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The Intelligent Grocery Distribution System in India

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Abstract- The Public Distribution System (PDS) in India is a government initiative that provides goods to those in need at set prices. On the other hand, manual material weighing results in imprecise measurements and unlawful usage of consumer goods. We currently have a system in place where the products are personally sent to the customer after their fingerprint is verified and their ration card is scanned. However, this was insufficient to halt the corruption. As a result, a two-step verification process has been suggested as part of the system. However, we deploy automation in place of manual labor when it comes time to handle the commodity. Customers are given an RFID card with a unique identifying number that serves as a ration card. An RFID reader scans the card.

Index Terms-RFID (Radio Frequency Identification), Fair Price Shop, Automation, Ration Distribution

I. INTRODUCTION

According to the suggested plan, every customer would have a distinct RFID (Radio Frequency Identification Device) card in this system. Every time a beneficiary buys products from FPS (Fair Price Shops), the server logs the transaction. This approach reduces labor expenses while increasing accuracy.

In order to manage scarcity, the Public Distribution System (PDS) was created, which provides food grains at affordable prices. Over time, PDS has developed into a key component of the government's approach to overseeing the country's food industry. But there are a lot of issues with the present ration card system. This strategy may significantly reduce unlawful activity within the FPS. The Smart Ration Distribution system replaces manual labor in ration shops.

As seen in Figure 1.1, a centralized server is used to automate the process overview, guaranteeing that the public is adequately supplied by government services. The implementation of the automatic ration distribution system represents a major advancement in the effort to optimize and modernize basic services.

This creative system transforms the conventional method of ration item dispensing by combining state-of- the-art technology such as RFID, fingerprint authentication, and precision-controlled servomotors. The system guarantees clear transaction logging, controlled dispensing, and secure user authentication through a methodical, step-by-step process.

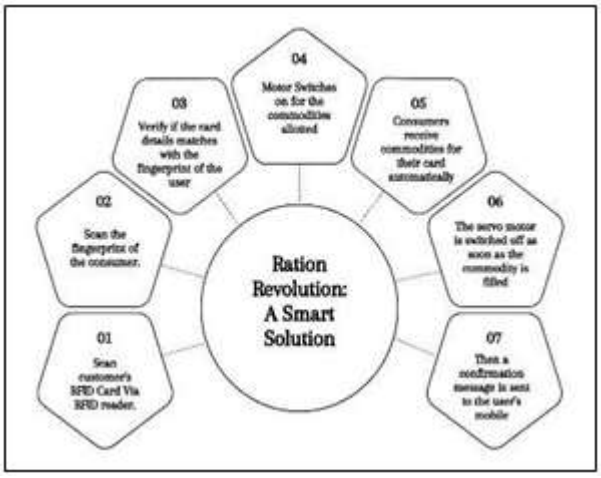

Figure 1: Overview of the Proposed System

This system is a game-changer for tackling accuracy and efficiency issues in the field of ration distribution because of its emphasis on dual-layer verification and strong error management, which improve security and dependability.

II. LITERATURE SURVEY

Aishwarya M. et.al (2017) introduce an automatic ration material distribution system using GSM and RFID technology. It replaces ration cards with RFID tags, informing customers about stock availability. Customers enter the required materials and quantity using selection keys, and the system sends information to the government. Additional features include a fire alarm system for emergencies and a tampering detector for theft. This system

ensures safety, and efficiency, and reduces corruption by allowing authorized individuals to buy ration materials without human intervention [1].

Mast. Amarsinh Ajit Desai. et.al (2022) proposed a system using an Arduino, a microcontroller, and an RFID reader to control ration distribution. The system uses a +5 V power supply, a relay unit, an LCD, a keypad for user authentication, and an RFID reader for scanning. It ensures accurate ration distribution and a user-friendly experience. Automated ration distribution offers advantages over manual distribution, such as equal distribution, time-saving, reduced theft, hygiene, and cost-effectiveness. It eliminates queues, ration theft, and black-market sales, and reduces the need for manpower and corruption. The project aims to significantly alter the public distribution system, improving control over ration distribution and benefiting the government [2].

Balasubramani A. et.al (2018) proposed a cashless automation system that uses an Atmega16 microcontroller and RFID cards as ration cards. The system stores cardholder information and generates an OTP for security. Cardholders can enter and withdraw ration amounts using a keypad, and the RFID card automatically cuts the amount and sends current balances via GSM to the customer and government database. This cost-effective, time-saving, and compact system addresses traditional ration systems' drawbacks, such as human error and material issues [3].

Butti Rajesh Kumar. et.al (2023) proposed a project that aims to build an automation and smart ration shop using Raspberry Pi's latest model, including RFID smart cards, fingerprint modules, keypad, driver circuits, DC motors, LCD, alarm, GSM modules, Raspberry Pi module with Raspberry operating system, and QR code for UPI payments. The system allows online or offline payment methods and eliminates hardware components using a webcam for input images, outperforming previous methods and requiring no specific recognition templates [4].

Naveen B et.al (2022) developed a system that automates collecting rations from local shops, starting with a "WELCOME TO RDU" message. It scans an RFID card, checks ID validity, and sends an OTP to the customer's registered mobile number. The system has two types of dispensing units: liquid items and grains. Liquid items are dispensed using a solenoid valve, whole grains are dispensed using a DC gear motor. This automated dispenser eliminates manual processes and human interaction problems, making it suitable for real-time applications and digital India. The device also provides food supply to eligible individuals under the Act of Right to Equality and Consumer Rights [5].

Pallavi Anil Gangurde. et.al (2018) proposed a solution to India's ration distribution system that uses an RFID-based application to manage customer balances, weight containers, and enroll new customers. This automated system addresses existing issues, prevents false entries, and acts as an anti-corruption tool. It is user-friendly, addressing challenges in the current ration system and benefiting both customers and vendors [6].

Mrs. Sathya S. et.al. **(**2023) proposed an application module that allows users to log in and store user details in a database. It allows adding users and employees with usernames, passwords, and card numbers. Retailers can view user details like name, city, email ID, mobile number, and card number. The paper discusses India's advanced ration material distribution system, highlighting issues like improper calibration, rate chart updates, and stock availability. Modifications aim to modernize villages, control unethical practices, and aid in disaster management through continuous monitoring and data collection [7].

Vaisakh A. K. et.al **(**2019) proposes a paper introducing a microcontroller-based system called IPRDS, which controls ration distribution operations. It uses a keypad and LCD to display commodity quantities and allows customers to enter their desired amount. The system automatically distributes commodities to containers and sends a bill to the customer's mobile number. The remaining quota is displayed and updated to a central agency via GSM. The system also features storage cabins for wheat, rice, and kerosene, operated by servo motor valve mechanisms. The system is transparent, saves paperwork time, and can be expanded with IoT and security features [8].

III. EXISTING WORK

The first stage of the current ration distribution system is the digitalization of identification by scanning ration cards. By converting paper records into digital format, this procedure makes data administration simpler and lowers the possibility of mistakes that come with manual record-keeping. A vital identifier that connects people to their rights within the system is the ration card. Fingerprint verification is used to offer an extra degree of security after the scanning procedure. By adding a strong component to the verification process, this biometric authentication phase makes sure that the distribution system is impervious to fraud. The technology improves accuracy and stops unwanted access to necessities by tying the cardholder's physical presence to their distinct fingerprint.

The distribution phase involves the manual allocation of commodities by on-site workers. These workers play a pivotal role in physically handing over the allocated goods to the verified cardholder. This manual distribution ensures a personalized touch, allowing for direct interaction between the

distribution personnel and the end-users. It also provides an opportunity to address any concerns or issues that may arise during the distribution process, fostering accountability and a more responsive service. Upon successful distribution, a completion message is sent to the user's mobile device via SMS. This notification serves as a confirmation to the consumer that the allocated commodities have been provided. The use of SMS for communication ensures wide accessibility, as it doesn't require advanced technology. This feedback mechanism not only enhances transparency in the distribution process but also keeps consumers informed in real-time about the status of their entitlements, contributing to a more accountable and user-friendly ration distribution system.

Even while the ration distribution system outlined has many benefits, it is important to recognize some drawbacks that are part of its design. The possible privacy issues around the gathering and use of biometric data for fingerprint verification represent a major disadvantage. It can be difficult to strike a balance between security precautions and individual privacy rights when such sensitive data is integrated since it raises concerns about data security and the possible misuse of personal identifiers. Addressing these issues requires finding the ideal mix between privacy protection and efficient security measures.

The hand distribution of goods during the distribution stage is another disadvantage. The human- centric strategy raises the risk of human mistake even though it guarantees individualized care and the capacity to resolve problems immediately. Manual procedures could be prone to errors like incorrectly allocating goods or incorrectly confirming cardholder identities.

Furthermore, depending on on-site personnel for distribution raises the possibility of inconsistencies and inefficiencies in service delivery, especially in situations with high demand or in places with little funding. dditionally, although the reliance on SMS for the confirmation message ensures broad accessibility, it may provide difficulties in areas with inadequate network coverage or for people without access to mobile devices. This restriction prompts questions regarding inclusion.

In conclusion, even though the ration distribution system described provides a thorough and effective method, it is crucial to take into account and minimize any potential disadvantages, such as privacy issues with biometric data, the potential for human error in manual distribution, and difficulties with depending only on SMS for communication in diverse and resource-constrained environments. For this reason, we have suggested a system in which the consumer will receive the goods immediately, devoid of any human involvement.

By employing a smart ration distribution system, bribery, inconsistent distribution, and other barriers faced by the impoverished are eliminated. Issues range from misleading reporting of food grains to the unpredictable opening of stores.

IV. PROPOSED METHOD

The suggested ration distribution method incorporates creative fixes to problems found in the current approach. The system's primary processing unit is an Arduino Uno microcontroller, which it uses to achieve increased automation and efficiency. The first step entails scanning ration cards with an RFID module, which now stores an allocated quantity of goods in addition to family information.

By eliminating the possibility of human data input errors, this digital transformation guarantees a more accurate and dynamic portrayal of entitlements. The system asks the user to submit their fingerprint for biometric verification after the RFID card scan.

By integrating fingerprint and RFID verification, this dual authentication method greatly improves security by lowering the possibility of fraud and guaranteeing that only authorized cardholders.

The system automatically dispenses the allocated commodities from a container after a successful verification. In addition to streamlining the distribution process, automation removes the need for human intervention, which lowers the possibility of mistakes and guarantees a prompt and precise delivery of goods in accordance with user entitlements.

A layer of efficiency is added by this automated dispensing device, which makes it possible for necessary commodities to be distributed smoothly and promptly. Customers make their money after the distribution is finished. After that, a GSM module creates and sends an SMS confirmation to the user's mobile handset.

This confirmation gives customers immediate feedback on their transactions and acts as a real-time acknowledgement of the purchase.

The confirmation message's reach is increased and dependable communication is ensured by using GSM. This measure contributes to an informed and empowered user base by improving transparency and enabling customers to maintain a record of their transactions and rights.

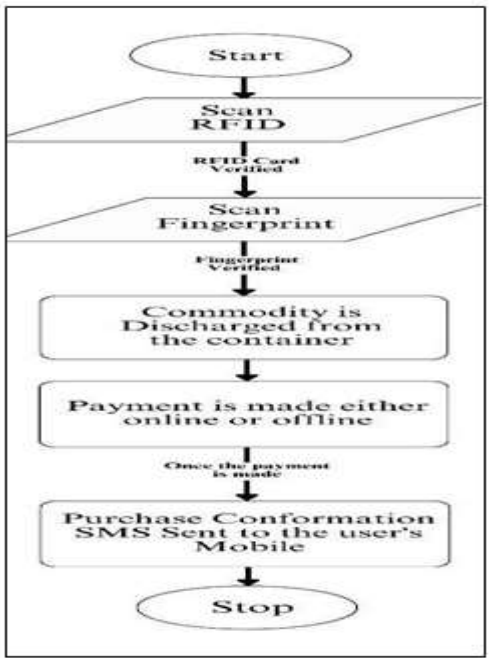

Figure: 1: Step by Step Working of the Proposed Model

As shown in the Figure: 4.1, the proposed ration distribution system leverages Arduino Uno, RFID technology, biometric verification, automated dispensing, and SMS confirmation to create a technologically advanced and user-friendly model. By addressing the shortcomings of the existing system, this innovative approach aims to revolutionize the efficiency, security, and overall user experience in the distribution of essential commodities through a ration shop. This creative method seeks to revamp the effectiveness, security, and general user experience in the distribution of basic goods via a ration shop by resolving the flaws in the current system.

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The suggested ration distribution system's incorporation of an Arduino Uno microcontroller, RFID technology, biometric identification, automated dispensing, and SMS confirmation offers a number of benefits that turn the conventional paradigm into a simplified and user-focused process. The increased security that dual authentication provides is one obvious benefit. By combining fingerprint verification with RFID card scanning, a strong layer of identity validation is established, greatly reducing the possibility of fraudulent activity. By guaranteeing that only authorized cards are able to access their entitled goods, this cutting-edge security feature fosters trust in the system's dependability and stops illegal use. In order to increase the distribution process's efficiency, automation is essential. The system removes the need for human involvement by using an Arduino Uno microcontroller to automate the dispensing of allocated goods from a container. In addition to lowering the possibility of human error, this expedites the distribution process and guarantees a smooth and prompt distribution of goods. The automated dispensing mechanism gives the system an extra degree of accuracy, making it possible for consumers to receive important commodities in a more dependable and precise manner. A more dynamic depiction of rights on ration cards is made possible by the integration of RFID technology. Digitally storing family information and a certain quantity of goods lowers the possibility of mistakes that come with human data entry.

The use of SMS confirmation via a GSM module serves as a real-time feedback mechanism, providing consumers with instant acknowledgment of their purchase. This not only enhances transparency but also empowers users by keeping them informed about their transactions and entitlements. The wide accessibility of SMS ensures that users receive confirmation regardless of their access to sophisticated technology, contributing to an inclusive and user-friendly experience. Overall, the proposed ration distribution system leverages technological advancements to offer heightened security, efficiency, accuracy, and user empowerment, marking a significant improvement, over traditional models.

V. SIMULATION RESULTS AND DISCUSSION

By accurately simulating the RFID-based ration card scanning procedure, the model made sure that two cards could be verified with ease. Within the well-designed circuit, three servo motors are part of the complete system. The automated food distribution system ensures precise and safe ration item delivery by following a methodical, step-by-step procedure. The three containers in the system are each used to store different ration goods, like sugar, wheat, and rice. The device that controls the opening and closing of the containers is a servomotor that is built into each container.

Presenting their RFID smart cards, which include vital information about their ration allocations, allows users to start the process. For further security, the system simultaneously takes the user's fingerprint. The technology ensures a dual-layer authentication process by comparing the fingerprint and RFID data.

After a successful verification, the system verifies the user's identification and grants permission to distribute the rations.

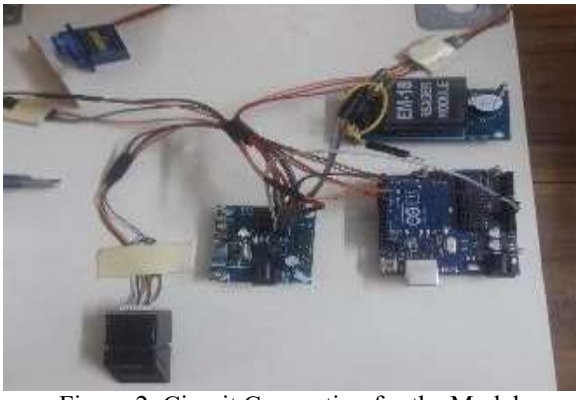

Figure 2: Circuit Connection for the Model

The relevant servomotor for the required ration item is activated via the circuit connection as seen in Figure 5.1 above. The container opens precisely to release the specified amount of the ration item that has been ordered. In order to avoid abuse or overuse, the dispensing procedure is controlled. Information about the completed transaction is conveyed to the user through a confirmation message. By limiting access to and receipt of ration items to authorized individuals with valid RFID cards and matching fingerprints, the system maintains strong security throughout the process.
The system has error-handling features to deal with any inconsistencies in the dispensing or verification process. The system notifies the user to try the process again or ask an operator for help if the verification fails. By following this methodical procedure, the automated ration distribution system creates a streamlined, safe, and user-friendly ration distribution solution by integrating technology, authentication, and controlled dispensing or verification process. The system notifies the user to try the process again or ask an operator for help if the verification fails. By following this methodical procedure, the automated ration distribution system creates a streamlined, safe, and user-friendly ration distribution solution by integrating technology, authentication, and controlled dispensing.

Figure: 3: Overall Setup of Our Proposed Model

The proposed model's overall setup is connected as seen in Figure 5.2 above. To provide users with timely updates and improve communication channels, the next phase also entails connecting the GSM module, which will allow the system to send SMS notifications.

A comprehensive and effective solution for ration distribution is being ensured by concurrent efforts to optimize container-based production operations. The continued development of this complex system, which aims to provide a safe, efficient, and technologically sophisticated method to ration distribution, is driven by our dedication to innovation and constant improvement.

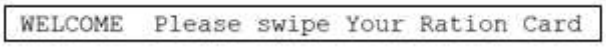

Figure 4: Entry Message

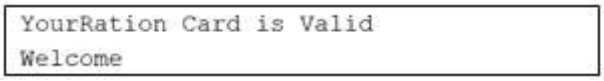

Figure 5: Verification message for RFID card of user

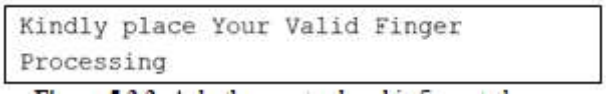

Figure 6: Asks the user to place his finger to be scanned

Figure 7: If both the verification matched Access will be granted

Figure 8: The comments when the servo motor opens and closes

As illustrated in Figure 5.3, the simulated output screen of the suggested model includes the aforementioned commands. First, the "Welcome" command is displayed, followed by a request for the user to swipe their ration card as illustrated in Figure 5.3.1.

If the RFID card is validated, the output is shown as illustrated in Figure 5.3.2. Next, the user is asked to scan their fingerprints using the fingerprint sensor, as illustrated in Figure 5.3.3. In contrast, the user will be able to retrieve the goods that have been assigned to them, as illustrated in figure 5.3, if the fingerprint sensor and the RFID card match.4. Figure 5.3.5 also displays the servomotor's condition when the simulation is in progress.

V. CONCLUSION

The simulation focuses on controlling a servo motor to open a container and successfully completing RFID card scanning. The outcomes will shed light on the precision and efficacy of the integrated system. With its controlled servomotors, RFID, and fingerprint authentication, the automatic ration distribution system provides a safe and effective solution. The methodical, step-by-step procedure guarantees accurate dispensing, user authentication, and transparent logging. While error management provides dependability, dual-layer verification improves security. All things considered, this solution is a revolutionary strategy that tackles security and accuracy issues while promoting effective, data- driven ration distribution.

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