

INTEGRATION OF 2D SECURE BARCODE IN IDENTITY CARDS: WITH ADDITIONAL SECURITY FEATURES

Manisha Bajpai, Arun Prakash Agrawal

Amity University, Noida
Email: manibajpai11@gmail.com
Amity University, Noida
Email: apagrawal@amity.edu

Abstract-In this paper, we extend our previous approach to develop an ID card management system that integrated 2-dimensional Barcode which is responsible to produce secure and reliable identification cards. In our previous [1] work we made use of only photograph of the holder, in order to make it secure from being forged. This time we have extended our approach and it uses photo as well as signature and the identity documents of the holder of the ID card. In this extended approach the system will capture more information including photo and signature and will dynamically generate an image of 2D barcode containing the information provided and will affix this barcode image on an ID card. This card will be used to validate and authenticate the holder. Main advantage of using 2D Barcode is its data encoding capacity, 2D Barcode is able to encode up to 500 bytes per square inch.

Keywords: 2D Barcode, ID Cards, ID card Management System, PDF417 Barcode.

I. INTRODUCTION

An Identity card is a primary requirement for an individual by which he can prove himself that he has all rights he is claiming for. An identity card is properly designed to provide the trusted credentials (The term – credential refers to information stored on the card that represents the individual’s identity document and privileges), that can be used to access or authenticate an individual for a particular service. To make ID card more secure it integrate with 2D Barcode that encoded the credentials of the individual in it. When authentication is required a 2D Barcode scanner scans the 2D Barcode image and authenticates the holder.

2D Barcode [2] is a graphical image that is using to stores the information both horizontally and vertically. Unlike one-dimensional barcode that is use to stores the information only. 2D Barcode is using to tag the various objects in the real world and map them to digital references. 2D barcodes are often used because that are enabling to store more information and they enable fast data access and now 2D Barcode is commonly used in variety of applications such as transport, identification, mobile application and inventory management. 2D barcode firstly known in Japan and now it is spreading to western countries as well.

II. IDENTITY ISSUES AND CHALLENGES

| Issue and Challenges | Citizen facing System | Employee or customer facing system |
|--|--|---|
| Many of today’s ID system fail to provide adequate security and privacy | Recent terrorist attacks point out the need for more security Identity theft has become a major problem in entitlement system | Data monitor reports that worldwide IT security breaches cost companies about \$15 billion year |
| Establishing the initial identity of ID system members can be difficult. | Legitimate persons can have unreliable or missing identity documentation. Person can easily obtain counterfeit or fraudulent | Employers encounter job applicants who misrepresent their identity when seeking employment. |

| | | |
|--|---|--|
| | identity breeder document. | |
| Identity id not sufficiently verified in most ID systems | Many citizen-facing systems use weak forms of identity verification, such as Social Security Number or driving license. | Password represent significant security risks because they are typically controlled by the user. |

III. BARCODE STANDARD

a) Barcode Symbologies is a term that describes the types of data that can be encoded and stored in the barcode (i.e. numeric), the checksum algorithm, the method of converting data to bar-space pattern, and the bar-space pattern printing requirements. AIM/AIDC (Association for Automatic Identification and Data Capture Technology), ISO (International Standards Organization) and similar bodies publish Barcode standards. Clear Image Barcode Products implement the features as specified in the Barcode Symbology.

b) Application Standards are developed by specific industry associations or governmental groups, and describe how to use particular symbologies in their applications. For each supported barcode application they specify how industry-specified data fields are encoded into the barcode and they impose rules about barcode length for symbologies with variable length. Sometimes they might specify their own checksum algorithm, to be added to the application data before it is encoded in the barcode. Examples include: Bookland ISBN, EAN-13 Israel, EAN-13 Special, HRI, ISSN, ITF-14, ITF-14 Israel, ITF-14 Old Style, NDC, ODETTE, Spanish Pharma CCP & SCP, UPC-A+UCC-128 (Coupons). The features of such Application Standards are typically interpreted and implemented by the customer applications that make use of Clear Image Barcode Products.

c) Proprietary Designations are purchase or business process specifications, which are adopted by various companies, especially large transportation and retail companies, such as Panasonic Video or MS-7 (Marks & Spencer). They use these terms to define specific barcodes, size, appearance, location on boxes or documents, and data formats that they want their business partners to utilize in order to transact business with them. It is impractical to keep track of the myriad of such names. Their significance affects primarily the printing step, because the appearance of the codes must adhere to these proprietary specifications. However, Clear Image Barcode Products can correctly recognize virtually all of them.

IV. TYPES OF 2D BARCODES AND ENCODING METHODOLOGY

1) **QR BARCODE:** QR Code [3] is a 2-dimensional barcode invented by the Japanese corporation Denso-Wave in 1994. The prefix QR stands for Quick Response, as the code that can be decoded at high-speed [4]. QR Code support Kanji encoding that the reason for its popularity in mobile tagging applications. QR code is most popular in Japan.

The Size of QR barcode symbol [5] depends on the information to be encoded. Symbol version defined in the range of 1 to 40. Each version has different module configuration (the module refers to the black and white dots of QR code). Version 1 size is 21 x 21 modules and as version increment by 1 module size increment by 4 x 4. e.g. version 1 module size is 21 x 21, version 2 module size is 25 x 25, version 3 module size is 29 x 29....version 40 module size is 177 x

177 modules



Figure 2: QR Code

There are four modes[6]:

- Numeric mode
- Alphanumeric mode
- 8-bit byte mode
- Kanji and kana characters mode.

The combinations of these modes are also possible.

QR code has in-built error correction based on Reed Solomon algorithms. Error correction level defined the readability percentage of damaged code. The QR code has four error correction levels Level L, Level M, Level Q [7] and Level H their data restoration capacities are 7%, 15%, 25% and 30% per symbol respectively.

1.1) **QR CODING METHOD:** The QR encoding method works as follows:

1.1.1. QR code uses a smallest number of coding capabilities to store the QR code and error correction level, in consideration the total coding capability of data information.

1.1.2. Maximum number of coding characters in each mode is as follows.

- Numeric mode: 7089 characters
- Alphanumeric mode: 4296 characters
- 8-bit byte mode: 2953 characters
- Kanji and kana character mode: 1817 characters

1.1.3. To Create the QR Code and data encoding it uses the Reed Solomon code algorithm. RS Code parameters are shown in parentheses

2) *DATA MATRIX*: Data Matrix is a form of 2D barcode with high data density. That able to encodes text or row data in a pattern of black and white square modules. Data size of data matrix is maximum up to 2 kbs. The symbols can be readable even if they are partially damaged by including error correction codes according to ECC200 standard.

The length of encoded data depends up on the number of cells in the matrix.



Figure 3: Data Matrix

2.1) *DATA MATRIX DATA CAPACITY*: A Data Matrix barcode can hold up to 3116 digits, 2335 alphanumeric characters or 1556 bytes, barcode's capacity depends up on the structure of data to be encoded, Data capacity also affected by the available printing space and printer resolution.

2.2) *DATA MATRIX ENCODING*: The encoding process is described in documents published by ISO website [8]. Open source software for encoding and decoding the ECC-200 variant of Data Matrix has been published [9].

The diagrams below illustrate the how a message data placed within a Data Matrix symbol. Message data arranged in a complicated diagonal pattern, start from the upper-left corner. In diagonal pattern some characters are split in two pieces like as initial W, and "I" is in "corner pattern 2" instead of usual L-shaped arrangement. Also as shown below omit some other bytes like end of message code (marked End), P (padding), E (error correction) bytes and X (unused space).

Multiple encoding modes used to store kinds of messages. By default mode to stores one ASCII character per 8 bit codewords.

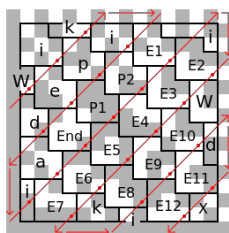


Figure 4: Encoding Data Matrix

3) *PDF417*: PDF417 is high-capacity two-dimensional barcodes. it is capable to store up to 2710 data characters. It is a stacked linear barcode symbol is extensively used for example with in aviation, automobile industry, identification, transportation and inventory management. It was originally published by Symbol technologies, Inc. But later it become as ISO standard. Here PDF is for Portable Data File and 417 describes the structure that how a single data character is encoded 4 bars and 4 spaces in a 17 units wide.

3.1) *PDF417 DATA CAPACITY*: PDF417 is high data density barcode. PDF417 is a row based barcode. It consists with a maximum of 90 rows and 30 columns. The maximum number of data is depending on the compaction mode used, the number of columns and rows and the error correction level. The maximum data size is dependent on both the compaction mode as well as input data.

1. 2710 digits in numeric compaction mode
2. 1850 characters in text compaction mode
3. 1108 bytes in byte compaction mode

A barcode can hold up to maximum of 929 codewords.

3.2) *PDF417 ENCODING SYMBOL STRUCTURE*: PDF417 symbology is also called a "stacked linear symbology" because a single PDF417 symbol [10] can be imagined as multiple linear barcodes stacked above each other. And a row is consists of maximum 90 rows and 30 columns. The shape of a PDF417 is rectangular. Figure shows the detail structure of PDF417.

- Quiet zone
- Start pattern
- Left row indicator symbol characters
- 1 - 30 data symbol characters
- Right row indicator symbol characters
- Stop pattern
- Trailing quiet zone

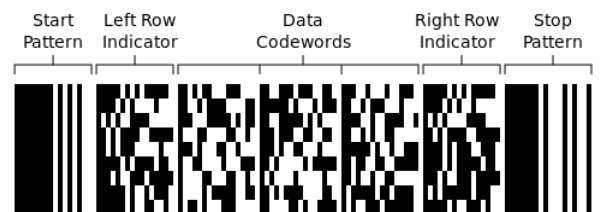


Figure 5:
PDF417[11]

Data region of each row is bounded by the left and right row indicators that provide the following information:

- row number
- number of rows (3 - 90)
- number of columns in the data region (1 - 30)
- error correction level (0 - 8)

ERROR DETECTION AND CORRECTION

Error correction mode is used to detect and correct the errors in PDF417 barcode. Each PDF417 have a user defined correction level. Up to 510 additional error correction codewords can be added to the end of payload data for maximum data correction and each barcode has a minimum 2 error detection codewords. The Reed Solomon [12] error control code algorithm is used to compute the error correction codewords.

Table shown below provides the error correction levels based up on the amount of data codewords in PDF417.

| # of Data Codewords | Error Correction Level |
|---------------------|------------------------|
| 1 – 40 | 2 |
| 41 – 160 | 3 |
| 161– 320 | 4 |
| 321 – 863 | 5 |

Table 1: Error Correction Levels

V. SECURE IDENTIFICATION SYSTEM

Security is the main concern in the identification system, In our research we created a new innovative 2D Barcode based ID Card system. That can be used to authenticate holder's information when they required. System integrates 2D Barcode that encode the user personal information in encrypted format.

A. SYSTEM INFRASTRUCTURE AND FRAMEWORK ARCHITECTURE

- **CLIENT LAYER** - This layer includes a user interface to interact with users and perform user account and membership that uses for Input Holder's information and management.
- **APPLICATION LAYER** - This layer will include the 2D Barcode based security and business logics.
- **DATA STORE LAYER** - This is the main layer of system that includes a centralized database for storing, maintaining and processing the Holder's account such as Name, Photo ID, signature etc.

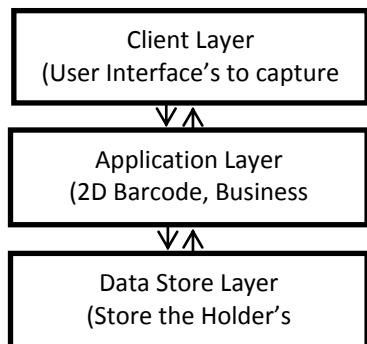


Figure 7: Architecture

B. SYSTEM WORKFLOW

1) **BASIC CONCEPTS:** For implementing the identity card management system, uses two processed first one is recording process and the second one is authentication process.

RECORDING PROCESS: In this process, the system consisting with a centralized database with Identity card management system that will take the inputs of the information given by the person and will issue an identity card with 2D barcode affixed on it.

AUTHENTICATION PROCESS: In this process, system authenticates the holder that he/she is a genuine one. A 2D Barcode scanner scans the image affixed on the ID Card and will send this image to centralized server for cross verification with the image already stored in database. If a relevant match found, then the person is genuine one.

2) BASIC STEPS FOLLOWED:

1. An Authenticated person will get holder's information and fill the key form manually and scan the identity documents and signature from the attached scanner and submit the form and forward the new application for verification to Admin department.
2. Next after the verification for the registered request received by the first step. Admin will check and validate that entered information and given documents are valid then he will forward it for card issue.
3. In this step a new interface that will issue a card with 2D Barcode affixed for respective request. Issued identity card contains signature and photo of holder and encoded 2D barcode.
4. Whenever a person needs to be identified, the barcode scanning machine extracts the holder's information from 2D Barcode and matches with information stored in the central database of the organization.
5. If scanned barcode information and stored information are same then the person is genuine and he allow accessing the services where authentication is required otherwise not.
6. If verification fails, he/she has to report to authority, so that necessary action can be taken. The verification failure happens mainly when the barcode is tampered.
7. If 2D Barcode is tempered or lost then person has to report to Admin for the re-generation of card.
8. For regeneration request admin has to follow step-2 and 3 for the re-issue cards.

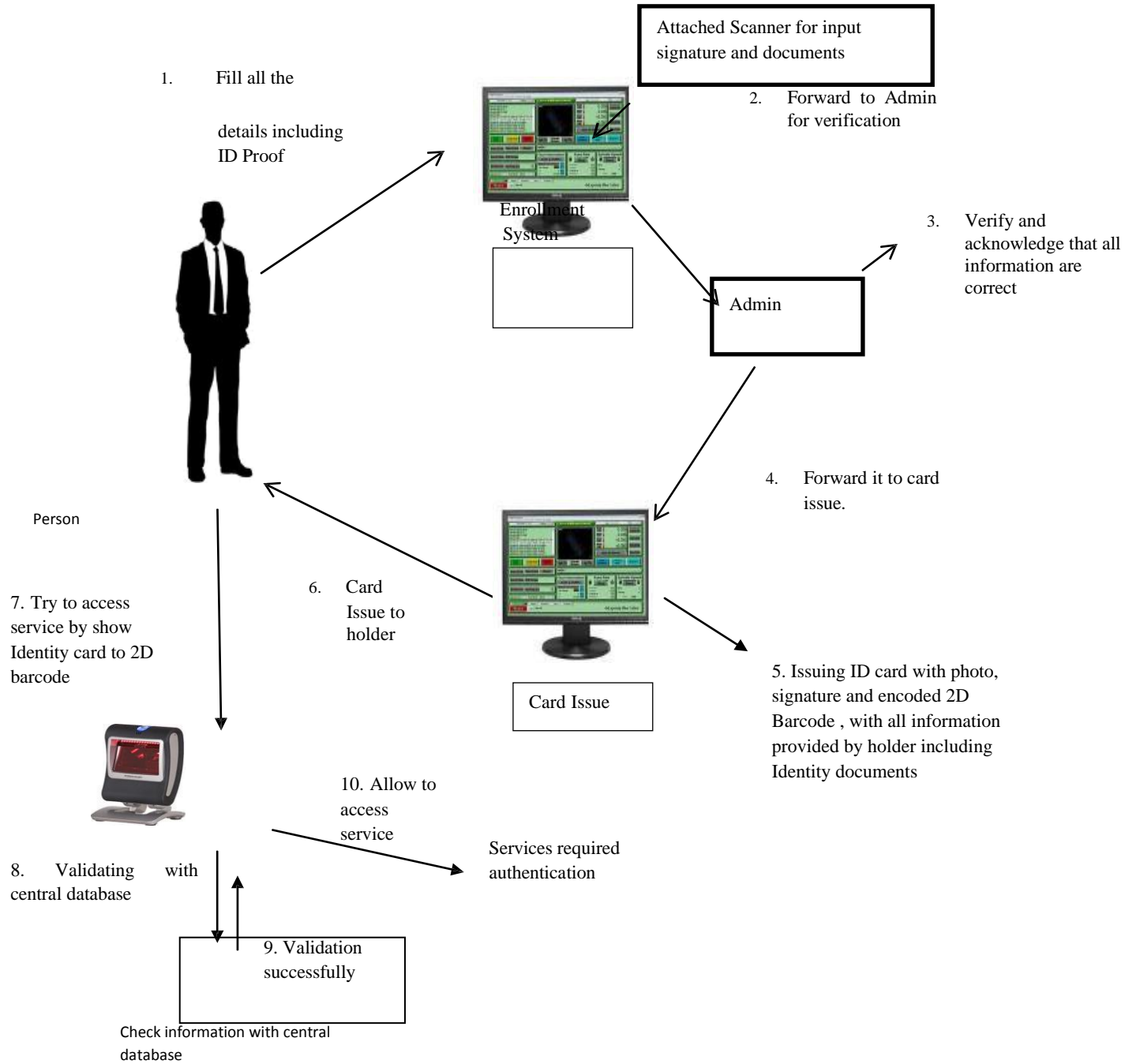


Figure 8: Workflow

VI. IMPLEMENTATION STEPS

We implemented this approach using "C# language" on Visual Studio 2010 with .Net Framework 4.0 installed on a PC running Windows 7 having Core i3 2.27 GHz processor and 320 GB of main memory.

The implementation consists of: Enrollment Form, Identification Form, Verification Form, Card Issue Form, Login Form, Change Password Form and Master Forms. Master Forms are used serves the purpose of changing master password.

VII. DETAILS OF SCREEN SHOTS

1) **ENROLLEMENT FORM:** This form is used to enroll the holder in organization. In this form authenticated person enter the holder's full information. This form has following three sub forms:

A) **BIOMETRIC DATA:** This form is used to input all the basic information about holder such as personal detail, birth detail, communication detail and identification detail.

The Enrollment form contains the following fields:

- Reg No:** 10027
- Personal Detail:** Name (Anita Singh), Father's Name, Mother's Name
- Birth Details:** Date of Birth (01-12-1986), Place of Birth (New Delhi)
- Communication Details:** Present Address (A-23, West Vinod Nagar), Permanent Address (A-23, West Vinod Nagar, New Delhi, India, 110092, 1122349674, 9650223111)
- Identification Details:** Identification Mark (Mole on Nose), Blood Group (O(+ve)), Gender (Female)

C) **DOCUMENT:** This form requires two types of documents for Date of Birth and address proof.

The Upload Scanned Documents form has two sections:

- Date of Birth Proof:** Includes an 'Upload' button and a preview of a scanned document.
- Address Proof:** Includes an 'Upload' button and a preview of a scanned document.

2) **IDENTIFICATION FORM:** This form basically provides the identification facility of the holder. It requires barcode on the ticket as input. It extracts the Reg. No. from the barcode and match with the all holders in database and returns all subsequent matches and shows the full information of the holder. This form is used by the Admin department for identify the holder.

The Identification form shows the following details:

- ID Card Barcode:** Vnp4N39r1JK+cP5; or Upload
- Identification Result Table:**

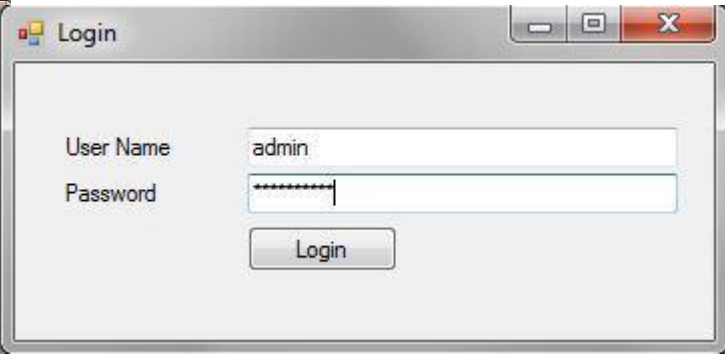
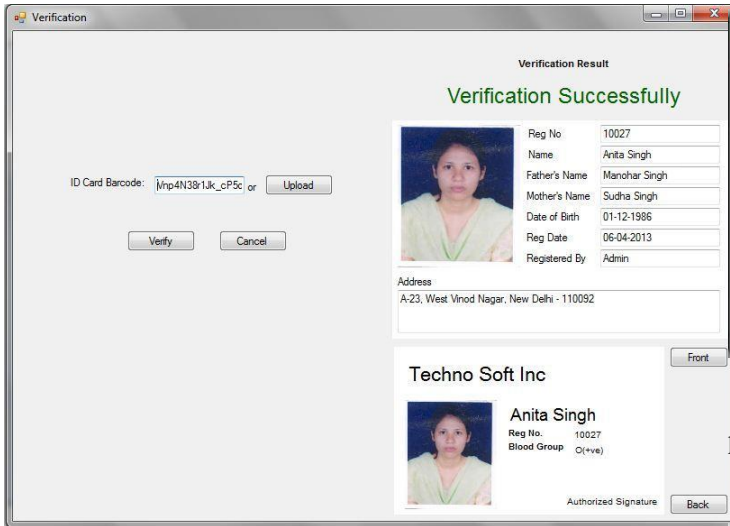
| Task Id | Status |
|---------|----------------|
| * 1 | 1 result found |
- Holder Information:** Reg No (10027), Name (Anita Singh), Father's Name (Manohar Singh), Mother's Name (Sudha Singh), Date of Birth (01-12-1986), Reg Date (06-04-2013), Registered By (Admin)
- Address:** A-23, West Vinod Nagar, New Delhi - 110092

3) **VERIFICATION FORM:** This form provides the v

B) **PHOTO AND SIGNATURE:** This form is used to input the

holder's photo and signature.



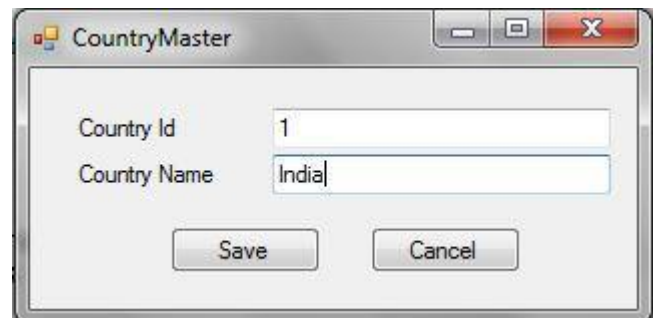


6) **CHANGE PASSWORD:** This form is used to change the password of admin user.

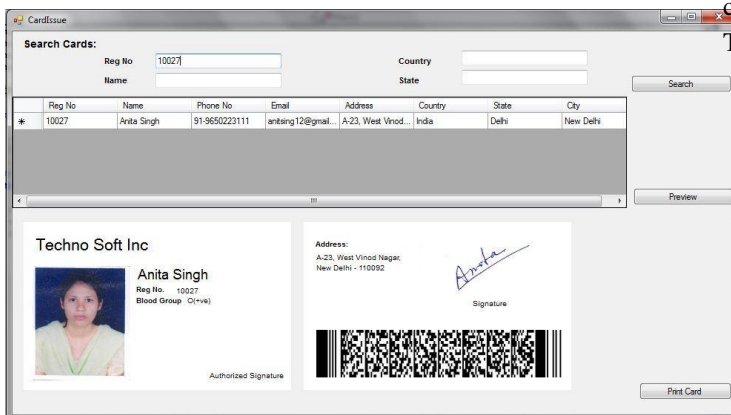


7) **MASTER FORMS:** These forms are used to store and update the master information such as Admin user's detail, country, state and status of holder's application for identity card. These forms are used by the admin person.

A) **COUNTRY MASTER:** This form is used to maintain countries master records.



4) **CARD ISSUE:** This form is used to issue card to the holder. It has three panels search panel, list panel and preview panel. Search panel have some field for finding the record from the database and resulted record will show in list panel and in the preview panel it show the identity card's preview of selected records from list panel. It shows the preview of card from both side front and back side of identity card, identity card has the holder's photo, name, reg. No. and authorized signature in front side, and contact address, signature and barcode in back side. This panel also has a print button to print the card in printer.



5) **LOGIN FORM:** This form provides the login facility of administrator person in the application.

B) *STATE MASTER*: This form is used to maintain state master records in database. It store states on the basis of country.

C) *STATUS MASTER*: This form is used to maintain status master records in database. These statuses used to know the current status of identity card.

203.Doi: 10.1007/11751588.

[3]"QR Code — About 2D Code". Denso-Wave.Archivedfrom the original on 2012-09-15.Retrieved 3 October 2011.

[4] Borko Furht (2011). *Handbook of Augmented Reality*. Springer.p. 341.

[5] "QR Code Essentials". Denso ADC. 2011. Retrieved 12 March 2013.

[6] "QR Code features". Denso-Wave. Archived from the original on 2012-09-15. Retrieved 3 October 2011.

[7] "2D Barcode: QR-Code". Archived from the original on 2012-09-15. — TEC-IT

[8] ISO e-commerce page for this standard http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_e_detail.htm?csnumber=44230.

[9] <http://code.google.com/p/zxing/>

[10] Detecting and Decoding Algorithm for 2D Barcode issued on

11, November 2012.

[11] The Symbol Technologies LS-4000 series.

[12] Cipra, Barry A. (1993), "The Ubiquitous Reed–Solomon Codes", *SIAM News* 26 (1).

VIII. CONCLUSION

This approach provides the way to authenticate the person at the organization by affix the barcodes on them. The basic idea behind the authentication is encrypt the unique ID of the person in the barcodes. This approach is more secure than previous one. Our proposed approach also handles identification properly.

The encryption/decryption scheme and barcode we used here are PDF417, respectively. Since, all information is stored in 2D Barcode; this approach requires a minimum use of the database as well as minimum use of Internet.

IX. REFERENCES

- [1] International Journal Of Engineering And Computer Science
ISSN:2319-7242Volume 2 Issue 4 April, 2013 Page No. 1225-1233
- [2] Duckki Kim &YoungsongMun (2006) Design and Performance Analysis of Multimedia Teachware Making System Using 2D Barcode. Proceedings of ICCSA'2006 on Computational Science and its Applications, pages 195-