

Smart Automatic Rationing For Public Distribution System

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Abstract- Public Distribution System (PDS) in India is meant to ensure that the common man gets essential commodities like rice, wheat, kerosene etc. at reduced price. The drawbacks associated with the present PDS are – erro-prone authentication of consumer, incorrect quantity disbursed to consumer, long waiting time at the shop, material theft in the shop and corruption and malpractices in the whole system. The main goal of the proposed system is Real Time Online Authentication of the consumer and automation of material disbursement in a ration shop. This Smart Card based Automatic Ration Shop is a novel approach which is secure, precise and ensures efficient distribution of ration commodity. In the proposed system, consumer will register with the Government Portal and get a Smart Card along with the password. When consumer visits the ration shop he/she presents the Smart Card for scanning, enters password and also puts fingerprint for scan. The biometric information of the consumer like fingerprint along with password is sent to the centralized Aadhar Card server where all the data is authenticated. Once the Authentication is done, system will display the eligibility of the consumer in terms of amount of ration and also the availability of the ration in that shop. The consumer will select the quantity of ration that he/she wants to buy, pay online after which the Automatic Dispenser will dispense the food grain material (solid or liquid). Once the material is dispensed the system will update the server and send SMS to the Consumer.

Keywords- Public Distribution System (PDS), Aadhar Card, Automated Measurement, E-Governance, Automation of Fair Price Shops (FPS), Digitalization, Make in India, Digital India.

I. INTRODUCTION

Public Distribution System (PDS) of India is largest retail system in the world and has a network of almost 5 lakhs Reasonable Price Shops for distribution of Food and Non-food grain material like rice, wheat, kerosene, oil etc. Under Ministry of Consumer Affairs, Food, and Public Distribution System (PDS) of India. In India, approx. 1.21 billion (29.8%) people live below poverty line and are dependent on a monthly supply of food grains. It also provides employment opportunities for Reasonable Price Shops Owners and their employees who work at the Government owned warehouses. The resulting leakage of subsidies, inefficiency in targeting the beneficiaries are major problems with this system. A report by Planning Commission of India on the PDS system, says that “On PDS for every Rs 4 spent, the amount which reaches poor people is only Rs1” and hence according to this report a total of 57% of food grain does not reach the poor. Leakages,

problem of quality, scale, quantity, accountability, transparency, unfair mechanism in overall system are some of the challenges that occur in the present PDS. Considering these factors, it’s important to reinforce this system to ensure judicious subsidies, sufficient materials, and efficient supply of food grains to deserving and poor citizens of India. Some families do not buy food grains from ration shops, such food grain material should be distributed among the poor families. Due to this reason, the government of every State in India has issued different types of ration cards namely Antyodaya Anna Yojana Cards (AAY), Below Poverty Line Cards (BPL), Above Poverty Line Cards (APL). These cards are paper based which are given to each and every family of India. In the proposed system these Paper based Ration cards are replaced by Smart Cards which are given to the consumer based on Aadhar Card Information. At present in India, Rationing System comprises of Traditional Ration Book System and E-POS Machine System. [3]

A. Traditional Ration System

People in India with BPL card holders are helped by the Ration Distribution System in supplying Food and Non-food commodities like Rice, wheat, Kerosene, LPG (Liquid Petroleum Gas), Sugar, etc. at reasonably cheap rate. Every family is provided with a simple paper based ration card booklet with colours which decide poverty levels. The demographic data of the family is included in the Ration Card.[2] In this system, multiple steps are done manually like ration card entry, product distribution, product weighing, product delivery, updating of ration book entries etc. and hence lot many issues and problems come up as listed below

- Consumers unaware of availability of ration in the shop before going to the shop.
- Corruption and Malpractices – e.g. Shopkeeper selling food grain stock in the open market at higher rate, quality of goods compromised etc.
- Processing speed slow – people have to wait for long time before they get their ration.
- Cheating of consumers particularly Illiterate-Overcharging, delivery of less quantity, substandard food grain. Human efforts are increased-So prone to errors

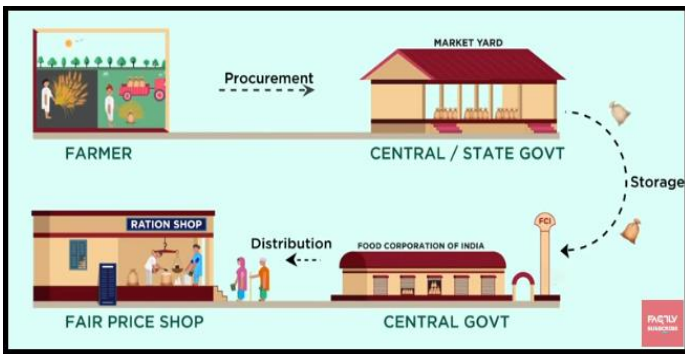


Fig.1: Traditional Ration System

(Source: <https://www.youtube.com/watch?v=RBEjfaM7gck>)

B. E-POS System

In the past few years, new technology is used in PDS, which is an improvement over traditional paper based system. This is called E-POS system. Initially registration is done at the government database by each user and all details about his family including the fingerprint impressions are recorded and uploaded in the central data base of the government of India. After verification is done then customer are allowed to take the ration. But this system also has drawbacks like,

- Manual system
- E-POS machine is just used for the authentication of the customer
- Weighing and delivery of food grains is done manually[2]

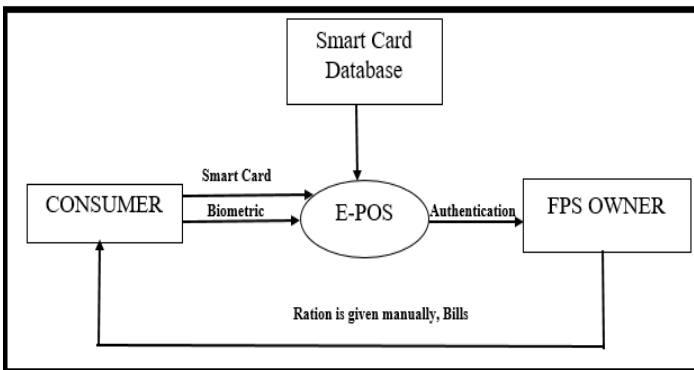


Fig.2: E-POS System

II. PROPOSED SYSTEM

Previous two systems like Traditional Ration System and E-POS System have drawbacks like consumer unaware of availability of the ration in the shop, corruption and malpractices, overcrowding at the ration shops etc. Hence we are proposing a novel idea which is Smart Automatic Rationing for Public Distribution System.

A. Features of the System

- Automatic Ration distribution with a mechanised dispensing assembly
- 24X7 Operation like ATM Machine
- Corruption and Forged Ration delivery problems minimised to a large extent
- Three level Authentication (RFID based Smart Card with password, Fingerprint, and Aadhar Card record checking)

- This System dispenses only the quantity of material which is selected
- The Government database will be updated after each transaction
- SMS will be sent to the consumer
- The Government authority is made alert in case of theft

B. Block Diagram

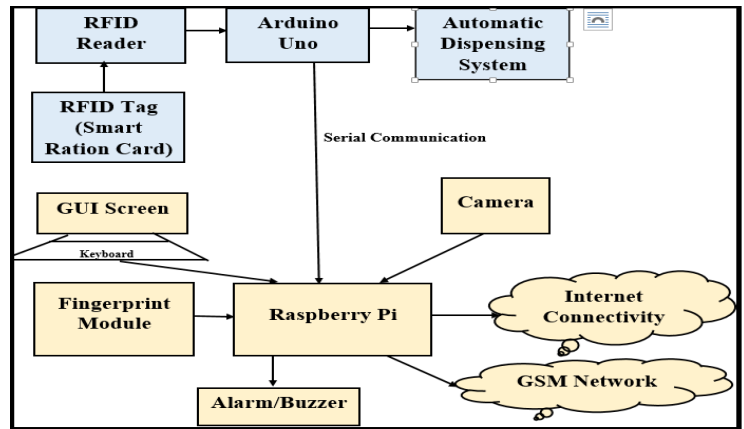


Fig.3: Smart Automatic Rationing System Block Diagram

Fig 3 shows the Block Diagram of the proposed Smart Automatic Rationing System. Raspberry Pi 3 and Arduino Uno are used as main processors to perform all the computational functions in this system. Arduino Uno controls the automatic dispensing assembly with the help of solenoid valves to dispense accurate quantity of material to the consumer. Solid material is measured by its weight and liquid material is measured by sensing flow. A delay controls opening and closing of the valve which decides the specific quantity of selected material to be delivered.

- RFID Reader, Auto dispensing Assembly are interfaced with Arduino Uno and Fingerprint Scanner, Web Camera, GSM module, Internet Connectivity ,Alarm Indicator, and a GUI Screen are interfaced with Raspberry pi. Both Arduino Uno and Raspberry pi are connected through serial communication links
- Raspberry Pi 3, Quad core 64-bit ARM processor with Four Serial Communication Ports are being used in this system. Web Camera is used for detection of correct grain in the dispenser. And is connected with first port of Raspberry Pi, similarly second and third port is used for Fingerprint Scanning for Authentication and GSM module to send SMS to consumer.
- Liquid items (kerosene and oil) and solid items (rice and wheat) are demonstrated by using Solenoid valve with the help of 2-Relay Driver.

C. Flowchart of Proposed System

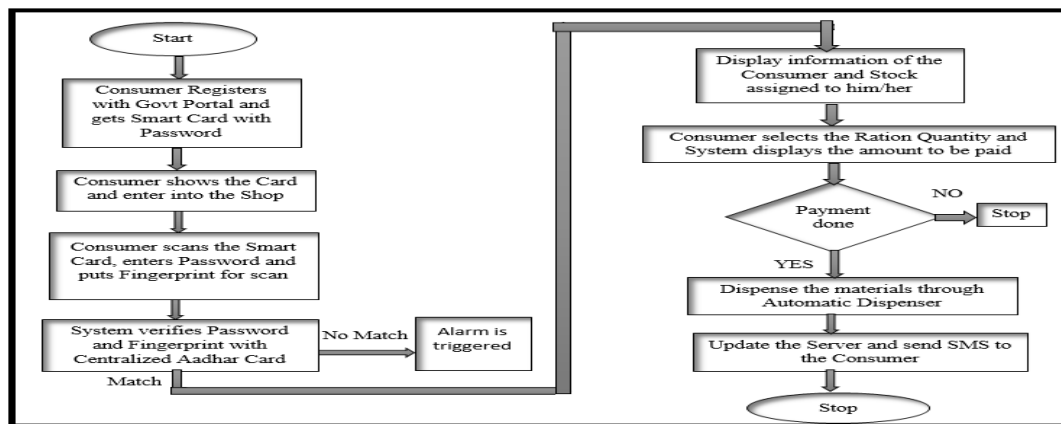


Fig.4: Flow Chart of Smart Automatic Rationing System

Fig 4 depicts system flow chart for Smart Automatic Rationing System. Working algorithm is divided into 3 parts namely card holder's authentication, automatic ration dispensing assembly, and intruder alert for optimization of overall system performance. When consumer visits the ration shop he/she presents the Smart Card (RFID Card) for scanning, enters password and also puts fingerprint for scan. The Biometric information of the consumer like fingerprint along with password is sent to the centralized Aadhar Card server where all the data is Authenticated. Once the Authentication is successful, system will go-ahead with the rest of the process. The eligibility of the consumer in terms of quantity of ration and also its availability of the ration in the shop will be displayed on the screen. The consumer will select the quantity and make the payment after which the automatic dispensing assembly will dispense the food grain material (solid or liquid). Once the material is dispensed, the system will update the server and send SMS to the consumer using GSM module. If any of the security methods like Fingerprint and Password is wrongly entered or the system is being misused then further processing will be blocked for that user. In case this happens repeatedly then Theft Alert Alarm will be activated further informing the Government Authority.

III. HARDWARE AND SOFTWARE REALIZATION

A. Hardware Part

The hardware required for proposed Smart Automatic Rationing System consist of Raspberry-pi, Arduino Uno, RFID Reader, Fingerprint Scanner, Alarm Indicator, GSM Module, Web Camera, and automatic dispensing system. RFID Reader, Automatic dispensing system is interfaced with Arduino Uno and Fingerprint Scanner, Web Camera, GSM module, Internet Connectivity, Alarm Indicator, and GUI Screen is interfaced with Raspberry-pi. Both Arduino Uno and Raspberry-pi is connected through serial communication.

Fig 5 shows the overview of Automatic Dispensing System and can be divided into following parts

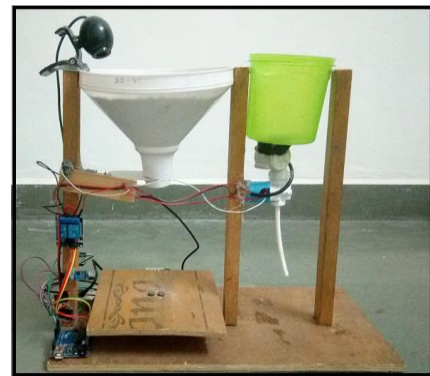


Fig.5: Overview of Automatic Dispensing System

1) *Arrangement for solid material dispensing:* This system consist of a container with attached hopper for dispensing solid materials like Wheat, Rice etc. It is operated through a Push-Pull Solenoid Valve and is interfaced with Arduino Uno. This mechanical arrangement is controlled by 2-Channel Relay Driver.

2) *Arrangement for Liquid material dispensing:* This system consist of a container for dispensing liquid items like oil, kerosene etc. It consists of liquid flow sensor which is connected with a RO Solenoid Valve and is interfaced with Arduino Uno. This mechanical arrangement is controlled by 2-Channel Relay Driver.

3) *Liquid and Grain quantity measuring system:* The quantity of liquid items like kerosene and edible oil is measured by flow sensor. The output of flow sensor is series of pulses which indicate flow of liquid. RO Solenoid valve is used to open and close the flow of liquid items. Both the solenoid valve and flow sensor are operated on 12V DC supply.

4) *Grain quantity measuring system:* To open and close the valve of solid material a Push-pull Solenoid Valve is used. Load cell is used to measure the weight of dispensed food grains. It consist two ends, one end is for mounting and another is for measuring. Output of load cell is in micro volts.

It is amplified and converted into digital form before further processing.

B. Software Part

Following software modules are used in Smart Automatic Rationing System

- For interfacing RFID reader and automatic dispensing assembly, Arduino embedded language with Arduino Software is used.
- Python language is used for interfacing fingerprint, GSM module and web camera.
- Internet connectivity of the system is done using HTML and JAVA SCRIPT.

IV. WORKING PRINCIPLE

Before the consumer uses this system it is assumed that he/she has already received a valid smart ration card from the Government. The process of issuing this smart ration card is not in a scope of this project.

Once the system is started, the consumer will get regular messages regarding availability of ration in a shop. When consumer visits the ration shop he/she presents the Smart Card for scanning, enters password and also puts fingerprint for scan. The biometric information of the consumer like fingerprint along with password is sent to the centralized

Aadhar Card server where all the data is authenticated. Once the Authentication is successful, system will display the information of the consumer on GUI screen and also the eligibility of the consumer in terms of quantity of ration and the availability of the ration in that shop. In order to buy the food and non-food commodities consumer will select particular commodities and its quantity he/she wants to buy. After getting the input from GUI Screen, controller checks whether the system has correct food grain with the help of web camera and then allows the consumer to pay the amount through payment gateway. After the payment is done then consumer will place his/her bag below the hopper and the food grain will directly fall into it. The load cell is used in a feedback loop to stop the flow of food grain as soon as required weight is detected in the bag. Once the material is dispensed the system will update the server and send SMS to the Consumer.

V. EXPERIMENTAL RESULTS

For demonstration purpose, wheat is used as solid material and water is used as liquid material to test the entire setup. The experimental results are tabulated in TABLE 1 and TABLE 2. From experimental results it is clear that the proposed system which is Smart Automatic Rationing is accurate.

TABLE I
ACCURACY TABLE (SOLID DISPENSING SYSTEM)

No of Trials	Expected Level (Gram)	Actual Level (Gram)	Percentage of Accuracy (%)
1	500	496.2	99.24%
2	500	492.4	98.48%
3	500	498.0	99.6%
4	500	478.6	95.72%
5	500	484.7	96.94%
6	500	495.4	99.08%
7	500	497.0	99.4%
8	500	486.7	97.34%
9	500	489.5	97.9%
10	500	482.7	96.54%

TABLE III
ACCURACY TABLE (LIQUID DISPENSING SYSTEM)

No of Trials	Expected Level (ml)	Actual Level (ml)	Percentage of Accuracy (%)
1	250	232	92.8%
2	250	236	94.4%
3	250	230	92%
4	250	242	96.8%
5	250	242	96.8%
6	250	234	93.6%
7	250	243	97.2%
8	250	247	98.8%
9	250	244	97.6%
10	250	233	93.2%

Hence from TABLE I & II, the proposed system gives an average accuracy of 98.024% for solid material (wheat) and similarly average accuracy of 95.32% for liquid material (water) is achieved during testing. Fig. 6 shows the actual dispensing of wheat and water through automatic dispenser.

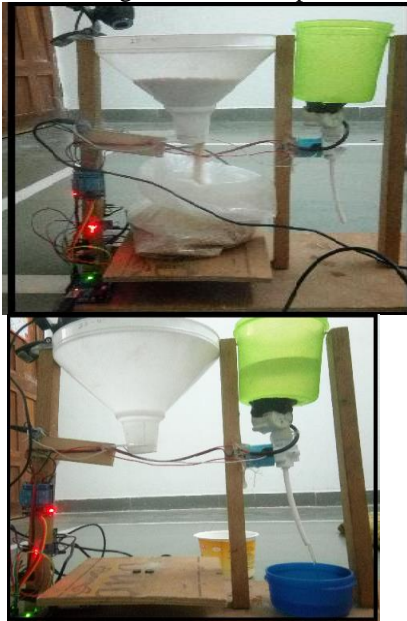


Fig.6: Automatic Dispensing of wheat and water

VI. CONCLUSIONS

In the near future, Customer's Bank Accounts can be directly linked to PDS system making the payment online through Payment Gateway. Also high quality sensors and hardware can be used for efficient implementation. To further enhance this system incoming quality of food grains can be checked using web camera using sophisticated image processing algorithms and increase the security using face and voice identification.

VII. FUTURE SCOPE

This proposed system helps to eradicate the corruption and malpractices in overall Rationing System to a large extent by providing transparency at each level. Hence this novel approach of Smart Automatic Rationing System with Automatic Dispensing of essential commodities at reduced price is helpful to every citizen of India. Hence we consider that this development will bring a huge change in the present-day society of India. This system will be a contribution towards "Digital India" Initiative and, also it will be the scheme of "Corruption free India! ". This development can become a part of E-Governance that India is under taking currently. This system makes the process of purchasing essential commodities, automated and time saving approach resulting in transparency in ration distribution system, in turn creating a connection between the people of India and the government, through electronic media to make India as a developed country.

VIII. ACKNOWLEDGMENT

I would like to express my deep sense of thanks and gratitude to my guide & teacher Mr Shripad Deshpande (Asst professor) who has been a constant support, encouragement and whose valuable guidance enabled me to complete this work. Without his guidance and persistent help this work would not have been possible. I would like to express my sincere gratitude to Mrs Neela. R (HOD department of E&C) for providing me with the facilities in the Institution. I am also very grateful to Mr.Parag Narkhede (Asst professor), Mr. Paresh Nasikkar (Asst professor) for their valuable suggestions and for being extremely supportive and kind.

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