

DEEP LEARNING CONCEPT TO IMPLEMENT PUBLIC RATION DISTRIBUTION SYSTEM USING MACHINE LEARNING

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ABSTRACT

Public Ration Distribution System is one of the biggest welfare programmes of the government, helping farmers sell their produce at remunerative prices as well as the poorer sections of society to buy food grains at affordable rates. The paper proposes a design for IOT based Machine Learning and Deep Learning with a capability of ration distribution without counterfeiting. Using the concept of Resnet-34 for facial authentication while distributing commodities and SMS based monitoring allows monitoring by citizens so they can register their mobile numbers and send/receive SMS alerts during dispatch commodities. The use of robotics' to reduce the manual work and time with the help of Arduino controllers which is going to measure the goods accurately and update the information regarding ration distribution, transactions and ration card holder information in a digital format on the centralized database.

Keywords: Distribution, Counterfeiting, Centralized Database, Monitoring, Digital Format.

I. INTRODUCTION

The conventional system of public Ration Distribution was established by Indian Government in February 1944 under the department of Ministry of Consumer Affairs, Food and Public Distribution to distribute essential food and fuel items to the people below poverty line. There are various ration shops in several states across the country. In order to get the ration, people have to go to the ration card which contains all the details such as address, name and age of all family members. There is a fixed amount of ration to be given to the customer and the entry of transaction is made in ration card. This is the complete process that is carried out. However, this system has loopholes too. [1]

Many a times customers are fooled by giving them the less quality and a poor-quality ration. Thus, ending up paying more money for the less quantity and quality of ration. The advantage of this situation is taken by the people working in ration stores. They often manipulate the records of ration for their personal benefits. It gives rise to corruption. As the process is manual and there is no central database to monitor the activities of ration shops, there is no transparency in this system. Even if customers find any trickery, there is no complaint system for the same and hence people suffers. [1]

The project relies on counterfeiting free ration distribution for needy people by counting facial authentication by using resnet-34 convolutional neural network, Aadhaar card identification to identify user's during each distribution by comparing it with encrypted aadhaar number stored in database which is the encrypt form of particular user's aadhaar number using Blowfish encryption algorithm. [3]

Arduino Distribution based server involves measuring of weight using load cell which is a force transducer which converts a force, compression, pressure into an electrical signal that can be measured and servo motor performs basic tasks like switch on and off nob of grain supply by performing linear motion. [14]

Each registered family on the system is uniquely identified by its particular registered mobile number, which is required to open a user's distribution history portal secured by one time password The stock portal is provided, so that distribution stock can be maintained by higher authorities. The distribution processing data has been stored in database into specific tables with proper relational architecture where data management and data create, read, update, delete (CRUD) operation are performed by RESTAPI's to maintain centralized database.

II. METHODOLOGY

The whole system involves two roles, first one is the ration user and second one is the vendor, between these two roles lots of process includes family registration by filling details, family login and vendor login using mobile number, Complaint section, user's ration history section, Ai face Capture and verification section, users' data update section and most important ration distribution section.

The whole system user interface is built in reactJS, which is one of the JavaScript's most popular framework, one which makes it dynamic is the nodeJS, which is responsible for performing all data fetching operations from database, authentication for security purposes, processing of Software development kit communication like OTP, AI/ML data actions, encryption to hide out private information. [11]

The whole system is not a monolithic based architecture, thereby huge count of users are there in the system and That's why to communicate with Arduino hardware section, another node server is established to deal with microcontroller and web sockets are integrated to transfer the data between two node servers. [14]

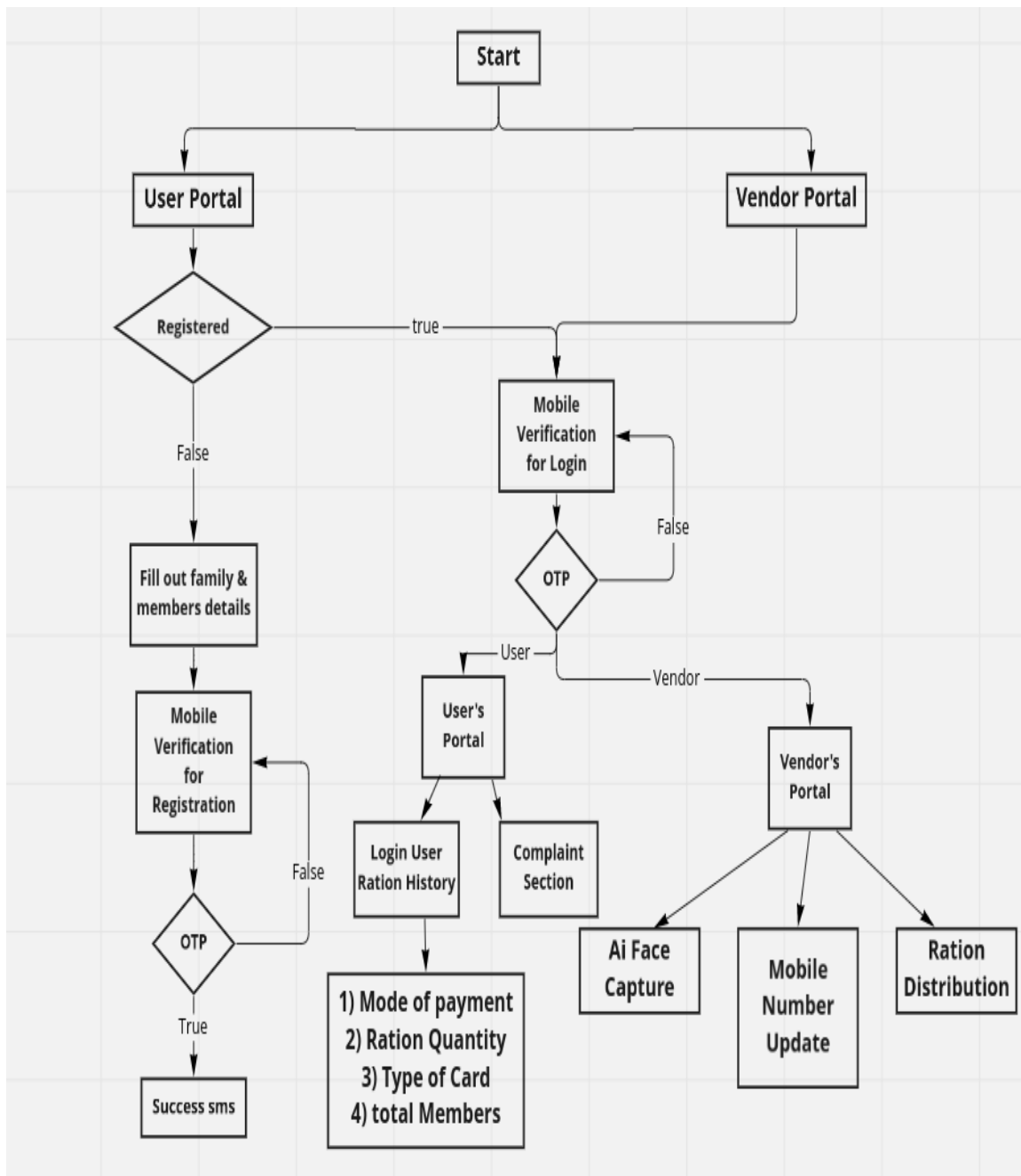


Figure 1: Overview of AI/ML Public Ration Distribution System using Deep Learning

The ration user is the needy commodities consumer and vendor is the official who is responsible for verification and maintenance of documents of the ration user, also the facial capture for facial authentication of ration user comes under portal of vendor and the ration distribution can only get processed through the vendor's portal.

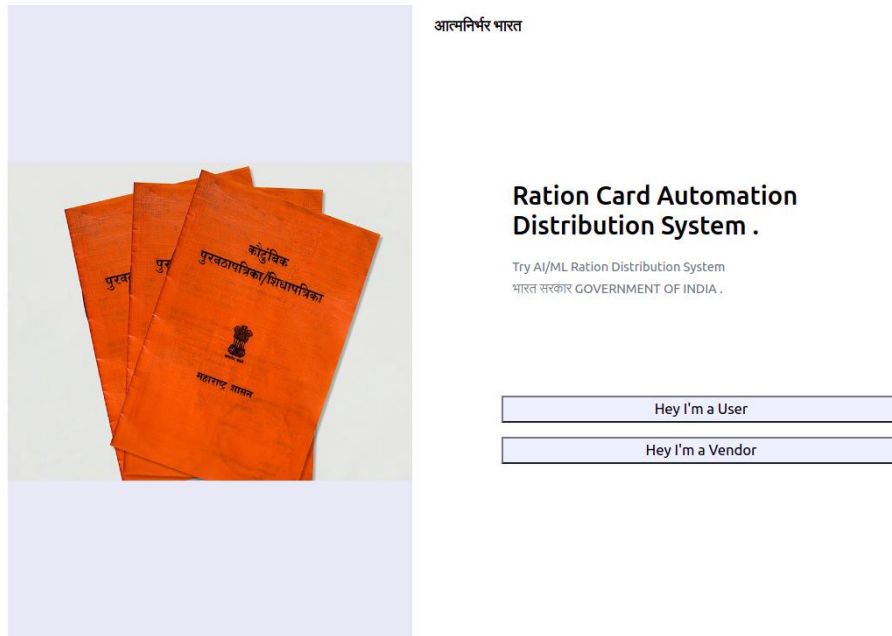


Figure 2: Home Screen User Interface

Home screen section showing the way into two portals of system named as vendor portal and ration user portal to get into their respected portals.

2.1 Registration of ration user section:

A registration of user section involves submitting a family detail alongside members details too, which includes Aadhaar card number, date of birth, name, address, family income, gender, and family relations (like wife, daughter, father).

React Forms are integrated on the user interface and the entered family data then, transfer to the NodeJS server to store it into database by making Hypertext transfer protocol secure (HTTPS) Api hit by using axios (Node package module to deal with Https request at reactJS) [11]

The private information like aadhaar number of the user gets encrypted by using blow fish Cipher Algorithm [13]

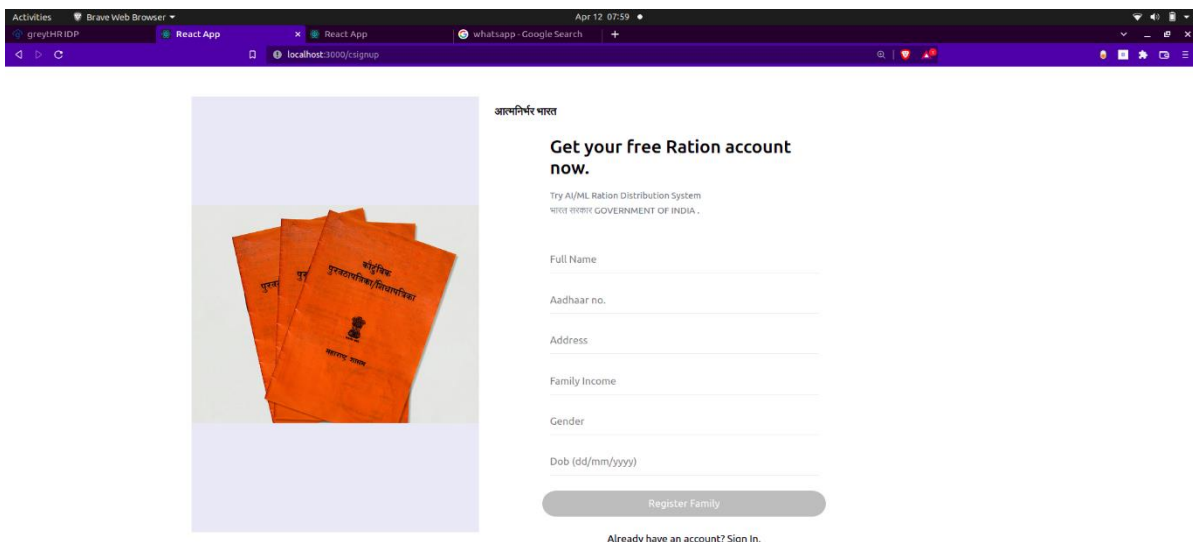


Figure 3: User's Family Registration Form User Interface

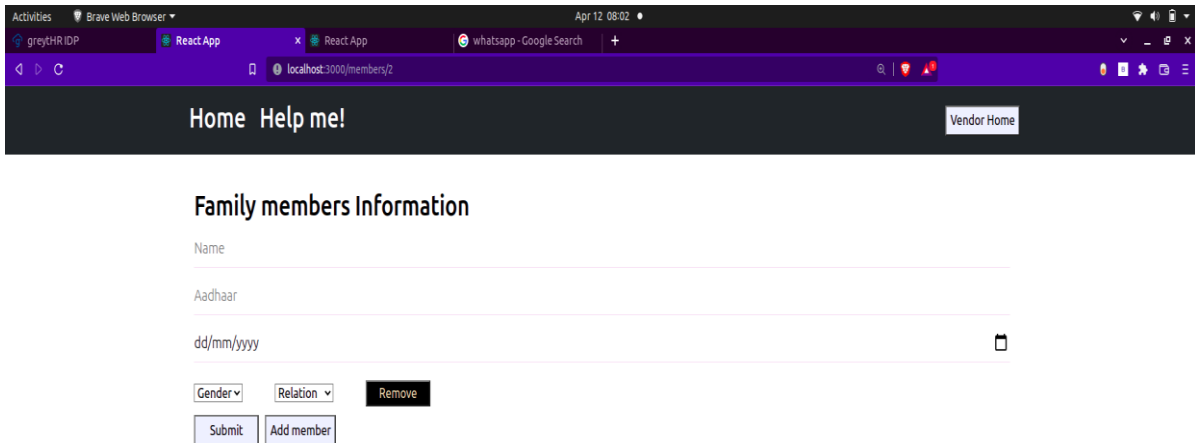


Figure 4: User’s Members Registration Form User Interface

2.2 Mobile Verification Login:

To login into the system user needs to login by using registered mobile number, system checks entered mobile number is registered or not by making a http request at server side by using representational state transfer (Restful) api’s, then One-time Password (OTP) is sent and stores it inside a database for later comparison. [16]

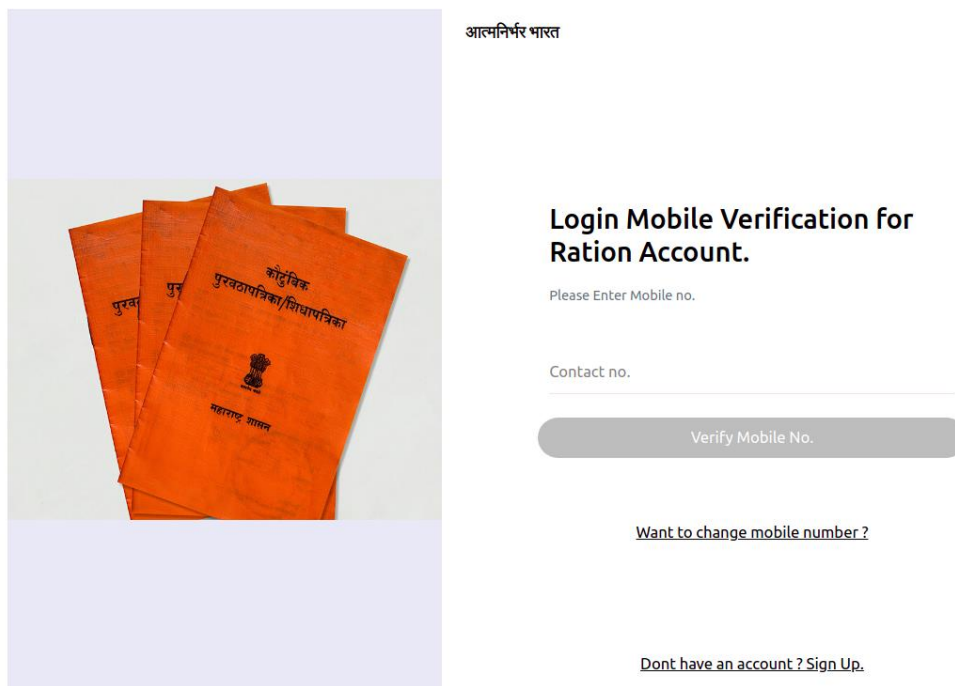


Figure 5: User Login by mobile number verification by one-time password

After entering registered mobile number, user will redirect to one-time password (OTP) check page then user have to enter right OTP, which is sent on its mobile number. If OTP is wrong, then it pops out wrong OTP notification and if it is right, user will get logged into the system

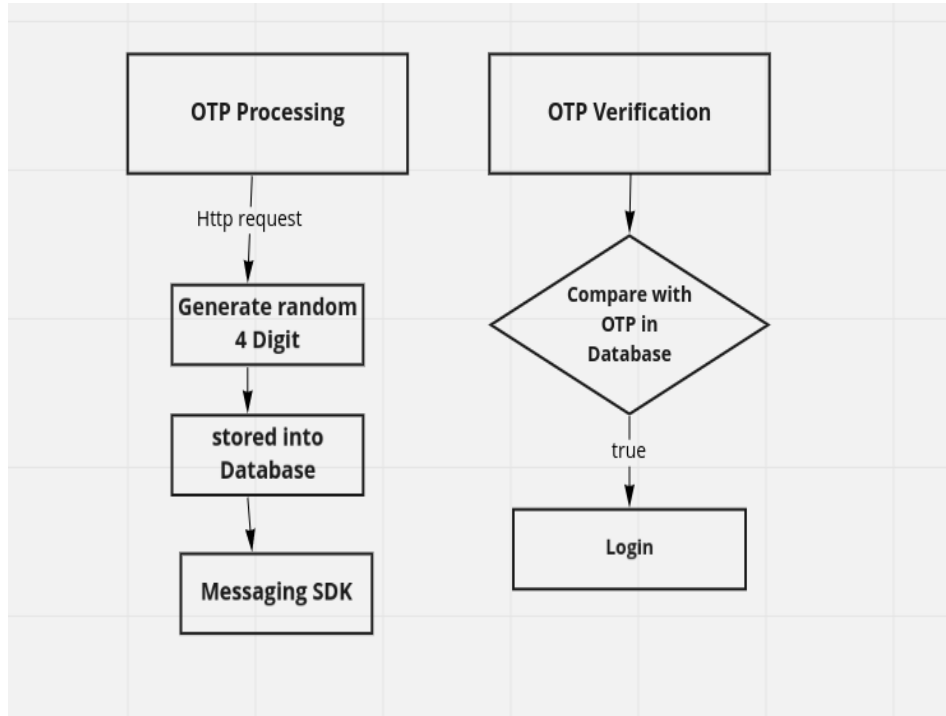


Figure 6: One Time password logic for login

For comparison, another http request is being made, which posts the user entered OTP to server side to check it with a corresponding generated OTP present on database, if it is true, then let user login if not then it pop outs the wrong OTP notification. [16]

2.4 Complaint Section

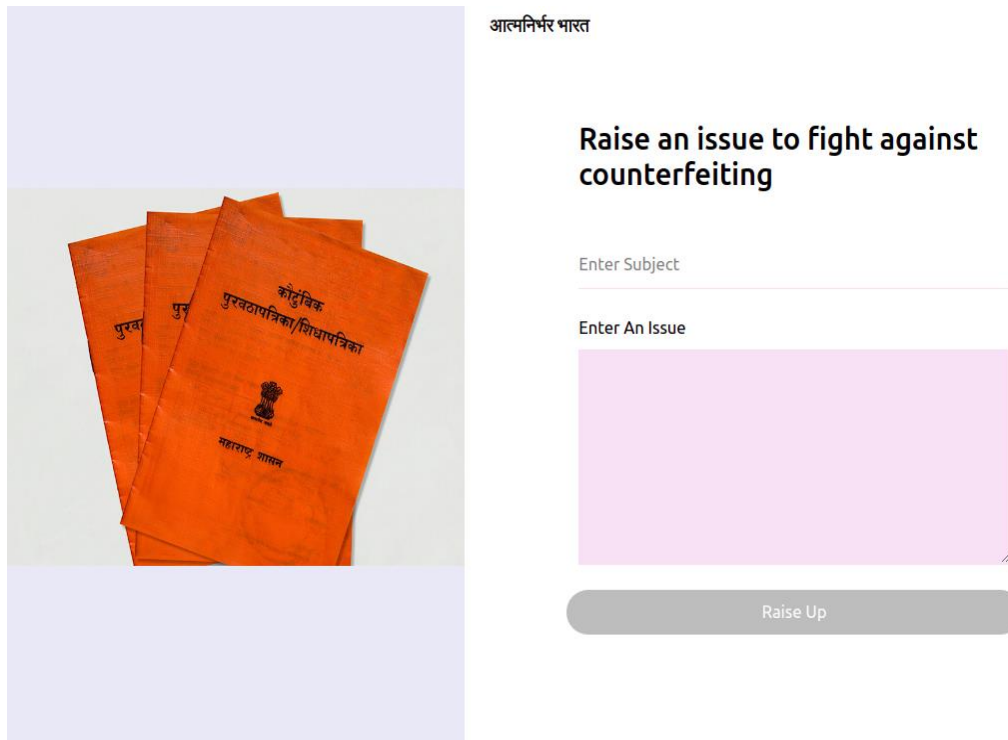


Figure 7: Complaint section to raise an issue against corruption

While using the system or while getting the commodities during distribution, etc. if user get into a trouble or issues, he or she can raise an issue in the complaint section, Complaint section involves the subject of the issue and the issue. If any issue is raised an issue, it will be privately transferred to government higher authorities.

2.3 User's Portal



Ration History

App No.	Amount	Payment Type	Date
1	50/-	Online	07/12/21
2	50/-	Offline	01/01/22

Figure 8: User's Ration History

After Login, there's a separate portal for users where they can see their ration history that involves type of ration card they have, total family members, reserved ration quantity which will help them to see their whole ration history.

2.4 Vendors Portal:

Vendors Portal Involves Three Modules

- Ration Distribution
- AI Face Capture and Authentication
- Mobile Number Update

2.4.1 Ration Distribution

The vendor role of the system comes up with privilege to distribute a ration by following counterfeiting free practices where this whole distribution process is done by the two node server, one is for data posting, gathering and communicating with database and another node server is just for communicating with Arduino hardware operation [14]



Figure 9: Arduino Micro Controller

To established a live connection between two server, web sockets are establish which is the most common way to transfer a live to any server for any sort of processing in Transfer control Protocol (TCP).

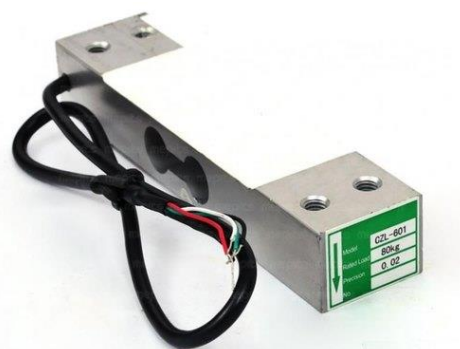


Figure 9: Load Cell

On nodeJS secondary server, hardware processes are running, which involves load cell to measure a weight and then transfer that weight to prime server for further distribution process



Figure 10: Servo Motor

On nodeJS secondary server, hardware processes are running, which involves servo motor to perform linear motion to stop and start supply of grains while distributing.

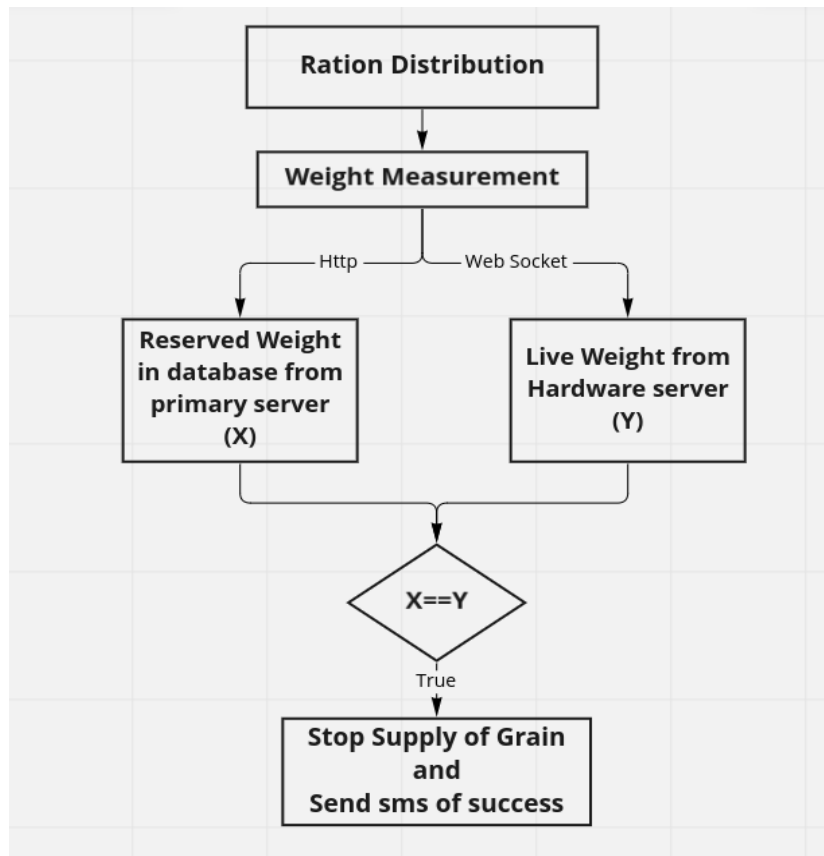


Figure 11: Ration Distribution Grain Distribution Logic

At the end, First nodeJS server gives out ration data respective to the specific family like reserved ration quantity (ex: 600gm of grains) and second nodeJS server give the hardware load cell which measures a weight and converts it into electronic signals, on comparison of reserved data from first server and live continuous data from hardware server, ration with proper weight will get distributed. [11]

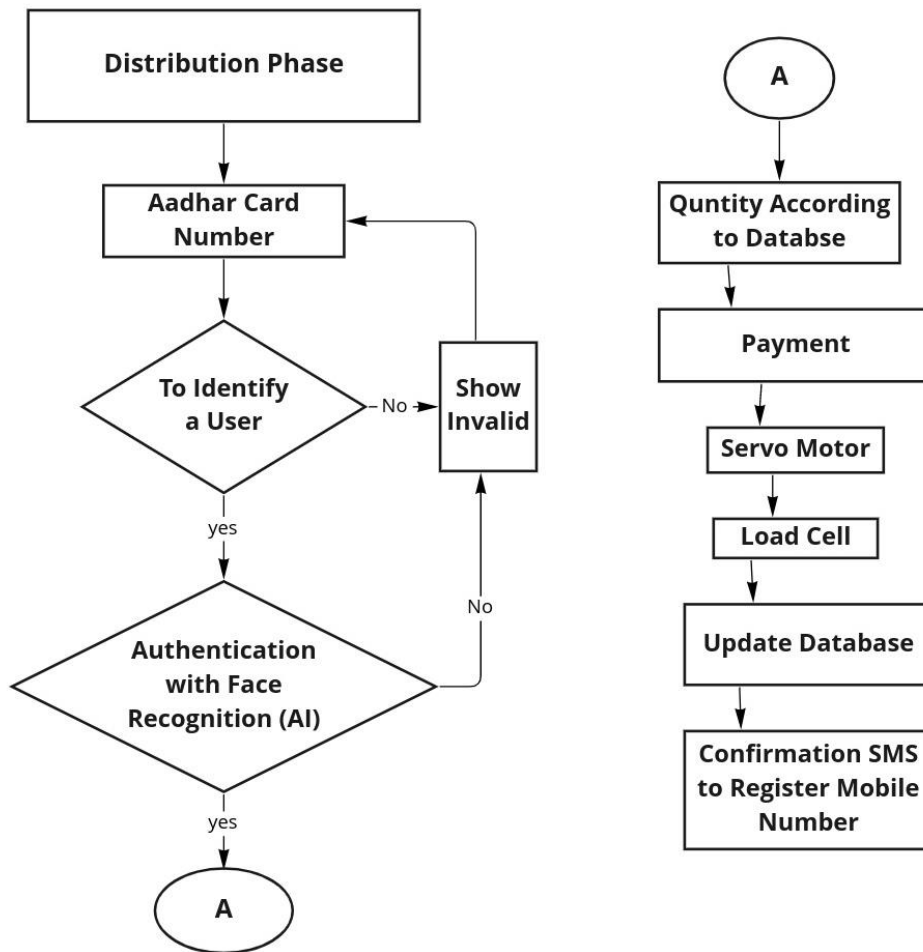


Figure 12: Ration Distribution Grain Distribution Flow Chart

To control the supply of grains or to reduce its wastage while distributing it, servo motor integration is established. The servo motor is a rotary actuator or linear actuator that allows for precise control of linear position, velocity and acceleration. With linear motion, we can stop and start the nob mounted on the servo motor rotator. Therefore, supply of the grains will get controlled. [14]

2.4.2 Mobile Number Update

It's a second module that comes under vendor's role, if user mobile gets changed or lost due to some reasons, system comes with an option to update mobile number. It involves https request RESTful api call from user which is of post type where user have to provide a aadhaar number and updated mobile number, then system verifies it with OTP and mobile number gets updated.

2.4.3 AI Face Capture and Authentication

In most of the systems, security involves string password or using RFID card, but the security module that we are using process on the live environment which is quite sustainable and dims the chances of hacking. [15]

We used Vincent Mühler's Face-api.js as a supporting module for resnet-34 in javascript.

The facial authentication is being divided into three phases :

- Detection of Face on screen.
- Create 68 points face landmark and use alignment-model.
- Pass it to ResNet-34 that returns a Face Descriptor.

First, it tried to detect if any face is present on the video camera, the model used here is Tiny Face Detector, which will return with bounding boxes of each face, telling us where the face is in the image, then uses Face Landmark Network to mark 68 points face landmark and uses alignment-model to make sure the face is centered before feed to Face Recognition Network.

The Face Recognition Network is another neural network (ResNet-34 like a neural network, to be precise) that returns a Face Descriptor (feature vector containing 128 values) that we used to compare and identify a person in the video cam. [15]

```

ImageExtraction.js:124
▼ {fullDesc: null, detections: Array(1), descriptors: Array(1), facingMode: 'user', status: true, ...}
  descCount: null
  descData: []
  ▼ descriptors: Array(1)
    ▶ 0: Float32Array(128) [-0.15487425029277802, 0.10053157806396484, 0.13151441514492035, 0.01862690970301628, -0.01614426
      length: 1
      ▶ [[Prototype]]: Array(0)
  ▼ detections: Array(1)
    ▶ 0: FaceDetection { _imageDims: Dimensions, _score: 0.8858101033132665, _classScore: 0.8858101033132665, _className: '',
      length: 1
      ▶ [[Prototype]]: Array(0)
    facingMode: "user"
    fullDesc: null
    result: true
    status: true
    ▶ [[Prototype]]: Object
9
ImageExtraction.js:155

```

Figure 13: Facial Landmark and Alignment of the particular user

Face Descriptors of the same person from different image sources should be very close when we compare them and Euclidean Distance to compare. The system will store the Face Descriptor of each person as a reference together with his or her name as the label in the database. When we feed a query image, the system will compare the Face Descriptor of the new image with all reference Descriptors and identify the person with the lowest one. If none of the comparisons are lower than the threshold, the person will be identified as Unknown. So more precisely Fetching images blob to API, takes that image and detects the face in the image then plot 68 face landmarks and return Face Feature of 128 values as Float32Array. In the final, we created the function named createMatcher from face.js and create a faceMatcher with the face profile that we prepared. after we get full face Descriptor from the image, we map out descriptors and find the best match of each face. To train the system for particular user’s face, we tried to capture 4 images facing left, right, centered, and top centered positions of the user and then store them in a database by making a post https request, we used nodejs ExpressJS for it [14]

```

▼ (4) [Array(1), Array(1), Array(1), Array(1)]
  ▼ 0: Array(1)
    ▶ 0: Float32Array(128) [-0.15758445858955383, 0.1037471815943718, 0.14164644479751587, 0.03719688579440117, -0.005766219
      length: 1
      ▶ [[Prototype]]: Array(0)
  ▼ 1: Array(1)
    ▶ 0: Float32Array(128) [-0.1467876136302948, 0.11257864534854889, 0.11869173496961594, 0.009893872775137424, 0.011747846
      length: 1
      ▶ [[Prototype]]: Array(0)
  ▼ 2: Array(1)
    ▶ 0: Float32Array(128) [-0.20053105056285858, 0.08339515328407288, 0.15571151673793793, 0.016183018684387207, -0.0204566
      length: 1
      ▶ [[Prototype]]: Array(0)
  ▼ 3: Array(1)
    ▶ 0: Float32Array(128) [-0.15487425029277802, 0.10053157806396484, 0.13151441514492035, 0.01862690970301628, -0.01614426
      length: 1
      ▶ [[Prototype]]: Array(0)
    length: 4
    ▶ [[Prototype]]: Array(0)

```

Figure 14: Four facial descriptor array’s nested inside bulk array from database

Then Final step after making an API call is to get the face descriptor of a particular person to pass it for face matching to perform recognized a user. And System gives out a result, either Unknown and Recognized.

III. MODELING AND ANALYSIS

There are several existing systems proposed to build a smart ration card automation distribution system. The study suggests that accuracy of arduino microcontroller processing and IOT capabilities includes server-side rendering, dynamic user interface with lots of application programming calls, centralized database going to be beneficial. After studying various approaches, a security is constant issue which increases the counterfeiting, a facial authentication for each distribution, OTP for users and authority's portal is proposed to level up the security therefore decreases counterfeiting.

Sr. No.	Title	Year	Author	Advantage	Disadvantage
1.	Ration Distribution For Poor and Needy People By Smart Ration Card Automation System	2021	Ravindra Jogekar, Rutuja Gavale, Ravi Singh, Tejas Padole, Urvi Khakkar	RFID Tag instead of ration card. Centralized Database.	No data encryption while transferring. Quite easy to manipulate RFID layer
2.	A Smart Public Ration Distribution System	2016	Shubham Maheshwari, Mukesh Tiwari	A 4-digit password-based security, RFID card for individual ration card identification	No backend server to get response from electronic devices. Low end encryption security.
3.	Smart Ration Distribution System	2018	Sonali Parit, Mayuri Patil, Rutuja Patil	Aadhaar card instead of ration card	Authentication layer needed to prevent
4.	Smart rationing system	2017	Surbhi Surkar, S. B. Somali, Rajkumar D. Komati	Authentication process will be through SMS and Aadhaar card	Not a scalable architecture to maintain database calls
5.	Smart Ration Distribution System	2017	Tarun Kumar, Shivani Sharma, Ankush Raina, Nikhil Pathania	Radio Frequency Identification (RFID) for security	Anybody carrying RFID of someone else can collect the ration

The paper on “Ration distribution For Poor and Needy People By Smart Ration Card Automation System” discusses automation in India's ration distribution system, where ration get distributed using automation system but the use of RFIDs for user identification dim’s its security module. [1]

The paper on “Smart Ration Distribution System” also discusses how the public ration distribution can be done but doesn’t have a security authentication layer so corruption will not get solved. [3]

The paper on “A Smart Public Ration Distribution System” discusses how smartly the public ration distribution can be done, where ration distribution with security layer to control the corruption in India. [4]

The paper on "Smart rationing system" discusses how public ration distribution can be done with a system which has authentication security layer processes with Aadhaar card number and one time password system on user mobile number. But it doesn't have proper monolithic scalable architecture to maintain the database calls. [5]

The paper on "Smart Ration Distribution System" indeed discusses the smart ration distribution module system perhaps its security layer should have some agile methodology to reduce a corruption. [6]

Above papers still have a void over authentication and scalable monolithic architecture, which needed the most to solve it, a need of proper backend server like a NodeJS, spring boot to achieve scalability and security for users.

IV. RESULTS AND DISCUSSION

The traditional Ration Distribution system has a number of flaws, such as the weight of the material being inaccurate due to human error, the long waiting time while distributing commodities at ration stores, the slow processing speed, and material theft in ration shops. The lot based ration shop plays a critical role in resolving these issues. To distribute grains and other commodities evenly, the ration distribution section involves use of two server side on nodejs, one is prime server for maintaining central database and second nodejs server for communicating with hardware. The ration card is replaced by an Aadhaar card number and facial recognition for authentication. User can views ration distribution data or ration history on its portal. Due to iot, the proposed system creates transparency in the public distribution system.

Firstly user have to register a family and family members then after successful registration, They have to visit nearest vendor store for verification. after verification with face extraction module, they are available for ration distribution. At vendor portal, verification of users and distribution process takes place and all the status related to distribution and verification is updated on the user's portal and system sends SMS to user's registered number about different status.

V. CONCLUSION

We have attempted to introduce a new technology through this paper that aids in the removal of the existing system's flaws. This technology also has its own set of benefits that can be applied to other applications; for example, it can be used as an anti-corruption tool because it reduces corruption to a large extent, which is one of the main reasons we came up with this concept. The Ration Distribution system has flaws such as the weight of the material being inaccurate due to human error, proper authentication modules, the slow processing speed, the long wait time for the material at the ration distribution, and material theft in the ration shop. If materials are not purchased by the end of the month, they will be sold to others without notifying the government or the consumer. The Automated ration distribution played a crucial role in overcoming the mentioned issues. To distribute grain material, the Automated ration shops used Server side with different portals for example user, vendor, et. AI/ML modules for facial recognition, aadhaar card identification and sms services to registered mobile number for updates on distribution and ration account status. As the work is automated, the proposed system creates transparency and mitigates in the public distribution system.

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- [20] Serial Ports <https://socket.io/docs/v4/server-api/>