

Unique IDentification (UID) based model for the Indian Public Distribution System (PDS) implemented in Windows Embedded CE

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Abstract— This paper proposes a centralized model for the Indian Public Distribution System (PDS) and states its benefits over the current system. The proposed system has its Point of Sale (POS) outlets centered around an ebox 3310 MSJK device which runs an OS customized in Windows CE. This processor communicates with three different centralized databases to access different data associated with the customer. This communication is triggered by a UID (Unique Identification) smart card. The various aspects of the system are discussed in detail. Also the results of a pilot implementation of the system and consequent deductions for its future scope are also enumerated.

Keywords— Public Distribution System (PDS), Windows CE, E-box MSJK3310, Biometric Identification, Unique Identification (UID)

I. INTRODUCTION

In any service initiative the basic goal that one looks to achieve is the complete and timely delivery of services to the target consumer. The criticality of this goal increases multifold when we talk about a public service initiative, headed by the Indian government (as the supplier) the aim of which is to supply essential daily utility commodities to the Indian citizen (as the consumer) 400 million of whom still go hungry due to the inadequacies in the present PDS [1]. Our application promises to metamorphosize the Public Distribution System (PDS), as it is practiced in India from a mismanaged, enervated and aboriginal entity to a streamlined, centralized and veritable system. The system we propose utilizes the UID (Unique Identity) feature proposed by the Government of India (it will be implemented by November 2010) [2]. The UID is basically a number that will be given to each citizen of the country by the UIDAI (Unique Identification Authority of India) in the form of a smart card. Each individual will be uniquely identifiable by his UID and it is this feature that we tap in our application to tag the 1 billion plus populace of India into a tangible PDS. The POS (Point of Sale) in the PDS is the FPS (Fair Price Shop). It is at these shops that the bulk of the population gets its allotted ration of

rice, wheat, sugar, kerosene oil, palm oil and other essential goods. In our proposed FPS there will be:

- A central processing device (represented by the e-box) which manages the flow of data between the FPS and the administrative server.
- A smart card reader to detect the UID smart card and pass on the UID to the processor.
- A fingerprint scanner to register a customer's fingerprint and pass it to the processor.
- A weighing machine to measure the exact weight of goods being dispersed and to pass this information on to the processor.
- A display (here a T.V.) to provide a user interface for all the steps involved in the transaction.
- A keypad and mouse to navigate through the UI.
- An internet connection for communication between the processor and the central server.
- A centralized server with the consolidated database of necessary information and transactional details.

II. RELATED WORK

For this paper we have been inspired by many pre-existing models in many different setups around the world. In the following section we will briefly discuss first the role of the UIDAI in our project and then the outlook of the systems implemented in the systems prevalent in Austria, Germany, Taiwan, Italy and Mexico.

A. UIDAI

The Unique Identification Authority of India introduced the UniqueID [3]. This inspired us to use the UID as tagging each individual will reduce fake beneficiaries from the roles and bring down the pilferages by a great extent.

B. Austria-Social insurance model

In 2004, the Austrian Social Insurance Institutions introduced the system of an e-card [4]. The fact that electronic transactions are more safer, efficient and cost-effective as compared to paper-based transactions prompted us to use a "smart card" for our PDS transactions as well.

C. Italy-Raiffeisen bank model

The Raiffeisen bank in Italy launched a system of chip-equipped payment cards [5]. The option of tagging a particular individual helps us to provide the customer with the exact amount of goods he is entitled to.

D. Weisn Card Model-Germany

The Weisn Card model was very relevant for us because it was designed for a POS and we learnt a lot from the high level of simplicity incorporated in its implementation [6].

E. Taiwan PKI Project for an “Electronic Identity Smart Card”

By studying the PKI project model [7] we were able to analyse the different types of defaulters possible and put in checks in our system to identify such cases even during execution.

F. Seguro Popular Project-Mexico

The implementation of this ehealthcare project [8] is highly analogous to that of the UIDAI in India. Thus the Seguro Popular model was an important start point for us in deciding our system implementation.

TABLE 1. LIST OF COUNTRIES WITH SMART CARD BASED PUBLIC UTILITY SYSTEMS

Country	Card type	Number of cards	Launch year
Austria	E card	11 million patient 24,000 professional	2007
Italy	Carta Nazionale dei Servizi	3 million (national services card)	2004
Germany	Gesundheitskarte	80 million 375,000 professional	2006
Taiwan	National Health Insurance Card	24 million patient 150,000 professional	2002
Mexico	Seguro popular Health Insurance cards	3.7 million	2006

III. PROBLEM ANALYSIS

As of today, all citizens of the country are allotted a ration card that classifies them on the basis of the annual family income. Those that come within certain lower brackets [9] are allocated a share of the national produce at subsidised rates through the PDS. The ultimate goal of our project is to bring to reality what has already been put on paper i.e. to ensure that no Indian citizen goes hungry due to inadequacies in the PDS.

We aim to eliminate the paper based decentralized inventory system prevalent today in which data gets staggered as it goes up the chain. Thus cross referencing information becomes a highly cumbersome task and as a result is seldom done. This breeds complacency, leads to illegal trading of

goods and as the inventory itself is inconsistent all accountability is lost. As a result the common man suffers. The goods that finally come through to him after passing through the sieve of corruption is barely enough to keep his family alive.

In the present PDS system there is a communication gap between the customer and the administration. Thus the FPS owner has the final word on the availability or unavailability of goods. The consumer has no choice but to believe whatever the FPS owner says be it on the present rate/kg of the goods or on the new schemes that the government has introduced for their benefit.

The goods given presently are only on receipt of hard cash which is a highly scarce commodity in rural areas. Hard cash apart in many instances finance itself is not available for the families to procure daily necessities from the PDS and there is no concrete framework in place to address this issue.

IV. ARCHITECTURE

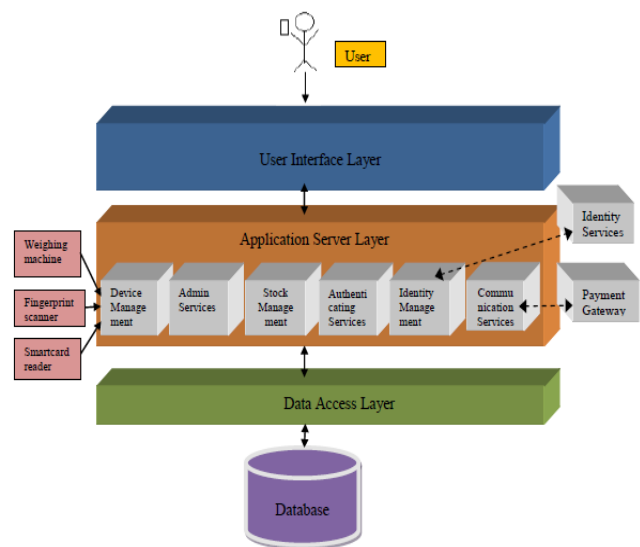


Figure 1. Software Architecture

A. The Software Architecture

The Software Architecture is layered into the following segments:

1) The User Interface Layer:

This layer essentially provides the required interactions with all types of users, like FP shop users, UID Service Providers, Banking Agents, administrators and the like. Essentially the UI interacts with the PDS shop owner to manage transactions for the consumers.

2) The Application Server Layer:

This layer provides all essential services needed to manage the entire application in a synchronized manner. It is comprised of the following

- **Device Management:** This offers basic functionality of managing all the devices interconnected to the system. This layer handles input / outputs from the fingerprint

scanner, the smart card reader, weighing machine, matrix keypad and Television.

- **Admin Services:** This module offers essential functionality to administer the system at various levels. The FP shop owner can handle core functionality and manage all master data.
- **Stock Management:** This module manages the core inventory at the FP shop, and provides necessary information to enable the FP shop user to synchronize the inventory with the central database. It also provides the mechanism to re-order stock for replenishment.
- **Authentication Services:** Authentication of all transactions, payments and entities are managed by this module, providing the required security for the application.
- **Identity Management:** UID identification is managed by this module to enable a smooth interaction with the UID central databases. This is an essential module which ensures the effectiveness of the PD system
- **Communication Services:** All communications in the form of e-mails, SMSes etc are managed by this module to ensure a uniform interaction with other sub-systems.

3) The Data Access Layer:

This layer, implemented as stored procedures, essentially provides a local repository of the core data and the transactional data for generating the required reports. This data store can be queried by the application to provide any information needed by all other monitoring agencies.

B. Hardware Architecture

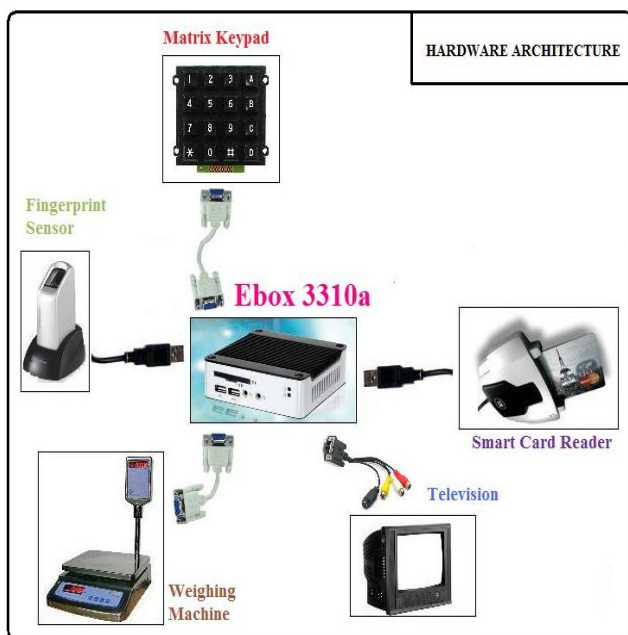


Figure 2. Hardware Architecture

TABLE 2. LIST OF HARDWARE USED IN THE SYSTEM

Sr. No	Device	Interface type	Specifications
1	Fingerprint Scanner	USB	OS: Windows CE Resolution: 500DPI
2	Smart Card Reader	USB	ISO 7816 landing type
3	Matrix keypad	Serial port	4X4 matrix
4	Weighing machine	RS232C	CT10
5	Television	VGA converter	14"

V. IMPLEMENTATION

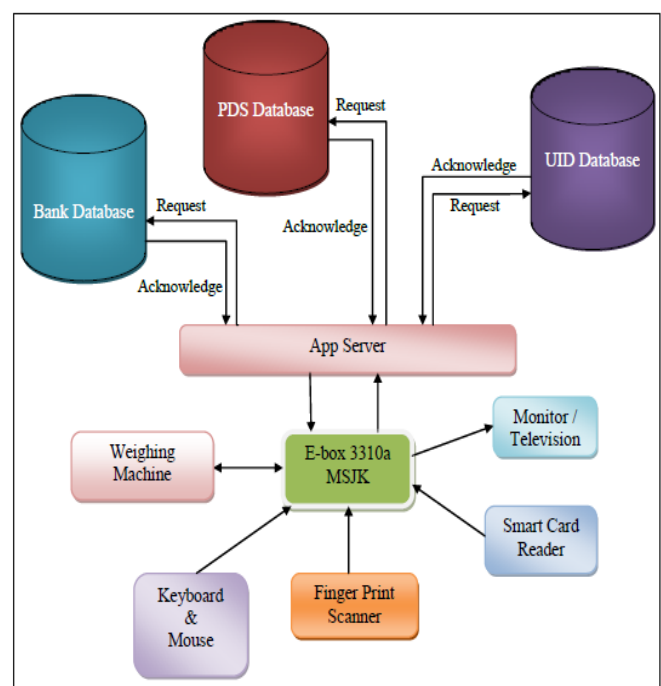


Figure 3. Overall Embedded Architecture

FIGURE 3 shows the flow of information in the system. A typical transaction at an FPS will be as follows:

- A customer approaches the vendor with his UID smart card and submits it to the owner for verification.
- The card is read by the smart card reader and the customer simultaneously submits his/her fingerprint for validation.
- The card information and the fingerprint are acquired by the processor (ebox) and then sent to the UID database. The values are matched and a result of either 'match' or 'invalid entry' will be displayed on the monitor.
- Once the match is found the User Interface (UI) proceeds to the inventory page. Here he is allowed to

enter the different goods he wants to buy and the individual quantity of each type of goods.

- The owner enters the goods as requested by the customer and this request is passed on to the processor.
- The processor passes this information along with the UID number of the customer to the PDS database to verify whether the customer is eligible for the requested goods as per his family's allotment.
- Once the request is validated the PDS computes the transaction amount based on the current rates of the goods and the result is conveyed to the ebox.
- The ebox then initiates communication with the bank database.
- It passes on the UID number as the primary key to the bank database along with the transaction amount. The bank computes whether the customer has the balance available in his account to support the transaction.
- If the requisite balance is detected, the transaction is passed and the amount is deducted from the account with a communication of the same being sent to the ebox.
- If the amount is not present the credit limit of the customer is accessed. If the transaction amount is within the limit the goods are given on credit and the credit limit is summarily reduced by the transaction amount.
- The ebox in turn displays the details of the transaction on the monitor and prints out a bill to the customer for the transaction.
- The owner, on approval of the transaction weighs the requested goods on the weighing machine.
- The output of the weighing machine is matched with the requested amounts by the ebox to ensure that the customer gets the amount he has requested.
- After the various goods requested are weighed one by one according to the directions of the UI the transaction is terminated.

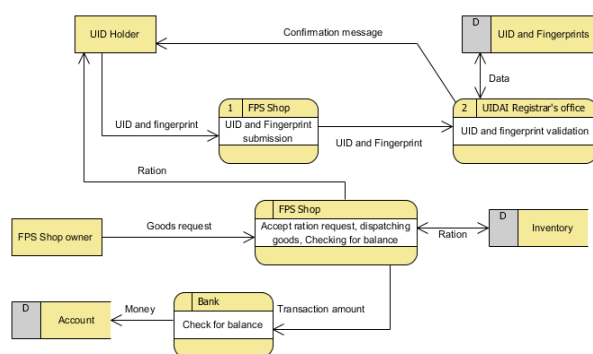


Figure 4. Data Flow

The data flow diagram as the name suggests is used to visualize the flow of data between the different components of the system. In the diagram users are represented by the yellow boxes, process tasks are in the yellow and white boxes where the task performing entity is entered as the header and the task is entered in the white space. Databases are in yellow with a grey section marked as D.



Figure 5. Use Case Diagram

The use case diagram is a very simple data representation technique. Its main purpose is to identify the various actors in the process (indicated by stick figures) and links them to the different stages of the process flow that they are involved in.

A. Testing Procedures

The testing of the pilot system was done at a local shop and the results obtained were found to be satisfactory.

VI.RESULT

TABLE 3. OPERATION TIME COMPARISON

Sr No.	Day	Turnaround time for existing PDS operation	Turnaround time for Pilot operation of proposed PDS
1	Day 1	15 minutes	4 minutes
2	Day 2	30 minutes	5 minutes
3	Day 3	45 minutes	6 minutes
Average Turnaround time taken per day		30 minutes	5 minutes

TABLE 4. INVENTORY EFFICIENCY COMPARISON

1	Goods Procured by the PDS shop from the warehouse	17234 kg
2	Goods Dispatched to the customer by the PDS shop	17011 kg
3	'Residual goods recorded in the pilot operation of the proposed PDS	223 kg
4	Residual goods recorded as per the existing inventory	56 kg
Therefore 223/56		400 % efficiency

A. Project Analysis

The crux of our solution for the deficiencies in our PDS is that we are making a shift from a locally recognized ration card to a centrally recognized UID smart card as the basis for procuring ration. The system that we have modelled on the UID implements a centralized inventory system on a database

that has inbuilt functions for cross referencing entries, not only within the PDS but also to a few tables in the bank and UIDAI databases. This linking will ensure that a uniquely identified person's full ration of goods is accessed and supplied to him whenever he wants it provided he has the resources to pay for it in his bank account or has a sufficient credit limit. Online verification of dispatch and receipt of goods from the central godowns to the FPS and dynamic database inventory of all transactions in the PDS provide a huge boost to the system's accountability and will go a long way to prevent misuse of the common man's ration. In an effort to establish unmediated communication between the PDS and its beneficiaries we have incorporated a prominent display (T.V.) that presents pre-programmed heads of each step in the transaction(in the local language) with information streamed from the central server. We have implemented a user interface intelligible to even the most acutely illiterate sections of the population. Provision for displaying advertisements and other infomercials to create awareness amongst the consumers about the benefits available to them have been made during the transaction processing time and when the machine is idle. The transaction has been made completely cashless specifically with those consumers in mind (farmers) who need all the ready cash they have to cope with the occupational hazards that they need to overcome to see through the next harvest. A structured credit framework will be made available for everyone whose source of finance is seasonal or erratic.

B. Market Analysis

The PDS system is implemented in India across 4.75 lakh FPS shops. This ensures that there is enormous scope for the solution to be deployed, and the solution will also be instrumental in bolstering the perception of the FPS system. Also, a central facility which provides data integration services can be deployed which charges each of the FPS an annual fee for providing the services.

C. Cost Analysis

Number of Fair Price Shops in India: 4.74lakhs

TABLE 5. TYPICAL COSTS PER FPS

A	Fixed Costs	Qty	Rate	Amount
	Hardware			
	EBox and associated hardware	1 set	\$1020	
	Printer	1	\$90	
	Software	1 set	\$227	
	Training	1	\$23	
	Total (A)		\$1360	\$1360
B	Recurring Costs(Per year)			
	Maintenance	Per year	\$136	
	Connectivity	Per year	\$136	
	Power & Misc	Per year	\$136	
	Total B		\$408	\$408
C	Central Computing Facilities(per FPS)	Per Year	\$498	\$498
	Total of A + B + C		\$2266	\$2266

VII. CONCLUSIONS

Implementation of our system will boost the present PDS in three ways: simplicity, channelization and accountability.

In order to make even the most unaware user at ease with the system we have substituted a password provision with fingerprint identification, incorporated large displays in the local dialect of the region, enabled cashless transaction and allowed any member of the family to go up and buy the entire family's ration of goods in a secure, foolproof manner.

Along with a user friendly GUI we have provided a secure channel for customer benefits like credit schemes to be directly relayed to the consumer on the FPS displays.

Through our system, each individual will be assured of 100% of his assigned quota of goods, a 400% improvement.

Last but not the least centralized data inventory also eliminates all possibilities of illegal siphoning of goods thus ensuring that the government "spends less to supply more".

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