

CONCEPTUAL MODEL FOR INTELLIGENT MANAGEMENT OF STOCK THROUGH BLOCKCHAIN AND ARTIFICIAL INTELLIGENT ALGORITHMS

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Abstract

The use of modern technologies is revolutionizing all spheres of life, including industry, on which the economic development and stability of the country and the population in general depend. The various modern intelligent systems used in warehouses, depots, and large factories assist the production process, management, and optimization of the purchase and sale of stock. Various artificial intelligence and blockchain techniques have transformed traditional systems into digital, intelligent, decentralized and secure platforms, but have also facilitated physical processes through the use of unmanned aerial vehicles (UAVs) and other intelligent agents, which directly impact productivity and cost-efficiency in the supply chain. The use of hybrid architectures, which will combine the advantages of contemporary technologies, with the aim of creating a secure, transparent ecosystem, where privacy, traceability, and above all a longer-term strategy for efficient stock management will be created, is of particular importance in the supply chain. Furthermore, the use of smart contracts, which in addition to automating processes on the blockchain network, also reduces human intervention and possible delays, and at the same time protects the supply chain from possible manipulations that could be threatened by malicious persons. Despite the fact that the integration of contemporary technologies leads to the improvement and facilitation of stock management processes, many challenges of practical implementation, scalability, and system interoperability such as the lack of standardization, privacy and ethical issues remain among the many challenges facing modern intelligent systems. Through this paper, we will first explain the importance of integrating contemporary technologies, in particular blockchain technology and artificial intelligence, into the inventory management process, and then propose a conceptual model for integrating these technologies into existing intelligent systems, with the aim of creating a more secure, transparent and reliable supply chain. We will also present an intelligent stock management system, which we have tested and is functional, with the aim of integrating functionalities from contemporary technologies into it in the future, to offer the highest quality and safest services.

Keywords: industry, blockchain, stock management, artificial intelligence, conceptual model, intelligent system.

1.Introduction

The development of digital technologies has significantly transformed the industry and has encouraged organizations to adopt various modern intelligent systems in order to improve efficiency, decision-making and, above all, the creation of long-term strategies regarding unforeseen situations that may arise in the future (Teixeira et. al, 2025). The implementation of contemporary technologies represents the fourth industrial revolution known as Industry 4.0, which mainly aims at automating processes and digitizing factories through various intelligent systems. While Industry 4.0 aims at full automation of processes and minimal human intervention through the use of technologies such as Artificial Intelligence (AI), Cloud and edge computing, Machine learning (ML) and blockchain, Industry 5.0 is a further evolution that aims to place humans at the center of every industrial process, deepening the collaboration between people and

technology. Industry 5.0, in addition to the use of contemporary technologies, focuses on stability, sustainability, ethical issues and the use of hybrid architectures of contemporary technologies, the use of renewable resources, explainable AI (XAI) and others (Tallat et al, 2023). When we talk about intelligent stock management, AI and ML play key components in process optimization, detailed data analysis, demand and market forecasting, and above all, automation of many decisions related to the management process (Samuel; 2025).

Advanced ML algorithms contribute significantly to the creation of long-term strategies, but also to reducing costs and increasing productivity and sales to consumers. In addition to features such as data immutability, traceability, decentralization, BT also offers automation of various exchanges between different actors involved in the supply chain and sales through smart contracts. Smart contracts offer the execution of processes based on conditions previously defined by the actors, without the need for third-party intervention, which makes the execution of various management and purchase processes reliable and secure (Li; 2023). IoT also plays an important role in collecting data through physical devices and various sensors, while analysis and control of logistics processes are carried out through Data Analytics. It is very important for creating long-term strategies to collect as much data as possible, because predictions and data analytics are more accurate the more data we have available (Zrelli & Rejeb; 2024). The use of hybrid systems, based on hybrid architectures that combine contemporary technologies across different data processing layers, is also very important for increasing sustainability and optimizing inventory in the supply chain, with the aim of creating stable, reliable, and above all scalable platforms (Mishra et al, 2024). Despite the numerous advantages resulting from the integration of contemporary technologies, there are still challenging issues related to data privacy, the lack of unified standards to be used internationally, and the easier integration of heterogeneous features in these intelligent systems. Therefore, recent research focuses on the development of multi-agent systems, the integration of Large Language Models (LLMs) and explainable AI (XAI) in order to facilitate and implement intelligent mechanisms for more efficient stock management in general. The integration of LLMs in these systems would enable, among other things, faster processing of large amounts of data, easier detection of errors and various misuses, and even data processing using Natural Language Processing (NLP) for the purpose of real-time communication between intelligent agents and the actors involved in the supply chain themselves (Jannelli et al, 2026).

The integration of contemporary technologies is an important step in the development of intelligent systems in all spheres, and especially for efficient inventory management. Through the paper, we first analyze these technologies and some real practical implementations of these technologies in the implementation of intelligent systems for inventory management. Then we will continue with a conceptual model of blockchain integration towards the creation of a secure supply chain, and the presentation of a practical intelligent system that serves for inventory management.

2. Related work

The integration of IoT and blockchain for intelligent inventory management, which among other things offers real-time monitoring and optimization of costs and time using physical sensors, Radio Frequency Identification (RFID) and blockchain is proposed among others by (Jin & Karki; 2025). RFID identifies tags attached to objects through electromagnetic waves, thus providing automatic identification. Among other things, the system demonstrates that the integration of contemporary technology with physical devices and sensors for identification and information collection significantly improves the process of efficient and intelligent management of inventory systems.

The use of blockchain in stock management has also been addressed by (Kaushik; 2025), where, among other things, the importance the system gives to products that become obsolete over time and measures must be taken for their emergency sale. The proposed model uses end-to-end mechanisms for data protection and integrity maintenance for all actors involved in the supply chain, respectively in the blockchain network. Undoubtedly, blockchain through a distributed ledger reduces the possibility of denial of responsibility, but at the same time traceability is offered for every action by each actor present. At the same time, none of the actors that are part of the supply chain can change anything without confirming all the other actors.

Through Figure 1, we have presented some key differences between traditional inventory management systems, which are widely used today, and intelligent systems based on AI, Blockchain and IoT, which are in the process of practical implementation and are showing good results. We have made the classifications into three most important categories, also describing the main characteristics, workflow and the challenges and advantages that intelligent systems offer.

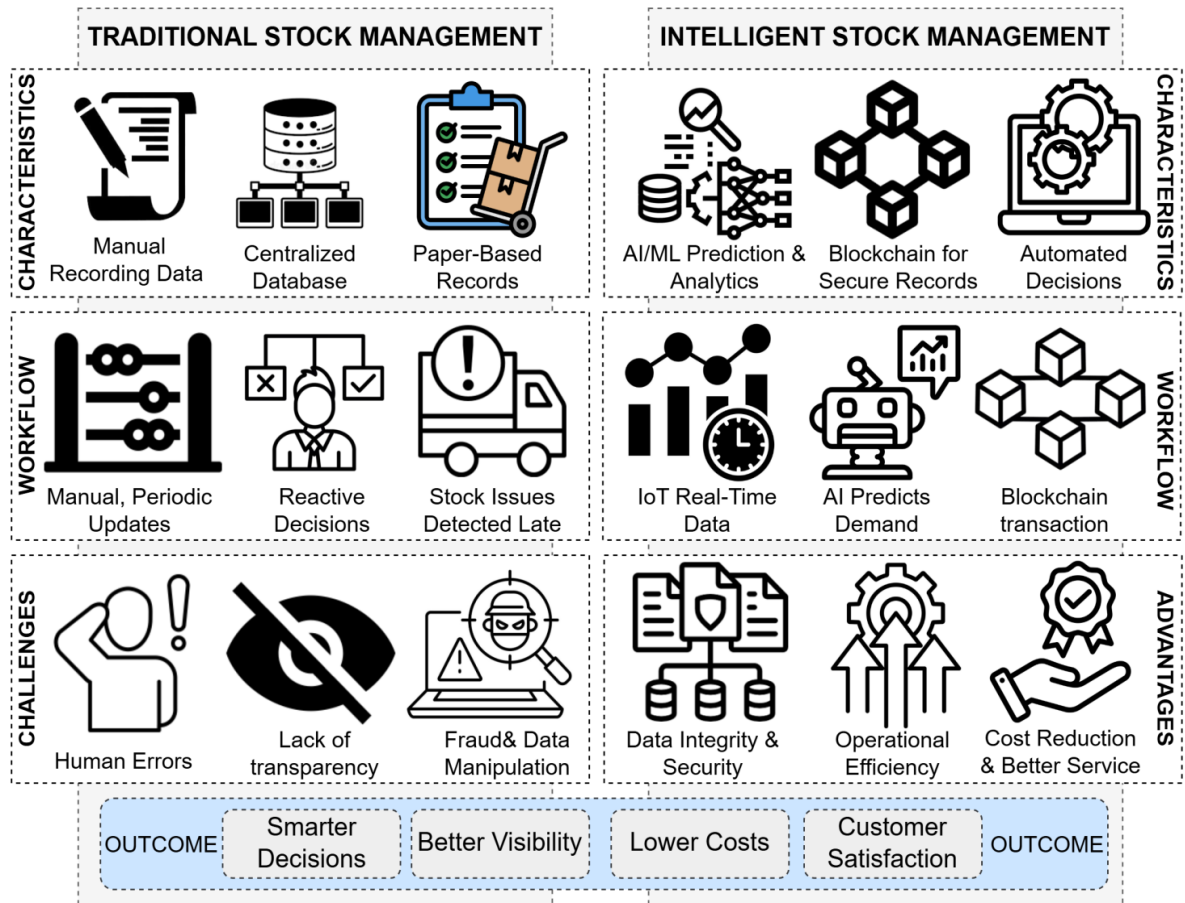


Figure 1. Comparison and key points of traditional management vs. intelligent inventory management

Similarly (Khajana; 2023), focuses on the combination of BT and AI and gives importance to smart contracts for creating secure autonomous supply chains. Among other things, it is proposed that AI can be used for forecasting and optimization of inventory, while BT offers automation through smart contracts and point-to-point data encryption mechanisms. Such a combination significantly improves efficiency and reduces costs. (Dong et al, 2022) emphasizes the importance of integrating ML and Data analytics into intelligent inventory management systems, where, among other things,

importance is given to demand and production forecasting, with the aim of making the most accurate and dynamic decision-making possible. (Anas Baig et al, 2022) gives importance to the adoption of IoT in the supply chain, and emphasizes that centralized systems are moving towards autonomous and decentralized systems, where various intelligent devices based on analytics and processing of collected data autonomously make intelligent decisions for further stock management in various industries. (Takawira & Duri; 2026) in their systematic analysis of the synergy of IoT and BT place emphasis on traceability, transparency and real-time monitoring in the supply chain. According to them, current research is oriented towards hybrid systems with the aim of higher performance and flexibility. These systems, among other things, in addition to improving operational efficiency, also address the issue of transparency, fragmentation and complexity of supplies. The use of advanced ML algorithms is of great importance for optimizing stock and the accuracy of requests for various products, and at the same time, compared to traditional methods, they significantly contribute to reducing costs and improving customer service.

(Jarašūnienė et al, 2023) has presented a study where IoT sensors enable real-time stock monitoring in a warehouse management, and at the same time the optimization of many processes in intelligent methods. The system presented by the authors, among other things, affects both the speed of operations, as well as the management of large data capacities, related to sales and purchases of stock in real time. Another practical implementation involving synergy between IoT and RFID in warehouses, for intelligent management and automation of processes through robots and at the same time real-time analysis is presented by (Whig; 2024). RFID provides automatic product identification, real-time tracking of products across warehouses or logistics centers, and is also a key source for data processing through ML and AI algorithms. So, without abundant and accurate real-time data, intelligent systems do not operate with the necessary accuracy. Unmanned Aerial Vehicles (UAVs) also play an important role in facilitating and automating physical processes of stock management, especially in large warehouses. They mainly offer heavy lifting, access to difficult areas, data collection from data transport, which in other words also offer a reduction in operating costs. While the combination of these two technologies offers opportunities for autonomous stock processing, and at the same time integration with other contemporary technologies, these two technologies serve, among other things, for data collection and facilitating physical processes in large warehouses (Fernández-Caramés et al, 2019).

3. Intelligent stock management system - case study

Before we begin with the presentation of a conceptual model where we will integrate contemporary technologies into intelligent stock management systems, we will initially present an intelligent stock management system, developed in the C# programming language, ASP.NET and a centralized SQLServer database. However, the main goal is to modify and integrate the same with contemporary technologies in the future. Through Figure 2 we have presented the dashboard of the inventory management system. The dashboard presents an overview of the system where the admin can see key statistics in real time such as daily sales, total products, stock value and critical products. There is a simple navigation on the left side for quick access to modules such as product, stock, suppliers and reports. It also provides a clear visual presentation of the state of the business.

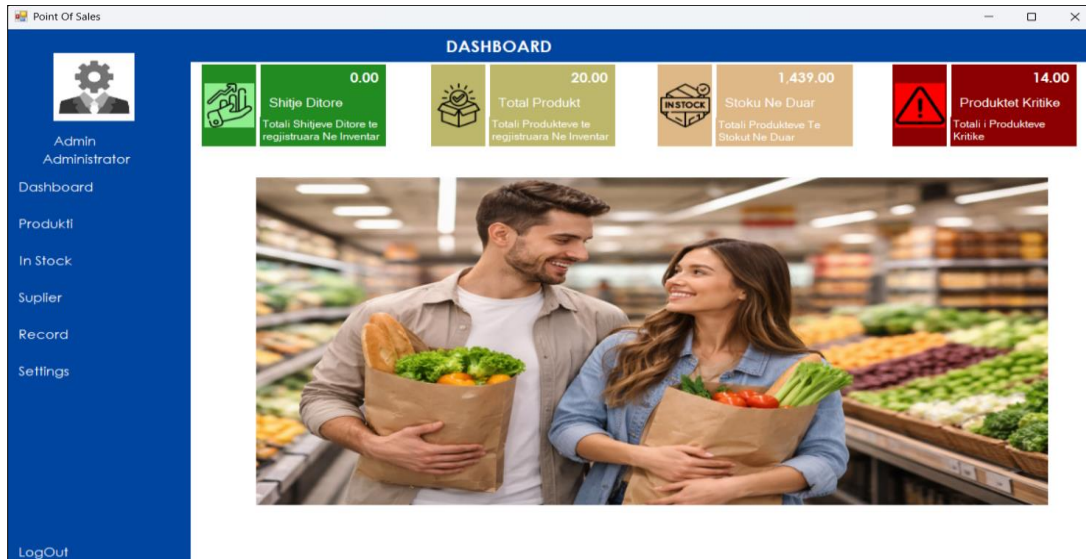


Figure 2. Dashboard of the centralized stock management system

What we plan to integrate into the intelligent system is monthly and annual analysis in automatic form through ML algorithms, and another automatic alert for the quantity of products and sales most in demand. One based on real-time measurements to provide notifications for sales or specific problems encountered in certain warehouses or factories. We also intend to add the personalized admin section, where the admin is given suggestions and assistance for certain problems that have been practically encountered during stock management, and how to manage them more efficiently, always based on predictive analysis and the use of LLM. Figure 3 shows the sales module. The sales module enables the registration of products in the cart by searching for them or by barcode. It automatically calculates the total price, discounts and taxes. It has the possibility of payments where the change is calculated and includes a numeric keypad for quick input. It generates the transaction number and records the date. It is optimized for quick use by the operator.

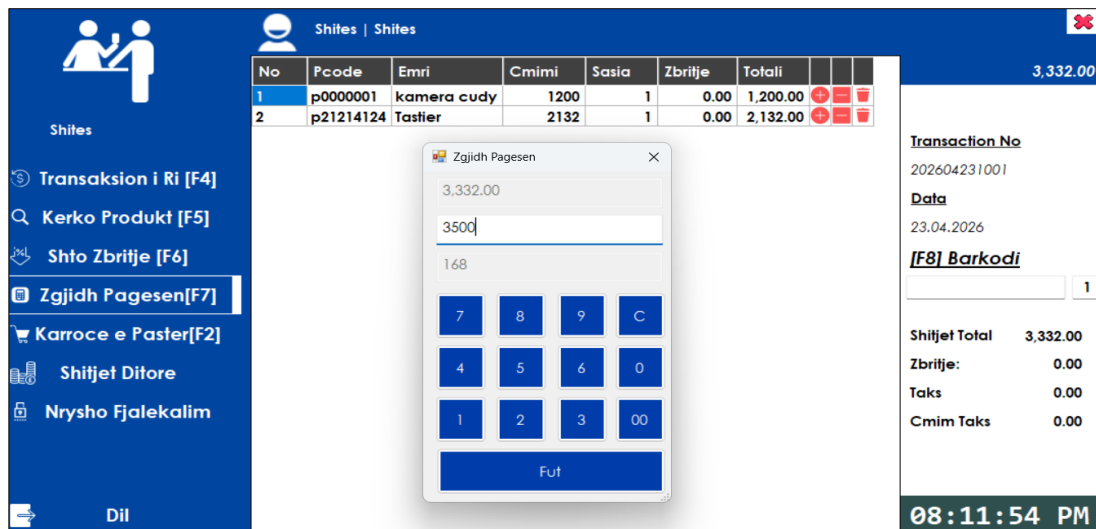
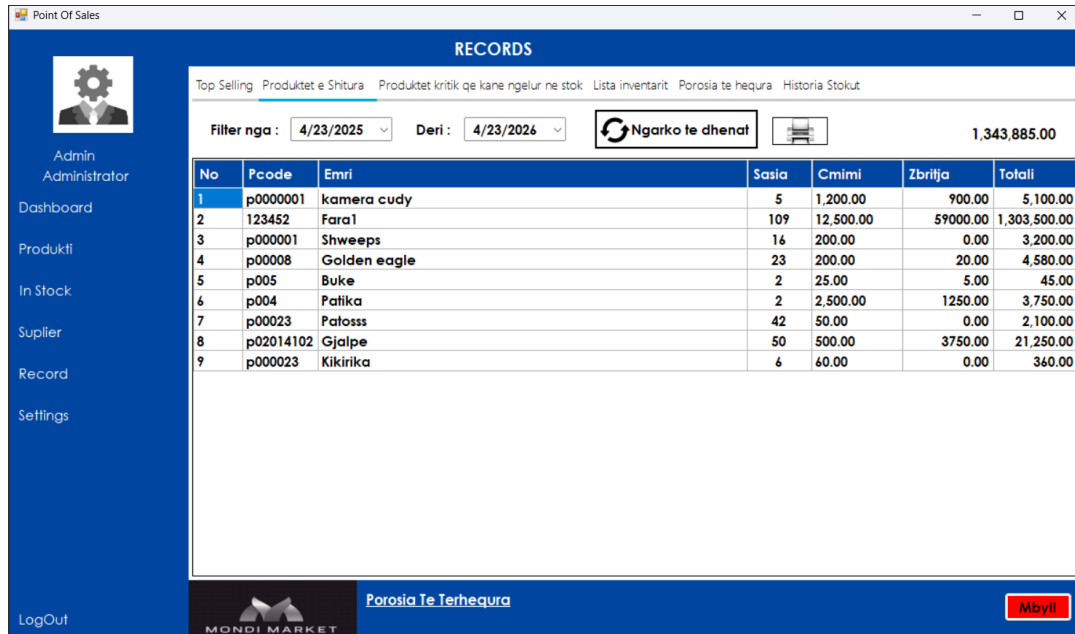


Figure 3. Sales module of the stock management system

What we can add to this system regarding the sales module is integration with a fiscal printer for automatic coupon printing. Also, several payment methods should be offered, even creating a

cryptocurrency for large companies in order to make even greater profits during money exchange. Using blockchain for data security and transaction transparency. We are also thinking of integrating a real-time scanner that, just by detecting products, automatically records sales and calculates the invoice. And finally, through the use of ML algorithms, an option for automatic promotions and discounts according to conditions should be created. Figure 4 shows the module for storing records and sales history by applying different filters. The user is given a detailed list of products sold with price, quantity, discount and total. There are categories such as top selling, sold products, critical products and stock history. It allows for analysis of sales performance and export or printing of data.



No	Pcode	Emri	Sasia	Cmimi	Zbritja	Totali
1	p0000001	kamera cudy	5	1,200.00	900.00	5,100.00
2	123452	Fara1	109	12,500.00	59000.00	1,303,500.00
3	p000001	Shweeps	16	200.00	0.00	3,200.00
4	p00008	Golden eagle	23	200.00	20.00	4,580.00
5	p005	Buke	2	25.00	5.00	45.00
6	p004	Patika	2	2,500.00	1250.00	3,750.00
7	p00023	Patosss	42	50.00	0.00	2,100.00
8	p02014102	Gjalpe	50	500.00	3750.00	21,250.00
9	p000023	Kikirika	6	60.00	0.00	360.00

Figure 4. Storing records and sales history of stock management system

Functions that can be integrated are real-time sales analysis, as well as analysis of the balance of sales and purchases. At the same time, automatic report generation, integration with cloud and blockchain storage, and finally AI analysis of sales trends and suggestions for optimizing stock management processes. The system that we present as a use case is a real system practically implemented, used in several warehouses and wholesale stores, however, the main goal is the integration of contemporary technologies with the aim of increasing security, reliability, and above all transparency and to automate many processes with the aim of optimizing and facilitating many physical tasks.

4. Conceptual model for integrating contemporary technologies into stock management

The digitalization of services is a process that is being integrated into every sphere of life, including industry itself, with the aim of facilitating processes, higher security, transparency, lower costs and optimizing processes, among others. Even in the field of industry, and especially in stock management across various industries, there is an attempt to integrate modules or intelligent systems to facilitate processes, although in practice they often face problems of different natures, which are directly related to the dynamic changes in the spaces where the same systems are

implemented. Therefore, we will present a conceptual model, where we think that the already created centralized system, which functions perfectly, and has shown good results, will be upgraded in the near future with functionalities of contemporary technologies, where IoT, AI and BT will be integrated, among others.

The first layer is data collection through IoT sensors, as well as assistance in various physical processes through RFID and UAV, which both assist in human management processes and enable data collection, which serves as input for processing in various ML and AI algorithms. Although there are many technical and operational challenges, the integration of IoT in inventory management has moved from the phase of conceptual models to the phase of practical implementations, which has significantly increased the efficiency in the management process (Takawira & Dura, 2026). Communication between different layers plays a very important role in the conceptual model that we have presented. Since we have a C# based system, different protocols such as API, MQTT or WebSocket are used to enable data transmission. However, the integration of decentralized systems undoubtedly requires hybrid architectures that are easily integrated and support continuous data flows and real-time interaction between different actors (Siddiqi et al, 2026). Data management is currently done through SQL Server in a centralized form. However, through hybrid architecture, or the integration of a special blockchain module or even microservices, data management in a decentralized form is enabled, where whether back-up, on-chain or off-chain storage will be enabled through consensus mechanisms in the blockchain network (Kaushik; 2025). While centralized databases have advantages in terms of data processing speed, blockchain offers a mechanism for data immutability, increasing trust between actors for secure supply chain management (Rustemi et al, 2023).

The intelligent processing layer through AI and ML algorithms enables data analysis, demand forecasting, detection of potential anomalies and even automatic decision-making based on real data obtained through physical devices. The combination of AI and blockchain technology significantly reduces errors and deficiencies in stock management (Putra et al, 2025). The system, which was created in C#, will once again function as the main control and management center for daily activities in stock management. The integration of contemporary technologies will be done by adding functionalities through intelligent modules, or as independent systems that will be interconnected through API (Rustemi et al, 2025). The blockchain layer, where we have given primary importance to smart contracts, will serve to automate decisions that are mainly generated by AI, offering opportunities for supplier management, or even automatic ordering of missing stock. Smart contracts, in addition to offering automation of processes in the supply chain, also reduce time and operational costs (Li; 2023). Figure 5 presents the main elements of this framework, where we have also presented the main parts of each layer that will be integrated into the inventory management system.

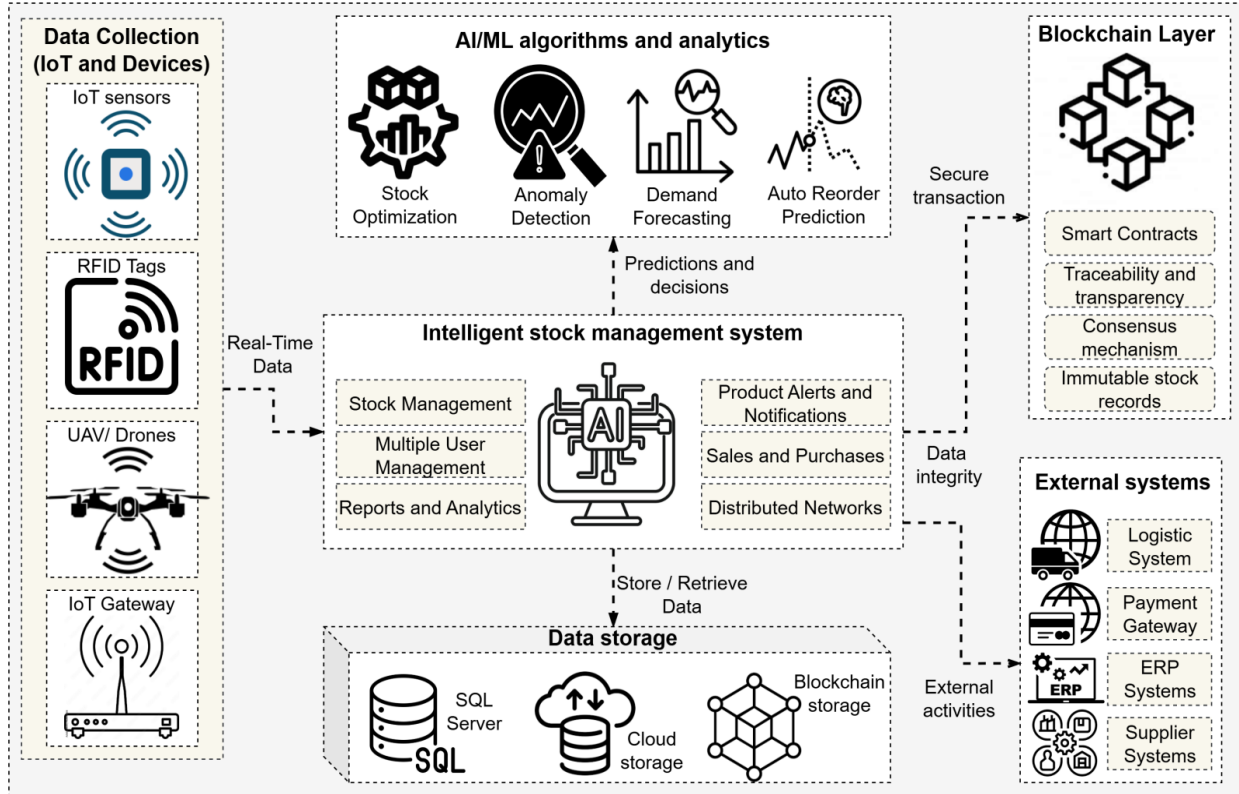


Figure 5. Conceptual model for integration contemporary technologies for intelligent stock management

Through the conceptual model, we aim to integrate AI, blockchain and IoT without hindering the functionality of the already created system. However, their combination will improve performance, as well as orient the system towards a more automated, transparent and intelligently assisted ecosystem. Such a phenomenon is key to sustainable, scalable and adaptable systems to the dynamic changes that occur in real environments (Priyan; 2024).

5. Conclusion and future work

Through the paper, we have focused on the synergy of contemporary technologies such as AI, BT and IoT with the aim of transforming centralized stock management systems, where we also presented a system that we have created and has shown good results in practice, and is showing great usability in warehouses and wholesale stores. In addition to a detailed analysis of the possibilities of integrating contemporary technologies, we also present a conceptual model with the sole purpose of showing that there are possibilities for introducing intelligent features, derived from modern contemporary technologies, into these centralized systems.

The model we presented offers an architecture that captures real-world practical phenomena, where through IoT sensors and other physical devices, real-time data collection will be provided, of processes related to stock management, while AI and ML algorithms will provide intelligent processing of this data, with the aim of creating longer-term strategies for selling and purchasing products, and one for stock optimization. And above all, BT will contribute to the creation of a secure ecosystem for stock management, guaranteeing above all transparency, immutability, privacy and integrity, up to the backup and execution of transactions on the blockchain network.

The integration of these contemporary technologies, both in every sphere, including the field of inventory management, and in the industry in general, is encountering real difficulties and challenges during practical implementations, related to privacy issues, ethical and legal issues of the use of AI and ML algorithms, the complexity of various heterogeneous characteristics, and the lack of standardization of various intelligent models.

As a future work, it is undoubtedly the practical implementation of these characteristics that we described through the conceptual model, and at the same time empirical validation in real industrial environments. In the future, the possibilities of integrating Large Language Models, Explainable AI, multi-agent systems can also be explored, which undoubtedly contribute, among other things, to increasing the efficiency, adaptability and autonomy of intelligent systems for stock management.

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