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LED-QR Authentication Technology for Access Control and Security

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Abstract

There are several possible places which are accessible in many buildings and facilities, various types of systems have been utilized such as access control or surveillance depending on the purpose. Especially if security is important, it must go through the various authentication procedures when people can access. Until now many access control systems have been proposed and developed, they are applied and utilized to companies which security is needed. However, as time passes the problems with existing access control systems occur or the vulnerabilities related to access control are reported, as technology advances. The solution to this, we propose authentication technology related to access control using LED-QR tag.

1. INTRODUCTION

Physical Access Control System is the most basic and important element of security. Until now, a variety of access control and security solutions have been proposed and used to maintain the secret of the company. Today, physical access control systems have continued to evolve, physical and software techniques have been applied. Especially as IT technology develops software technology has been applied to access control system, in recent years, integration solutions that combine the physical security with IT security system are released to the market. Nowadays a lot of people use smart phones so that a variety of services using smart devices are increasing. Among services using smart devices, services using code such as bar code are also increasing. Particularly QR codes, a type of two dimensional bar code, are used in various fields such as URL, business cards, and promotional means. LED has a high utilization in real life, it can be used in various fields due to the low power and eco-friendly material, the range of its applications has widened . Thus, a variety of materials and technologies have been developed, if you apply this security solutions then new services can available. Existing access control technologies should be authenticated by using an additional device and go through an additional process, so it is uncomfortable and takes a lot of time.

In this paper, we proposed LED-QR tag authentication technology that can be used in the physical access control system. Physical Access Control System using LED-QR tag that can generate dynamic authentication code easily for low cost. The overall structure of the paper takes the form of five chapters, including this introductory chapter. Chapter 2 introduces   technologies for QR tag and LED, Chapter 3 explains the

structure of LED-OR tag authentication technology, Chapter 4 conforms the performance about access control system using LED-QR tag authentication, finally, the conclusion gives a brief summary.

2. OVERVIEW OF QR CODE AND LED

2.1 QR code

QR code, the the abbreviation of "Quick Response Code", was developed by Denso Wave in Japan in 1994. It is a two-dimensional bar code of high information density matrix and a high-speed fast recognition code, so it can provide a lot of information, easy to use in a small area.
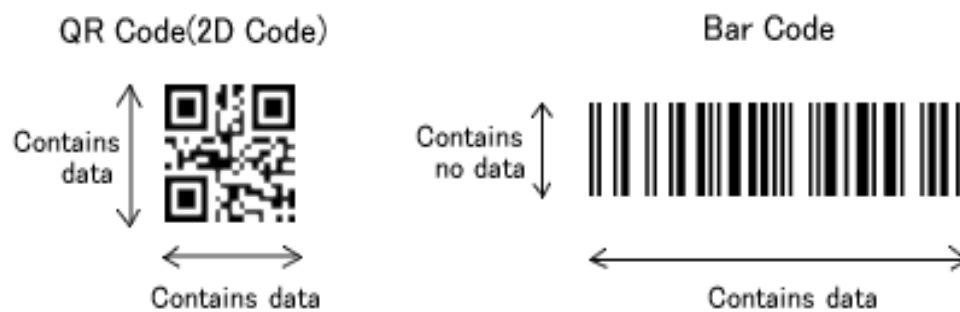

Figure 1. QR Code and one-dimensional Bar Code [3]

QR code can store up to 7,089 numeric characters or 4,296 alphanumeric characters or 2,953 characters, and also be restored using error correction feature even if some of the code is damaged. These position detection patterns guarantee stable high-speed reading, circumventing the negative effects of background interference. QR Code can be divided into multiple data areas. Conversely, information stored in multiple QR Code symbols can be reconstructed as a single data symbol.

Table 1. The differecnce between one-dimensional barcode and QR code [3]

	One-dimension barcode	Two-dimension QR code
Characters	Up-to 20	Up-to 7,089
Type of information	Only number	Alphanumeric and characters
Restore Data	impossible	Up-to 30%
Reading rule	Only horizontally	Both vertically and horizontally

QR code consists of cells which refers to the black and white dots, format information, position detections patterns, Alignment, Timing patterns, and margin(quiet zone). The symbol versions of QR Code range from Version 1 to Version 40. Each version has a different number of cells, commencing with Version 1 (21×21 modules) up to Version 40 (177×177 modules). Each higher version number comprises 4 additional modules per side. Each QR Code symbol version has the maximum data capacity according to the amount of data, character type and error correction level. In other words, as the amount of data increases, more modules are required to comprise QR Code, resulting in larger QR Code symbols.
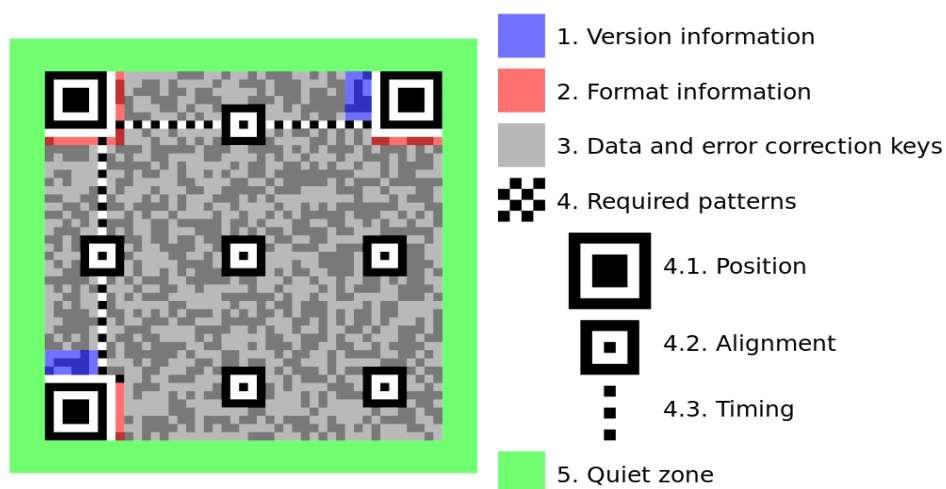
Figure 2. Structure of a QR code [3]

2.2 LED Tag

LED is a light-emitting diode, made from exotic semiconductor compounds such as Gallium Arsenide (GaAs), Gallium Phosphide (GaP), Gallium Arsenide Phosphide (GaAsP), Silicon Carbide (SiC) or Gallium Indium Nitride (GaInN) all mixed together at different ratios to produce a distinct wavelength of color. LED has a long service life, light-emitting speed is faster, can be expressed in a variety of shapes as compared former light emitting materials [5]. A QR Code can be implemented by using LED, expressed in a variety colors by using three colors of LED, R, G and B. LED in various expressions can be implemented as tag using a high recognition rate of one of the strengths of the QR code, so it is possible to create a LED-QR tag with LED control. It is possible to authenticate using printed QR tag related access control that we propose in this paper, but it is inefficient as sercurity perspective because QR code should be changed frequently for security of access control. We want to solve this problem using features of LED. LED can be individually controlled, expressed to create QR code pattern using its feature. Printed QR tag has a problem that print new QR code and redistribute it when you change a new access control authentication QR code, but it is very easy to change QR code pattern using LED-QR tag, and it can improve security related to access control when the QR code is leaked to the outside.

3. LED-QR CODE AUTHENTICATION TECHNOLOGY

It is possible to receive data of LED-QR tag using camera on smartphone, can be authenticated using the data of the LED-QR tag. Figure 3 shows the concept that receives the LED-QR data using a camera on smart devices. In order to implement technology related to access control, It is building data server to express LED-QR as in the form of information code set in the LED panel, to be able to change information code as the order of the data server, to perform the function related to access control with expressed information code so that additional information can be transmitted. First of all, data server is responsible for code generation by selecting one or more data among the stored data information. Data server decodes the data information, generates information code, and control each light emitting element of LED to show the type of the information code in front of LED-QR tag. Data server can store data information in advance, also send to LED-QR tag immediately receiving the request to be show in real time.

Figure 3. The concept of expression LED-QR tag

In this paper, we used LED to implement QR code of the type of matrix using colors. Using LED, it uses various types of QR code that differentiates the limits expressed black and white of various two dimensional code, and highlights the advantage that generate codes by the combination of the types. We made the LED-QR tag to be used for QR code analysis and study that can link with smartphones, Figure 4 shows the diagram.
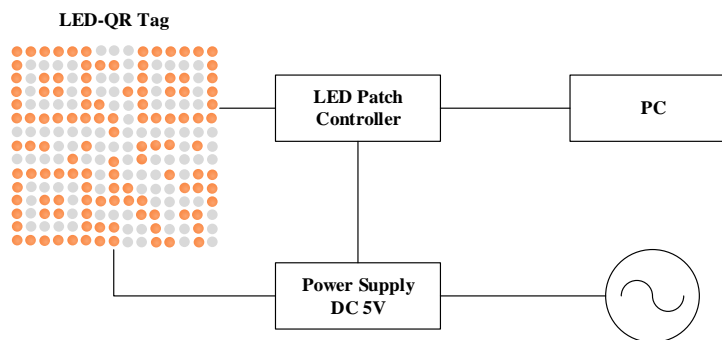

Figure 4. The diagram of expression LED-QR tag

It can transmit the information with QR pattern of LED-QR tag, user can receive the information provided by smartphone and request authentication. LED-QR tag applying the QR code consists of display using a variety of LED light-emitting materials, control unit that controls LED and expression of QR code, and power supply that supplies LED and controller with electricity.

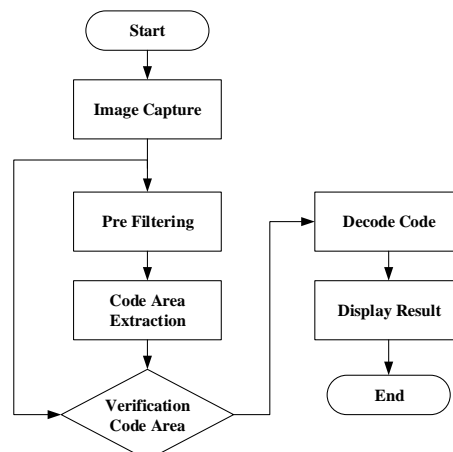Figure 5 shows process flowchart for the recognition of the information code using smartphone.

Figure 5. The flowchart for the recognition of QR information code using smartphone

The images of the QR code are captured frame by frame from the camera on smartphone, saved to image array, and transmitted to the pre-filtering stage. In the pre-filtering stage, performed the filtering operation to adjust the color balance and contrast of the image, to determine the location of the information code and extraction the information code area, to verify if this information code area is correct or not. Finally decoded the extracted QR information code, requested authentication related to access control using the result of the extracted information.

4. EXPERIMENT AND RESULT

We performed the experiment that we could read the information of the QR code using smart phone when LED matrix display showed QR code. Figure 6 shows the experiment that LED matrix display expresses QR code and smart phone acquires the QR code data by camera.
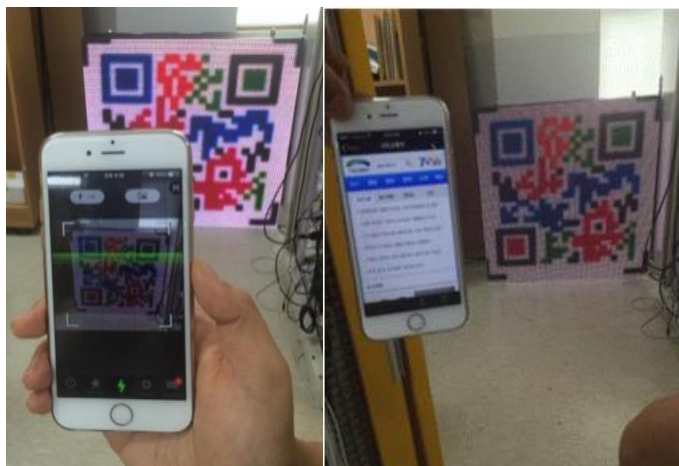

Figure 6. The experiment of QR code using LED matrix display

Through the above experiment we was able to confirm that we could get the data of the QR code when QR code was expressed using LED, and it was possible to use authentication technology using LED-QR tag for access control and security system. We have conducted the following experiment, Figure 7 shows the experimental environment. The LED matrix display was installed and expressed the QR code on the entrance gate.
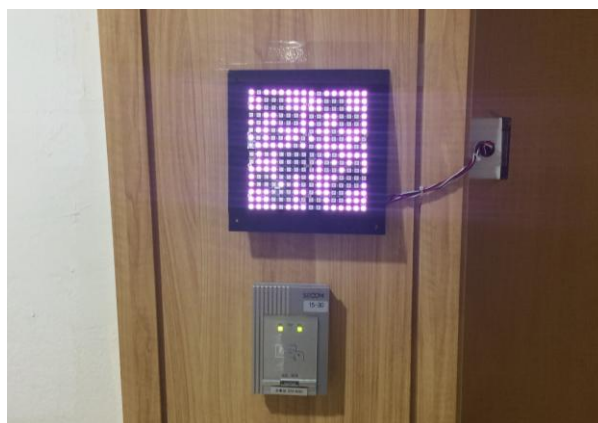

Figure 7.The experimental environment of the authentication using LED-QR tag

When we conducted the experiment we prepared two smart device, in Figure 9, the left one was set to get the access authorization and the right one wasn't get the access authorization.
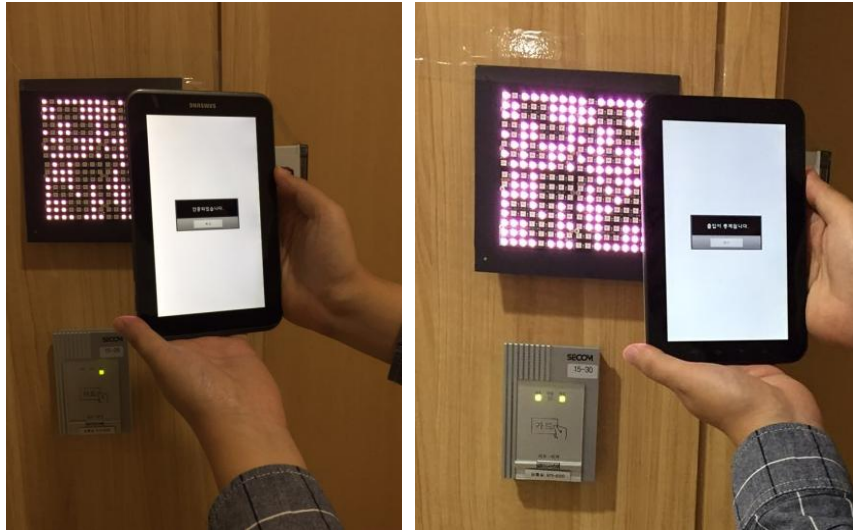

Figure 8. The result of the authentication experiment using LED-QR tag

As the result of Figure 8, we could check that left smart device had the access authorization so that read the LED-QR tag and confirmed the authentication, but the light smart device had not the access authorization so that the entrance gate didn't open with the message that the access is limited. We conducted the experiment and confirmed the result about LED-QR tag authentication technology we would like to propose for access control and security.

5. CONCLUSION

In the paper, authentication technology using LED-QR code for access control and security is presented. This authentication technology is easy to use and recognize, using Smart device and LED which environmentally friendly and effectively controllable. The technology that can increase the security for access control system using LED-QR tag. We think this result of the paper could be one of the references for access control technology and expect to be utilized as a new technology quickly and without loss of time using LED-QR tag related to the access control technology.

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