Efficient Resource Management in Cloud Computing

Rushikesh Shingade [#1], Amit Patil [#2], Shivam Suryawanshi [#3], M. Venkatesan [#4]

[#] First-Fourth School of Computing Science and Engineering, First-Fourth VIT University
Vellore Institute of Technology, Vellore-14, Tamilnadu, India
[1] rushikeshprakash.shingade2015@vit.ac.in
[2] patilamit.madhav2015@vit.ac.in
[3] shivamravindra.suryawanshi2015@vit.ac.in
[4] mvenkatesan@vit.ac.in

Abstract— Cloud computing, one of the widely used technology to provide cloud services for users who are charged for receiving services. In the aspect of a maximum number of resources, evaluating the performance of Cloud resource management policies are difficult to optimize efficiently. There are different simulation toolkits available for simulation and modelling the Cloud computing environment like GridSim CloudAnalyst, CloudSim, GreenCloud, CloudAuction etc. In proposed Efficient Resource Management in Cloud Computing (EFRE) model, CloudSim is used as a simulation toolkit that allows simulation of DataCenter in Cloud computing system. The CloudSim toolkit also supports the creation of multiple virtual machines (VMs) on a node of a DataCenter where cloudlets (user requests) are assigned to virtual machines by scheduling policies. This paper represents, allocation policies, Time-Shared and Space-Shared are used for scheduling the cloudlets and compared with the constraints (metrics) like total execution time, a number of resources and resource allocation algorithm. CloudSim has been used for simulations and the result of simulation demonstrate that Resource Management is effective.

Keyword- Cloudlets, CloudSim, Cloud Computing, Resource Management, Scheduling Policies

I. INTRODUCTION

In computer science, computing is nothing but any goal-oriented task for creating various application in the computer which includes designing and building software systems for different purposes. In simple term, cloud computing allows users to store their digital data and retrieve it over the internet. In addition, the cloud computing services are choice-based services which can be available at any time as required by user at anyplace. With the help of internet and resources, services are provided to maintain data and applications on Cloud. Cloud computing is very useful while accessing personal files remotely. Due to its various characteristics such as virtualization, reliability, scalability and many more, cloud computing attracts a rapidly increasing number of users [1].

Cloud computing has been used over the years to mean a number of cloud services: and Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). SaaS is a model of software deployment where an application is hosted as a service provided to consumers over the Internet. SaaS provides scalability and may load the application on several severs under system administration privilege. Single instance, multi-tenant, flex tenancy, multi-instance these are the common approaches of software as a service. Next, PaaS is a programming and runtime environment which mainly reduces the administration efforts, increases the flexibility and focuses on business applications. PaaS provides an application container for one or more programming languages. PaaS providers support multi-tenancy partially through namespaces for tasks on several layers. IaaS is Infrastructure as a Service, here you are provided the physical infrastructure like server, and storage etc. and user can access the services with the help of internet. Providers of IaaS refers to online services and offer computers physical as well as virtual machines and other resources. In infrastructure as a service, utility computing center providing on-demand server resources [2].

In our model, the main task is to manage the resources in cloud environment which helps to assign/allocate resources efficiently. Virtual machine plays an important in resource management. It creates a virtual environment that helps the hosts to assign and manage the Cloudlets (user request) effortlessly [3]. In Cloud computing, resource management requires algorithm to schedule the resources efficiently. The scheduler is at the heart of any distributed system. Scheduler decides which job or virtual machine should go on which machine. An effective scheduler can reduce operational costs, reduces queue waiting time and increases resource utilization [4] [7].

Cloud computing will be a major technology in the development online storage. Service providers want to provide good service of clouds in order to satisfy user requirement. In order to save energy consumption, the ideal use of available resources is the most important job in cloud management. As it is difficult to test new mechanism in real cloud computing environment because of unavailability of different resources. So that we use

a virtual environment for simulating algorithms and measurement of quality that will be provided [5] [6]. There are different tools available for the simulation like GridSim CloudAnalyst, CloudSim, GreenCloud, CloudAuction etc.

In EFRE model, CloudSim is used; which works on Java. This is a new platform for the cloud environment that allows simulation Clouds and different analysis in Cloud computing. Cloud computing infrastructures and management services using Java platform. This tool supports modeling of Cloud system components [8].

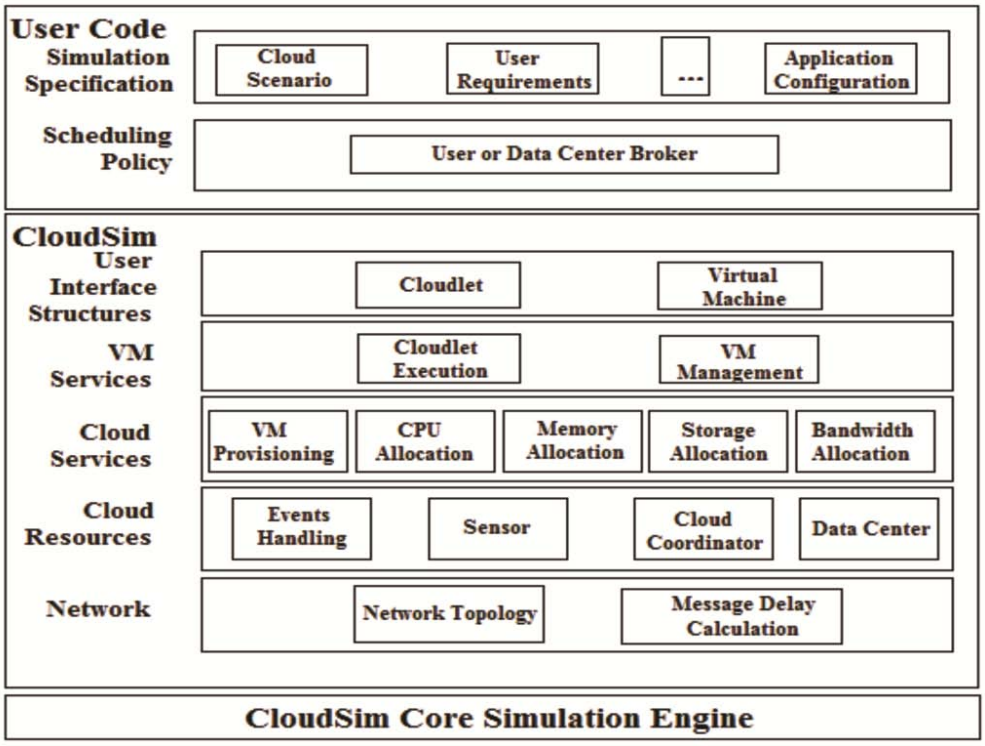

Figure 1: The Architecture of CloudSim [12]

CloudSim is Java based package having its own libraries. These libraries directly runs on JVM only by importing into Java file. The basic components of CloudSim are:

- Cloudlet
- DataCenter
- DataCenter Broker
- Host
- Virtual Machines
- VM Scheduler

A. Cloudlet

It is the characteristics of particular task (user request) given by the end-user [9].

B. DataCenter

DataCenter is the important component of CloudSim, simply this is the collection of cloud computing resources from which VMs are created by using hosts [9].

C. DataCenter Broker

Broker intermediates between customer and Clouds, and according to type of request by the customer, it provides the services with help of DataCenters [9].

D. Host

In DataCenter, hosts are used to create and manage resources of DataCenters and assign them to the VMs [9].

E. Virtual Machines (VMs)

Virtual Machines are cybernetic machines which are managed by hosts [9].

F. VM scheduler

Scheduler used to manage the given set of requests [9].

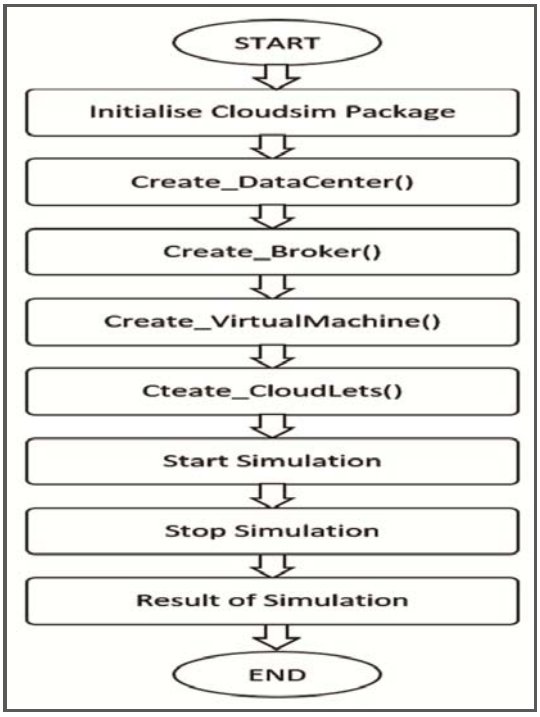

Figure 2: CloudSim Life Cycle [8]

II. RELATED WORK

The simulation is basically useful in the experimenting different methods for managing resources. Also useful to calculate approx. cost for optimizing. Many open source simulators are available for manipulating the energy efficiency of Cloud DataCenter. Every available simulation works according to its features and type of goals. CloudSim is the simulation program for the above two purpose [10]. It provides designing of VMs in DataCenter to process the Cloudlets. And it also shows the result of time, power, and traffic consumption. This paper will introduce the CloudSim simulator including its architecture, and how to use it to modeling the cloud environment [11]. The open-source simulator CloudSim is selected because we can study their source code in details, develop the new algorithm and improve them if necessary. DataCenter, it is big resource pool and used in CloudAnalyst and CloudSim which works on GridJava and SimSim, and consider application-level workloads. CloudSim designs VMs in DataCenters, and user uses Cloudlets for sending service request. The VM instance may require some resource such as memory, storage and bandwidth on the host to enable its allocation, which means assign specific cores of CPU, an amount of memory and bandwidth to specific VMs [12].

The resources of the cloud computing need management. Abishi Chowdhury, Priyanka Tripathi presented in conference [13] that for working on cloud computing there is the necessity of finding out the metrics to be used for evaluation of performance. They have discussed the resource management metrics such as Load, throughput, Response time, Throttled Load Balancer, Cost effective Provisioning, Heterogeneity, Threshold-based allocation etc. Based on these they have given a comparison between different resource allocation techniques. Cloud computing provides on-demand services. These techniques are applicable on the different models of the cloud. These techniques, mainly manage the infrastructure of the cloud computing environment.

Cloud is the important part to manage distributed computer systems which can be used for outsourcing. Currently, lots of service providers like Amazon, ES2, etc. For this purpose, we need to analyze the basic requirements to provide quality. Amid Khatibi Bardsiri, Seyyed Mohsen Hashemi [14] presented metrics about the quality of service in cloud computing which includes characteristics like Elasticity, Reliability, Agility and adaptability, Availability, Cost reduction based on different existing cloud providers(Amazon, EC2, VMware, FlexNet, Google Apps Engine).

Sukhpal Singh, Inderveer Chana [15] proposed a QoS metric based resource provisioning technique based on the QoS requirements of cloud workloads to find the best resource and workload match with reliable cloud services without violation of SLA. For resource provisioning, QoS parameters must be described in the form of SLA. They have identified required objectives for QoS such as identify the recent and prospective desires and potentials of the cloud user, workload patterns based on workload details and clustered based on workload patterns, calculate submission burst and cost for resource provisioning and resources are provisioned for actual scheduling. From experimental study, they have given different results of load balancing depends on various cases and case study of Airline reservation system to show the use of load balancing.

III. METHODOLOGY

In cloud computing, managing cloud resources and handling the request (task) is an important job. There is the various component of cloud computing such as DataCenters, cloudlets, virtual machine etc. from which DataCenters are used for managing and allocating resources to the virtual machines. Scheduling of resources is a difficult problem in Cloud Computing because there is a need to serve many user requests in real time Clouds. The key goal of scheduling algorithms is to minimize the allocation time maximize resource utilization [17]. In our EFRE model, two schedulers are used first is VMScheduler which helps to manage and allocate resources to the VMs and Second is CloudletScheduler which helps to manage all the user request appropriately. There are some already known algorithms scheduling algorithm like FCFS, Round Robin, etc. With the help of these algorithms, we have defined policies for scheduling the tasks [16]. There are two scheduling polices:

- Space Sharing
- Time Sharing

A. *Space shared policy*

1. DataCenter accepts tasks from user
2. The first task is assigned to virtual machine
3. After completing the previous task, it assigns next task to the virtual machine and so on for the remaining tasks.

B. *Time shared policy*

1. It takes a task from a broker.
2. All the tasks are assigned to the virtual machine according to capacity.

C. *Comparison of above scheduling policies*

Time shared policy supports parallelism to serve more requests in a small time period and it works as a round-robin algorithm where in space shared policy fixed space is allocated for a particular task, so we need more resources for serving more requests and it uses first come first serve algorithm. We can notice that the simulation result of both approaches seems to be quiet but space-shared completes almost all tasks before it meets the deadline. By increasing the number of cloudlets and virtual machines we can observe the more difference and conclude that Space-shared approach is better than Time-shared approach [16].

In this paper, we compare the performance of the simulation by increasing the number of DataCenters, Tasks, and VMs. If we consider single DataCenter, then the simulation results take more executing time compared to multiple DataCenters. In this case Time-shared performance better. As if we take multiple DataCenters all the tasks are distributed among the virtual machines.

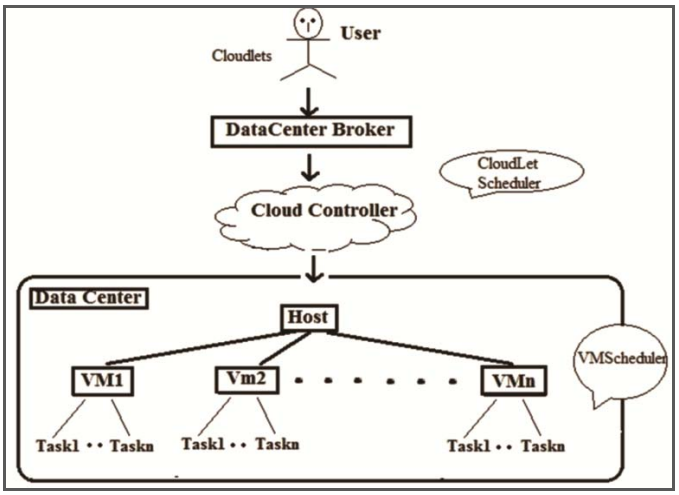

Figure 3: Scheduling Architecture

In the above Scheduling Architecture, Users send a request for their tasks to DataCenter Broker, this broker behaves like an interpreter between user and DataCenter and helps to manage task on VMs. In DataCenter, hosts allocates the VMs and schedules tasks according to the scheduling polices discussed earlier. The number user request of the cloud is similar to Cloudlets. Both the CloudletScheduler and VMScheduler are useful for the simulation result. The DataCenter Broker submit the user request to cloud controller and schedule the submitted tasks [16].

IV. SIMULATION AND ANALYSIS

We have tried CloudSim for analysing Time-Shared and Space-Shared environment. Following experiment gives results for single resource only with given specifications

- *DataCenter: 2*

Architecture = "x64", Operating System = "Unix", VMM = "Xenon1", Time Zone = 10.0, Cost = 7.0, CostPerMem = 0.001, CostPerStorage = 0.4, CostPerBw = 0.2.

- *Virtual Machines: 5*

Size = 10000 MB, ram = 512 MB, MIPS = 1000, Bandwidth = 1000, PesNumber = 1 CPU.

- *Number of Hosts: 2*

TABLE I. Host Characteristics

Host Characteristics	**Host 0**	**Host 1**
RAM	2048	1024
Storage	1000000	500000
Bandwidth	10000	50000
Machine	Quad Core	Dual Core

- *Cloudlets: 20*

Length = 1000, File Size = 300MB, Output Size = 300MB, PesNumber = 1CPU;

Let’s consider 20 tasks (Cloudlets) given to the DataCenters which are having 5 virtual machines to run them. These machines are monitored by 2 Hosts in the DataCenter.

Result #1

In this, we used time shared allocation policy for the resource management. For the above tasks after simulation on CloudSim we got following results:

1. As explained in methodology, in time shared policy tasks can be scheduled in such way that they can run simultaneously.
2. So we are getting same Start and Finish time for the specific task as shown in Table No. II

TABLE II. Time-Shared Policy

Cloudlet	STATUS	DataCenter ID	VM ID	Time	Start Time	Finish Time
0	Done	2	0	4	0.1	4.1
5	Done	2	0	4	0.1	4.1
10	Done	2	0	4	0.1	4.1
15	Done	2	0	4	0.1	4.1
1	Done	2	1	4	0.1	4.1
6	Done	2	1	4	0.1	4.1
11	Done	2	1	4	0.1	4.1
16	Done	2	1	4	0.1	4.1
2	Done	2	2	4	0.1	4.1
7	Done	2	2	4	0.1	4.1
12	Done	2	2	4	0.1	4.1
17	Done	2	2	4	0.1	4.1
4	Done	2	4	4	0.1	4.1
9	Done	2	4	4	0.1	4.1
14	Done	2	4	4	0.1	4.1
19	Done	2	4	4	0.1	4.1
3	Done	2	3	4	0.1	4.1
8	Done	2	3	4	0.1	4.1
13	Done	2	3	4	0.1	4.1
18	Done	2	3	4	0.1	4.1

Result #2

For this experiment, we have used Space-Shared allocation policy for assignment of tasks. For the above tasks after simulation on CloudSim we got following results:

1. In Space-Shared policy, only one task can be active on a virtual machine at a time.
2. Give tasks are scheduled one after another
3. So we are getting different Start and End time for specific tasks as shown in Table No. III

TABLE III. Space-Shared Policy

Cloudlet	STATUS	DataCenter ID	VM ID	Time	Start Time	Finish Time
0	Done	2	0	1	0.1	1.1
1	Done	2	1	1	0.1	1.1
2	Done	2	2	1	0.1	1.1
3	Done	2	4	1	0.1	1.1
4	Done	2	3	1	0.1	1.1
5	Done	2	0	1	1.1	2.1
6	Done	2	1	1	1.1	2.1
7	Done	2	2	1	1.1	2.1
8	Done	2	4	1	1.1	2.1
9	Done	2	3	1	1.1	2.1
10	Done	2	0	1	2.1	3.1
11	Done	2	1	1	2.1	3.1
12	Done	2	2	1	2.1	3.1
13	Done	2	4	1	2.1	3.1
14	Done	2	3	1	2.1	3.1
15	Done	2	0	1	3.1	4.1
16	Done	2	1	1	3.1	4.1
17	Done	2	2	1	3.1	4.1
19	Done	2	4	1	3.1	4.1
18	Done	2	3	1	3.1	4.1

Result #3

For the optimizing performance of Cloud Computing number of resources should be used. If we have a number of resources, we can schedule the task on multiple DataCenters to reduce response time.

Comparison between single resource and multiple resources is given in Table No. 4

TABLE IV. Comparison with Constraints

DataCenters	Hosts	VMs	Cloudlets	Policy	Time
1	1	10	1000	Time-Shared	166.9
4	4	20	1000	Time-Shared	50.2
1	2	10	1000	Space-Shared	167.1
4	4	20	1000	Space-Shared	50.2

Result #4

For analysing the proper time taken by the scheduler, we used different number of cloudlets assigned to specific environment

DataCenter: 1

Hosts: 2

Virtual Machines: 5

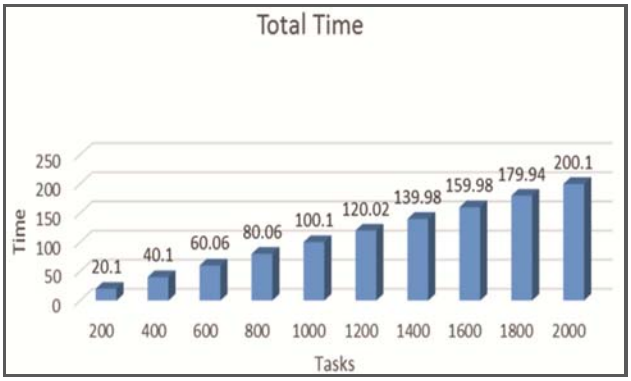

Figure 4: Task Vs Time

V. CONCLUSION

In this paper, we introduced the CloudSim simulator with its architecture, and how to do modelling in a cloud environment. In our simulation results, we can find outputs like which cloudlet is assigned to which VM and DataCenter, with the execution time. After doing experiments, we got to know that different scheduling policies give different results like Time-Shared policy works better in Single Resource and Space-Shared gives better performance in multi-DataCenter architecture. Also, other experiments conclude that if we increase the number of resources like DataCenters, Hosts, VMs it gives the good performance.

In future research, we will work with the method which allows multiple users like real time system to enhance the overall performance of Cloud Computing. Also, we can think of creating cloud system having hybrid DataCenters i.e. combination of different architectures and assigning user tasks according to their characteristics.

ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. M. Venkatesan and Prof. T. Arunkumar, Associate professor in VIT University, School of Computer Science and Engineering Department, for their invaluable guidance with Cloud Computing Technology especially CloudSim toolkit. We would also like to thank VIT University for letting us use the computer labs for our project work and also thankful to all our colleagues for their suggestions.

REFERENCES

[1] Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi – "Mastering Cloud Computing - Foundations and Applications Programming", Morgan Kaufmann is an imprint of Elsevier
[2] Cloud Computing Wikipedia:https://en.wikipedia.org/wiki/Cloud_computing_architecture
[3] Yuan Yuan, Wen-Cai Liu," Efficient Resource Management for Cloud Computing", Int. Conference on System Science, Engineering Design and Manufacturing Informatiztion, 2011
[4] Preeti Agrawal, Yogesh Rathore, "Resource Management In Cloud Computing With Increasing Dataset", International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 6, June 2012).
[5] R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud computing and emerging it platforms: Vision, hype, and reality for delivering computing as the 5th utility," Future Gener. Comp. Sy., vol. 25, no. 6, pp. 599– 616, 2009.
[6] M.G. Avram. "Advantages and Challenges of Adopting Cloud Computing from an Enterprise Perspective", Procedia Technology, 12, 2014, pp. 529-534.
[7] Vignesh V, Sendhil Kumar KS, Jaisankar N, "Resource Management and Scheduling in Cloud Environment", Int. Journal of Scientific and research Publications, Volume 3, Issue 6, June 2013, ISSN 2250-3153
[8] Ranjan Kumar, G.Sahoo, "Cloud Computing Simulation Using CloudSim", International Journal of Engineering Trends and Technology (IJETT) – Volume 8 Number 2- Feb 2014
[9] Cloud Simulation Frameworks by Biarry Lumpkin, Tuan Nguyen, Nguyen, http://cloud-simulation-frameworks.wikispaces.asu.edu/home
[10] R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, "Cloudsim: A toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms," Software – Practice and Experience, vol. 41, no. 1, pp. 23–50, 2011.
[11] Wang Long, Lan Yuqing and Xia Qingxin," Using CloudSim to Model and Simulate Cloud Computing Environment", 2013 Ninth International Conference on Computational Intelligence and Security 978-1-4799-2548-3/13 131.00 © 2013 IEEE DOI 10.1109/CIS.2013.75
[12] Wenhong Tian, Minxian Xu, Aiguo Chen, Guozhong Li, Xinyang Wanga, Yu Chen, "Open-source simulators for Cloud computing: Comparative study and challenging issues", Simulation Modelling Practice and Theory, Elsevier Journal 2015
[13] Chowdhury A, Priyanka Tripathi," A Metrics Based Analysis of Cloud Resource Management Techniques", 2014 IEEE Interntional Conference on Advanced Communication Control and Computing Technologies (ICACCCT).
[14] Amid Khatibi Bardsiri Seyyed Mohsen Hashemi, "QoS Metrics for Cloud Computing Services Evaluation", I.J. Intelligent Systems and Applications, 2014, 12, 27-33 Published Online November 2014 in MECS (http://www.mecs-press.org/) DOI: 10.5815/ijisa.2014.12.04
[15] Sukhpal Singh, Inderveer Chana, "Q-aware: Quality of service based cloud resource provisioning", http://dx.doi.org/10.1016/j.compeleceng. 2015.02.003

[16] Himani, Harmanbir Singh Sidhu, "Comparative Analysis of Scheduling Algorithms of CloudSim in Cloud Computing", International Journal of Computer Applications (0975 – 8887) Volume 97– No.16, July 2014
[17] Isam Azawi Mohialdeen, "A Comparative Study of Scheduling Algorithms in Cloud Computing Environment", Science Publications, 2013.

AUTHOR PROFILE

Rushikesh Shingade is a student of M. Tech in Computer Science and Engineering at VIT University, Vellore, Tamilnadu. He received B. Tech in Information Technology from VJTI, Mumbai, Maharashtra in 2014. His areas of interest include Networking, Designing, Web Designing, Programming and algorithms, Multi-Core Programming, Cloud Computing.

Amit Patil is a student of M. Tech in Computer Science and Engineering at VIT University, Vellore, Tamilnadu. He received B. E. in Information Technology from MIT, Alandi, Pune-University, Pune, Maharashtra in 2014. His areas of interest include Cloud Computing, Database and Programming

Shivam Suryawanshi is a student of M. Tech in Computer Science and Engineering at VIT University, Vellore, Tamilnadu. He received B.E. in Computer Engineering from R. C. Patel Institute of Technology, Shirpur, NMU- Jalgaon, Maharashtra in 2014. His areas of interest are Web Designing, Programming Languages and Database

M. Venkatesan is working as an Associate Professor in School of Computing Science and Engineering, Vellore Institute of Technology, Vellore, Tamilnadu. He is working in the area of spatial data mining. His research area includes databases, data warehouse, big data analytics, data mining and applications of data mining in disaster management. He has good knowledge in data mining tools like Clementine, rapid miner. He is the Principal investigator in ISRO funded project on data mining in a landslide. He completed his BE, M. Tech and PhD in the area of spatial data mining. He published 25 papers in international journal and 30 papers in the reputed Conferences.