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Virtual Machine for Big Data in Cloud Computing

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ABSTRACT: Cloud computing has revolutionized data management for businesses and individuals alike, ushering in an era of unprecedented accessibility and scalability. As demand for cloud services continues to surge, the imperative for efficient and secure systems becomes paramount. One approach to meeting this challenge is the consolidation of virtual machines onto fewer physical servers, optimizing resource utilization and yielding significant energy savings. Moreover, this consolidation strategy bolsters overall security by enabling more effective monitoring and control of virtual machine instances. Through the implementation of encryption, access control mechanisms, and intrusion detection systems, sensitive data can be safeguarded against unauthorized access, thereby mitigating potential risks and vulnerabilities inherent in cloud computing environments. In the realm of cloud computing, security and efficiency are paramount concerns, driving innovation and evolution in system design and management. By consolidating virtual machines onto fewer physical servers, organizations can realize tangible benefits in terms of resource optimization and energy efficiency. Yet, beyond the operational advantages, this consolidation approach also enhances the security posture of cloud environments. Through the adoption of robust security measures such as encryption and intrusion detection, sensitive data can be shielded from unauthorized access, bolstering the integrity and trustworthiness of cloud-based systems.

KEYWORDS: Virtual machine, Big data processing, cloud computing, Hadoop.

I. INTRODUCTION

Cloud computing has transformed the landscape of resource management, offering users unparalleled flexibility and efficiency in utilizing computing resources. Through cloud platforms, users can seamlessly share a multitude of resources including memory, CPUs, GPUs, software, and network infrastructure. One of the key features of cloud computing is the implementation of auto-scaling mechanisms, which dynamically adjust resource allocation based on real-time demand. This ensures optimal resource utilization, allowing users to leverage only the resources they need at any given moment, thereby enhancing efficiency and cost-effectiveness. Central to the optimization of cloud computing systems is the consolidation of resources, particularly servers and storage infrastructure. By consolidating virtual machines onto fewer physical servers, organizations can significantly improve resource utilization, leading to reduced energy consumption and substantial cost savings. Moreover, this consolidation approach contributes to the overall security posture of cloud environments by facilitating better monitoring and control of virtual machine instances. Through the strategic implementation of consolidation strategies and robust security measures, organizations can harness the full potential of cloud computing while mitigating risks and maximizing operational efficiency.

II. CLOUD COMPUTATION

Cloud computing has emerged as a transformative force in the realm of information technology, revolutionizing the way businesses and individuals manage, store, and access data. This paradigm shift allows users to leverage a vast array of resources, including memory, CPUs, GPUs, software, and network infrastructure, through shared environments facilitated by cloud service providers. One of the hallmark features of cloud computing is its ability to implement autoscaling mechanisms, dynamically adjusting resource allocation in response to fluctuating demand, thereby ensuring optimal utilization and cost efficiency. Moreover, the consolidation of cloud computing systems plays a pivotal role in optimizing resource utilization by consolidating virtual machines onto fewer physical servers, leading to reduced energy consumption and increased cost savings. Additionally, this consolidation of cloud environments, enabling better monitoring and control of virtual machine instances.

Cloud computing services

IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service), SaaS (Software-as-a-Service) and serverless computing are the most common models of cloud services, and it's not uncommon for an organization to use some combination of all four.

IaaS (Infrastructure-as-a-Service)

- In the IaaS model, cloud providers offer virtualized computing resources over the internet. These resources typically include virtual machines, storage, and networking infrastructure.
- Users have full control over the operating systems, applications, and data deployed on these virtualized resources.
- IaaS allows organizations to quickly scale their IT infrastructure up or down based on demand without the need for investing in physical hardware.

PaaS (Platform-as-a-Service)

- PaaS provides a platform for developers to build, deploy, and manage applications without the complexity of managing the underlying infrastructure.
- PaaS offerings include development frameworks, databases, middleware, and other tools necessary for application development and deployment.
- Users can focus on writing and deploying code, while the PaaS provider manages the underlying infrastructure, including scalability, security, and maintenance.
- PaaS accelerates the development process and enables rapid deployment of applications.
- PaaS provides a platform for developers to build, deploy, and manage applications without the complexity of managing the underlying infrastructure.
- PaaS offerings include development frameworks, databases, middleware, and other tools necessary for application development and deployment.
- Examples of PaaS providers include Heroku, Microsoft Azure App Service, and Google App Engine.

SaaS (Software-as-a-Service)

- SaaS delivers software applications over the internet on a subscription basis, eliminating the need for users to install, manage, or maintain the software locally.
- Applications are hosted and maintained by the SaaS provider, who also handles tasks such as software updates, security patches, and data backups.
- Users access SaaS applications through a web browser or API, typically paying a monthly or annual subscription fee.
- SaaS offerings cover a wide range of applications, including email, customer relationship management (CRM), enterprise resource planning (ERP), and collaboration tools.
- Examples of SaaS providers include Salesforce, Microsoft Office 365, Google Workspace, and Dropbox.

III. REVIEW OF LITERATURE

[1] Privacy-Preserving Data Dissemination in Untrusted Cloud

PUBLISHED BY Denis Ulybyshev; Bharat Bhargava ,2017.

DESCRIPTION: B2B (business-to-business) systems often use service-oriented architecture (SOA) with decomposed business services. These services can interact and share data among each other. Service might use a cloud – hosted database, such as a non - relational encrypted key – value store. However, the cloud platform hosting the database can be untrusted. Data owner needs to be sure that each service can access only those segments of a shared database for which the service is authorized. Furthermore, data requests can come from a service also hosted by untrusted cloud. Hence, there is a need for designing a cloud enterprise framework that can ensure privacy-preserving data dissemination in SOA and accurately detect data leakages. We design and prototype a solution that ensures privacy – preserving dissemination of data. The solution is based on (a) role-based access control, (b) cryptographic capabilities of client's browser, (c) authentication method, (d) subject's trust level. The prototype enables privacy – preserving dissemination of Electronic Health Records (EHRs) hosted in an untrusted cloud.

[2] Ontology Based Image Retrieval by Utilizing Model Annotations and Content

PUBLISHED BY J Faritha Banu; P Muneeshwari,2022.

DESCRIPTION: Study on image indexing and retrieval concepts have evolved the research further on Content Based Image Retrieval (CBIR). The CBIR system analyses the image content features such as shape, texture, and colour. In recent systems, these low level features are combined with high level semantics in order to achieve high performance. Analyzing the image content will increase the time of feature extraction and complexity of the retrieval process. The proposed system describes the content of an image region using Color and texture as visual features. An ontology model is constructed to analyze the contents. Content Analysis comprises image segmentation and annotation, which scrutinizes images by subdividing them into entities, selecting primary entities, and finally extracting feature signifiers possessed by these entities. To explore the mechanism of content analysis system, a new fused framework using content and model based annotations was proposed. The proposed integrated framework for CBIR system was experimented and the performance was assessed over a large image database with number of features, compared against traditional approaches from the literature. From the experimental results, it is evident that the proposed system performs substantially better and faster than the existing systems.

[3] Cloud Classification using K-Means Clustering and Content based Image Retrieval Technique

PUBLISHED BY Gujanatti Rudrappa; Nataraj Vijapur,2020.

DESCRIPTION: Presently whole sky imagers (or ground based imagers) are becoming popular because of the upward pointing nature of the imaging system and also its ability to capture the ground truth relevant to images being captured. These imaging systems also provide high resolution images which gives an added advantage. In this paper we present a system which makes use of ground based images of clouds in order to classify the cloud as high level, middle level and low level clouds. We make use of k-means clustering and Content Based Image Retrieval (CBIR) techniques for cloud classification. The system developed classifies the clouds as low level, middle level and high level clouds. Cloud class plays a vital role on deciding the rainfall precipitation. The result of this cloud classification can be later used as an input to a system which dynamically decides rainfall precipitation. For this purpose, identification of the low-level clouds is of high importance.

[4] Block Design-Based Key Agreement for Group Data Sharing in Cloud Computing

PUBLISHED BY Jian Shen; Tianqi Zhou,2019.

DESCRIPTION: Data sharing in cloud computing enables multiple participants to freely share the group data, which improves the efficiency of work in cooperative environments and has widespread potential applications. However, how to ensure the security of data sharing within a group and how to efficiently share the outsourced data in a group manner are formidable challenges. Note that key agreement protocols have played a very important role in secure and efficient group data sharing in cloud computing. In this paper, by taking advantage of the symmetric balanced incomplete block design (SBIBD), we present a novel block design- based key agreement protocol that supports multiple participants, which can flexibly extend the number of participants in a cloud environment according to the structure of the block design. Based on the proposed group data sharing model, we present general formulas for generating the common conference key IC for multiple participants. Note that by benefiting from the $(v, k + 1, 1)$ -block design, the computational complexity of the proposed protocol linearly increases with the number of participants and the communication complexity is greatly reduced. In addition, the fault tolerance property of our protocol enables the group data sharing in cloud computing to withstand different key attacks, which is similar to Yi's protocol.

[5] Secure Content-Based Image Retrieval in the Cloud With Key Confidential

PUBLISHED BY Jung-Shian Li I-Hsien Liu,2020.

DESCRIPTION: Owing to the rapid development of cloud services and personal privacy demand, secure cloud storage services and search over encrypted datasets have become an important issue. Recently, the leaking of images such as identification and driver's licenses catches much attention. The trend towards secure computation has been widely discussed, especially asymmetric scalarproduct-preserving encryption (ASPE) and homomorphic encryption (HE). Although ASPE have ability to encrypt and determine the similarity between ciphertexts efficiently, it is not a practical methodology due to its assumption that the users are fully trusted in real world and it also may have key leakage problem. Contrary to ASPE, HE can execute addition and multiplication in the encrypted domain and solve key leakage

problem. Hence, in this paper, we combine the opinions of HE and ASPE to propose new privacy-preserving content-based image retrieval with key confidentiality scheme against the attacks from data owner, cloud server and users. Our privacy preserving image retrieval scheme is developed under strong threat model that is close to real world. Furthermore, to the best of our knowledge, our work is the first one that developing scheme under the assumption that all the entities involved in privacy-preserving image retrieval system are semi-trusted. Our scheme ensures the confidentiality of key and privacy of query information at the same time.

[6] Encrypted Image Retrieval Method using SIFT and ORB in Cloud

PUBLISHED BY K.Nalini Sujantha Bel; I. Shatheesh Sam,2020.

DESCRIPTION: With the increasing development of image retrieval techniques, we propose an encryption based retrieval of images by the use of local image information SIFT and ORB in the cloud environment. In this encrypted image retrieval work, to extract features of an image by using SIFT, and ORB. To generate the protected index on the features Random Projection with min-hash algorithm is proposed. For preserving the privacy, encrypting the images by using position scrambling method. This proposed method outperformed other methods with the precision of 93%. Due to the improvement of information technology, photo associated gadgets, photos and other multimedia statistics play a prime role in scientific, advertising and marketing. Due to this, it increases effects in demand for retrieval of images. In olden days, retrieving images based on text is carried out. In this method, images are searched primarily based at the text records. Nowadays, many image retrieval techniques are available for retrieving images from the database. In Content-Based Image Retrieval (CBIR) photos or images retrieved by the usage of content or otherwise called as features of the image. Some key information is extracted as the low-level features. With the growing number of images, cloud computing ends up extra popular because of the high garage facility. Storing images in the cloud is a challenging task, because of preserving privacy. The privacy-maintaining scheme and retrieval of images era gives the imperative additives for retrieval of images

[7] Reducing the Effects of DDoS Attacks in Software Defined Networks Using Cloud Computing

PUBLISHED BY K. Radha.; R. Parameswari,2023.

DESCRIPTION: Software-defined networking (SDN) is a networking architecture that enables simple programming of network devices. SDN allows the isolation of network resources using clearly defined APIs to accomplish multiple tenant networks with appropriate QoS (Quality of Service) and SLAs. The most critical issues among Cloud providers and organizational network infrastructures are Denial of Service (DDoS) attacks. SDN is more susceptible to controller resource exhaustion due to the rising frequency of distributed denial-of-service (DDoS) attacks. DDoS attacks make it difficult for the SDN controller to handle all received packets effectively, which may cause a network crash or deny authorized users access to network resources. The proposed traffic rate-based threshold (TRT) to overcome these DDoS attacks in SDN. The proposed work calculates the threshold based on the traffic and provides an alternate path enabling SDN with highly efficient and flexible solutions. To examine the efficiency of the proposed work, a comparison work is carried out with Renyi Joint Entropy-Based Dynamic Threshold Approach (RJE) and reactive & proactive (RP). The performance metrics considered are throughput, recovery time, and traffic. On all the metrics, the performance obtained by the proposed TRT is far better than the others.

[8] Bio-Inspired Optimization Algorithm on Cloud based Image Retrieval System using Deep Features

PUBLISHED BY T. Vijayakumar; K Ramalakshmi,2022.

DESCRIPTION: With the tremendous improvement of cloud computing (CC) technique, increasing count of users choosing to outsource image data to the clouds. Cloud resource provider decreases the storing problem on local hardware by outsourcing massive image database to cloud server and exploiting the cloud computation ability to image processing application. Learning effective feature representation and similarity measures are essential for the performance of content-based image retrieval (CBIR). Despite wide-ranging research efforts for decades, it remains a challenge that significantly hinders the success of real-time CBIR system. Since the trail and error hyperparameter selection is a tedious process, metaheuristic optimization can be used. This paper introduces an Evolutionary Optimization Algorithm for Cloud Based Image Retrieval System (EOA-CIRS) technique. The presented EOA-CIRS technique derives a new CBIR model for retrieving highly related images. To obtain this, the EOA-CIRS technique initially employs MobileNetv3 model as a feature extractor, which derives features from the query and database images. Next, the bamboo forest growth optimizer (BFGO) approach was applied as a hyperparameter optimizer to

appropriately tune the hyper parameters of the MobileNetv3 approach. Finally, Euclidean distancebased similarity measurement is utilized for retrieving the related images. The experimental validation of the EOA-CIRS model on Corel10K dataset demonstrates the effectual efficacy of the EOA-CIRS model over other recent approaches.

[9] A Cloud-Enabled Collaborative Hub for Analysis of Geospatial Big Data

PUBLISHED BY Wei Wan; Xingqiang Du,2021.

DESCRIPTION: Geospatial big data are analyzed for addressing a specific research or management problem on global scale, and science gateways or Hub, have been widely adopted in recent years as an effective platform for an entry to computational resources, research collaboration, dissemination of data, applications and publications, and community engagement. However, replicating deployment and setup is a non-trivial task. Cloud computing provides an attractive alternative, simplifying resource provision and enabling reliable and scalable replication. This paper describes ongoing efforts to a cloud-enabled Geospatial Hub hosting general-purpose software building blocks, which provides geospatial data access, processing, analysis, and visualization capabilities. The technologies underlying these components, the automation of deployment and configuration on cloud with the Elastic Compute Service (ECS) and Object Storage Service (OBS) are described. This work builds geospatial big data analysis capabilities into web-based Hub platform and empower it by cloud computing. This will open a way for easy development of a variety of online tools for probing and presenting geospatial big data and digital information.

[10] Secure Image Retrieval Based on Deep CNN Features in Cloud Computing

PUBLISHED BY Zhongkui Fan; YePeng Guan,2022.

DESCRIPTION: In cloud computing owners become increasingly motivated to outsource their images from local sites to the commercial public cloud for great flexibility and economic savings. For the consideration of users' privacy, sensitive images have to be encrypted before outsourcing, which makes effective data utilization a very challenging task. Image CNN features are once considered confidential for image retrieval in cloud computing. However, recent studies have shown that these features contain ambiguous semantic information and can be reconstructed to images. We design a computable encryption scheme based on vector and matrix calculations for the risk of CNN feature-based image retrieval. The scheme uses SIFT and CNN features to pre-build a feature-based index to provide feature-related information about each encrypted image and then chooses the efficient image.

IV. SYSTEM ANALYSIS

4.1 EXISTING SYSTEM

In the existing system privacy-preserving Support Vector Machine (SVM) computing scheme is proposed in this paper. Cloud computing has been spreading in many fields. However, the cloud computing has some serious issues for end users, such as unauthorized use and leak of data, and privacy compromise. We focus on templates protected by a block scrambling-based encryption scheme, and consider some properties of the protected templates for secure SVM computing, where templates mean features extracted from data.

The existing system scheme enables us not only to protect templates, but also to have the same performance as that of unprotected templates under some useful kernel functions. Moreover, it can be directly carried out by using wellknown SVM algorithms, without preparing any algorithms specialized for secure SVM computing. In an experiment, the existing scheme is applied to a face-based authentication algorithm with SVM classifiers to confirm the effectiveness

4.1.1 DISADVANTAGE

The scheme introduces additional complexity to the SVM computation process due to encryption and decryption steps, which can increase implementation and maintenance challenges.

- The scheme may not be suitable for all types of data or scenarios, as it relies on specific properties of the protected templates and kernel functions, limiting its generalizability.
- To enhance privacy, any encryption scheme introduces potential security risks, such as vulnerabilities in the encryption algorithm or key management.

4.2 PROPOSED SYSTEM

In the proposed system, we introduce a dynamic VM placement framework designed to optimize resource allocation within the cloud environment. Leveraging the First Fit algorithm, virtual machines (VMs) are systematically assigned to physical servers based on their resource requirements, minimizing computational overhead and ensuring swift deployment. This approach allows for efficient utilization of available server capacity while accommodating the dynamic nature of cloud workloads, enabling the system to adapt to fluctuating resource demands in real-time.

Furthermore, the integration of the Best Fit algorithm enhances resource optimization by meticulously matching VMs with the most suitable physical servers. By thoroughly evaluating all available server options, this algorithm minimizes resource fragmentation and maximizes overall resource utilization across the cloud infrastructure. Together, these VM placement strategies, coupled with robust VM management tools and high-performance physical servers, form a comprehensive framework poised to deliver enhanced scalability, performance, and cost-efficiency for cloud-based applications and services.

4.2.1 ADVANTAGE

- The VM placement algorithms to optimize resource allocation, minimizing wastage and enhancing overall efficiency.
- VM lifecycle management with intuitive interfaces and automation capabilities, streamlining operations and reducing administrative overhead.
- The user authentication, authorization, and security modules to safeguard data and mitigate risks of unauthorized access or breaches.
- To provide scalability to meet varying workload demands and flexibility to adapt to changing business needs, ensuring seamless performance and growth.
- To Optimizes VM placement and resource allocation, resulting in improved system performance and responsiveness for users and applications.
- To ensures high availability and reliability of cloud services through efficient resource management and proactive security measures. A userfriendly interface and streamlined management processes, enhancing the overall user experience and productivity.

V. SYSTEM ARCHITECTURE

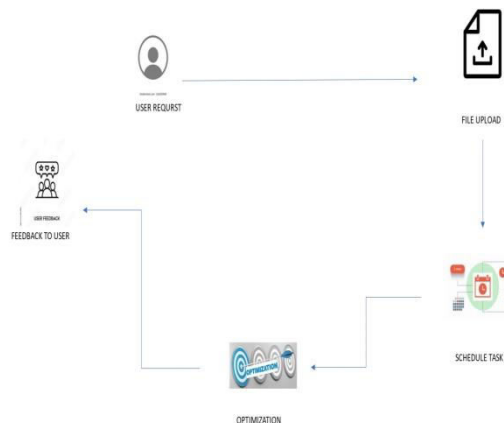


Fig 3.1 System Architecture

5.1 DESCRIPTION

VIRTUAL MACHINE MANAGEMENT

The Virtual Machine Management module serves as the backbone of the cloud computing environment, responsible for orchestrating the provisioning, monitoring, and lifecycle management of virtual machines (VMs). At core, this module enables seamless creation, deployment, and termination of VM instances in alignment with user-defined requirements and workload demands. By providing a centralized platform for VM management, it empowers users to efficiently allocate computing resources while maintaining scalability and flexibility. Furthermore, the Virtual Machine Management module plays a pivotal role in ensuring optimal resource utilization within the cloud infrastructure.

Through dynamic allocation and deallocation of VMs, it maximizes the utilization of physical server resources, effectively minimizing wastage and enhancing cost-effectiveness. Additionally, the module offers comprehensive functionalities for monitoring VM performance, managing configurations, and facilitating VM migrations to optimize resource usage and maintain system stability. Overall, this module serves as a critical component in enabling organizations to harness the full potential of cloud computing by providing robust VM management capabilities tailored to their evolving business needs.

USER AUTHENTICATION AND AUTHORIZATION

The User Authentication and Authorization module plays a crucial role in safeguarding the integrity and security of the cloud computing system by managing user access. This module verifies the identities of users through robust authentication mechanisms, ensuring that only legitimate users are granted access to the system. Additionally, it enforces granular access control policies based on users' roles and privileges, thereby restricting unauthorized access to sensitive resources and data. By implementing stringent authentication and authorization processes, the module mitigates the risk of unauthorized access and potential security breaches, enhancing the overall security posture of the cloud environment. Moreover, the User Authentication and Authorization module contributes to compliance with regulatory requirements and industry standards by enforcing access control policies and maintaining audit trails of user activities. By providing a comprehensive framework for user management and access control, it enables organizations to maintain data confidentiality, integrity, and availability within the cloud infrastructure. Ultimately, this module plays a pivotal role in ensuring trust, confidentiality, and accountability in user interactions with the cloud computing system, fostering a secure and resilient computing environment for users and stakeholders.

SECURITY MODULE

The Security module is a cornerstone of the cloud computing system, encompassing a comprehensive suite of measures and mechanisms designed to safeguard the integrity, confidentiality, and availability of data and resources. At its core, this module employs a multi-layered approach to security, incorporating features such as encryption, access control mechanisms, intrusion detection systems, firewalls, and regular security audits. These measures collectively aim to fortify the cloud infrastructure against a wide range of security threats and vulnerabilities, including malware infections, unauthorized access attempts, and data breaches. The proactively addressing security risks and implementing robust security measures, the Security module helps mitigate potential security breaches and ensure compliance with industry standards and regulations. Through continuous monitoring and threat detection, this module enables prompt detection and response to security incidents, thereby safeguarding sensitive data and critical assets within the cloud environment. Ultimately, the Security module plays a pivotal role in fostering trust and confidence among users and organizations, ensuring that the cloud computing system remains a secure and trustworthy platform for conducting business operations and accessing critical resources.

VI. CONCLUSION

In conclusion, the proposed cloud computing system presents a comprehensive framework equipped with advanced virtual machine management capabilities, robust security measures, and efficient resource allocation algorithms. Through the strategic utilization of virtual machines as the cornerstone of its infrastructure, the system offers users unparalleled flexibility, scalability, and performance in deploying and managing applications within the cloud environment. By optimizing resource utilization, enhancing security protocols, and streamlining management

processes, the system empowers organizations to leverage the full potential of cloud computing while mitigating risks and maximizing operational efficiency. Furthermore, the integration of innovative VM management techniques and stringent security measures ensures that the system remains resilient and adaptable to the evolving needs and challenges of modern business environments. With its focus on efficiency, reliability, and security, the proposed system sets the stage for transformative advancements in cloud computing, enabling organizations to achieve greater agility, cost-effectiveness, and competitiveness in the digital era. The proposed system represents a forward-thinking solution poised to drive innovation and empower organizations to thrive in an increasingly dynamic and interconnected world.

VII. FUTURE SCOPE

*Edge Computing: The rise of IoT devices and the need for low-latency processing is driving the adoption of edge computing, which involves processing data closer to the source. This trend will lead to the decentralization of computing resources and the emergence of edge clouds.

*Quantum Computing: Quantum computing holds the potential to revolutionize cloud computing by exponentially increasing processing power. While still in its early stages, quantum computing is expected to enable breakthroughs in areas such as cryptography, optimization, and machine learning.

*AI and Machine Learning Integration: Cloud platforms will increasingly integrate AI and machine learning capabilities to automate tasks, optimize resource allocation, and enhance user experiences. This integration will enable more intelligent and efficient cloud services across various industries.

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