# Exploring Concept of QR Code and Its Benefits in Digital Education System

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***Abstract***— This research paper concentrates on the concept of Digital Authentication using QR Code in Digital Education System. This paper aimed to provide a better solution to the Digital Security. There are two challenges of the work i.e. first one is to explore the usability of QR Code in general life and second is to incorporate QR Code technology with an educational document for security to avoid duplicity. The literature review is done to synthesis digital encoding and decoding technique as well as basics of Bar Code and QR Code. The implementation of QRC (Quick Response Code) for verification is presented where web environment, programming logics, and URL embedding are discussed.
The result analysis and testing of experiment are done in the sense to get best quality of QR Code though the information embedded should not affected and the QR Code must easily be decoded the embedded information from common tools. The goal of this research paper is to explore and analyze the best image under the testing of Error Correction Level and Matrix Point Size parameters by calculating the PSNR and MSE values for QR Code images with different image file format (PNG and JPG). The calculated values are compared and the final conclusion of the work found which state that the PNG image with Error Correction Level- L and Matrix Point Size 1 are the best to generate quality QR Code.
. The testing and result are presented which state that the QR Code is the best way to compose the identical information of any entity to quickly figure out the originality.

Keywords — Digital, QR Code, URL, 2-D BAR Code, Error Correction Level.

## I. INTRODUCTION

The new technologies advent based on Digital Authentication, the goal of this research is to provide a better solution to the Digital Security. The condition of Digital Document Security is poor, especially in an education system. With the little changes, one can easily create a duplicate document and take the color hardcopy of the document. This research implements as well as tested a conceptual system for "***Digital Authentication using on QR Code Verification in Education System***". The identified challenges of the dissertation are:

- ✓ **To explore usability of QR Code in general life.**
- ✓ **To incorporate QR Code technology with an educational document for security and to avoid duplicate entity.**

This research presents a prototype for digital document security especially. It is the system which stores the record of any entity and generates the QR Code for the same. The generate QR code then used for verification either 1:1 or 1: N matching. The overall scenario presented with a channel as medium of information exchange is requiring. The core objectives of the research work are as follows:

- To inserts owner's information into QR Code.
- To read decode the QR Code Image.
- To improve QR Code Image quality for best result.
- To verify embedded information that must not be corrupt after decoding process.
- To test the applicability of developed QR code on various documents.
- The embedded information must be easy to decode by other QR Reader Applications.

According to the two objectives of the study, there are some researches questions are formulated, which promote the strength of QR Code Technology as well as motivate to research for real life problems.

- ➢ **What is the role of QR Code in Society?**

This question initiates readers to know the fundamentals of QR Code and understand why QR Code is popular in different areas. Now a day, QR Code is increasingly and widely used in various fields. However, QR Code is still new for most companies and individuals, therefore more

knowledge about to QR Code should be acquired by public. In this manner, one-dimensional barcode would be compared with QR Code and find the characteristics of QR Code.

- **What are the benefits of using QR Code for Companies?**

  There are so many benefits of using QR Code for companies in intensive ways and this research question focuses on understanding and recognizing the benefits for it. After the exploring and analyzing, this research can help more companies to know QR Code deeply.

- **How can one take advantage of QR Code in Education System?**

  It is a base of the research which motivates towards finding a significant advantage of the research. The QR Code for Verification can easily be implemented in Education System.

Education sector in Republic of India has long estimated an overhaul to fulfill the growing demand for a recent education system that's accessible to any or all. Youngsters and youth in our country dead the last decade become progressively technology-driven, revealing goodish potential and readiness to imbibe and learn by digital media.

Network directors should keep current on the safety desires for technology inside the college, including configuration testing, monitoring, and change of all systems, as well as computers, servers, and networks. They are accountable for:
1. Knowledge backup
2. Personal devices connecting to the network
3. Work and log analysis
4. Antiviral and spy ware suppression
5. Filtering, patching, and firewalls
6. Documentation of systems
7. Applicable user access
8. Crisis preparation

Secure the information algorithmic program generated passwords, and don't share them with anyone (except oldsters or guardians). Per a recent analysis, "one out of 5 net users still decides to depart the digital corresponding of a key under the doormat: they select a straightforward, basically guessed word like 'abc123,' 'iloveyou' or perhaps 'password' to safeguard their knowledge. To form a lot of artistic word, combine letters, numbers and even symbols.
Back up knowledge. Microsoft analysis showed that 9 out of 10 homeowners don't often copy their files.
[1][2]

Primarily Digital Education has three components:
1. The content
2. The technology platforms
3. The delivery infrastructre

## II. THE RISE OF MOBILE LEARNING

Overview of Mobile application for digital authentication: Digital Authentication in authorization possibilities using mobile devices, Mobile device capability to capture or scan objects information from the real world. It is very much important to focus that the QR code is become a key of application interface i.e. without QR code user is not allow to get their information from the datacenter.
The advancement in technology leaded the mobile devices to perform intelligent actions. In which Quick Response (QR) code boosts the mobile based analysis of product or identity and especially the whole-sole account information. The recent development in mobile based communication between devices while connecting to the internet is based on QR Code Technology. The live examples of it are What's App and WeChat Mobile based Social Networking Applications.
What's App is a most popular and approachable mobile application for social communication. It is extremely popular though What's App application is available in almost all platforms of Mobile Devices (like Android, Windows, Apple, etc.). The communication through What's App is very sensitive for inspection of criminal activity. The message send by one user should be appropriate show that the other user should not affect.
The privacy of the personal message is the major action taking by many social networking applications. What's App is mobile dependant application which is further improving to view message on the laptop or desktop monitors. This is achieved by using QR Code. The message contain on a mobile device should only be visible if the mobile device is present on that time. So, the What's App facilitate it user or consumer to view as well as operate their message directly from the desktop or laptop browser for better visualization. The application provides a What's App Web option under the option tab in smart mobile devices. [3]
Steps to get What's App data on laptop/desktop screen using QR Code.

1. Download the What's App on Mobile phone
2. Configuration of What's App by identifying mobile number user.
3. Go for What's App web option available on mobile application.
4. Start the computer and type the URL on browser. (http://web.whatsapp.com).
5. Now, scan the QR Code using phone.
6. This result all the message available on mobile device will now visible on laptop/desktop screen.

## III. QR CODE

Denso Wave was inventing QR Code in 1994. It uses as a registered trademark by Denso Wave for tracking product. Denso Wave promoted the widespread use of QR codes, by providing QR code tutorial at www.qrcode.com. QR codes as a quick, easy method to tracking their vehicles and auto parts.

### A. *Concept Behind the Quick Response Code:*

- ✓ It is a merit of QR Code that it has greater storage capacity.
- ✓ The variety of data that can be hidden in QR code is Plain text, URL, SMS, E-Mail, contact information (Phone number, address, etc.)
- ✓ QR Code Scanning is possible through different platforms by developing a decoding application.
- ✓ The User can reach at Virtual stores by Scanning QR Codes.
- ✓ QR Code is use in online payments by hiding payment details (Intermediate payment channel, Account Information, etc.)
- ✓ Websites can traverse by user to login form or a specific page to access data.
- ✓ Encryption.
- ✓ It is store different type of data like Numeric, Alphanumeric, Binary, Kanji.

TABLE 1

DATA CHARACTERS PER SYMBOL

| S. No. | Encoding Mode | Maximum Capacity |
|---|---|---|
| 1. | Numeric | 7089 digits |
| 2. | Alphanumeric | 4296 characters |
| 3. | Binary | 2953 |
| 4. | Kanji | 1817 |

QR codes have been used on large scale in marketing campaigns since the early 1990s to create an interaction with a consumer. Denso Wave made an extensive use of this technology because of their potential in the auto trade. The QR code first came into the market as a commercial product in 2011 when the telecommunications industry was on the hike. Today QR Code has become popular due to new technology with Smart Phones. [5]

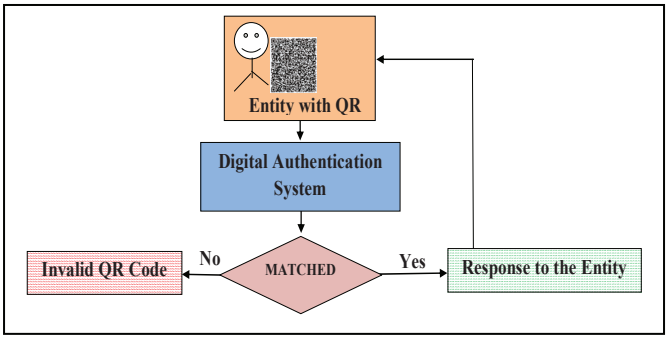



Fig. 1.1 Concept of QR Code

### B. *Characteristics Of QR Codes*

1 High Capacity Encoding of Data.
2. Small Printout Size.
3. Kanji and Kana Capability.
4. Capacity of Restoring and Error Correction.
5. Readable from Any Direction in 360 Degrees
6. Structured Appending Feature [4]

### C. *Applications of QR Code*

1) The Use of Quick Response Codes in the **Classroom** with the help of Mobile Devices.
2) Quick Response (QR) Codes in **Mobile Tagging System** for Retrieving Information about Genetically Modified Food (GMF).
3) **Automated Exam Process** using QR Code Technology.
4) **Certificate Generation System** based on credit based grading system (CBGS).
5) **Enhancing Security in Identity Documents** using QR Code.
6) QR Code Based **Digitized Mark Sheet System.**
7) **QR Codes in Education**: The arrival of using QR codes in Education System is growing.

### D. *Error Correction Level*

There are four error correction levels L, M, Q, H. Higher the Error Correction Level reflects the less storage capacity. Basically, the message is broken up into multiple Reed-Solomon code blocks. [5]

TABLE 2

LEVEL OF ERROR CORRECTION

| Sr. | Level | Meaning | Restoring |
|---|---|---|---|
| 1. | Level-L | Low | 7% |
| 2. | Level-M | Medium | 15% |
| 3. | Level-Q | Quartile | 25% |
| 4. | Level- H | High | 30% |

## IV. DIGITAL EDUCATION SYSTEM

The security matters when there is any chance of steal the information. Especially, when one deals with digital system it is very tough to control on data privacy. The Computer Science and Information Technology are two branches those are still research the new techniques to protect credential information. Due to new techniques and user faith it is now possible to place user's private data on Web Server. The Banking and E-Commerce processes now operated fully using Internet Web Services. They assure the customer to protect their personal banking information. This is now the condition of World today, computers are being

using worldwide. The vast variety of computer peripheral are availing resource to the client, beside multiple other technique and private subsidiaries are providing system protection while providing secure communication channels. The Digital Education System is secure enough if data binding is proper, but sometimes some leakages allows intruders to steal credential information from the server machine. The Web Server only associate with the Web Services parallel to the Dynamic Web Application and back-end components. What are the Security Issues associated with Digital Education System? This is an important question to give strength to any developer association when program is online. The security issues are:

1. To provide data security which available in the database.

2. To protect contents from duplicity. [6]

## V. LITERATURE REVIEW

There have been number of technologies proposed to generate the QR code for documents or mark sheets.

**Mamtha Shetty –** the author is mainly focused on confidential encrypted data hiding in QR code. A smart phone running on Android or iOS or any other new generation of mobile OS, can be used to extract the encrypted data from embedded QR-code and finally that data to be decrypted using the TTJSA decryption algorithm. In the present work, they have used three types of algorithms to Encrypt and Decrypt the data or any type of information. With the analysis of all these three algorithms using different formats of images they conclude that the Vernam method is more acceptable to encrypt the images or data. Comparing, NJJSAA algorithm as it has the larger PSNR value and Less MSE value it is not considered much for the encrypting of any information. [7]

**Somdip Dey** - the author presents a brand new methodology to digitize the educational transcript i.e. mark-sheets, and insert the digital format within the mark-sheet itself within the variety of encrypted QR Code and that they used unambiguously encrypted algorithmic rule i.e. own custom engineered cipher methodology with unambiguously generated key, that is extremely secure so. [8]

**Saroj Goyal et al.** - explored the methods for generating and scanning of Quick Response (QR) codes. Quick Response codes are 2-D Matrix codes that are used to encode and decode information. QR codes can enclose information such as text, URL links, and automatic. The different types of the QR code and their basic structure are discussed. The practical analysis performed to examine how actually QR Codes Generation and gives the steps to QR code generation. [9]

**Dr. Neeraj Bhargava et al**.–They deal with the ability to come up with QR bar codes with facilitate of document package like ms-word document 2007/2010. The main goal is to attain creation and understanding the technology of QR code in today's atmosphere. [10]

**Andy Ramsden** – proposed that concept of learning and teaching scenarios in education. An approach is to use QR codes in presentation material to provide people with just in time information. For instance, the presenter might be discussing a concept and making reference to various online resources. These links can be made available as a QR code. The student could scan the QR code and either access the supporting online resource directly or save it in their web bookmarks. This offers a significant efficiency gain over having to enter a long URL manually, whilst the slide is disappearing. [11]

## VI. QR CODE IMAGE QUALITY EVALUATION

To test the best suitable error correction level of this research work the Peak Signal to Noise Ratio (PSNR) is calculated in which PSNR values are calculate to judge quality of Digital QR Code Image.

- **PSNR**: It is Peak Signal to Noise Ratio reflect the ratio between the maximum possible power of a signal and power of corrupting noise. It also affects the originality of the signal. The PSNR is usually expressed in terms of the logarithmic decibel scale. It is commonly used to check quality construction of loss compression.
- **MSE**: MSE is nothing but *Mean Squared Error*. If one have a noise-free m x n monochrome image A and it has noisy approximation of K, then MSE is defined as:

The PSNR calculation (in dB) is defined as:

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2$$

$$\mathbf{PSNR} = 10.\log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

$$= 20.\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

$$= 20.\log_{10}(MAX_I) - 10.\log_{10}(MSE)$$

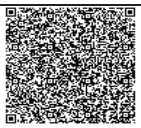
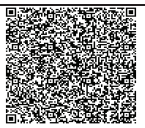
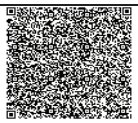
Here, MAXI represents the maximum possible value of the pixel in the image. The MSE is the sum of all squared value differences which is divided by the image size and by three so the PSNR. The somehow typical values for the PSNR in lossy image and video compression are between 30 to 50 dB, (if provided the bit depth is 8bits) and for 16 bit files values will exist between 60 to 80 dB for good quality. Once if consider the wireless transmission then the signal quality loss are consider between 20 dB to 25 dB. There is an important point to notice that the two images I and k are identical (in this case the PSNR is infinite or undefined) if the noise is absent, and so the MSE will be zero.

## VII. RESULT

The experiment is done upon the quality constraints which aim to develop a QR code and examined its possibilities of imposing over the Digital Documents. The following tables bellow presents the obtained output values as well as calculated score for certain QR Codes:

TABLE 3

QR CODE IMAGES OBTAINED WITH PNG AND JPG EXTENSION

| S. No. | Matrix Point Size | | | |
|---|---|---|---|---|
| | 1 | 2 | 1 | 2 |
| | PNG | | JPG | |
| 1. |  L1.png |  L2.png |  L1.jpg |  L2.jpg |
| 2. |  M1.png |  M2.png |  M1.jpg |  M2.jpg |
| 3. |  Q1.png |  Q2.png |  Q1.jpg |  Q2.jpg |
| 4. |  H1.png |  H2.png |  H1.jpg |  H2.jpg |

The table above signifies the QR Code images developed for two different image file format for Quality analysis between QR Code images with specific image file extension.

### A. Comparison of Level and Matrix Point Size:

The table below represents the MSE and PSNR value which is calculated for Matrix Point Size of 1 & 2 for JPG & PNG image format. The comparison of Error Correction Level-L with other Level and as well as comparison of image file formats are examine. From the table above it is very clear that**:**

Table 4: L1 stands best in all case for JPG file format after comparison of PSNR values. Beside, the compression L1 is fine and has good quality compare to the value calculated for PNG file format.

TABLE 4

COMPARISON OF LEVEL-L WITH OTHERS FOR MATRIX POINT SIZE OF 1

| S. No. | Image1 | Image2 | MSE | PSNR |
|---|---|---|---|---|
| **JPG** | | | | |
| 1. | L1 | M1 | 13.4697 | 36.8712 |
| 2. | L1 | Q1 | 9.3994 | 38.4338 |
| 3. | L1 | H1 | 7.6877 | 39.3068 |
| **PNG** | | | | |
| 1. | L1 | M1 | 0.2961 | 53.4498 |
| 2. | L1 | Q1 | 0.3079 | 53.2812 |
| 3. | L1 | H1 | 0.3005 | 53.3858 |

Table 5: This table states that L2 with PNG image is best in comparison with the PSNR values calculated for JPG image file format. The calculated value for PSNR is 47 in dB which is far better than any other case, especially it closer to 50 dB which actually require.

TABLE 5

COMPARISON OF LEVEL-L WITH OTHERS FOR MATRIX POINT SIZE OF 2

| S. No | Image1 | Image2 | MSE | PSNR |
|---|---|---|---|---|
| **JPG** | | | | |
| 1. | L2 | M2 | 153.82 | 26.29 |
| 2. | L2 | Q2 | 147.18 | 26.48 |
| 3. | L2 | H2 | 0.3044 | 53.3297 |
| **PNG** | | | | |
| 1. | L2 | M2 | 1.2195 | 47.303 |
| 2. | L2 | Q2 | 1.1865 | 47.422 |
| 3. | L2 | H2 | 0 | Inf |

### B. Comparison between Image Formats:

TABLE 6

COMPARISON OF ECL FOR MATRIX POINT SIZE OF 1

| Sr. No. | Image1 | Image2 | MSE | PSNR |
|---|---|---|---|---|
| 1. | L1.png | L1.jpg | 0.3598 | 52.6034 |
| 2. | L1.jpg | L1.png | 181.07 | 25.5863 |
| 3. | M1.png | M1.jpg | 0.4306 | 51.8234 |
| 4. | M1.jpg | M1.png | 227.92 | 24.5868 |
| 5. | Q1.png | Q1.jpg | 0.5878 | 50.4718 |
| 6. | Q1.jpg | Q1.png | 290.10 | 23.5392 |
| 7. | H1.png | H1.jpg | 0.7246 | 49.5637 |
| 8. | H1.jpg | H1.png | 338.34 | 22.8712 |

The table 6 and table 7 representing the direct comparison of JPG and PNG file extension for all the level of Error Correction and for Matrix Point Size of 2.

TABLE 7

COMPARISON OF ECL FOR MATRIX POINT SIZE OF 2

| Sr. No. | Image1 | Image2 | MSE | PSNR |
|---|---|---|---|---|
| 1. | L2.png | L2.jpg | 1.4553 | 46.5352 |
| 2. | L2.jpg | L2.png | 724.26 | 19.5658 |
| 3. | M2.png | M2.jpg | 1.7368 | 45.7672 |
| 4. | M2.jpg | M2.png | 911.65 | 18.5665 |
| 5. | Q2.png | Q2.jpg | 2.3837 | 44.3921 |
| 6. | Q2.jpg | Q2.png | 116.06 | 17.5177 |
| 7. | H2.png | H2.jpg | 0.3549 | 52.6627 |
| 8. | H2.jpg | H2.png | 1.8104 | 25.5868 |

## XI. FUTURE SCOPE

This research work is very interesting and effective. It can be used in many cases like Computer Aided Learning, Students Admission and Tracking, Academic Information including Geographical Locations, Feedback, Inspection of Institute, Classroom Assessment and Attendance through various web based modules, continuous standard evaluation of entity performance and also degree evolution, Students fees account statement, Students activity records, Faculty Records, and Study Material as well. This proposed concept is very significant for Government Organization, which deals public matter such as E- Mitra (billing system), Government Certificate, Government Policies, etc.

The core advantages of QR Code are **easiness of scanning**, using without license and free of charge. Technically, this work can be further improved by using the other algorithms in which used parameters can give the less PSNR values and MSE values for best image quality.

## X. CONCLUSION

The research work is done, gives a wonderful experience which elaborate the usability of available concept of new enhanced development. As the topic of dissertation relates to the document security via verification through online web-service extremely motivated to use QR Code technology.

- The methodology follows bring possibilities to use QR Code to store Mark-sheet entries which is really a great experience to avail Mark-matching on just single scan by QR Code Reader.
- The implementation part not just included QR Code generation mechanism but also include accessibility to Student Record over the network.
- The verification of embedded information can easily be achieved by just putting QR Code Lenses over the URL QR Code.
- The technology communication is too robust and reliable also. QR Codes for multiple records are obtained for synthesis likely to explore the various possibilities of QR Code in different sizes.

The testing is done so that of analyze the best QR Code in such a way that must be stand and able to produce information in worst environment. The testing is done with kept in mind that if the QR Code image compress and share online then the QR Code must not be dump the channel or medium of information authentication process. This authenticity is providing by URL QR Code. This is very simple and innovative method to digitize the mark sheet in the digital era.

The concept of digitally mark mark-sheet with QR Code can also be applied to college and university for higher education. The Rajasthan Technical University with facilitating students to view result and Mark sheet online but there is no authenticity, and it can easily be duplicate.

By using the concept of this research the overall efficiency and faith of user as well as university can be established. If RTU provides Mark sheet online with QR Code embedded a person can directly check the originality of the QR Code.

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