ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 3, Special Issue 13, March 2016

# An Efficient Data Transferring Via SRAC Image Captured By Portable Devices

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***Abstract*—** SRAC image is a new type of data transfer method. The created code image is visually similar to selected target image in which, messages are embedded. It is produced by encoding the messages into binary bits streams of code patterns of 2 × 2 blocks. Code patterns are injected into the target image by using novel image-block luminance modulation scheme .The Signal-Rich-Art code image is first printed or displayed then recaptured using mobile device or camera .Techniques for counting the number of pattern blocks and recognition of code patterns are proposed for extraction of messages from the recaptured SRAC image.

***Index Terms*—** Barcode, code pattern, data transfer, QR code, signal-rich art, SRAC (signal-rich-art code) image**.**

## I. INTRODUCTION

**S**IGNAL-RICH-ART, as defined in [3] includes all form of creative communication. It is the art that communicates its identity to context aware devices. Identities such as digital media, pictorial material, art works etc can be used as Signal-Rich-Art. The image/video identity has more effects than other identities.

In this paper we are using the Signal-Rich-Art image with its identity being an image which is not only as any digital file, but also any real objects, such as posters, labels ,illustrations etc…The advantages of Signal-Rich-Art, is it help people to conduct ubiquitous computing. That is exchange information via images everywhere and any time. For example, one can use camera on a phone to capture an image of an advertisement on a magazine or painting to obtain the detailed information related to the advertisement or painting.

Two common techniques used in Signal-Rich-Art communication is Data hiding and use of barcodes**. Data hiding [6]** is an alternative technique that embedded data into cover media for applications, like covert communication, copy right protection, and authentication. By using advanced computer technology, many data hiding techniques can be used for digital cover Medias like video, audio, image, text etc...It transfers data via digital files only. **Barcodes** are used for identification purpose. It is represented as machine-readable data by patterns of lines, rectangles, dots etc. various techniques are proposed earlier for barcode reading which includes many steps.[8].

Barcodes are attached to objects for identification. The following figures shows the barcode and QR code which are commonly used.

Fig 1: QR code

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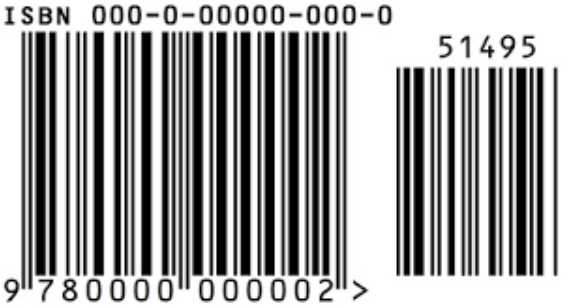


Fig 2: Bar code

The data can be extracted by using barcode reading technique. An image processing frame work was proposed by Onaviani et al.for 2D barcode reading. It has four stages 1) Region of interest detection 2) Code localization 3) Code segmentation 4) Decoding.

Then a 2 real-time barcode localization [10], [7] of a 2 stage process is proposed by Zang et al. It 1) segments the barcode into low resolution by region based analysis. 2) Extraction of barcode from original resolution. Also Yang et al. proposed accurate barcode localization. Method followed by Yang et al. proposed an adaptive thresholding technique for binarization barcode.[2]

Another type of data hiding which can be embedded information is hardcopy data hiding. The encoded information can be decoded from hardcopy version by scanners. So the encoded information will survive from print-and-scan attacks.

If one uses a mobile device to capture the image of a hard copy of the aforementioned image barcodes, the image might not be decoded successfully, because the captured image will suffer from more types of distortions than acquired by scanning.

To solve the issue Lee and Tsai proposed a new type of SRA image called Signal-Rich-Art Character image.[1] It is created from a targeted image used as a carrier of a given message by fragmenting the shape of the composing characters of the message and injecting the resulting character fragments to the target image by using block luminance modulation scheme. The signal-rich-art character image so created has the visual appearance of the corresponding preselected target image while barcodes do not.

The data embedded can be extracted from a camera captured version of created signal-rich-art character image, where barcodes are not used. This function can be implemented on mobile devices. Signal-rich-art character image contains small character fragments with undesired visual effects which is time consuming also the size of each block. Cannot be small to keep resolution in the captured image for correct extractions. To solve this problem signal-rich-art code image is proposed in our project. Here the message is converted in the sense of data coding into bit streams then represented by binary code pattern of 2×2 unit blocks.

Signal rich art, as defined by Davis [1], is the art that communicates its identity to context-aware devices. A type of image in this nature called signal-rich-art image, is proposed in this paper. The image may be printed as a hardcopy for use of any purpose, which is then "re-imaged" by a mobile-phone camera and "understood" by some Automatic identification and data capture (AIDC) techniques [2].

With the advance of technology, machines have long been used to read automatically information in the reality for various applications, like optical character recognition (OCR), license plate recognition, supermarket checkout systems, etc. Recently, many more methods have been developed for this purpose, and they are collectively known as AIDC techniques [2]. The processed information is presented in various forms, some being visible (like barcodes or non-transparent watermarks) and others invisible (like watermarks hidden behind images). Such forms of information, often presented artistically, are termed integrally as *signal rich art* in [3] as mentioned previously.

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One technique that realizes the use of signal rich art for the AIDC purpose is *barcode reading*. Being attached to objects, barcodes represent machine-readable data by patterns of lines, rectangles, dots, etc. But most types of barcodes, such as PDF417, QR code, and Data Matrix code, just encode information to yield unsightly images with no aesthetics. If a barcode contains not only the encoded information but also has a visual appearance of an

art image, the artistic effect of the barcode will be more attractive than those of conventional ones. For this, many methods have been proposed recently to embed information into *image barcodes* using halftone techniques [6].

These barcodes have the visual appearances of other images and the encoded information can be decoded from their *hardcopy* versions acquired by scanners. That is, the encoded information can survive *print-and-scan "attacks."*

However, if one uses a mobile phone to capture images of *hardcopy image barcodes*, the information might not be decoded successfully since the captured image will suffer from more types of distortions than those acquired by scanning, such as geometric deformation, noise addition, blurring, etc. Also, message carriers other rather than printed papers, such as screens on display devices, cannot be used to encode information since the halftone methods are based on the printing technique. Instead, the method proposed in this study can decode the message which is carried in an image captured from a printed paper or a display screen using a mobile-phone camera, achieving the effect of signal rich art.

## II. PROPOSED METHOD

The proposed method includes two main phases of works 1) signal-rich-art code image generation and 2) message extraction. In the **first phase**, given a target image and a message, a signal-rich-art code image is created by four major steps.

Step 1.1: Transform message into a bit stream of codes.
Step 1.2: Transform every 3 bits of $B$ into 4 bits and represent them by a binary pattern block, resulting in a *pattern image*
Step 1.3: Modulate each pattern block by two *representative values* calculated from the $Y$ – channel values of the corresponding block of target image yielding a *modulated* pattern image.
Step 1.4: Replace the $Y$ -channel of target image with to get a signal-rich-art code image as the output.
These are the steps mentioned in the first phase.

In the **second phase**, given a camera-captured version of a paper or display copy of the signal-rich-art code image which is supposed to be identical original message is extracted from signal rich art image by four major steps.

Step 2.1: Localize the region of the original part of the signal-rich-art code image from the captured image.
Step 2.2: Correct the geometric distortion in captured image to get corrected image.
Step 2.3: Identify the unit blocks in the corrected image automatically and divide into pattern blocks, each with $2 \times 2$ unit blocks.
Step 2.4: Binarize each pattern block and recognize the result to extract the bits embedded in it, compose all the extracted bits to form a bit stream and transform it reversely to get original image.

**Algorithm 1** Signal-Rich-Art Code Image Creation

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**Input :** A target image, a message.
**Output:** A signal-rich-art code image

*Stage* 1*–Transforming the message into a bit stream.*

*Stage* 2*–Generating the pattern image.*

*Stage* 3*–Modulating the pattern image.*

*Stage* 4*–Injecting the pattern image into the target image.*

## I. GENARATION OF SRAC IMAGE

**Generation of pattern image:**

The signal rich art image is generated by using the following procedure. For that initially we transform the message into character message image. First the message is converted into binary bit stream, in which bits are in 3 bits so they have to convert into 4 bits. For converting into 4 bits, the 3 bits is undergoes OR operation then for the resultant bit is complement is taken and then that bit is added as the $4^{th}$ bit. So we can get the required 4 bits and that is used to make 2×2 unit blocks.

Then for generating pattern image we have to arrange this unit blocks. The size of the pattern image and the original image must be same.

**Modulation technique:**

Then the pattern image has to be injected into the target image before that the original image must be changed. First the original image is a color image means the luminance component of the image is extracted. For that extraction here we are taking the YCC color model because in that model only the chrominance component does not affected while extracting the luminance because in this model only the chrominance and luminance are independent to each other.

Then in the extracted image the pattern image is injected, the unit blocks are repeated until completing the full image size. Then after injection from that image the luminance component only extracted that is Y component. This resultant image is known as signal rich art code image. Signal rich art character image is proposed in previous method.

The message conversion may be as follows, if the message is converted into binary bits as 000000011110010111 means they have separated as 3bits that is shown as follows and they are the 3 bits extracted from message

000 000 011 110 010 111

Then for identify the fourth bit OR the 3 bit that is while OR ing 000 we get as 0 then we take the complement that is complement of 0 is 1 so the 000 is changed as 0001. Then they are converted into unit blocks that is '0' means that is mentioned with black color and '1' means that is mentioned with white color.

This is the way to change the message and that is embedded by using the above procedure then finally we got the signal rich art code image , the generated image must be identical to original image.
The message extraction in barcodes or other method has some problem and they are discussed in previous methods and they leads to some error.[4],[5].

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**Algorithm 2:** Message Extraction

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**Input :** A captured version of a SRAC image
**Output:** A message extracted from the captured version SRAC image which is same as to original message.
*Stage* 1*–Localizing the signal-rich-art code image.*

*Stage* 2*–Correcting geometric distortion.*

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*Stage* 3*–Identifying pattern blocks in the code image.*

*Stage* 4*–Binarizing the pattern blocks to extract the message.*

## II. MESSAGE EXTRACTION

The following process explains how the message embedded from the SRAC image; it includes the following steps according to the algorithm.

**Localization of SRAC image:**

Initially the signal rich art image which is printed or labeled was captured by using any captured devices.

The image is captured and then it has to be separated that is done as follows. While capturing the image the image must contain some background parts, so that parts must be removed for that we are using HOUGH TRANSFORM or some INVERSE PERSPECTIVE TRANSFORMATION. Hough transform is used to separate our required part from the captured image; This is known as localization technique. Polygonal approximation is also used to done this localization.

**Geometric Distortion &Block Segmentation:**

The localized image should be a distorted one. That is if we capture via mobile means the angle difference to the mobile and the image must make some distortion, so that could be avoided by using geometric distortion.
Then to identify unit blocks we have to done binarization and pattern recognization that is similar to HOUGH TRANSFORM, which uses the statistics of pixels that is to identify the gradient values to identify the number of unit blocks in horizontal and vertical direction.

From the gradient values nearest to the gradient value is found and the average gradient values are obtained. According to that the total number of unit blocks is identified. Then depending on that count the image is divided, thus the process is completed.

**Message Extracting from pattern blocks:**

After dividing the image into unit blocks we have to identify the pattern blocks presented in the pattern image. That is four mutually connected unit blocks are grouped to get the pattern blocks.

From the pattern blocks we have to extract the bits that is if a block is black means that is represented as ‘0’ and the block is white means that is represented as ‘1’. Then the 4 bits are obtained from that the 3 bits have to be extracted.

Then from those binary bits we are extracting the message by using any binary to character conversion.

## III. EXPECTED EXPERIMENTAL RESULTS

We are expecting our result may come as explained as follows, that is we are generating a SRAC image and that is captured by using another laptop which having web camera, then after capturing the further processing is done on that system then we are expected to got back our original message. This is what we are expecting in our project.

According to the peak signal to noise ratio we are got the signal rich art image as same to target image. So the message extraction accuracy and obtaining the better visual quality image is depends on that factor. In the existing method the accuracy is depending upon the threshold value. If the threshold value is higher means according to that the quality of the image is obtained.

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The message extraction accuracy is depending on one factor 'Number of unit blocks'. This value larger means the message embedding capacity may be larger so the message extracting accuracy will be affected. These information gather from the existing method.

**TABLE 1**

**Comparison of our expecting results with existing result with the threshold value-40**

| *Our assumed no of blocks in target image (fig3)* | *Method* | *Accuracy (%)* | *Recognition Time (ms)* | *Amount of information (bits/image)* |
|---|---|---|---|---|
| 16 | Proposed | 100 | 60 | 256 |
| | Existing | 100 | 1186 | 512 |
| 32 | Proposed | 99 | 62 | 1024 |
| | Existing | 96.53 | 1812 | 2048 |
| 64 | Proposed | 99.5 | 93 | 4096 |
| | Existing | 40.53 | 3045 | 8192 |

Fig 3: Our assumed target image with the threshold value of 40.

## IV. CONCLUSION

We are proposing a new image which is mainly used for transferring of data, which is known as SRAC image. That is created from the target image and used as a carrier of our required message. Compared to other signal rich art technique as barcodes, data hiding this SRAC image has following advantages as,

1. This image was identical to the target image which is mostly impossible in barcodes or other techniques.
2. Our proposed method can undergo with some noise and blur but that is not occur in data hiding.

In the existing method SRA character image was proposed that has the some merits as,

1. The message extraction speed is higher.
2. Higher accuracy in message extraction process.
3. Better visual outward show.

Further the design of SRA image can be extended that is they can be modified for using that in videos also. Then the noise, blur and some error occur can be overcome in future.

However some interference occurs during message extraction and they can also overcome in future. For increase the message extraction rate, we can use one error correction technique in future that is known as Reed Solomon Code.[9]

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