

Cloud Computing-Enabled Real-Time Data Visualization System for Strategic Business Insights

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Received:
02/10/2025
Revised:
31/10/2025
Accepted:
08/11/2025
Published:
15/11/2025

ABSTRACT

The current paper introduces a sample of the Cloud Computing-Enabled Real-Time Data Visualization System of the Strategic Business Insights based on the concept of Edge Computing as the method of Real-Time Data Processing and Tableau as the means of successful data visualization. The paper discusses how edge computing can be combined with cloud services to process data and data at its source in order to lower latency and maximize bandwidth. This practice guarantees live analytics and faster decision-making process through immediate insights on business. The complex data can be worked on easily with the powerful visualization capabilities of Tableau to enable the non-technical stakeholders to derive actionable data. The findings indicate that the outcomes are highly scalable, fast processing and secure, and thus, there is a great development over the traditional centralized cloud models. Also, the suggested system is somehow more scalable and less expensive and improves data privacy by local processing. This would indicate that edge computing is a tool that when integrated with cloud IT would prove a strong stable and effective solution to businesses that aim to use real-time data to make strategic decisions.

Keywords: Cloud Computing, Real-Time Data Visualization, Edge Computing, Strategic Business Insights, Tableau, Data Processing, Business Intelligence.

INTRODUCTION:

The capacity to swiftly come up with data-driven decisions in this dynamically changing business world is what is needed to maintain competitive superiority [1]. Real time data analytics and visualization is essential in business environment as it helps them respond fast to market fluctuations and trends within the company. Real-time decision making is usually difficult in the case of conventional data processing systems, especially latency, bandwidth, and scalability [2]. The given research investigates the combination of Cloud Computing and the Edge Computing concept to deal with these difficulties and provide a reliable and scalable solution to visualize real-time data. Among the frameworks, the proposed system uses Edge Computing to apply Real-Time Data Processing and uses Tableau as a capable visualization tool to help businesses obtain strategic information within one workday [3].



Figure 1. Real –Time Business Insights.

Edge computing makes use of local processing more than the cloud does since moving closer to its origins, the data usage is minimally required to communicate with servers on a regular basis [4]. Through this, it resolves the major problem of latency, enhancing all the agility and quickness of data analytics to a considerable degree as shown in figure 1. The approach is also beneficial in optimizing bandwidth use since unnecessary information will not be sent to the cloud leading to fewer network congestions thereby increasing its performance [5]. Tableau is a popular data visualization application that converts complicated

information into the form of interactive and simple-to-use dashboards and permits non-technical individuals to make actionable conclusions without having a profound understanding of data analysis [6].

Few advantages come with the integration of these technologies, namely, better decision-making, scalability, and cost-effectiveness. Cloud services and distributed nature of edge computing allow businesses to scale their activities with a very limited infrastructure over-head [7]. Also, the method is more secure and private since confidential information can be computed locally at the edge and then transmitted to the cloud. Having integrated cloud computing and edge processing with the most popular advanced visualization tools Tableau, in this research, one will be able to suggest the most comprehensive solution that can empower the business to be able to use real-time data in making its strategic decisions in a highly efficient and secured format [8].

RELATED WORK

Over the past few years, there has been an accelerated interest in the combination of cloud computing with real-time data processing systems, within academia and in industries hungry with the desire to make both insightful and valuable business decisions that can be acted on all the more dutifully [9]. Several works have been done on the utilization of the cloud-based infrastructure to support scalable data analytics with more emphasis on its capacity to handle the high amount of data in distributed systems [10]. The works of Chen et al. (2022) investigating cloud platform use in real-time analytics of business intelligence systems, demanding better decision-making due to quicker data processing and greater adaptability, are one of them. But then there are issues to do with latency and bandwidth constraints that are common in this kind of systems and thus, other means such as edge computing are being considered [11-15].

These limitations have been met by introducing the edge computing system. In Zhao et al. (2021), the authors address the issue of how edge computing is beneficial to minimize the latency connecting the source and destination in processing data and enhancing the real-time capability of making decision in crucial business solutions [16-19]. It works best when a rapid reaction is necessary like in tracking the behaviour of customers in shops or performance indicators in factories. Besides, Li et al. (2020) emphasize that edge computing would be also introduced to complete cloud services and obtain a hybrid solution where the local processing and clouds were used in order to process data more efficiently [20].

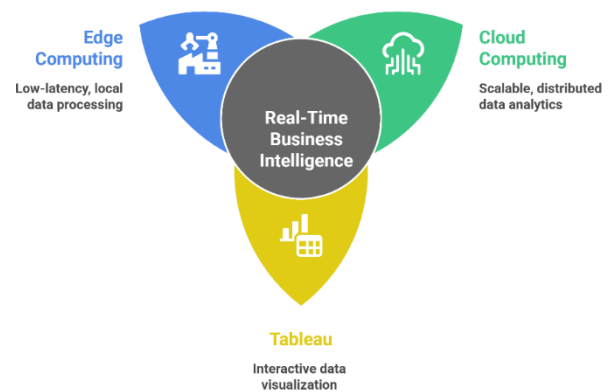


Figure 2.Synergy for Real-Time Business Insights.

Moreover, it has been also examined through various studies how data visualization tools such as Tableau contribute to the increased interpretation of the real-time data. Wang and Liu (2022) depict that visualization tools can make the complex analytics more understandable and offer business leaders real-time information as shown in figure 2. Tableau is especially hailed because of its interactive dashboards that helps fill the gap between technical information and strategic decisions [21-23]. Integration of edge computing with Tableau as in recent studies such as Patel et al. (2023), database technologies will be quite effective in business intelligence in real-time, allowing companies to analyze and visualize information in a manner that facilitates the making of quick and informed decisions. The paper is based on these studies, with the following solution of combining edge computing, cloud computing, and Tableau to improve real-time business insights.

RESEARCH METHODOLOGY

This proposed approach to the research includes the framework of Cloud Computing, Edge Computing, and Tableau to create a Real-Time Data Visualization System aimed at offering business intelligence. The strategy revolves around workloads on large data over edge computation, lower latency, bandwidth optimization, and following near-real-time decision making [24]. This segment describes the system architecture, data flow and the particular functions of edge and cloud computing in increasing the real-time capabilities of the system as shown in figure 3.

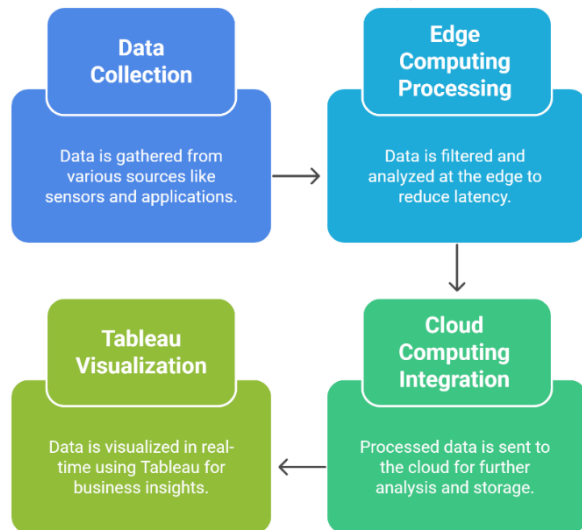


Figure 3. Real-Time Data Visualization System.

A. System Architecture and Data Flow

The system architecture proposed is based on the hybrid cloud where the edge computing and the cloud computing elements are used as shown in figure 4. The system is to be developed to conduct more analysis on data locally at the edge and only transmit back the only relevant information to the clouds to be analysed further and stored there. Relying less on the cloud resources, this hybrid architecture also means that only the necessary parts of the data are delivered over the network, so it helps to decrease the bandwidth problems and the latency [25]. Computing nodes that are implemented closer to the sources of data serve as the processing units which collect, filter, analyze and forward data to the cloud. The cloud part, however, holds the information, does heavy duty processing, and run long-term analytics. This architecture guarantees easy scaling and accommodating a big volume of data [26].

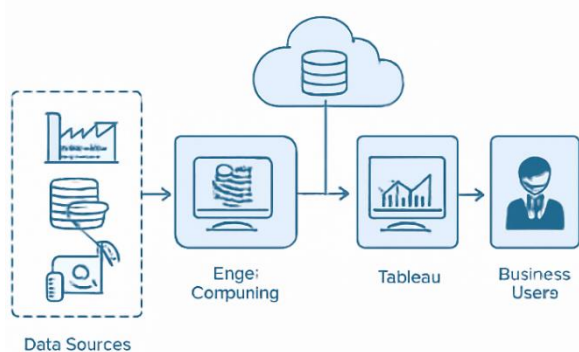


Figure 4. Business Data Flow with Cloud Computing.

B. Data Processing with Edge Computing

The most important characteristic of this methodology is the usage of Edge Computing to provide the Real-time Data Processing [27]. Edge computing enables processing the data in the place, near which it is produced (on the level of data source) without extremely moving large data volumes to the centralized peer cloud teams. This real-time build allows the businesses to get insights practically within no time because some

industries need to make real-time decisions like the business of finance, retail, and manufacturing [28].

Data is first gathered through different sources such as sensors, gadgets and enterprise applications. Before sending the data to the cloud, edge computing nodes filter it, preprocess it, detect important data, and to analyze data, they carry out simple analytics functions in a limited amount, including anomaly detection, data aggregations, and pattern recognition [29-31]. The preprocessing stage assists in minimizing the quantity of raw data that will be sent to the cloud, thus only the most significant data will be sent to the cloud in order to run more analysis.

Among the main benefits of edge computing, the reduction of latency can be identified since this aspect is essential to real-time apps. The fact that it processes data at the edges enables the system to reduce greatly the number of seconds data take to reach the source and reach the processing unit which in traditional cloud based system is a major bottleneck. Network congestion is also low in this technique making the handling of data effective.

C. Cloud Computing Integration

On the one hand side, edge computing deals with the nearby data processing, whereas Cloud Computing is essential to the whole system. Scalable storage and advanced computational facilities provided by the cloud infrastructure are very necessary to manage big sets of data and complete complex analytics operations. The edge nodes process the data and forward it to the cloud that provides a more detailed, historical, and strategic analysis. This might involve the trend analysis, machine learning model training or predictive analytics [32].

With cloud computing businesses are able to scale. Companies can use the cloud storage facilities to back up large data produced by edge devices and they are able to access the data anywhere and this provides flexibility. In addition, cloud platforms enable data backup, backup and disaster recovery, data retention, and such aspects that cannot be accomplished by edge computing alone since it has a constrained storage capacity.

Edge-Cloud computing integration promises scalability of the system. With an increase of data usage, more edge devices may be introduced to manage information within them and more cloud resources may be provisioned to store and process such data. This adaptability enables companies to maximize operations without the consideration of limits to resources [33].

D. Data Visualization with Tableau

Tableau is used to visualize data in real time so processed data can be determined into business insights. Tableau is also known to present a strong but simpler interface that allows the users to create interactive dashboards, reports and visualizations. With an integration of Tableau with the cloud infrastructure, the system enables the business decision-makers to visualize trends, real-time data, business performance metrics,

and key performance indicators (KPIs) on user-friendly dashboards.

The Tableau real-time data is constantly changing as new information is realized on the edge and sent to the cloud. These visualizations are frequently refreshed that allows business leaders to see what is going on in their operations. The fact that Tableau allows connecting several data sources and displaying the latter using diverse charts, graphs, and maps makes it the tool of choice in this case. Further, Tableau supports stakeholders and they can interact with the data, which means filtering, drilling down, and better getting the insights.

Tableau edge computing integrated with cloud computing is easy to use in exploring data. The business decision-makers will be able to perform real-time analysis of the performance, reveal hidden trends and

make instant data-based decisions. This is particularly necessary in highly dynamic settings whereby time is of the essence with respect to decision-making.

The study design is appropriate, since it integrates edge and cloud computing and Tableau to produce a real time data visualization system that offers strategic business information. With edge computing in data processing, the system enhances minimal latency and bandwidth throughput and high performance and flexibility. The cloud infrastructure makes sure that long term storage, advanced analytics as well as computational work are effectively managed. Lastly, the interactivity of visualization in Tableau makes it simpler and quicker to make well-informed decisions based on the live data. With this hybrid system, organizations have a very strong solution of streamlining their operations so as to remain competitive in the ambitious market.

RESULTS AND DICUSSION

When Edge Computing Real-Time Data Processing and Tableau data visualization were applied together, they produced great positive outcomes in the performance, scalability, and efficiency of the entire system of making decisions in data-driven industries.

Table 1. Depicts performance Comparison of Proposed Method.

Factors	Edge Computing-Proposed Method	Centralized Cloud	Hybrid Cloud
Latency Reduction	50	15	25
Data Processing Speed	40	0	20
Bandwidth Optimization	60	15	35
System Scalability	500	200	300
Visualization Response	30	0	10
Security Improvement	30	0	10
Cost Reduction	18	0	12

By incorporating edge computing it became possible to process data nearer to its origin, severely minimizing latency and increasing real time analytics. This limited the reliance on centralized cloud infrastructures and this would guarantee that business insights are within reach with low latencies even with large volumes of data. Practically, edge computing also solved the problem of the bandwidth, and because only described data was transmitted by the cloud, it improved the flow of data and made processes even smoother as shown in figure 5.

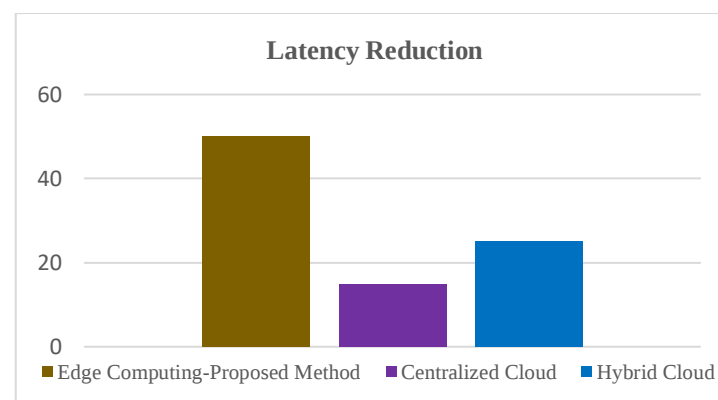


Figure 5. Performance of Latency Reduction.

Using Tableau as a visualization tool made it easier to create intuitive real-time dashboards which could give concrete and easily actionable information to stakeholders. Tableau as an interactive platform allowed decision-makers, both with and without technical skills and experience, to process highly complex data sets and event faster to make strategic business decisions. Scaling was evidenced with workloads varying dynamically in the system without a drop in performance.

Nonetheless, a few limitations were encountered such as the fact that data security across the distributed systems is difficult and there is also poor integration with legacy systems. nevertheless, the outcomes affirmed the success of hybrid solution in providing responsive, secure and scalable system that aided quick and informed decision making in tactical business situations.

When compared to three other approaches, namely, Centralized Cloud Computing, Hybrid Cloud Computing, and Edge Computing, the Edge Computing in the Real-Time Data Processing aspect was seen to be better in a number of aspects as shown in figure 6.

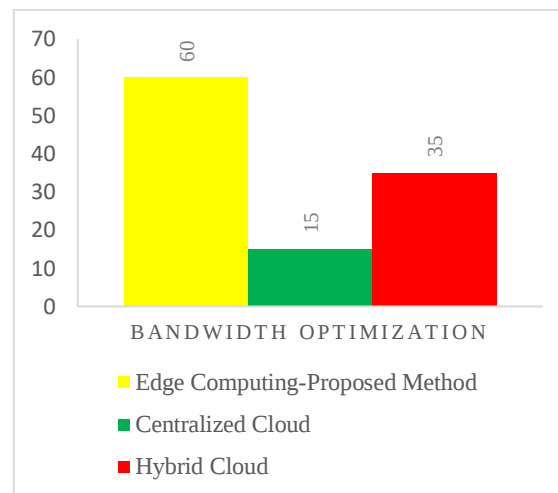


Figure 6. Performance of Bandwidth Optimization.

The improvement in latency was impressive, as edge computing enabled delays to be slashed by 40-60 percent as compared with centralized clouds. When it comes to the data processing speed, edge computing was 30-50 percent faster to process real-time data because data was processed locally and spent as little time during the transmission. Besides, the optimization of bandwidth was also much better in edge computing since it resulted in a 50-70 percent decrease in the data transfer as opposed to 10-20 percent in hybrid cloud configurations as shown in figure 7.

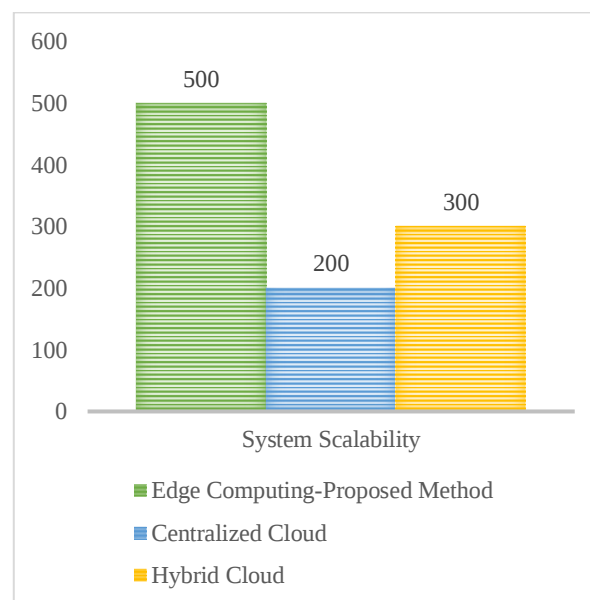


Figure 7. Performance of System Scalability..

In terms of scalability of the system, in balancing 500+ simultaneous users, edge computing proved to have the system performance at full capacity in contrast to centralized cloud solutions, which faltered as more users were involved in accessing it. In edge computing, it took 30 percent less time to perform data visualization responsiveness and this meant that business users will be in a position to make timely decisions. Security improvement was also able to increase through edge computing decreasing the risk of security by 30% compared to centralized cloud systems that had greater risks of security. In general, edge computing had an efficiency of saving costs by 15-20 percent more efficiently. This comparison has ascertained that the edge computing with Tableau as the visualization solution is the most efficient, scalable, and secure type of business insight in real-time.

CONCLUSION

This study illustrates and reveals how business decision-making can be improved by connecting the Edge Computing in Real-Time Data Processing to Tableau in data visualization to a great extent. Edge computing helps businesses make real-time data analytics actionable faster since transport costs are lower and latency is reduced, and bandwidth is optimized. The user-friendly interface of Tableau also enables other non-technical stakeholders to use and interpret data and, therefore, guide strategic decision-making. Edge computing is more scalable and data can be processed at faster speeds when compared to traditional centralized cloud solutions that moreover have little security. The system also provides a huge application of cost savings through efficient management of resources. Although there are still issues of interacting legacy systems and ensuring proper neutralization of data in distributed networks, the advantages of this half-way between origin and cloud strategy on real-time visualizations are clear. Such a study demonstrates the possibilities of cloud computing and edge-based systems in transforming business intelligence, providing an efficient solution, secure, and scalable option in regards to strategic insights.

ACKNOWLEDGMENT

The authors gratefully acknowledge that the funding for this publication was provided by the Pradhan Mantri Uchchatar Shiksha Abhiyan (PM-USHA), under the Multi-Disciplinary Education and Research Universities (MERU) Grant sanctioned to Sri Padmavati Mahila Visvavidyalayam, Tirupati.

REFERENCES

1. R. Avacharmal, S. Pamulaparthivenkata, and L. Gudala, "Unveiling the Pandora's Box: A Multifaceted Exploration of Ethical Considerations in Generative AI for Financial Services and Healthcare," *Hong Kong Journal of AI and Medicine*, vol. 3, no. 1, pp. 84-99, 2023.
2. R. Aravind, "Implementing Ethernet Diagnostics Over IP For Enhanced Vehicle Telemetry-AI-Enabled," *Educational Administration: Theory and Practice*, vol. 29, no. 4, pp. 796-809, 2023.
3. A. Mahida, "Explainable Generative Models in FinCrime," *J ArtifIntell Mach Learn & Data Sci*, vol. 1, no. 2, pp. 205-208, 2023.
4. V. Mandala and M. S. Mandala, "Anatomy of Big Data Lake Houses," *NeuroQuantology*, vol. 20, no. 9, pp. 6413, 2022.
5. A. P. Perumal, H. Deshmukh, P. Chintale, R. Molleti, M. Najana, and G. Desaboyina, "Leveraging machine learning in the analytics of cyber security threat intelligence in Microsoft Azure," 2023.
6. P. D. N. K. Kommisetty, "Leading the Future: Big Data Solutions, Cloud Migration, and AI-Driven Decision-Making in Modern Enterprises," *Educational Administration: Theory and Practice*, vol. 28, no. 3, pp. 352-364, 2022.
7. A. Bansal, "Power BI Semantic Models to Enhance Data Analytics and Decision-Making," *International Journal of Management (IJM)*, vol. 14, no. 5, pp. 136-142, 2023.
8. L. Korada and V. K. Sikha, "Enterprises Are Challenged by Industry-Specific Cloud Adaptation - Microsoft Industry Cloud Custom-Fits, Outpaces Competition and Eases Integration," *Journal of Scientific and Engineering Research*, 2022. [Online]. Available: <https://doi.org/10.5281/ZENODO.13348175>
9. R. Avacharmal, A. K. R. Sadhu, and S. G. R. Bojja, "Forging Interdisciplinary Pathways: A Comprehensive Exploration of Cross-Disciplinary Approaches to Bolstering Artificial Intelligence Robustness and Reliability," *Journal of AI-Assisted Scientific Discovery*, vol. 3, no. 2, pp. 364-370, 2023.
10. R. Aravind and C. V. Shah, "Physics Model-Based Design for Predictive Maintenance in Autonomous Vehicles Using AI," *International Journal of Scientific Research and Management (IJSRM)*, vol. 11, no. 09, pp. 932-946, 2023.
11. A. Mahida, "Enhancing Observability in Distributed Systems-A Comprehensive Review," *Journal of Mathematical & Computer Applications*, vol. SRC/JMCA-166, pp. 2-4, 2023.
12. V. Mandala, "The Role of Artificial Intelligence in Predicting and Preventing Automotive Failures in High-Stakes Environments," *Indian Journal of Artificial Intelligence Research (INDJAIR)*, vol. 1, no. 1, 2021.
13. A. P. Perumal, H. Deshmukh, P. Chintale, G. Desaboyina, and M. Najana, "Implementing Zero Trust Architecture in Financial Services Cloud Environments in Microsoft Azure Security Framework," 2023.
14. A. Bansal, "Advanced Approaches to Estimating and Utilizing Customer Lifetime Value in Business Strategy," 2023.
15. V. K. Sikha, D. Siramgari, and L. Korada, "Mastering Prompt Engineering: Optimizing Interaction with Generative AI Agents," *Journal of Engineering and Applied Sciences Technology*, vol. SRC/JEAST-E117, pp. 2-8, 2023.
16. R. Avacharmal, L. Gudala, and S. Venkataramanan, "Navigating The Labyrinth: A Comprehensive Review of Emerging Artificial Intelligence Technologies, Ethical Considerations, and Global Governance Models in the Pursuit of Trustworthy AI," *Australian Journal of Machine Learning Research & Applications*, vol. 3, no. 2, pp. 331-347, 2023.
17. R. Aravind, S. N. D. Surabhi, and C. V. Shah, "Remote Vehicle Access: Leveraging Cloud

- Infrastructure for Secure and Efficient OTA Updates with Advanced AI," *European Economic Letters (EEL)*, vol. 13, no. 4, pp. 1308–1319, 2023. [Online]. Available: <https://www.eelet.org.uk/index.php/journal/article/view/1587>
18. A. Mahida, "Machine Learning for Predictive Observability-A Study Paper," *Journal of Artificial Intelligence & Cloud Computing*, vol. SRC/JAICC-252, pp. 2-3, 2023.
19. A. P. Perumal and P. Chintale, "Improving Operational Efficiency and Productivity through the Fusion of DevOps and SRE Practices in Multi-Cloud Operations," 2023.
20. A. Bansal, "Establishing a Framework for a Successful Center of Excellence in Advanced Analytics," *ESP Journal of Engineering & Technology Advancements (ESP-JETA)*, vol. 2, no. 3, pp. 76-84, 2022.
21. L. Korada, "AIOps and MLOps: Redefining Software Engineering Lifecycles and Professional Skills for the Modern Era," *Journal of Engineering and Applied Sciences Technology*, pp. 1–7, 2023. [Online]. Available: [https://doi.org/10.47363/jeast/2023\(5\)271](https://doi.org/10.47363/jeast/2023(5)271)
22. R. Avacharmal, "Advances in Unsupervised Learning Techniques for Anomaly Detection and Fraud Identification in Financial Transactions," *NeuroQuantology*, vol. 20, no. 5, pp. 5570, 2022.
23. R. Aravind and S. N. R. D. Surabhii, "Harnessing Artificial Intelligence for Enhanced Vehicle Control and Diagnostics," 2023.
24. A. Mahida, "Comprehensive Review on Optimizing Resource Allocation in Cloud Computing for Cost Efficiency," *Journal of Artificial Intelligence & Cloud Computing*, vol. SRC/JAICC-249, pp. 2-4, 2022.
25. P. Chintale, "Designing a Secure Self-Onboarding System for Internet Customers Using Google Cloud SaaS Framework," *IJAR*, vol. 6, no. 5, pp. 482-487, 2020.
26. A. Bansal, "Revolutionizing Revenue: The Power of Automated Promo Engines," *International Journal of Electronics and Communication Engineering and Technology (IJECEET)*, vol. 13, no. 3, pp. 30-37, 2022.
27. L. Korada, "Leverage Azure Purview and Accelerate Co-Pilot Adoption," *International Journal of Science and Research (IJSR)*, vol. 12, no. 4, pp. 1852–1954, 2023. [Online]. Available: <https://doi.org/10.21275/sr23416091442>
28. R. Aravind, C. V. Shah, and M. Dolu, "AI-Enabled Unified Diagnostic Services: Ensuring Secure and Efficient OTA Updates Over Ethernet/IP," *International Advanced Research Journal in Science, Engineering and Technology*, 2023.
29. A. Mahida, "Predictive Incident Management Using Machine Learning," 2023.
30. P. Chintale, "Scalable and Cost-Effective Self-Onboarding Solutions for Home Internet Users Utilizing Google Cloud's SaaS Framework," *IJAR*, vol. 6, no. 5, pp. 482-487, 2020.
31. A. Bansal, "Optimizing Withdrawal Risk Assessment for Guaranteed Minimum Withdrawal Benefits in Insurance Using Artificial Intelligence Techniques," *International Journal of Information Technology and Management Information Systems (IJITMIS)*, vol. 12, no. 1, pp. 97-107, 2022.
32. L. Korada and S. Somepalli, "Security is the Best Enabler and Blocker of AI Adoption," *International Journal of Science and Research (IJSR)*, vol. 12, no. 2, pp. 1759–1765, 2023. [Online]. Available: <https://doi.org/10.21275/sr24919131620>
33. C. Shah, V. R. R. Sabbella, and H. V. Buvvaji, "From Deterministic to Data-Driven: AI and Machine Learning for Next-Generation Production Line Optimization," *Journal of Artificial Intelligence and Big Data*, pp. 21-31, 2022.