ENHANCING ACCESSIBILITY AND TRANSPARENCY IN RATION DISTRIBUTION UNDER PUBLIC DISTRIBUTION SYSTEM

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Abstract –The Public Distribution System (PDS) has emerged as a transformative solution to improve the efficiency in the distribution process of the subsidized food grains to the eligible families under Right to Food Act in India. This research investigates the integration of biometric technologies and transparency into the existing ration distribution framework to streamline its objectives. The work presented in this paper has developed a Smart Ration Distribution System (SRDS) which is a complete automatic system that keeps the record of user profile and their consumption of various subsidized food grains in the current month and year. The developed SRDS has the advantages of foolproof authentication and identification of eligible citizen, reduction in the waiting time of customers, real-time tracking and monitoring of distribution process, enabling timely interventions and resource allocation based on demand patterns, reducing administrative burdens, etc. This type of system can also be effective in implementing various other social welfare programs such as anganwadi, arogyasri, ammavadi, Telangana Aasara Pension Scheme, etc.
Keywords: Smart Ration Distribution System, Biometrics, Authentication, Efficiency, Security, Beneficiary Identification.

1. INTRODUCTION

The National Food Security Act (NFSA) 2013, is a landmark legislation aimed at ensuring food security for all citizens. It provides subsidized food grains to eligible households through the Public Distribution System (PDS) and aims to eradicate hunger and malnutrition. The act entitles priority households to receive food grains at highly subsidized rates. Public Distribution Systems (PDS) are critical for providing essential food supplies to economically disadvantaged individuals and families, particularly during times of crisis and hardship. However, existing systems face challenges to provide their effectiveness and efficiency.

One major challenge in ration distribution systems is the reliance on manual processes and paperwork. These procedures often result in delays, inefficiencies, and longer wait times for beneficiaries. The extensive paperwork, verification processes, and documentation involved impose administrative burdens and increase the likelihood of errors. Streamlining these processes through digitalization and automation can reduce delays, improve efficiency, and expedite the distribution of essential food supplies. Another crucial issue is the lack of robust authentication mechanisms within the systems. Traditional methods of identification, such as ration cards, are susceptible to fraud, duplication, and unauthorized access. This compromises the integrity of the system and poses challenges in accurately identifying genuine beneficiaries. By implementing biometric authentication, such as fingerprint or iris scans, the ration distribution system can enhance security and ensure that rations reach the intended beneficiary.

Monitoring and tracking systems also present significant challenges in ration distribution. Inadequate systems make it difficult to identify and address issues such as hoarding, diversion, or unequal distribution of rations. Effective monitoring is essential to ensure fair and equitable allocation of food supplies and to detect and rectify any misuse. The challenges being faced in the ration distribution systems necessitate innovative solutions to improve their effectiveness and efficiency.

Digitalization, biometric authentication, advanced monitoring and tracking systems, and enhanced coordination among stakeholders are the measures to be taken to improve food distribution. By addressing these challenges, it is possible to create more efficient, transparent, and equitable ration distribution systems that effectively meet the needs of vulnerable populations. Authentication issues have also received considerable attention in the literature. Research by Patel and Shah (2019) pointed out that traditional methods of identification, such as ration cards, are prone to fraud and duplication. The authors proposed the integration authentication, such as fingerprint or iris scans, to enhance security and ensure accurate identification of beneficiaries. They argued that biometric-based systems can significantly reduce the risk of identity theft and unauthorized access monitoring and tracking. In today's ration distribution systems, there are several pressing problems that need to be addressed. Firstly, manual processes and paperwork result in delays and inefficiencies, leading to longer wait times for beneficiaries. Secondly, there is a lack of robust authentication mechanisms, making the system vulnerable to fraud and identity theft. Additionally, inadequate monitoring and tracking systems make it difficult to identify and address issues such as hoarding, diversion, or inadequate distribution of rations. Finally, limited access to updated beneficiary data and poor coordination between different stakeholders further hampers the effective functioning of the system. These challenges call for innovative solutions to improve the overall effectiveness and transparency of ration distribution systems.

2. Literature survey

Ration distribution systems are a subject of significant research interest due to their crucial role in addressing food insecurity and ensuring the equitable distribution of essential food supplies. In recent years, scholars have focused on identifying the challenges faced by existing systems and proposing innovative solutions to enhance their efficiency, effectiveness, and overall impact.

Several studies have highlighted the limitations of manual processes in ration distribution systems. In a Monitoring and tracking systems have been identified as crucial aspects for improving the transparency and accountability of ration distribution. In a study by Rahman et al. (2020), it was found that inadequate monitoring mechanisms led to challenges in identifying and addressing issues such as hoarding, diversion, and unequal distribution of rations. The authors suggested the implementation of advanced tracking technologies and data management systems to improve real-time monitoring, enhance transparency, and enable timely interventions.

Furthermore, the importance of coordination and data management among stakeholders has been emphasized. A study by Gupta and Sharma (2021) highlighted the significance of accurate and updated beneficiary data, as outdated or incomplete information can lead to exclusion errors. The authors called for improved coordination among government agencies, NGOs, and other entities involved in ration distribution to ensure seamless information flow and efficient resource allocation.

Overall, the literature survey reveals a consensus on the need for innovative solutions to overcome the challenges faced by ration distribution systems. The integration of digital technologies, biometric authentication, advanced monitoring and tracking systems, and improved coordination among stakeholders emerges as key recommendations To overcome the problems in today's ration distribution system. We need to use of technology such as smart ration cards, biometric authentication, and digital monitoring can help eliminate fraud, ensure transparency, and streamline distribution processes. Implementing it ensure timely availability of essential commodities. Furthermore, enhancing the quality and nutritional value of ration supplies can address the issue of malnutrition. Lastly, regular monitoring, audits, and feedback mechanisms can help identify and address any shortcomings in the ration system, ensuring continuous improvement and better service delivery.

Recently Vikram et al. [1] has proposed Smart Ration Card System. The smart card is modified as a smart ration card by coding Microprocessor chip present in it according to the requirement. The smart card contains unique barcode. When the consumer visits the ration shop, he has to show this card in front of barcode reader. Dealer verifies the smart card & accordingly delivers ration. S.Valarmathy et al. [2], Mohan et al. [4] has proposed an automatic ration material distribution based on GSM (global system for mobile) and RFID (Radio Frequency Identification) technology instead of a ration card. This system is automatic and provides ration without interference of human. In this system various sensors are used to measure and dispense the commodities. Dhanashri et al. [5] and Neha et al. [3] has developed web enabled superior public distribution system. The system remotely monitors the outlets of various goods and vehicles, providing ration to ration shop. In this system, subscriber has to access the website every time they desire to get a ration.
Sharma et. al. [6] has proposed new ration distribution system using biometrics, face recognition and voice recognition system. Laxman L. Kumarwad, Rajendra D. Kumbhar
[7] these researchers proposed the linkage between the biometric fingerprints, GPS and UID with the PDS.

3. ARCHITECTURE OF SRDS

The smart ration distribution system utilizes technologies like biometric authentication to streamline the process. It ensures efficient and transparent distribution of ration supplies, eliminating fraud and promoting accountable consumption.

3.1 BLOCK DIAGRAM

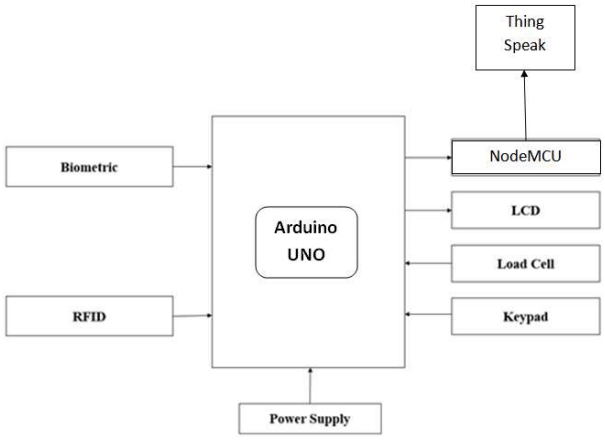

fig 1: Block Diagram

2. 2 Components Used

The following components are used in building the SRDS.
1) Arduino
2) ESP8266 ESP-01 Serial wifi
3) Load cell
4) Fingerprint Sensor
5) Servo
6) LCD
7) Push Buttons
8) Jumper Wires
9) Velcro Board
10) PCB
11)Potentiometer
12)An AC to DC Transformer

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1. Arduino UNO is an Development board having digital pins, analog pins, pwm pins. Featuring the Atmega328P microcontroller and a user as an ideal platform for various electronic projects. The Arduino Uno's simplicity in programming, coupled with its extensive library support, makes it suitable for both beginners and experienced users. Its versatility allows for a wide range of applications, from robotics projects to wearable electronics and home automation systems.

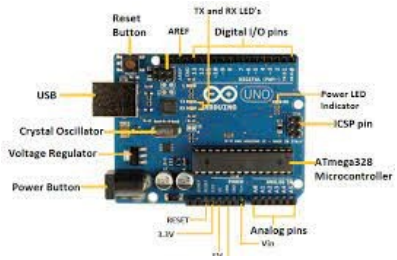

fig 2: Arduino

2. The ESP8266 is a popular Wi-Fi module that integrates a microcontroller and Wi-Fi capabilities into a single chip. It offers a cost-effective solution for adding Wi-Fi connectivity to various electronic projects. The ESP8266 can be programmed using the Arduino IDE and provides a wide range of features and functionalities, making it suitable for IoT applications, home automation, and wireless communication projects. With its small size, low power consumption, and robust performance, the ESP8266 has become a popular choice among professionals alike for wireless connectivity projects.

fig 3: ESP8266 ESP-01

3. A load cell is a device that measures force or weight and is commonly used in weighing and industrial applications it's a transducer that converts force or weight into an electrical signal, making it ideal for applications such as weighing scales, industrial automation, and force measurement in various industries.

fig 4: Load cell

4. A fingerprint sensor is a biometric device that captures and analyzes unique patterns on an individual's fingertip. inger print authentication [11], It is widely used for secure authentication and access control in

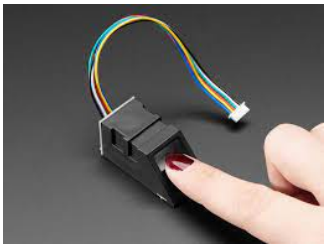

fig 5: finger print sensor

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5. An LCD (Liquid Crystal Display) is a flat panel display technology that utilizes liquid crystals to produce visual output. It is commonly used in electronic devices for information display and user interaction

fig 6: LCD Display

6. Push buttons are mechanical switches that are activated by pressing down on them. They are commonly used in electronic devices and control systems to initiate specific functions, trigger actions, or toggle between different states. Push buttons provide a simple and tactile interface for user input.

fig 7: Push buttons

7. A servo is a small electric motor that provides precise control over the rotation or position of mechanical components, making it widely used in robotics, automation, and remote control systems

fig 8: Servo Motor

8. Vector board is a type of Printed circuit board where we mount the elements on the vector board. Using the hardware elements like soldering and the components

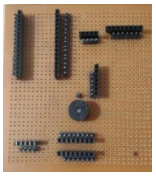

fig 9: Vector board

9. A jumper wire is an electrical wire or group of wires used to connect circuits without soldering. They have connectors or pins at their ends. Depending upon the configuration of end connectors, they are classified into three types they are: 1. male-to-male, 2.male-to-female and 3. female-to-female.

fig 10: Jumper wires

2.3 Software Requirement

1. Arduino IDE is an Integrated Development

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Environment (IDE) it is an open-source cross platform IDE. The Syntax of this programming language is very much similar to that of C language with a little bit difference in keywords. Arduino IDE is generally used for Arduino Based Projects and in the field of robotics. We write program for different sensors and motors for them to work according to the user input.

fig:11 Arduino IDE

2. Fritzing is an open-source software tool designed to facilitate the creation of electronic circuits, prototyping, and documentation. It offers a user-friendly interface that allows users to design circuits, create schematics, develop PCB layouts, and even simulate their projects. Fritzing provides a vast library of components and modules, making it easy to assemble and visualize circuit connections. With its visual representation and easy-to-understand interface, Fritzing is a popular choice among beginners and hobbyists for prototyping and sharing electronic projects

fig:12 Fritzing

3. Serial WiFi Terminal App is a mobile application that allows users to establish a wireless connection between their smartphone or tablet and a device equipped with a serial interface, such as an Arduino or other microcontroller. It provides a convenient way to communicate with the device over a wireless network, eliminating the need for physical cables. Some key features of the Serial WiFi Terminal App include real-time data transmission, customizable baud rates, support for various serial protocols, and the ability to send and receive commands and data wirelessly. It simplifies the process of interacting with serial devices and enables remote monitoring and control of connected systems.

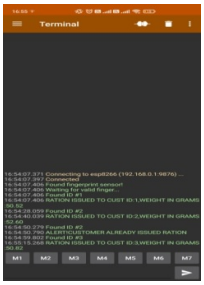

fig:13 Serial Wifi terminal(Data base)

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3. IMPLEMENTATION AND WORKING

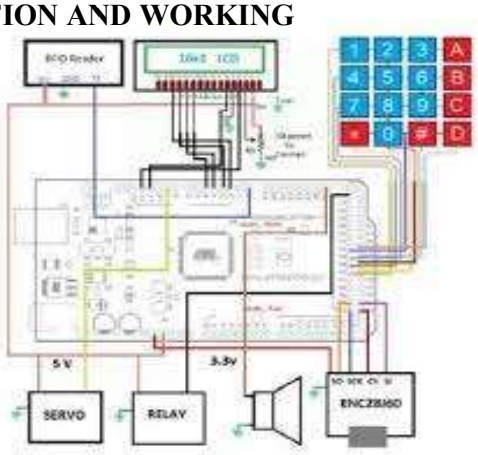
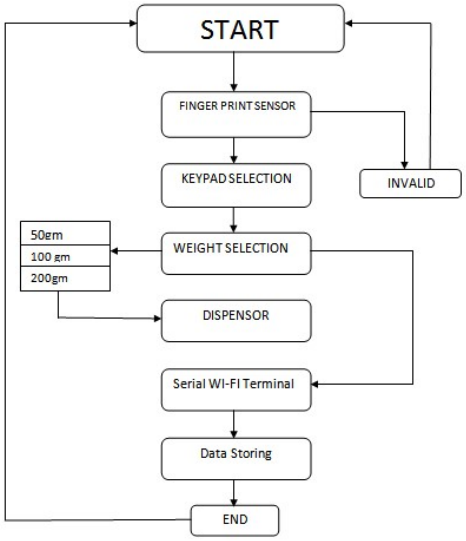


fig:14 Circuit Diagram

This is the circuit diagram of SRDS, which connects to the all components mentioned in the components list.



The working process of the proposed system in ration shops involves the following steps:

1. At each ration shop, an RFID reader is installed to scan the RFID ration card of users. Another RFID reader is used to validate the user's eligibility and categorize them as white ration or pink ration. A fingerprint scanner is employed for user identification, and the fingerprints are stored in a database for future reference.
2. The system replaces manual work in ration shops, reducing human effort and minimizing the possibility of fraudulent activities.
3. When a user arrives, their identity is verified by a microcontroller that connects to the data. The microcontroller retrieves the necessary information for the user.
4. User details, along with the quantity of the item to be loaded, are displayed on an LCD screen for transparency and convenience.
5. The weight of the item is measured using a load cell, which accurately determines the quantity to be dispensed.
6. The load cell sends the information to the microcontroller, which in turn sends it to the LCD screen for display.
7. The user takes the quantity of the item displayed on the LCD screen, ensuring that the correct amount is distributed.

8. A message is sent to the head of the family member through NodeMCU, utilizing the built-in WiFi chip. The data is transmitted and stored in ThingSpeak, providing real-time updates and tracking.
9. If an unauthorized person or the same individual attempts to take ration again, the system performs an authentication check. The microcontroller alerts the controller by displaying a notification on the LCD screen, ensuring that the appropriate actions can be taken
10. The data is going to store in the data base which shows in the figure..this helps of maintaining the records to whom we had issued the ration.

4. EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Results and

The project successfully fulfils the requirements and addresses the problem statements identified earlier. Both the biometric and RFID components functioned without any issues. During testing, the prototype demonstrated its ability to handle loads up to the specified limit of 1 kilograms, as determined by the load cell.

The project's outcomes have been positive, with notable improvements in efficiency, fraud prevention, and transparent record-keeping. The system facilitates accurate record-keeping for future auditing, decision-making, and monitoring purposes. These outcomes highlight the effectiveness and potential benefits of the implemented solution.

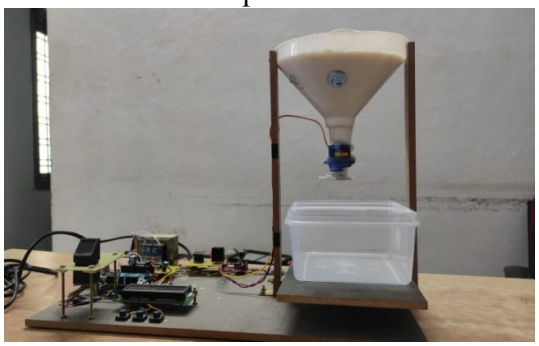


fig: 15 Working process

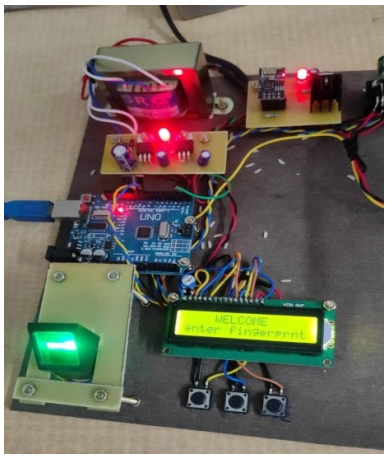


fig: 16 Biometric Working

5. CONCLUSION AND FUTURE ENHANCEMENT

5.1 Conclusion

In conclusion, the implementation of a smart ration distribution system using RFID technology and biometrics has the potential to significantly improve the efficiency, accuracy, and security of ration distribution in shops. By replacing manual processes with automated systems, the proposed system

reduces human effort and minimizes the risk of fraudulent activities. The integration of RFID readers, fingerprint scanners, microcontrollers, load cells, LCD screens, and NodeMCU with WiFi facilitates seamless identification, verification, and data transmission.

The system's ability to store user information, track ration distribution, and send notifications enhances transparency and accountability. Overall, the smart ration distribution system holds great promise in revolutionizing the traditional ration distribution process, benefiting both the ration shop operators and the beneficiaries. Further research and development in this area are warranted to refine and expand the system's capabilities, ensuring its successful implementation in real-world scenarios.

5.2 Future Enhancement

In the future, there are several potential enhancements that can be implemented to further improve the smart ration distribution system some of them are Mobile Application Integration, Biometric Authentication Enhancements, Integration with Cashless Payment Systems, Expansion to Other Essential Commodities.

These future enhancements have the potential to make the smart ration distribution system even more efficient, user-friendly, and adaptable to changing needs. Continued research, technological advancements, and collaboration between relevant stakeholders will drive the evolution and success of the system in the years to come.

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