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Smart Ration Card Distribution System

Abstract: - Ration shops in India are essential for distributing subsidized commodities like wheat, rice, and sugar to the public. However, the existing manual ration distribution system is plagued by inefficiencies, human errors, and corruption, leading to issues such as inaccurate weighing, unauthorized data manipulation, and illegal diversion of goods. To tackle these problems, we propose a Smart Ration Distribution System that utilizes advanced technologies like IoT and biometric authentication. In this system, Aadhaar based biometric verification replaces traditional ration cards, ensuring secure and accurate customer identification. The distribution process is fully automated, allowing ration materials such as sugar, rice, and wheat to be dispensed through a precise, human free mechanism, ensuring accurate measurements. Real-time data tracking improves transparency, prevents fraud, and enables efficient stock management. By automating the entire system, this solution eliminates the drawbacks of manual processes, enhancing both accuracy and efficiency while ensuring equitable and secure distribution of essential commodities.

Keywords: STM32, GSM, Google Spreadsheet database, Ration distribution, OTP Authentication.

I. INTRODUCTION

In India, the Public Distribution System (PDS) plays a crucial role in providing subsidized essential commodities like wheat, rice, and sugar to the population, particularly targeting lower income households. Traditionally, ration distribution at PDS outlets has been managed manually, involving physical ration cards and in-person verification processes. However, this system faces numerous challenges, including inefficiencies, human errors, and corruption. Issues such as inaccurate measurements, unauthorized data manipulation, and illegal diversion of goods significantly impact the integrity and effectiveness of the system, often resulting in resources not reaching the intended beneficiaries.

To address these issues, we propose a **Smart Ration Distribution System** that leverages **Internet of Things (IoT)** and **biometric authentication** to automate and secure the ration distribution process. In this system, Aadhaar-based biometric verification is utilized instead of traditional ration cards, providing secure, unique identification for beneficiaries and eliminating the risk of duplication or misuse. The automated distribution mechanism dispenses rationed items such as sugar, rice, and wheat precisely, removing the need for manual weighing and ensuring that each recipient receives the exact allocated quantity.

The Smart Ration Distribution System integrates components such as **STM32 microcontrollers**, **RFID modules**, **ESP32 IoT modules**, and **GSM communication**, with data managed on a **Google Spreadsheet database**. This architecture enables real-time tracking of user transactions and stock levels, thereby enhancing transparency and preventing fraud. The system also supports OTP-based authentication, where users receive an OTP on their registered mobile numbers, adding an additional layer of security.

By automating the ration distribution process, this system minimizes human intervention, thereby reducing errors, preventing tampering, and ensuring efficient and equitable distribution of essential commodities. This approach not only modernizes the traditional ration distribution system but also strengthens its reliability, transparency, and accessibility for the public.

II. LITERATURE SURVEY

Cashless automatic rationing system by using GSM and RFID Technology, Sunil Kumar H U BE, M. Tech Lecturer, IEEE (ISMAC 2018), Ration system has many drawbacks such as inaccurate & human mistake and ration material cannot receive at any time and takes more money for ration material. This paper shows RFID & GSM can be used issues in ration to most accurate, efficient automatic distribution of ration materials.

Ration Distribution System in a Panchayat Level Using Automatic Dispenser Naveen B, Ajay M R, Akash H M (MysuruCon)- IEEE 2022 The quantity they receive is less than what the government provides, and there are complains about the product's quality. Additionally, it is formed by the shop workers who used to steal the materials. This paper Shows the Concept of OTP based Authenticating the User before purchasing the material.

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Real Time Automatic Ration Material Distribution System Pranjal Pedwa, Ms. Shubhangi Borkar CSE & Nagpur University, India (2016, IJCSMC) In this system having drawbacks, if not buy the materials at the end of the month, they will sale to others without any intimation to the government and customers. The proposed ration shop system is connected to the government database via GSM modules, which further sends the up-to-date information to the government and the consumer.

RFID and GSM based Rationing System using STM32 Aniket Satpute, Supriya Raut Jspm's Bhivrabai Sawant Institute of Technology and Research (2023, IJSREM) The smart ration card system using Radio Frequency Identification (RFID) Technique and IOT to prevent malpractices and corruption in the current ration distribution system. The user's identity is verified by a microcontroller that is connected to a database, and an OTP is sent to the user's registered mobile number for added security

Automatic Rationing Distribution System Dr. Jillella Venkateswara Rao Professor, Department of ECE, VITS, Hyderabad, TS, (India), IJARSE,2017 To distribute the ration using biometric of any one or the entire family members. The dealer in that area cannot sell the ration to black market. In this way the dealers' corruption can be reduced or avoided. This proposed project definitely paves way for a corruption reduced India in the future.

Automated Ration Distribution System Jinali Goradia, Sarthak Doshi, 2015 Published by Elsevier B.V PDS is one of the widely controversial officers that involves corruption and illegal smuggling of goods. The main reason is shop involves manual work and there are no specific high-tech technologies to automate the job. Our main objective here is to automate the process of the distribution.

III. Block Diagram

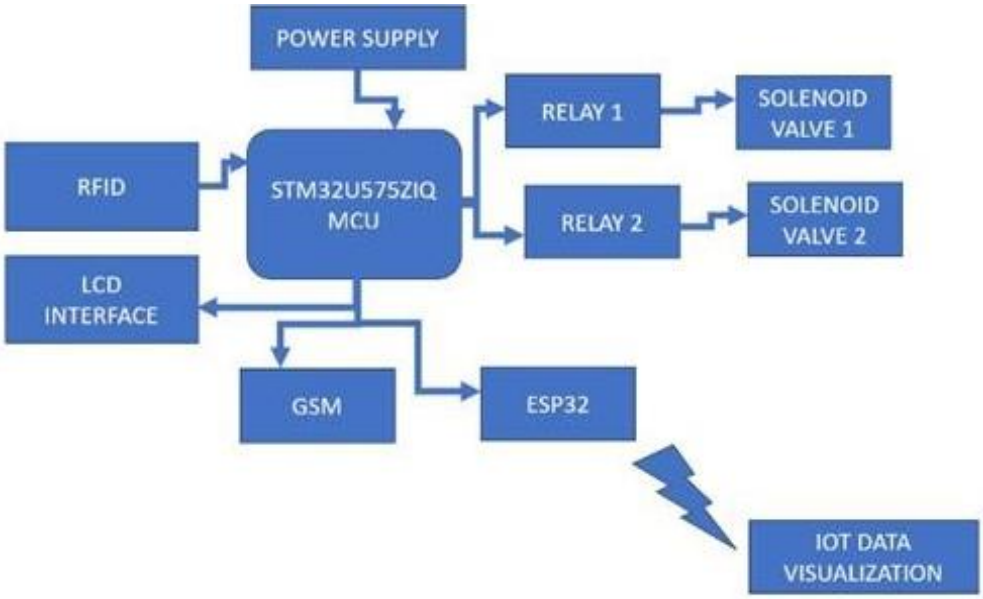


Figure 1

IV. Proposed Methodology

The Smart Ration Distribution System streamlines the process of new user registration. To enroll, a prospective user simply provides their essential information, such as name, address, and contact details, to the system administrator. The administrator then carefully verifies the accuracy of the provided information and manually adds the user's details to the Google Spreadsheet database, which serves as the system's central repository. Once the registration process is complete, the user receives a unique RFID card.The System operates seamlessly through RFID technology and OTP authentication. A user presents their RFID card, acting as their ration card, to the system. The system reads the card's unique ID and retrieves the user's information from the Google Spreadsheet database. If the user's details match the database records, they are eligible to receive ration products. To ensure security, the system sends an OTP to the user's registered mobile number. Upon successful OTP verification, the system authorizes the transaction and dispenses the ration products to the user. The entire process is automated and efficient, reducing manual intervention and eliminating potential errors or fraudulent activities.

V. Module Description

A. LCD Display

The figure-2 is a LCD display serves as the primary user interface, showing important information to users, such as authentication status, OTP confirmation, available ration quantity, and transaction success or failure messages. Here a 16x2 or 20x4 character display, it provides clear, real-time feedback that improves usability and guides users through each step of the ration collection process. The display is driven by the STM32 microcontroller, which updates the screen based on data from various modules.

Figure 2

B. GSM

The figure-3 is a GSM module that enables mobile communication within the system, primarily for OTP authentication and user notifications. It sends one-time passwords (OTPs) to the user's registered mobile number to confirm their identity before ration distribution begins. Additionally, it sends transactional alerts and notifications regarding ration availability and status. By connecting to the STM32 MCU, the GSM module ensures secure, real-time interaction between the system and the user's mobile device, enhancing both security and user engagement.

Figure 3

C. Solenoid Valve

The figure-4 is a solenoid valve which is an electromechanical device that controls the flow of ration commodities (such as rice or wheat) in precise amounts. Upon successful user authentication, the STM32 microcontroller signals the solenoid valve to open, dispensing the specified quantity of ration material. The valve closes automatically after distribution is complete, ensuring accurate measurement and preventing wastage or unauthorized distribution. This automation reduces manual intervention and improves distribution accuracy.

Figure 4

D. Relay

The figure-5 is a relay module acts as an electronic switch to control high-power components like the solenoid valve and other dispensers connected to the system. It receives signals from the STM32 MCU, allowing it to control power to the valve, motor, or other devices as needed. The relay module provides isolation between low power control circuits and high-power components, ensuring safe operation of the system and improving the durability of the hardware.

Figure 5

E. RFID

The figure-6 is a RFID module which is responsible for identifying and authenticating users. Each registered user is assigned an RFID card containing a unique ID, which is scanned by the RFID reader. When a card is scanned, the RFID module communicates the unique ID to the STM32 MCU, which then verifies the user's eligibility for ration distribution by cross-referencing their data in the Google Sheets database. This process ensures secure, non-replicable identification, enhancing system security and user accountability.

Figure 6

F. ESP32

The figure-7 is a ESP32 module which is a Wi-Fi-enabled microcontroller used for IoT communication in the Smart Ration Distribution System. It connects the system to cloud-based databases (such as Google Sheets) for real-time data storage and retrieval. The ESP32 facilitates data synchronization, logging each transaction (including purchase date and ration amount) to keep records up-to-date and enable remote monitoring. It communicates with the STM32 MCU, providing access to real-time data for accurate ration management and enhanced system transparency.

Figure 7

G. STM32U575ZIQ MCU

The figure-8 is a STM32U575ZIQ microcontroller unit (MCU) which is the central processing unit of the system, managing data processing, communication between modules, and control of the dispensing process. It receives input from the RFID, GSM, and ESP32 modules to verify user identity and eligibility, coordinates with the solenoid valve and relay module for precise ration distribution, and updates the LCD display with relevant transaction information. As the core component, it ensures synchronized operation, accurate data handling, and efficient management of all system functions. The STM32U575ZIQ's low-power, high performance design makes it ideal for reliable, continuous operation in this application.

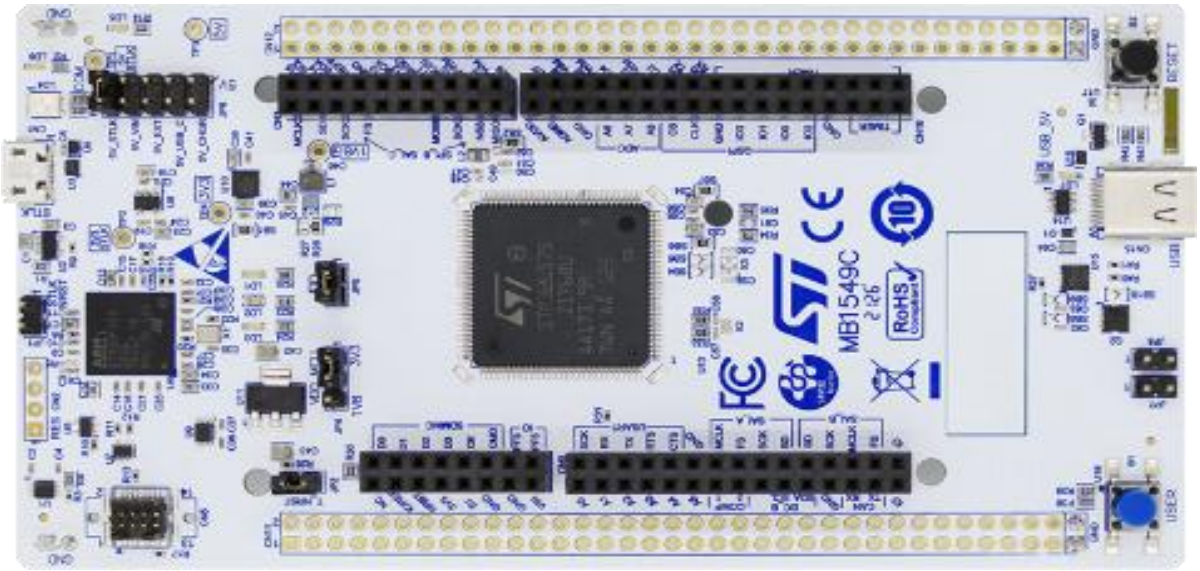
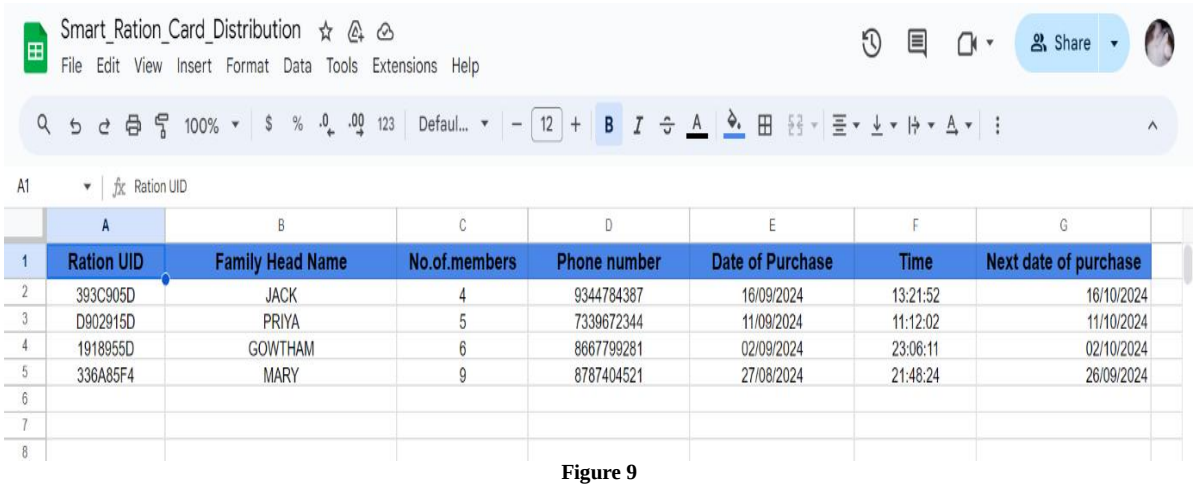


Figure 8

VI. REAL TIME EXPERIMENTATION

A. Data Base (Spread Sheet) For Records

This figure-9 sheet is used to store the data 's of the customer like customer's **RATION UID, FAMILY HEAD NAME, NO.OF. MEMBERS, PHONE NUMBER, DATE OF PURCHASE, TIME and NEXT DATE OF PURCHASE.**


Smart_Ration_Card_Distribution

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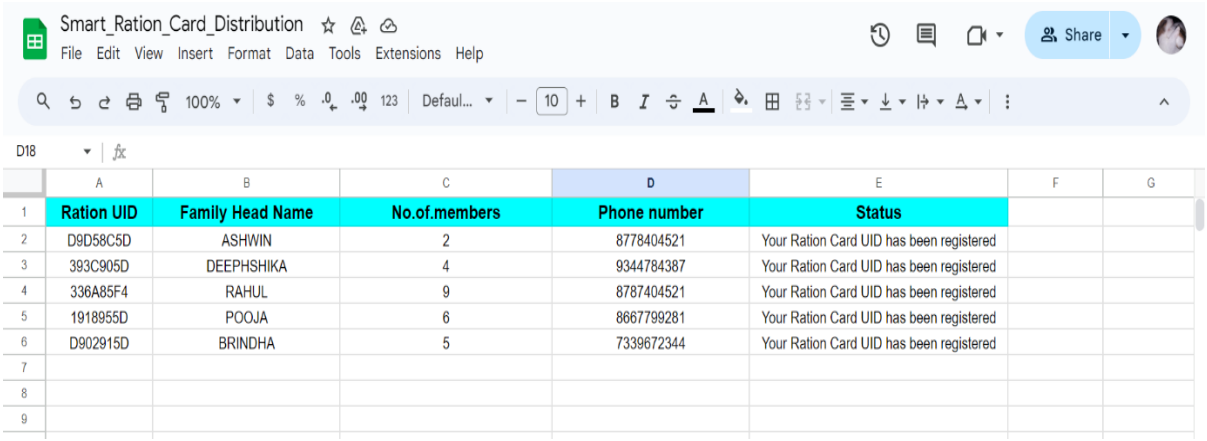
A1 Ration UID

	A	B	C	D	E	F	G
1	Ration UID	Family Head Name	No.of.members	Phone number	Date of Purchase	Time	Next date of purchase
2	393C905D	JACK	4	9344784387	16/09/2024	13:21:52	16/10/2024
3	D902915D	PRIYA	5	7339672344	11/09/2024	11:12:02	11/10/2024
4	1918955D	GOWTHAM	6	8667799281	02/09/2024	23:06:11	02/10/2024
5	336A85F4	MARY	9	8787404521	27/08/2024	21:48:24	26/09/2024
6							
7							
8							

Figure 9

B. Data Base (Spread Sheet) For New Registration

This figure-10 sheet is used to store the data 's of the customer when they come for new registration. It shows customer's **RATION UID, FAMILY HEAD NAME, NO.OF. MEMBERS, PHONE NUMBER and STATUS OF REGISTRATION.**


Smart_Ration_Card_Distribution

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D18

	A	B	C	D	E	F	G
1	Ration UID	Family Head Name	No.of.members	Phone number	Status		
2	D9D58C5D	ASHWIN	2	8778404521	Your Ration Card UID has been registered		
3	393C905D	DEEPHSHIKA	4	9344784387	Your Ration Card UID has been registered		
4	336A85F4	RAHUL	9	8787404521	Your Ration Card UID has been registered		
5	1918955D	POOJA	6	8667799281	Your Ration Card UID has been registered		
6	D902915D	BRINDHA	5	7339672344	Your Ration Card UID has been registered		
7							
8							
9							

Figure 10

VII. MERITES

1. **Enhanced Security through Biometric Authentication**: Aadhaar-based biometric verification ensures secure and accurate customer identification, eliminating the possibility of unauthorized access and reducing the chances of fraud or misuse.
2. **Accurate and Consistent Ration Distribution**: The automated dispensing mechanism ensures precise, human-free distribution of ration materials such as wheat, rice, and sugar, providing each recipient with the exact allocated quantity and reducing errors in measurement.
3. **Real-Time Data Tracking and Transparency**: By using IoT to track and store transaction data in real time, the system provides improved transparency and accountability, helping to prevent data manipulation and stock discrepancies.
4. **Reduced Corruption and Unauthorized Manipulation**: The digital, automated system minimizes human intervention, reducing opportunities for corruption, such as illegal diversion of goods or unauthorized data alteration.
   Efficient Stock Management: Real-time tracking of stock levels and automated data updates enable more efficient and responsive stock management, ensuring adequate supplies are maintained and wastage is minimized.
5. **Improved User Experience with OTP-Based Security**: The inclusion of OTP-based authentication enhances security while providing users with a convenient and straightforward verification process, ensuring equitable access to rations.

VIII. ABBREVIATION

RFID – Radio – Frequency Identification
GSM – Global System for Mobile Communication
IOT – Internet of Things
MCU – Microcontroller
OTP – One Time Password

IX. WORKING MODEL

Figure 11. Final Project view (Front view)

Figure 12. Output Valve (Front view)

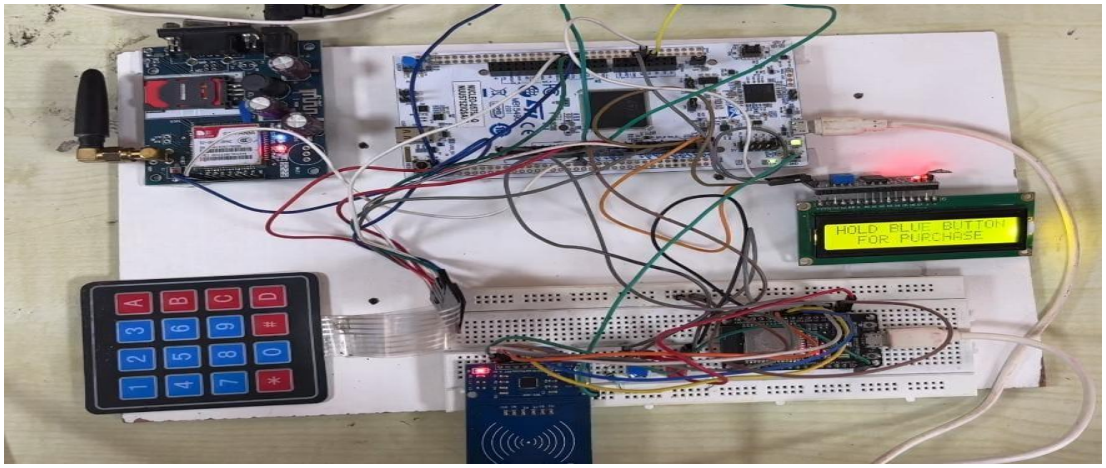

Figure 13. Circuit and Connection (Top view)

X. RESULT AND DISCUSSION

The proposed **Smart Ration Distribution System** addresses critical challenges in India's public distribution system by introducing automation, IoT integration, and Aadhaar-based biometric verification to replace traditional manual processes. This system ensures precise, error-free ration distribution by eliminating human intervention, thereby preventing issues like inaccurate weighing, unauthorized data manipulation, and corruption. By securely identifying beneficiaries through biometric authentication and tracking transactions in real-time via cloud base databases, the solution increases transparency, reduces fraud, and improves stock management. The adoption of OTP-based verification further enhances security, ensuring that only verified users access their entitled rations. Overall, this system promises a more efficient, reliable, and equitable method for distributing essential commodities, enhancing both operational accuracy and public trust in the ration distribution process.

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