# A Technique to Add Error Detection of QR Code Decoding by Using Micro QR Code

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Abstract—This paper introduced method for error detection of the information in QR Code by using Micro QR Code, by creating a gravscale OR Code. Image processing technique is used before decoding. Image processing offer ability of fixing error and restore module that have been damage such as tear, stain or bend before decoding process. General OR Code has no error detection which helps to verify the correctness of information in OR Code. Therefore, the contents of Micro QR Code is generated using MD5 (Message-Digest Algorithm 5) and overlapping onto the three corners of Finder Pattern of standard QR Code. The experiment is conducted on QR Code version 5 and over. The decoding is done by focusing on the region of interest on the overlapped Micro QR Code. After that the binarization is done using multilevel-threshoding to separate the content of the Micro QR Code. The opening technique is used to remove edges, eliminate noises and compare the decoding data.

*Index Terms*—2d barcode, quick response code, micro quick response code, error detection

#### I. INTRODUCTION

QR Code have been developed by Denso Corporation in 1994 [1] and approved in 2000 as the ISO/IEC 18004 standard [2]. The QR Code structure is 2-dimentional bar codes and ability to response with haste. Initially, QR Code was used in the industrial, later it was used widely in advertising and media due to it quick response feature. The main characteristic of QR Code is capacity, QR Code able to store data up to 7,089 character and able to decode with smartphone equip with camera.

Since QR Code has error correction, is used to recover data from damaged barcodes. The damage is limited to the portion to be able to decipher, but when the damage exceeds the QR Code could not be able to decode. Therefore, many of research were conduct with several methods to helps recover the data on the bar code such as scratches removal method on a bar code [3]. However, there is no guarantee that recovers method result correct decoding. Researchers have studied how to add information to verify decoding process. General research papers research regard to QR Code is based on increasing capacity of QR Code by increasing QR Code color [4][5].

Researchers conducted a study on the process of error detection by overlaying information on the QR Code. As

the result, researcher obtain image of QR Code with the addition of error detection using encryption Micro QR Code and able to decode the QR Code with the general QR Code reader application. Image processing method is require to extract part of Micro QR Code off the QR Code in order to decode error correction and is used to check the correctness of decoding QR Code. Section 2 is present on the composition and structure of the QR Code and Micro QR Code. Section 3 is present about the theory involved in processing to encode and decode. Section 4 is presents encoding procedure and decoding procedure of creating a QR Code with the addition of error detection. Section 5, experimental results and the final conclusion in Section 6.

#### II. THE QUICK RESPOSE CODE

## A. QR Code Property

QR Code [2] is a two-dimensional barcode come with square shape consist of x axis and y axis as shown in Fig. 1 image. QR Code could store up to 7,089 characters and able to decode at haste by smartphone applications.



Figure 1. QR Code



Figure 2. Structure of a QR Code

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The composition of the QR Code in Fig. 2, which consists of the following.

- **Quiet Zone** consist of empty space around the QR Code with a width of 4 modules, allowing application to locate QR Code more quickly.
- **Finder Pattern** is used to locate the position of QR Code.
- **Separator** is used to separate Encoding Region and Finder Pattern.
- **Timing Pattern** is helps in detecting the coordinates of the symbol.
- Alignment Pattern ,this help scanner to detect tilted QR Code and allow decoding efficiency
- Format Information store type of data which is Data Type and Binary Indicator of Error Correction Level and Data Mask. which is used to encrypt the data.
- Version Information store version information data.
- Data and Error Correction Codewords is used to store encode and error correction coding data which is used to restore corrupted data
- B. Micro QR Code Property







Micro QR Code [2] is a two-dimensional barcode feature similarity to QR Code, but reduces in composition to make QR Code less complex, as shown in Fig. 3 and Fig. 4. Therefore the size of barcode become small and could store up to 35 characters. The size of Micro QR Code version M4 is equivalent to 17 modules x 17 modules. Encode and decode Micro QR Code in this work used modified source code of "Zxing" [6], based on ISO / IEC 18004 standard [2].

# III. RELATED THEORY

# A. Grayscale Image

Grayscale image is the images that have intensity of light in each level vary from black to white. The grayscale images have resolution of 8 bit. Light intensity of black is equal to 0 and light intensity of white is equal to 255.

#### B. Morphological Image Processing

Opening is useful technic in image processing. Erode technique is used and follow by dilate for the purpose of extracting objects and noise removal from images.

#### C. Message-Digest Algorithm 5(MD5)

MD5 is a cryptographic hash function with a 128-bit number that results in a log base 16 with 32 characters. MD5 is commonly used to check the accuracy of the information or statements.

## IV. ENCODING AND DECODING QR CODE WITH ERROR DETECTION

In the experimental, the process is divided into two separate processes. QR Code barcode encoding process with additional error detection method and decoding process is by splitting error detection of QR Code to verify the correction of the transcription.

## A. Encoding QR Code with Error Detection

The process is split into two parts .Encoding of information process to achieve Matrix of QR Code and Micro QR Code for the overlap. Process is shown in Fig. 5.



Figure 5. The process of encoding QR Code with error detection

"Zxing" [6] library is used to encrypt imported message to obtain matrix of the QR Code. Error detection data is obtain by encrypt messages using MD5 and error detection data is require to encrypt Micro QR Code. To implement error detection on QR Code, matrix of the QR Code and Micro QR Code is require to overlay bar code with the area of the Finder Pattern. These process require to implement on all three corners of the Finder Pattern of the QR Code. The overlay technique is used date from Table I. In order to determine the density of the bar code grayscale. Fig. 6 shows the example of QR Code with error detection.

TABLE I. THE VALUES OF MODULES IN GRAYSCALE BARCODES

QR Code's	Micro QR Code's	Values
True	False	0
True	True	85
False	True	170
False	False	255



Figure 6. Example of a QR Code with Error Detection

#### B. Decoding QR Code with Error Detection

Decoding process is break down to two parts which is QR Code and error detection encrypted with Micro QR Code shown in the workflow Fig. 7.



Figure 7. The process of decoding QR Code with error detection

The snapshot image shown in Fig. 8 (a), image is imported using the digital camera require to be controlled illuminance to ensure consistency in order to separate the QR Code and error detection.



Figure 8. (a) Example of a QR Code with error detection was captured with digital camera. (b) QR Code image was made binarization.

Decoding the QR Code Image is using common standards in the binarization to extract QR Code Fig. 8(b) from processed image by using the threshold value Th in Fig. 9. As the result decodable QR Code image is obtain and ready to decoding process.



Figure 9. Typical histogram used to calculate threshold parameter in QR Code image.

The error detection is to determine the ROI (Region of Interest) of image to extract Micro QR Code. To determine Micro QR Code is to calculate the size of Micro QR Code itself which is 17 modules x 17 modules and extract from the area of Finder Pattern.



Figure 10. Determine the area of error detection with Micro QR Code overlay

From Fig. 10 error detection with Micro QR Code overlay, image that were process with binarization technique using multilevel-thresholding based on histogram shown in Fig. 11. Histogram chart indicate that group of gray level were divided into four groups. Group 2 and 3 are Micro QR Code. The gray value which is suitable to use in thresholding process is Th1 and Th2. The data that suitable is interval between Th1 and Th2 only.



Figure 11. Typical histogram used to calculate multilevel threshold parameters in Micro QR Code image.

After binarization process, Micro QR Code is obtain, but not yet complete due to the edges of the QR Code's modules residual Fig. 12. Decoding is not possible, therefore, is require to perform image processing using Opening technique to eliminate edges and the noise off the barcode image as Fig. 13.



Figure 12. Micro QR Code image after perform binarization process using multilevel-thresholding.



Figure 13. Micro QR Code image after opening process to remove edges and noise.

# V. RESULT

The experimental result of decode the image QR Code with error detection. The experiment is conduct with QR Code version 5-14 that print on paper with the size of the barcode is 6.9 cm x 6.9 cm, each of the version has different data. 15 photos is taken at a time with condition that bar code has to be held to the same illuminance. Fig. 14 shows the snapshots that presented the examples of QR Code image in test set.

From the results of experiments from Table II, decoding is efficiency. QR Code is verifying with MD5 and data that was decode from Micro QR Code is corresponding. Therefore, it could be used to verify accuracy of decoded QR Code data correctly.



Figure 14. Snapshots that presented the examples of QR Code in test set.

TABLE II. RESULT: THE FIRST COLUMN SHOWS THE QR CODE'S Version. The Second Shows the Result of Error Detection Decoding (Micro Qr Code).

QR Code	Error Correction's	
version	decoding	
5	100%	
6	100%	
7	100%	
8	100%	
9	100%	
10	100%	
11	100%	
12	100%	
13	100%	
14	100%	

# VI. CONCLUSION

This paper introduced an algorithm for encoding and decoding the QR Code with the additional of error correcting technique using Micro QR Code. This technique generated grayscale QR Code image. In the decoding process, image processing is used to extract the error by determining. The ROI (Region of Interest) on the overlapped area of Micro QR Code located at the three corners of the Finder Pattern. The binarization process is used to extract the Micro QR Code using multilevel-thresholding. Opening technique is used to remove edges and eliminate noises. As can be seen form the results, the error correction data in decoded correctly as well as the information in the QR Code.

The purposed method can be used for error correction to verify that the information in the QR Code is correct.

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