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REVIEW ON INVENTORY MANAGEMENT WITH RFID

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Abstract : In Managing modern warehouses has become increasingly intricate and dynamic. The integration Radio Frequency Identification and the Internet of Things is anticipated to play a pivotal role in enhancing warehouse operations. This integration, termed RFID-IoT, aims to create automated, seamless, and highly secure systems by linking IoT devices via the internet. This paper presents a systematic review and discussing the application of RFID-IoT in warehouse management. The paper's primary contribution is a comprehensive review of the current state-of-the-art literature and potential trends in RFID-IoT's application in warehouse management. There is a clear need for a thorough analysis of the latest literature to enhance warehouse efficiency, increase productivity, and reduce costs. The review also identifies the current challenges faced in implementing RFID-IoT in warehouses. A conceptual framework is presented, considering four critical perspectives: receiving and storage, order picking and packing, inventory management, and shipping operations. The insights and recommendations provided in this review aim to stimulate further development of RFID-IoT technologies in warehouse management.

IndexTerms **- Component,aurdino,tags,insert.**

I. INTRODUCTION

Inventory Management Utilizing RFID Technology aims to revolutionize traditional inventory practices by leveraging RFID technology to enhance inventory management processes. The project's primary objective is to develop an RFID reader system that interacts with RFID tags on inventory items, automating inventory management tasks and improving precision by reducing human error. By providing real-time visibility into inventory levels and locations, the system aims to streamline processes, reduce manual tracking costs, and optimize inventory control operations. Automating inventory management through RFID technology is crucial for achieving operational efficiency and cost savings. By enabling the RFID reader to communicate with RFID tags on inventory items, the system can seamlessly gather essential data, reducing the reliance on manual intervention and enhancing accuracy. The hardware setup, including components such as an RFID reader, Arduino Uno, LCD display, breadboard, LEDs, and connecting wires, plays a crucial role in facilitating communication between the RFID reader and RFID tags. Overall, the project offers a comprehensive solution for effective inventory management by integrating RFID technology to automate processes, improve precision, and provide real-time insights into inventory status.

II. LITERATURE SURVEY

Yacine Rekiko's study [1] delves into the realm of retail inventory management, specifically targeting theft-related errors. The research conducts a comparative analysis of three distinct inventory approaches, with a particular emphasis on the cost-effectiveness and operational efficiency of Radio Frequency technology, which operates at short range. The study evaluates RFID's efficacy in mitigating errors associated with theft and enhancing overall inventory accuracy within the retail sector. The document delves into the prevalent issue of inventory inaccuracies within retail environments, pinpointing theft and other discrepancies as the primary culprits. It meticulously outlines two distinct strategies aimed at mitigating these inaccuracies. The first strategy is predicated on the assumption that theft is the predominant factor contributing to inventory discrepancies. In contrast, the second strategy concentrates on refining the holding costs while adhering to a specified service level constraint. Furthermore, the document highlights the innovative application of RFID technology as a pivotal tool for optimizing inventory management. By leveraging RFID, retail stores can significantly enhance the accuracy of their inventory records, thereby reducing the associated costs and minimizing losses. The term “shrinkage” is employed within the document to describe the phenomenon of inventory loss, which is commonly attributed to theft or clerical errors as shown in the **Figure 1.** This shrinkage poses a substantial challenge to retailers, as it directly impacts profitability and operational efficiency.

Bayu Setyawan's work [2] addresses the critical issue of delays in inventory control, focusing on the detrimental impact of manual processes on warehouse operations, particularly in relation to material shortages. The study also proposes the implementation of an RFID-based inventory system to revolutionize real-time monitoring in warehouses as shown in the **Figure 2.** This proposed system aims to revolutionize inventory control practices by reducing reliance on error-prone manual processes,

improving data accuracy, and facilitating more efficient decision-making processes. Despite recognizing challenges such as implementation costs and dependence on RFID technology, the study underscores the transformative potential of RFID in modernizing warehouse operations and overcoming the prevalent issues in inventory management.

Weng Chun Tan's research [3] fills a significant gap in the literature by exploring the application of RFID-Internet of Things (IoT) integration in supply chain management (SCM). The study introduces a comprehensive conceptual framework that categorizes existing literature into four key SCM perspectives. It provides a detailed overview of the trends in RFID-IoT application, emphasizing its role in enhancing efficiency, productivity, visibility, traceability, and security across the supply chain as shown in the **Figure 3.** Moreover, the study sheds light on the numerous challenges associated with RFID-IoT implementation, including high costs, complexity, interoperability issues, standardization concerns, as well as privacy, security, and ethical considerations.

Manufacturers recognize that a shift of procedure and organization mindset is essential to succeed in the current market, especially in monitoring and managing raw material workflow. The development of this sustainable agile manufacturing supply chain can be assisted with the help of technology. With the sensory wireless network from RFID and ubiquitous data accessibility from IoT, materials or objects can be identified and streamed to the servers through the internet to provide real-time information. In other words, it also eases the complex process of assembly tasks by delivering the suitable material and accurate location (i.e., row and column of the shelves). Furthermore, the intervening RFID-IoT technology impacts high-efficiency labor work and cost-efficiency in manufacturing with less human error. Indirectly, this also solves high turnover rates in manufacturing companies by intervening with fewer workers in the overall process. At each stage of the supply chain, the authors assessed the advantage of the RFID-IoT application in terms of effectiveness, interoperability, scalability, and compatibility. The advantages of RFID-IoT are divided into three main categories: product and resource management, operational management and information management. At each stage, the advantages of using RFID-IoT are different. For example, in product and resource management, RFID-IoT plays a role in tracing the origin of the resource and tracking the product, machine and workforce to maximize the operation process.

Bhuvan Unhelkar's study [4] addresses the existing gap in literature by conducting a thorough review of RFID technology's application alongside decision support systems in SCM. Through a meticulous thematic analysis, the study identifies common themes, challenges, and opportunities. It underscores the significant benefits of RFID-IoT integration in improving efficiency, productivity, visibility, traceability, security, and sustainability throughout the supply chain. Despite providing valuable insights and recommendations, the study acknowledges certain limitations such as potential subjectivity and a lack of empirical evidence. Nonetheless, the research contributes significantly to advancing understanding at the intersection of RFID technology and decision support systems in SCM.

Effective supply chains form the heart of the modern-day economy. This is evident in the popularity and success of Amazon and XPO Logistics. These companies have each developed a competitive advantage by using modern technologies within their supply chains to support strategic and operational decisions. Supply chains are continuously challenged by varying demands from customers, rapid and unpredictable changes to supply routes, major uncontrollable disruptions (e.g. the COVID-19 pandemic and ensuing lockdowns) and legal and compliance issues associated with cross-border goods movements. Enterprises systems associated with data science and Industry 4.0 enabled technologies that has the potential to augment sustainable performance. Efficiency in the supply chain process is achieved by embedding RFID as a service, in the networks, or as an IT infrastructure. RFID with remote data transmission helps decision-makers in supply chains. **Figure 4** depicts the operations process of the supply chain firm when RFID technology is implemented. With the emergence of advanced technologies, including cloud computing and robotics.

Harry Groenevelt's investigation [5] evaluates the feasibility of RFID technology compared to traditional barcodes for pharmaceutical inventory management within radiology practices. The study focuses on implementing process improvements, system redesign, and assessing cost-effectiveness. It analyzes three specific strategies aimed at addressing inventory inaccuracies caused by theft, alongside evaluating the overall cost-effectiveness of RFID implementation. By examining practical challenges and costs associated with RFID adoption, the study provides valuable insights into the benefits, challenges, and cost considerations of implementing RFID technology in pharmaceutical inventory management within radiology practices.

Monitoring involves being aware of specific information, often to track progress towards or away from a goal over time. It can encompass direct methods, such as physically checking goods, as well as indirect methods, like reviewing written or oral reports. An effective monitoring system, especially in inventory management, provides timely information on inventory availability and facilitates quick decision-making. Technology plays a crucial role in enhancing monitoring systems, enabling real-time information presentation and efficient data processing. Logistics service providers can enhance their performance by embracing innovative technologies, knowledge enhancement, and building robust relationship networks. Radio Frequency Identification (RFID) is a technology widely used in logistics and supply chain management, offering significant benefits in inventory operations. **Figure 5** By transitioning from manual to computerized systems, inventory monitoring information systems can streamline data processing, enhance control, and deliver more accurate information. and can be controlled directly, and the information obtained is better and more accurate.

Ali Alwadi [6] explores innovative solutions for RFID-based inventory management systems in his comprehensive survey article. The research aims to provide a reliable and up-to-date reference for developers and operators seeking to enhance efficiency, productivity, and reduce material loss in inventory management. The article discusses the latest technologies, algorithms, and state-

of-the-art localization techniques that can be employed to automate RFID systems, serving as an Internet of Things (IoT) communication protocol.

The use of low-cost IoT devices, including RFID systems, has become widespread across various applications such as education, transportation, animal tracking, and inventory management. Alwadi's survey delves into the design challenges faced by RFID-based inventory management systems, followed by an extensive examination of RFID technologies, types, and architectures. **Figure 6** The study also evaluates recent advancements in RFID infrastructure and middleware, encompassing passive RFID tags, antennas, middleware, and readers.

Moreover, the article scrutinizes the performance and advantages of different passive RFID techniques, including collision and anti-collision algorithms, for various applications. The rapid urbanization and societal growth witnessed globally have driven the need for increased mobility and automation in manual processes, leading to the development of smart technologies that enhance quality of life. However, deploying technology in complex infrastructures can present challenges related to geographical limitations and infrastructure mobilization. To address these challenges, Alwadi emphasizes the importance of IoT, defining it as a network that connects real-life objects to exchange specific information using intelligent network devices. This facilitates the creation of an integrated informational network based on standard communication protocols like RFID. The IoT plays a crucial role in exchanging mobility data between services, facilitating public transport use, traffic control, connecting emergency services, managing library processes, and more, ultimately contributing to the overall advancement of smart cities and societies.

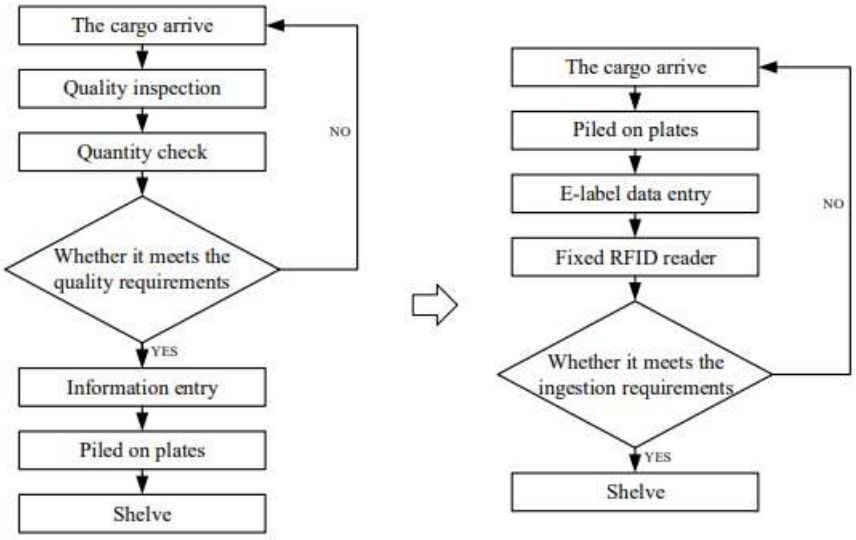

Figure 1: Optimization diagram of the inbound process.

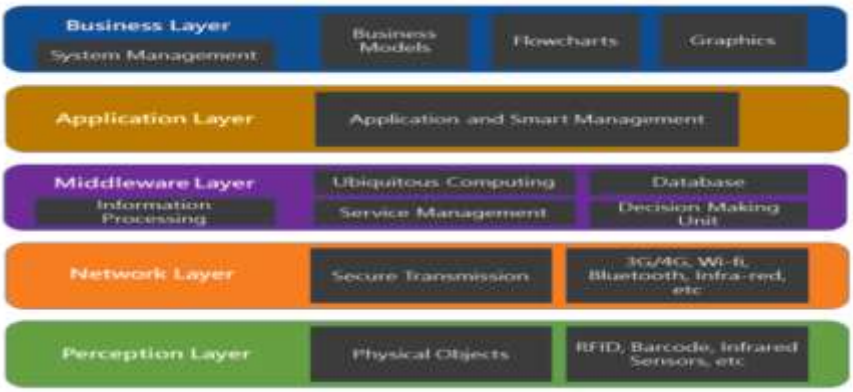

Figure 2: Tells about the different applications of RFID technology.

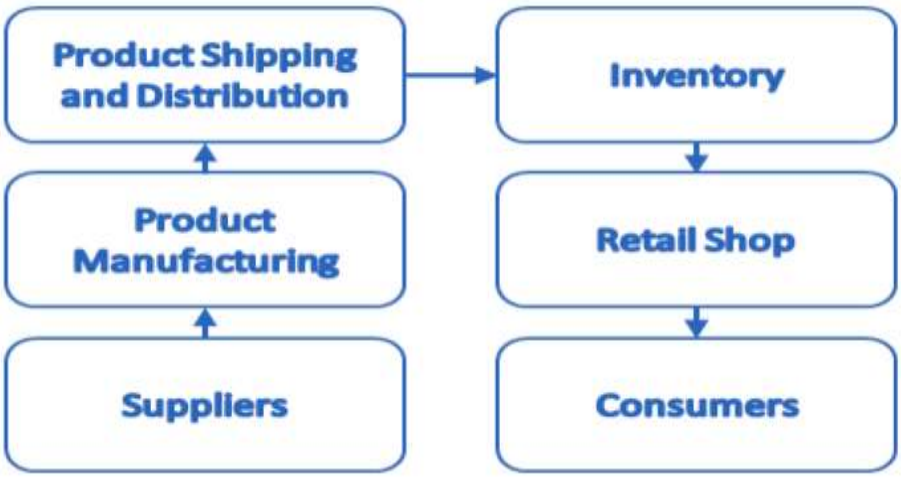

Figure 3. stages of RFID implementations in SCM.

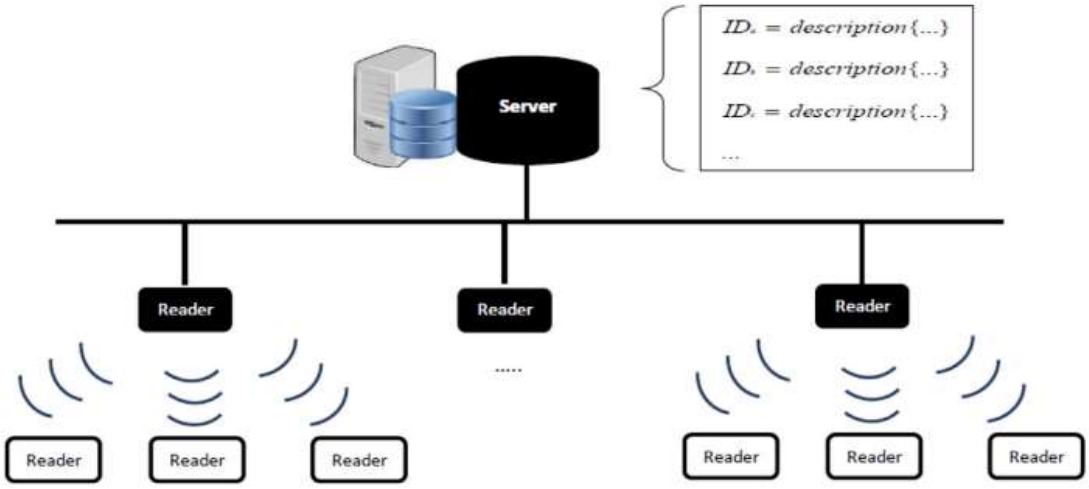

Figure 4. Generalized RFID layout.

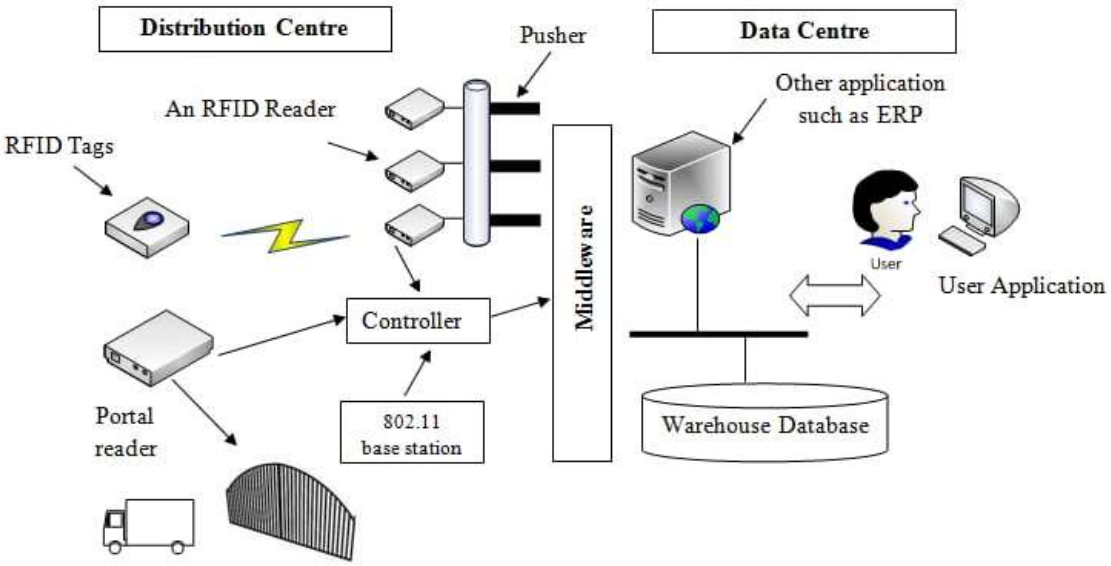

Figure 5. RFID implementation in distribution and data center.

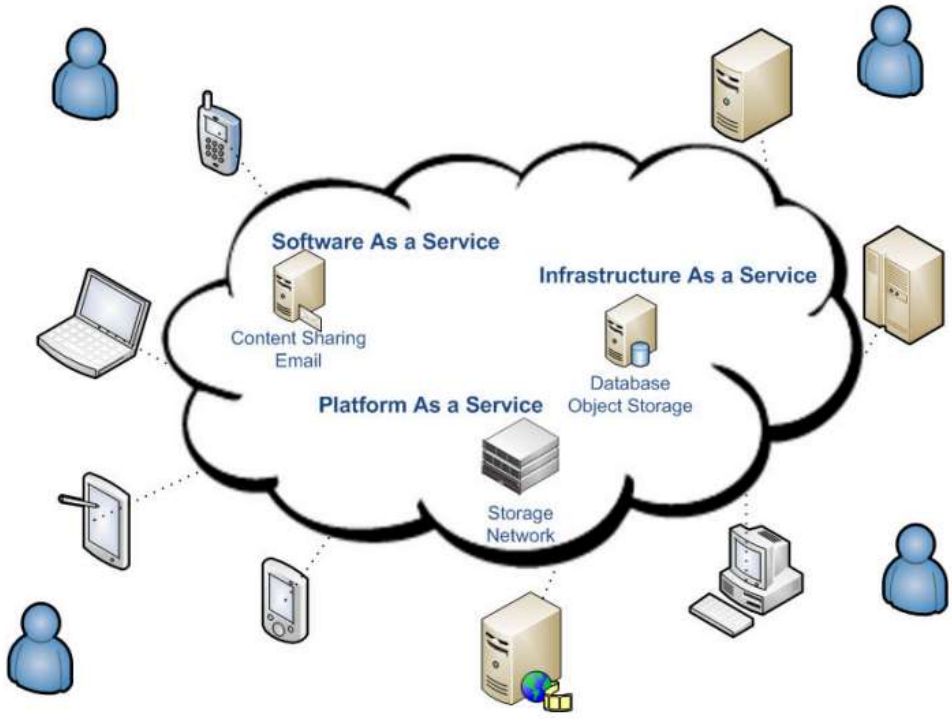

Figure 6. The Inventory system architecture.

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