

An Efficient Virtual Machine Migration for Smart Healthcare Using Particle Swarm Optimization Algorithm

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Abstract— Cloud Computing is a computing infrastructure for enabling access to the shared pools of configurable and storage resources. The primary objective of the project is to design and develop the Smart Healthcare mobile application which is the emerging technology for improving the quality of life of urban people by accessing their medical records wherever they go using Virtual Machine (VM) migration method. Smart Healthcare is generally used for storing the patient's medical record, analyze them and also for monitoring the patients regularly. A Strong wireless and mobile communication infrastructure is necessary to connect and access Smart Healthcare. VM migration is essential for transferring medical data from master cloud to the local clouds. VM must provide the local clouds with the user requested health information but with minimized response time and to process more user requests. In existing system Ant Colony Optimization (ACO) algorithm is used for VM selection which is done by generating the sequence of random optimized solutions with more iteration and its task execution time needs to be reduced further. In proposed system, an efficient Virtual Machine Migration is done by Particle Swarm Optimization (PSO) algorithm. PSO is a VM selection algorithm which effectively minimizes the number of VMs to be migrated, reduces the energy consumption and minimizes the response time by serving more users.

Key words: Cloud Computing, Smart Healthcare, VM Migration, PSO algorithm.

I. INTRODUCTION

Cloud Computing is a term that is widely used over the last years. Cloud Computing is the method of distribution of computing services like servers, storage space, databases, connectivity, software and so on through the Internet. It leverages the advancement in Information and Communication Technology. It also exploits the mobile computing technologies efficiently. Storage Capacity in the cloud used to store more information which is much easier than storing the same in physical device. Once the user registers in the cloud, they can access the information from anywhere with internet connection. Cloud Computing is probably the most cost efficient method to use and maintain and upgrade. Cloud also provides major application like healthcare, e-learning, banking sectors, telecommunication industries etc. Cloud Computing has a wide range of application in the healthcare field for the purposes like storing and processing the medical data from the cloud to user's mobile device using VM migration.

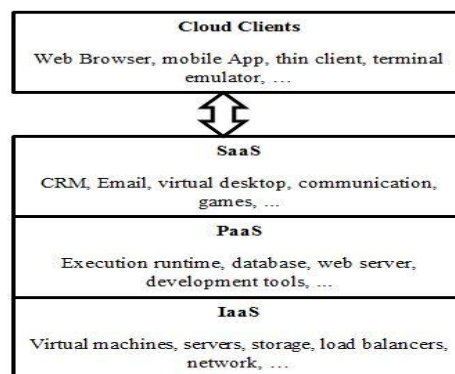


Fig.1 Architecture of Cloud Computing Layers

The Fig.1 represents architecture of cloud computing layers is the configuration of the system that involves local and cloud resources, services, middleware and software, cloud clients and cloud storages, networks and geolocation. The cloud computing provides software service which is used to run application on computers. Platform Service is one of the categories of cloud computing that provides platform and environment to allow the developers to build applications and services over the internet. Infrastructure Service is also a service that involves a method for delivering everything from operating systems to servers and storage through IP-based connectivity as part of on-demand service. Smart Healthcare is the emerging technology which is developed for improving the quality of life of people living in cities. It should deliver the user requested health information through the mobile application. VM migration method is used by smart healthcare, which is essential for transferring medical data from master cloud to local cloud, from the local cloud it reaches the user's mobile device. This problem is to select proper VM with minimum migration policy and that also should deliver the requested data to user with minimized task computation time and to process more user's requests.

Virtualization is one of the technologies in cloud computing where it can create more virtual version of physical computer i.e. desktop, laptop rather than actual. In the smart healthcare application operating system virtualization and storage virtualization is used. Virtualization software are available in various types which are efficiently used to create the virtual machines and also they store more data centers.

Virtualization technology acts as a middle layer between the hardware and software layers. Data center is like a server where it contains facility like CPU, hardware, network, data storage etc. Data center works as an on premise hardware where the organization or company can store their data in a secured manner within their buildings on a local network. In this Smart Healthcare application there are two different data centers where both are available in VM. Here Physical Machine (PM) acts as a master cloud and VM acts as a local cloud.

Main server is present in the PM and two data centers are present in the VM. Data are retrieved by data centers from PM through VM migration. This method is used by smart healthcare, which is essential for transferring medical data from master cloud to local cloud, from the local cloud it reaches the user's mobile device. This problem is to select proper VM with minimum migration policy and that also should deliver the requested data to user with minimized task computation time and to process more user's requests.

II. RELATED WORK

Abawajy J.H. et al [1] described about the current situation of improvement in the technology and cost of the treatment in the hospital required by every patient made to develop healthcare systems. It also make the patient to have more involvement in their health and treatment and it made to develop home monitoring system. This system enables the patient to take care of them in their home itself through the monitoring system. The doctor can treat the patient through the monitoring system and it also helps in doctor and patient involvement more in treating the disease by being in home, but it lacks of security and privacy control.

Baisiri M., et al [2] presented a work smart city solutions which is devoted to investigate concepts and principles of smart city and sustainable urban development, components and urban planner's role. Smart City concept already holds the potential to address aspects of the sustainability challenge by promoting citizen participation, developing innovative and smart solution for sustainability. This work contributes to the exciting research only within smart cities and aides in maximizing the potential for the smart city concept to stand as a solution for sustainability in our increasingly urbanized world.

Bobroff N., et al [3] introduced an algorithm based on consolidation and migration. The algorithm is created to provide substantial development which to reduce the capacity and to minimize the service level agreement violations. It can be used to predict previously over intervals lesser than the required time of different demands. This algorithm is based on management of minimizing the amount of physical capacity which is the requirement for supporting an accurate rate of violations on Service Level Agreements for certain work load 50% compared to other methods, but it needs to refine the model further to capture the relationships between multiple resources, such as CPU and I/O. The Static consolidation method is less efficient than dynamic consolidation method.

Buyya R., et al [4] developed an architecture for market based allocation of resources within clouds. This system has discussion on some representative platforms for cloud computing covering the

state-of-the-art. This work has explained many things about the state of art approaches but it won't work in many circumstances. Market maker for bringing service providers and consumers, market registry is used for publishing and discovering cloud service providers and their services, clearing house and brokers for mapping service requests to providers who can meet Quality of Service (QoS) expectations are included, payment management and accounting infrastructure for trading services but it needs to address regulatory and legal issues which go beyond the technical issues.

Chun B-G., et al [5] presents mobile applications are becoming increasingly ubiquitous and provide ever richer functionality on mobile devices. This work presents the design and implementation of Clone Cloud, a system that automatically transforms mobile applications to benefit from the cloud. During the execution time, the application partitioning is more affected by migration of thread from the mobile there by executing there for the remaining of the partition and re-integrating the migrated thread back to the mobile.

Cimblor R., et al [6] developed a design of the watch dog healthcare application, this solution is based on the client running on the smart phone and the server side running in the cloud. Sensors embedded in the smartphone are used for the measurement of the different information about the monitored person such as position, temperature, breadth frequency etc. Basic algorithms are evaluating current person's health status execute on the smart phone. Measured data are sent to the second part of the application running in the cloud for deeper analysis.

Dinh H.T et al [7] developed a mobile cloud application models which is based on augmented execution of the smartphone clone in the cloud that are required to the synchronization of the smartphone and the clone. If a smartphone clone is misused by someone, then the fraudulent may install the clone on a same model smartphone and access them illegally. To solve this problem new security framework is required.

Doukas et al [8] work presents the implementation of a mobile system that enables electronic healthcare data storage, update and retrieval using cloud computing. The mobile application is developed using Google's android operating system and provides management of patient health records and medical images.

Gkatzikis, L. et al [9] investigated the power of task movements to decrease the accumulation of the shared resources of a mobile cloud computing architecture in which local clouds are connected to the wireless access infrastructure. The main base idea is the migration must done only if it is profitable for the running time of the task, including the delay on migration. This work followed an algorithmic approach to the problem of task migration, currently in the process of implementing these techniques in a real cloud cluster of tens of nodes and it does not used for report findings.

Hassan M.M., et al [10] created a healthcare data sharing approach in multimedia domain through cloud –based body area network, wireless body area network (WBAN) as a platform of pervasive computing and communication is applied in a healthcare sectors. Since the patient related data is in the form of text, image, voice, etc. It is significant in the process of healthcare sectors and also it is managing these media data from various WBAN is vital for various applications. In this article efficient network model that contains WBAN and cloud for valid data sharing, but scalability of the network need more efforts to improve further. It doesn't consider any security aspects.

Hossain M.S. [11] developed a patient state recognition system for the healthcare framework. The system is designed in such a way that it provides good recognition accuracy, provides low-cost modelling and is scalable. The accuracy and time required by the system suggests that this system can efficiently be used in a healthcare framework, but it needs to reduce the time taken by the system using features with fewer dimensions.

Kulkarni P. and Farnham, T. [12] provided an overview of issues involved in water monitoring and management and highlighted the wireless connectivity considerations to enable smart water management. On a different but related note, it is worth bearing in mind that connectivity is merely an enabler and it is up to the application to exploit the information that is gathered by deploying the connectivity solution. Therefore, the benefits that one can accrue from the information should be carefully weighed against the cost of gathering the information in the first place so as to identify the optimal cost-benefit trade off.

Moufijul Islam, M., et al [13] developed an ACO based VM migration for healthcare application using Mobile Cloud Computing (MCC) in the smart city atmosphere. In this model, the problem of

user's movement and VM migration problems are explained properly. It needs to be further discover the optimization solution with minimized task computation time and data access latency by considering the presence of other types of clouds and crowd sourcing. In this aspect, it needs to be further considered about the movement of the user from one place to another through the vehicle. The user mobility on vehicle is not considered in this work.

Kumari, R. and Kaushal S. [14] developed health care monitoring application model enhances the distant health monitoring systems by classifying the collected ECG data of the patient as urgent or non-urgent and performing aggregation of the non-urgent data. Data aggregation reduces data transmission time and end-to-end delay. The Aggregation efficiency need to be improved more by taking into account the overhead of performing aggregation on the normal data as compared to existing aggregation models in WBANs.

III. METHODOLOGY

A. Meta-Heuristic Virtual Machine Migration

Particle Swarm Optimization (PSO) is an algorithmic method that helps to solve any optimization problem to find a best solution. PSO is a meta-heuristic algorithm as it works few or no assumptions about problem being optimized and can search very large spaces of candidate solutions. PSO is different from classical optimization problem. Each iteration is starts with the candidate solution called particles. The particles are moved by their best position and solution space. It also used for physical machine selection for reduced power consumption by using dynamic voltage and frequency scaling technique, when processor is idle it goes into sleep mode which reduces supply voltage and clock frequency.

The Proposed System featured with global optimization algorithm i.e. PSO which is used for global mobility management for dealing with the problems in which the best solution can be represented as point or surface to meet the Quality of Service QoS requirement of cloud application. It process with low computational cost. It will maximize the resource utilization with minimum response time and by selecting the physical machine (PM) using PSO algorithm reduces the energy consumption. For this purpose, the threshold of resource utilization based on the load pattern of PMs is set because the VM migration time will affects the QoS of the cloud application, a VM selection algorithm based on minimum migration policy is used which effectively minimizes the number of VMs to be migrated.

B. PSO Steps for VM Migration

- Step 1: Task Scheduling
- Step 2: Identifying available VMs
- Step 3: Load Balancing for extracting data from VM data centers
- Step 4: QoS based Prediction
- Step 5: Migration of different dataset
- Step 6: Energy aware scheduling
- Step 7: Extract healthcare data.

C. PSO Pseudocode of VM Migration

Input: VM (V) migration initialization after the data (d) request.
Output: d retrieval from the data center (C)

1. Creation of many V's with many C
2. C contains user's information (i.e.) d
3. Initialization of prediction of d in C in V
4. Selection of required d in C.
5. while (C ∈ V)
6. Evaluate user request
7. if (V predict d in C)
8. Retrieve the d
9. else search d in other C
10. end if
11. end for
12. end while

D. Program Code

Program below is the coding for virtual machine migration service. Virtual Machine service retrieve all the user entered data when VM migration is clicked.

```
Imports System.Data
Partial Class VMMigration
Inherits System.Web.UI.Page

Dim vm_cls As New localhost.VM_MIGRATION
Dim cls1 As New common_source
Dim dst1 As New DataSet
Protected Sub btnBind_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
btnBind.Click
Try
    dst1 = vm_cls.VM_Migration()
    VMList.DataSource = dst1
    VMList.DataBind ()

Catch ex As Exception
Response.Write(ex.Message.ToString())
End Try
End Sub
End Class
```

IV. SYSTEM DESIGN

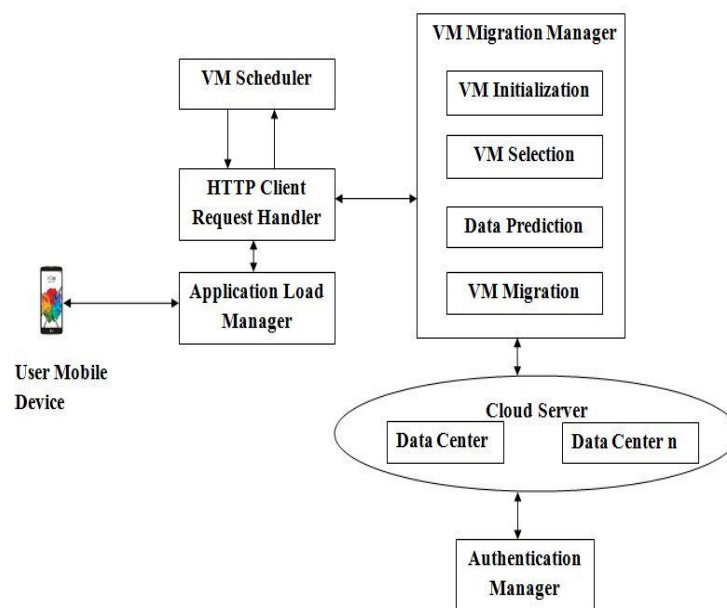


Fig.2 Architecture of Virtual Machine Migration

The Fig.2 describes the following components of VM migration system.

A. Application Offloading Manager:

It manages and provides secure access to both internal and publicly hosted web applications. An applications offloading will transfer the computation task of mobile to the cloud.

B. HTTP Client Request Handler:

It is responsible for opening and closing the network connection to the server applications, sending of requests receiving and dispatching of responses, handling of timeouts, threading issues and innovation errors.

C. VM Scheduler:

VM Scheduler uses the information from hypervisor to initiate the VM scheduling. After a specific time period, VM migration manager interacts with the VM scheduler to select tasks and to migrate so as to reduce task execution time.

D. VM Selection:

It selects which VM to be migrated for the particular user request, according to that VM is chosen. It also contributes to making optimal migration decisions.

E. VM Initialization:

It will start the migration process. It will initiate the task of moving a VM from one physical hardware environment to another. It is the part of managing hardware virtualization systems and is something that providers look at as they offer virtualization services.

F. Data Prediction:

It finds which data should be selected for migration i.e. it finds the data which is requested by the user.

G. VM Migration:

It transfers the requested data from one machine to another machine.

H. Cloud Server:

The server is Cloud which contains number of data centers that contains hospital and clinical details that can be accessed through authentication server.

I. Data Centers:

Data centers contain the details of hospital, doctors, nurses and patients health information.

J. Authentication Server:

The hospitals, doctor and other employees of hospital should register themselves in this application with login id and passwords to communicate with the customers.

V. IMPLEMENTATION

A. Data Center Authentication:

Data Center Information modules is used for registering the user. In data center information, nodes are acting, managing the healthcare information and that are stored in Database. The Administrator maintains VM Data Center node specific information like IP Address, Node Name and Current Network Bandwidth etc. The information is utilized by managing data or migrating data from one disk to another disk by using VM Selection and Migration Techniques.

B. Cloud Data Storage:

Cloud computing is the largest data storage domain which is provided over the internet or intranet. Cloud computing module is used for moving individual computer's applications to be hosted in internet. Cloud sources can be used by any number of users as per their usage and demands. Cloud can be used and paid as per use of the user. Cloud data storage also virtually created by the different kinds of open source software like VMware etc.

C. VM Migration:

Virtualization is the developing of a real like physical computer that is personal computer which has same read only memory, random access memory and operating system and network resources and so on. In this module, Initialization, Selection, data prediction and VM migration are performed. The process of running two or more virtual computer system so on in the set of physical hardware. Minimization of SLA (Service level agreement) violations by proper allocation of the virtual servers.

D. VM Scheduling:

The VM Scheduling communicates with VM migration manager for schedule which VM should migrate according to the user request. VM Scheduling is mainly used for scheduling the migration of VM by VM selection and predicting the data.

E. Mobile Application Development:

The Development of healthcare application is used for user request and access. User can give request for connecting the doctor. User should sign up with their login id and password. User can access their information after VM migration through their mobile site.

VI. CONCLUSION

Virtual Machine Migration is done for moving the medical data from master cloud to local cloud by selecting optimal VM for migration using ACO algorithm, but it selects the VM for migration by generating the sequence of random optimized solutions with more iteration and its task execution time needs to be minimized further. The proposed work is done by PSO algorithm. PSO is an evolutionary computation scheduling algorithm. It has gained popularity due to its simplicity and its usefulness in broad range of applications with low computational cost. It has been used diversely in cloud environments. PSO algorithm tries to minimize the finishing time of the task and maximize the resource utilization of VM. PSO finds the optimal VM efficiently with minimum migration policy reduces the energy consumption of physical machine and minimizes the task computation time by serving more users which achieves the overall system objectives. The proposed system able to deliver the user requested medical information and get the treatment from doctor with minimum response time through the smart healthcare mobile application. In future work, data will be protected more by cryptographic methods and the data centers will be made available accessed through centralized cloud server.

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