iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56643

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Automation of Databases in Oracle

Harsh Bhandari[1], Dr. Rupesh C. Jaiswal[2]
Electronics and Telecommunication Department, SCTR's Pune Institute of Computer Technology

Abstract: ***Ever since notable advancements were made concerning Database Management and regulation in the early 2000s, Automation of Databases in the Oracle environment have long been a crucial topic for research and development within the Computer Science and Information Technology sector. This research paper aims to explain what all factors necessarily require automation whilst bringing into light the growing demand for automation database management. As organizations across the globe face the imminent issue of overwhelming volumes of data, efficient database management systems that offer minimum complications are highly in demand. The paper not only highlights automation of various tasks such as routine maintenance, performance tuning, backup and recovery routine, but also emphasises the importance of security enhancements, real-time monitoring and scalability whilst placing forth key requirements of automation in general. The research presents a smarter and more robust database system model that can manage itself without the need of constant monitoring or intervention. Furthermore, we discuss the combining of cloud-based technologies such as Oracle Cloud and other containerization techniques to make the database more flexible and sustainable, all while keeping in mind the importance of having absolute rules and procedures for managing data in an automated system, which ensures that the data is well-organized, complies with legal requirements and is ready to be audited for accountability if needed. To conclude, the paper suggests nurturing practices of setting up systems that keep track of changes and versions to automate the infrastructure and managing of databases more consistently and efficiently. As organizations delve deeper into the landscape of database automation, they inadvertently face several challenges such as accuracy, security and accessibility of the data. This research paper specifically explores the requirements that promise to reshape the future of data management.***

I. INTRODUCTION

In order to enhance efficiency, reducing operational complexities, and ensuring the availability and integrity of the data, the automation of fundamental database operations has emerged as a pivotal objective in the ever-evolving landscape of database management. This research aims to understand this not only important but imperative issue while attempting to address it by focusing on automating core database tasks such as routine maintenance, performance tuning and backup and recovery with "Oracle Cloud Services" Technology chosen for this endeavor.

A. Objectives

1) *Routine Maintenance Automation:* To develop a model for automating routine database maintenance operations such as indexing, optimizing queries, and ensuring data consistency.
2) *Performance Tuning Automation:* To create a model that can identify and rectify performance bottlenecks and ensure that the database operates efficiently.
3) *Backup and Recovery Automation:* To design a model that can automate backup and recovery processes and maintain a robust mechanism to schedule and execute backups at regular intervals while being capable of executing swift recoveries in case of any system failure or data loss.

B. Model and Technology Selection

This research utilizes Oracle Cloud Services for the proposed model, a very scalable and easy to use cloud platform provided by Oracle Corporation. Oracle Cloud provides a rich toolset and ample resources that include Oracle Autonomous Database, Oracle Cloud Management Services and Oracle Cloud Infrastructure which will act as building blocks for the automation of database management operations. The model will leverage these services to create a self-sufficient database system capable of handling the objective tasks mentioned above. The purpose of this research is not just limited to automate database operations but also to ensure data security, compliance, and scalability whilst exploring the potential of Oracle Cloud Services to address the imperative need for automation in database management by proposing a model that harnesses its full capabilities to solve the increasing demand for an efficient and automated database management in the modern-day IT world.

II. LITERATURE REVIEW

Currently, there are 5 database automation technologies that are most-widely used across the globe, these techniques play a significant role in in database management. To delve deeper into the functionalities of each and improvise, we explore the status of existing research.

A. *Database as a Service (DBaaS)*

Database as a Service (DBaaS) is the most widely used technique to automate databases in the current market. Leading tech giants such as Microsoft, Amazon and Oracle offer managed database services for automation of routine administrative tasks [1]. While this approach may simplify database management, it tends to limit customization and control.

B. *Machine Learning and Artificial Intelligence (AI)*

AI and ML techniques have been applied to automate certain parts of database management such as query optimization and anomaly detection [2]. While research may indicate the high potential of using AI to improve efficiency and deem the AI technique to be the most promising amongst all in the future, the current market faces challenges related to data privacy and the imperative need of training datasets to train the model.

C. *DataOps and DevOps*

DataOps and DevOps practices have introduced automation pipelines for database deployment, testing and version control [3]. While these practices may enhance control over automation, they are very complex to implement and require changes as per the user's demands.

D. *Serverless Databases*

Serverless databases, offered by cloud providers like AWS, automatically scale resources based on workload demands [4]. Serverless Databases may simplify management and reduce costs but face challenges regarding the performance of the model. Meanwhile, the cost of the third-party management tools remains the same.

E. *NoSQL Databases*

NoSQL Databases such as MongoDB and Cassandra, emphasize scalability and flexibility but may lack ACID compliance and structured querying capabilities [5]. These databases are usually suitable of customised use cases but have limitations in others.

While these techniques are what the current automation market relies on, they come with their own set of drawbacks and challenges, after thorough research, the following challenges seemed to be persistent and difficult to troubleshoot.

1) *Security and Compliance:* "Compliance in the context of database automation, especially with industry-specific regulations, demands an automated approach. Our research delves into the automation of compliance checks and reporting to ensure adherence to regulatory standards" [6].
2) *Performance Optimization:* "Automating index selection and maintenance is essential for achieving optimal indexing strategies in varying workloads. Our research introduces novel techniques for automated index management in database systems" [7].
3) *Inter-operability:* "Data interoperability challenges in heterogeneous database environments necessitate standards and tools to facilitate automated data integration. Our study explores methods for achieving automated data exchange and transformation across diverse databases" [8].
4) *Expense Control:* The development of more sophisticated tools for monitoring and controlling costs in cloud-based database automation remains a pressing research area, as organizations seek to manage expenses more effectively [9].
5) *Customization:* "Automation of adaptable database configurations is essential for customization in database management. Our research introduces techniques for automating the adjustment of database parameters based on specific workloads and business requirements" [10].
6) *AI Ethics:* "Ethical challenges posed by automated decision-making systems are of growing concern. Our research emphasizes the need for ethical guidelines and governance in AI-driven automation to mitigate potential biases and discrimination" [11].

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

III. METHODOLOGY

The Methodology for this model is based on a sequence of tasks based on logic to efficiently manage the Autonomous Database on the Cloud, Recommended practices for a healthy database working environment such as Maintenance, Performance, Backup and recovery as well as Security were taken into consideration and a concrete flow was determined by putting together a set of various components.

The model initiates ensuring a clean start and execution path, to gain access to the database and perform operations while upholding the security obligations, it is necessary to take Authentication into consideration. The model prioritizes authentication with Oracle Cloud before delving deeper into the said operations.

Regular maintenance of database ensures its health and stability, monitoring anomalies and patching vulnerabilities should be offered precedence in terms of priority due to their impact on the system's security. Furthermore, optimization of performance is imperative for a production level database, this step should succeed routine maintenance because stability of the system is as important as its security and is a pre-requisite for performance tuning.

In an event of data compromise, backups are most crucial for the sustainability of the model, regular backups ensure data protection while recovery operations ensure its availability before the model ends its operations.

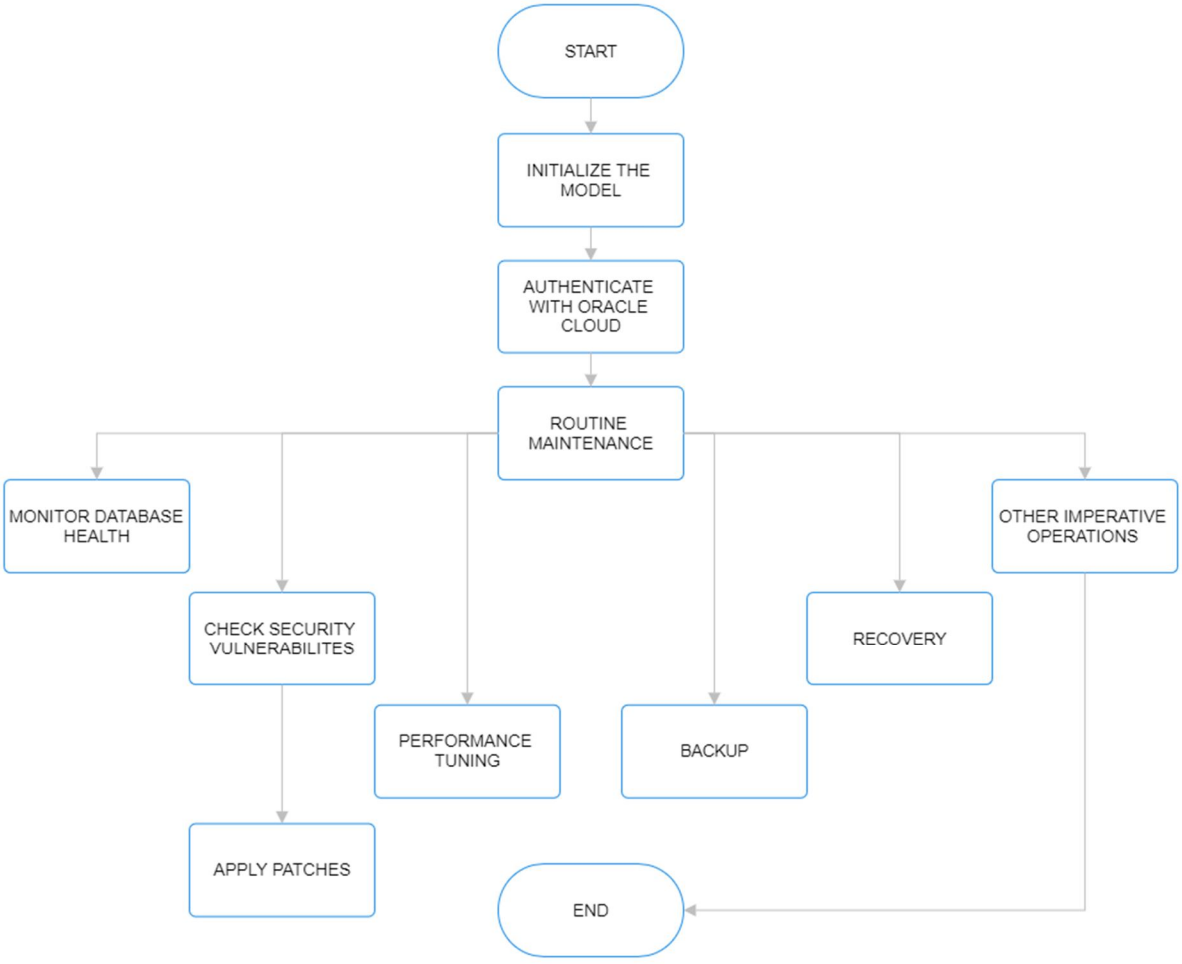


Fig 1. Basic Block Diagram

In the above diagram, the Performance Tuning block is responsible for maintaining the performance of the database. It gathers performance data and other necessary parameters from the database, analyzes them collectively and identifies areas for improvement to implement recommended tuning related changes for the database to enhance its performance. Furthermore, this block is also responsible for optimization of queries as well as managing of Indexes of the database. It also adjusts configuration parameters of the database to obtain better performance. These operations occur concurrently within the block. Detailed block diagram of the Performance Tuning block is depicted below in figure 2.

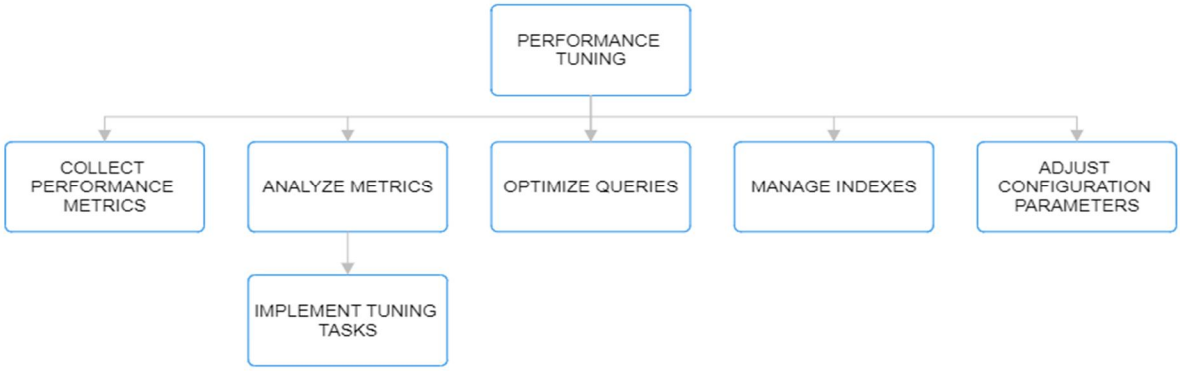


Fig 2. Performance Tuning Block

The Backup and Recovery Blocks mentioned in figure 3 deal with the database backup and recovery processes respectively, hence ensuring data availability, the backup block consists of two sub-processes for scheduling automated backups and verifying their status respectively to ensure data integrity. Meanwhile, the recovery block is triggered only in the event of a data loss or database failure. It maintains records of locations and timestamps for recovery, selects appropriate backup to restore data from and the appropriate database to restore it to. After the restore process, data integrity is cross verified to determine whether the recovery has been successful or not.

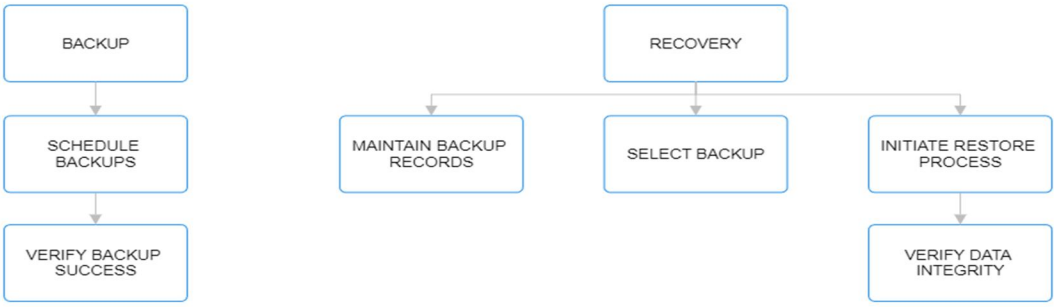


Fig 3. Backup and Recovery Blocks

Continuous Monitoring runs in parallel with other tasks to be able to detect issues in real-time. In case any issue is detected, alerts are triggered, and the user is notified. The model can integrate with alerting tools to provide detailed information about the alerts if deemed necessary.

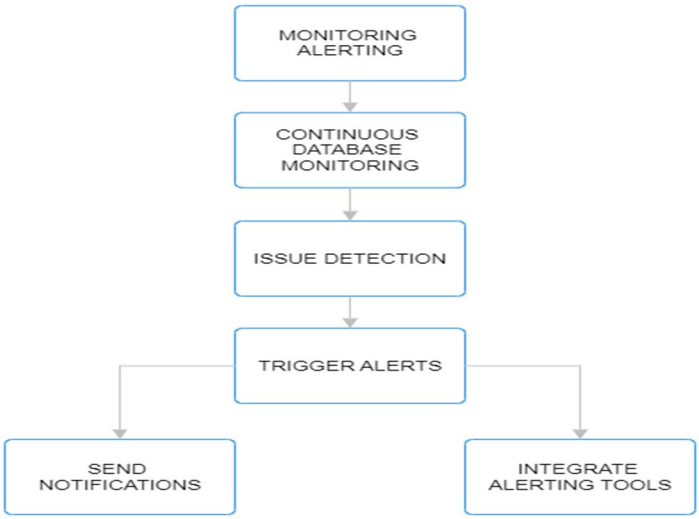


Fig 4. Monitoring and Alerting Block

Scheduled Processes and other automation operations run concurrently with other tasks, as configured by the user, it can be configured to run at specific times or on defined schedules, or some tasks can be initiated as a response to specific events or triggers. Detailed Logs of the model's actions that are ready to be audited at any given moment are maintained as a measure towards compliance and troubleshooting.

Fig 5. Scheduling Block and Auditing Logger Block

Furthermore, the model goes through testing and validation to ensure that it works correctly. The model simulates failure scenarios to verify its robustness while ensuring that all its functions and configurations stay documented, and staff are trained to use and maintain it effectively. Detailed flow can be found in figure 6.

Figure 6. Testing Validation Block and Documentation Training Block

It is important to devise a plan for disaster recovery to maintain reliability while maintaining compliance and security standards throughout the process. The model's configuration should be backed up routinely to safeguard against potential issues and to ensure a faster service restoration in case of failures while adhering to the security standards for system protection. The data shall be encrypted for security with well defined user access controls that manage access to the model (refer figure 7).

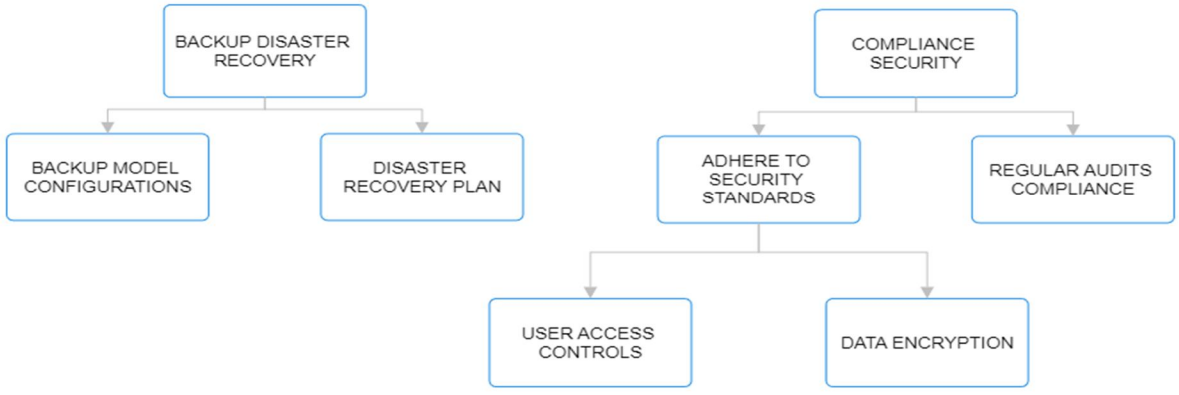


Figure 7. Disaster Recovery Block and Security Compliance Block.

The model shall undergo regular audits to verify ongoing compliance with described standards. The model may potentially add advanced features to itself as the requirements change, as per the requirement, the model can be expanded with advanced features (refer figure 8), but it needs planning to handle increasing workloads, thus concluding the automation model's workflow.

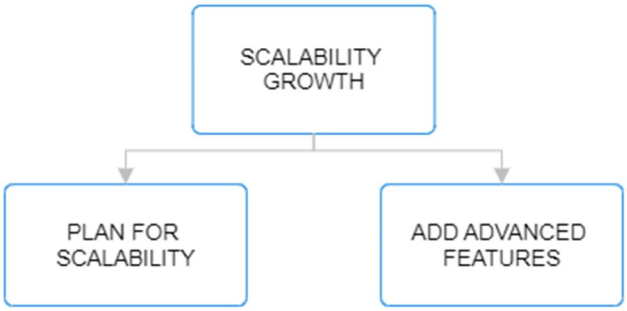


Figure 8. Scalability with reference to Future Interests.

IV. CONCLUSION

In the proposed model, we have presented an approach for the automation of basic database operations such as routine maintenance, performance tuning, backup and recovery with Oracle Autonomous Database of the Oracle Cloud acting as a leverage. We were able to provide a structured model that can manage and maintain an Oracle Database system efficiently.
Below are the key findings of this approach as well as its contributions to the field of database automation.

1) This model offers a systematically managed detailed workflow to automate basic database operations.
2) The model includes integrated continuous monitoring and alerting that enables it to proactively detect issues and respond timely.
3) The model complies with the security standards such as regular auditing and user access controls to maintain data integrity and keep the system safe.
4) The model takes into consideration the future development and scalability and is adaptable to increasing workloads and accommodating advanced features.
5) The model offers to integrate best practices, such as real-time monitoring of database while complying with the security standards to maintain a robust and secure database.
6) The approach takes into consideration the importance of scalability and the importance of adaptation as per new business requirements.

This approach can enhance the efficiency of database management, while reducing the risk of data loss and improving performance and thus offers far-reaching implications.

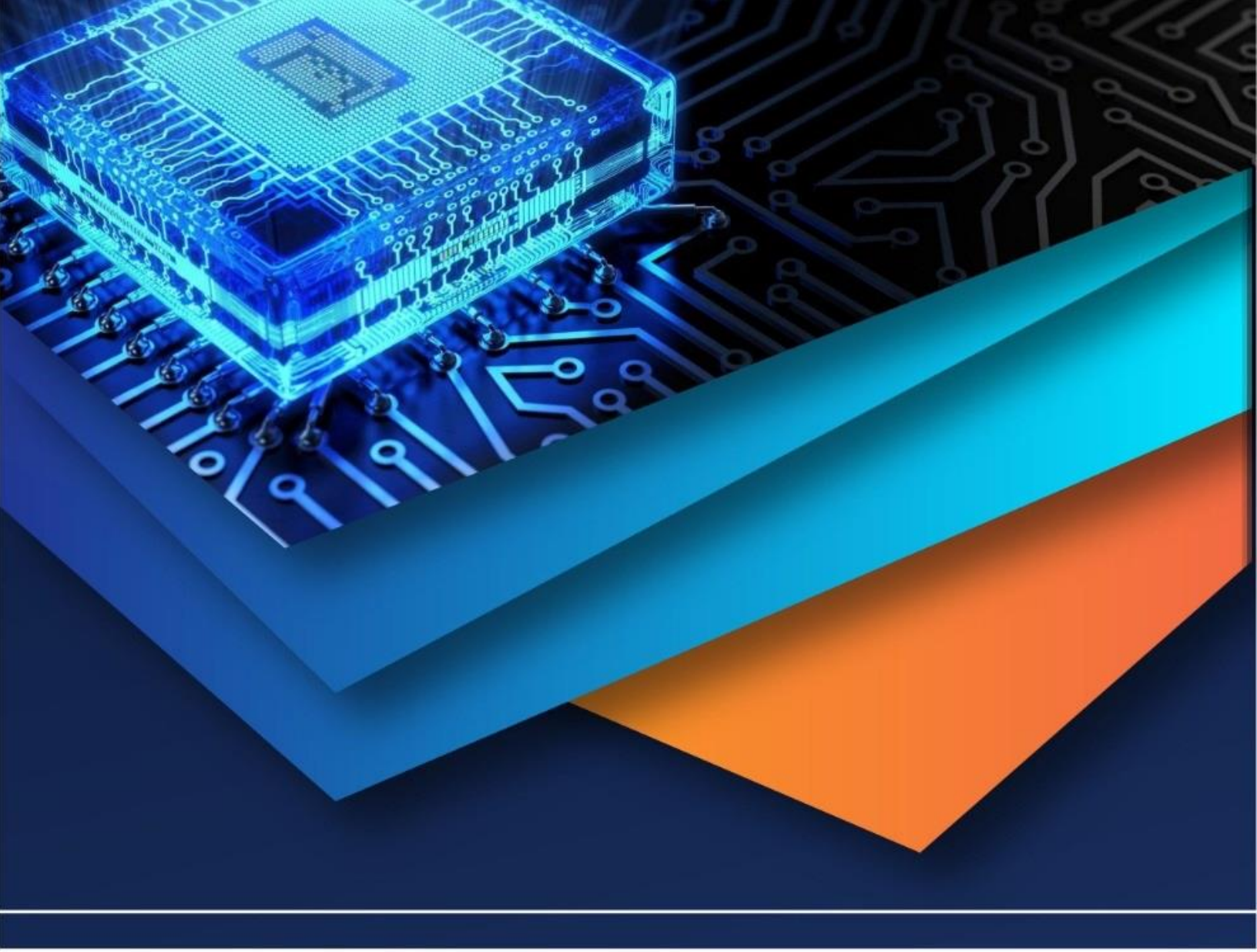
While the model does provide a comprehensive approach, unfortunately practical results and specific implementation details are not yet available, thus future research directions should be primarily focusing on the following:

a) Practical Implementation and Testing in Oracle Autonomous Database environments to receive validation and improvisation from experts.
b) Analysis of performance data to fine-tune the model accordingly to obtain optimal results.
c) Future development does involve involving more advanced monitoring systems and trigger alert systems to detect any issues and tend to them precisely.
d) Integration of Machine learning and AI can predict maintenance scenarios and can act accordingly, while this may seem far-fetched for now, automated decision-making within the model if successfully implemented, can bring about a revolutionary change in the field of database automation.

To conclude, the approach merely offers a solution for automation of Oracle Databases and while it does provide a strong foundation to efficiently manage database operations, practical results, performance data and proportional fine-tuning is imperative to validate its applicability in real-time. Future research should focus on the implementation and validation of this approach before exploring further optimizations within the system, however while the model has not yet been validated, it does a great job exploring necessary optimizations within databases.

REFERENCES

[1] Tsuchiya, R., Miyaki, A., & Shioya, K. (2019). Database as a Service: A Survey of Trends and Techniques. IEEE Access, 7, 46867-46884.
[2] Yan, S., Li, L., Zheng, Y., Wang, Z., & Kandula, S. (2020). Building Self-Driving Database Management Systems. Proceedings of the VLDB Endowment, 13(12), 2674-2687.
[3] Kimball, R. (2020). The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data. Wiley.
[4] Chung, K. M. (2019). Serverless Computing: Design, Implementation, and Performance. IEEE Cloud Computing, 6(4), 6-14.
[5] Hecht, R. (2020). The NoSQL Ecosystem. In The Art of Software Architecture (pp. 33-49). Apress.
[6] Balashankar, V., Rao, B. K., & James, A. P. (2019). Automated Compliance Checking for Cloud-Based Database Systems. In 2019 IEEE International Conference on Cloud Computing Technology and Science (CloudCom) (pp. 229-235).
[7] Boncz, P. A., Zukowski, M., & Nes, N. (2020). Database Index Management by Algorithms. ACM Transactions on Database Systems (TODS), 45(1), 1-36.
[8] Akdere, M., & Ülker, F. E. (2018). Data Interoperability in Heterogeneous Database Environments. In 2018 IEEE International Conference on Data Science and Advanced Analytics (DSAA) (pp. 310-319).
[9] Gupta, D., Buchmann, A., & Schallehn, E. (2016). Auto-Scaling with Automatic Database Deployment. Proceedings of the 2016 International Conference on Management of Data (SIGMOD), 451-465.
[10] Alnanih, R., Ariwa, E., & Ashman, H. (2018). An Approach to Database Configuration and Adaptation Automation in Cloud Computing. In 2018 IEEE/ACM 11th International Conference on Utility and Cloud Computing (UCC) (pp. 219-226).
[11] Jobin, A., Ienca, M., & Vayena, E. (2019). The Global Landscape of AI Ethics Guidelines. Nature Machine Intelligence, 1(9), 389-399.
[12] Zeel Patel, Jaiswal R.C., "Data-Driven Quantitative Risk Modeling In Financial Engineering", International Journal "Gradiva Review Journal" (GRJ), UGC Care group-II journal, Open Access, Peer Reviewed, refereed and multidisciplinary Journal, Google Scholar, Scribd, ResearchGate, Scopus indexed, ISSN: 0363-8057; SJR Impact Factor:0.101, Volume 9, Issue IX, pp. 656-668, September 2023.
[13] Manasi Thonte, Jaiswal R.C., "Technical review on Synthetic Data Generation", International Journal "Gradiva Review Journal" (GRJ), UGC Care group-II journal, Open Access, Peer Reviewed, refereed and multidisciplinary Journal, Google Scholar, Scribd, ResearchGate, Scopus indexed, ISSN: 0363-8057; SJR Impact Factor:0.101, Volume 9, Issue VII, pp. 100-109, July 2023.
[14] Jaiswal R.C. and Shivani Pande, "Microservices in Cloud Native Development of Application", International Journal of Creative Research Thoughts (IJCRT), Open Access, Peer Reviewed and refereed Journal, Indexed in Google Scholar, Microsoft Academic, CiteSeerX, Thomson Reuters, Mendeley: reference manager, ISSN: 2320-2882; SJ Impact Factor:7.97, Volume 10 Issue X, pp. d170-d183, October 2022.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY