Eration-Hub: An Automated Food Dispensing System

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Abstract- The development of "E-Ration Hub", an automated food dispensing machine for ration shops, aims to modernize and streamline the distribution of essential food supplies to beneficiaries under public distribution systems (PDS). Traditional ration shops often face challenges such as manual errors, long waiting times, corruption, and inefficiencies in delivering subsidized food items to deserving individuals. This project introduces an automated system integrated with advanced technologies to ensure accuracy, transparency, and user convenience.

The machine's automation not only reduces labor costs but also improves efficiency, minimizes human errors, and enhances the overall user experience. By promoting transparency and fairness in food distribution, the E-Ration Hub can significantly contribute to strengthening public trust in ration shops. Furthermore, it addresses the challenges faced in rural and urban settings, ensuring equitable access to subsidized food supplies.

This project represents a sustainable and scalable solution to modernize ration shops, aligning with the goals of Digital India and smart governance initiatives.

Keywords- Automation, Transparency, User convenience, Scalability

I. INTRODUCTION

The **E-Ration Project** is a cutting-edge solution aimed at improving the efficiency and transparency of ration distribution systems. By leveraging face recognition technology, the platform ensures secure and seamless user authentication, allowing individuals to register by capturing their face images, which are later used for login verification. This ensures that only authorized users can access sensitive ration-related information, reducing the risk of fraud and unauthorized access.

The system includes a user dashboard, where users can place orders for ration items, track their requests, and file complaints if needed. The complaint system ensures that users' concerns are addressed in a timely and efficient manner. Additionally, the platform allows users to make updates to their personal details, making the process more flexible and user-centric.

On the administrative side, the admin dashboard provides comprehensive controls for managing the overall system. Admins can monitor and update ration inventory, review and respond to user complaints, and manage user accounts. This role-based access system ensures that each user and admin have the right level of access and control over the platform's features. With this streamlined approach, the E-Ration Project enhances transparency**,** security**,** and accessibility, addressing common challenges faced by traditional ration distribution methods.

Ultimately, the project aims to foster efficiency, accountability, and sustainability in ration distribution, making it easier for both users and administrators to manage the process effectively**.**

II. EXISTING SYSTEM

The Public Distribution System (PDS) in ration shops was largely manual and paper-based. Beneficiaries had to visit their assigned Fair Price Shops (FPS) with their ration cards, where the shopkeeper would verify their identity and manually record the transaction in a register. Commodities like rice, wheat, sugar, and kerosene were weighed using traditional scales, which often led to inaccurate measurements and under-supply. The lack of digital tracking allowed some shopkeepers to divert food grains to the black market or forge records, leading to widespread corruption and leakage in the system. Since records were not digitized, it was difficult for government

authorities to monitor stock levels, verify transactions, or ensure that the right person received the right amount. There were also issues like duplicate or fake ration cards, long queues, and limited working hours, which made the process inconvenient for the beneficiaries. Overall, while the manual system aimed to provide food security to the poor, it faced serious challenges in terms of transparency, efficiency, and accountability.

***Fig 1**. Manual ration distribution at ration shop*

III. PROPOSED SYSTEM

Eration-hub in ration shops brings numerous benefits that can greatly improve the Public Distribution System (PDS). These machines ensure transparency by digitally recording every transaction, including the time, date, quantity, and details of the beneficiary. This minimizes the chances of fraud and makes monitoring and auditing much easier for government authorities. Biometric or Aadhaar-based authentication ensures that only eligible individuals receive their rations, effectively eliminating issues like fake ration cards, duplicate entries, and identity fraud. Moreover, the machines are programmed to dispense accurate quantities of goods, preventing under-weighing and ensuring fairness in distribution. By reducing human intervention, they also help in avoiding corruption, mismanagement, and black marketing of essential commodities.

Another key advantage is the convenience they offer to beneficiaries. Automated machines can potentially operate 24/7, giving people the flexibility to collect their rations at any time, which is especially useful for those with tight or irregular work schedules. The system also allows for real-time tracking of inventory and transactions, enabling authorities to manage stock efficiently and detect any irregularities immediately. Additionally, the digital nature of the process reduces the need for paper records, supporting an eco-friendly and paperless system. Overall, the introduction of **Eration-hub** in ration shops makes the PDS more efficient, secure, user-friendly, and transparent, ultimately benefiting both the government and the public.

Despite the many advantages, the successful implementation of automated dispensing machines also requires addressing certain challenges. Initial setup costs can be high, especially in rural areas where infrastructure like electricity, internet connectivity, and technical support may be limited. There is also a need to educate and train both beneficiaries and ration dealers on how to use the machines effectively, especially in areas with low digital literacy. Regular maintenance, timely software updates, and having a manual backup system in case of technical failures are equally important to ensure uninterrupted service. If these challenges are carefully managed, automated dispensing machines have the potential to bring about a significant transformation in the public distribution system, making it more modern, inclusive, and reliable for all sections of society.

***Fig 2**. Starting interface of the system*

IV. SYSTEM DESIGN AND IMPLEMENTATION

The **E-Ration Project** is designed to provide a seamless, secure, and efficient platform for ration distribution. It combines face recognition technology with a web-based interface to manage user authentication, ration stock, and complaints. The system is modular, meaning each part of the process is handled by a dedicated module. Below is a detailed description of the key modules and their respective functionalities

IV.1. User Registration Module:

The **User Registration Module** enables new users to create an account within the system. It ensures the accuracy and security of user identity by integrating face recognition technology during registration.

Process:

A. User Registration Form:

- Users are required to fill out personal information, including their **name**, **contact number**, **address**, and **email**.
- This data is stored in the system's database for later reference and communication.

B. Photo Capture:

- During registration, users are asked to upload or **capture a clear photograph** of themselves using their webcam or smartphone camera.
- The photograph is processed using **face recognition technology** (e.g., **OpenCV** or **Dlib**) to

create a unique facial feature profile that will be used for subsequent logins.

C. Face Data Storage:

- The captured image is **stored in the database** along with other personal information.
- The system extracts **unique facial features** from the image and stores them as a reference for future authentication.

D. Verification:

- Once the user has registered, the system verifies the data and stores it securely in the database.
- The user receives a **confirmation message** upon successful registration and can now proceed to the **login** phase

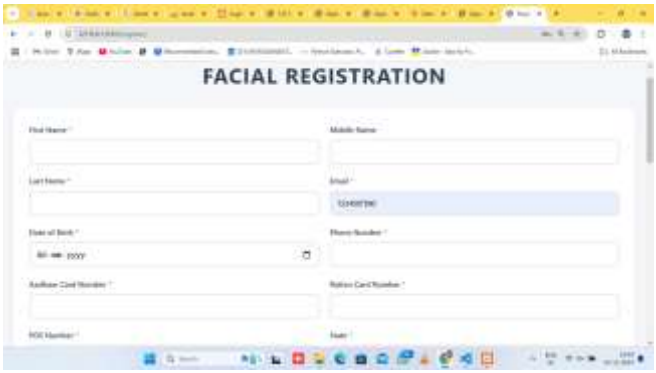

***Fig 3**. User registration*

IV.2. Login Module:

The **Login Module** enables users to access the system by verifying their identity using face recognition technology, ensuring that only registered users can access their accounts.

Process:

A. Login Interface:

- Users are presented with a **login screen**, where they are prompted to click a **"Login"** button to begin the authentication process.

B. Face Recognition Authentication:

- The system prompts the user to **capture a live photograph** using their device's camera (webcam or smartphone).
- The captured image is then compared with the **facial features** stored during the user's registration.
- If the **match is successful**, the user is granted access to their personal **dashboard**.
- If the match is unsuccessful, the system notifies the user that the **face recognition failed**, and they can try again or contact support for assistance.

C. Session Management:

- Once the user logs in successfully, the system creates a **secure session** that allows the user to interact with the application until they log out.
- The session is maintained using **secure cookies** and **token-based authentication** to ensure data privacy and security.

***Fig 4**. User's login interface*

IV.3. User Dashboard

The **User Dashboard** is the core interface for users once they have logged into the system. It provides users with several functionalities to manage their ration-related activities, file complaints, and place orders.

Key Features:

A. Complaints Management:

- Users can **file complaints** related to ration delivery, quality, or other issues.
- The complaint form allows users to **describe the problem**, upload **images** if needed, and **submit the issue** to the system.
- Complaints are categorized based on urgency (e.g., urgent, general, non-urgent) and flagged for review by the admin

B. Order Ration Items:

- Users can browse a catalog of available ration items, including essentials such as rice, wheat, sugar, and pulses.
- The system displays **stock levels** for each item and allows users to **order** their desired quantity.
- Once an order is placed, users receive an order ID and can track the status of their order (e.g., pending, dispatched, delivered).

C. Personal Information Updates (Permanent Module):

- Users can update their **personal information** (e.g., address, contact details) within the dashboard to ensure accurate communication and delivery.
- The system ensures that only the authenticated user can update their data, and all changes are securely recorded in the database.

D. Order History:

- The dashboard displays a history of **previous orders**, allowing users to track and review their past ration purchases.

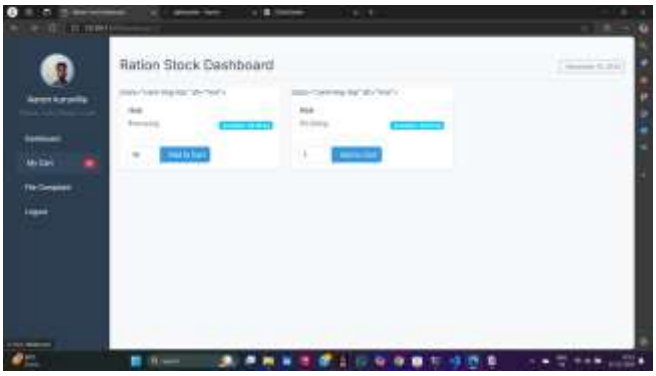

***Fig 5**. Dashboard page where stock availability is shown*

IV.4 Admin Login

Admins can securely log in to the backend of the system using their **username** and **password**. The admin login ensures that only authorized personnel can access the admin dashboard and manage critical aspects of the system.

Process:

- Admins enter their **username** and **password** on the login page.
- The system verifies the credentials against stored data and grants access to the **admin dashboard** upon successful authentication.
- Admin login is protected by additional security measures such as **two-factor authentication** or **CAPTCHA** to prevent unauthorized access.
- All login activities, including failed and successful attempts, are recorded to ensure transparency and traceability.
- If incorrect credentials are entered repeatedly, the system temporarily locks the account or sends an alert to the admin's registered contact for security reasons.

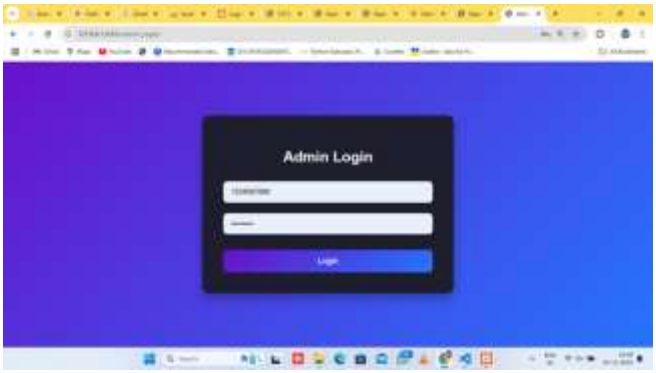

***Fig 6**. An interface used by admin*

IV.5 Admin Dashboard

The **Admin Dashboard** provides system administrators with the necessary tools to manage ration stock, monitor complaints, and manage user data. The dashboard is the heart of the **Admin Module**, allowing administrators to perform various actions related to user and stock management.

Key Features:

A. Stock Management:

- Admins can view and **update ration stock** levels in real-time. This includes adding new items, updating quantities, and removing expired or damaged items.
- The system tracks **stock usage** and provides notifications when stock levels fall below the threshold, prompting the admin to replenish the stock.
- Admins can view **detailed reports** of ration item usage, ensuring that stock management is optimized.

B. User Management

- Admins have the ability to **view and edit user data**, including personal information, order history, and complaint records.
- They can deactivate or delete user accounts if necessary (e.g., in cases of fraudulent activity or violation of system terms).
- Admins can reset user passwords or assist users with login issues.

C. Complaint Monitoring:

- The admin dashboard allows admins to **view and manage complaints** submitted by users.

- Admins can assign complaints to relevant departments or personnel for resolution, track the status of complaints, and update users about the progress of their issue.
- Admins can categorize complaints based on urgency and importance, ensuring that critical issues are prioritized.

D. Reporting and Analytics:

- Admins have access to various **reports and analytics** related to stock usage, complaints, and user activity.
- These reports help administrators identify trends (e.g., which items are in high demand) and improve decision-making.

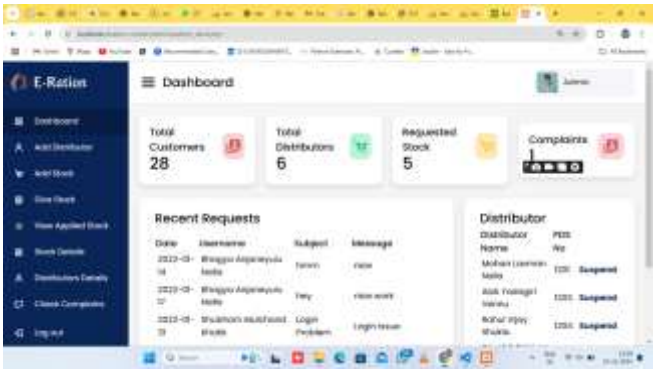

***Fig 7**. Admin's Dashboard*

IV.6. Face Recognition Integration

Face recognition technology plays a central role in ensuring that only authorized users can log in and access the system. It helps streamline the authentication process, reducing the risk of unauthorized access.

Process:

- **Image Capture**: The system uses the device camera to capture the user's face during both registration and login.
- **Feature Extraction**: The captured image is processed using libraries like **OpenCV** or **Dlib** to extract unique facial features.
- **Matching Algorithm**: The extracted features are compared with the stored image data to verify the user's identity.
- **Database Integration**: The feature profile is securely stored in the database, and comparisons are made with incoming images during login.

V. SYSTEM ARCHITECTURE

The E-Ration system operates on a client-server architecture designed to efficiently manage user data, ration distribution, and face recognition functionality. This system architecture ensures scalability, flexibility, and streamlined user interaction. Here's a detailed breakdown of the components involved:

The frontend is built using React.js, providing an interactive and responsive user interface. It handles essential user interactions, including face recognition login, order placement, complaint tracking, and updating personal information. React's component-based architecture enhances maintainability and allows for the reuse of UI components across the application. By using state management tools like Redux or the React Context API, the frontend ensures that application data—such as user details, orders, and complaints—are updated in real time. Communication between the frontend and the backend is asynchronous, using APIs such as Axios or the Fetch API for seamless data exchange without requiring page reloads. This responsiveness improves the overall user experience.

The backend of the system is powered by either Flask or Django, two widely used Python web frameworks. Flask is a lightweight framework ideal for smaller, more straightforward applications, offering flexibility and ease of integration with external tools like face recognition libraries (e.g., OpenCV or Dlib). It is especially suitable for microservices or projects with minimal feature sets. Django, on the other hand, is more feature-rich and is best suited for larger, more complex applications that require robust built-in functionalities like user authentication, an admin panel, and an ORM for database interaction. Both frameworks support essential backend functions such as user authentication, face recognition integration, and API endpoint management for the frontend.

The system's database is designed to handle various data types, including user information, ration inventory, order history, and complaints. The choice of database can either be MySQL or PostgreSQL, depending on the needs of the system. MySQL is known for its speed and efficiency, making it a good fit for systems with high read operations and simpler data structures. It's ideal for applications that require fast query responses. PostgreSQL, on the other hand, offers advanced features such as complex query handling, data integrity, and support for JSON data types. It's better suited for applications that demand complex data relationships and high consistency, especially as the system scales.

A crucial component of the system is face recognition, which is implemented using OpenCV or Dlib. OpenCV, a robust open-source computer vision library, provides powerful tools for image processing and face detection. It can recognize faces using pre-trained models like Haar cascades or deep learning-based approaches, ensuring reliable face authentication during user login. Dlib offers even higher accuracy, providing facial landmarks detection

and advanced face recognition models that perform well under varying lighting conditions and facial expressions. This technology ensures that only authorized users can access their accounts, increasing security and reducing the risk of impersonation.

The hosting platform is crucial for ensuring the system's scalability, availability, and performance. AWS and Heroku are two common hosting options, each with distinct advantages. AWS provides a comprehensive cloud computing solution with scalable services like EC2 for virtual servers, RDS for managed databases, and S3 for file storage. This makes it ideal for systems that require flexibility and scalability to handle large amounts of traffic and data. Heroku, on the other hand, is a platform-as-a-service (PaaS) that simplifies deployment and management. It is particularly useful for smaller projects or quick deployments, offering seamless integration with various add-ons and easy scalability.

The software stack includes Python for backend development, with Flask or Django as the web frameworks. JavaScript, particularly React.js, is used for the frontend to create an engaging and dynamic user interface. The system integrates libraries like OpenCV or Dlib for face recognition, enabling accurate identification of users based on their facial features. MySQL or PostgreSQL databases store the system's data, with MySQL being suitable for simpler, faster applications and PostgreSQL ideal for more complex needs requiring advanced querying and data relationships. For web hosting, AWS or Heroku is used to ensure the system remains highly available, scalable, and secure.

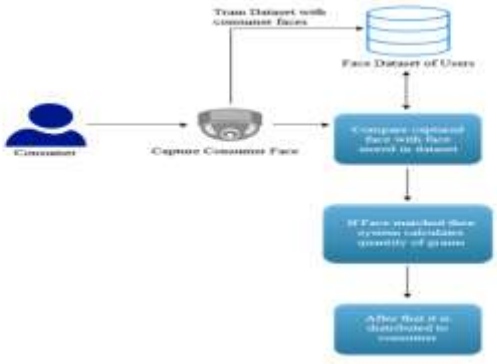

***Fig 8**. A flow diagram of the process*

VI. CONCLUSION

The **E-Ration Project** has successfully achieved its goal of enhancing the ration distribution system by introducing modern technology, particularly **face recognition**, to ensure **security**, **efficiency**, and **accessibility** for both users and administrators. The integration of biometric authentication ensures that only legitimate beneficiaries can access their rations, while the user-friendly interface and comprehensive admin dashboard make the system easy to manage and operate.

The scalability and flexibility of the platform set the stage for future enhancements, ensuring that the E-Ration system can evolve with the growing needs of society. As the project progresses, the integration of mobile applications, expanded biometric features, and machine learning-based optimizations will continue to refine and enhance the user experience, making ration distribution even more effective, secure, and accessible for all users.

The **E-Ration Project** not only modernizes the ration distribution process but also serves as a model for the future of digital public service delivery systems, ensuring that resources are distributed in a fair, transparent, and secure manner.

The **E-Ration Project** represents a significant leap forward in the modernization of ration distribution systems, integrating cutting-edge **face recognition technology** with secure, user-friendly features to improve accessibility, efficiency, and transparency for both users and administrators. The project effectively addresses several challenges in the traditional ration distribution system, including ensuring the **authenticity of beneficiaries**, streamlining the **registration** and **login processes**, and providing an organized and **transparent dashboard** for both users and administrators.

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