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A Review on Inventory Management of Warehouse using ERP Software

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Abstract*: *This paper provides a thorough review of existing inventory management systems (IMS), tracing their evolution and examining the diverse methodologies and technologies that have been integrated over time. The study underscores the critical role of inventory management in ensuring that organizations maintain the right balance of stock, thus minimizing the risks of both excess inventory and stock outs. Starting from traditional manual methods, the review explores significant advancements such as the Just-in-Time (JIT) methodology, the introduction of barcode scanning, and the implementation of Radio Frequency Identification (RFID) technology. The analysis also considers the impact of modern technologies like the Internet of Things (IoT) on enhancing inventory tracking accuracy and efficiency. Despite these technological advancements, the paper highlights ongoing challenges in the effective integration of IMS with other business processes, particularly in complex, multi-location environments. The review further differentiates the needs of various industries and business sizes, emphasizing that the choice of an IMS should align with the specific operational requirements of the organization. Moreover, the paper discusses the importance of understanding the strengths and weaknesses of current systems to guide future research and development in the field. As businesses continue to adapt to rapidly changing market conditions and customer demands, the need for innovative and adaptable IMS solutions becomes increasingly important. This review not only provides insights into the current state of inventory management but also identifies areas for improvement and future research, aiming to contribute to the development of more efficient and effective IMS tools that meet the evolving needs of businesses.

Keywords: Inventory management, ERP software, warehouse operations, real-time data tracking, demand forecasting, automated inventory controls

I. INTRODUCTION

Inventory management plays a crucial role in the smooth operation of warehouse systems, directly affecting operational efficiency, cost control, and customer satisfaction. With the rise of globalization and increasing competition, businesses are constantly seeking ways to streamline their operations and optimize their inventory management processes [1]. One of the most effective solutions that have emerged is the integration of Enterprise Resource Planning (ERP) software into warehouse inventory management systems. ERP systems are designed to consolidate and automate business processes, including inventory control, procurement, and sales, thereby improving efficiency and decision-making capabilities. The integration of ERP software in warehouse [2] management allows businesses to gain real-time visibility into their inventory, making it easier to track stock levels, monitor product movement, and prevent stockouts or overstocking. This level [3] of transparency ensures better control over the inventory, reducing human error and improving order accuracy. Additionally, ERP systems often provide advanced forecasting tools, [4] which help predict future demand trends and optimize stock levels accordingly. This leads to more efficient resource allocation and reduced carrying costs.

Fig 1: ERP System in Inventory Management in Warehouse

By consolidating data and automating routine tasks, ERP systems reduce human errors, enhance inventory accuracy, and improve decision-making capabilities.

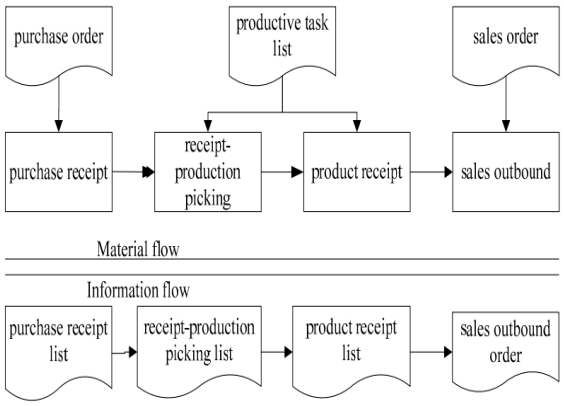

Figure 2: Material flow and information flow in the inventory management

The implementation of ERP software in warehouse management offers significant advantages over traditional methods. Unlike manual systems, ERP software allows for seamless integration across departments, providing a centralized view of inventory data. This leads to reduced stockouts, better [5] demand forecasting, and optimized stock levels. Furthermore, ERP systems improve operational efficiency by automating tasks like order fulfillment and inventory audits, saving both time and labor costs. While initial setup may require some investment and training, the long-term benefits [6] of increased accuracy, cost reduction, and streamlined processes make ERP systems an invaluable tool for modernizing warehouse management. Moreover, the automation of routine tasks such as order processing, [7] inventory tracking, and reporting frees up valuable time for employees, allowing them to focus on more strategic activities. This increases overall productivity and reduces operational costs. In conclusion, the use of ERP software in warehouse inventory management is an [8] essential tool for modern businesses, offering numerous benefits, including improved efficiency, reduced costs, better decision-making, and enhanced customer satisfaction. As technology continues to evolve, ERP systems will play an even more pivotal role in shaping the future of warehouse management.

A. ERP Inventory Management Benefits Your Business

ERP systems draw on a variety of data sources to help companies better understand the performance history of various SKUs, among many other insights. Organisations use this data to make more informed ordering decisions and create more accurate forecasts to meet future demand, without ending up with excess stock.

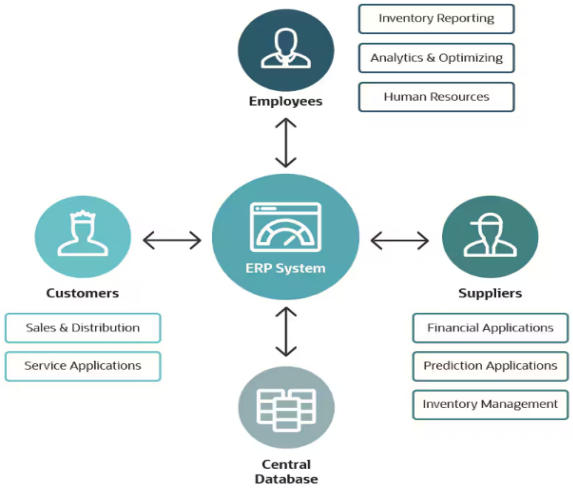

Figure 3: ERP Inventory Diagram

Other benefits of incorporating ERP into inventory management include:

1) Supply chain transparency: When a business can effectively integrate back-end systems and communicate directly with its partners, that minimises disruptive surprises, like a critical component not being delivered when expected or being priced [9] higher than makes sense for the product. Integrated ERP systems also allow for syncing order and shipping information.
2) Improved reporting: Accurate inventory data enables decision-makers to take full advantage of data-driven insights, such as understanding top performing SKUs, landed cost of goods sold (COGS) and sales by location and channel. ERPs enable [10] custom reports and, therefore, accurate and usable data, without being time consuming.
3) More accurate counts: ERP systems track and report excess inventory, shortages, planned replenishment, obsolete inventory and metrics, such as average turnover rate and COGS. In the warehouse, the system tracks and reports on product transfers through shipping and receiving.
4) End-to-end inventory analysis: ERPs provide analytics for each stage of inventory flow, such as cost of goods sold, turnover rates and shrinkage. By analysing key inventory metrics, companies can improve inventory efficiency.
5) Quality checks: Most ERP systems have logic that you can use to specify inventory quality checks. For example, if products must comply with environmental or safety standards, you can specify those [11] and the system will check for the safety information on the products. If the system detects the item may be out of compliance, it will notify staff to update it.
6) Inventory planning: Each product has an inventory status listed in the ERP, enabling staff, partners and customers to check availability and numbers on hand, as well as on order. Having your inventory history [12] and metrics easily available eases planning and increases customer satisfaction.
7) Cycle counting: An ERP system helps guide staff through a thoughtful and well-planned cycle count process. Integrating regular cycle counting into your warehouse operations serves as an important means of checks and balances and improves inventory records.

II. RELATED WORK

Yi and Tu (2015) conducted a study on "Method Research to Improve Inventory Management based on Enterprise Resource Planning (ERP) Environment", addressing challenges [13] in material management within manufacturing enterprises. The study explores how ERP systems can optimize processes, improve resource allocation, and streamline information flow within supply chains, leading to better cost control and productivity. Similarly, Anas M. (2015) in "Performance Improvement of Inventory Management System Processes by an Automated Warehouse Management System" focused on [14] implementing a Warehouse Management System (WMS) in a telecommunications company, highlighting the transition from manual processes to an automated ERP system. This shift improved warehouse space utilization, reduced human errors, and enhanced decision-making, despite challenges like high costs and the need for skilled IT personnel. F. D. Utami (2020) in "Design of Planning Model for ERP System in Warehouse Management" developed a model to address inefficiencies in inventory management at a hospital in Indonesia [15], using the OpenERP platform to improve data accuracy and overall efficiency. In "Research and Development of Inventory Management and Human Resource Management in ERP," Bo Zhao (2021) examined the integration of inventory and HR management within ERP systems to improve operational efficiency and competitiveness, proposing improvements for better alignment [16] with modern business needs. Saeeda Alansari (2020), in "Inventory System Transition Towards ERP," explored the transition to ERP systems, emphasizing its role in improving internal processes and organizational competitiveness while highlighting [17] challenges in resource allocation .

A. *Inventory Management Systems*

Proposed an implementation of Inventory Management System. The research addresses the challenges and solutions related to inventory management in the context of e-commerce and other industries [18]. The objective of the work is to develop an inventory management system that can efficiently store, update, and manage data related to dealers, suppliers, manufactured goods, and raw materials aiming to provide a [19] user-friendlyinterface that can be accessed by individuals without technical backgrounds. The research proposes a system that uses MongoDB for backend data storage and Java on NetBeans for the frontend development. MongoDB was chosen for its ability to handle unstructured data, which is common in inventory management scenarios. Thesystem is designed to track various modules, including departments, warehouses, raw materials, suppliers, andemployees. The work describes the use of NetBeans to create a graphical user interface (GUI) that simplifies interaction [20] with the system.

The GUI is designed to be intuitive, allowing users to perform tasks like adding,updating, and deleting records without needing extensive technical knowledge. The system successfully addresses the issues of data fluctuation and improper inventory control. They highlight the system's ability to provide highlevels of customer service by ensuring accurate and timely data management.The work suggest future directionsfor research, such as integrating the system with other enterprise resource planning (ERP) systems and exploringthe use of artificial intelligence (AI) for predictive analytics

Automated Inventory control system for a university cafeteria management, the research addresses the challenges associated with manual inventory control systems in university cafeterias. Manual systems are often labor-intensive, costly, and prone to errors, which can lead to inventorydiscrepancies and inefficiencies. In order to improve operational efficiency, minimize human error, and streamline inventory management procedures, the authors suggest an automated inventory control system. The study's main goal is to create and put into place an automated inventory control system for a Nigerian university cafeteria. Thesystem aims to efficiently handle the movement and tracking of goods without human involvement, ensuring real-time updates and accurate inventory status. The work employed a comprehensive analysis and design methodology to develop the proposed system. Key aspects of their approach include:

1) System Design: Python was used as the main programming language during the system's construction, and an object-oriented database was used to manage data.

2) Implementation: The implementation phase involved coding the system to automate inventory tracking and updates. The system was tested through observation and interviews with users to validate its effectiveness.

3) Comparison with Existing Systems: The study demonstrated the benefits of automation in terms of accuracy, efficiency, and cost-effectiveness by contrasting the automated system with the already in use manual systems.

4) The results of the study indicate that the automated inventory control system successfully handles the movement and tracking of goods without human involvement. Based on their findings, the authors recommend the adoption of automated inventory control systems in university cafeterias and other similar settings. Theysuggest that further research could explore the scalability of such systems and their application in differentcontexts.

Developed a Livestock Inventory Management System (LIMS). The system was designed to streamline the management of livestock inventories, enhancing efficiency and accuracy in tracking and managing livestock data. The research is motivated by the challenges faced by livestock farmers in managing their inventories. Conventional techniques are frequently labor-intensive, error-prone, and manual. The study highlights the requirement for a more efficient system that leverages modern technology to address these issues [22]. The objectives of the research were to design a user-friendly LIMS that can be easily adopted by farmers and help enhance the efficiency and precision of managing livestock inventories. The research employed a systematic approach to develop the LIMS. The system was designed using Android Studio, XML, Java, and MySQLite. The choice of these technologies was driven by their robustness and [23] compatibility with mobile devices, enabling a broad spectrum of users to access the system. The system was tested in a real-world environment to evaluate its performance. The authors conducted a series of tests to ensure the system's reliability, accuracy, and user- friendliness. Feedback from users was collected and used to make necessary improvements. The implementation of the LIMS showed significant improvements in the management of livestock inventories. The technology minimized errors and cut down on the time and effort needed for inventory management. Users reported high satisfaction with the system's ease of use and the accuracy of the data provided. The system developed was not an intelligent system and its built as a standalone system. The authors suggest that future research could explore the integration of additional features, such as predictive analytics and IoT devices, to further improve the system.

B. Smart Inventory Management Systems

Developed an intelligent warehouse management system using the Internet of Things. The creation of an intelligent warehouse management system (WMS) is the study's main goal that leverages IoT technologies to enhance operational efficiency, accuracy, and real-time monitoring. The work aim to address common challenges in traditional warehouse management, such as inventory inaccuracies, manual errors, and inefficiencies in tracking and monitoring inventory. The suggested system aims to offer real-time data, automate inventory tracking, and enhance decision-making processes through the integration of IoT devices. The study suggests a framework for [24] automating inventory tracking and management by integrating IoT devices like RFID tags and sensors. The components of the system architecture for data processing, analysis, and gathering are made to give real-time insights into warehouse operations and inventory levels. The suggested IoT-based WMS's deployment resulted in notable gains in operational effectiveness, a decrease in manual error, and inventory accuracy.

The ability of the system to monitor in real time facilitated improved resource allocation and decision-making. The report admits its limitations, including the requirement for a strong network infrastructure and the initial expense of integrating IoT technologies. Additionally, the work suggest that further research is needed to explore the scalability of the system in larger warehouse environments. The effectiveness of the IoT-based [25] WMS depends on the availability of a robust network infrastructure. In order to track items at a steel company more quickly, created an Android-based inventory management system with NFC enabled. In this study, a steel company's use of Near Field Communication (NFC) technology to deploy an Android-based inventory management system is investigated. The primary objective isto enhance the efficiency of inventory tracking and reduce the time required for stocktaking processes. The study employs a case study approach, focusing on a steel company where inventory management is crucial for operational efficiency. The methodology includes:

1) Development of the Application: The Android application was designed to read NFC tags attached to inventory items. This allows for quick and accurate data capture
2) Participants: Eleven employees from the steel company participated in the study. They were tasked with performing stocktaking using both the new NFC-based system and the conventional method.
3) Data Collection: A total of 54 samples were collected for time evaluation. The time taken for stocktaking using both methods was recorded.
4) Data Analysis: A t-test was used to analyze the data and compare the time efficiency between the twomethods.
5) The results of the study indicate a significant improvement in time efficiency with the new NFC-based system. Key findings include:
6) The average time required for stocktaking using the NFC-based system was significantly shorter than the conventional method.
7) The t-test results showed a statistically significant difference in time efficiency ($df = 26$, $t = -7.075$, $p < .001$),indicating that the new system is much faster[1].
8) The new system also reduced the likelihood of human error, as the NFC tags provided accurate and instantdata capture.

The study illustrates how adding NFC technology to inventory management systems may have advantages. The results imply that the Android-based NFC system can greatly increase the accuracy and time-efficiency of stocktaking procedures. Although the study offers insightful information, more research with bigger sample sizes and a range of industry scenarios is advised to confirm the conclusions. developed an Artificially Intelligent Warehouse Management System. The research explores the development and implementation of an Artificially Intelligent Warehouse Management System (AI-WMS) designed to increase the effectiveness as well as the precision of warehousing operations. The frameworkleverages artificial intelligence (AI) to automate various warehouse processes, thereby reducing humanintervention and improving overall operational efficiency. The principal aim of the research is to develop an AI- WMS that can manage warehouse operations more effectively by utilizing AI technologies. The system's aim is to increase inventory record accuracy, minimize operating expenses, and optimize inventory management. To create the AI-WMS, the research used a thorough methodology that included:

- System Design: The system architecture was designed to integrate various AI technologies, includingmachine learning algorithms and computer vision, to automate warehouse operations
- Data Collection and Processing: The system tracks warehouse activities in real time by collecting data from several sources, including cameras and sensors. Subsequently, the data is processed using machine learning algorithms to enable informed inventory management decisions.
- Implementation: The AI-WMS was implemented using a combination of hardware and software components. The hardware includes sensors and cameras, while the software comprises machine learningalgorithms and a user interface for managing warehouse operations
- Testing and Evaluation: The system was tested in a real-world warehouse environment to evaluate its performance. The testing focused on assessing the system’s accuracy, efficiency, and reliability.

The implementation of the AI-WMS resulted in several significant outcomes:

- Improved Efficiency: The system automated various warehouse processes, reducing the need for manualintervention and improving overall efficiency
- Enhanced Accuracy: The use of AI technologies improved the accuracy of inventory records, reducingerrors and discrepancies
- Cost Reduction: The automation of warehouse operations led to a reduction in operational costs, as fewerhuman resources were required to manage the warehouse

- Real-Time Monitoring: The system provided real-time monitoring of warehouse activities, enabling betterdecision-making and resource allocation.

The paper presents a robust solution for improving warehouse management through the use of AI technologies. The AI-WMS offers significant improvements in efficiency, accuracy, and cost reduction.

Developed a new intelligent warehouse management system that is created and put into use with MySQL database technology. In response to company demands for improved material management, the study creates an intelligent warehouse management system (WMS) built on MySQL database technology. The system uses real-time data management and automated procedures to improve the accuracy and efficiency of warehouse operations. The main goal is to create a warehouse management system (WMS) that incorporates MySQL database technology to offer thorough and instantaneous administration of warehouse operations. Inventory management, warehousing management, procurement management, and system management are all covered by the system's design. The WMS was designed and implemented using an organized methodology in the study.

System Design: A variety of functional modules, including basic information management, system management, inventory management, warehousing management, and procurement management, were incorporated by design into the system architecture.

- Database Construction: A MySQL database was built to store and manage all relevant data. The database design focused on ensuring data integrity, security, and efficient retrieval.
- System Implementation: The system was implemented using MySQL database technology, with a focus on achieving high performance and reliability. The implementation included developing user interfaces and integrating the system with existing enterprise resource planning (ERP) systems.
- Testing and Evaluation: The system underwent rigorous testing, including unit tests and integration tests,to ensure it met the expected requirements and performed within acceptable response times (within 3seconds).

The paper presents a robust solution for improving warehouse management through the use of MySQL database technology. The intelligent WMS offers significant improvements in efficiency, accuracy, and real-time data management. However, the complexity of integration and scalability issues are challenges that need to be addressed for broader adoption developed a Smart warehouse management system. The research addresses the challenges in warehouse automation and digitalization, particularly in the context of Industry 4.0. Despite significant advancements in technology, many warehouses still struggle with effective automation and digitalization. Thework propose an Internet-of-Things (IoT)-based architecture to enhance real-time warehouse management bydividing the warehouse into multiple domains. By segmenting the warehouse into several domains, the paper suggests an Internet-of-Things (IoT)-based architecture to improve real-time warehouse management. The research's goals were to design an Internet of Things (IoT)-based architecture for real-time warehouse management, build a working prototype system for effective data collecting and transmission, and validate the suggested system by implementing it in an actual environment—a textile factory, to be exact. The work employed a multi-faceted approach to develop the smart WMS. The methodology includes: System Architecture Design which integrates various components such as RFID tags, IoT sensors, and a central database. The architecture was designed to facilitate real-time data collection and processing. A prototype of the smart WMS was developed to demonstrate its functionality. The prototype includes hardware components like RFID readers and IoT sensors, as well as software components for data processing and user interface. The system was implemented in a controlled environment to test its real-time capabilities. The implementation phase involved setting up the hardware and software components, and conducting tests to evaluate system performance. The study presents several key finding, which include.

III. CONCLUSION

Effective inventory management plays a pivotal role in optimizing warehouse operations, minimizing costs, and improving customer satisfaction. The integration of Enterprise Resource Planning (ERP) software in inventory management has emerged as a transformative solution, addressing the complexities and inefficiencies often associated with traditional inventory practices. This review highlights how ERP systems streamline inventory processes through real-time tracking, automated stock replenishment, and precise demand forecasting. Key benefits include enhanced inventory accuracy, reduced holding costs, and improved operational efficiency. The ability of ERP software to integrate seamlessly with other business functions fosters better decision-making and supports the overall strategic goals of an organization. Moreover, the scalability and customization offered by ERP solutions make them suitable for warehouses of varying sizes and industries. However, implementing ERP software comes with challenges such as high initial investment, complex deployment, and the need for employee training. Addressing these challenges requires careful planning, adequate resource allocation, and a strong change management strategy.

In conclusion, ERP-based inventory management is an indispensable tool for modern warehouses aiming to remain competitive in a dynamic market. Future research should focus on integrating advanced technologies like AI, IoT, and blockchain with ERP systems to further enhance warehouse efficiency and resilience.

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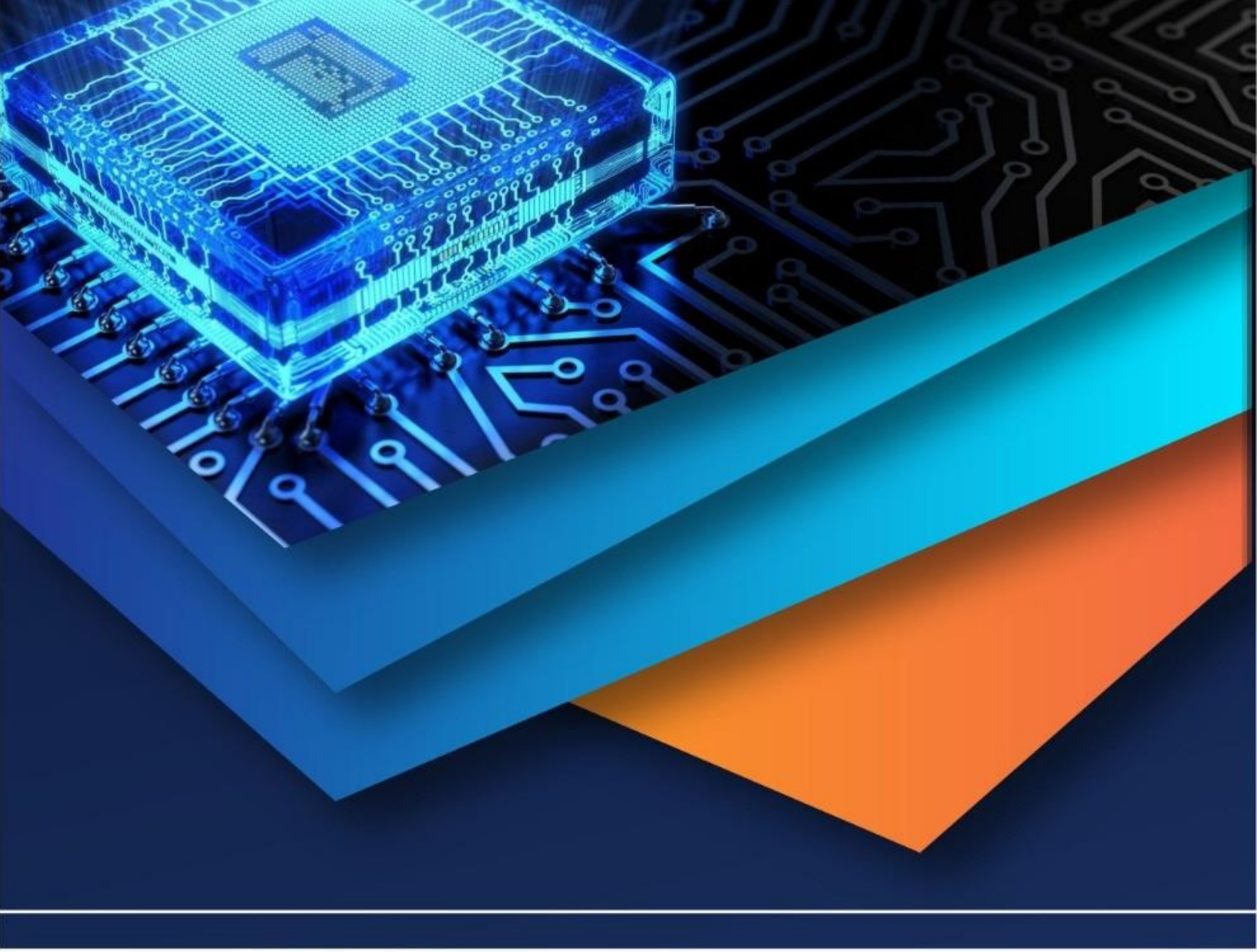

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