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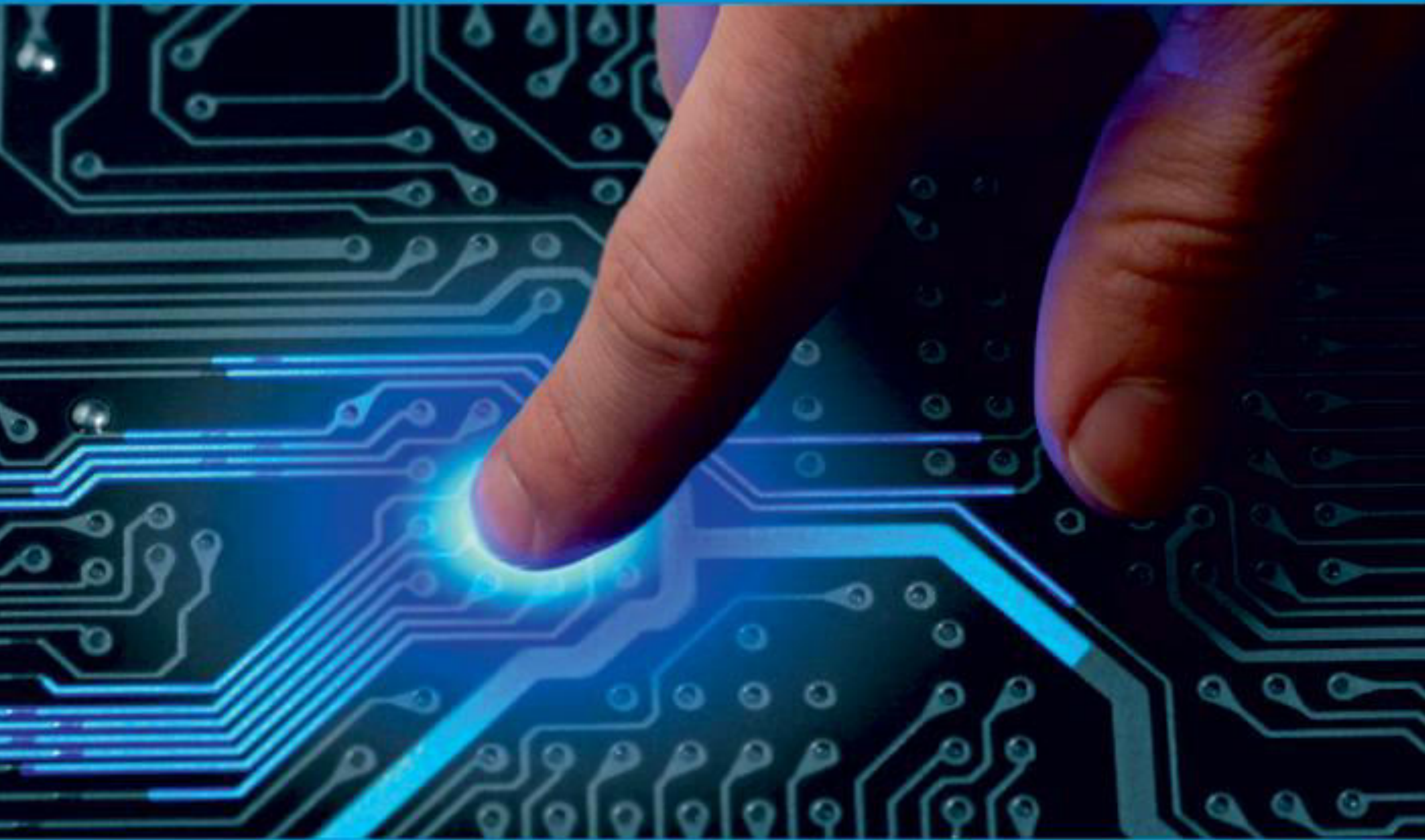

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Virtualization in Grid Computing

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ABSTRACT: Cluster and grid computing are becoming very popular, particularly for scientific and engineering applications. Higher bandwidth of Computer Networks has further boosted development of cluster computing. Local and geographically dispersed deployment of computing resources is the most prominent differentiating issue between a cluster and grid computing based setups. Cluster necessarily requires deployment of multiple nodes at a single location connected via a high speed switch, while grid computing is based on access to remote computing resources, which may be a cluster. Integrating software with multi-layer integration has been the main thrust of research and development in the field of cluster and grid computing. We introduced the concept of virtual workspaces which can be configured, managed and deployed in a Grid environment. Since clusters underlie most significant Grid deployments today, in this paper. We extended the notion of virtual workspaces to include virtual clusters. We describe changes to Grid architecture and evaluate virtual cluster creation and management, the impact of executing in virtual clusters on applications as well as the possibility of running several virtual clusters on one physical cluster. The study focuses on the impact in the area of virtual cluster and virtual workspaces in virtual machines by supporting virtualization.
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KEYWORDS: Virtualization – Virtual Cluster – Grid computing - virtual machine – virtual workspace .

I.INTRODUCTION

Cluster Computing/ Grid Computing technology is becoming popular for scientific and engineering applications, because of improved high performance/ low cost ratio. With the enormous increase in computing power on desktop PCs in recent years, it has become possible to integrate distributed computing Resources into a single image, thus providing enhanced computing power.

Cluster refers to two or more nodes connected together either within a cabinet or over a LAN, giving the users a single system image [1] and typically it has features like high performance, expandability, scalability, high throughput, high availability and all these at low cost. Presently, desk top PCs are integrated as a cluster resource and their power is dedicated for the applications running on the cluster [2]. Cluster based computing is fast maturing as a technology and it is poised to take a giant leap by
Integrating the distributed cluster computing power into a grid based infrastructure.

Grid Computing refers to a group of clusters operating at geographically dispersed locations, connected over high-speed networks.

II.VIRTUALIZATION AND GRID COMPUTING

Virtualization is a framework or methodology of dividing the resources of a computer into multiple execution environments, by applying one or more concepts or technologies such as hardware and software partitioning, time sharing, partial or complete machine simulation, emulation, quality of service, and many others. Virtualization of resources can be achieved using a number of technologies. A virtual machine [5] is an emulation of lower layers of a computer abstraction on behalf of higher layers. A VM representation contains a full image of RAM, disk, and other devices. A virtual machine monitor (VMM) is a software process that manages the hardware resources of the real machine among instances of VMs, thus allowing multiple instances of VMs to run simultaneously on the same hardware.

With superior isolation properties, fine-grained resource management, and the ability to instantiate independently configured guest environments on a host resource, virtual machines provide a good platform for Grid computing [8, 9]. The In-Vigo project [13, 14] and the associated Virtuoso project [15] explored some of the issues involved in combining Grid and virtual machine technology especially as relates to networking and deployment. Our approach differs in that it focuses on virtual workspaces, first-class entities that need to be managed independently of their deployment, treating virtual machines as one of their implementations Driven by community requirements; we also focus on clusters as a primary Grid platform. Such a focus has been recognized by other groups. The Cluster on

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Demand infrastructure [4] first introduced the notion of a virtual cluster (albeit in its first iteration not using virtual machines).

2.1 Virtual clusters

Distinguish two kinds of nodes in a virtual cluster: a head-node and worker nodes. The purpose and configuration of a head-node are typically different from those of worker nodes, especially in software and operational setup.

Although worker node configurations are similar, they may be assigned different names or their status may be different (for example, some nodes may not be operational). For these reasons, I represent each node of a cluster by a separate atomic workspace, each with its own metadata and image handle, as described in [10]. A set of atomic workspaces representing the nodes of the cluster is then wrapped by an XML section containing the information about the cluster as a whole such as its type (cluster/atomic), name, number of nodes, or time it was instantiated. All other information about a workspace is derived from the metadata of the atomic workspaces describing those nodes.

Virtual clusters work by means of:

• Collections of atomic workspaces.
• A method of describing collections of atomic workspaces.
• A method of managing collections of atomic workspaces.

The workspace metadata schema is extended to include aggregations of atomic workspaces. Workspaces now become aggregate workspaces. An aggregate workspace contains sets of workspaces; each set contains homogeneous workspace configurations. It is through the combination of sets within an aggregate workspace, that a heterogeneous cluster may be described using a single workspace metadata schema. Importantly the ability of aggregate workspaces to define heterogeneous clusters allows both service and worker nodes to be described.

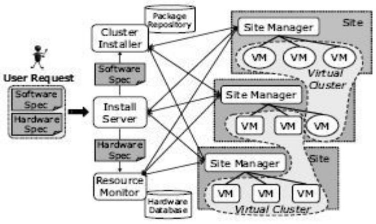

Figure 1. Overview of the virtual cluster installation system.

Virtual cluster workspaces for grid computing Virtual machines provide a promising platform for computational Grids. Virtualization of underlying hardware they enable instantiation of a new, independently configured guest environment on a host resource. In addition, they offer the benefits of isolation and fine-grain enforcement and, given the ability to serialize their state and migrate, offer increased flexibility to environments in the Grid.

To take advantage of this new technology in Grid computing, introduced the concept of virtual workspaces which can be configured, managed and deployed in a Grid environment. Since clusters underlie most significant Grid deployments today, in this paper I extended the notion of virtual workspaces to include virtual clusters. I describe changes to Grid architecture and evaluate virtual cluster creation and management, the impact of executing in virtual clusters on applications as well as the possibility of running several virtual clusters on one physical cluster.

III.VIRTUAL WORKSPACES

Grid computing involves the sharing of heterogeneous Grid resources between VOs, each with potentially conflicting resource requirements. Such shared use often results in under-utilization of Grid resources caused by a mismatch between resources offered and the application requirements [4] of the shared users'. However sharing is not the only cause of resource under utilization. [10] Draw attention to the potential incompatibility of a cluster's installed libraries across VOs as another difficulty with current Grid use.

Virtual Workspaces (VW) are an attempt to address the following three problems with

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Grid clusters:
• Lack of performance isolation.
• Little control over resource sharing.
• Fine grained usage difficult to enforce

3.1 Describing Virtual Workspaces

A workspace description should contain sufficient information for a deployment service to create the environment represented by this workspace. This information is of two kinds:
(1) Description of packages or other data that need to be obtained from potentially external sources and put together (such as a software installation package or a VM image), and
(2) Deployment logistics information, which needs to be interpreted and configured at deployment time (such as network connection configuration for a VM).

The quantity of information that must download and the amount of deployment-time configuration will depend on both workspace implementation (installation-based deployment versus deploying a VM image) and the deployment service implementation (deploying a VM based on a pre-configured image [16] or refining configuration at deployment time [17]). Thus, a wide range of approaches to workspace description are possible, from the simple but inflexible (e.g., a pointer to a VM image and a default deployment configuration) to the complex but powerful (e.g., arbitrary on-the-fly configuration of an image).

3.2 Workspaces as Virtual Machines

A virtual machine (VM) [3] provides a virtualization of a physical host machine.

Software running on the host, typically called a virtual machine monitor (VMM) or hypervisor is responsible for supporting this abstraction by intercepting and emulating instructions issued by the guest machines. A hypervisor also provides an interface allowing a client to start, pause, serialize, and shut down multiple guests. A VM representation (VM image) is composed of a full image of a VM RAM, disks (or partition) images, and configuration files. Recent exploration of para virtualization techniques [9] has led to substantial performance improvements in Virtualization technologies, making virtual machines an attractive option for high-performance applications.

Virtual machines allow a client to create a custom execution environment configured with a required operating system, software stack and access policies and then deploy it on any resource running a hypervisor. Further, VM state may be serialized into a VM image, allowing the client to pause or shut down VM operation, and resume it at a different time and in a different location, decoupling image preparation from its deployment and enabling migration. In addition, virtual machines offer excellent enforcement of resource usage: typically, a virtual machine is configured with a specific memory and disk size and some, such as [9], allow those qualities to be managed during deployment. Using schedulers, such as , a client can assign a percentage of CPU to a given virtual machine effectively regulating the CPU usage of the Group of processes encapsulated in it. For these reasons, VMs provide an excellent implementation option for workspaces: the configuration of a VM image can reflect a workspace's software requirements while the hypervisor can ensure the enforcement of hardware properties.

Overall, VMs have the advantage of both flexibility and speed of deployment. The flexibility stems from the VM concept, which provides an abstract representation of state that can be deployed anywhere a hypervisor is present. In modern hypervisors such deployment is quick: show that deploying a VM can take less than a second [4], which is comparable to the overhead induced by the Grid tools. In addition to this, hypervisor's ability to provide fine-grain enforcement makes virtual machines an ideal solution for short-term deployment of uniquely configured workspaces requiring controlled resource usage.

software [7], a cluster of virtual machines configured with the software configuration required by Open Science Grid (OSG) [8], and a set of physical machines configured with Xen hypervisor [20] all represent a workspace.

3.3 Virtual Cluster Workspaces

Workspaces implemented via any of the methods just described can be grouped to create virtual clusters of various topologies. A virtual cluster workspace can be constructed via, for example, the Cluster- on- demand (COD) infrastructure [7], an existing cluster with tools for dynamically enabling access, or a cluster of virtual machines.

When using a virtual machine implementation, a virtual cluster workspace is implemented in terms of multiple VM images that may represent specialized nodes such as worker or head nodes.

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IV.PERFORMANCE ISSUES AND EVALUATION

Performance comparison of VCG as an integrated system of pooled-in resources against networked resources, which are accessible to users, is based on multiple and varied parameters, which are discussed in this section.

4.1 Job Size Assessment Criteria

Size of a task or a job can be evaluated in many ways; following are the major ways in which job size assessment can be made:

Job size definition: Typically, complexity of
Computing task is evaluated on the basis of CPU time required; total I/O bound dependency, total output file size, total swap/ temporary file space size etc. When multiple tasks are handled by a CPU, the CPU time gets divided among the tasks, while other above mentioned parameters remain bound to the task itself.

Small job vs. large job: It is important to understand the associated issues when a small task runs on a machine as compared to the large tasks, which runs on a machine. Even before we assess the issues, the definition of small and large jobs are essentially to be clarified. Small jobs gets completed in a reasonable time frame which could be ranging from few minutes to few hours, while the large jobs may take much larger time, from few tens of hours onwards. Statistically speaking large jobs also need large swap and file storage, but this cannot be a generalized statement.

CPU bound vs. Input/output bound: Some tasks are highly CPU bound, meaning they consume more of CPU power than the memory space, either the main memory or the swap/ temporary space. While some tasks could be highly Input/output bound meaning that they consume large memory space and use little of CPU time. Of course, it is worth mentioning here that some tasks could be a combination of the two features, leading to moderate use of CPU power and reasonable memory usage.

4.2 Network Resources vs. Pooled Resources

Networked resources: When the resources are only connected on a network and are accessible to the user as 'stand alone' resource, task submission and execution of the task is governed by the following factors:
Access right to submit the task on the resource: The user is required to make a 'login' to the system, for which the user needs a 'login id' and 'password'. The user also needs disk space on the node for source files, input and output files etc.
Job preparation for execution is also to be done on each machine by the user, by login to the system. Management of user's data (program and data files – input and output) for backup etc. is also to be taken care on each machine separately; this is a complex job for the computing resource provider.
Job monitoring: The user has to monitor status of the task specifically from the node on which task has been submitted and may cause a lot of inconvenience in terms of user's own time utilization.
Object code compatibility: The user needs to prepare the task as per the resource to satisfy the object code compatibility requirements.
Parameters on the performance of the pooled resources:
Network latency: The time required to copy
Executable and input data files guide the initiation of the task on remote resource. Network latency plays a pivotal role for this parameter. Network latency also plays a role for task monitoring, which is automatically updated in the job status table by task daemon.
Operating System over head: The VCG does load the operating system of the pooled resource, but does not have any additional load as compared to a task which may be submitted to the node directly.
Memory management: Since the memory of the
Pooled resource is going to be consumed, even if
Temporarily, by the tasks coming from remote users, it is not really in the control of the owner of the resource and proposed VCG architecture does not take into account memory management of the pooled resources.

V. RELATED WORK

Past projects on configuration and customization of computing environments for clusters and Grids include the work of Krsul at al. [11] and Papadopoulos et al. [14]. Krsul et al. proposed a VM creation and customization framework called VMPlant [11] for virtual Grid environments such as In-VIGO [1]. It provides a graph-based configuration interface to the user, which encodes each configuration as a node and dependency between each

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configuration as directed edges. The package-based system installation in our framework is similar to their graph-based configuration;

In essence, the package-dependency structure can be represented as a DAG. Their approach lie in two points. First, exploit an existing infrastructure for cluster configuration management and extend it for virtual clusters, whereas they rely on their own custom configuration schema. Therefore, while our framework requires the user to prepare only declarative configuration files in most scenarios, they require the user and the resource provider to provide actual implementation, typically written in scripts, of such configurations as well.

Second, they do not allow the user to create VMs on the fly; rather they assume offline-created VM images available for every user request. Such assumption is unlikely to be held in multi-organization, multi-site, heterogeneous Grid environments. Papadopoulos et al. presented their cluster installation and management tool called Rocks in [14]. Efficiency and scalability of installation has been another important topic in providing user-specific environments since the scale of underlying physical clusters has continued to increase. VMPlants support reuse of partially configured VMs through partial graph matching [11].

VI. CONCLUSION

Cluster based computing has provided a new thrust to computing, by way of combining the computing power of large number of resources into a single system image.

A prototype model of Virtual Computing Grid has been deployed and it is giving promising results. System can be enhanced in future to provide improved error handling and system flow.

We tried to provide an overview on the current and future use (and benefit) of virtualization techniques for Grids.

The selection of usage scenarios may not be extensive but probably gives a quite thorough list of envisioned changes on how Grids are used or deployed. In our view this trend is not actively steered or influenced by the Grid communities. Instead, we see that the common trend of moving towards virtualization in data centres is happening right now and will stay with us for a long time. This affects how we deal with resources in general, including Grids The paper is intended to provide a summary on the effect of this trend and provide food of thought for current developments.

We presented several scenarios which we see as relevant for adopting virtualization in the light of Grids environments. Some of these scenarios are currently under development by different groups, corresponding results are becoming available in the near future. Some other scenarios need more technological advancements in different areas. Thus, it is unlikely that single research groups will be able to overcome those challenges in a short time frame. Here, We expect an evolutionary approach towards these scenarios when partial features become commonly available.

The current interest and success in cloud computing was made possible through the adoption of virtualization. Cloud computing limits some of the challenges and difficulties that Grid computing is facing.

Similarly, Grids and their current users will adopt more virtualization models and become more independent from the specifics of resources and applications. Thus, we believe that the presented models will become key use cases in the near and mid-term future.

REFERENCES

[1] Kalaiprasath, R; Elankavi, R; Udayakumar, R; , Cloud security and compliance-a semantic approach in end to end security, International Journal on Smart Sensing and Intelligent Systems, V-10, I-5, PP:482-494, 2017.

[2] Elankavi, R; Kalaiprasath, R; Udayakumar, R; , Wireless Zigbee Network Cluster-Capacity Calculation and Secure Data Conveyance Using Indegree, International Journal on Smart Sensing and Intelligent Systems, V-10, I-5, PP:174-185, 2017.

[3] Kalaiprasath, R; Elankavi, R; Udayakumar, R; , A New Approach for Cloud Data Security: From Single to Cloud-of-Clouds, International Journal on Smart Sensing and Intelligent Systems, V-10, I-5, PP:604-613, 2017.

[4] Elankavi, R; Kalaiprasath, R; Udayakumar, R; , Data Mining with Big Data Revolution Hybrid, International Journal on Smart Sensing and Intelligent Systems, V-10, I-5, PP:560-573, 2017.

[5] Elankavi, R; Kalaiprasath, R; Udayakumar, Dr R; , A fast clustering algorithm for high-dimensional data, International Journal Of Civil Engineering And Technology (Ijciet), V-8, I-5, PP:1220-1227, 2017.

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|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106066 |

[6] Gajmal, Yogesh M; Udayakumar, R; , Blockchain-based access control and data sharing mechanism in cloud decentralized storage system, Journal of web engineering, PP:1359–1388-1359–1388, 2021.

[7] Gajmal, Yogesh M; Udayakumar, R; , A Bibliometric Analysis of Authentication based Access Control in Cloud using Blockchain, Library Philosophy and Practice, PP:0_1-16, 2021.

[8] Shirke, S; Udayakumar, R; , Robust lane identification by using EW-CSA based DCNN, J. of Critical Reviews, V-6, PP:18-21, 2019.

[9] Subhash, Ligade Sunil; Udayakumar, R; , A BIG SHARK ADAPTION ALGORITHM BASED RESOURCE ALLOTMENT APPROACH IN CLOUD COMPUTING ENVIRONMENT, PalArch's Journal of Archaeology of Egypt/Egyptology, V-17, I-7, PP:5374-5379, 2020.

[10] Gajmal, Yogesh M; Udayakumar, R; , Privacy and utility-assisted data protection strategy for secure data sharing and retrieval in cloud system, Information Security Journal: A Global Perspective, V-31, I-4, PP:451-465, 2022.

[11] Gajmal, Yogesh M; Udayakumar, R; , Analysis of Authentication based Data Access Control Systems in Cloud, PalArch's Journal of Archaeology of Egypt/Egyptology, V-17, I-7, PP:5319-5328, 2020.

[12] Shirke, Suvarna; Udayakumar, R; , Evaluation of crow search algorithm (CSA) for optimization in discrete applications, 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), PP:584-589, 2019.

[13] Shirke, Suvarna; Udayakumar, Ramanathan; , A novel region-based iterative seed method for the detection of multiple lanes, International Journal of Image and Data Fusion, V-11, I-1, PP:57-76, 2020.

[14] Shirke, Suvarna; Udayakumar, R; , Fusion model based on entropy by using optimized DCNN and iterative seed for multilane detection, Evolutionary Intelligence, PP:44940, 2022.

[15] Shirke, Suvarna; Udayakumar, R; , Hybrid optimisation dependent deep belief network for lane detection, Journal of Experimental & Theoretical Artificial Intelligence, V-34, I-2, PP:175-187, 2022.

[16] Subhash, Ligade Sunil; Udayakumar, R; , Sunflower whale optimization algorithm for resource allocation strategy in cloud computing platform, Wireless Personal Communications, V-116, PP:3061-3080, 2021.

[17] Subhash, Ligade Sunil; Udayakumar, R; , A Supremacy–Responsive Resource Distribution Technique for Controlled Workflow Implementation in Cloud Surroundings, Solid State Technology, V-63, I-5, PP:7662-7669, 2020.

[18] Sindhu, Velagapudi Swapna; Lakshmi, Kavuri Jaya; Tangellamudi, Ameya Sanjanita; Lakshmi, C; , A Deep Learning Approach For Detecting Type 2 Diabetes Mellitus, 2022 International Conference on Computer Communication and Informatics (ICCCI), PP:44936, 2022.

[19] Priyan, Siluvayan; Udayakumar, R; Mala, Pitchaikani; Prabha, Mariappan; Ghosh, Ananya; , A sustainable dual-channel inventory model with trapezoidal fuzzy demand and energy consumption, Cleaner Engineering and Technology, V-6, PP:100400, 2022.

[20] Elankavi, R; Kalaiprasath, R; Udayakumar, R; , Potential Exploitation of Broadcasting System Using Multiple Smart Directional Antennas-Help of Sensor Network, International Journal of Mechanical Engineering and Technology (IJMET), V-8, I-6, PP:678-687, 2017.

[21] Udayakumar, R; Kalam, Muhammad Abul; , Sentiment Analysis Using Machine Learning Algorithms, Mathematical Statistician and Engineering Applications, V-71, I-3s2, PP:1186–1200-1186–1200, 2022.

[22] GAJMAL, YOGESH M; UDAYAKUMAR, R; , Data Access Controls in Cloud: A Survey., International

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 6, June 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1106066 |

Journal of Pharmaceutical Research (09752366), V-12, I-4, 2020.

[23] Udayakumar, R; Khanaa, V; Kaliyamurthie, KP; , Optical ring architecture performance evaluation using ordinary receiver, Indian Journal of Science and Technology, V-6, I-6, PP:4742-4747, 2013.

[24] Udayakumar, R; Khanaa, V; Kaliyamurthie, KP; , Performance analysis of resilient ftth architecture with protection mechanism, Indian Journal of Science and Technology, V-6, I-6, PP:4737-4741, 2013.

[25] Udayakumar, R; Khanaa, V; Saravanan, T; , Synthesis and structural characterization of thin films of sno2 prepared by spray pyrolysis technique, Indian Journal of Science and Technology, V-6, I-S6, PP:4754-7, 2013.

[26] Udayakumar, R; Khanaa, V; , Health monitoring system for induction motors, Int. J. Eng. Comput. Sci, V-2, I-4, PP:1117-1122, 2013.

[27] Udayakumar, R; Khanaa, V; , Quantum Computers-A Revolution InComputing, Quantum, V-8, I-4, PP:33-36, 2013.

[28] Khanaa, V; Udayakumar, R; , Protecting privacy when disclosing information: k anonymity and its enforcement through suppression, database, V-1, I-2, 2012.

[29] Khanaa, V; Udayakumar, R; , Hybrid Fuzzy Approches for Networks, International Journal of Innovative Research in science, Engineering and Technology, V-12, I-3, PP:24-31, 2012.

[30] Udayakumar, R; Khanaa, V; Saravanan, T; Saritha, G; , Cross layer optimization for wireless network (WIMAX), Middle-East Journal of Scientific Research, V-16, I-12, PP:2013, 2012.

[31] Udayakumar, R; Thooyamani, KP; Khanaa, V; , Coarse-Grained Parallel Genetical Gorithm to Solve the Shortest Path Routing Problem Using Genetic Operators, Middle-East Journal of Scientific Research, V-15, I-12, PP:1651-1654, 2013.

[32] Khanaa, V; Udayakumar, R; , Efficient Pc Controlled By Hand Movement Using Mems Sensor Mouse, Indian Journal of science and Technology, V-12, I-6, PP:1438-1442, 2012.

[33] Udayakumar, R; Khanaa, V; , Sixth Sense Technology, International Journal Of Engineering And Computer Science, V-2, I-4, 2013.

[34] Udayakumar, R; Thooyamani, KP; Khanaa, V; , Secure Incentive Protocol for Multi-Hop Wireless Network with Limited Use of Public Key Cryptography, Middle-East Journal of Scientific Research, V-20, I-11, PP:1651-1656, 2014.

[35] Udayakumar, R; Kaliyamurthie, KP; Khanaa, TK; , Data mining a boon: Predictive system for university topper women in academia, World Applied Sciences Journal, V-29, I-14, PP:86-90, 2014.

[36] Udayakumar, R; Saravanan, T; , Tailored Image District Processing Precision Andwritten Appreciation, Middle-East Journal of Scientific Research, V-20, I-11, PP:1615-1625, 2014.

[37] Udayakumar, R; Thooyamani, KP; , Khanaa, Deploying site-to-site VPN connectivity: MPLS Vs IPSec, World Applied Sciences Journal, V-29, I-14, 2014.

[38] Udayakumar, R; Thooyamani, KP; , Random projection based data perturbation using geometric transformation, World Applied Sciences Journal, V-29, I-1, PP:24-31, 2014.

[39] Thooyamani, KP; Khanaa, V; Udayakumar, R; , Wide area wireless networks-IETF, Middle-East Journal of Scientific Research, V-20, I-12, PP:2042-2046, 2014.

[40] Khanaa, V; Thooyamani, KP; Udayakumar, R; , Modelling Cloud Storage, World Applied Sciences Journal, V-29, 2014.

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[41] Khanaa, V; Thooyamani, KP; Udayakumar, R; , Elliptic curve cryptography using in multicast network, World Applied Sciences Journal, V-29, 2014.

[42] Khanaa, V; Thooyamani, KP; Udayakumar, R; , Two factor authentication using mobile phones, World Applied Sciences Journal, V-29, I-14, PP:208-213, 2014.

[43] Khanaa, V; Thooyamani, KP; Udayakumar, R; , Patient monitoring in gene ontology with words computing using SOM, World Applied Sciences Journal, V-29, 2014.

[44] Kaliyamurthie, KP; Parameswari, D; Udayakumar, R; , Malicious packet loss during routing misbehavior-identification, Middle-East Journal of Scientific Research, V-20, I-11, PP:1413-1416, 2014.

[45] Udayakumar, R; Saritha, G; Saravanan, T; , Modelling and Simulation of Electromechanical Systems Working with Nonlinear Frictional Loads and Controlled by Subordinated Control System of Coordinates, Middle-East Journal of Scientific Research, V-20, I-12, PP:1918-1923, 2014.

[46] Saravanan, T; Saritha, G; Udayakumar, R; , Cassette Steganography for Entrenched Metaphors in Squashed Videos, Middle-East Journal of Scientific Research, V-20, I-12, PP:2475-2478, 2014.

[47] Udayakumar, R; Khanaa, V; Saravanan, T; , Energy Demand Management Motor Control Using Multilevel Inverter, Middle-East Journal of Scientific Research, V-20, I-12, PP:2613-2619, 2014.

[48] Thooyamani, KP; Khanaa, V; Udayakumar, R; , Wireless cellular communication using 100 nanometers spintronics device based VLSI, Middle-East Journal of Scientific Research, V-20, I-12, PP:2037-2041, 2014.

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