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Integrating Public and Private Clouds: The Future of Hybrid Cloud Solutions

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Abstract
A hybrid cloud system basically mixes on-premises and cloud computing resources to provide workload distribution, security, and mobility. A hybrid cloud might contain two or more personal clouds, or it could have one public cloud and one private cloud, depending on what is needed. Typically, third-party providers like Microsoft, Google, and Amazon offer cloud services to the public. The primary goal of cloud computing, which is an innovative approach, is to provide net computation and safe, rapid, and easy data storage. Security concerns are crucial even if cloud computing significantly lowers the cost and upkeep of the IT sector. Security concerns are crucial even if cloud computing significantly lowers the cost and upkeep of the IT sector. Cloud-based services including private, public, and hybrid cloud computing are being used by an increasing number of IT firms. However, they are also worried about security-related issues. Private, public, and hybrid cloud computing challenges are covered in great detail in this article. As more businesses use cloud services and architectures in the modern business world, additional dangers and concerns surfaces.

Keywords: - IT Industry, Optimal Data, Cloud Computing, Hybrid Cloud, Industry Security, Public Clouds, Workflow Technology, Protection Techniques.

I. INTRODUCTION

A computer paradigm known as "cloud computing" enables remote access across the Internet without requiring the direct installation of IT resources including servers, platforms, and applications [1]. Regarding the way services are provided, cloud computing may be divided into two categories: private and public. Flex era's "Right scale 2019 state of the Cloud Report" [1] states that 84% of businesses have multiple clouds in place and 58% have a hybrid cloud strategy as per the most recent edition. According to Market Watch, the worldwide hybrid market is anticipated to reach USD 140.86 billion by 2025, growing at an average yearly pace of 22.8% [1, 2].

The use of cloud computing is the on-demand provision of computer services over the internet, including network connectivity, storage, computer systems, analytics, intellect, and applications. Generally, only the services that we utilise are subject to payment [2, 3]. The IT sector is expanding, and meeting its service needs is difficult. When on-premise resources are insufficient, it is sometimes necessary to take use of the alluring possibilities offered by cloud service providers. Platform as a Service (PaaS), Software as a Solution (SaaS), and Infrastructures as a Service (IaaS) are among the common services offered by cloud computing [2, 3]. However, no two cloud are the same, and no one cloud can meet the needs of every client. As a consequence, a wide range of services are developing to meet any organization's needs. The services that cloud computing offers include the following [3].

1.1 Cloud Computing

- **Scalability:** IT services are no longer limited to offline resources; cloud services accessible online may work wonders. By using cloud computing services, any organisation may grow in response to market demands [3, 4]. All that is practically necessary for a customer is a computer with an internet connection; cloud suppliers may provide the other services. Businesses may expand in accordance with needs [3, 4]. Adoption of every new paradigm is contingent upon its scalability. With the use of cloud computing technologies, an organisation intended for 100 individuals may be readily expanded up to 1,000 (preferably any number) persons [4].
- **Cost:** The cost of starting a company has drastically decreased since cloud computing offers services on a pay-per-use basis. It is no longer necessary to spend capital money on servers, software, and infrastructure management professionals since vendors may provide every one of these services [4, 5]. One of the most profitable aspects of cloud computing is cost savings. Every start-up firm can afford the setup fee needed to orchestrate the public cloud, allowing them to devote all of their resources to the growth of their business [5].
- **Speed:** Any organisation may operate more quickly overall with the use of cloud computing. Designers and programmers may freely consider their inventions since there are many profitable, user-friendly solutions at their fingertips [5], which can improve speed and performance. Furthermore, the fastest and easiest way to execute any sophisticated thought is because cloud service providers manage the majority of background threats [5, 6].
- **Reliability:** When managing massive amounts of data constantly, reliability is a crucial component. Data dependability in cloud computing is improved by using disaster recovery techniques and performing regular data backups. Clients may also retain mirrored data since space is no longer an issue. Frequently, a secure system follows from a dependable system. All organisations must manage enormous amounts of sensitive user-focused data in addition to business-related data. A number of laws and regulations must be upheld in order to maintain the data's trustworthiness.
- **Performance:** Better customer service, enhanced operations, and a flexible work environment all help businesses outperform traditional on-premise systems [6, 7]. Toyota is assisted by Amazon in the construction of cloud-based data centres. The business will transmit servicing and insurance-related information by using the vehicle owner's behavioural data [7]. Facebook and Twitter may also be accessed via an automobile's dashboard. There are many more; this is only one example. Modern technology adaptation improves the functionality of the current system since the cloud is essential in this situation.
- **Security:** Cloud service providers use a range of security methods, such as encryption, authenticating users, authority, and the usage of different Artificial Intelligence (AI)-based approaches, to safeguard their app, statistics, and infrastructures from possible attacks [7, 8]. A combined network and a combination of open source protected technologies may be used for safe cloud hybrid deployment, such as in HCDM [8, 9]. Before adoption, the user must choose the most suitable kind of cloud-based computing architectural [8]. There are three configurations for cloud computing: public, private, and hybrid. Here, we'll discuss hybrid cloud and its benefits and security aspects.

The objective of this study is to provide a general overview of hybrid cloud computing, explain why it is becoming more and more popular, discuss how cloud adaptation will impact business in the near future, what security concerns suppliers should address, and how Artificial Intelligence (AI) might assist in this respect. These subjects are all covered in the sections that follow.

1.2 Hybrid Cloud

A hybrid cloud is defined as "a combination of two or more different types of cloud computing environments that are bind together with the help of privately owned and standardised technologies for the purposes of data and application portability" by the National Institute of Technologies and Standards [9, 10]. Therefore, a straightforward combination of on-premises and cloud data shouldn't be mistaken for a hybrid cloud. Additionally, it must to provide the following amenities:

- Distribution of workload based on portability [9].
- Networking via LAN, WAN, or VPN between devices and systems.
- Making use of an all-inclusive, one automation tool.
- A sophisticated and potent middleware for removing the background information.
- Considering resource scalability and availability into account [10].
- Combining recovery and catastrophe management techniques.

As a result, it gives the consumer the opportunity to grow their company by using the alluring services offered by public cloud while protecting sensitive data with private cloud. Hybrid clouds are the greatest choice in situations when a business's demand changes and may see a sudden uptick or decline due to their flexibility [10, 11]. Companies don't need to provide direct access to their on-premise servers' data centres in order to use publicly accessible cloud services. Therefore, crucial company data and apps may be safeguarded behind, while difficult operations can be completed using the public cloud's processing capacity [12]. Businesses won't have to pay for services they don't use, nor will they have to pay for the capital costs associated with acquiring, developing, and sustaining new resources that may be idle for many years or only be utilised temporarily [11, 12]. Conversely, private clouds are more akin to public clouds; nonetheless, they are often deployed in customer data centres and prioritise self-servicing, scalable architecture. The single-tone service the natural world, Service-Level Agreements (SLA), [12], and related associations strengthen and ease the client-cloud connection.

1.3 Architecture

When deploying a hybrid cloud, any mix of cloud services may be used. The customer may use a public cloud as SaaS and have its own on-premise private cloud as IaaS. On-site or sometimes off-site private clouds are located on specialised servers [12]. No one architecture suits all situations perfectly. While public clouds may be rented from providers like Amazon, Microsoft, Alibaba, Google, and IBM, private clouds can be created on an individual basis. Subsequently, a middleware is needed to integrate public and private clouds, which are often offered by cloud suppliers as part of their bundle [11]. A generic diagram of a hybrid cloud is shown in Figure 1.1. These are a few characteristics of hybrid cloud architecture that need to be considered:

- To access an API for user services, a common middleware that connects many devices over LAN, WAN, or VPN is required. A single operating system must be utilised across the network rather than a wide network of APIs, and APIs may be constructed on top of that [11, 12].
- Virtualization makes resources accessible to all linked devices and allows for infinite scaling.
- All device coordination is handled by the middleware, and resources are made accessible as needed with the appropriate authentication [13].

1.4 The requirement for Hybrid Cloud?

For various individuals, hybrid cloud implies different services. An organization's needs are dependent on a variety of IT factors. Because application designers, business developers, and infrastructure support staff have distinct viewpoints from one another, [13, 14], so too do their expectations of the system.

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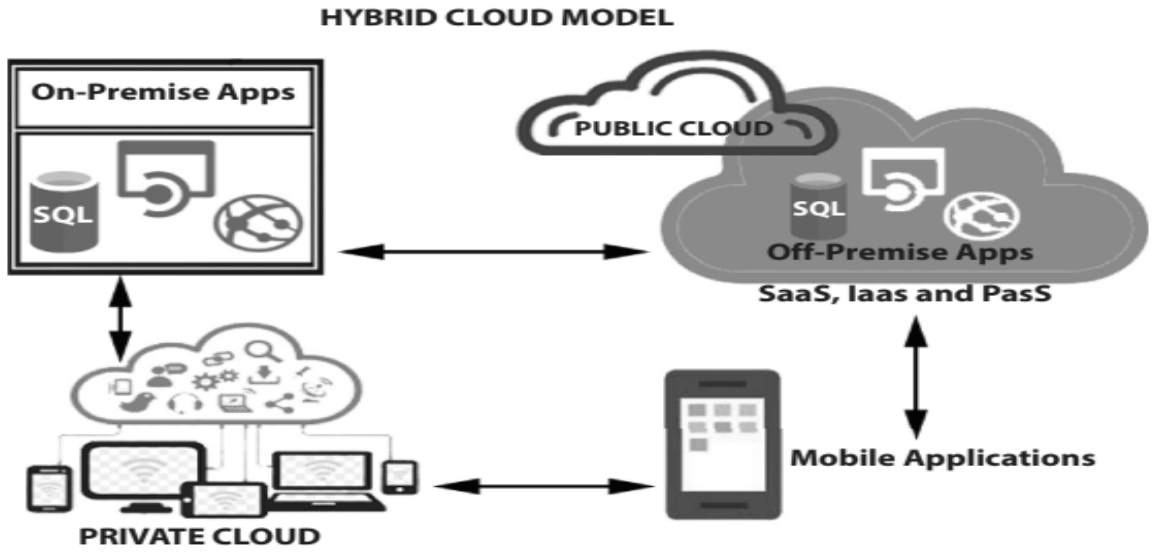

Fig. 1 Hybrid cloud structures in general. [14]

- Application developers constantly need support for edge technologies. First and foremost, a developer has to have access to the best resources and the most recent technical support. Off-premises support is essential for such [14, 15]. The capacity to deploy changing technological offerings with flexibility [15], the quick availability of extra resources required by the solution, the best possible support for on-premise systems, and the seamless and ongoing integration of system services are some of the main challenges associated with hybrid cloud deployment. Disaster administration is also a crucial part of it [15].
- On the other hand, employees who provide infrastructure support aim to consistently provide more help in order to guarantee that the organization's overall operations run smoothly. Off-premise assistance is often needed in IT for virtualized computer resources. The personnel that support the infrastructure is crucial in this case [16]. The administration of deployed setup for auditing and security administration, visibility of all resources wherever they are, federation monitor in accordance with SLA, [16, 17], accessibility of all resources, and control provision are important factors to take into account when implementing a hybrid cloud.
- On the other hand, business developers concentrate on consumer marketing in an economical way. There are several needs for IT businesses [18]. Agile and simple-to-expand networks are needed to support emerging technologies like web- and mobile-based applications, but reliable process management services and a consistent system are unavoidable [18]. Thus, company developers need to consider each of these factors while keeping costs in mind. The whole financial budget shouldn't be exceeded by the costs of administration and upkeep. They must create financial strategies that can meet all of the requirements for the whole organisation while taking SLAs and software licence exposure into consideration [18]. No matter how well we prepare for the future, it will always be unclear. Hybrid cloud computing offers the flexibility to employ cloud services only when needed.

Furthermore, it is improbable that an organization's workload stays constant for the whole year. If a company is engaged in analytics of large amounts of data, it may use public cloud computing capabilities for very sophisticated calculations; however, this is not always necessary and may only be required temporarily. Public cloud resources are available for short-term loan here [18, 19]. Similarly, new businesses might begin with a small amount of personal equipment and use cloud services to handle the remaining processing. They may then plan to use public cloud to grow the company depending on

performance [20]. Only with hybrid clouds, which provide enhanced connection and security, agility, scalability, data dependability, and quick recovery, are all of these possibilities conceivable [19, 20].

II. PROTECTION CONCERNS IN CLOUD COMPUTING

IT administrators place the utmost importance on security and privacy when it comes to cloud computing. It is surrounded by multi-domain environments with common resources. Hardware share and data location appear to be very dangerous practices [20]. Unauthorised users may readily hack, either intentionally or accidentally, thanks to malicious attacks. Data storage would thus constitute a serious security breach. In 2008 and 2009, IDC conducted two polls taking these security concerns into account. Here, their observations are examined and made available.

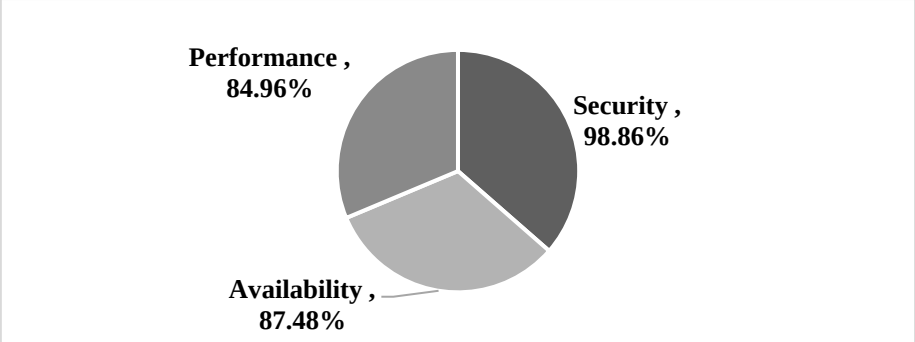

Fig. 1 Frequency of challenges/issues with the cloud/on-demand notion in 2008. Source: IDC enterprises portal, 2009. [21]

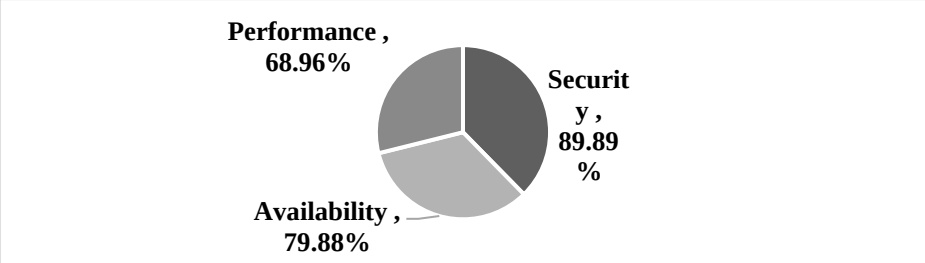

Fig. 2 Frequency of challenges/issues with the cloud/on-demand notion in 2009. Source: IDC enterprises portal, 2008. [22]

An increasing number of IT companies are moving to cloud services including both public and private and hybrid cloud computing services. They are concerned about security threats, however. Public, private, and hybrid computer challenges are the main topics of this study. New risks and issues surface as more companies employ cloud infrastructures and services.

III. DIFFERENT TYPES OF CLOUD COMPUTING

The three major categories of computing in the cloud have been investigated and highlighted in the following sections. This paragraph offers us a good concept of the numerous sorts of cloud computing.

3.1 Public Clouds

One of the most popular kinds of cloud computing technologies are public clouds. In this case, individuals and businesses may access sources like apps, infrastructures or storage over the World Wide Web thanks to the service providers. Data centres from service providers like Microsoft and Google have integrated infrastructure. The internet will be the only means of access. The public cloud architecture does not foresee a direct connectivity [21–22]. Services offered may be provided to businesses on a charge-per-use basis or for free (Gmail). The location of the computer infrastructure is not something that the user can see or control. Public cloud offerings are more affordable and easier to use, but they are not seen to be as secure as private clouds.

3.2 Private Clouds

It's a platform for online computing based on your own hardware and applications. It is also known as the internal or corporate cloud. It offers hosted services to a restricted amount of users behind a firewall. When you need more privacy and authority over your apps, this form of cloud is the best option [22]. The services and infrastructure supplied are managed via a private network and are mostly utilised by corporations. This private cloud solution is more expensive since we have to purchase, create, and administer it. However, the dependability supplied makes them famous and has given them the potential as a developing business.

3.3 Hybrid Clouds

When you need to handle many business applications with different levels of safety, this approach is really helpful. A combination of public and private clouds provided by different providers is known as hybrid cloud computing services [22]. The drawback of these services is that we have to manage many security systems at once.

IV. THE CLOUD COMPUTING DEPLOYMENT APPROACHES

Cloud computing deployment methods are classified into four types based on infrastructure ownership. Each type has unique benefits and downsides. This is when security concerns begin.

4.1 Public Cloud

Concerns over the security and reliability of the public clouds are shared by most executives of IT departments. It is often owned by a big company like App Engine, Google, or Amazon EC2. Using a self-serve, multitenant architecture, the company's owner provides customers with online access to the public cloud infrastructure [22, 23]. This is the most economical approach, which begs security questions. It is a strong choice for application design and testing, collaborative projects, ad hoc tasks related to software development, and SaaS apps from vendors that have implemented security plans.

4.2 Private Cloud

In a private cloud, the infrastructure and services are maintained on a different network. It offers the most degrees of control and security. Nevertheless, the cost reductions are diminished since the company has to buy and maintain all of the infrastructure and software [22]. This setting is for a single renter.

It might be run on or off the leased property by a third party or by the tenant entity. Public clouds are less expensive than private clouds. Nonetheless, compared to a data centre, it yields more cost savings. It is suitable in situations when control and security are crucial and the business is your data and application.

4.3 Hybrid Cloud

With some data stored in the public cloud and some in the private cloud, it integrates the two hybrid cloud computing technologies that were previously discussed. On- and off-premise are often combined [22, 23]. Below is a comparison of the many challenges associated with cloud computing while implementing cloud technologies.

Table 1 Cloud deployment techniques and problems.

Model	Security problems	Cost problems	Control problems	Legal problems
Public	• Transferring data over the internet; • Multi Tenancy; • Least secured	Setup: Highest Usage: Lowest	Least control	Storage Authority

Private	Most secure	• Setup: high • New operating procedures are necessary.	Most command	-----
Hybrid	Control over security between the public and private clouds.	---	Leased control	Storage Authority

V. SECURITY Problems FOR PRIVATE CLOUD

5.1 Private

Clouds and public clouds both have security threats. Nonetheless, this Private Cloud idea raises a few unique security issues. IT decision makers need to think about compliance, data protection, and legality while establishing a private cloud, based on social TechNet reports [22]. The data safety industry tackled fresh security threats in private clouds. The following are some suggestions for enhancing security in the private cloud. They're,

i) Patch and management of configuration should be taken into consideration in addition to scale and continuity [23].
ii) Take into account the hypervisor's security and integrity.
iii) Cloud management platforms need secure automation.
iv) Hypervisors should be replaced with strict controls to improve security.

Gabriel Consulting has conducted a study on security vulnerabilities in private cloud builders. 38% of organisations employ private cloud computing services, based on the research. Regarding serious worries about the security of their private cloud, according to their survey, over 40% of businesses believe that cloud security has to be strengthened, and over 8% believe that cloud security in private clouds is atrociously inadequate. 40% of respondents seeking to construct a private cloud feel their internal cloud security is extremely robust.

5.2 Security Control

Businesses using private cloud infrastructure need to ensure they have sufficient control over the new setting [23]. Management should be able to monitor ecological safety elements and the business's present risk levels thanks to the private cloud computing architecture. A web dashboard will provide the control overview by translating security issues into understandable languages.

5.3 Compliance

Organisations such as healthcare and finance are subject to a variety of contractual requirements and laws [23]. With multinational organisations, it is probable that migrating to private cloud, various nations would follow different sets of legislation to access data.

VI. THE COMPARISON OF PUBLIC, PRIVATE, AND HYBRID CLOUD

- Security: Ensure that the hosting site addresses legal data jurisdiction problems.
- Flexibility: Enables application authors to easily move between testing and development.
- Promoting web-scale development Performance: Run apps synchronously or asynchronously at suitable rates. According to IT Candour Acronym Buster, a comparison advantages of various types of cloud computing [23].

6.1 Private Cloud Chiefs

Officers at major corporations are often perplexed about the form of Cloud Computing to use inside their organisation. The top system vendors, including IBM, HP, and Fujitsu, are assisting their largest clients in establishing their own private clouds. In order to provide their employees and customers a

more modern experience, they are interested in changing the data centres and IT systems that are already in place [23, 24]. The following are the ratings for using private cloud.

- **Security 5.0:** Many well-being, monetary, and government organisations demand total data security to be done in-house.
- **Elasticity 1.0:** managing your own servers. A few companies in the data storage space, like Hitachi, could be willing to install equipment at your place; you just have to pay for it when you use it [25].
- **Performance 4.0:** Naturally, performance planning will be a component of the build out, but it will be limited compared to some of the on-premise options.
- **Total Cost of Ownership 1.5 (TCO):** This gets a score of 1.5 since you will be spending money on new policies and processes; there aren't many examples of "spend to save" in this category.

6.2 Using Public Clouds Earlier

Applications may be developed "on the Cloud" and then deployed by application developers thanks to the Cloud Computing services offered by Sun, Google, and Amazon [23]. As an alternate to more expensive in-house tolerant of faults systems, a provider might provide asynchronous repeating servers, as shown in the discussion with Double Take Solutions [24]. The following are the public cloud scores:

- **Total Price of Ownership 5.0:** Programmes that are made available via public clouds are often the least expensive, and they also have the advantage of being billed based on lower use during recessions [27].
- **Elasticity 5.0:** Since Google and Amazon have huge resources, it is unlikely that they would be unable to offer your applications [24, 25].
- • **Performance 2.0:** We've evaluated performance lower than hybrid clouds since public clouds now provide little direct control over resource and there may be significant distances between your users and the provider's servers [26, 27].
- **Security 1.5:** Security is a key factor for many enterprises; financial services companies are legally required to have their systems evaluated [28], and in many countries, you are restricted from experiencing.

6.3 Hybridised Private Clouds

Hybrid cloud computing comes in a variety of forms, where an organisation manages certain resources internally while outsourcing others to provide customers with apps. Two varieties exist: one whereby the vendor assumes control of the customers systems in a multi-tenanted setting, and the other where workloads are split between the customer's and supplier's data centres. The Public is increased by the supplier's involvement, while the Private is increased by understanding where the data is processed. Compared to personal clouds, hybrid clouds are more affordable and may provide sufficient security for a wide range of enterprises.

VII. CONCLUSION

In this work, we offered a fundamental description of cloud computing and explored the security concerns or problems associated with public, private, and hybrid clouds. Table 1 also shows several types of challenges associated with using cloud-based strategies. Each of the three cloud types has advantages and disadvantages. As a result, security will be an ongoing concern. Several security challenges for private, public, and hybrid clouds were highlighted. SPSS is used to do a comparative study of three clouds. According to an IT Condor poll conducted in November 2010, private (on-premise) clouds had the greatest security score.

Future work

Furthermore, we provide some future ideas that use time series analysis to attempt to predict future trends regarding security concerns and the growth of cloud computing.

VIII. REFERENCES

1. Garg, K.S., Versteeg, S., Buyya, R.: SMICloud: a framework for comparing and ranking cloud services. IEEE International Conference on Utility and Cloud Computing. (2011).
2. Zheng, X., Xu, D.L., Chai, S.: QoS recommendation in cloud services. IEEE Access. 5, 5171–5177 (2017).
3. Grozev, N., Rajkumar, B.: Inter-cloud architectures and application brokering: taxonomy and survey. Softw.: Pract. Exp. 44, 369–390 (2014).
4. Markoska, E., Ackovsak, N., Ristov, S., Gusev, M.: Software design patterns to develop an interoperable cloud environment. IEEE Telecommun. Forum Telfor. (2015).
5. Meireles, F.: Integrated Management of Cloud Computing Resources. Diss. Instituto Superior de Engenharia do Porto (2014)
6. Saaty, R.: The analytic hierarchy process – what it is and how it is used. Math. Model. 9, 161–176 (1987).
7. Gal, T., Stewart, T., Hanne, T.: Multicriteria Decision Making: Advances in MCDM Models. Theory, and Applications. Kluwer Academic Publishers, Algorithms (1999).
8. Whaiduzzaman, M., Gani, A., Anuar, N., Shiraz, M., Haque, M., Haque, I.: Cloud service selection using multicriteria decision analysis. Sci. World J. 2014, 1–10 (2014).
9. Neukrug, E., Fawcett, R.: Essentials of testing and assessment: a practical guide for counselors, social works, and psychologists. CENGAGE Learning. (2006).
10. Hutto, C., Gilbet, and E.: VADER: A Parsimonious Rule-Based Model for Sentiment Analysis of Social Media Text, International AAAI Conference on Weblogs and Social Media, pp. 216–225 (2014).
11. Gamma, E., Helm, R., Johnson, R., Vlissides, J.: Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley Reading, Massachusetts (1995).
12. Zheng, Z., Zheng, Y., Lyu, R.M.: Investigating QoS of real-world web services. IEEE Trans. Serv. Comput. 7, 32–39 (2014).
13. Rhoton, J.(2011). Common definition. Cloud Computing Explained: Second edition. Recursive Press, Us.
14. Grance,T.,Mell,P.(2009) The NIST Definition of cloud computing. Retrieved march15, 2012.
15. Islam, N. and Rehman, A., A comparative study of major service providers for cloud computing, in the Proceedings of 1st International Conference on Information and Communication Technology Trends, at Karachi Pakistan, 2014.
16. Kimmy, A Comparative Study Of Clouds In Cloud Computing. Int. J. Comput. Sci. Eng. Technol. (IJCSET), 4, pp. 843–849 2013.
17. Sharma, A. and Garg, S., Comparative Study of Cloud Computing Solutions. IJCST, 6, 4, pp. 231–233, Oct - Dec 2015.
18. Dhinakaran, K., Kirtana, R., Gayathri, K., Devisri, R., Enhance hybrid cloud security using Vulnerability Management. Adv. Intell. Syst. Comput., 613, pp. 480–489, December 2018.
19. Cearley, W. and Hilgendorf, K., Cloud Computing Innovation Key Initiative Overview, Gartner Research Database, Volume 15 pp. 45–52, 2014.
20. R. Ramaswami, (n.d.). The Platform for Your AI Success, AI in the Enterprise, Nutanix.
21. Rajkumar Buyya et al., (2010). Intercloud: Utility Federation of Cloud Computing Environment for Scaling of Application Services, ICA3PP 2010 Part I LNCS, 6081, pp. 13-31.

22. T. Grance, (2009). The NIST Definition of Cloud Computing version 15, National Institute of Standards and Technology (NIST) Information Technology Laboratory.
23. Y. Demchenko, Y., Ngo, C., De Laat, C., Garcia-Espin, J. A., Figuerola, S., Rodriguez, J., & Ciulli, N. (2013, March). Inter- cloud architecture framework for heterogeneous cloud based infrastructure services provisioning on-demand. In 2013 27th International Conference on Advanced Information Networking and Applications Workshops (pp. 777-784). IEEE.
24. Chen, H., & Wang, L. (2016). Scalability and Resource Pooling in Cloud Computing. International Journal of Cloud Applications and Computing, 9 (1), 34-49.
25. Garner, M. (2009). Virtual Machine Monitors: A Survey. ACM Computing Surveys, 42 (4), Article 12.
26. Jackson, R. (2018). The Impact of Hypervisors on Cloud Infrastructure. Journal of Cloud Technology, 14(3), 201-218.
27. Bernstein, D., et al. (2014). Containers and Cloud: From LXC to Docker to Kubernetes. IEEE Cloud Computing, 1(3), 81-84.
28. Smith, A., & Brown, R. (2020). Containerization for Micro services in Cloud-Native Applications. Journal of Cloud Computing, 8(4), 301-315.
29. Kaur, J. (2021). Big Data Visualization Techniques for Decision Support Systems. Jishu/Journal of Propulsion Technology, 42(4). https://propulsiontechjournal.com/index.php/journal/article/view/5701
30. Ashok : "Choppadandi, A., Kaur, J.,Chenchala, P. K., Nakra, V., & Pandian, P. K. K. G. (2020). Automating ERP Applications for Taxation Compliance using Machine Learning at SAP Labs. International Journal of Computer Science and Mobile Computing, 9(12), 103-112. https://doi.org/10.47760/ijcsmc.2020.v09i12.014
31. Chenchala, P. K., Choppadandi, A., Kaur, J., Nakra, V., & Pandian, P. K. G. (2020). Predictive Maintenance and Resource Optimization in Inventory Identification Tool Using ML. International Journal of Open Publication and Exploration, 8(2), 43-50. https://ijope.com/index.php/home/article/view/127
32. Kaur, J., Choppadandi, A., Chenchala, P. K., Nakra, V., & Pandian, P. K. G. (2019). AI Applications in Smart Cities: Experiences from Deploying ML Algorithms for Urban Planning and Resource Optimization. Tuijin Jishu/Journal of Propulsion Technology, 40(4), 50-56.
33. Case Studies on Improving User Interaction and Satisfaction using AI-Enabled Chatbots for Customer Service . (2019). International Journal of Transcontinental Discoveries, ISSN: 3006-628X, 6(1), 29-34. https://internationaljournals.org/index.php/ijtd/article/view/98
34. Kaur, J., Choppadandi, A., Chenchala, P. K., Nakra, V., & Pandian, P. K. G. (2019). Case Studies on Improving User Interaction and Satisfaction using AI-Enabled Chatbots for Customer Service. International Journal of Transcontinental Discoveries, 6(1), 29-34. https://internationaljournals.org/index.php/ijtd/article/view/98
35. Choppadandi, A., Kaur, J., Chenchala, P. K., Kanungo, S., & Pandian, P. K. K. G. (2019). AI-Driven Customer Relationship Management in PK Salon Management System. International Journal of Open Publication and Exploration, 7(2), 28-35. https://ijope.com/index.php/home/article/view/128
36. Ashok Choppadandi, Jagbir Kaur, Pradeep Kumar Chenchala, Akshay Agarwal, Varun Nakra, Pandi Kirupa Gopalakrishna Pandian, 2021. "Anomaly Detection in Cybersecurity: Leveraging Machine Learning Algorithms" ESP Journal of Engineering & Technology Advancements 1(2): 34-41.

37. Ashok Choppadandi et al, International Journal of Computer Science and Mobile Computing, Vol.9 Issue.12, December- 2020, pg. 103-112. (Google scholar indexed)
38. Choppadandi, A., Kaur, J., Chenchala, P. K., Nakra, V., & Pandian, P. K. K. G. (2020). Automating ERP Applications for Taxation Compliance using Machine Learning at SAP Labs. International Journal of Computer Science and Mobile Computing, 9(12), 103-112. https://doi.org/10.47760/ijcsmc.2020.v09i12.014
39. Chenchala, P. K., Choppadandi, A., Kaur, J., Nakra, V., & Pandian, P. K. G. (2020). Predictive Maintenance and Resource Optimization in Inventory Identification Tool Using ML. International Journal of Open Publication and Exploration, 8(2), 43-50. https://ijope.com/index.php/home/article/view/127
40. AI-Driven Customer Relationship Management in PK Salon Management System. (2019). International Journal of Open Publication and Exploration, ISSN: 3006-2853, 7(2), 28-35. https://ijope.com/index.php/home/article/view/128
41. Narukulla, Narendra, Joel Lopes, Venudhar Rao Hajari, Nitin Prasad, and Hemanth Swamy. "Real-Time Data Processing and Predictive Analytics Using Cloud-Based Machine Learning." Tuijin Jishu/Journal of Propulsion Technology 42, no. 4 (2021): 91-102.
42. Narukulla, Narendra, Joel Lopes, Venudhar Rao Hajari, Nitin Prasad, and Hemanth Swamy. "Real-Time Data Processing and Predictive Analytics Using Cloud-Based Machine Learning." Tuijin Jishu/Journal of Propulsion Technology 42, no. 4 (2021): 91-102.
43. Big Data Analytics using Machine Learning Techniques on Cloud Platforms. (2019). International Journal of Business Management and Visuals, ISSN: 3006-2705, 2(2), 54-58. https://ijbmv.com/index.php/home/article/view/76
44. Shah, J., Prasad, N., Narukulla, N., Hajari, V. R., & Paripati, L. (2019). Big Data Analytics using Machine Learning Techniques on Cloud Platforms. International Journal of Business Management and Visuals, 2(2), 54-58. https://ijbmv.com/index.php/home/article/view/76
45. Big Data Analytics using Machine Learning Techniques on Cloud Platforms. (2019). International Journal of Business Management and Visuals, ISSN: 3006-2705, 2(2), 54-58. https://ijbmv.com/index.php/home/article/view/76
46. Fadnavis, N. S., Patil, G. B., Padyana, U. K., Rai, H. P., & Ogeti, P. (2021). Optimizing scalability and performance in cloud services: Strategies and solutions. International Journal on Recent and Innovation Trends in Computing and Communication, 9(2), 14-23. Retrieved from http://www.ijritcc.org
47. Challa, S. S. S., Tilala, M., Chawda, A. D., & Benke, A. P. (2021). Navigating regulatory requirements for complex dosage forms: Insights from topical, parenteral, and ophthalmic products. NeuroQuantology, 19(12), 971-994. https://doi.org/10.48047/nq.2021.19.12.NQ21307
48. Fadnavis, N. S., Patil, G. B., Padyana, U. K., Rai, H. P., & Ogeti, P. (2020). Machine learning applications in climate modeling and weather forecasting. NeuroQuantology, 18(6), 135-145. https://doi.org/10.48047/nq.2020.18.6.NQ20194.
49. Purohit, M. S. (2012). Resource management in the desert ecosystem of Nagaur district_ An ecological study of land agriculture water and human resources (Doctoral dissertation, Maharaja Ganga Singh University).
50. Kumar, A. V., Joseph, A. K., Gokul, G. U. M. M. A. D. A. P. U., Alex, M. P., & Naveena, G. (2016). Clinical outcome of calcium, Vitamin D3 and physiotherapy in osteoporotic population in the Nilgiris district. Int J Pharm Pharm Sci, 8, 157-60