International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

QR CODE BASED TECHNIQUE FOR DATA TRANSFER FROM COMPUTER TO ANDROID MOBILE DEVICES

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Abstract - *Data transfer between devices is becoming a crucial part and nowadays we are having many options to transfer data to and from devices. Theoretically data transfer needs wired or wireless connection between devices. In proposed system, we present a differnt camera phone-based V Barcode technology, which allows users to download content to their camera-enabled android mobile phones. The visual content is encoded in a streaming barcode which can be decoded efficiently by camera smart phone. Significant work is that content can be reliably transferred through camera anytime and anywhere without any kind of connection between computer to Android device. The system does not requires special hardware, and users do not need to spend money for the data plan since it relies on "visual" communication. This application allows a user to select any media file from computer and transfer this file to Mobile phone just by converting it to QR code sequence and scanning this sequence.*

Key Words: Quick Response code, Data transfer, Barcode, Encoder, Decoder, Smart phone, Mobile application, etc

1. INTRODUCTION

Mobile phones are poised to be the world's most pervasive technology, already outnumbering landlines, personal computers, and even people in some countries. The innovation and growth on the mobile phones front are highly amazing. The increased use of Smartphone turned them into a microcomputer which can be used almost for anything. It allows Creating and Editing of documents, audio, Video and presentations. This need data transfer from various devices. Most of the Mobile applications are now using Camera of smart phone as input channel and this made a new and fast trend of information transfer. Nowadays popular application of camera phones is not just capturing the image but to scan QR codes shared online for advertisements or printed on business cards.

In this system we use similar technique to transfer input file by scanning sequence of QR code generated of that file and decode it in the original format on scanning device. The increased ability of camera of smartphones makes this task very easy for the user. Use of QR code makes data transmission faster and simpler because of its 2D format. This 2D format again allows to store more data than the normal one-dimensional barcode.

2. LITURATURE REVIEW

The content discussed in this paper are related to QR code Review, Camera base channel capacity and Data Recognition.

2.1 **QR code Review:** The various barcodes like 1D Barcode, Line barcode, PDF457, QR Code have various data encoding techniques. The exposure of smart phones increases the use of QR code because a smart phone has features of scanning and decoding a QR code. QR code stands for 'Quick Response' code. QR codes developed by Denso Wave Corporation in Japan. QR code is a two-dimensional barcode which is able to encode more information than one-dimensional barcode.[3] Also, reading of QR codes are fast. There are different Methods for improving speed of encoding and decoding. Even faster data transfer as pressing needs and there have been many improvements with high reliability have emerged on the original barcode designs that were made [12]. QR Codes are categorized into five broad categories. The original QR Code is QR Code Model 1, a code capable of coding 1,167 numerals with its maximum version being 14 (73 x 73 modules). [14]QR Code created by improving Model 1 so that this code can be read smoothly even if it is distorted in some way. [14]

2.2 **Camera base Channel capacity**: comparing wired or wireless data channels to visual channel i.e. using camera has normally less capacity. A specially designed images needs to be generated for data transfer. An encoder to generated these images and camera specific module to decode these images need to be developed.[9] To send maximum data 2D barcodes plays important role. As images are used, colour degradation in images and optimized colour selection protocols need to be considered [7]

2.3 **Data Recognition:** Visual communication uses camera and barcode, at the time of acquiring barcode image relative movements can induce motion-blur distortions in the captured image. This problem can be solved by using orthogonal frequency division multiplexing (OFDM) modulation along with differential phase shift keying (DPSK). 2D barcodes are index-based barcodes which internally a data matrix of encoded data.[11]

3. SYSTEM ARCHITECHURE:

The system can be loosely partitioned into encoding, frame display, barcode acquisition, code area detection and recognition, error correction and their implementation on mobile devices. Overall, the procedures presented include the following.

- Design of the QR code symbology by considering the specifics of various devices.
- Development of an encoder so that any data stream can be encoded as a QR code sequence.
- Development of display module which can display QR code on flat panel displays.
- Development of components for acquisition and processing of QR code images, including a user interface, acquisition and image-enhancement components. This can include image detection, normalization, decoding.
- Decoding the captured QR code frame by frame and reconstruct the data encoded.
- Integrating all of the algorithms onto the mobile device. We propose a preliminary user interface, developed integrated software on mobile devices, and optimized code for best resource utilization.

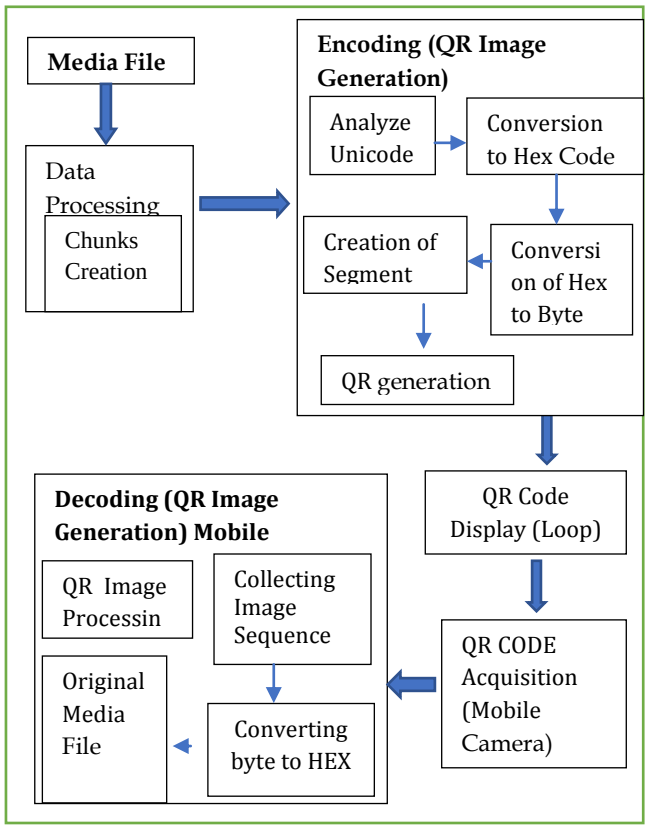


Figure 1: Basic System architecture

3.1 Algorithms

As shown in the block diagram of this System, it starts with the first module that encodes the file into sequence of QR codes.

3.1.1 Encoding Algorithm for Desktop Application

INPUT: //Decide type of media file to be encoded
MEDIA FILE(*Fm*), PACKETSIZE (*Ps)*
OUTPUT: Sequence of QR code Image.
Begin:
1: Select Media file to be decoded.
2: Read file_name and Packet size
3: IF Fm not Exist THEN Generate Error Massage
Else Create Array of Strings
4: Read data from file [Packet size] to Buffer
5: Encode Buffer to Hex Values.
6: Covert Hex_values to String
7: Add String to ArrayList
8: Repeat step 4 to step 7 until end of the file
9: FOR All strings *S* in array
APPEND file_info to Array[string]
10: End For
11: FOR all Strings S in array
Generate QR Code ()
12: End FOR
13: Display QR code Sequence

3.1.3 QR code Acquisition by Mobile Camera

The acquisition of QR code are constrained by the size of an encoded image and rate of display the sequence of these images. Here Camera specification of the device and user movements during capturing the image performs major role. The process, however, must optimize performance by balancing the acquisition speed, image resolution, and processing requirements.

3.1.3 Decoding Algorithm for Mobile Application

INPUT: Sequence of QR code Images
//scanned using camera of smart phone.
OUTPUT: Original Media file

Begin:
1: Create a Buffer //to store the scanned data
2: Create an Empty File
3: Loop till user exit
a) Scan QR header Section
b) Set error correction bits
c) Scan QR Data Section
d)Read data Section into buffer
e) Convert Hex Value to Byte
f) Extract File name
g) Extract Data part into blocks as per image.
h) Save data blocks in to created file
4: Combine all data blocks file into one Main file
5 Validate the data

6: Display original file on Device.

4. IMPLEMENTATION

In encoding of the file into QR Code the data is encoded in different frames. In each frame, the first byte indicates its frame type. Data partitioning and Error correction is required to while framing the data.

4.1 QR Encoder:

Encoder of this system is developed as a desktop application using Java Language. This application allows to choose any file (Audio, Video, Image, PDF etc).

To encode a data file into a QR Code, we first need to split the data file into small segments, and then encode each segment into an image sequence. This scheme is straightforward but, the challenge is to make the encoding robust to the degradation and data loss which is inevitable in the imaging process.

1. Dividing data into small chunks each of which is further divided into individual frames which forms three layers. Each chunk can be visualized as cube which consists of three areas: data area, inter and intra frame error correction areas. The data file to be encoded is filled into this "Data Cube".

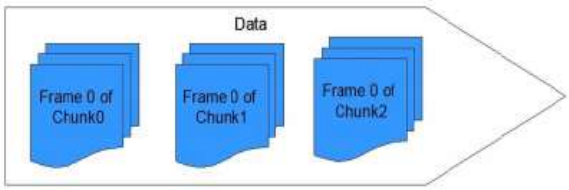


Figure 2. Data chunks

2. Error correction coding is done while partitioning data into 3 dimensions K*W*H where K is frame number, W and H are the width and height of each frame. Error correction in inter and intra frames is done by padding error control bits in frames.
3. QR code rendering that is converting each frame (including error correction frames) into an image, which can be displayed on flat screens.
4. QR code acquisition – The acquisition process itself is very simple: Users only need to aim the camera at the QR Code to keep the frames at the center of the display. Detection and decoding will occur at frame rate. For each frame, the first type indicates its frame type.

   Type I – Static Single Frame: the following bytes encode the message body as a null-terminated string.

   Type II – Sequence Header: this is a unique frame for sending data file in hand-held mode and dock mode. This frame encodes the file name and size.

   Type III – Data Frame: this frame encodes a chunk of data beginning with its offset and chunk length. Since each frame carries with its own offset and chunk length, the reading order of the frames has no importance.

4.2 QR Decoder

Decoder is an android application (mobile application) which can run on any Android smartphone. Before decoding, each captured frame needs to be corrected, enhanced, and converted into a binary sequence.

1. **Image Processing***:* The application works efficiently to meet the real-time requirement. The following are the challenges when processing the detected image.

   a) Perspective distortion**:** when users capture the image, it is not guaranteed that the camera image plane is parallel to the display plane. Perspective distortion is inevitable. The Square boundary box appears as a border.

   b) Uneven lighting: Parts of the image are darker than other parts.

2. **Binarization:** This part converts the processed image into binary values which will further be converted into original data form. For M × N Matrix computer sample M× N coordinates on the image and read their gray scale values.

The decoder tries to decode every single frame it "sees" through the camera. To guarantee that the frame is read correctly, the first byte is used as a verification byte which must be 0x10, 0x2x or 0x30 indicating Type I, II or III, respectively, to be accepted as a valid frame. For Type I, it will decode all other bits in this frame and show it as a pop-up message.

After completion of the decoding the file is stored at basic Android directory of device.

5. EXPERIMENTS AND RESULTS

QREncoder: -This desktop application generates a series of QR codes for a single file. For testing the working of Encoder following 4 test sample files are considered. It generates different number of QR codes shown in the Table 2 and images. Table provides data about file, its size and number of QR codes generated after encoding. The number of bytes for encoding each packet are 400 bytes.

Table 1: Encoding Test samples

Sr.no	Test samples	Size	Encoded QR Image
1	teddy-small-size-500x500	40KB	54
2	Sample Videos - Dummy Videos For Demo Use	64KB	289
3	IPhone Note SMS(Audio)	72KB	188
4	NOTICES FOR BARCODE4J(PDF)	72KB	178

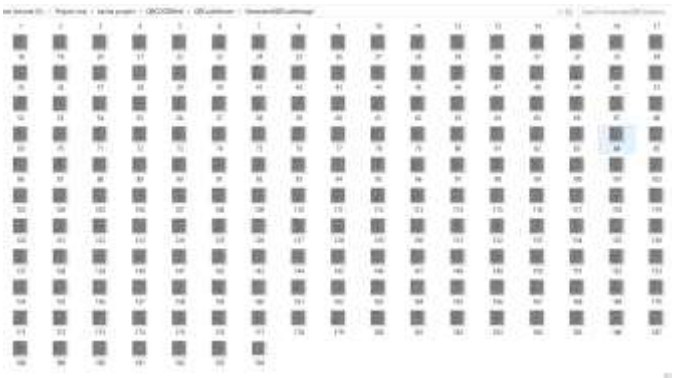
If packet size is low like 100 or 200 bytes for single QR code generation the for-sample file then it generates more QR codes and if it is high e.g. 400 or 500 then encoder generates a smaller number of QR codes. Example is shown in following Table 2.

Table 2: Encoding of Images with packet size 200

Sr.no	Test samples	File size	Encoded QR
1	teddy-small-size-500x500	40KB	194
2	Sample Videos - Dummy Videos for Demo Use	64KB	577
3	IPhone Note SMS(Audio)	72KB	360
4	NOTICES FOR BARCODE4J(PDF)	72KB	355

By comparing Table 1 and Table 2 it is seen that as packet size varies number of QR code images created also varies as well as the type of file also a considerable element while creating QR codes.

Results of Encoder:



QRDecoder: - This is an android application which is installed on the following testing devices which have different camera specification as well as processor. For Decoding QR code image – QRDecoder uses rear camera of the mobile. Following Table 3 shows the specification of mobile phone used for testing.

Table 3: Test device specification

Test Device	Camera Spec.	Device name
Device 1	48.0 MP + 12.0 MP + 5.0 MP + 5.0 MP	Samsung Galaxy A51
Device 2	12 MP, f/2.0	Moto 5g plus
Device 3	12MP+5MP	Asus Zenphone Max Pro M2
Device 4	12MP AI camera	Redmi 7A

To validate results of decoder same test samples are used as mentioned in table no 2. When a series of QR code of same test file is being decoded on different smart phones, it requires different time to complete scanning and decoding. This is because of the camera specifications of the test devices as well as processing speed. The next table shows the time required to perform scanning and decoding of each file on each device.

Table 4 : Decoding Time for file.

Sr. no	Test sample	QR codes	Testing Devices			
			Time required to scan QR Codes			
			Device 1	Device 2	Device 3	Device 4
1	teddy-small-	54	4 min 50sec	5 min 20Sec	5 min	4 min 58sec
2	Sample Videos -	289	13 min	15 min	14 min	13min 45 sec
3	IPhone SMS (Audio)	188	12min	14 min	14 min	13 min
4	NOTICES FOR BARCOD(PDF)	178	10 min	12 min	11 min	10 min

Table 4 shows that the device with high camera specification captures image fast and decoding time required is less than other low cameras. It is observed that when a file is encoded with minimum number packet size, decoding becomes faster but number of QR code generated are more. The encoder works similar for each file, while result of scanning and decoding of series of QR code is different for each decoding device. This difference is due to camera quality and handling of camera to scan the QR code.

Results of decoder:

6. CONCLUSION

In this paper, a novel scheme for data transfer between computer to mobile phone is demonstrated. This consist of QREncoder and QRDecoder which are briefly described. This system will help to transfer data without using any existing wired or wireless channel. The experimental result shows that the system works robustly during entire process. The major part focused in this approach is introducing mobile camera as a data channel.

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