

Chaotic Encryption for Anti 2D Barcode Cloning

Poomyos Payakkawan, Suwilai Phumpho,
Anurak Jansri, Direk Tongaram and Prasart Sukkasat
Faculty of Technology and Innovation,
Bangkok Thonburi University
Taweewatana, Bangkok 10170 Thailand
poomyos@bkkthon.ac.th

Satree Areejit
College of Data Storage Innovation,
King Mongkut's Institute of Technology Ladkrabang,
Ladkrabang, Bangkok 10520, Thailand
satree@gmail.com

Chanachai Punnua
President of Fresh Air Premium Co.,Ltd.,
Fresh Car Co.,Ltd., Fresh Group Co.,Ltd.
Saphansung, Bangkok 10240, Thailand
info@freshcar.co.th

Pitikhate Sooraksa
Department of Computer Engineering,
Faculty of Engineering,
King Mongkut's Institute of Technology Ladkrabang,
Ladkrabang, Bangkok 10520, Thailand
kspitikh@kmitl.ac.th

Abstract—2D barcode can be found on the largely product in the department store. The purpose of 2D barcode is generally used to identify basic product information. In the industrial application has a 2D barcode in the assembly production line. The use of both a characteristic of the 2D barcode can be easily copied. In this paper, 2D barcode encrypted with multi-encryption technique, difficult to replicate and reproduce. The decoding system is read 2D barcode encoding only and can be record 2D barcode when the repeat of 2D barcode are found. This research has led to real benefits, which can be inhibited to prevent commercial use of 2D barcode in Thailand.

Keywords—2D barcode; encryption; chaos; anti-copy; security;

I. INTRODUCTION

The studying of 2D barcode were invented in 1994 by a Japanese company called Dens wave by copyright as a QR Code by means of fast response (Quick Response) and has been used. widely in Japan and several other countries. It can be seen throughout the book or department store. The purpose of 2D barcode commonly used in public relations for news or content referrals through 2D barcode containing information sites [1-5].

Cell phones that can take photos and connect to the Internet, either read 2D barcode quickly and easily. The user can download the program to read 2D barcode for free from a 2D barcode can be used in advertising widely and can also be applied to the management of assets in the library or in the garage. nurses [6,7] with respect to the health care system [8] In addition, the use of 2D barcode are used in a robotic system moving at various points in the area of control or input. commands to the robot in plants [9-12] problem using 2D barcode is generally not easy to replicate.

Hence its use in applications that require high data security, it is necessary to design a 2D barcode encoding system [13,14] or creating a special 2D barcode such as 2D barcode based techniques. similar images watermark to help verify that they are genuine [15-17], which, with the aforementioned characteristics make hardware connections increases, so does the ease of use. To solve such problems can be solved by encoding a 2D barcode variations for copy protection 2D barcode and can be used for commercial purposes by creating an added value to the product or service they need the security of a high profile.

The example of conventional 2D barcode are shown in Figure 1, the URL information (a) contains a website of URL of Bangkok Thonburi University, and (b) contains a website of URL of Fresh Car company limited in Thailand. Otherwise 2D barcode are embedded the other information such as text, email, phone number, location, and etc. The location application of 2D barcode was in route finding system for manual wheelchair [18]. This paper is generated 2D barcode form text and used multi-encryption technique with chaotic key for ensured 2D barcodes in the system hardly to copy.

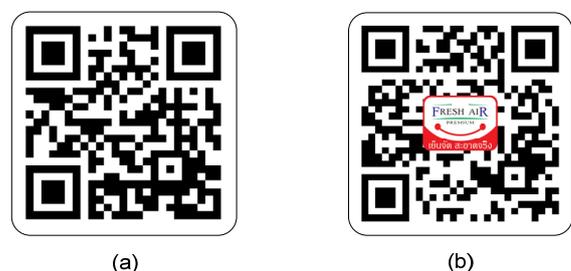


Fig 1. Example of 2D barcode URL information of the website (a) <http://www.bkkthon.ac.th/> (b) <http://www.freshcar.co.th/>

II. ENCRYPTION AND DECRYPTION TECHNIQUE

The main of cryptography technique is protecting the plain text data from attackers. The data protecting information by encrypting data into an unreadable format, called cipher text. Only those who possess a secret key can decrypt the message into plain text. Encrypted messages can sometimes be broken by cryptanalysis, also called code breaking, although modern cryptography techniques are virtually unbreakable.

A. Chaotic cryptography

The growth of electronic commerce and the emphasis of privacy have intensified the need to find a fast and secure cryptographic method. As chaotic signals are usually noise-like and chaotic systems are very sensitive to the initial condition, they can be used in cryptography [18]. Figure 2 are shown a schematic of encryption and decryption data with chaotic key.

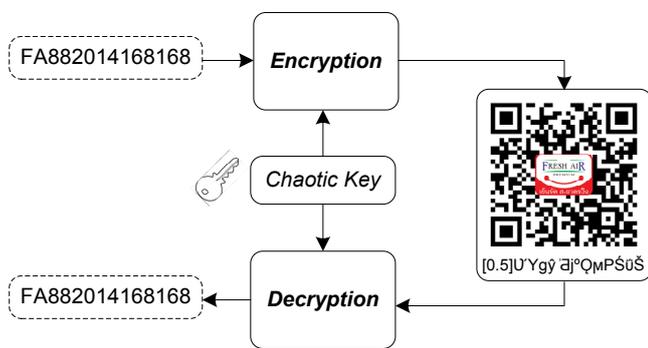


Fig 2. The schematic of encryption and decryption data with chaotic key.

The plain text data in the example is “FA882014168168” when the data encrypt with chaotic key the data change to cipher text “ [0.5]UYgy äj°QmPŠöŠ” The 0.5 value is a seed of chaotic key when the data decrypt the seed are generated the group of key for decryption cipher text to plain text.

B. 2D barcode anti-copy Technique

The 2D barcodes are picture which can be copied from conventional camera. This system can be protected commercial 2D barcode, the 2D barcode can be used only once time. Figure 3 shown schematic of 2D barcode anti-copy system. The overall equipments are included: Raspberry Pi embedded board, snake camera for 2D barcode reader, input/output module, and communication system for connect the server. The embedded board is used for data decryption and control the system. The steps of processing are follow:

- Received the command form input controller for start the decryption process.
- When the command decryption enable, insert the 2D barcode.
- Decryption process and check the repeat 2D barcode; if the 2D barcode is unfound in thee e database “pass”

- If the 2D barcode “fail”, the system alarm and send the data to the main server.
- The server can be shown the amount of 2D barcodes are pass and fail repeat

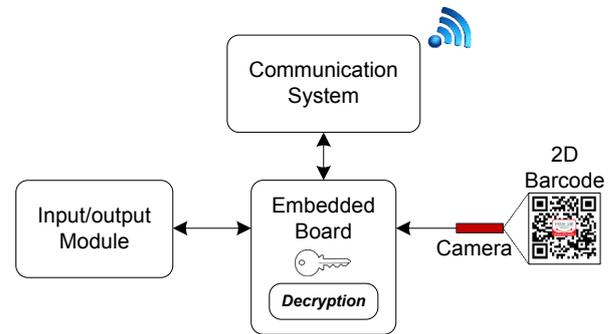


Fig 3. The schematic of overall system.

III. DESIGN AND IMPLEMENTATION

The hardware was design from the commercial product in Thailand which the installation area of machine is limited. Therefore, this paper are selected the snake camera for implement in the old system. The reasonable to design are following:

A. Design of anti-copy 2D barcode system

The equipment are shown in the Figure 4, the main control is contain in the hardware box and used the gravity slope at 45 degree for insert the bottle product, for ensure the same position of 2D barcode cover in the view of camera area. The control box is inside the main box. In the Figure 4 (a) shown the side view of the main box and (b) shown the front view of the main box. The important of this system is the position of the lighting, the lighting position do not create a shadow in the camera area because if the shadow employ in to the 2D barcode, the software cannot decrypted the 2D barcode. The snake camera is fixed in the inside of the main box, the area of 2D barcode reader depend on the length between camera to 2D barcode on the bottle

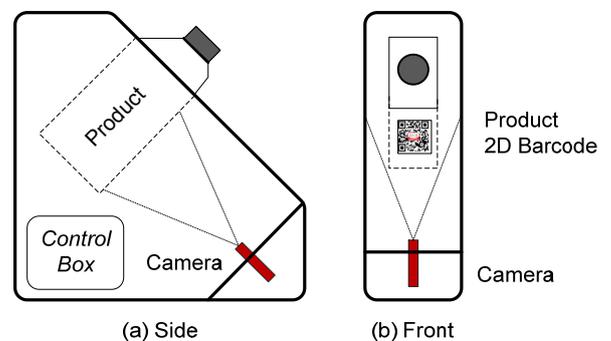


Fig 4. The design of anti-copy 2D barcode system.

B. Hardware implementation of anti-copy 2D barcode system

The implement hardware of the anti-copy 2D barcode are created from fiberglass for easy to modify and installation. The snake camera is installed inside the main box. The lighting lamp is installed upper the 2D barcode area. The 2D barcode is adhesive in the side of the bottle. When the system is turn on, insert the bottle in to the main box. The lighting lamp is automatic turn on, if the 2D barcode is pass lighting lamp turn off, else the lighting lamp will brink lamp for indicator fail 2D barcode, and if the snake cannot detect within 10 second then the system will be standby mode. The installation of anti-copy 2D barcode system is shown in Figure 5.

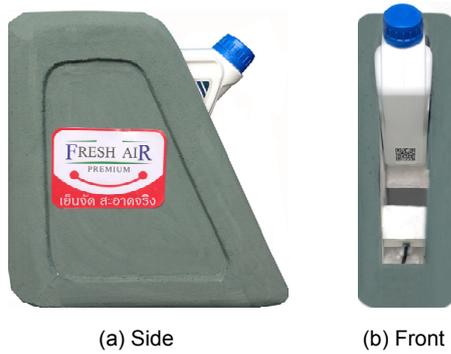


Fig 5. The installation of anti-copy 2D barcode system.

IV. EXPERIMENTS AND RESULTS

After the design and implement the chaotic encryption within the conventional 2D barcode. In an experiment to simulate the 2D barcode for compare processing time and image size between regular 2D barcode and 2D barcode encoded. The 2D barcode with chaotic encryption key can be generated for chaotic equation. The chaotic equation must be setting parameter for seed the data encryption form that equation. Every time to generate the key depend on the initial condition. Thus, every data when the generated not repeat, The normal 2D barcode (N1-N5) and multi-encryption 2D barcode (E1-E5) shown in Figure 6.

The steps of experiment are following:

- Insert product bottle into the main box, follow in the sequential N1-N5 and E1-E5
- Recording the processing time from the software and repeat all bottles.
- In the second round, insert the used bottle normally the signal alarm on the map.
- If the 2D barcode “fail”, the system alarm and send the data to the main server.
- The server can be shown the amount of 2D barcodes are pass and fail repeat



Fig 6. Normal 2D barcode (N1-N5) and Multi-encryption 2D barcode (E1-E5)

TABLE I. PROCESSING TIMES OF NORMAL 2D BARCODE

| Number | Detail | | |
|--------|------------|-------------|------------------|
| | Dimensions | Image sizes | Processing times |
| N1 | 580x580 | 24.0KB | 42mS |
| N2 | 580x580 | 24.0KB | 46mS |
| N3 | 580x580 | 24.0KB | 52mS |
| N4 | 580x580 | 23.9KB | 49mS |
| N5 | 580x580 | 24.0KB | 50mS |

References

TABLE II. PROCESSING TIMES OF MULTI-ENCRYPTION 2D BARCODE

| Number | Detail | | |
|--------|------------|-------------|------------------|
| | Dimensions | Image sizes | Processing times |
| E1 | 660x660 | 45.1KB | 154mS |
| E2 | 660x660 | 45.2KB | 165mS |
| E3 | 660x660 | 45.2KB | 149mS |
| E4 | 660x660 | 45.1KB | 160mS |
| E5 | 660x660 | 45.1KB | 152mS |

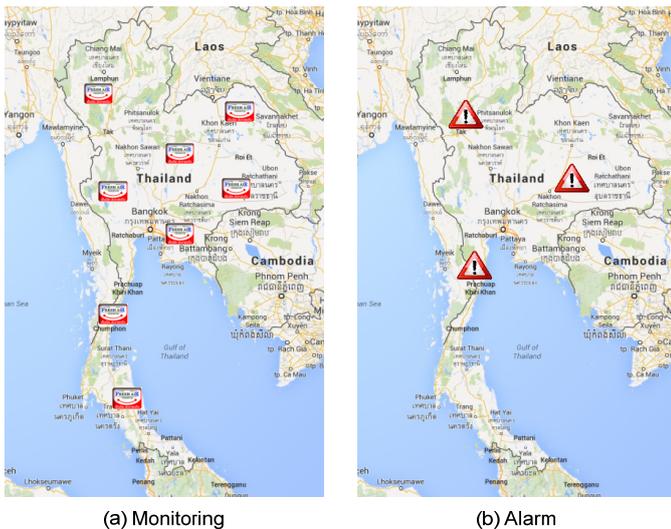


Fig 7. The indicator of (a) monitoring system (b) alarm system.

V. CONCLUSION

2D barcode encrypted with multi-encryption technique, difficult to replicate and reproduce as shown in Figure 7 when the repeat 2D barcode into the system, the system will be alarm. In the Table I and II as show the processing time compare between normal 2D barcode (N1-N5) and multi-encryption 2D barcode (E1-E5). The processing time average of normal 2D barcode is 47.8 mSec but the processing time average of multi-encryption 2D barcode is 156 mSec. The both of value faster for this system. The decoding system is read 2D barcode encoding only and can be record 2D barcode when the repeat of 2D barcode are found. This research has led to real benefits, which can be inhibited to prevent commercial use of 2D barcode in Thailand.

Acknowledgment

This research is supported in part by the Bangkok Thonburi University research grant of the year 2014, and is also financial supported by Fresh Group Co.,Ltd. of the year 2014.

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