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A Literature Review on Smart Ration System

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Abstract: *The Smart Ration System with Fingerprint Authentication is designed to enhance the efficiency and transparency of the Public Distribution System by integrating modern biometric technology. The traditional ration distribution process faces significant challenges such as fraud, corruption, and inefficiencies in delivering subsidized goods to eligible beneficiaries. This project introduces a system that utilizes fingerprint scanners for biometric authentication, ensuring that only legitimate users can access their ration entitlements. Each beneficiary's fingerprint is linked to their digital identity, such as an Aadhaar number, and stored in a centralized database. When a user visits the ration shop, they can authenticate themselves using a fingerprint scanner, which cross-checks their identity with the database in real time. Once authenticated, the system automatically calculates and allocates the appropriate ration based on the user's entitlement. The transaction is recorded instantly, allowing authorities to monitor the process, track inventory, and ensure the proper flow of goods. The system minimizes human intervention, reducing the chances of fraud or misallocation. By ensuring only genuine beneficiaries access the system, the Smart Ration System with Fingerprint Authentication aims to provide a transparent, secure, and efficient method for delivering essential commodities to those in need, strengthening the overall effectiveness of the PDS.*

Keywords *–Smart ration, Iot, Sensors, Inventory Tracking, Dispensor.*

1. INTRODUCTION

The Public Distribution System (PDS) is a key component of the social welfare framework in many countries, aimed at providing essential food and non-food commodities to economically vulnerable populations at subsidized rates. Its primary goal is to ensure food security for marginalized groups, reduce poverty, and improve the nutritional standards of these communities. However, despite its noble objectives, the traditional PDS has faced persistent challenges such as corruption, inefficiencies in distribution, and widespread manual errors. These issues have resulted in the diversion of resources, leading to significant losses and preventing the intended beneficiaries from receiving their rightful share of food supplies. Furthermore, many ineligible individuals exploit loopholes to benefit from the system, deepening food insecurity and eroding public trust in the effectiveness of the PDS.

Various attempts to address these issues have been made over the years, including the implementation of technology-driven solutions. Despite these efforts, the system continues to be riddled with inefficiencies that hinder its ability to deliver on its promises. Previous work has explored digitization, automation, and the introduction of monitoring tools to curb corruption and improve transparency in PDS operations. However, these solutions have often been limited in scope or have failed to address the root causes of fraud and leakage.

In response to these challenges, this paper introduces the concept of the Smart Ration System with Fingerprint Authentication, a novel approach designed to revolutionize the PDS by integrating biometric technology. The system leverages fingerprint scanners to authenticate beneficiaries, ensuring that only eligible individuals can access their designated rations. By linking biometric data to a digital identity, such as an Aadhaar number or other government-issued ID, the Smart Ration System significantly reduces the risk of fraud, misuse, and inefficiency. This paper outlines the potential of this system to modernize the ration distribution process, mitigate long-standing issues in the PDS, and contribute to achieving the overarching goal of food security for all. The contributions of this paper lie in presenting a comprehensive solution that addresses the root causes of

inefficiencies and corruption, thus enhancing the credibility and effectiveness of the PDS in delivering benefits to the intended beneficiaries.

2. LITRATURE REVIEW

[1] Arowolo, Matthew Oluwole et al., "Design, Implementation, and Evaluation of an Automated Liquid Dispensing Machine," (2024):

The paper outlines the development of an automated liquid dispensing machine designed to improve efficiency and accuracy in laboratories and manufacturing. It discusses the selection of components like pumps, sensors, and microcontrollers for precise volume measurement and user-friendly operation. The system integrates hardware and software with an intuitive interface for setting and monitoring dispensing volumes in real time. Experimental results highlight its reliability, speed, and accuracy compared to traditional methods. The study concludes that the system reduces human error, increases throughput, and offers scalability for various liquids and applications, emphasizing automation's potential to enhance operational efficiency across industries.

[2] Sharma, Ruchi, and Praveen Sharma. "The Role of Biometric in Banking: A Review," (2023):

Biometrics significantly enhances security and convenience in banking by using unique traits like fingerprints, facial recognition, and voice patterns for identity verification. This technology replaces traditional passwords and PINs, reducing risks of theft and hacking. It is widely applied in mobile banking, ATMs, and online transactions to ensure secure customer authentication. Biometrics also improves the customer experience by enabling faster and seamless transactions, enhancing security, operational efficiency, and combating fraud and identity theft.

[3] R Selvam. "Design and Implementation of Automated Food-Ration Material Distribution System," (2023):

The paper discusses the design, implementation, and evaluation of an automated liquid dispensing machine aimed at improving efficiency and accuracy in liquid handling for laboratories and manufacturing. It highlights the selection of components like pumps, sensors, and microcontrollers to ensure precise volume measurement and user-friendly operation. The implementation involves integrating hardware and software with an intuitive interface for setting and monitoring dispensing volumes in real time. Experimental results demonstrate the machine's reliability, speed, and accuracy compared to traditional methods. The study concludes that the system reduces human error, enhances throughput, and provides a scalable solution adaptable to various liquid types and dispensing needs, showcasing automation's potential to boost operational efficiency.

[4] Meennapa Rukhiran et al., "IoT-Based Biometric Recognition Systems in Education for Identity Verification Services: Quality Assessment Approach," (2023):

The paper examines the use of IoT-based biometric recognition systems in educational institutions to enhance identity verification for students and staff. It explores biometric methods like fingerprint, facial recognition, and iris scanning, focusing on their accuracy, speed, and user satisfaction. A quality assessment framework is proposed to evaluate system performance and reliability, while addressing challenges like privacy concerns and data protection. Empirical testing shows that IoT-based biometrics improve security and streamline administrative processes. The study highlights the need for comprehensive quality assessments to ensure the systems meet institutional requirements while protecting personal information.

[5] Muhammad Naufal Mansor1 et al., “Arduino IOT Based Inventory Management System Using Load Cell and NodeMCU,” (2023):

The paper presents an IoT-based inventory management system using Arduino, a load cell, and Node MCU for real-time weight measurement and inventory tracking. The Node MCU enables wireless connectivity, allowing remote monitoring and instant stock notifications via a web interface. The system's scalable and user-friendly design automates inventory processes, reducing human error and improving data accuracy. It provides a cost-effective and efficient solution for modern inventory management, particularly benefiting small to medium-sized businesses aiming to optimize operations and enhance decision-making.

[6] Mrs.Sathya S et al., "Web Based Ration Provisioning System in Public Distribution Shop," (2023):

The paper proposes a web-based ration provisioning system to modernize the public distribution system (PDS). The platform improves efficiency, transparency, and accountability by allowing users to check entitlements,

access ration information, and place orders online. For shopkeepers, it provides real-time inventory management and stock tracking, enabling effective replenishment. Additional features include transaction tracking and report generation to reduce fraud and misuse. The system enhances service delivery, reduces wait times, and optimizes resource allocation, ultimately improving beneficiary satisfaction. The study concludes that this system could significantly reform PDS operations and ensure efficient ration distribution.

[7] Mercy Eberechi Benson-Emenikeet., "Leveraging Advanced Technology in Inventory Control System for Tracking Good," (2023):

The paper explores the use of advanced technologies like IoT, AI, blockchain, and cloud computing to improve inventory management. IoT devices, such as RFID tags and sensors, enable real-time tracking and better visibility, while AI enhances demand forecasting and automates reorder processes. Blockchain ensures data integrity and transparency, and cloud computing provides scalable data management solutions. These technologies boost efficiency, reduce costs, and improve customer satisfaction. Despite challenges like high implementation costs, system integration, and data security concerns, the study concludes that adopting these technologies is essential for businesses to optimize operations and stay competitive.

[8] Syed, M. S. "A Review of Fingerprint Sensors: Mechanism, Characteristics, and Applications," (2023)

Fingerprint sensors are biometric devices that identify individuals based on unique fingerprint patterns using optical, capacitive, ultrasonic, or thermal methods. They offer high accuracy, security, and ease of use, enabling quick authentication with minimal effort. Compact and versatile, these sensors are widely used in smartphones, laptops, access control, banking, and government ID programs, enhancing security and user convenience.

[9] Swapnil Kurkute et al., "E-Rationing System," (2019):

The E-Ration Distribution System modernizes the Public Distribution System (PDS) by replacing manual processes with a digital platform to enhance efficiency, transparency, and accessibility. It uses technologies like biometric authentication, RFID-enabled ration cards, and centralized databases to ensure that only eligible beneficiaries receive their subsidized goods. Transactions are authenticated through biometrics and recorded in real-time, reducing fraud, corruption, and pilferage. The system may include web or mobile applications for beneficiaries to check entitlements, track usage, and schedule pickups. Overall, it improves accountability and creates a more citizen-friendly PDS.

[10] C P Mallikarjuna Gowda et al., "Development of IoT for Smart Ration Distribution System Using Raspberry Pi," (2020):

The development of an IoT-based Smart Ration Distribution System using Raspberry Pi (Raspbian OS) aims to modernize and automate the traditional Public Distribution System (PDS). Utilizing IoT technology, the system facilitates real-time monitoring, control, and management of ration distribution. The Raspberry Pi serves as the central controller, integrating various hardware components such as biometric sensors for user authentication, RFID readers for smart card access, and digital scales for precise commodity measurement. All transactions are recorded and updated to a centralized cloud database, ensuring transparency, minimizing manual errors, and preventing fraudulent activities. Beneficiaries authenticate themselves through biometric or RFID systems, and their entitlements are automatically dispensed. Authorities can monitor real-time data on stock levels and distribution patterns through IoT connectivity, enabling efficient supply chain management. Overall, the system provides a secure, transparent, and streamlined approach to ration distribution, enhancing user experience while improving accountability and resource management.

[11] Tarun Kumar et al., "Smart Ration Distribution System," (2017):

The Smart Ration Distribution System is a technologically advanced solution designed to modernize and streamline the traditional Public Distribution System (PDS) for distributing subsidized goods. It incorporates key technologies such as biometric authentication (fingerprints, iris scans), RFID-enabled smart cards, and real-time data management through centralized databases. This system ensures that only eligible beneficiaries can access their allotted rations, effectively reducing fraud, corruption, and inefficiencies. Transactions are automatically recorded, enabling authorities to monitor the distribution process, manage stock levels, and track consumption patterns efficiently. Beneficiaries can access their ration details, track usage, and schedule pickups via mobile or web platforms, enhancing convenience and transparency. By minimizing human intervention and ensuring

accurate, secure, and timely distribution of goods, the Smart Ration Distribution System significantly improves the efficiency and accountability of the PDS.

[12] Hemalatha S. "A Systematic Review on Fingerprint-Based Biometric Authentication System," (2020):

The paper "A Systematic Review on Fingerprint-Based Biometric Authentication System" provides a comprehensive analysis of advancements and challenges in fingerprint-based biometric authentication technologies. It examines various algorithms and techniques used in fingerprint recognition, focusing on their accuracy, speed, and reliability. The study categorizes existing systems based on operational mechanisms such as image acquisition, feature extraction, and matching processes, while also emphasizing the importance of preprocessing steps to improve fingerprint quality. It explores real-world applications of fingerprint authentication in sectors like banking, mobile devices, and secure access control systems. Additionally, the review addresses challenges such as variability in fingerprint quality, environmental conditions, and security concerns related to spoofing attacks. The paper concludes by identifying future research directions, including the integration of machine learning techniques and multimodal biometric systems to enhance security and user convenience. Overall, it highlights the significance of fingerprint-based biometric authentication as a robust solution for secure identity verification in various applications.

[13] Kashinath Wakade et al., “Smart Ration Distribution and Controlling,” (2015):

The paper "Smart Ration Distribution and Controlling" explores the implementation of a smart ration distribution system designed to enhance efficiency and transparency in the public distribution of essential goods. By leveraging advanced technologies such as IoT (Internet of Things), RFID (Radio Frequency Identification), and cloud computing, the system enables real-time tracking of ration stocks and automated inventory management. It discusses the design and development of a user-friendly interface for both beneficiaries and administrators, allowing easy access to information about available rations, entitlements, and transaction histories. The system also includes features for monitoring and controlling distribution processes, reducing the potential for fraud and ensuring beneficiaries receive their rightful allocations. Through case studies and user feedback, the paper highlights the system's positive impact on reducing wait times, improving service delivery, and increasing user satisfaction. The findings suggest that adopting smart technologies in ration distribution can transform traditional practices, resulting in a more accountable and efficient delivery of essential resources.

[14] Birgitte Ljunggren et al., "Health Professionals' Experiences with the Implementation of a Digital Medication Dispenser in Home Care Services: A Qualitative Study," (2020):

The study "Health Professionals’ Experiences with the Implementation of a Digital Medication Dispenser in Home Care Services: A Qualitative Study" explores the perspectives of health professionals on the use of digital medication dispensers in home care settings. Using in-depth interviews and focus groups, the research highlights both the benefits and challenges of implementing this technology. The study found that digital medication dispensers significantly improved medication adherence among patients by providing timely reminders and reducing the likelihood of medication errors. This was seen as a major benefit for enhancing patient safety and ensuring proper treatment. However, several challenges were identified, including the need for comprehensive training for both healthcare staff and patients, concerns about the reliability of the technology, and difficulties in integrating these devices into existing care workflows. The findings underscore the importance of addressing these challenges to fully optimize the use of digital dispensers in home care. The study emphasizes that successful implementation requires not only adequate training and technical support but also a focus on user-centered design that meets the needs of both health professionals and patients. Ultimately, the study concludes that while digital medication dispensers offer significant advantages for improving care quality and patient safety, their effective use depends on careful planning, support systems, and seamless integration into healthcare practices.

4. CONCLUSION

The Smart Ration System represents a significant advancement in the modernization of the Public Distribution System (PDS). By leveraging biometric technology, this system addresses critical issues such as fraud, inefficiencies, and delays in ration distribution. The implementation of fingerprint scanning ensures that only eligible beneficiaries can access their entitlements, promoting transparency and accountability within the system. Additionally, the real-time tracking of transactions and inventory allows authorities to monitor the supply chain effectively, minimizing losses and ensuring that resources reach those who need them most. Overall, this innovative approach not only enhances the reliability of the PDS but also fosters a more inclusive

and equitable distribution of essential commodities, ultimately contributing to improved food security and welfare for vulnerable populations.

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