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A Novel Method of Butterfly Optimization Algorithm for Load Balancing in Cloud Computing

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Abstract—Cloud computing is frequently alluded to as a model that furnishes boundless information handling conveniences with a compensation for each utilization framework. Present day cloud foundations resources as virtual machines (VMs) to actual machines utilizing virtualization innovation. All VMs works their involved structure and exhaust resources from their actual machine which behaves like a host. For load adjusting, Cloud moves VMs from exceptionally troubled real machines to low troubled actual machines. The delay of this calculation expansions in the organization as virtual machines are relocated. This work puts forward a new algorithm, namely Butterfly optimization for VM migration. The proposed optimization algorithm has been implemented in the MATLAB software. A comparative analysis is performed between the outcomes of the preceding and the new algorithm. The proposed algorithm has been evaluated over three performance parameters including delay, bandwidth used, and space used.

Keywords—Load Balancing; Cloud Computing; Optimization Algorithm; Butterfly Algorithm.

I. INTRODUCTION

Cloud computing (CC) is a kind of parallel and distributed framework that consist of an assortment of interlinked and virtualized powerfully provisioned computer systems, that are introduced as at least one or many integrated computational assets dependent on SLA (Service Level Arrangements) set up via exchange amongst customers and the SPs (Service Providers) [1]. The word Cloud alludes to a Network or Internet. Cloud can offer services across different types of networks including private networks (WAN, LAN or VPN) and public networks. There are various applications, for example, email, online conferencing, CRM (Client Relation Management) that run on cloud. Cloud computing provides easy-to-use, on-request admittance to shared pools of information, applications and hardware tools. Cloud computing facilitates clients and businesses with different capacities so that they can store and handle their data in the data centers of third party [2]. It depends on exchange of assets to obtain intelligibility and substantial savings, just like a utility (like the power grid) across an organization [3]. Cloud computing model differs dramatically from existing IT models, possibly by sophisticated automation, provisioning, and virtualization technologies because of its ability of separating data and software from the servers and storage schemes that run them. Cloud computing allows IT assets to be progressively distributed and transferred as an amenity, either in element fragments where clients buy in to explicit applications or merely rent computing power or as a unified entirety. Cloud computing is also concerned to make the efficiency of the shared resources to maximum level. Cloud resources along with sharing among a large number of customers are also re-distributed as per the demand in dynamic manner. This event helps in resource distribution among customers. For instance, a cloud computing amenity serving European customers within European working hours by a certain application (such as E mail) can re-distribute the similar resources for serving the customers in North America within North America's working hours by a dissimilar application (for example, a web server) [4].

Cloud computing has various clouds. The user may get the subscription of these clouds according to his/her requirement. A person who owns home or a small business will probably utilize public cloud services. Following are the different cloud computing models.

A. Public Cloud

In public cloud, the general public or a big company is allowed to use the cloud model over the Internet [4]. The customer does not own framework, but it is controlled by a company that provide cloud services. It is possible to deliver services either free, as a subscription, or as per a pay-per-use model. The customer does not control or has any knowledge from where the cloud services are being delivered. Multiple companies share

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main infrastructure. However, data and application used by every company is rationally distributed for making the services available only to legal customers. In contrast to other cloud models, public clouds are less safe due to their extra load of guaranteeing overall implementations. Also, info obtained on this architecture do not subject to malevolent activities. Some popular instances of public clouds Oracle, Google App Engine, etc.

B. Private Cloud

The Service may be defined as provision that is setup and hosted on a private platform in the user data centre entirely for usage by a single company. A specific company gets the access to this service and not the other companies. The company generally plays the role of a CSP (Cloud Service Provider) to inner business elements that gain all advantages of a cloud without provisioning their individual framework. A company, a third party, or a mixture of both may manage, own and operate private cloud [5]. The architecture of private cloud is generally housed in the company's sites, but can also be hosted in a data centre, whose owner is a third party. Using this architecture may be securer than the above-mentioned framework due to its specific interior revelation.

C. Community cloud

A cloud model of this form is jointly used by many companies and assists a certain group including healthcare sharing worries about mission, policy and compliance contemplations [6]. Community cloud is concerned with providing advantages (e.g., shared design overheads, pay-per-use billing concept) of a private cloud to its partner companies with extra level of privacy, security, and policy amenability generally related to a private cloud. It is possible to deploy the model of community cloud on sites or at the data centre of a third party. The partner company or a third party can manage this model.

D. *Hybrid cloud*

This architecture is an amalgamation of public and private cloud models. These architectures are bound together by either standardized or exclusive technique enabling the portability of data and applications. This type of cloud centres around combining services and data from different sorts of cloud models for generating an integrated, automatic, and properly controlled computing atmosphere. This architecture allows facility suppliers to use third party cloud deliverers completely or partially, in this way, makes computing more flexible. In a hybrid cloud, a business can get the benefit of the scalability and profitability of a public cloud without being exposed to applications and data outside the business intranet.

II. LITERATURE SURVEY

Dalia Abdul kareem Shafiq, et.al (2021) suggested an algorithm which helped to balance load more competently and also optimize data sets in relation to metrics of QoS, the priority of VMs, etc. [7]. This algorithm emphasized on improving the process of utilizing and allocating the cloud resources and mitigating the time that was consumed in scheduling a task such as the efficacy of the CC was boosted. The results depicted that the suggested algorithm provided the resource usage of 78% in comparison with the traditional algorithm. This algorithm had performed well with regard to least execution time and makespan.

Nithin K. C. Das, et.al (2017) aimed to incorporate the WRR algorithm in HA with the objective to minimalize the reaction and processing period [8]. The weights were assigned to every VM (Virtual Machine) to implement the presented algorithm. The selection of VM was done in accordance with the necessity of resource in the tasks. The outcomes of experiments demonstrated that the presented algorithm yielded superior performance concerning response time and time to process the data center. The future work would focus on more QoS components concerning waiting time, migration time cost etc.

M Jeyakarthic, et.al (2020) introduced CS-SS and GO along with Man Reduce for dealing with the issues of offloading and to cut down the exploitation of assets [9]. The server was selected by the client and a request was sent for enhancing the redundancy, reliability and availability. The implementation of GO was done with a map reduction method concerning precision. The experimental outcomes revealed that the introduced approach provided the accuracy around 97.7%.

Dharavath Ramesh, et.al (2018) developed a mechanism recognized as SCLBA in order to utilize the resources efficiently [10]. This algorithm performed on the basis of UBs of the cloud infrastructure layer and useful to handle the process of allocating the VM (virtual machine) in dynamic manner. CloudSim toolkit and Cloud Analyst were utilized for implementing and testing the developed algorithm in various conditions. The experimental outcomes indicated that the developed algorithm was capable of managing the load effectively for which the resources were utilized in effective manner. Moreover, the developed mechanism offered superior access time and execution time in comparison with the traditional techniques.

M. Lawanyashri, et.al (2017) established a hybrid FOA (Fruitfly Optimization Algorithm) on the basis of SA (Simulated Annealing) with the objective of enhancing the convergence rate and optimization accuracy [11]. A better resource usage was obtained and energy utilization and cost were mitigated using the established algorithm in CC (cloud computing) environment. The outcomes acquired in established algorithm offered an enhanced approach. The outcomes of experiments validated that the established approach was more effective to balance the workload in comparison with the traditional algorithms.

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A. Francis Saviour Devaraj, et.al (2020) designed a novel hybrid approach named FIMPSO in which FFA (Firefly algorithm) was integrated with IMPSO in order to balance the load [12]. The search space was diminished using FFA in this approach. The IMPSO algorithm was adopted for recognizing the improved response. The designed approach provided efficient load. The simulation results exhibited that the designed approach performed more successfully in contrast to other techniques. The designed approach provided the memory utilization up to 93%, reliability around 67% and throughput up to 72%.

Lung-Hsuan Hung, et.al (2021) projected and incorporated two genetic-based techniques for balancing the load [13]. Initially, in view of several metrics productivity of virtual machines was scrutinized. Also, their quantification was performed in a cloud environment. The symbolic regression algorithms were produced using GEP (gene expression programming). These algorithms were useful to define the performance of VMs and forecast the loads of VMHs when the load was balanced. Subsequently, Jnet was executed to compute the projected techniques. The experimental results confirmed the superiority of projected techniques over others.

Muhammad Junaid, et.al (2020) recommended a schema recognized as DFTF wherein an upgrade variant of CSO was implemented with SVM to balance the load [14]. First of all, the recommended algorithm was capable of classifying the data taken from different sources into distinct classes in cloud. After that, the modified algorithm made the deployment of that data as input for distributing the load on VMs (virtual machines). The simulation outcomes proved that the recommended approach provided the throughput of 7%, the response time up to 8.2% and migration time around 13% in comparison with traditional models.

H. Lathashree, et.al (2018) intended a model so that the load was balanced effectively in the CC [15]. This model emphasized on balancing the load in efficient manner and to maintain the QoS requirements of the client which had described in SLA. For this, CAs and ANN algorithms were utilized. CAs had potential to make the significant decisions in a dynamic environment. The intended model performed well with regard to execution time, throughput and resource usage.

Zixi Cui, et.al (2021) devised a scalable methodology called Closer in order to balance the load for cloud data centers [16]. The system was divided into centralized route computing and distributed route decision for ensuring that it was flexible and stable in huge networks. The INT was leveraged for extracting the exact information related to link state. For this, weighted ECMP was adopted in a simple and effectual algorithm at the edge of fabric that assisted the devised methodology in mapping the flows to the suitable path and avoiding great congestion occurred in a single link. The devised methodology provided superior FCT (flow completion time) at 70% network load in comparison with the conventional techniques.

Karan D. Patel, et.al (2019) formulated an algorithm to balancing the load in which two algorithms were put together so that the workload was balanced over the cloud system [17]. An expansion of HBB (honey bee behavior) inspired algorithm was implemented to accomplish the priority-based tasks and the normal tasks were accomplished using an extension of WRR. This algorithm concentrated on enhancing the performance of system, superior resource usage and least completion time. The formulated algorithm mitigated the completion time and boosted the efficacy.

III. RESEARCH METHODOLOGY

To manage node difficulties associated with the failure in cloud organizations, this work presents a nature inspired algorithmic solution called BFO (Butterfly Optimization). This solution comprises of numerous nodes. Contingent upon the briefest ET (Execution Time) and FR (Failure Rate), a participating node is browsed between this large number of nodes. This case utilizes an expert node to fix a limit or threshold. It incorporates two metrics namely mentioned above i.e., ET and FR. The expert mote picks those motes as applicant that have minimal FR and ET. Contrasted with the set threshold, the value of node N1 is less. This is the fundamental explanation of choosing this mote (or node) as the competitor node. N2 has both high and low metrics. Hence, this node can't be chosen as a competitor node. N3 is chosen as the competitor mote since it has a value equivalent to the set limit. Likewise, it isn't attainable to choose N4 as applicant node on the grounds that its value higher than the set threshold. The competitor node starts executing its job once it is determined. For this situation, different errands are started. A node moves from its position once the task is over. It results in the failure of task. This work presents another solution to overcome the concern of failure event because of node mobility. The new solution enlists another measure called period of master node. The ultimate period to induct end clients is alluded to as master node spell which aids node cooperation. The following formula is used to measure the duration of master node:

- E-cost=maximal execution time + Time required by master node (master node time)

Then, we will compute each node’s profit.

- Profit of each node= E-cost + Failure time of each node
- Weight of each node= No. of tasks + maximal execution time/Profit

The node with highest weight is selected. The provided formula is used for the weight measurement.

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The envisioned algorithm takes the following steps:

- Get list of all VMs working on all hosts.
- Initialize no migration is performed.
- Get resource consumption, failure rate, and execution time of all machines.
- Built transition matric for hosts and VMs.
- Loop will execute until all machines in over-utilized hosts are migrated.

a) Calculate the current utilization of each host for that particular VM that needs migration.

b) Check creation history of the VM.

c) Compare increase in utilization of selected hosts with other hosts.

d) Select host for which increase in utilization is minimum

e) End Loop

f) If maximum utilization exceeds upper utilization threshold go to a).

- Else choose that particular host for migration.
- return migration List

End

IV. RESULT AND DISCUSSION

The MATLAB is the abbreviation for Matrix Laboratory. The LINPACK and EISPACK have developed matrix software that MATLAB can accessed with ease. Since MATLAB is a programming and mathematic computation tool, a large number of programmers and researchers use it to examine data, create algorithm-driven solutions along with frameworks. The core of MATLAB software is incorporating computation, visualization and programming environments. All these features make MATLAB a promising tool in the research and development domain.

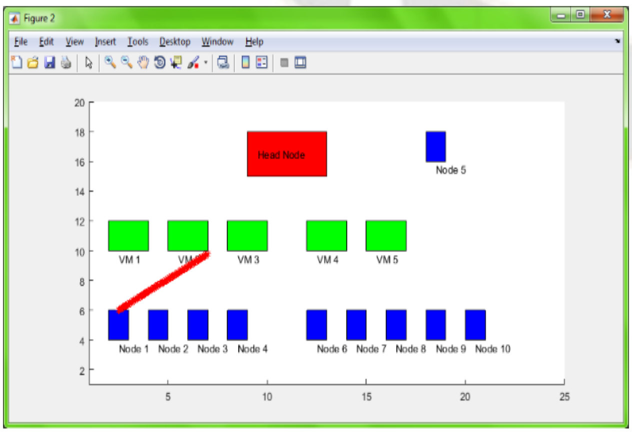

Figure 1. Example of a Virtual Machine Migration using ACO algorithm

Figure 1 depicts the selection of the highest value virtual machine as the best machine. The tasks on this machine will be migrated for execution with the ACO algorithm.

TABLE I. Response Time

Number of Task	Genetic Algorithm	Improved Genetic Algorithm
1000	700	500
2000	1100	900
3000	1400	1100
4000	1700	1500
5000	2100	1600

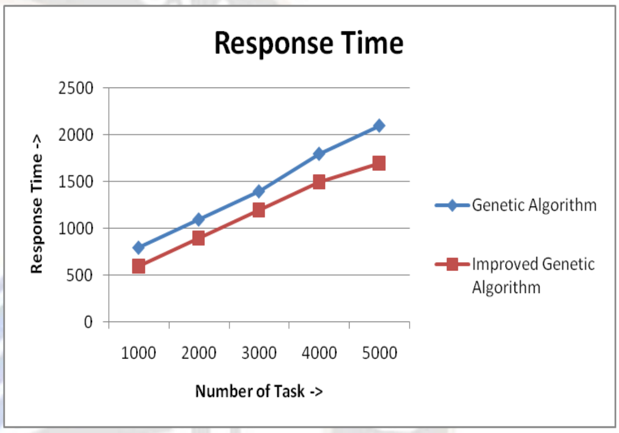

Figure 2. Example of a Response Time based comparison

Figure 2 evidence response time-based comparison between the GA and IGA. Unlike GA, the response period of IGA is less.

TABLE II. Energy Consumption

Number of Task	Genetic Algorithm	Improved Genetic Algorithm
1000	3 joules	1 joules
2000	6 joules	3 joules
3000	9 joule	7 joules
4000	11 joule	9 joule
5000	15 joule	12 joule

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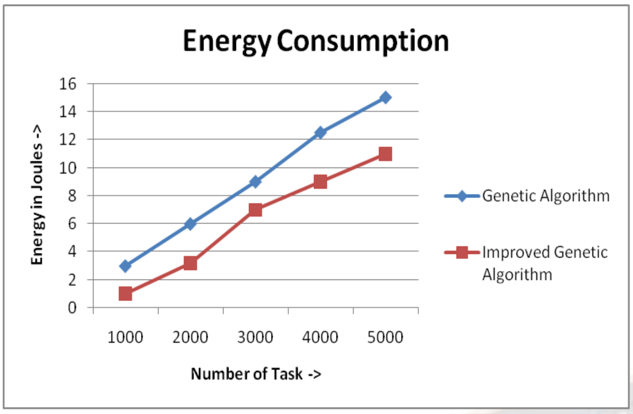

Figure 3. Example of a Consumed Energy based Comparative Analysis

Figure 3 illustrates comparison between the GA and IGA on the basis of energy consumed. The presented IGA is more energy efficient as opposed to the classic GA.

TABLEIII. Cost Analysis

Number of Task	Genetic Algorithm	Improved Genetic Algorithm
1000	100	62
2000	103	100
3000	160	110
4000	205	170
5000	302	200

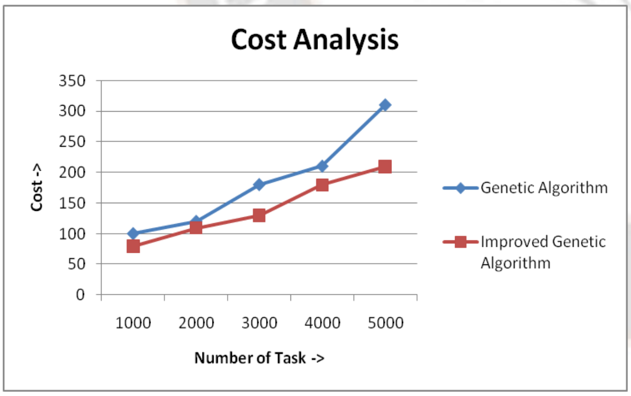

Figure 4. Example of a Cost driven Comparative Analysis

Figure 4 depicts cost-based comparison between the GA and IGA. In contrast to GA, the cost of newer IGA is lower.

TABLEIV. VM Migration Analysis

Number of task	Genetic Algorithm	Improved Genetic Algorithm
1000	5	4
2000	8	6
3000	12	8
4000	17	11
5000	18	15

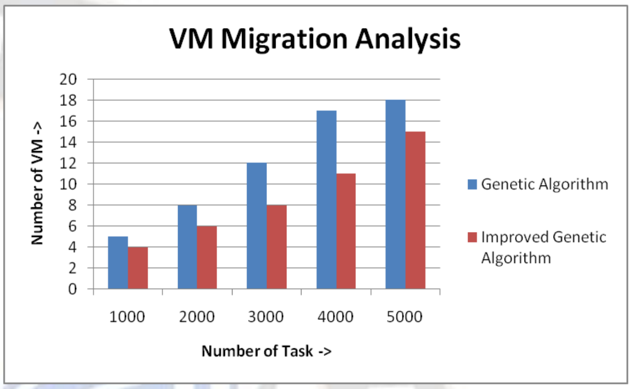

Figure 5. Example of a Migrations based Comparative Analysis

Figure 5 depicts comparison between the classic GA and newly developed IGA based on the number of migrations. In contrast to GA, the migration rate of newer IGA is lower.

V. CONCLUSION

This paper is focused on the issue related to the balancing of load in cloud framework. Improper load balancing can lead to increased delays in the structure. The preceding project migrated VM by implementing genetic algorithms. It is seen that a lot of complexity is involved in GA. Therefore, the time of virtual machine migration increases. The main aim here is to accomplish VM migration through the implementation of advanced genetic technology. This project adopts MATLAB tool to implement the presented algorithmic solution. A number of parametric values are computed for studying the performance of this algorithmic approach. The experimentation reveals that the introduced algorithmic solution yields improved performance than the existing algorithm.

REFERENCES

[1] Amandeep Kaur Sidhu, SupriyaKinger, “Analysis of Load Balancing Techniques in Cloud Computing”, International Journal of Computers & Technology, Vol. 4, No. 2,2013
[2] Po-Huei Liang1 and Jiann-Min Yang, “Evaluation of Two-Level Global Load Balancing Framework in Cloud

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Environment", International Journal of Computer Science & Information Technology (IJCSIT), Vol 7, No 2, 2015

[3] Abhishek Kumar Tiwari, Sreeja Nair, "A Review of Load Balancing Technique of Cloud Computing Using Swarm Intelligence", International Journal of Computer Science and Information Technologies, Vol. 7, No. 2, pp. 741-744. 2016

[4] Srinivasa Rao Gundu & T. Anuradha, "Improved Hybrid Algorithm Approach based Load Balancing Technique in Cloud Computing", Global Journal of Computer Science and Technology, Vol. 19 Issue 2, 2019

[5] Alok singh, Vikas Kumar Tiwari, Dr. Bhupesh Gour, "A Survey on Load Balancing in Cloud Computing Using Soft Computing Techniques", International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 9, 2014

[6] Gill, D. R. . (2022). A Study of Framework of Behavioural Driven Development: Methodologies, Advantages, and Challenges. International Journal on Future Revolution in Computer Science &Amp; Communication Engineering, 8(2), 09–12. https://doi.org/10.17762/ijfrcsce.v8i2.2068

[7] Saher Manaseer, MetibAlzghoul, Mazen Mohmad, "An Advanced Algorithm for Load Balancing in Cloud Computing using MEMA Technique", International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol. 8, No. 3,2019

[8] Kiran, M. S., & Yunusova, P. (2022). Tree-Seed Programming for Modelling of Turkey Electricity Energy Demand. International Journal of Intelligent Systems and Applications in Engineering, 10(1), 142–152. https://doi.org/10.18201/ijisae.2022.278

[9] Dalia Abdulkareem Shafiq, Noor Zaman Jhanjhi, Azween Abdullah, Mohammed A. Alzain, "A Load Balancing Algorithm for the Data Centres to Optimize Cloud Computing Applications", IEEE Access, 2021

[10] Ahmed Cherif Megri, Sameer Hamoush, Ismail Zayd Megri, Yao Yu. (2021). Advanced Manufacturing Online STEM Education Pipeline for Early-College and High School Students. Journal of Online Engineering Education, 12(2), 01–06. Retrieved from http://onlineengineeringeducation.com/index.php/joee/article/view/47

[11] Nithin K. C. Das, Melvin S. George, P. Jaya, "Incorporating weighted round robin in honeybee algorithm for enhanced load balancing in cloud environment", International Conference on Communication and Signal Processing (ICCSP), 2017

[12] M Jeyakarthic, N. Subalakshmi, "Client Side-Server Side Load Balancing with Grasshopper optimization Mapreduce Enhancing Accuracy in Cloud Environment", Fourth International Conference on Inventive Systems and Control (ICISC), 2020

[13] Dharavath Ramesh, Sweta Dey, "SCLBA-CC: Slot Based Carton Load Balancing Approach for Cloud Environment", International Conference on Current Trends towards Converging Technologies (ICCTCT), 2018

[14] M. Lawanyashri, Balamurugan Balusamy, S. Subha, "Energy-aware hybrid fruitfly optimization for load balancing in cloud environments for EHR applications", Informatics in Medicine Unlocked, 2017

[15] A. Francis Saviour Devaraj, Mohamed Elhoseny, K. Shankar, "Hybridization of firefly and Improved Multi-Objective Particle Swarm Optimization algorithm for energy efficient load balancing in Cloud Computing environments",Journal of Parallel and Distributed Computing, 2020

[16] Lung-Hsuan Hung, Chih-Hung Wu, Chiung-Hui Tsai, Hsiang-Cheh Huang, "Migration-Based Load Balance of Virtual Machine Servers in Cloud Computing by Load Prediction Using Genetic-Based Methods", IEEE Access, 2021

[17] Muhammad Junaid, Adnan Sohail, Rao Naveed Bin Rais, Adeel Ahmed, Osman Khalid, Imran Ali Khan, Syed Sajid Hussain, Naveed Ejaz, "Modeling an Optimized Approach for Load Balancing in Cloud", IEEE Access, 2020

[18] H. Lathashree, Niveditha J. MokaKatte, K. P. Pooja, B. Sathish Babu, K. Bhargavi, "Multiple CAs based Framework with ANN for Load Balancing in Cloud Computing Environment", 4th International Conference for Convergence in Technology (I2CT), 2020

[19] Zixi Cui, Pengshuai Cui, Yuxiang Hu, Julong Lan, Fang Dong, Yunjie Gu, Saifeng Hou, "Closer: Scalable load balancing mechanism for cloud datacenters", China Communications, 2021

[20] Katuk, N., & Chiadighikaobi, I. R. (2022). An Enhanced Block Pre-processing of PRESENT Algorithm for Fingerprint Template Encryption in the Internet of Things Environment. International Journal of Communication Networks and Information Security (IJCNIS), 13(3).

[21] Karan D. Patel, Tosal M. Bhalodia, "An Efficient Dynamic Load Balancing Algorithm for Virtual Machine in Cloud Computing", International Conference on Intelligent Computing and Control Systems (ICCS), 2019