# Investigation on Perceptual and Robustness of LSB Digital Watermarking Scheme on Halal Logo Authentication

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Abstract— In Malaysia, Halal Certificate can only be issued by Jakim. For the time being, there is no specific method to verify authentication of Halal Certificate displayed at food or service premises. Watermarking technique however, offered a solution for authenticity of the data and copyright protection. In this paper, an investigation on perceptual and robustness of least significant bit (LSB) digital watermarking scheme on Halal Logo authentication is implemented using MATLAB software. LSB digital watermarking scheme allows pixel value modification by dividing its entire bit leaving most significant bit (contains most information) and least significant bit (contains less information). These small modifications offer a high perceptual transparency to the watermarked image. A Quick response (QR) code with message is generated as an embedded watermark image for Halal Logo. The watermarked image quality is measured based on Peak signal-to-noise (PSNR), mean square error (MSE), and Normalized Cross-Correlation (NC). The investigation shows the scheme provided high PSNR performance which is between 12-22 dB with Gaussian noise added. The scheme successfully shows the ability to retrieve the embed watermark even though the cover image visual quality is degraded with 50 % Gaussian noise variance. The reliability of the scheme is proven when it successfully to produce an acceptable 0.8442 NC value. The observation on perceptibility shows 51 dB of PSNR with 0.4714 MSE.

# *Keywords* — Least Significant Bit (LSB), Digital watermarking, Grayscale images, Halal logo, QR code, PSNR.

### I. INTRODUCTION

The advanced technologies that involved internet and multimedia have rapidly growth and it become part of human life[1]. Thus, people have commonly tends to create copy, transmit and distribute digital data. As more systems and data are connected to the internet, data protection has become significantly important today to prevent unauthorized replication[2]. Apparently, to overcome replication problem, there must be a reliable and secure copyright protection techniques for digital data[3]. One of the valid solutions is to implement the digital watermarking. With the important application of digital content, it is now attracting significantly attention. Digital watermarking is known as type of technology that embeds copyright or authenticity information into digital data [4][5]. Watermarking is a method where pattern of bits inserted into a digital image, audio or video file that specifies the file's copyright information such author, rights and so on [6]. Basically, it is used to make sure that the data is secure. Watermarking can be evaluated from its robustness, imperceptibility and capacity. There two categories of watermark techniques: Invisible and visible, the invisible watermark is embedded into a original image by certain algorithms and is invisible to the human eyes, whereas the visible watermark is used when the embedded watermark is intended to be seen by human eyes [7][8]. For example, the trademark logo or text that are placed on the corner or anywhere in a picture.

The watermarking process takes place when watermark is embedded into the cover image using watermarking algorithm and as a result, the watermarked image. In order to evaluate the information of the watermarked image, the watermark must be extracted from the watermarked image. The correlation between extracted watermark and original watermark has to be determined by comparing the result to a predefined threshold that sets the degree of similarity accepted as a match. If the value of threshold value and correlation is match, watermark is detected and the original image is owned by the user [9].

This paper is divided into several sections. Sections 2 briefly describe least significant bit (LSB) watermarking scheme. Section 3 discusses the embedding, extraction and verification of Least Significant Bit (LSB) watermarking scheme on Halal logo as well as the types of measurement that being used. Section 4 presents the experimental results and discussion of the technique. The conclusion is given in section 5.

#### II. LSB WATERMARKING SCHEME

Digital watermarking can be divided into image watermarking, video watermarking and audio watermarking [10]. As for image watermarking, hidden information can be inserted directly into every bit of image information or the

more busy areas of an image can be calculated so as to hide such messages in less perceptible parts of an image [6].

The main idea of this watermarking technique is an image with matrix NxM (where N and M are the dimension of the image) the value of the pixel can be represent as a binary number. This binary number can be divided in all of it bit, so that we will have a most significant bit. The first bit is the least significant bit (LSB) contains few information about the image and the last bit is the most significant bit contains the main lines and edges of the pictures [2][6][7]. For example, the grayscale image, each pixel is represented by 1 byte consist of 8 bit. It represents 256 gray colors between the black which is 0 to the white which is 255. The principles of encoding make use of the Least Significant Bit (LSB) of each of these bytes, the first bit from right side.

#### III. METHODOLOGY

Based on LSB technique, the flow of the process of watermarking is shown in figure 1. First, select the cover image which is Halal logo and transfer the watermark image which is quick response (QR code) image to binary value. Then we embed the watermark image in the Halal logo using the algorithm. As a result we get the watermarked image. The watermark will be extracted from the watermarked image which is Halal logo.

#### A. Watermark Embedding

As for watermark embedding, the Halal logo has to be in form of grayscale image. The Halal logo is set as the cover image. The raw image of Halal logo from internet which is in JPEG format has to be change from truecolor image to grayscale image. After that, we have to determine the size of cover image (Halal logo) used for embedding, as well as size of the message image (QR code) to embed. After that, title the message object out to cover object size to generate watermark. Set the LSB of cover image to the value of the MSB of watermark. Then, watermarked image will be produced and will be saved. Apart from that, the Gaussian noise is added to the watermarked image to determine the quality of the watermarked image.

## B. Watermark Extraction.

As for watermark extraction, after getting the watermarked image, determine the size of the watermarked image. Use least significant bit (LSB) of watermarked image to recover watermark and scale the recovered watermark image. After that, display the recovered watermark.

#### C. Verification

After the watermark image (QR code) being extracted from the cover image (Halal logo), decode the watermark image using QR decoder from internet to get the hidden message. The hidden message shows link to the website *http://www.halal.gov.my/v3/index.php/ms/direktori-halalmalaysia*. The website shows the details about the Halal logo and determines the authenticity of the Halal logo.

#### D. Measurement

For the measurement, Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR) and Normalized Cross-Correlation (NC) are used to determine the quality of the images. Mean Square Error (MSE) is defined as in equation (1).

$$MSE = \frac{1}{MN} \sum_{j=1}^{M} \sum_{k=1}^{N} [I(j, k) - K(j, k)]^2$$
(1)

M and N are number of pixels in row and column directions, respectively. I represent the original image and K represents the watermarked image. The large value of MSE indicates the image is poor quality [11].

The PSNR measurement is used to determine the quality of the watermarked image. The PSNR also is known to evaluate the transparency of the watermarking technique [12]. PSNR is measured by calculating the distortion between original and watermarked image [6]. PSNR is defined as in equation (2).

$$PSNR = 10*\log 10 \ (255^2) / MSE \ (dB)$$
(2)

The small value of PSNR indicates the image is poor quality. The unit of PSNR is decibel (dB) [11].

The comparison between of the original watermark and extracted watermark is measured by Normalized Cross-Correlation (NC)[4]. NC is defines as in equation (3).

$$NC = \frac{\sum_{j=1}^{M} \sum_{k=1}^{N} [I(j,k) - K(j,k)]}{\sum_{j=1}^{M} \sum_{k=1}^{N} [I(j,k)]^2}$$
(3)



Figure 1. LSB Digital Watermarking scheme

#### IV. RESULT AND DISCUSSION

In our experimental results, for testing the performance of this least significant bit (LSB) technique, the experiment is simulated with the MATLAB software. Figure 2 illustrated the cover image (Halal logo) in JPEG format which is selected from internet. The size is 300x306. The watermark image as shown in Figure 3 is a quick response code image (QR), generated from the QR code generator and the size is 344x344. Both cover and watermark image have to be changed from truecolor image to grayscale image before watermark is embedded into the cover image. It is important to make sure that the number of pixels for both cover image and watermark image has to be identical so that it can match properly.

Figure 7 shows the exact flow of the watermarking process in this experiment. The watermark image (OR code) is successfully embedded into the cover image (Halal logo) with good quality image. The result is named as LSB watermarked image as depicted in Figure 4. The LSB watermarked image is tested by added different variance of Gaussian noise. Figure 5 and Figure 6 as depicted shows the LSB watermarked image with minimum 0 percent and maximum 50% of Gaussian noise added. The hidden message is shown in Figure 8. The results are measured by PSNR, MSE and NC as shown in Table 1. The higher the value of PSNR, indicate that the image is good quality. The value of PSNR is decreased as the value of MSE is increased. With the increases of distortion being added to the watermarked image, it increases the value of MSE. By comparing the pixels, the value of NC determined the similarity between original watermark and extracted watermark. In order to test on the perceptual of the LSB watermarking scheme, the embedded watermark image is tested in term of PSNR and MSE performance without Gaussian noise. The robustness of the watermarked image is determined by tested different variance of Gaussian noise on the watermarked image. Results that tabulated in Table 1 shows that the quality of the image degraded as the variance value increased. The value of NC shows good result for the watermarked image which is 0.8442. Figure 4 also shows the value of PSNR and MSE for watermarked image. From the obtained results, the LSB digital watermarking scheme shows that the watermark can still be retrieved even though the visual quality of cover image is degraded by Gaussian noise.



Figure 2.Halal logo (Cover image)



Figure 3. QR code (Watermark image)



Figure 4. LSB watermarked image without noise (PSNR=51.3968 dB and MSE=0.4714)



Figure 5. LSB watermarked image with Gaussian noise (0 %)



Figure 6. LSB watermarked image with Gaussian noise (50%)





#### V. CONCLUSION

This paper proposed the use of least significant bit (LSB) technique to show the genuineness of Halal logo. The experimental result shows that the technique is successfully made the watermarked image between cover image (Halal logo) and watermark image (QR code). This paper also shows a good results regarding to measurement values on PSNR, MSE and NC. The perceptibility of the watermarked image shows good quality image by calculated PSNR and MSE value for that image. The watermarked image also being tested with different variance of Gaussian noise and it shows that watermarked image with the lowest value of variance gives better values compared to the other value of variance. The value of NC as well shows good results for the watermarked image. As for recommendation, the LSB watermarking scheme can be use by implement it on the scanner device. Capture the watermarked image and the device will extract its watermark. With the QR code being used as the watermark image, the authenticity of the watermark image can be determined by decoder of QR code from the internet. In future work will study the types of watermarking algorithms and its technique of watermarking and used that approach to improved the security of authenticity the Halal logo.

#### ACKNOWLEDGMENT

I would like to express my gratitude to Miss Harnani Hassan who always gives me new ideas and path along the way to make this project successfully. Also, PM. Kartini Salam for her advice to make this project successfully. I would like to thank to my family and also my friend which helping me to give some ideas in my way to resolve few problems that occur in this project. Thank you so much for giving me your internal and external support.

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