2D Bar Code Authenticated RORs: Innovative Use of 2D Bar Code and Hashing Technology to Provide Authenticated and Verifiable Copies of ROR

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ABSTRACT

With the successful implementation of dynamically integrated property registration and Land Records system in Haryana, a need was felt to devise a security mechanism for Computer generated Record-Of-Rights (ROR). The NIC-HRSC combined Bar Codes, Hashing & XML techniques to develop verifiable two Dimensional Bar Coded ROR, which, can be verified by any third party in a time, bound manner at the time of acceptance with minimum resource. Solution developed has two main components first one is 2-D Bar Code generation modules and other is Bar Code verification module. The 2-D Bar Coded RORs has created a sense of trust among the revenue administration, public and agencies providing loan and other services. Solution has all set to reduce the chances of frauds by tempering the ROR.

Keywords: Jamabandi, ROR, HALRIS, HARIS, 2-D bar Code, XML, Nakal, SHA-1, PDF 417, CCD, DOM

1. Introduction

The Department of Revenue, Government of Haryana deals with maintaining and updating of revenue records, transaction by way of sale, mortgage, collection of revenue, consolidation of holdings, etc. The functionaries of Revenue department come into close contact with general public in connection with various activities/transactions dealing with immoveable property. The department also operates a large number of Acts and Rules, which have a direct bearing with the public. The department plays a crucial role in matters fundamentals to the existence of the citizen. Jamabandi is a document prepared as part of Record-Of-Right (ROR) in every revenue estate. It contains entries on ownership, cultivation and other rights of land. The presumption of truth is attached to the entries in Jamabandi under section 44 of the Punjab Land Revenue Act, 1887. All changes of rights in land coming to the notice of the revenue agency are reflected in the Jamabandi according to a set procedure after the revenue officer has verified these. The NIC-Haryana State Centre has developed an integrated HALRIS (Haryana Land Records Information System) Software product, which dynamically integrates the property registration (HARIS- Haryana Registration Information System) and Land Records workflow under a single unified database. The HARIS & HALRIS are being implemented at all districts of Haryana. The successful implementation has resulted in greater transparency, ease of service delivery and increase in revenue collection.

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With the rollout of HARIS (Property Registration) and HALRIS (Land Records) projects by the Revenue Department across Haryana, new challenges started emerging in delivery of service to the general public. One such issue is authentication and verification of ROR copies so that other agencies like financial institutions, builders and buyers can trust the computer generated RORs. This is necessary to check the frauds, which can be committed by tempering the hard copies of Nakals issued by the HALRIS centres or generation of duplicate RORs by scanning and modifying the original ones. The computer printed copies of RORs are issued with the seal and signatures of Patwari posted at the HALRIS Centre. There are amble chances that a person can temper the ROR before submitting it to the Bank or any other agency.

Therefore, a need was felt to devise a security mechanism for Computer generated RORs. The NIC-HRSC studied Bar Codes, Hashing & XML techniques and by using a combination of these technologies developed verifiable two Dimensional Bar Coded ROR. Solution developed has two main components first one is 2-D Bar Code generation modules and other is Bar Code verification module. Both these components use 2D Bar Code, XML and Hashing technology. The main objective of devising this solution is to generate the RORs that can be verified by any third party in a time bound manner at the time of acceptance with minimum resource. The 2-D Bar Coded RORs has created a sense of trust among the revenue administration, public and agencies accepting the RORs as security for providing loan and other services. Solution has all set to reduce the chances of frauds by tempering the ROR to a considerable extent. The State government has accepted the solution and already procured 2-D Bar code readers for each district. Necessary administrative & legal changes, required to be incorporated in Land Records manual, are under active consideration by State Revenue Department. Solution can be replicated in any state government who are providing the ROR services. Replication cost will include the bar code scanners and license of bar code generator software. NIC offices are situated in each State; therefore, horizontal transfer of the solution to respective NIC State Centres and necessary training to their development teams for local customizations can be handled very easily.

2. Solution Developed

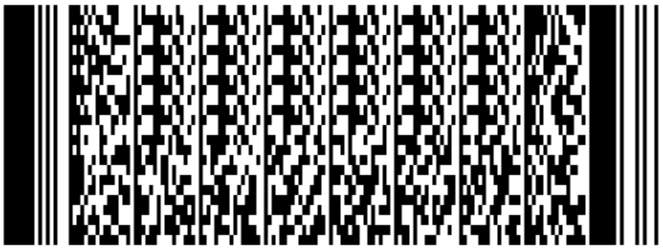
Main objective of the 2D Bar Coded ROR is to provide a mechanism to counter check the copies of ROR issued by the HALRIS centres in a time bound manner with minimum resources. Keeping this broad objective in mind NIC-HRSC developed the solution to generate and verify the 2D bar coded copies of RORs.

This solution has two parts first Bar Code Generation & Bar Code Verification:

- Bar code generation – Before discussing the steps involved in the bar code generation lets first discuss the different technologies involved in bar code generation.
- XML – Extensible Mark-up Language is a markup language designed to describe the data by using Document Type Definition (DTD) or XML schema. In bar coded ROR solution XML document object model (DOM) is used to manipulate the XML document containing the ROR. XML Document Object Model (XML DOM) defines a standard way for accessing and manipulating XML documents. The DOM presents an XML document as a tree-structure (a node tree), with the elements, attributes, and text defined as nodes.
- Hashing – SHA-1 (Secure Hashing Algorithm) is used for computing the condensed representation of the ROR in XML form. This algorithm produces a 160-bit output known as message digest, which is then converted into the bar code using the bar code generation component.
- Bar Code – A Bar code is a graphical representation of alpha and/or numeric information. A bar code can be compared to a ‘word’ that is easy for a machine to read. This ‘word’ can be written in different ‘fonts’ or bar code symbologies.
- 2D Bar Codes – 2D bar codes were developed to offer the advantage of being able to encode up to

several thousand characters of machine-readable data. 2D Bar codes use the PDF417 (Portable Data File) standard to store the data in the bar code.

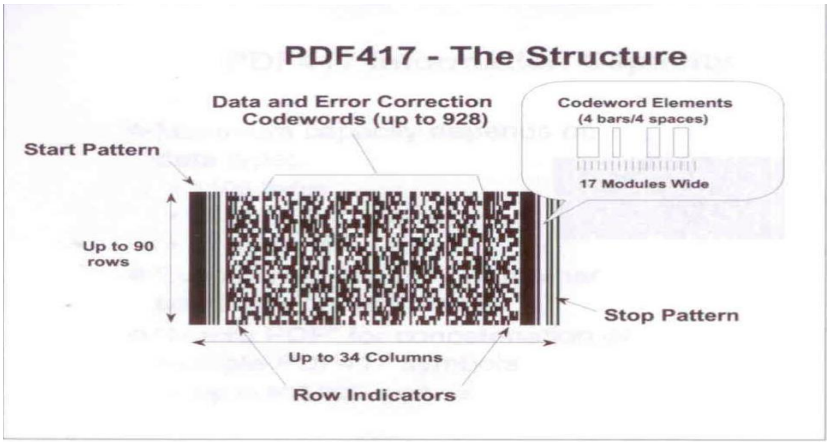
- PDF417 – PDF417 is a 2-dimensional barcode (also known as matrix code) used in a variety of applications, including Transport, Identification cards, and Inventory management. It is best suited for cases where information needs to move with an item or document. PDF stands for Portable Data File. The PDF417 format was developed by Symbol Technologies, and has spawned an Open Source decoder project together with an Open Source encoder.



PDF-417 can store up to about 1,800 printable ASCII characters or 1,100 binary characters per symbol. The symbol is rectangular; the shape of the symbol can be adjusted to some extent by setting the width and allowing the height to grow with the data. It is also possible to break large amounts of data into several PDF-417 symbols, which are logically linked. There is no theoretical limit on the amount of data that can be stored in a group of PDF-417 symbols.

The maximum data density is determined by the smallest elements, which can be reliably printed and scanned. Using the smallest recommended element size of 0.0075 inch wide and 0.010 inch high, the maximum data density in the binary mode is 686 bytes per square inch (106.2 bytes per square centimeter). In the printable ASCII mode the density is 1,144 characters per square inch (177.2 characters per square centimeter).

Structure of PDF 417



The PDF417 barcode (also called a symbol) consists of several (minimum 3, maximum 90) rows, each of which is like a small linear barcode. Each row has:

- A quiet zone. This is a mandated minimum amount of white space before the barcode begins.

- A start pattern, which identifies the type of symbol as PDF417. Every type of bar code symbology has a unique start and stop pattern.
- A "row left" codeword containing information about the row (such as row number and what error correction rate the row is using)
    - 1 - 30 data codeword: Codeword are a group of bars and spaces representing one or more numbers, letters, or other symbols.
    - All rows have the same number of codeword.
    - Every codeword contains four bars and four spaces (where the 4 in the name comes from).
    - The total width of a codeword is 17 times the width of the narrowest allowed vertical bar (the X dimension). This is where the 17 in the name come from.
    - Each codeword starts with a bar and ends with a space.
    - There are 929 codeword to choose from, 900 for data, and 29 for special functions.
    - Each codeword is printed using one of three distinct clusters:
        - A cluster is a bar-space pattern for each of the 929 codeword
        - No bar-space pattern is repeated between clusters
        - The row number determines which cluster to use
        - The cluster is the same for all codeword in a row.
        - The purpose of clusters is to determine which row (mod 3) the codeword is in, allowing the scan to be skewed from the horizontal. For instance, the scan might start on row 6 at the start of the row, and be on row 10 at the end.
- A "row right" codeword with more information about the row.
- A stop pattern.
- A quiet zone.

Features of PDF 417

- More storage of data than linear (1-dimensional) barcodes. PDF417 barcodes can store up to 2710 characters.
- Error correction - The PDF417 code can detect and correct erasures, smudges, misprints and other errors, with a configurable amount of redundancy.
- Data compaction - Several schemes are defined for representation of certain types of data in a smaller space.
- Fast reading - It is not significantly slower than reading a linear barcode
- Linking - PDF417 symbols can link to other symbols, which are scanned in sequence allowing even more data to be stored.
- Cross-row scanning - This means that a barcode scanner doesn't need to read the symbol in an exactly horizontal pattern.
- Bi-directionally decodable - The symbols can be scanned from either the top or the bottom equally easily.
- User-specified dimensions - The user can decide how wide the narrowest vertical bar (X dimension) is, and how tall the rows are (Y dimension).
- Public domain format - Anyone can implement systems using this format without any license.

PDF-417 symbols require a 2-D scanner; or a standard CCD(Charged Couple Device) or laser scanner and special decoding software. A number of scanners are on the market using both laser and CCD camera technologies.

Bar Code Generation Module Involves the Following Steps

- ROR is converted into Unicode format.

- Unicode ROR is then converted into the XML document using the XML DOM.
- XML ROR document is converted into the message digest by using the SHA-1 algorithm. This algorithm computes the 160-bit message digest.
- Message digest is encrypted and then converted into the 2D Bar Code using the 2D bar Code generator.

3. Bar Code Verification

Bar code verification module is provided to verify the copy of ROR with the ROR issued by the HALRIS Centre using the 2D bar code printed on the ROR. It provides the verification at HALRIS centres. Person who want to get the ROR verified will visit the HALRIS Centre and get it verified from the counter running the verification service. This option is provided for the ordinary user having no bar code scanner.

Bar Code verification involves following steps:

1. Read the bar code using any bar code scanner device.
2. Input the scanned value to the bar code verification module.
3. Bar code verification module will decrypt the scanned value to get the message digest. This message digest will be used to pick the XML ROR from the server.
4. Verification module will then compute the message digest for the saved XML file and compare it with the message digest obtained from the scanning process. If both the message digests are same then software will open the XML file to the user for verification purposes.

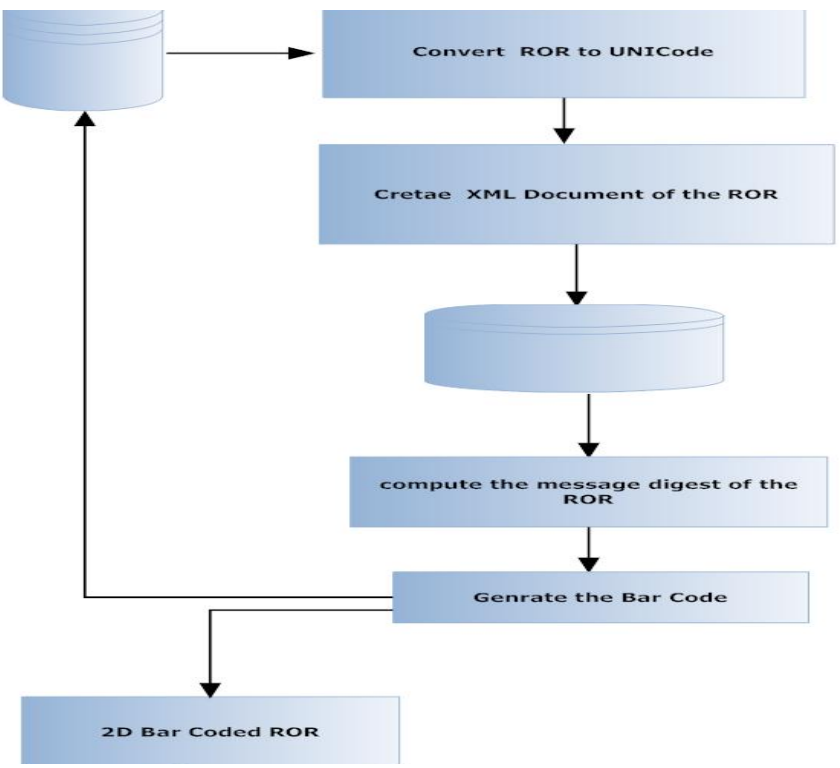


Figure 1: 2D Bar Code creation

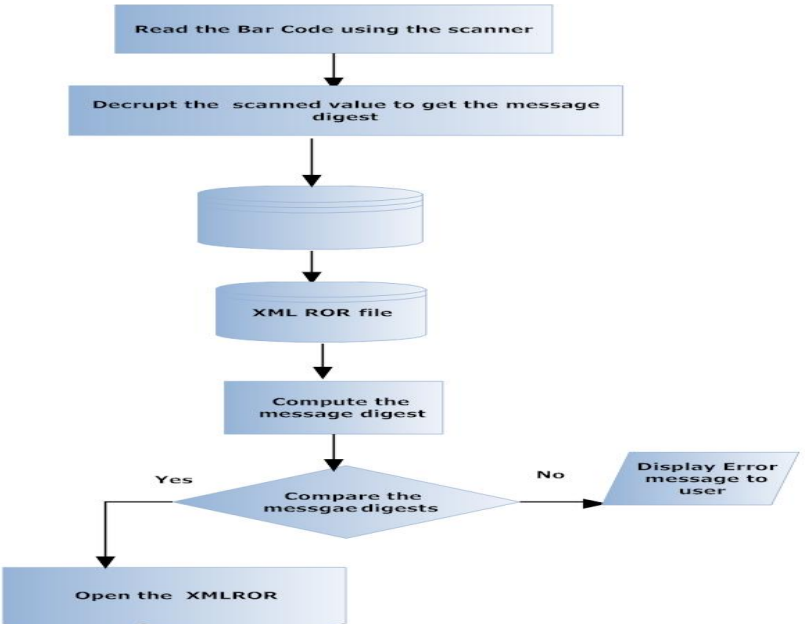


Figure 2: 2D Bar Code verification

4. Results Achieved / Anticipated

The facility to generate ROR with 2D bar code and verification service has been made available at District HQ level Tehsils. This solution has created a feeling of trust among the landowners. With the increasing land prices potential buyers can use this system of ROR verification before entering into any sale and purchase of land. Bank and other financial institutions can use this service before disbursing the loan to the landowners. Haryana Chief Minister Sh. Bhupinder Singh Hooda has appreciated the initiative.

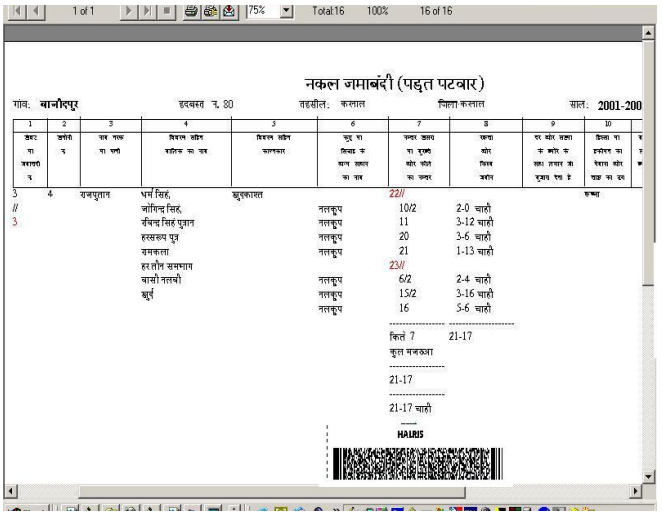


Figure 3 : Showing a HALRIS generated Record-Of-Right with 2-D Bar Code

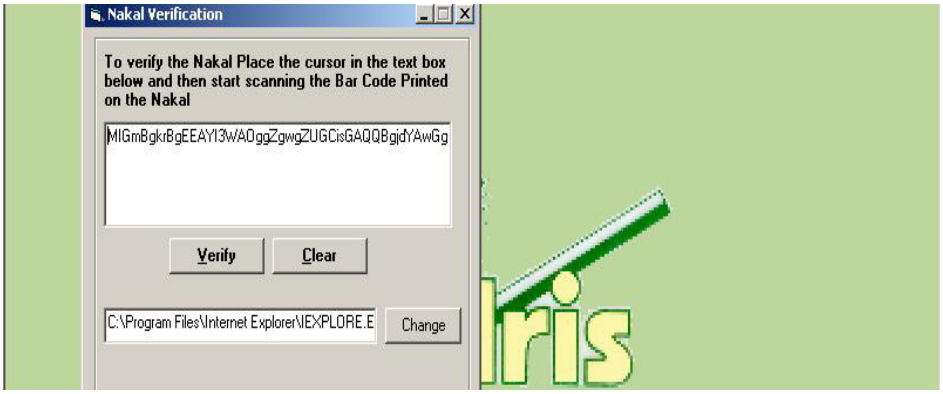


Figure 4: Showing a Bar Code verification Service of HALRIS System

- All the HALRIS centres to provide the ROR verification services by charging service charges from the public.
- Other departments and agencies can use Land Records database if suitable interface is provided to them. 2D Bar Coded ROR verification service is one such example, which can enable the departments to provide the hassle free service to farmers.
- Currently this verification service is running at HQ level Tehsils only. Very soon it will be extended to all the operational HALRIS centres in the state.
- This solution can be very easily used by other states to provide the similar service to the public without making major changes to their existing land records software.

5. Concluding Remarks

Remote verification of ROR will be provided to verify the RORs on the WEB. User will visit the HALRIS web site to verify the ROR. Prerequisite for this is a Bar Code scanner to scan the bar code printed on the ROR. User will scan the bar code and put the result in the space provided on the site then submit it. Site will then show the actual nakal issued to the farmer by the HALRIS Centre. User will then check the hard copy with the copy of nakal shown by the site. Remote verification will be very useful to the financial institutions, which provide the funding to farmers to carry out agriculture related operations. This service will be developed and implemented, once the State Wide Area Network is in place.

This solution is an attempt to check the frauds and provide the reliable service to the public. It can also be used in the number of other e-governance applications like certificate issuing etc. To provide the real benefit to the masses verification service should be available on any time any where basis. So that public can verify the documents issued by the various citizen service centres. It will also save lot of public money and time.

References

1. URL: Free encyclopedia www.wikipedia.org available at http://en.wikipedia.org/wiki/pdf417
2. William Stallings, *Cryptography & Network Security.*