#### Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 March 2023

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

# Review Comprehensive Study of The Cloud Computing Service Providers

Khalifa Alhosani Student at CIS Department, Sharjah College Higher Colleges of Technology Sharjah, UAE H00420611@hct.ac.ae

Abstract-Whether it's cellphones, personal computers, or gaming consoles, technology is a part of everyone's everyday lives, and storage is frequently a problem. One of the solutions we have for this difficulty is the on-demand accessibility of computer framework assets, which enables cloud storage and makes it accessible in any format and from any device. It is a major benefit of cloud computing. Amazon Web Administrations (or basically AWS) may be a secure cloud services stage advertising about everything businesses ought to construct advanced applications with adaptability, versatility, and unwavering quality. Another advantage is that it is significantly less expensive than purchasing items with comparable functionality, such as an SSD storage device. For many enterprises, it is also preferable to host their servers in the cloud using services like Google Cloud and Oracle Cloud. Our main topic of the paper is to compare three different major cloud computing services-AWS, Google, and Azure. Since there are different types of cloud computing services available, we would compare them to determine which is best for usage by individuals or organizations. We can also look at the services' shared features and unique aspects that they provide to consumers.

Index Terms—AWS, Cloud computing, Cloud services, Virtualization

#### I. INTRODUCTION

This paper aims to provide a comparison of three cloud computing platforms: AWS, Google, and Azure. [44] To achieve this objective, this paper will provide a detailed overview of each mentioned platform. The adoption of cloud computing by a business provides them with an affordable choice. As a result of this decision, they benefit from improved efficiency, security, remote access, flexibility, scalability, mobility, and agility. Unlike in the case of investing in computer hardware, cloud computing allows businesses to use applications that improve their ability to process loads. This mechanism allows businesses to save on infrastructural, innovation, and technical costs by using cloud applications that allow them to meet their demands. Importantly, it becomes easy to use and access business information from anywhere because of the data security guarantee in cloud computing services. [1], [11], [32] As a new concept, cloud computing has revolutionized how businesses manage their information systems. For instance, through cloud storage, companies maintain their databases in secure locations, which eliminates the hustle of data security. Most importantly, the computing

(c) (i)

Osama Hosameldeen CIS Department, Sharjah College Higher Colleges of Technology Sharjah, UAE mohandesosama@yahoo.com

performance of cloud computing is high and can operate with limited hardware resources, for instance, in the case of a distributed system. In that light, the motivation of this study is to understand how cloud computing solves engineering concerns for businesses. Such include risk management, operational flexibility, and regular network upgrades. [35] In that case, the shift to cloud computing provides businesses with a virtual infrastructure, which demands low maintenance compared to traditional systems. More so, the failure of a component does not affect access to shared resources. Instead, operating on cloud clusters allows business to meet their ondemand computing needs. [12], [22], [26] In this paper, we will introduce a comprehensive analysis of three cloud computing service providers, AWS, Google, and Azure.

# II. MODELS AND SERVICES

Cloud computing allows businesses to prioritize what matters using different operating models and on-demand services. In that case, to realize the benefits of this technology, enterprises must identify the models and services they need. [7], [36], [39]

#### A. Microsoft Azure Services

The Azure cloud stage is made up of more than 200 items and cloud administrations that can be utilized to create modern arrangements, address current issues, and predict long-term. Utilizing your favored apparatuses and systems, you'll make, execute, and oversee apps over different clouds, on-premises, and at the edge. Azure is in charge of safeguarding the network, data center, and host infrastructure. While customers are in charge of safeguarding their data, endpoints, accounts, and access control. [9], [23], [33]

## B. Microsoft Azure Models

The provision of services and applications on demand via the internet is known as cloud computing. Services are offered for servers, apps, data, and other resources. The user does not see the service's specifics. [4], [15], [29], [48] You can use the service with little management and instantly provision computing resources. Cloud computing is not the same as a data center that is accessible online. With the use of virtualization, affordable technology, and automated procedures, cloud computing offers users a self-service user experience that is akin to that of a public utility. There are there 3 cloud models in Microsoft Azure:

- 1) public
- 2) private
- 3) hybrid cloud

By choosing one of them over the other, you can alter the pricing, upkeep needs, and security of the services you.

1) Public Cloud: The foremost prevalent strategy of conveying cloud computing is through open clouds. Anybody who needs to buy administrations has got to them through the common web. A third-party cloud benefit supplier claims and runs the servers and capacity that make up the cloud assets, which are at that point provided through the web. Free or on-demand administrations are accessible, permitting clients to pay as they were for the CPU time, capacity space, or transmission capacity they require. A prime outline of an open cloud is Microsoft Purplish blue. [20], [21], [34], [47]

2) Private cloud: Computing resources utilized only by users from a single company or organization make up a private cloud. It may be physically situated at the on-site data center of your company, or it may be facilitated by a distinctive benefit supplier. Private clouds should not be mistaken for conventional on-premises data centers that have been given a new name. A private cloud offers similar advantages to a public cloud by utilizing infrastructure and services already present on-site. It makes use of an abstraction platform to offer comprehensive cloud environments like Azure Stack or cloud-like services like Kubernetes clusters. The company is in charge of selecting, setting up, and maintaining the hardware. The business's owner and maintained network infrastructure, such as a private inside arrangement or a devoted fiber optic association between buildings, are typically used for communication between the systems. [2], [6], [8], [49]

*3)* A hybrid cloud : combines the advantages of both public and private clouds. Organizations can smoothly extend their on-premises infrastructure to handle any overflow without providing third-party data centers access to all their data. Businesses benefit from the public cloud's flexibility and processing power for routine and non-sensitive computing chores while retaining business-critical applications and data behind a company firewall.

# C. AWS Services

Amazon Web Services (AWS) is the foremost total and widely used cloud stage in the world. AWS is made to empower providers, ISVs, and application suppliers to have your apps. To get to AWS's application facilitating stage, utilize the AWS Administration Comfort or well-documented web administration APIs. [10], [19], [25], [37]

1) Infrastructure as a Service (IaaS): The basic components of cloud computing, too known as IaaS or IaaS, incorporate get to organizing capabilities, computers (virtual or on devoted equipment), and data capacity space. With the foremost adaptability and administration control over your IT assets, Foundation as a Benefit is most comparable to the current IT assets that numerous IT offices and designers are acclimated to nowadays.

2) Platforms as a service (PaaS): Stages as a Benefit permit you to concentrate on the sending and organization of your applications by expelling the requirement for companies to oversee the fundamental foundation (regular equipment and working frameworks). As a result, you'll be able to run your application more efficiently as you won't have to bargain almost things like asset procurement, capacity arranging, computer program upkeep, fixing, or any other undifferentiated overwhelming lifting.

3) software as a service (SaaS): With a computer program as a benefit, the benefits supplier gives you a wrapped-up item that's worked and overseen for your sake. The lion's share of the time when a program as a benefit is specified, end-user applications are implied. With a SaaS solution, you merely ought to consider how you may utilize that particular piece of a computer program; you are doing not have to consider how the benefit is overseen or how the basic framework is kept up. Web-based e-mail may be a normal case of a SaaS application since it permits you to send and get emails without having to oversee include upgrades or upkeep for the servers and working frameworks that the e-mail program is utilizing.

# D. AWS Models

There are there 3 cloud models in AWS

1) Cloud: An entire cloud-based application is installed there, and the entire application functions there. In order to benefit from cloud computing, applications in the cloud have either been built there or have been moved there from another infrastructure. The architecture, design, and scaling requirements of core infrastructure can be abstracted from by using higher-level services, or by using low-level infrastructure components.

2) Hybrid: A hybrid deployment is a means to link current resources that are not in the cloud with existing infrastructure and applications. The most popular hybrid deployment strategy involves extending and growing an organization's on-premises foundation into the cloud while interfacing cloud assets with inside frameworks. Visit our crossbreed site for extra details on how AWS can support your hybrid implementation. [13], [14], [27], [46]

3) On-premises: The term "private cloud" is occasionally used to describe resource deployment using virtualization and resource management software on-premises. In spite of the fact that on-premises arrangement needs numerous of focal points of cloud computing, it is occasionally preferred because it can offer specialized resources. The majority of the time, this deployment methodology is the same as traditional IT infrastructure while attempting to maximize resource consumption by utilizing application management and virtualization technologies.

# E. Google Cloud Models and Services

Google Cloud (too known as Google Cloud Stage or GCP) may be a supplier of computer assets for developing, conveying, and working applications on the Internet. In expansion to cloud administration, security, and engineering instruments, Google Cloud gives administrations for computing, capacity, organizing, enormous information, machine learning, and the Web of Things. Your choice of cloud computing service model will depend on how much control, adaptability, and management your company needs. There are three primary types of cloud computing service models:

- Access to IT infrastructure services like computation, capacity, organizing, and virtualization is given through framework as a benefit (IaaS). It gives you the foremost control over your IT resources and is the foremost comparative to ordinary on-premises IT
- All the computer hardware and software capital required for the creation of cloud applications are provided via the platform as a service (PaaS). With PaaS, businesses can completely concentrate on developing applications without having to worry about managing and maintaining the supporting infrastructure.
- Software as a Service (SaaS) offers the whole application stack, from the supporting foundation to upkeep and overhauls for the app computer program, as a benefit. A SaaS arrangement is as often as possible an end-user application where the cloud benefit supplier oversees and keeps up both the foundation and the benefit. [18], [28], [30], [45]

#### III. LOAD BALANCING

The method of the similarly scattering stack (approaching arrange activity) among a collection of backend assets or servers is alluded to as stack adjusting. [5], [31], [42]

# A. Azure Load Balancing

Layer 4 of the Open Frameworks Interconnection (OSI) show is where Purplish blue Stack Balancer capacities. It serves as the client's sole point of contact. The stack balancer disperses inbound streams to backend pool occasions that arrive at the stack balancer's front conclusion. These streams are decided by load-balancing rules and well-being tests. The occasions within the backend pool may well be Purplish blue Virtual Machines or occasions from a virtual machine scale set.

Types of load balancers are shown in figure 1

- Public load balancer: Connections for virtual machines within a virtual network can be made using a public load balancer. This feature is enabled by converting private IP addresses into public ones. The load balancer is then used to balance the traffic between your virtual machines and the internet.
- Internal (or private) load balancer Private IPs are required at the front end when using an internal load balancer. These are then used inside a virtual network to carry out load-balancing operations. A load balancer can be accessed from a hybrid network

Importance of AZURE load balancing You can measure your apps and establish highly available services with Azure



Fig. 1. : Balancing multi-tier applications by using both public and internal Load Balancer.

Load Balancer. Load balancers may hold both incoming and outgoing traffic. Load balancers provide low latency and high throughput for all TCP and UDP applications, and can scale up to millions of flows.

# B. AWS Load Balancing

Versatile Stack Adjusting consequently equalizations your approaching activity over various targets in one or more Accessibility Zones, such as EC2 occasions, holders, and IP addresses. It checks the well-being of its enrolled targets and sends activity as it were to those that are in great condition. Flexible Stack Adjusting consequently alters your stack balancer capacity in reaction to varieties in approaching activity.

Advantages of a load balancer Workloads are conveyed among various computing assets, such as virtual servers, through a stack balancer. Employing a stack balancer progresses your apps' accessibility and blame tolerance. As your needs alter, you'll include and subtract computing assets from your stack balancer without hindering the overall stream of demands to your apps. You will characterize wellbeing checks, which screen the wellbeing of computing assets so that the load balancer as it were conveys demands to those that are in great well-being. You'll too designate encryption and decoding to your stack balancer, permitting your computational assets to center on their essential tasks. Application Stack Balancers, Arrange Load Balancers, Door Stack Balancers, and Classic Stack Balancers are all upheld by Versatile Stack Adjusting. You will select the stack balancer that best meets your requirements.

# Features of a load balancer

Security: You will construct and oversee security bunches related to Flexible Stack Adjusting when utilizing Amazon

Virtual Private Cloud (VPC) to grant additional organizing and security choices for Application Stack Balancer and Classic Stack Balancer. Any of the Stack Balancers may be designed to be Web confronting, otherwise, you can establish a stack balancer without open IP addresses to operate as an inside (non-internet confronting) stack balancer.

High level of availability: Flexible Stack Balancers are broadly open. Approaching activity may be dispersed among your Amazon EC2 occurrences in a single or numerous Accessibility Zones. In reaction to approaching application activity, a Versatile Stack Balancer consequently alters its askpreparing capability. Versatile Stack Balancer performs wellbeing checks on targets on a configurable cycle to ensure that they are accessible and sound. *High Throughput:* Versatile Stack Balancer with Tall Throughput is expected to oversee developing activity and can stack adjust millions of demands per moment. It can too bargain with fluctuating activity designs. Health checks: As it were solid targets, such as EC2 occasions, holders, IP addresses, microservices, Lambda capacities, and apparatuses, are directed by a Versatile Stack Balancer. You get superior perceivability into the well-being of your applications with Flexible Stack Adjusting in two ways: (1) well-being check upgrades that permit you to set particular blame codes. The well-being checks empower you to screen the well-being of each of your administrations behind the stack balancer; and (2) unused measurements that give activity understanding for each of the administrations working on an EC2 occasion.

### C. Google Cloud Load Balancing

A load balancer shown in figure 2 divides user traffic across numerous instances of your apps. Load balancing decreases the likelihood of performance difficulties in your applications by distributing the load. Cloud Stack Adjusting is based on the same innovation that bolsters Google's frontend. It can handle 1 million or more demands per moment while keeping up reliable tall execution and moo inactivity. Cloud Stack Adjusting activity enters through 80+ partitioned around the world stack adjusting focuses, optimizing the remove traveled on Google's quick private arrange spine. You'll give substance as close to your clients as conceivable by utilizing Cloud Stack Adjusting.

The following load-balancing capabilities are available on Google Cloud:

A single anycast IP address. With Cloud Stack Adjusting, a single anycast IP address serves as the frontend for all of your backend occurrences in several nations over the world. It offers cross-region stack adjusting, as well as mechanized multi-region failover, which diverts activity to failover backends in the event that your essential backends fall flat. Cloud Stack Adjusting reacts right away to changes in clients, activity, organization, backend wellbeing, and other related circumstances.

**Software-defined stack adjusting** Cloud Stack Adjusting could be a totally conveyed, software-defined, overseen arrangement for all of your activity. Since it is neither an instance-based or device-based arrangement, you may not be

bound into a physical stack-adjusting framework or endure the HA, scaling, and organization challenges related to instancebased stack balancers.

**Smooth autoscaling.** Cloud Stack Adjusting can grow as your clients and activity create, counting the capacity to handle gigantic, startling, and quick spikes by steering activity to other regions over the world that can handle it. Autoscaling does not require pre-warming: you'll be able to go from to full activity in seconds.

Load adjusting on Layers 4 and 7. To coordinate activity based on information from organize and transport layer conventions such as TCP, UDP, ESP, GRE, ICMP, and ICMPv6, utilize Layer 4-based stack adjusting. Include ask-directing choices based on traits such as the HTTP header and the uniform asset distinguishing proof utilizing Layer 7 stack adjusting.

**Balancing of outside and inside loads.** Whereas your clients get to your apps through the web, you'll be able to utilize outside stack adjusting, and when your clients are inside Google Cloud, you'll be able to utilize inside stack adjusting. - Load adjusting at the worldwide and territorial levels. Disseminate your load-balanced assets over different locales in arrange-to-end associations close to your clients and fulfill your tall accessibility needs.

**Support for progressed highlights.** The IPv6 worldwide stack adjusting, source-IP-based activity directing, WebSockets, user-defined ask headers, and convention sending for private VIPs are highlights backed by cloud stack adjusting.



Fig. 2. Simple overview of load balancing

#### **IV. CLOUD SECURITY**

#### A. Security in Google Cloud

Because many standard security solutions cannot be installed in cloud environments or are ineffective there, protecting the cloud can be challenging. Google cloud platform(GCP) offers a range of integrated cloud security products to address this problem, including:

1- Virtual Private Cloud (VPC): With virtual networking, networks may be segmented and secured more effectively.

2- Data Encryption: In GCP, data is encrypted both in transit and at rest.

3- Access to logs in almost real-time to improve security visibility.

4- Only trusted containers are allowed to be installed on the Kubernetes Engine due to binary authorization. Intrusion

Detection System (IDS): Cloud-native threat detection.

5- Protect sensitive data from leakage by preventing data loss.6- Web app and API protection: DDoS mitigation, WAF, bot defense, and API security

#### B. Security in AWS

AWS offers administrations to help you in avoiding unauthorized get to to your information, accounts, and workloads. Encryption, key administration, and danger location are all highlights of AWS information assurance administrations that ceaselessly screen and protect your workloads and accounts. [3], [16], [40], [41]

- Identify and access management: You'll be able safely oversee personalities, resources, and authorizations at scale with the assistance of AWS Character Administrations. To urge begun rapidly and control get to to your workloads and apps, AWS offers personality administrations for your workforce and customer-facing applications.
- Detection: By persistently watching the arrange action and account behavior inside your cloud environment, AWS recognizes dangers.
- Network and application protection: You'll actualize finegrained security approach at arrange control focuses all through your organization by utilizing organize and application protection administrations. You'll be able utilize AWS administrations to look at and channel activity at the have-, arrange-, and application-level boundaries to halt illicit asset get to.
- Data Protection: You'll utilize AWS administrations to defend your information, accounts, and workloads against illicit get to. In arrange to persistently screen and protect your accounts and workloads, AWS information security administrations offer encryption, key administration, and risk location.
- Compliance: Based on the AWS best hones and industry measures your organization follows to, AWS gives you with a careful see of your compliance status and persistently screens your environment.

#### V. DATABASE TECHNOLOGY

# A. AWS

There are 15 specifically designed databases available in AWS, including relational, key-value, document, in-memory, graph, time-series, and ledger databases. AWS's relational databases operate 3-5 times faster than other common choices. Additionally, you won't have to worry about management responsibilities with these databases.

#### B. Azure

The majority of database management operations, such as upgrading, backing up, fixing, and observing, are robotized by the stage as a benefit (PaaS) database motor known as Sky blue SQL Database, Figure 3. Sky blue gives a determination of completely overseen social, NoSQL, and in-memory databases, traversing restrictive and open-source motors, to coordinate the desires of advanced app engineers. Mechanization in foundation administration guarantees versatility, steadfastness, and security whereas sparing you time and cash. [17], [24], [38], [43]



Fig. 3. The architecture of Microsoft Azure database services

# C. Google

Oracle databases are only one of the many applications that may be managed and run using the tools and services that are provided by (GCP). While some features might not be accessible at first. BigTable, Spanner, Google Cloud SQL, MySQL, Dremel, Millwheel, Firestore, Memorystore Firebase, Cloud Dataflow, BigQuery, and a number of other tools are used by Google.

## VI. CONCLUSION

We looked into the features of GCP, Azure, and AWS in order to compare which of the three is the best choice for your needs. We believe that the service that the customer wants to use is the one that will determine which one of them is the best. Each service has a price, and the more distinguished the service, the higher the price.

#### VII. ACKNOWLEDGEMENT

Special thanks to Dr. Osama Hosameldeen for providing his research which helped me a lot to come up with the idea for this paper.

#### REFERENCES

- Rasha Abousamra and Osama Hosam. Quantitative classification of cognitive behaviors for industrial projects' managers in the mena region. In 8th International Conference on Information Technology Trends (ITT. IEEE, 2022.
- [2] Muhammad Hammad Ahmad and O. Hosam. Hybrid design for cloud data security using combination of aes, ecc and lsb steganography. *International Journal of Computational Science and Engineering (IJCSE*, 19(2), 2019.
- [3] Tanweer Alam. Cloud computing and its role in information technology. *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, 1(2):108– 115, 2020.
- [4] Munwar Ali, Low Tang Jung, and O. Hosam. A new text-based wdistance metric to find the perfect match between words. *Journal of Intelligent and Fuzzy Systems*, 9(Pre-press):1–12,, 2019.

- [5] KC Anupama, R Nagaraja, and M Jaiganesh. A perspective view of resource-based capacity planning in cloud computing. In 2019 1st International Conference on Advances in Information Technology (ICAIT), pages 358–363. IEEE, 2019.
- [6] Microsfot Azure. What is a private cloud? retrieved july 7, 2017.
- [7] Blend Berisha, Endrit Mëziu, and Isak Shabani. Big data analytics in cloud computing: an overview. *Journal of Cloud Computing*, 11(1):1– 10, 2022.
- [8] Y. Chen, L. Xiao, and O. Hosam. A performance evaluation method of coal-fired boiler based on neural network. In *International Conference* on Smart Computing and Communication, page 277–285, Cham, 2019. Springer.
- [9] Marshall Copeland, Julian Soh, Anthony Puca, Mike Manning, and David Gollob. Microsoft azure and cloud computing. In *Microsoft Azure*, pages 3–26. Springer, 2015.
- [10] Bernard Golden. Amazon web services for dummies. John Wiley & Sons, 2013.
- [11] Eugene Gorelik. *Cloud computing models*. PhD thesis, Massachusetts Institute of Technology, 2013.
- [12] Prashant Gupta, Arumugam Seetharaman, and John Rudolph Raj. The usage and adoption of cloud computing by small and medium businesses. *International journal of information management*, 33(5):861–874, 2013.
- [13] Nadhir Ben Halima and O. Hosam. Embedding image roi watermark into median dct coefficients. *IRECOS*, 10(6), 2015.
- [14] Nadhir Ben Halima and O. Hosam. Bag of words based surveillance system using support vector machines. *International Journal of Security* and Its Applications, 10(4):331–346, 2016.
- [15] M.F. Hany, B.A. Youssef, S.M. Darwish, and O. Hosam. Intelligent watermarking system based on soft computing. In *International Conference on Advanced Intelligent Systems and Informatics*, page 24–34, Cham, 2019. Springer.
- [16] O. Hosam. Motion compensation for video codec based on disparity estimation. In *The Seventeenth IEEE Symposium on Computers and Communications (ISCC'12)*, Turkey, 2012. Cappadocia.
- [17] O. Hosam. Side-informed image watermarking scheme based on dither modulation in the frequency domain. *The Open Signal Processing Journal*, 5(ue 5):1–6, 2013.
- [18] O. Hosam. Car license plate localization using hole filling and support vector machine. *International Review on Computers and Software* (*IRECOS*, 9(10), 2014.
- [19] O. Hosam. Colored texture classification with support vector machine and wavelet multiresolution analysis. In *The IEEE Symposium on Signal Processing and Information Technology (ISSPIT'05*, 2015. Abu Dabhi, UAE.
- [20] O. Hosam. Hiding bitcoins in steganographic fractals. In 2018 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT. IEEE, 2018.
- [21] O. Hosam. Toxic comments identification in arabic social media. International Journal of Computer Information Systems and Industrial Management Applications, 11:219–226, 2019.
- [22] O. Hosam. An earthquake query system based on hidden markov models. *International Journal of Embedded Systems*, 15(2):149–157, 2022.
- [23] O. Hosam. Intelligent risk management using artificial intelligence. In Advances in Science and Engineering Technology International Conferences (ASET, pages 1–9,, 2022. pp.
- [24] O. Hosam and Abdulaziz S. Alraddadi. Novel image watermarking technique based on adjacent pixel position switch. *JNIT*, 4(3):81 88, 2013.
- [25] O. Hosam and N. Ben Halima. Adaptive block-based pixel value differencing steganography. *Security Comm. Networks*, 2016.
- [26] O. Hosam and Fan BinYuan. A comprehensive analysis of trusted execution environments. In 8th International Conference on Information Technology Trends (ITT. IEEE, 2022.
- [27] O. Hosam and Nadhir Ben Halima. A hybrid roi-embeddingbased watermarking technique using dwt and dct transforms. *Journal of Theoretical and Applied Information Technology*, 81(3), 2015.
- [28] O. Hosam, Nadhir Ben Halima, Sameh Dakroury, and Essam O. Abdel-Rahman. Reconstructing, augmenting and manipulating 3d scene from sequence of images. *Journal of Theoretical and Applied Information Technology*, 73(3):12–17, 2017.
- [29] O. Hosam and Hani M. Modified fast gray level grouping approach for enhancing image contrast. *Journal of Theoretical and Applied Information Technology*, 97(21), 2019.

- [30] O. Hosam and Zohair Malki. Steganography technique for embedding secure data into the image regions with abrupt changes. *Life Sci J*, 11(9):126–130, 2014.
- [31] O. Hosam, Lincong Yang, Wei Liang, and Xingming Sun. Watermarking 3d triangular mesh with high visual quality. *JDCTA: International Journal of Digital Content Technology and its Applications*, 4(4):107 116, 2010.
- [32] Osama Hosam and Rasha Abousamra. Enhancing deep training of image landmarking with image captcha. In 8th International Conference on Information Technology Trends (ITT. IEEE, 2022.
- [33] J. Hu, W. Liang, O. Hosam, M.Y. Hsieh, and X. Su. 5gss: a framework for 5g-secure-smart healthcare monitoring. *Connection Science*, page 1–23, 2021.
- [34] W. Huang, R. Li, J. Xu, Y. Huang, and O. Hosam. Intellectual property protection for fpga designs using the public key cryptography. *Advances* in *Mechanical Engineering*, 11(4):16–22, 2019.
- [35] Vivek Kundra. Federal cloud computing strategy. White House, 2011.
- [36] Q. Lei, L. Xiao, O. Hosam, and H. Luo. A novel watermarking algorithm based on characteristics model of local fragmentary images. *International Journal of Embedded Systems*, 12(1):11–21, 2020.
- [37] W. Liang, Y. Xie, X. Chen, O. Hosam, and Chen. A two-step mf signal acquisition method for wireless underground sensor networks. *Computer Science and Information Systems*, 13(1), 2016.
- [38] Wei Liang, Dafang Zhang, Zhiqiang You, Wenwei Li, and O. Hosam. A survey of techniques for vlsi ip protection. *Information Technology Journal*, 2013. published June 12, 2013.
- [39] B. Liu, L. Xiao, J. Long, M. Tang, and O. Hosam. Secure digital certificate-based data access control scheme in blockchain. *IEEE Access*, 8:91751–91760, 2020.
- [40] W.M.Sheta O. Hosam, Bayumy A.B. Youssef, and M.A. Abdou. Public watermarking scheme for 3ds laser scanned archeological models. In *The Seventeenth IEEE Symposium on Computers and Communications* (ISCC'12), Turkey, 2012. Cappadocia.
- [41] Xingming Sun O. Hosam. Stereo image reconstruction using adaptive window approach. In *the proceeding of 2nd International Conference* on Advanced Computer Theory and Engineering, ICACTE2009, page 33–41, 2009.
- [42] Xingming Sun O. Hosam. Three dimensional reconstruction using enhanced shape from stereo technique. In *the proceeding of "2009 Eight IEEE/ACIS International Conference on Computer and Information Science"*, page 627–632, 2009.
- [43] Kumaresan Perumal, Senthilkumar Mohan, Jaroslav Frnda, and Parameshachari Bidare Divakarachari. Dynamic resource provisioning and secured file sharing using virtualization in cloud azure. *Journal of Cloud Computing*, 11(1):1–12, 2022.
- [44] Derya Ucuz et al. Comparison of the iot platform vendors, microsoft azure, amazon web services, and google cloud, from users' perspectives. In 2020 8th International Symposium on Digital Forensics and Security (ISDFS), pages 1–4. IEEE, 2020.
- [45] Jinesh Varia, Sajee Mathew, et al. Overview of amazon web services. Amazon Web Services, 105, 2014.
- [46] Li-Chih Wang, Chun-Chih Chen, Jen-Li Liu, and Pei-Chun Chu. Framework and deployment of a cloud-based advanced planning and scheduling system. *Robotics and Computer-Integrated Manufacturing*, 70:102088, 2021.
- [47] Pallavi Wankhede, Minaiy Talati, and Rutuja Chinchamalatpure. Comparative study of cloud platforms-microsoft azure, google cloud platform and amazon ec2. J. Res. Eng. Appl. Sci, 5(02):60–64, 2020.
- [48] Ahmed E Youssef. Exploring cloud computing services and applications. *Journal of Emerging Trends in Computing and Information Sciences*, 3(6):838–847, 2012.
- [49] Wei Zhu, O. Hosam, and Xiaodong Zheng. A secure hierarchical community detection algorithm. *International Journal of Computational Science and Engineering (IJCSE)*, 19(2), 2019.