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Automated Ration Distribution:Addressing Challenges in Food Distribution System

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Abstract

India's Public Distribution System (PDS) is a government policy that distributes commodities to needy people at fixed rates. However, manual intervention in weighing materials leads to inaccurate measurements and illegal use of consumer materials. At present, we have a system where the products are manually forwarded to the consumer by scanning their ration card and by verifying their fingerprint. But this was not enough for the corruption to stop. So, a system has been proposed where there will be a two-step verification as usual. But, when the step to handle the commodity comes, we use automation instead of manual labor. Consumers are provided with an RFID card that acts as a ration card with a unique identification number. The RFID card is scanned by an RFID reader interfaced with a microcontroller at a ration shop. The system then asks for the customer's fingerprint, and it identifies whether the fingerprint matches the card. If both matches then the system automatically activates after verifying the consumer's allotted amount of rice, wheat, and sugar. The consumer receives the products when they provide their bowl or cover at the bottom of the container. The motor at the entry point rotates, such that the selected item falls into the main outlet, and the consumer gets the material by weighing it on the load cell. A confirmation message is sent to the consumer's mobile number upon successful completion of the purchase. It is much more efficient than the manual system as it reduces labor costs and also stops the way to smuggle goods.

Keywords—RFID(Radio Frequency Identification), Fair Price Shop, Automation, Ration Distribution

1 INTRODUCTION

In this system, each consumer will have their unique RFID (Radio Frequency Identification Device) card under the proposed scheme. The server records every transaction whenever a beneficiary purchases goods from FPS (Fair Price Shops). This system improves accuracy and cuts down on labor costs.

The Public Distribution System (PDS), which distributes food grains at reasonable costs, was developed as a means of managing scarcity. PDS has evolved through time to play a significant role in the government's strategy for managing the nation's food economy. However, the current ration card

system has numerous problems. With this approach, illegal actions within the FPS might be drastically decreased. In ration shops, the Smart Ration Distribution technology takes the place of manual labor.

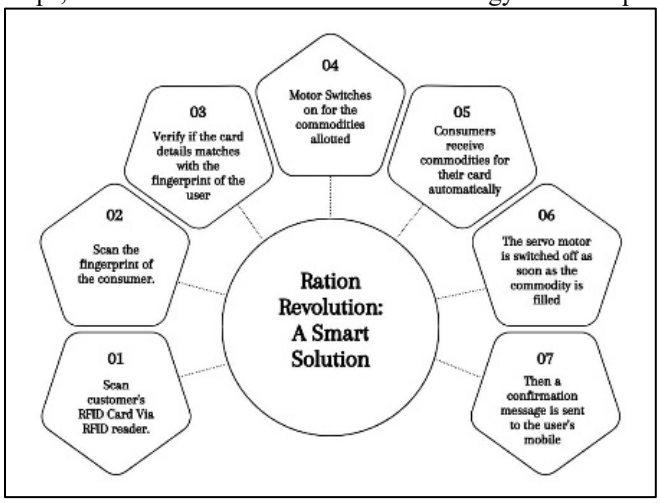

Figure 1.1. Overview of the Proposed System

The overview of the process is automated using a centralized server, ensuring that the public is properly served by government services as shown in the Figure 1.1. In the quest for optimizing and modernizing essential services, the introduction of the automatic ration distribution system marks a significant leap forward. This innovative system integrates cutting-edge technologies, including RFID, fingerprint verification, and precision-controlled servomotors, to revolutionize the traditional process of dispensing ration items. With a meticulous step-by-step approach, the system ensures secure user authentication, controlled dispensing, and transparent logging of transactions.

It's emphasis on dual-layer verification and robust error handling enhances both security and reliability, making this system a transformative solution for addressing challenges in accuracy and efficiency within the realm of ration distribution. This introduction sets the stage for exploring how this advanced technology contributes to a more streamlined, secure, and data-driven approach to meeting the essential needs of the community.

2 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].

3 EXISTING WORK

In the existing ration distribution system, the initial step involves the digitization of identification through the scanning of ration cards. This process converts physical documents into a digital format, facilitating easier data management and reducing the likelihood of errors associated with manual record-keeping. The ration card serves as a crucial identifier, linking individuals to their entitlements within the system. Following the scanning process, an additional layer of security is implemented through fingerprint verification. This biometric authentication step adds a robust element to the verification process, ensuring that the distribution system is not susceptible to fraudulent activities. By linking the physical presence of the cardholder with their unique fingerprint, the system enhances accuracy and prevents unauthorized access to essential commodities.

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.

While the described ration distribution system presents several advantages, it is essential to acknowledge certain disadvantages inherent in its operational framework. One significant drawback lies in the potential privacy concerns associated with the collection and utilization of biometric data for fingerprint verification. The integration of such sensitive information raises apprehensions about data security and the potential misuse of personal identifiers, posing a challenge in balancing security measures with individual privacy rights. Striking the right balance between effective security measures and respecting privacy becomes crucial to address these concerns.

Another drawback stems from the manual allocation of commodities during the distribution phase. While the human-centric approach ensures personalized service and the ability to address issues on the spot, it also introduces the possibility of human error. Manual processes may be susceptible to mistakes such as misallocation of commodities or errors in verifying the identity of cardholders. Additionally, reliance on on-site workers for distribution introduces the risk of inefficiencies and inconsistencies in service delivery, particularly in high-demand scenarios or areas with limited resources. Furthermore, the dependency on SMS for the confirmation message, while ensuring wide accessibility, might pose challenges in regions with poor network coverage or for individuals who lack access to mobile devices. This limitation raises concerns about inclusivity and whether certain demographics might be inadvertently excluded from receiving crucial updates about their entitlements. To address this, alternative communication channels or redundant systems may need to be considered to ensure information reaches all intended recipients, regardless of their technological resources.

In summary, while the described ration distribution system offers a comprehensive and efficient approach, it is important to consider and mitigate the potential drawbacks, including privacy concerns related to biometric data, the possibility of human errors in manual distribution, and challenges associated with relying solely on SMS for communication in diverse and resource-constrained environments. For which we have proposed a system where the commodities will be provided to the consumer directly without any human intervention.

Problems range from the false reports of a food grains to the unpredictability of store openings by using a smart ration distribution system bribery , erratic distribution , and other obstacles encountered by poor people are abolished.

4 PROPOSED METHOD

The proposed ration distribution system integrates innovative solutions to address challenges identified in the existing model. Utilizing an Arduino Uno microcontroller as the core processing unit, the system aims for enhanced efficiency and automation. The first step involves the use of an RFID module for scanning ration cards, which now store not only family details but also an allotted amount of commodities. This digital transformation ensures a more dynamic and accurate representation of entitlements, reducing the chances of errors associated with manual data entry. Following the RFID card scan, the system prompts the consumer to provide their fingerprint for biometric verification. This dual authentication process, combining RFID and fingerprint verification, significantly enhances security, minimizing the risk of fraudulent activities and ensuring that only legitimate cardholders can access their entitled commodities. The integration of biometric data acts as a robust layer of identity verification, surpassing the security measures employed in traditional systems.

Upon successful verification, the system automatically dispenses the allotted commodities from a container. The use of automation not only streamlines the distribution process but also eliminates the need for manual intervention, reducing the likelihood of errors and ensuring a swift and accurate allocation of commodities based on the user's entitlements. This automated dispensing mechanism adds a layer of efficiency, allowing for a seamless and timely distribution of essential goods. Post-completion of the distribution, consumers proceed with their payment. Following this, an SMS confirmation is generated and sent to the user's mobile device via a GSM module.

This confirmation serves as a real-time acknowledgment of the purchase, providing consumers with instant feedback on their transactions. The use of GSM ensures reliable communication and widens the reach of the confirmation message. This step not only enhances transparency but also allows consumers to keep a record of their transactions and entitlements, contributing to an informed and empowered user base.

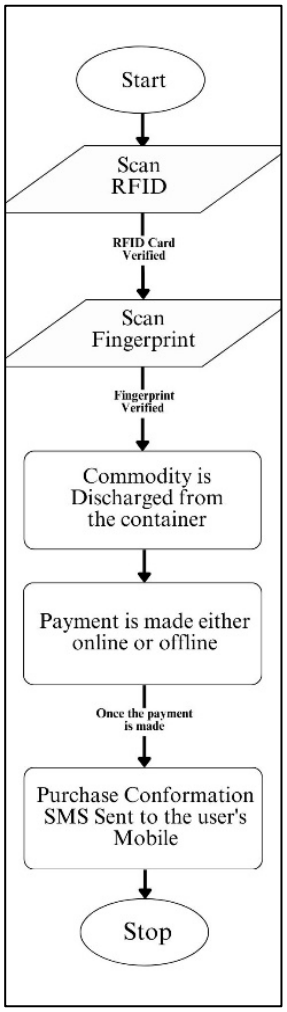

Figure: 4.1: Step by step working of the proposed model

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.

The integration of an Arduino Uno microcontroller, RFID technology, biometric verification, automated dispensing, and SMS confirmation in the proposed ration distribution system brings forth several advantages, transforming the traditional model into a streamlined and user-centric experience. One notable advantage is the heightened security achieved through dual authentication. The combination of RFID card scanning and fingerprint verification establishes a robust layer of identity validation, significantly minimizing the risk of fraudulent activities. This advanced security mechanism ensures that only legitimate cardholders gain access to their entitled commodities, instilling confidence in the system's integrity and preventing unauthorized usage.

Automation plays a pivotal role in enhancing the efficiency of the distribution process. By utilizing an Arduino Uno microcontroller to automate the dispensing of allotted commodities from a container, the system eliminates the need for manual intervention. This not only reduces the likelihood of errors associated with human involvement but also speeds up the distribution process, ensuring a seamless and timely allocation of goods. The automated dispensing mechanism adds a layer of precision to the system, contributing to a more reliable and accurate distribution of essential commodities to consumers. The incorporation of RFID technology allows for a more dynamic representation of entitlements on ration cards. Storing family details and an allotted amount of commodities, digitally reduces the chances of errors associated with manual data entry, contributing to a more accurate and up-to-date record. This digital transformation ensures that consumers receive the correct entitlements, promoting fairness and minimizing discrepancies in the distribution process. The system's ability to adapt to changes in entitlements dynamically enhances the overall reliability of the ration distribution process.

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.

5 SIMULATION RESULTS AND DISCUSSION

The model successfully simulated the RFID-based ration card scanning process, ensuring the seamless verification of two cards. The comprehensive system includes the operation of three servo motors within a well-designed circuit. The automatic ration distribution system operates through a s systematic step-by-step process to ensure accurate and secure dispensing of ration items. The system has three containers, each designated for storing specific ration items such as rice, wheat, and sugar. Servomotors are integrated with each container, acting as the mechanism to control the opening and closing of the containers.

Users initiate the process by presenting their RFID smart cards, containing essential information about their ration entitlements. Simultaneously, the system captures the user's fingerprint for additional verification. The system checks for a match between the RFID information and the fingerprint data, ensuring a dual-layer authentication process.

Upon successful verification, the system confirms the user's identity, signifying authorization to proceed with the ration distribution.

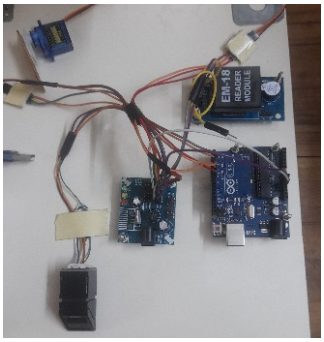

Figure 5.1: Circuit Connection for the Model

The circuit connection as shown on the above Figure 5.1 activates the relevant servomotor corresponding to the requested ration item. The container opens precisely to dispense the predetermined quantity of the requested ration item. The dispensing process is controlled to prevent overuse or misuse. A confirmation message is relayed to the user, providing information about the completed transaction. Throughout the process, the system maintains high security, ensuring that only authorized users with valid RFID cards and matching fingerprints can access and receive ration items.

The system incorporates error-handling mechanisms to address any discrepancies in the verification process or dispensing errors. In case of failed verification, the system prompts the user to reattempt the process or seek assistance from an operator. By following this step-by-step process, the automatic ration distribution system seamlessly integrates technology, authentication, and controlled dispensing to create an efficient, secure, and user-friendly solution for ration distribution.

Figure: 5.2 Overall Setup of Our Proposed Model

The overall setup for the proposed model has been connected as shown in the above Figure 5.2. Additionally, the upcoming phase involves connecting the GSM module to enable the system to send SMS notifications to users, providing timely updates and enhancing communication channels. Simultaneously, efforts are underway to optimize container-based production processes, ensuring a holistic and efficient solution for ration distribution. Our commitment to innovation and continuous improvement drives the ongoing development of this multifaceted system, aimed at providing a secure, streamlined, and technologically advanced approach to ration distribution.

```
WELCOME  Please swipe Your Ration Card
```

Figure 5.3.1 Entry Message

```
YourRation Card is Valid
Welcome
```

Figure 5.3.2: Verification message for RFID card of user

```
Kindly place Your Valid Finger
Processing
```

Figure5.3.3 Asks the user to place his finger to be scanned

```
Access Granted
 Collect Your Things
 Thank You
Rice : 20kg , Sugar : 1kg , Wheat : 2kg
```

Figure 5.3.4: If both the verification matched Access will be granted

```
Open
Close
```

Figure 5.3.5: The comments when the servo motor opens and closes

The simulated output screen of the proposed model consists of the above commands as shown in the Figure 5.3. At first the 'Welcome' command at first and ask the user to swipe his or her ration card as shown in the Figure 5.3.1. Then if the RFID card is verified then the output will be displayed as in Figure 5.3.2. Then it asks the user to scan his or her fingerprint using the fingerprint sensor as shown in the Figure 5.3.3. Whereas if the fingerprint sensor is matched with the RFID card then the user will be granted access to collect the commodities as allotted to the consumer as shown in the figure 5.3.4. And the Figure 5.3.5 shows the status of the servomotor when the simulation is in progress.

6 CONCLUSION

The simulation focuses on the successful completion of RFID card scanning and the control of a servo motor for container opening. The results will provide insights into the effectiveness and accuracy of the integrated system. The automatic ration distribution system, featuring RFID, fingerprint verification, and controlled servomotors, offers a secure and efficient solution. The meticulous step-by-step process ensures user authentication, precise dispensing, and logging for transparency. The dual-layer verification enhances security, while error handling adds reliability. Overall, this system represents a transformative approach, addressing challenges in accuracy and security, and contributing to efficient and data-driven ration distribution.

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