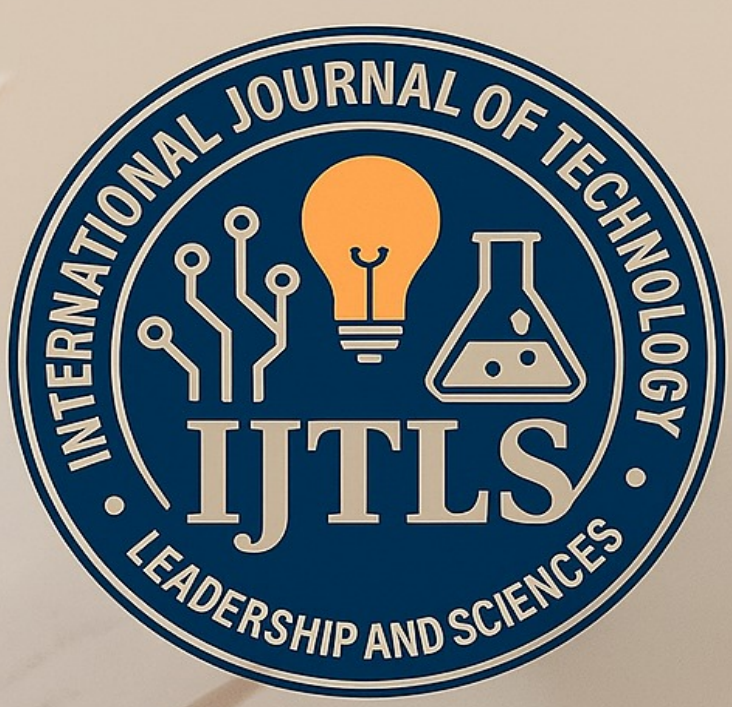

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DRUG INVENTORY AND SUPPLY CHAIN TRACKING SYSTEM

Professor P. RAMESH ***Associate Professor &HOD*****,**
Department of CSE,
KKR AND KSR INSTITUTE OF TECHNOLOGY AND SCIENCES(AUTONOMUS), AP.

ABSTRACT: The Drug Inventory and Supply Chain Tracking System (DISCT) is a cutting-edge system that was developed to enhance the efficiency and tracking of pharmaceutical goods throughout their production and distribution processes. At each point in the supply chain, DISCT ensures precise documentation by integrating state-of-the-art technology such as barcode scanning, real-time data collection, and monitoring. This ensures that everything is clearly visible from start to finish. While maintaining accountability and addressing critical issues like preventing stockouts and decreasing the dangers of counterfeit pharmaceuticals, it retains detailed records of pharmaceutical amounts, expiration dates, and transit information. The system's automated notifications help stakeholders stay informed about potential issues, such as low stock or unusual shipments, which promotes a dependable and timely procedure. It is an essential tool in modern healthcare logistics due to its intuitive design that allows healthcare providers, hospitals, and distributors to simplify inventory management, meet regulatory standards, and ensure patient safety.

Keywords: Drug Inventory Management, Real-time Tracking Stock Monitoring

1. INTRODUCTION

Pharmaceutical firms play a crucial role in improving global health, but there are challenges in preserving medicine inventories and ensuring effective distribution [1], [2]. These challenges stem from factors such as legal constraints, the complexity of supply chains [3], and the threat of counterfeit drugs [1], [2]. Ineffective inventory management systems can cause medicine shortages, stockouts, or expired supplies, all of which can have a direct impact on patient care[4], [5]. A one-of-a-kind solution to these issues, the Drug Inventory and Supply Chain Tracking System (DISCT) uses state-of-the-art technology like barcode scanning, real-time tracking, and data analytics to ensure the precise tracking of pharmaceutical products from their point of origin all the way to their final destination, be it a hospital or a pharmacy [4], [5], [7]. To optimize operations and ensure the availability of safe and effective pharmaceuticals,

DISCT automates inventory management and provides real-time insights into stock levels, batch information, and supply chain activity [4], [5], [7], [9]. This system ensures regulatory compliance and reduces the danger of counterfeit drugs by the installation of extensive record-keeping and transaction transparency [2], [4], [6], [12]. Improved healthcare outcomes for everyone are guaranteed by DISCT's reduced costs and increased productivity, which greatly enhance the security and dependability of pharmaceutical supply chains [3], [7], [11].

A. PROBLEM STATEMENT

Stockouts, overstocking, outdated pharmaceuticals, and the prospect of counterfeit items are just a few of the issues that plague the pharmaceutical industry as a result of ineffective inventory management and an absence of real-time monitoring [2], [4], [5]. The majority of healthcare facilities rely on antiquated or manual systems, which hinder their capacity to track the whereabouts, quantity, and expiration date of medications [4], [5]. By enabling counterfeit medications to infiltrate the supply chain, this inefficiency not only raises operational expenses but also endangers patient safety[1], [2], [4]. Safe, transparent, and accurate monitoring of pharmaceutical supply deliveries can only be achieved with the help of a dependable automated system [5], [7], [11].

B. RESEARCH GAPS

One area where research is lacking in medicine inventory and supply chain tracking systems is the use of blockchain, AI/ML, and IoT to improve traceability, forecasting, and real-time monitoring. For real-time tracking to be accurate, data synchronization and quality control need to be improved [4], [7]. Improving user interfaces and error avoidance systems is crucial for reducing errors and increasing system adoption [5], [11]. The effectiveness of these systems will be enhanced once these gaps are filled [7], [10], [13].

2. LITERATURE REVIEW

Raja Jayaraman: holds a Master of Science degree. plus a bachelor's and master's degree in mathematics. both a master's degree and a doctorate in industrial engineering. An associate professor at Abu Dhabi's Khalifa University, Raja is passionate about healthcare system protocols, supply chain data standards, and blockchain technology [1], [4], [7]. Systems engineering is the tool he employs to analyze and enhance complicated systems; his work primarily concerns healthcare and supply networks [3], [6], [12].

Udit Agarwal: maintains a Master of Science degree. and a Master of Computer Applications from M.J.P. Rohilkhand University. A doctorate in computer science is his current goal at

M.J.P. Rohilkhand University. Distinguished journals have published seven of his research articles. He explores IoT, blockchain, machine learning, network security, and agri-traceability [6], [7], [8].

Farid Kochakkashani: acquired a Master of Science degree. She earned an industrial engineering degree from Sharif University of Technology in 2022 and is now pursuing a doctorate in electrical engineering at George Washington University. Some of his research interests include mathematical optimization, power system planning, reliability, healthcare systems, and energy economics [4], [12].

M.J. Marcus: He held the position of lecturer at Sharif University of Technology before becoming a Postdoctoral Research Fellow at Hamad Bin Khalifa University. Two books and twenty conference papers round out his extensive body of work, which includes over forty peer-reviewed academic works. Supply chain management, logistics, healthcare optimization, and digital supply chains with an emphasis on sustainability are some of his areas of interest[3], [5], [7]. In 2016, Marcus was awarded the A*STAR ARAP grant and was recognized by the Iran National Elite Foundation, among other notable awards [7].

Yue Zhang (Jeff): holds the position of professor of information systems at California State University, Northridge. His research interests lie in the following areas: the impact of information technology on society, e-government, electronic commerce, and IS/IT governance[6], [8]. **Communications of the ACM**, **Journal of Electronic Commerce Research**, and **Sustainability** are among the journals that have published his work [9].

Junaid Arshad: teaches computer security as an associate professor at Birmingham City University and holds a doctorate in the field from Leeds University. Cybersecurity issues with the Internet of Things, distributed ledger systems, cloud computing, and distributed computing are the main topics of his research[6], [8], [12]. Not only has he written extensively in the field, but he also serves on the editorial boards of multiple journals and conferences, and is an associate editor for **Cluster Computing** and **IEEE ACCESS**[7].

Chakchai So-In: holds computer engineering degrees from both Washington University and Kasetsart University, and is also a Senior Member of the IEEE. Among his previous internships are those at Cisco Networking Academy, WiMAX Forums, and Bell Laboratories. Eleven books and over a hundred technical articles are his works. He now teaches computer science at Khon Kaen University in Thailand [6], [7], [12].

Khaled Salah: acquired a Bachelor of Science degree. also holds the position of IEEE Senior Member. You have an M.S. needs to be present in information engineering. a master's degree

in computer science and a doctorate in computer systems engineering. At Khalifa University in the UAE, where he is a full professor, he instructs students in cloud computing, network security, and performance analysis[6], [8], [12]. He had formerly studied at the King Fahd University of Petroleum and Minerals in Saudi Arabia. His scientific interests are evident in his over 190 papers and three patents, all of which pertain to computer networks and systems[7].

3. EXISTING SYSTEM

Stockouts, expired medications, and inaccurate data are results of the inefficiency caused by the use of spreadsheets and paper records, which are the most common manual approaches in drug inventory and supply chain monitoring systems. A survey taken in 2021 found that 40% of healthcare workers increased the likelihood of error by manually keeping track of stocks. It is more difficult to track products and manage inventory using these systems since they do not integrate with supply chain partners, do not synchronize data in real-time, and do not provide end-to-end visibility. Inadequate oversight procedures contribute to the World Health Organization's estimate that 5% of medications in high-risk nations are fake.

Data breaches and assaults are also more likely to occur in the absence of automated compliance procedures and safe platforms. A research conducted by IBM in 2021 found that a majority of healthcare organizations had a data intrusion in the previous year. Predictive analytics and other state-of-the-art technologies are required to automate operations, optimize inventory, or estimate demand in existing systems. In 2020, researchers in the United States calculated that institutions spend as much as $150 billion annually due to inadequate inventory management. The current options are too costly, don't work, and don't guarantee safety or increase operational effectiveness.

S.No	Year	Author's	Article Title	Key Findings
1	2021	RAJA JAYARAMAN, et.al	A Block chain-Based Approach for Drug Traceability in Healthcare Supply Chain	Counterfeit reduction, supply chain
2	2024	UDIT AGARWAL, et.al	Exploring Block chain and Supply Chain Integration: State-of-the-Art, Security Issues, and Emerging	Automation, speed, Tranparency.

			Directions	
3	2024	FARID KOCHAKKASHANI, et.al	Innovative Applications of Unsupervised Learning in Uncertainty-Aware Pharmaceutical Supply Chain Planning	Unsupervised learning, inventory management
4	2020	M. J. Marcus.et.al	An IoT-Based Traceable Drug Anti Counterfeiting Management System	Non-reputiation, Data integrity
5	2021	YOUSOF AL-HAMMADI et.al.,	Block chain-Based Solution for the Administration of Controlled Medication	Off-chain storage, Privacy.
6	2020	YUE ZHANG (JEFF),et.al	A Blockchain Based Solution for Medication Anti-Counterfeiting and Traceability	Traceability, Counterfeiting, Medication.
7	2020	JUNAID ARSHAD, et.al	Blockchain-Based Verifiable Tracking of Resellable Returned Drugs	Point accumiliation, consensus, efficiency
8	2022	CHAKCHAI SO-IN, et.al	Blockchain-Based Traceability System for Product Recall	Transparency, security, recall
9	2021	KHALED SALAH, et.al	Blockchain-Based Decentralized Digital Manufacturing and Supply for COVID-19 Medical Devices and Supplies	Decentralized, supply, Chain, covid-19

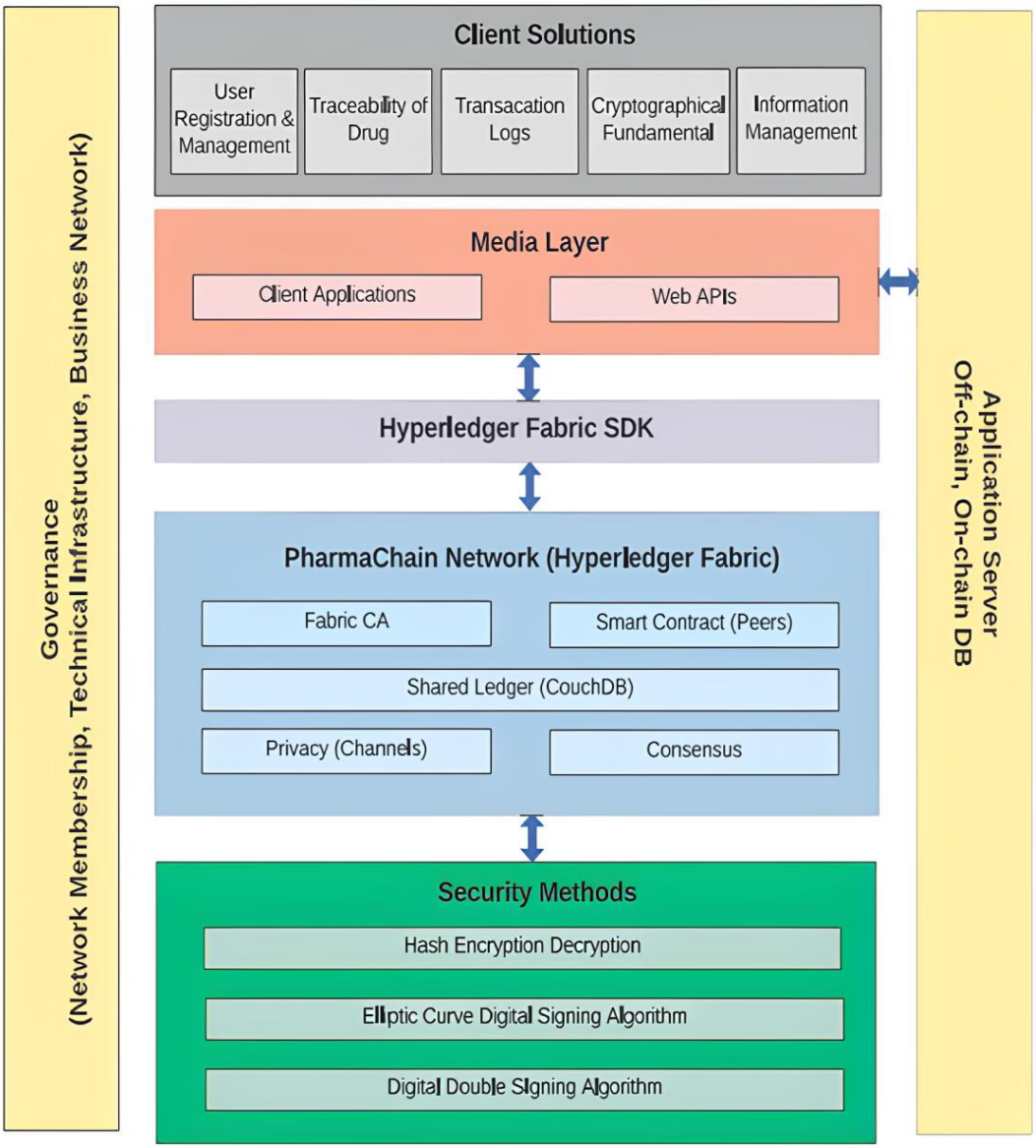
Table 1. Key Findings of Literatures

4. METHODLOGY

OBJECTIVES

- To prevent storage issues, it is critical to maintain appropriate stock levels of drugs.
- Continuous tracking: to maintain tabs on inventory levels and supply chain status in real-time
- Adapt to changes or increases in losses due to damaged or wasted items in order to reduce waste.
- Adapt to the changing or expanding demands of the supply chain for scalability.
- Regulatory compliance refers to living up to the standards set out by various national and international bodies.

ARCHITECTURE DESIGN



IMPLEMENTATION

Drug Inventory Management

Upon receipt or sale, users (such as pharmacists and warehouse administrators) have the ability to add or remove medications from the inventory. The expiration date is included in every medicine entry, and notifications will be sent out when the drug's expiration date approaches. Sold, available, and reorder points are all part of real-time inventory tracking.

Supply Chain Tracking

Even without Internet of Things (IoT) or GPS, this system can update basic location data (such warehouse and city) while a material moves between stakeholders. Keep tabs on how drugs make their way from the manufacturer to the wholesaler, the store, and eventually the doctor's office or pharmacy. Make sure to record all the important facts of the cargo, including the date, the mode of transportation, and the batch details.

Database Design

Develop a database schema using tables to keep track of customers' information, orders, shipments, stock, and medications.

Example Tables:

- **Drugs**: The medicine's name, batch number, maker, and expiration date are all recorded.
- **Inventory**: Records the whereabouts and quantity of medication prescribed.
- **Orders**: Records every aspect of each order, including the customer, the requested medications, the amount of each, the order's current state, and the information of the shipment.
- **Users**: Maintains a record of users, including those with roles such as administrator, pharmacist, and manufacturer.

Backend Implementation (Python)

Django is a great choice for developing the backend that manages APIs and database interactions, making it a more comprehensive solution.

Frontend Implementation (UI)

With either React.js or Vue.js, you can build a dynamic and responsive user interface (UI) that users may utilize to interact with the system.

Key UI Features:

- **Dashboard**: Important facts, including as supply levels, expired prescriptions, and unfilled orders, are displayed on a summary page.
- **Inventory Management Page**: A form that allows users to add or remove medications from the inventory; the form has editable fields including names, amounts, and expiration dates.
- **Order Placement and Tracking**: People can place orders and see where they stand in the process.

5. RESULTS AND DISCUSSIONS

The Drug Inventory and Supply Chain Tracking System, built with a web-based UI and a Python backend, adequately and effectively improved drug inventory management. By offering real-time monitoring, the system makes sure that everyone—from pharmacists and warehouse managers to customers—is aware of stock levels and expiration dates. This helps to minimize stockouts, blunders, and the delivery of drugs that are outdated. The system also monitors the flow of pharmaceuticals from producers to distributors, guaranteeing timely, clear, and trouble-free supply.

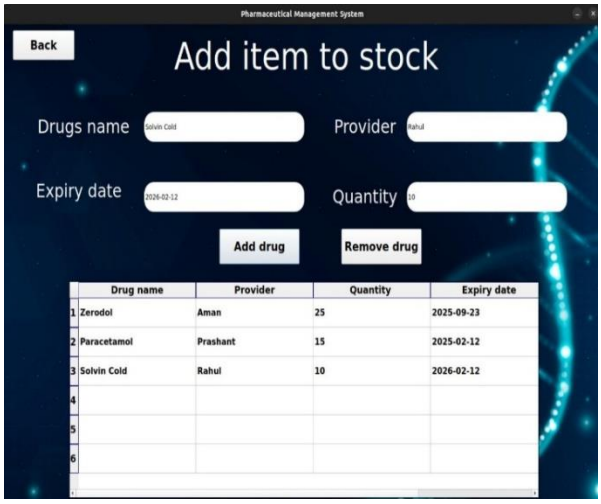


Fig . Stock page

In addition to quickly handling compliance, the system accurately records drug batches, including certifications and quality inspections. This position ensures that the medications are up to code and safe for distribution. Thanks to the intuitive design, users can easily browse and edit inventory. A secure role-based access mechanism further ensures that confidential information is shielded from eavesdropping. Collectively, these responsibilities aid healthcare facilities and pharmacies in improving operational efficiency, enhancing resource management, and reducing expenditure.

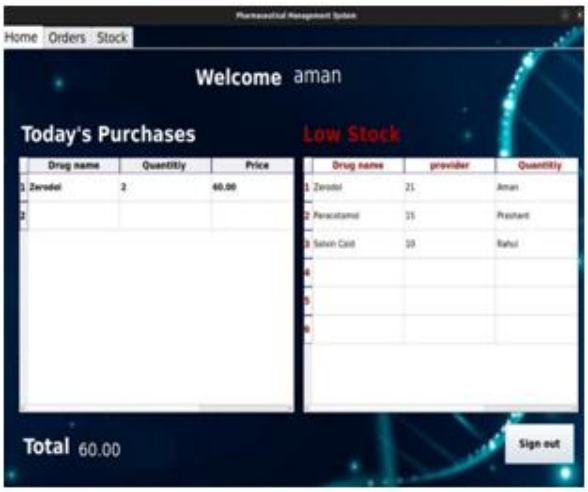


Fig 2 . Purchases page

Some downsides to the system include potential security issues with other integrations and the necessity for additional scalability testing when dealing with big data volumes. The method could be even better with the use of predictive analytics to gauge demand and the Internet of Things to monitor the state of medicines in transit. Overall, the system is a helpful tool for better pharmaceutical supply chain management, and it offers substantial savings in terms of time, money, and resources.

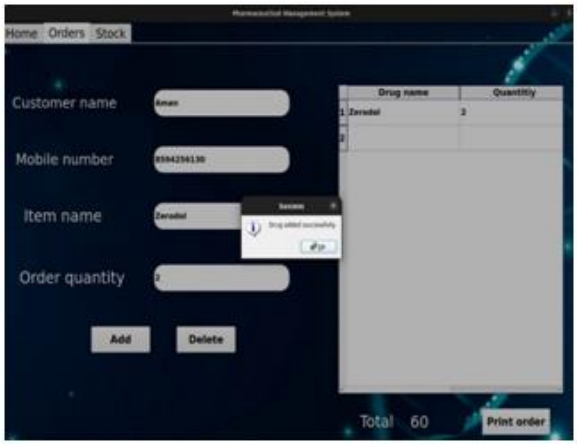


Fig 3 . Order page

6. CONCLUSION

Efficient and practical answer to issues related to pharmaceutical supply chain management and inventory is the Drug Inventory and Supply Chain Tracking System, which has a web-based user interface and is built on Python. Using transparent procedures and continuous monitoring, it significantly reduces mistakes, prevents drug shortages, and halts the shipment of expired medications. Its user-friendly layout and robust security features make it ideal for

protecting sensitive information. Through the automation of supply chain activities, the system enhances resource allocation and reduces costs for healthcare providers. The system is already a valuable tool for improving the efficiency and efficacy of medical field pharmaceutical inventory management. However, its utility could be significantly enhanced in the future with advancements like IoT connectivity and scalability.

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