

A Case Study on Public Distribution System(PDS)

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This paper is a case study on an Indian food security system,namely **Public distribution system (PDS)**. Established by the Government of India under Ministry of Consumer Affairs, Food, and Public Distribution and managed jointly with state governments in India, it distributes subsidized food and non-food items to India's poor.

Here, we work out a detailed requirement specification for effective PDS and also proposes a functional design for the same. Several possibilities of evaluating the designs using formal techniques are also explored in the process.

1 Existing Public Distribution System

1.1 Aadhaar—Based Biometric Authentication (ABBA)

1. What is ABBA?

ABBA's linchpin is the electronic "Point of Sale" (PoS) machine, a handheld device installed at every PDS outlet ("ration shop") and connected to the Internet. The list of ration cards attached to that outlet, and their respective entitlements, are stored in the PoS machine and updated every month.

2. Working(User-Machine Interaction):

When a cardholder turns ups, the PoS machine first "authenticates" her by matching her fingerprints with the biometric data stored against

her Aadhaar number in the Central Identities Data Repository (CIDR). The machine then generates a receipt with the person's entitlements, which are also audible from a recorded message (if the machine's voice-over facility is functional and the dealer activates it, which is not always the case). The transaction details are also supposed to be entered by the dealer in the person's ration card.

3. **Processing the data**

Meanwhile, the PoS machine generates electronic transaction records that are automatically uploaded on the Jharkhand government's PDS website (<http://aahar.jharkhand.gov.in/>)—hereafter the "Aahar website." The Aahar website, incidentally, is relatively well designed and extremely useful.

2 **Challenges(Fallouts in current PDS Design)**

1. **Transaction failures :** A significant amount of transaction failures occur due to poor connectivity issues or authentication failure. This probably is the most important and major challenge that needs to be tackled in the current ABBA system.
2. **Separating authentication and transaction :** As the working and connectivity problems were very frequent, the current PDS system proposes that whenever there would availability of internet connection, the dealer would first do authentication for everyone and then provide ration a day or two later. This actually causes inconvenience for the people and also provides loopholes for corruption to peep in.
3. **Double transaction, single given :** When households are unable to buy their food rations in a particular month, the PoS system allows them, in principle, to buy double rations the next month. This well thought of rule of giving the previously not received ration on the next transaction is being misused by dealers by giving only single ration quantity, due to lack of awareness about this right among villagers.

4. **Faking authentication failure :** As authentication failure is a frequent and common thing, sometimes the dealer would fake a authentication failure, and use the allotted ration themselves or for black-marketing.
5. **Non-fixed schedule :** Due to connectivity issues, the schedule of providing ration is very erratic and depends on when the internet connection comes out to be better.
6. **Inferior Quality Food Grains :** Deceitful dealers replace good supplies received from the F.C.I(Food Corporation of India) with inferior stock and sell FCI stock in the black market. Numerous malpractices make safe and nutritious food inaccessible and unaffordable to many poor thus resulting in their food insecurity.

2.1 Point To Ponder

- Most of the disadvantages or challenges faced(Challenges: 1, 2, 4, 5) boil down to one single feature of ABBA, that is a major dependence on internet connectivity.

3 Important functionalities to be satisfied by the Public distribution System

- **Regional allocation and Coverage of FPS :** The reach of ration shops is to be increased focusing more on rural areas and meeting the core objective of providing essential commodities to the needy.
- **Prevention of Bogus Cards :** There shouldn't be a way for the illicit fair price shop owners to create bogus cards or in general fake/steal a person's identity to take ration.
- **Independent of the network issue :** The internet connection/mobile network shouldn't form an essential part of the system as in the current scenario, it is not easily available at every place in India.
- **Low transaction failures :** The system should be robust enough that there is very low probability of transaction failures due to all possible reasons.

- **Preventing rate change by shop owners :** There should be a way of preventing fair price dealers to manipulate the price/ rate of quantities.
- No leakage due to wrong person taking it away
- **Electronic easily verifiable/Searchable data :** The data about transactions and its details should be of electronic for, such that it can be easily searchable and verified.
- **One member can take for the rest of family :** As there can be handicapped or old people in a family, a system should be in place that any one member of the family can take the ration of other family members.
- **No multiple transaction by same identity :** The authentication process should be such that same person cannot make multiple transactions within a time frame when only one transaction is allowed.

4 Proposed Public Distribution System

To tackle both the problems, we propose a Biometric Smart-card system, where in the card stores the details of person including the fingerprint details

4.1 Getting to the solution :

Let's understand and analyze the two main challenges that current PDS system doesn't solve. We cannot have a authentication with a central database, as accessing and matching with a central database would require internet connectivity.

But to include biometric authentication, which is unique for each individual, a predefined set of key codes cannot be generated and given.

Also a pure smart-card system can lead to identity theft and duplication problems.

Therefore instead of storing the fingerprint on central database we can either decentralise it on reader machines, but then loading the right readers with the correct data for the right village would add an extra level of complexity.

4.2 Design Solution :

To avoid the above problems, we thus decentralise biometric authentication further to store the fingerprints into individual smart cards given to each person. The insertion of smart card would provide the fingerprint data needed to match with the actual fingerprints, and the QR code on smart card can be matched with the allowed codes. Also the past record of the individuals transaction can be stored on the smartcard, to allow future access.

Hence, we propose a Biometric Smartcard system, where in the card stores the details of person including the fingerprint details. For authentication the card is inserted in the offline reader machine and fingerprints of the person is matched with that on the card, along with general DDA authentication of the card. If these match, then the Unique identification details of that card is stored in the memory of reader machine, and the appropriate amount of ration (based on details in the card) and receipt is issued.

4.3 Other design decisions in the Proposed PDS:

Some of the important features of the proposed PDS are as follows:

1. Card + Bio-metric Reader fed with the amount of ration with merchant when a new lot of ration comes in. Thus based on the ration issued, the total quantity of ration remaining can be read through it in offline mode itself.
2. Voice reader of the receipt.
3. Option of verification through mobile(OTP) in case of Bio-metric failure.
4. Any household member can collect for others with only card verification (with at least one bio-metric authentication).
5. Monthly update of the offline data online while taking new ration lot (based on the remaining ration shown).
6. The fair price dealers seldom display rate chart and quantity available in the block-boards in front of the shop. This should be enforced.

4.4 Evaluating the design against required functionalities :

1. **Regional allocation and Coverage of FPS :** Since, the proposed design does not depend on internet connectivity during authentication and transaction, this solves the problem of reaching to areas with poor internet connectivity.
2. **Prevention of Bogus Cards :** As biometric authentication is used, even if the card gets stolen, replicating fingerprints is very difficult. Also the first level of authentication ensures that cards cannot be generated which satisfy the biometric authentication of the person.
3. **Independent of the network issue :** As the fingerprint details and past records of individual are stored in the card itself, there is no need of accessing a central database, and thus the requirement of internet connection is not required.

4. **Low transaction failures :** Independence of Network connectivity, backup OTP authentication and offline process makes the design robust enough to transaction failures.
5. **Preventing rate change by shop owners :** The enforcement of making the fair price dealers display rate chart and quantity available in the block-boards in front of the shop and the voice output of the actual readings provide very little chance of cheating by shop owners.
6. **Electronic easily verifiable/Searchable data :** As the past records is stored in the card itself, while authenticating the reader can easily access the individuals past records to provide previously remaining ration as well. Also the transactions from a reader is stored and monthly updated online to a central database.
7. **One member can take for the rest of family :** This directly corresponds to one of the features of the proposed PDS.
8. **No multiple transaction by same identity :** As the past records are stored in the card itself, as well for a given month on reader, multiple transactions would just not be possible.

5 Discussed with :

- Anoosh Kotak(2015CS10211)