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An Approach for Minimizing Energy Consumption in Cloud Environment

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Abstract

Background/Objectives: Cloud computing could be considered of vital paradigms in IT which allows services to be delivered to the users via the internet on demand and on pay as you go basis. The growing demand on cloud computing environments increasing the number of datacenters which in turn increase the amount of power consumption in datacenters along with cooling equipment. Load balancing is considered a major challenge affecting in cloud performance **Methods:** An existing problem is how to allocate Virtual Machines (VMs) to Physical Machines (PMs) or hosts. This process is called VM placement. An algorithm is proposed that can reduce power consumption. **Findings:** The proposed algorithm assigns VMs onto PMs based on first fit decreasing algorithm and improves an existed one through reducing power consumption by turning-off some under load hosts if available and migrating their VMs to other active hosts. **Application:** The presented approach could decrease significantly energy consumption in comparison with the existing one through migrating VMs from underload hosts and turns them off.

Keywords: Cloud Computing, Energy Consumption, Load Balancing, Migration, VM Placement

1. Introduction

The key trend of cloud computing is to provision on-demand computational resources and services over the Internet[1]. Cloud environment gives many kinds of services like Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) or Infrastructure-as-a-Service (IaaS)[2,3]. The users could select suitable service satisfying their requirements.

There are some situations that should be taken into consideration regarding cloud computing. The major situations are load balancing and power consumption[4,5]. This work concerns with power consumption. Since the rapid spread of cloud technology in worldwide requires increasing in datacenters. These resources are considered the most power consumption source as they need always cooling equipment. In this paper, a modified algorithm for energy efficient during VM placement has been proposed. The presented scheme checks, through VM placement in appropriate PM, whether there exist a PM under load in order to migrate, as possible, its VMs to other loaded PMs and turns it off. The improved algorithm can significantly reduce power consumption.

This work is comprised of five sections. The second illustrates related work. While third, displays the proposed approach. An example explains our work is given in the fourth section. Finally, conclusions have been discussed in Section 5.

2. Research Methodology

- In[6] have proposed an enhanced energy efficient VM placement which puts VMs such that hosts' overload and underload status is addressed and maintain Service Level Agreement between cloud user and provider. Furthermore, they presented their algorithm to reduce energy consumption and achieve better load balancing.

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- In[7] have presented the First-Last algorithm which introduces balances on energy consumption and performance through reducing migration. Moreover, time complexity could also be minimized.
- In[8] have presented an off-line scheme to migrate a VM to more suitable PM and when PM capacity is not sufficient, another VM must be chosen to migrate from it to free some space for the required VM. The results showed that it is more efficient.
- In[9] have proposed a method to energy-efficient resource provisioning with SLA for Virtual Machine scheduling. Obtained results show that it is outperforms other ones in power consumption.
- In[10] have proposed a scheme for load balancing among many VMs based on some threshold. The results obtained are compared with other methods and proved that it is best.
- In[11] have proposed an approach for enhancing both processing time and response time with load balancing. They showed that it is better in comparison with others.

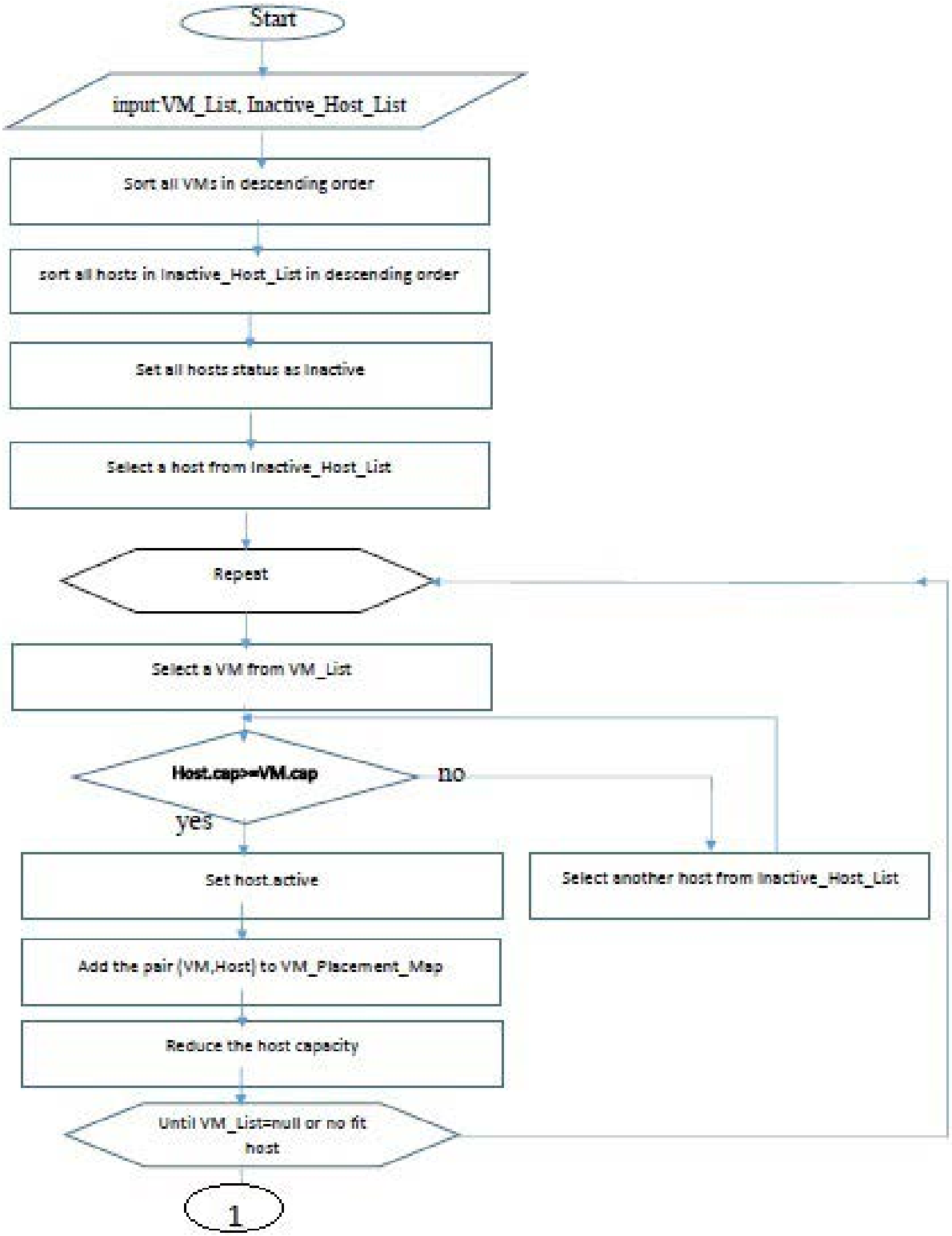
3. The Proposed Algorithm

In this section, an improved algorithm based on that mentioned in paper[6] is presented. It uses a policy of migration VMs from a host as possible whenever its status underload and turns it off in order to saving power. Figure 1 illustrates the pseudo code of the algorithm. Figure 2 shows flow chart of our algorithm.

Algorithm: An Improved Power Aware VM Placement Algorithm

```
1.  Input: VM_ List, Inactive_ Host_ List
2.  Output: VM_ Placement_ Map
3.  Sort all VMs in descending order
4.  Sort all hosts in Inactive_ Host_ List in descending order
5.  Set all hosts status as Inactive
6.  Select a host from Inactive_ Host_ List
7.  Repeat
8.  Select a VM from VM_ List
9.  If (host. capacity >= VM. capacity) then
10.  Set host. active
11. Add the pair (VM, Host) to VM_ Placement_ Map
12. Reduce the host capacity
13. Else select another host from Inactive_ Host_ List
14. Go to step 9
15. End if
16. Until VM_ List is Null or there is no sufficient host
17. For every host. active
18. If (host. capacity<=under load threshold) then
19. Migrate all its VMs to other active hosts as possible
20. Turn-off the host for power saving and reset its status as host. inactive
21. End if
22. End for
23. End
```

Figure 1. The proposed algorithm.


Start
input:VM_List, Inactive_Host_List
Sort all VMs in descending order
sort all hosts in Inactive_Host_List in descending order
Set all hosts status as Inactive
Select a host from Inactive_Host_List
Repeat
Select a VM from VM_List
Host.cap>=VM.cap
no
yes
Set host active
Select another host from Inactive_Host_List
Add the pair (VM,Host) to VM_Placement_Map
Reduce the host capacity
Until VM_List=null or no fit host
1

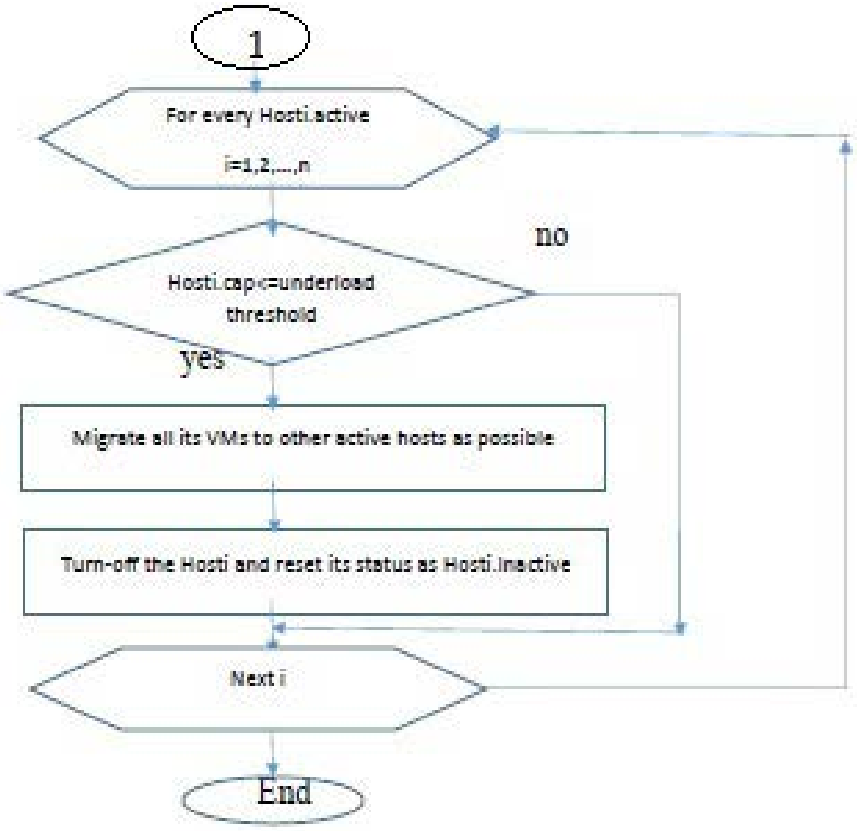


Figure 2. Flow chart of the proposed algorithm.

4. Example

Let there are four active hosts {H_1, H_2, H_3, H_4} and some VM requests. It is assumed that RC is a brief of Remaining Capacity. The proposed algorithm checks periodically whether there exists a host is underload to migrate its VMs as possible. Here H_4 is found underload and VM12 could be migrated to H_2 such that (RC2 > = VM12.capacity). Then the host H_4 will be turned off in order to save power. Figure 3 illustrates the example.

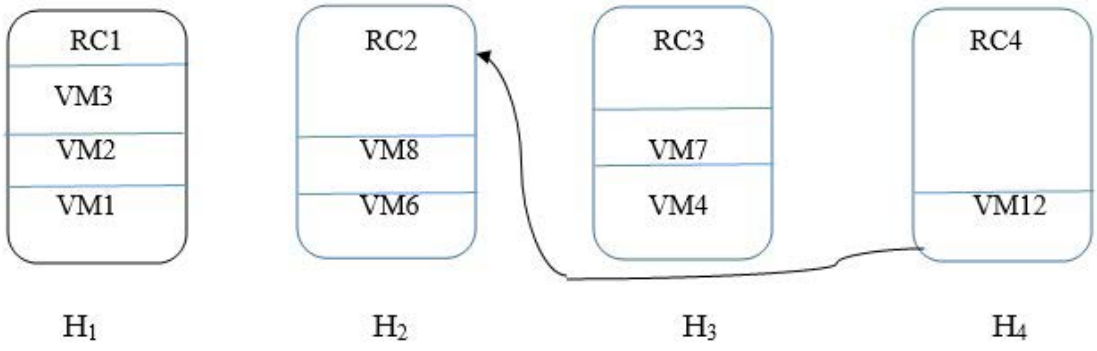


Figure 3. An example of the proposed algorithm.

5. Conclusion

VM placement is a crucial challenge in cloud environment. Due to the huge power consumption in cloud datacenters, the problem of finding an efficient algorithm capable of reducing power consumption became more important. In this paper, an algorithm for reducing power consumption based on VMs migration is presented. It deploys VMs onto hosts according to load balancing. The results show that our algorithm can significantly reduce power consumption.

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