IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech 2017

LBS College of Engineering, Kasaragod

Vol. 5, Special Issue 1, March 2017

Picode and Vicode: Embedded Picture and Embedded video Barcode Technique

Vrindha U.K[1], Rajesh R[2]

M. Tech Student, ECE, KMCT College of Engineering, Calicut, India[1]

Asst. Professor, ECE, KMCT College of Engineering, Calicut, India [2]

Abstract: 2D barcodes are considered as an interface to connect potential customers and advertisement contents. Due to their crowdie appearance it gives no human readable information before the barcode is successfully decoded. The information content present in a 2D barcode can be delivered via a simple camera phone with a suitable decoding software in it.With the advanced communication principle a picture could be integrated into a 2D barcode called picode is developed, with this idea, a video clip, an image and an audio is integrated into a series of 2D barcode called vicode is also developed. To realise both picode and vicode a new modulation and demodulation schemes are developed and a new decoding scheme known as low density parity check code is used to provide better error rate performance than a traditional 2D barcode. The use of OFDM will increase the speed and accuracy while transmitting the multimedia messages. Picode and Vicode has been implemented in the MATLAB on a PC and it is successfully demonstrated for the real-world applications.

Keywords: 2D barcode, 3D barcode, embedded picture, video and audio, Perceptual quality.

I. INTRODUCTION

In day today life the role of 2D barcode is to link the online and offline content in advertisement sector. Potential customers can retrieve the information about a product by scanning the barcode using their mobile phone. The traditionally used barcodes are QR code and Data matrix code, in which QR codes are most widely used in all advertisement content. As an application purpose of latter a company logo is embedded in the centre of the code inoder to promote it to the potential customers. Since the logo is too small to be visible and the brand image it represent will be distorted inoder to fit into a small area, it is highly desirable to design a 2D barcode with a perfect integration of code and picture. This basic idea has lead for the development of the picode, which is a 2D picture embedding barcode. We can also increase the barcode storage capacity by a 3D or video barcode, which is almost similar to a video series of 2D barcode which is embedded in a low resolution video clip, known as vicode. Both vicode and picode provide eye-appealing visual information such as video clip or a picture that are useful to common man.

(a) (b) (c)

Fig. 1. (a) is the QR code,(b) is the data matrix code and (c) is the picode image

II. PICODE

Picode is similar to that of QR code and data matrix code. In general the finder patterns of picode is similar to that of data matrix code and they have a pattern of solid lines on the left and the bottom side and a pattern of broken lines on the top and right side (Note that the finder patterns of QR code and Picode are of very different shape).These barcode differ in three aspects. Firstly, picode has an odd number of module on each side while that of data matrix code is even. Secondly, picode does not include extra fixed patterns in the interior region of barcode and hence no additional distortion is incurred to the embedded image. Lastly a new modulation scheme known as adaptive modulation is used which induces less distortion in the embedded image comparing to binary modulation scheme used in existing

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

IJIREEICE

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech 2017

LBS College of Engineering, Kasaragod

Vol. 5, Special Issue 1, March 2017

beautified QR code. In the picode system we use colour to deliver the visual information to human but in some other barcode colour is used to store more information [3].The channel coding describes the method adopted for channel estimation. The modulation demodulation part of the system gives the information about how to add visual information in the barcode and how to recover the stored data from the barcode. The module used in the existing 2D barcode is usually a black and white square module to modulate the data bits, which gives no helpful information .The picode system introduce distortion to the embedded image since data bits are carried by the modules via customized modulation schemes. Therefore improving the system performance is one of the main important aspects to be considered while designing the system.

A. Modulation and demodulation

We have two process to be carried during modulation, one is input processing and another is picode generation process. In the first part the input message is converted into a stream of bits by using source coding and channel coding. This improves the efficiency and robustness of encoded message. The input message is converted into grey image and is then divided into a 2D grid of image blocks according to user's input on the number of modulesper dimension. Each block consist of n×n pixels. During the second process the pixel in each image block are modified by the adaptive modulation process so that each block gives an output of '0' and '1'.Finder pattern of one module wide is added to the exterior of the modulated 2D grid of image block to form the picode. The aim of the modulation is to represent a message by bit '0' or '1' by varying some physical parameter of the modulation waveform[5].The modulation is performed with the considerations on the trade-off between decoding robustness and perceptual quality.

During the demodulation the captured picode image is converted to grayscale and is binariesed which search for the potential barcode regions which are then checked against detection criteria. If the check is passed, the four corners are obtained, otherwise the image is rejected and the processes is repeated with another image frame. The perspective distortion is obtained based on the corner location which is then compensated on the gray level image. Based on the broken line parts of the finder patterns the region for each picode module is obtained. Basically the demodulation processes is the reverse of modulation processes which is done by inspecting the intensity differences between the inner and outer parts of each module. During this process modulated bit in each module is retrieved. Finally the message is obtained by applying channel and source decoding to the demodulated bits.

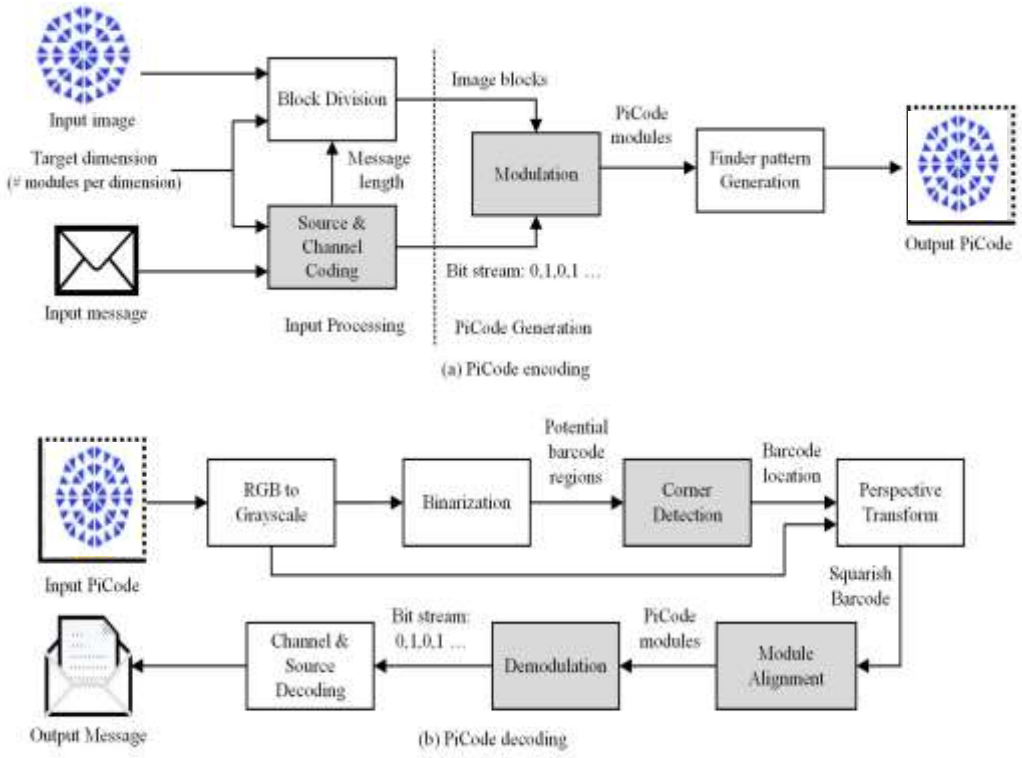


Fig. 2. Block diagram of Picode encoding and decoding

B. Channel coding

In picode soft decoding technique is used instead of hard decoding, in which information bit loss take place. Hard decoding is widely used in existing barcode system. The goal of channel decoding is to protect the information bits after demodulation step against error. The demodulator finds the histogram of intensity difference between inner and

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech 2017
LBS College of Engineering, Kasaragod
Vol. 5, Special Issue 1, March 2017

outer parts of every module, from which the histogram channel parameter can be estimated. Since the major distortion to the above mentioned intensity difference between the inner and outer part of every module occurred due to edges and sharp change in the embedded picture. The errors in the picode system are closer to random errors than burst errors. In data matrix and QR code, Reed Solomon (RS) is used but in the picode we use LDPC, which offers better performance in terms of bit and block error rate.

III.VICODE

Vicode is the technique to embed a video clip, an audio or an image in a 3D barcode which can transmit data at a very high rate using commonly available mobile phones.Vicode is mainly applicable for mobile application and have higher storage capacity than a 2D barcode can ever provide, such as storing a brochure, a ringtone, a photo, an app file, and so on. Because of extra time dimension and high data transmission rate the data storage capacity of vicode is unbounded.

Fig. 3. A ringtone, a video, a photo, and so on can be stored in vicode which can be later retrieved using a mobile phone conveniently.

A. System structure

Vicode can be considered as a 3D barcode extension of picode. Vicode as a 3D barcode, can store more information than any single 2D barcode because of added time dimension. Vicode can also show an embedded video clip or animation, a music or an audio clip or an image itself which is useful for attracting consumer's eyeballs in mobile marketing appications.Vicode system produces a series of barcodes which can be shown as a video clip or a video stream, when a video is embedded in the barcode. As vicode can store a multimedia messages, here a video, an audio and an image is embedded in the barcode image. When video is embedded, it is converted into the frames and again frames are converted into blocks. The image blocks, the audio blocks and the frame blocks are subjected to intensity modulation along with the testing image, which is used as the barcode. Once the modulation is over a finder pattern is added to the exterior of the embedded image which results to form a vicode. The processes is represented by the block diagram in the fig 4.

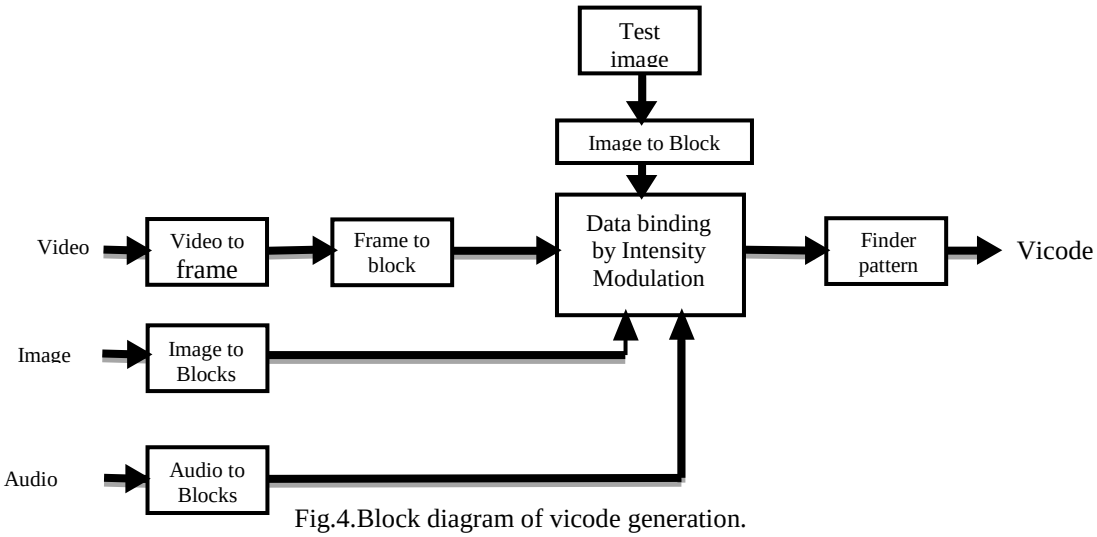


Fig.4.Block diagram of vicode generation.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech 2017
LBS College of Engineering, Kasaragod
Vol. 5, Special Issue 1, March 2017

At the decoding part the vicode is used as the input to the system. The corner detection is performed and the finder pattern which is added while encoding the barcode is then removed. The demodulation process, which is reverse of modulation, is performed inoder to extract the embedded video, audio and an image from test image. The processes is shown in fig 5 below.

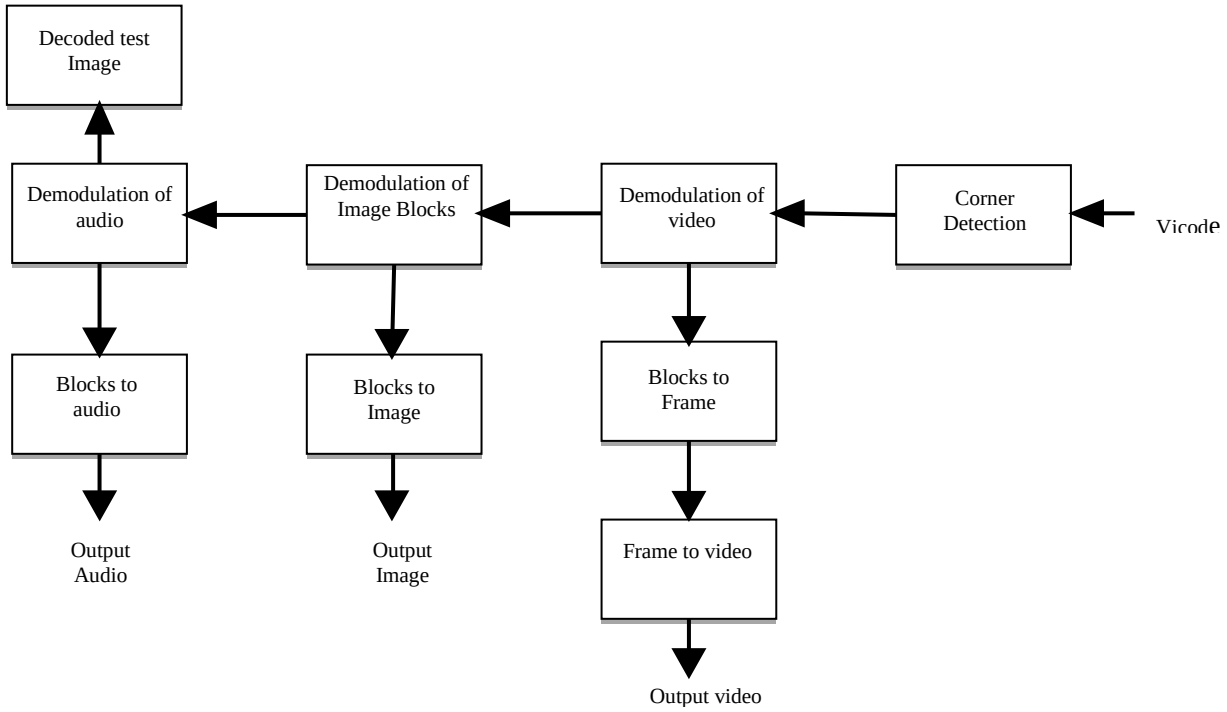
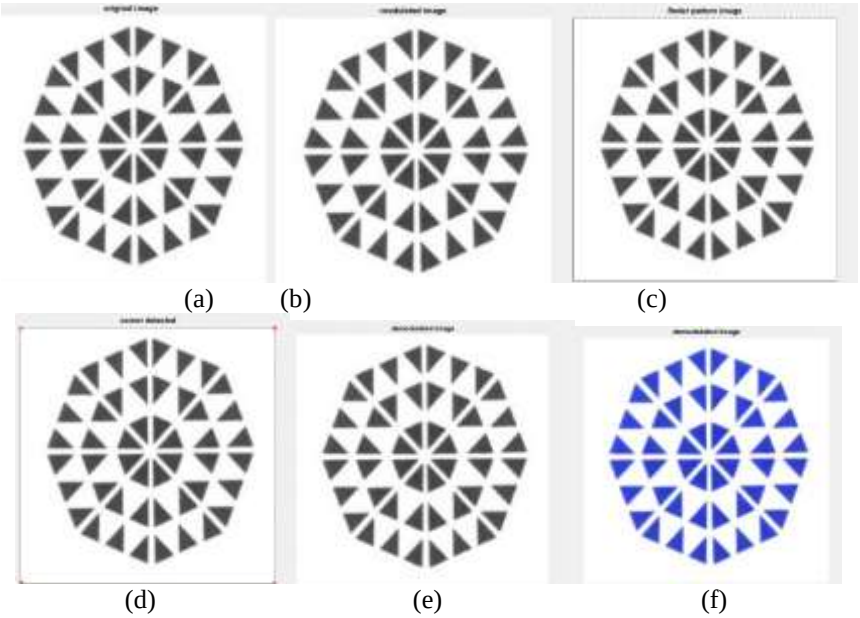


Fig.5.Decoding processes of Vicode

B. Experimental work and results

The 2D barcode with embedded picture and video is satisfied by both the human visual system and the barcode decoder. Hence the main two features have taken into consideration, perceptual quality and decoding robustness. The perceptual quality contribute to the visual attractiveness of the barcode, while the decoding robustness affects the user experience during the decoding process.



(a) (b) (c)

(d) (e) (f)

Fig. 6. Picode: (a) original image,(b) modulated image(c) finder pattern image,(d)corner detection,(e)demodulated image,(f)processed image

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

IJIREEICE

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech 2017

LBS College of Engineering, Kasaragod

Vol. 5, Special Issue 1, March 2017

The input message given to picode is 'KMCT' and the output for each process is given in the following diagram. The output of each step explains the process through which the input image undergoes. The proposed picode and vicode introduces the distortion to the embedded image and video since data bits are carried by the modules by modulation schemes. For the evaluation of such distortion, the structural similarity metric (SSIM) is used.However the multi-scale structural similarity (MS-SSIM) is used to evaluate high capacity barcode. The metric ranges from0 to 1.Ahigher value indicate higher similarity between the original and processed images and hence less distortion are incurred by the picture embedding process. The structural similarity between the original image and processed image in the picode experiment is 0.9996 and for the vicode is 0.9987.

Fig. 7. Vicode: the video clip which is to be embedded in an image.

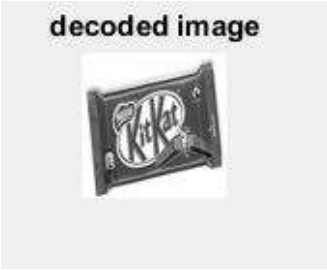


Fig.8.The decoded image

IV. CONCLUSION

Comparing with existing 2D barcodes available in mobile phone platforms Picode and Vicode can offer excellent performance in terms of decoding robustness and data capacity. Both this technology can provide eye-appealing visual information, such as a picture or video clip significant to people, hence it is a promising tools for mobile marketing applications. This technology of picode and vicode can be used as a company logo, commodity packages, electronic billboards, digital signage, TV advertisement, and so on, it can effectively connect potential customers to commercial products. In this paper we have performed Picode by taking a logo in the formof barcode and embedding a message into it, which results to form a Picode image. The Picode image is then demodulated to obtain the message embedded in the barcode.The extension of this idea is being used to form a Vicode.As the multimedia messages can be embedded and transmitted, the work has been carried out and succeeded by embedding a video,an audio and an image, in a barcode and transmitting it. The speed of transmission can be improved using OFDM. Other multimedia messages such as documents, music, and short films can also be embedded in a barcode on which the work is being carried out.As the technology progresses Vicode and Picode will appear everywhere as they can deliver various types of information and data to people at no cost.

ACKNOWLEDGMENT

The authors would like to acknowledge the members of the HKUST barcode group for their contribution and idea on which this work is based.

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

IJIREEICE

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

nCORETech 2017

LBS College of Engineering, Kasaragod

Vol. 5, Special Issue 1, March 2017

REFERENCES

[1] Wai Ho Mow,Chiu Yeung Au,Cheuk Yin Chiu,Ka Shun Li,andWenjianHuang.A Method for Embedding Visual Information in TwoDimensional Bar Codes.US Patent, Application No.13/866, 028, filling date: May 3, 2013.
[2] Wai Ho Mow,Chiu Yeung Au, Cheuk Yin Chiu,Ka Shun Li, and WenjianHuang.A Method for Embedding Visual Information in Two Dimensional Bar Codes. Chinese Patent, Application No. 201310160620.7,Filing date: May 2,2013.
[3] Devi Parikh and Gavin Jancke.Localization and Segmentation of a 2D High Capacity Color Barcode.In Proceedings of 2008 IEEEWorkshop on Applications of Computer Vision (WACV'08),pages 1-6,2008.
[4] W.Huang and W.H Mow,"Picode:2D barcode with embedded picture and Vicode:3D barcode with embedded video",inProc.Int.Conf.MobileComput.Netw., 2013, pp.139-141.
[5] J.G.Prokis and M.Salehi,Digital Communications(McGraw-Hill International Edition).New York,NY,USA:McGraw-Hill,2008.
[6] H.Kato,K.T.Tan,andD.Chai,Barcodes for Mobile Devices.Cambridge.U.K,:Cambridge Univ,Press.2010.
[7] S. Ono, K. Morinaga, and S. Nakayama, "Two-dimensional barcode decoration based on real-coded genetic algorithm," in Proc. IEEECongr.Evol. Comput., Jun. 2008, pp. 1068–1073.
[8] D. Samretwit and T. Wakahara, "Measurement of reading characteristics of multiplexed image in QR code," in Proc. 3rd Int. Conf. Intell.Netw.Collaborative Syst. (INCoS), Nov./Dec. 2011, pp. 552–557.
[9] T.Wakahara and N. Yamamoto, "Image processing of 2-dimensional barcode," in Proc. 14th Int. Conf. Netw.-Based Inf. Syst. (NBiS), Sep.2011, pp. 484–490.
[10] Y.-H. Lin, Y.-P. Chang, and J.-L. Wu, "Appearance-based QR code beautifier," IEEE Trans. Multimedia, vol. 15, no. 8, pp. 2198–2207,Dec. 2013.
[11] Information technology-Automatic identification and Data capture Techniques-QR code 2005 Bar code Symbology Specification, document ISO/IEC 16022,2005.
[12] H.Kato and K.T.Tan,"2D barcodes for mobile phones",in Proc.2nd Int.Conf.Mobile Technol.,Appl.,Syst.,Nov.2005,p.8.

BIOGRAPHY

Vrindha U.K is an M-Tech Digital signal processing student of KMCT College of Engineering Calicut India, degree in Electronics and communication engineering from Srinivas Institute of Technology Mangalore, India.