

A Review on Biometric-Based Automated Ration Distribution Systems with LCD and SMS Integration

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Abstract

Corruption, human errors and leakages of resources are some of the high-level challenges facing the traditional ration distribution mechanism. The solution to these problems is presented in this review, which discusses biometric-based automated ration systems combined with the Liquid Crystal Display (LCD) and SMS notification modules. The suggested solution will guarantee safe authentication of beneficiaries, real-time access to transactions, and good interaction between members and operators. Comparative essay on the applied technology also shows the main shortcomings and advantages. This paper also addresses the possibility of improving transparency, accountability, and operational efficiency of automated ration management using blockchain, cloud computing, and computer vision. **Keywords:** Biometric Authentication, Automated Ration System, LCD Display, SMS Notification, IoT, Public Distribution System (PDS), Transparency.

1. Introduction

Some of the well-known challenges that have seen continuous interference in the traditional ration distribution system in India are corruption, data manipulation and lack of transparency because of manual operations and paper records. To address these constraints, scholars and engineers are working on automation with the current technologies such as biometrics and the Internet of Things (IoT). In such systems, the use of a manual check is substituted by biometric verification that is done by fingerprints and only the verified beneficiaries access the rations that are allocated to them. The system enables real-time information about transactions (one can know how much has been dispensed and the balance left) through the integration of LCD display modules as SMS helps to improve communication and trust between users and the operators. This review identifies the main technological developments, obstacles, and gaps in the creation of biometric-based systems of ration with the LCD and the SMS functionalities. The discussion highlights how the said integrations can enhance transparency, accountability, and user satisfaction in the ration distribution process in India.

2. Literature Review

Ration Distribution Biometric Authentication.

Biometric authentication is one of the most sure ways of identity verification in a public distribution system. Sharma et al. [1] came up with the idea of a fingerprint-based smart ration distribution system, which will make sure that the ration allocated to the beneficiaries goes to the right individuals only. It operated on a microcontroller based system with a biometric sensor that was used to identify people. Nevertheless, it was not very transparent and aware of its users due to the absence of communication and feedback mechanisms. On the same note, Patil and Joshi [2] designed a biometric rationing system based on Aadhaar verification in which the fingerprint sensor was connected to a central government database. Even though this method was better than the previous one in terms of security, it needed an active internet connection, and lacked user-side communication such as LCD or SMS messages.

Smart Rationing IoT and Embedded Systems.

The invention of the IoT and embedded systems has enabled it. eased automatization in the allocation of rations. Kumar et al. [3] proposed a ration system that is automated based. using Node MCU, sensors, and Wi-Fi to interact on the IoT. transmit data in real-time. This minimized the human supported user transparency but lacked user involvement. Another system by used Raspberry Pi and IoT sensors. Reddy et al. [4] to track food inventory and automated theirs. distribution. However, the system did not have such. which are the GSM or the LCD screen, communication units. made the system less accessible in the rural. low internet connections environments.

Transparency Role of LCD Display

LCD screens are important units of visual display that helps in building trust and transparency both between the system beneficiaries. Singh and Deshmukh [5] also suggested a smart ration vending machine where the transaction details were displayed on an LCD screen with the amount dispensed as well as the balance left displayed. The system contributed to eradicating the misunderstandings between the users and the operators. Nonetheless, in the absence of the support of notifications, users were not able to check the transactions remotely. Real-time feedback achieved through the integration of an LCD and biometric authentication will enhance the level of trust in the user and minimize the number of confrontations at the distribution points.

GSM/SMS-Based Systems on Notification.

GSM-based SMS notifications can be used to enhance communication between the ration center and the beneficiaries. Gupta and Raina [6] implemented a GSM-based ration distribution system with the use of SMS. All the users were given a confirmation message upon ration collection. This system enhanced

accountability but was not secure in authentication because it used card based identification. GSM integration with the biometrics and LCD display can, therefore, result into a complete and dependable system that guarantees the safety and the transparency of information.

3. Problem Identification / Research Gap

Nevertheless, even with the developments of automated distribution of rations, there are still a number of challenges associated with the current systems:

Poor Distribution Disclosure: Most systems are authenticated (biometric or RFID) and fail to present the user with real-time transaction details. The amount of dispensed and the remaining quota cannot be verified at the moment by the beneficiaries which can bring into conflict.

Poor Communication with the Users: SMS notifications are only integrated with a small number of systems. Absence of instant alerts makes accountability low and they cannot easily monitor their transactions remotely.

Internet or High-Tech Infrastructure Dependence: Rural environments do not have reliability to Aadhaar-based systems or IoT systems because of the need to have internet connectivity all the time. This limitation can be overcome by offline biometric verification with GSM SMS notification.

Disjointed Technological Integration: The majority of systems concentrate on either a single or two areas, i.e. authentication or monitoring. Not many systems combine such features as biometric authentication and LCD display with SMS notification all into one platform.

Research Gap: A full-fledged, dependable smart ration distribution system is required which integrates: Ensure biometric validation, Transparency through real time LCD display, and Instant communication notification with beneficiaries through SMS.

4. Proposed Model

System Architecture

Biometric-Based Automated Ration Distribution System that is proposed is an integration system that is capable of accommodating both hardware and software to provide the ration in a secure, transparent, and efficient way. The architecture is mainly made of:

Biometric Sensor Fingerprint

Fingerprint of each beneficiary is already registered in the database and correlated to ration card. In conclusion, the user can make a transaction by simply placing his finger on the sensor and then the system identifies him or her. This assists in preventing fraud, duplication of records and only genuine beneficiaries are rationed.

ESP8266 Wireless Controller

It is a miniature controller which functions as the brain of the system. It also performs communication with all the modules like the biometric sensor, LCD and the GSM/SMS module and dispensing unit. Once the user has been authenticated, it will activate the dispenser, refresh logs and issue notifications.

LCD Display Module

The LCD will be displayed to provide real time feedback to the user such as dispensed ration, remaining balance and confirmation messages. This increases transparency and the users find it easy to come up with an insight of the process.

GSM/SMS Alert System

Each sale, after it is made is automatically sent as an SMS to the registered mobile number. The date, quantity of item dispensed and quota remaining are put in the message. This generates confidence and keeps the users informed.

Ration Dispensing Unit

It is a dispensing system that dispenses a specific amount of ration with the assistance of a servo or motor system once the authentication process has been carried out. This reduces the chances of human error, excess or insufficient distribution.

Database Design

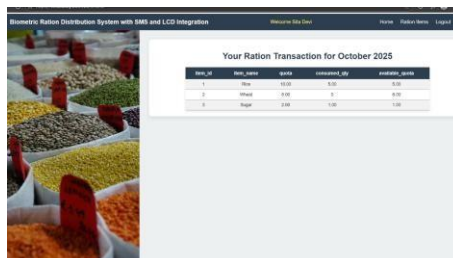
The database forms the basis of the system where all the information about the users as well as the records of the transactions are stored safely. It happens to be correct, consistent and information can be easily retrieved. The database comprises to a great extent two tables:

User Table

- ID User ID Fingerprint-linked id.
- Name – Beneficiary’s full name.
- Authenticate by Fingerprint Data Encrypted biometric data.
- Annual/burgh District Allocation Ration- Monthly/periodic ration quota.
- Remaining Ration -It is updated each time there is a transaction.
- Mobile Number - To get SMS notifications.

Dispense Data Table

- Transaction ID Unique transaction Id.
- User ID- This refers to a connection to the beneficiary.
- Kind of grains -e.g. wheat, sugar, etc.
- Weight – Quantity dispensed.
- Date & Time- Date of the transaction.
- Status SMS Status This field shows the success of transfer of the SMS.
- LCD Info- The information that is displayed to the user during dispensing.



5. Research Methodology

Power Supply: The micro controller and other parts attached to it operate with the use of external AC adapter that provides the necessary power. Microcontrollers do not generally possess the voltage regulation elements hence to secure that the microcontrollers run at proper voltage levels an external power circuit is required. To render the system safe the primary switch regulates the overall circulation of power.

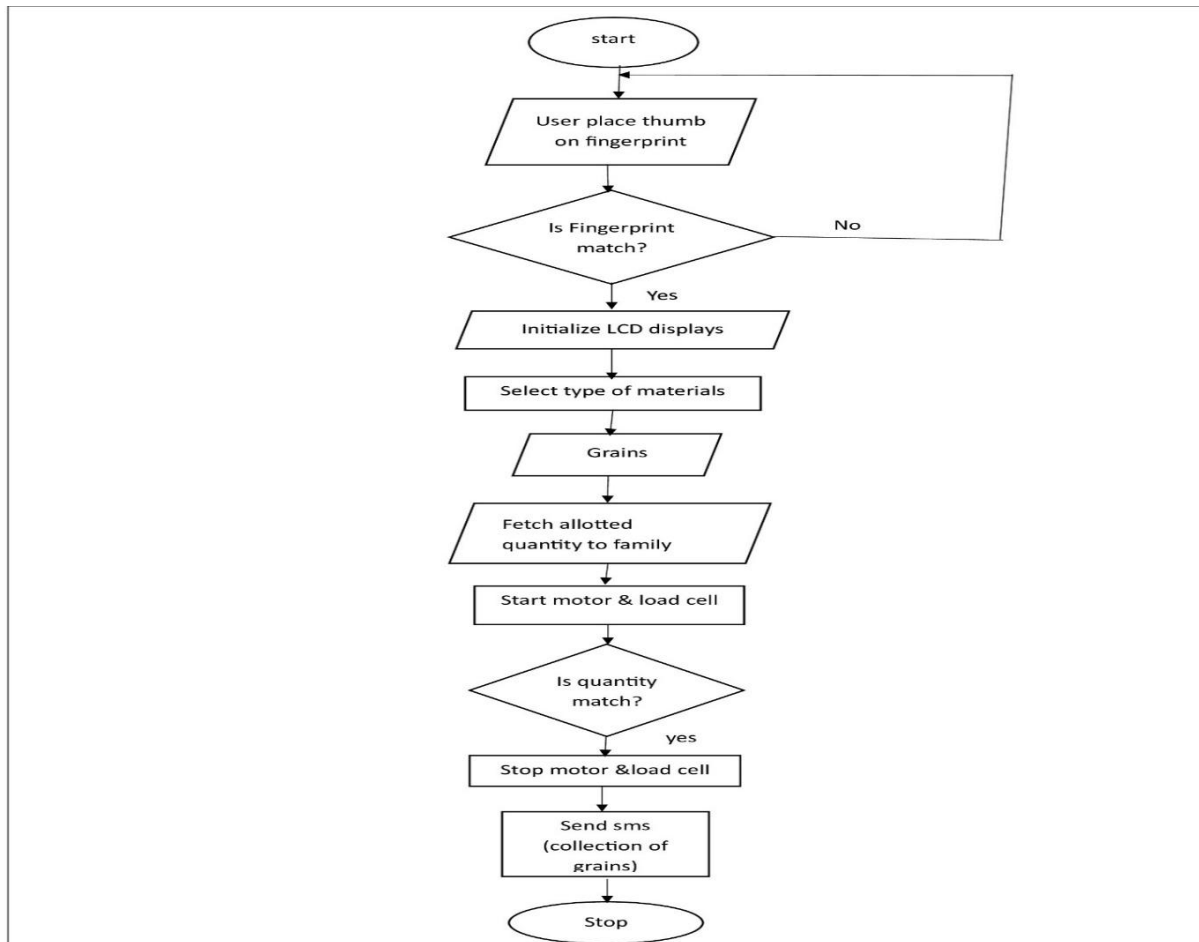
DC Motor: A DC motor is one of the electromechanical motors, which converts electrical energy into a mechanical motion through the principle of electromagnetic induction. There is the principle that describes how a magnetic field can act upon an electric-carrying conductor resulting in its rotation. The motors are also used in automated processes in which a need to possess automated movement that is highly controlled and precise.

Load Cell: One of the significant components of the measurement and weighing unit in the system is the load cell. It converts the force/weight applied into electric signal. Application of HX711 amplifier module improves the accuracy and sensitivity of this product and therefore it can be used in the situation where the weight accuracy and sensitivity of signal are needed to be high and efficient.

Demand Forecasting: Demand forecasting is utilized in the estimation of number of commodities that are needed, according to the trend of past utilization. The system will also be in a position to predict the future demand through comparison of past demand and supply hence ensuring that appropriate quantities of the ration will be available to be distributed. This helps in reduction of shortages and overstocking.

Inventory Management: The issue of inventory management is concerned with keeping the optimum inventory to reduce wastage, and simultaneously, ensuring that stock is available. Another aspect that is followed through the system is the inventory which is followed through the supplies received and the commodities distributed. Good inventory management implies that what is needed by the beneficiaries is there when they are needed and instances of high stock outs are reduced.

Supply Channels: Distribution system can offer the functionality of the system through various channels and they can be modified basing on the abilities of the system and the concentrations of input to sustain the functionality of the system. This is because it is flexible thus it can manage its resources effectively and it can easily distribute its ration to the beneficiaries Working Flow :



6. Future Innovation

Tap Card Integration: The system will be accommodating the use of NFC-based Tap Card technology that will undergo biometric authentication to enhance user identification and security of transactions.

AI-based Ration Prediction: It is possible to predict the needs of a ration based on consumption patterns with the help of artificial intelligence (AI) models. The approach can be useful in enhancing the structuring and distribution of a food supply.

Mobile Application Development: It will introduce a convenient mobile application which will enable checking the ration availability, follow-ups order, and get instant updates. **Nationwide Scalability:** The Smart Ration System will be extended to national scales and interconnecting to the local distribution systems and ensuring that the Smart Ration System applies an equal amount of access to all people in all regions.

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7. Conclusion

In India, the Public Distribution System (PDS) is an important tool in facilitating access to the basic food resources, though it suffers due to such problems as corruption, leakage of resources, and low transparency rates that are due to manual operation. This review indicates the possibilities of combining the biometric authentication system, LCD screen, and SMS to establish a safer, more transparent, and convenient automated system of ration distribution. Biometric verification also prevents distribution of rations to wrong beneficiaries, and real time transaction information and SMS notification in the LCD also enhances communication and trust. Also, IoT and embedded systems will be able to simplify the processes even in the rural places with limited connectivity. Ration optimization can be further enhanced in future developments such as the integration of Tap Card, ration prediction with the help of AI, as well as expanding the solution to nationwide scales. On the whole, the suggested smart ration distribution system may be considered an important milestone concerning the transparency, accountability, and efficiency of PDS operations.

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