time through an appropriate distribution of the application [4].

Load balancing algorithm are two type static and dynamic, Static load balancing algorithms allocate the tasks of a parallel program to workstations based on either the load at the time nodes are allocated to some task, or based on an average load of our workstation cluster. The decisions related to load balance are made at compile time[5].

A few static load balancing techniques are Round robin algorithm, Randomized algorithm, simulated annealing or genetic algorithms, and Dynamic load balancing algorithms make changes to the distribution of work among workstations at run-time; they use current or recent load information when making distribution decisions [6]. Multicomputers with dynamic load balancing allocate/reallocate resources at runtime based on no a priori task information, which may determine when and whose tasks can be migrated [7].

As a result, dynamic load balancing algorithms can provide a major improvement in performance over static algorithms. However, this comes at the additional cost of collecting and maintaining load information, so it is important to keep these overheads within reasonable limits [8].

There are three major parameters which usually define the strategy a specific load balancing algorithm will employ [9]. These three parameters answer three important questions:

- Who makes the load balancing decision
- What information is used to make the load balancing decision, and
- Where the load balancing decision is made.

2. RELATED WORK

Various Load Balancing Algorithms are available now days but they contain several drawbacks. Such type of problems can be eradicated by our proposed dynamic load balancing algorithm [10].

Comparison of Existing and newly Proposed Algorithm are:

	Information Gathering Policy	**Firing Triggering Policy**	**Hitting Selection Policy**
Existing Load Balancing	Load Balancing information is composed using periodic approach	Load Balancing is triggered based on Queue Length	Task is selected for migration using Job Length as criteria.
Proposed Load Balancing	Load Balancing information is collected using Activity based approach	Load Balancer is triggered based on Queue Length and current CPU Load	Task is selected for migration based upon CPU consumption of tasks

In Condor (Existing) based algorithm, Information Policy may be fired by periodic approach while in Proposed algorithm it may be Activity based.

Triggering Policy in Existing Algorithm is based on Queue Length while in Proposed Algorithm it is based on Queue Length and current CPU Length. Selection Policy in Existing Algorithm is done by Selected Task may be migrated using Job Length while in Proposed Algorithm Selection Policy may be fired by Selected task which is migrated based upon CPU Utilization.

Major purpose of our proposed algorithm is Time Complexity i.e., in Proposed Algorithm time complexity is 3 while in Existing Algorithm time complexity is more than newly proposed algorithm. Execution time in .Net Framework using our proposed algorithm is too much fast compared to existing algorithms[11].

3. OUR PROPOSED ALGORITHM

In this paper we propose a dynamic load balancing algorithm for improving performance of grid computing. In this there are four basic steps: Monitoring workstation performance (load monitoring), exchanging this information between workstations (synchronization), Calculating new distributions and making the work movement decision (rebalancing criteria) Actual data movement (job migration). In proposed load balancing algorithm the activities can be categorized as following:

Arrival of any new job and queuing of that job to any particular node, Completion of execution of any job, Arrival of any new resource, Withdrawal of any existing resource.

Segment of code related to algorithm:-

Function: LoadBalancing_start
Return Type: Boolean
Start:
If (CPU Idle of Node is Min and Free Memory of Node is Min and Queue Length of Node is Max)
HeavilyLoaded_Node
End if
If (CPU Idle of Node is Max and Free Memory of Node is Max and Queue Length of Node is Min)
Lightlyloded_Node
End if
Migrate Heavy Loded_Node_Job to Lightly Loded_Node
End

Functions used in the above algorithm are:-

Activity_ happens (): this function return Boolean value. If any of above defined activity occurs it returns true otherwise it returns false.

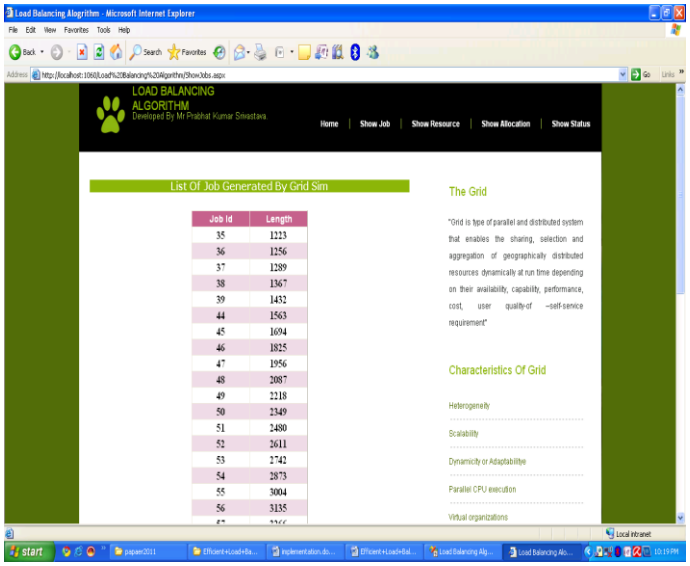
LoadBalancing_start (): this function also return Boolean value. If on the basis of given parameters (CPU utilization and queue length) load balancing will be required it will return true else it will return false. This function also updates two lists: HeavilyLoaded_list and LightlyLoaded_list.

4. IMPLEMENTATION AND RESULTS

A Load Balancing component has been developed which executes in simulated grid environment (i.e., Gridsim toolkit). This application has been developed using ASP.NET 3.5 and SQLServer 2005 database server. Following is the snapshot of the index page.

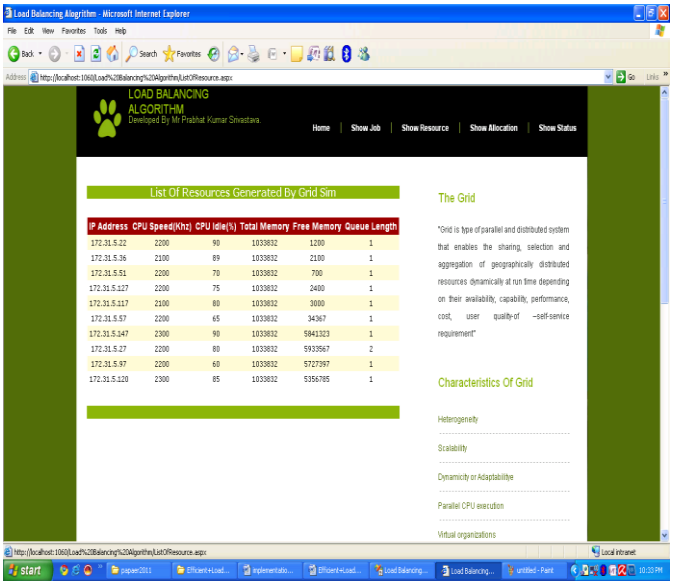
Screen Shot 4.1: Home Page

It contains link to different pages: show jobs, show resources, show allocation and show status. A click on one of the links will link to the different pages.



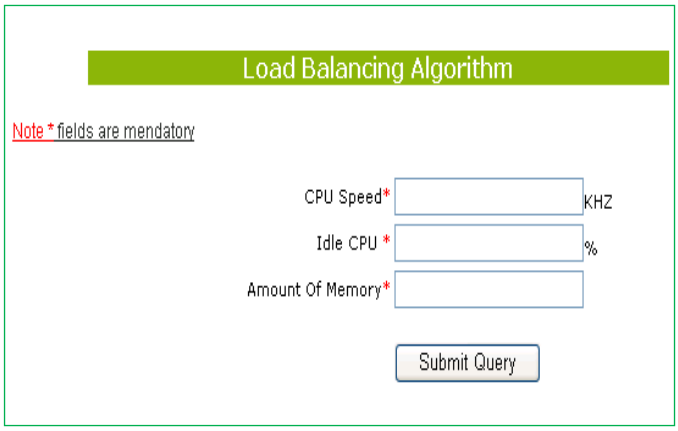
Screen Shot 4.2: Show Job Page

Screenshot 4.2 shows two columns: first column is JobID and second is job length. JobID is unique for each job submitted to Grid. Length is the expected job time length given at the time of submission.

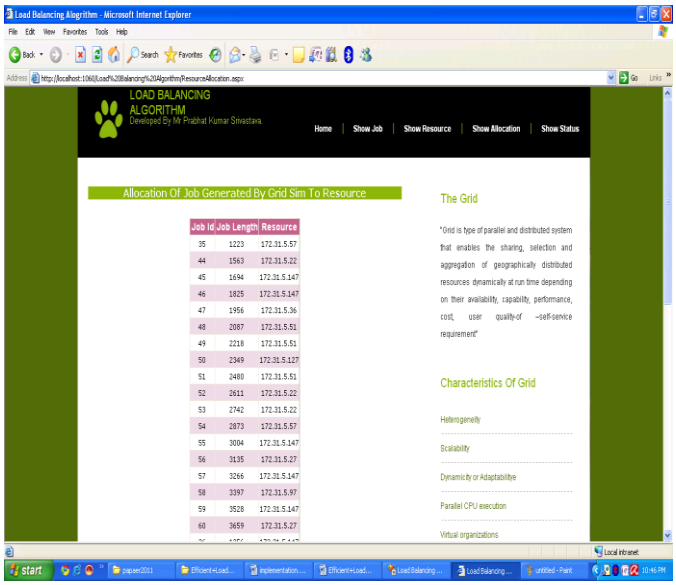


Screen Shot 4.3: Show Resources Page

Screenshot 4.3 is the image of show resources page. This page shows six fields: IPAddress (resource name), CPUSpeed, CPUIdle, TotalMemory, FreeMemory and Queuelength. Three fields CPUIdle, FreeMemory and Queuelength are important because these fields are used to decide that particular resource is heavily loaded or lightly loaded resources and is shown in screen Shot 4.4. If any resource is heavily loaded then the actual load balancing starts.

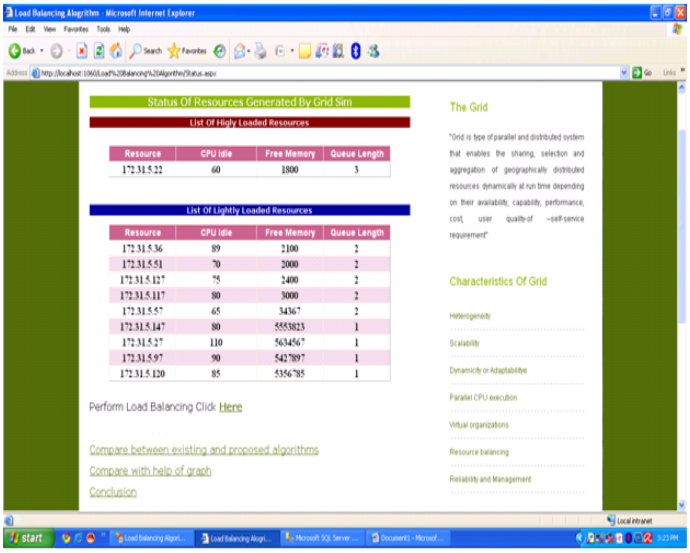


Screen Shot 4.4: Input Field format



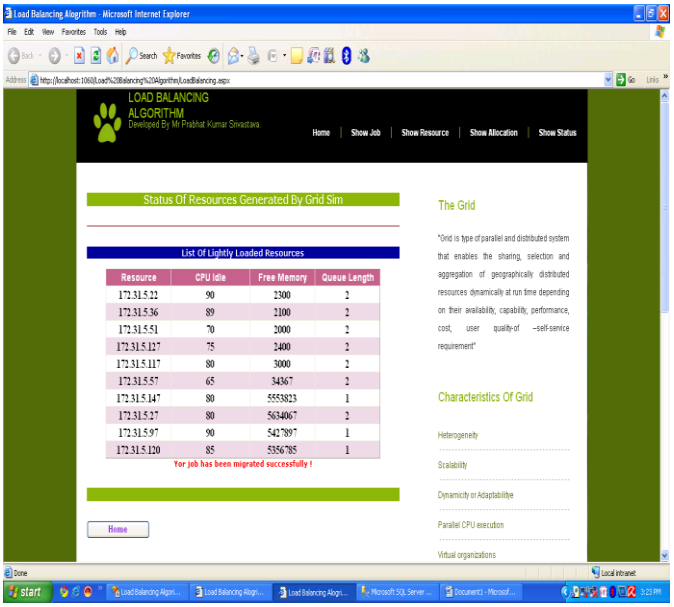
Screen Shot 4.5: Show Allocation Page

Screenshot 4.5 shows three fields JobId, JobLength, Resource. This is generated after allocation of job to resource. Allocation is based on free resource according to requirement of job that has been submitted to resource. This allocation maximizes the resource utilization. In this screenshot corresponding to each JobID, there is a resource name.



Screen Shot 4.6: Show Status Page

Screenshot 4.6 shows information about gathered about Load Balancing. This page contains two Grids. First Grid contain name of those resource which is heavily loaded and second Grid contain those resources which are lightly loaded. These two Grids are used to decide which resource will act sender and which resource will act as receiver. Job will be migrated from sender (heavily loaded) resource to receiver (lightly loaded) resource if sufficient lightly loaded resources are available then after load balancing no heavily loaded resource will be available. Job from all heavily loaded resource will be migrated to lightly loaded resource. This page also gives information about which heavily loaded resource will migrating the Job to which lightly loaded resource. In above Screenshot resource 172.31.5.22 (name of resource) is heavily loaded resource which has three Jobs. This Page has a link button (i.e. perform load balancing) that performs the action to migrating the job from heavily loaded resource to lightly loaded resource, which is the main concept of our proposed algorithm and is demonstrated in our developed application.



Screen Shot 4.7: Load Balancing Page

Screenshot 4.7: Load Balancing Page appears after Load Balancing has been performed and job is migrated to resource 172.31.5.27. This is one particular case when heavily loaded resource has been finalize and job which should be migrated has been finalize and no heavily loaded resource is available If no lightly resource is available then no migration will be done.

5. CONCLUSION

Through this proposed algorithm, we have described multiple aspects of load balancing algorithm and introduced numerous concepts which illustrate its broad capabilities. Proposed algorithm is definitely a promising tendency to solve high demanding applications and all kinds of problems. Objective of the grid environment is to achieve high performance computing by optimal usage of geographically distributed and

heterogeneous resources.

But grid application performance remains a challenge in dynamic grid environment. Resources can be submitted to Grid and can be withdrawn from Grid at any moment. This characteristic of Grid makes Load Balancing one of the critical features of Grid infrastructure. There are a number of factors, which can affect the grid application performance like load balancing, heterogeneity of resources and resource sharing in the Grid environment. In this we have focused on Load Balancing and tried to present the impacts of Load Balancing on grid application performance and finally proposed an efficient Load Balancing algorithm for Grid environment. Every Load Balancing algorithm implements five policies. The efficient implementation of these policies decides overall performance of Load Balancing algorithm. In this work we analyzed existing Load Balancing algorithm and proposed an enhanced algorithm which more efficiently implements three out of five policies implemented in existing Load Balancing algorithm. These three policies are: Information Policy, Triggering Policy and Selection Policy. Proposed algorithm is executed in simulated Grid environment. Load Balancing is one of most important features of Grid Middleware for efficient execution of compute intensive applications. The efficiency of Load Balancing Module overall decides the efficiency of Grid Middleware.

6. REFERENCES

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