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A QR-Code Authentication for Medical Image Access Environment

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Abstract: ***Quick Response Code(QR-Code) an 2D barcode are simply the fastest and most effective method to reach, interact with and get information out about your product or service. As the Mobile Application Development has seen many emerging areas one such is Hospital Management and Patient information Systems, in this paper we propose an framework combining the most powerful Android operating system and QR-Code in Data and Image Retrieval Application.***

Keywords: 2D barcode, Hospital Management, Image Retrieval, QR Code, Android

1. Introduction

The millions of medical images generated each year represent an enormous challenge for healthcare organizations as they struggle to manage, access and share this data while trying to reduce costs [1]. Medical images storing and retrieving domain terminology represented as Picture Archive and Communication Systems (PACS) are crucial management systems for diagnosing image research that are potentially used in hospitals and health information care systems. It is essential for PACS to be an integrated part of the total hospital electronic information system in order to be maximally effective [2]. The PACS application is changed with advanced technology, and it not only can be used at hospital but also makes medical image can be used at everywhere via mobile device and internet which has already been acknowledged and well established [3].

Since the inception of cloud computing storage in the cloud seem to be a solution to many problems we face today for highly potential medical image archives [3], Tengs' al et.[4] proposed medical image interchange and management framework based on industry standards and leading cloud computing platform, which developed for mobile medical imaging devices and applications to securely communicate with a cloud-based image storage and management service using standard DICOM protocol. The mobile application is developed using Google's Android OS and provides management of patient health records and medical images [5].

In this paper, we proposed a prototype of medical image (DICOM [6]) retrieval Application with Quick Response Code (QR-Code) [7] authentication based on Android operating system, which can help personal clinics and clinicians in the remote area develop their own mobile retrieval system by the lower cost way.

2. Related Work

We designed an application based on Android Operating System [8], which can make doctor to retrieve medical images of patient after doctor authenticates identity. The identity procedure has two ways to authenticate, that are typing identity information and scanning the QR-Code of identity. The QR-Code is not only used to authenticate but also used in the searching patient number (every patient has their own QR-Code which is their patient number). Because of the information security reason, the code is encrypted by Advanced Encryption Standard (AES) [9].

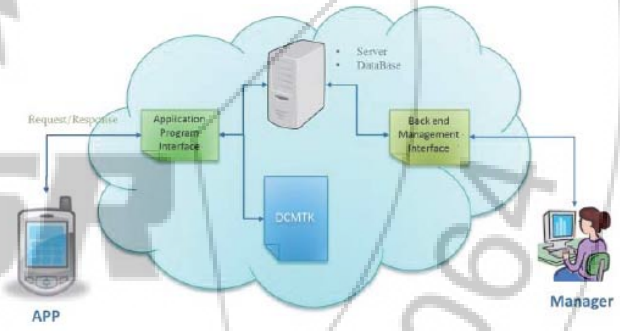

Figure 1: The System Architecture

At the server, there is an application program interface (API) which is used to communicate application with server. It handles up all requesting, responding information and encoding it to JSON [10] format between mobile application and server. The API is coding in PHP [11], which is a popular general-purpose scripting language that is especially suited to web development. With processing medical image (DICOM), this paper uses the DCMTK tools [12] for extracts tags and image. DCMTK is a collection of libraries and applications implementing large parts the DICOM standard. It includes software for examining, constructing and converting DICOM image files, handling offline media, sending and receiving images over a network connection, as well as demonstrative image storage and work list servers. DCMTK is written in a mixture of ANSI C and C++, and it comes in complete source code and is made available as open source software. Fig. 1 is the proposed system architecture.

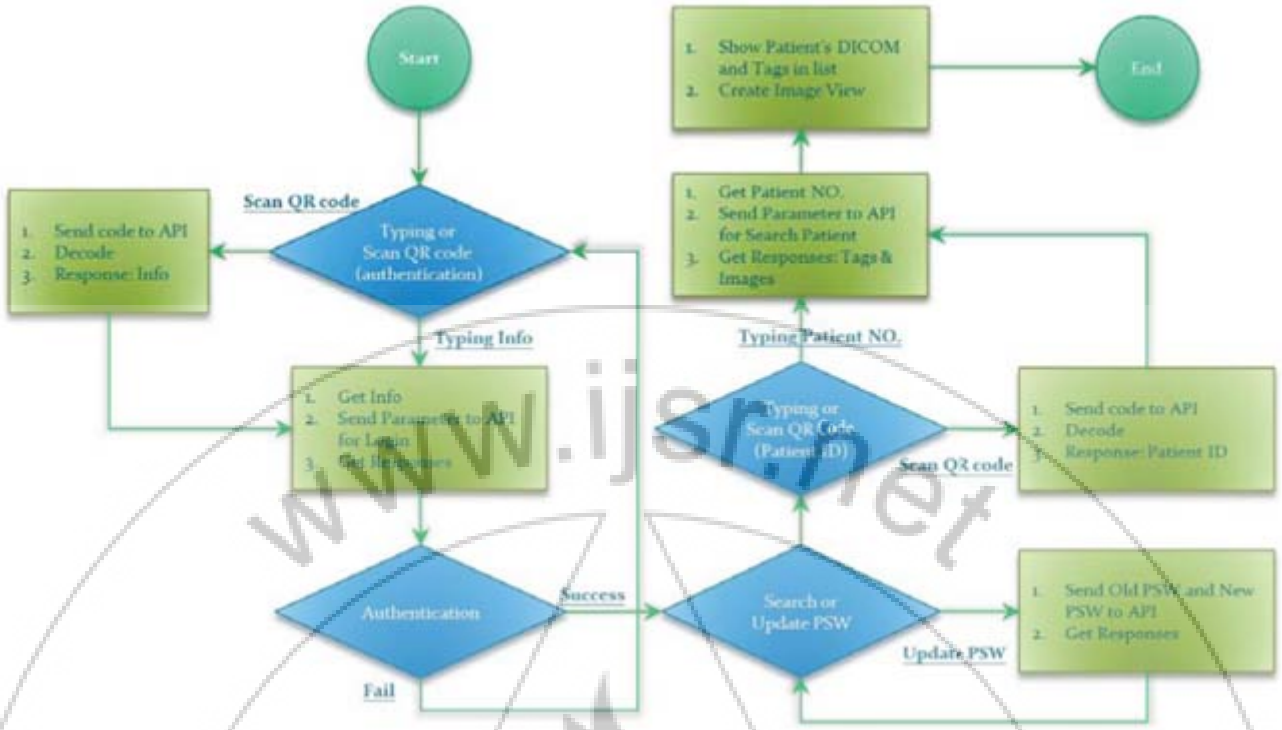

Figure 2: The flow chart of Android application

The System Architecture has contained the following sections:

2.1 Android application

There functions are authenticating identity; authenticate identity by QR-Code, searching identity of patient, searching identity of patient by QR-Code and daily logging. The connection between application and server is using in transport layer security (TLS) [16], that is currently used to protect data during transportation. The flow chart of Android application is shown in Fig. 2.

2.2 Server and Database

We built and simulated data on own private cloud based on Apache server [13]. DCMTK tools will be executed and extract information when user requests information by API. Fig. 3 is data flow chart of API, which is explaining for requesting and responding information. For example, the API will respond medical image and tags of DICOM from Database and DCMTK tools when user is searching identity of patient.

2.3 Back end Management Interface

The manager of organization can create user, delete user, building the QR-Code of identity with AES encrypt, loading medical image of patient to database and check out daily logging. The daily logging contains following schemas: user, date, time, and type of access and International Mobile Equipment Identity number (IMEI). IMEI is a unique 15 digit code upon production on mobile device and it can checked all known information regarding manufacturer, model type, and country of approval of a handset.

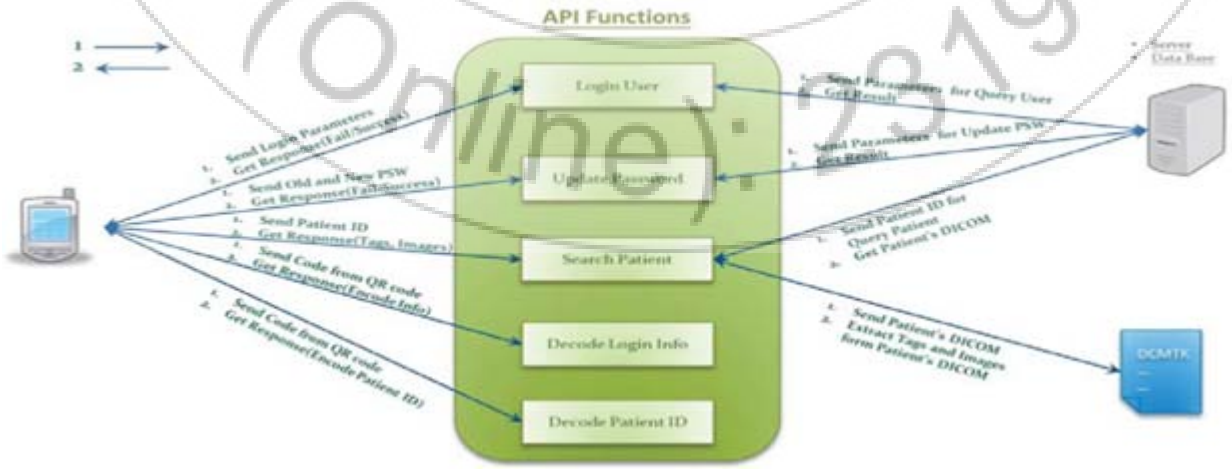

Figure 3: The Data Flow Chart of API

Figure 4: The QR-Code of identity and The QR-Code of patient identity. (a) Sample of patient identity (b) Sample of doctor identity

There is a problem during the system encodes cipher to QR-Code with AES encrypt, that the cipher cannot be decrypt after decode the QR-Code, because the cipher contains the character which is out of code list, and we used Base64 encoding [17] to solve the problem. Base64 encoding is a group of similar binary-to-text encoding schemes that represent binary data in an ASCII string format by translating it into a radix-64 representation. The method of encryption is following:

Cipher = AES_Encrypt (Information);
Base64_C = Base64_Encode (Cipher);
QR-Code = QR-Code_Encode (Base64_C);

3. Implementation and Result

We set up the QR-Code of identity which is shown in Fig. 4, and the application screens are shown in Fig. 5. The application is named "D's Viewer". The personal information of patient has replaced QR-Code, and it only can be read by application because it has encrypted by AES. The cipher is encoded in Base64 before encoding QR-Code. It makes sure to protect privacy of patient in the ward, and the key of AES is set on the server. It are presented authentication, searching patient and showing list of result that screens in Fig. 5, and user can use button of QR-Code for application both in first and second screen. The third screen is showing list of result, that contains medical image, name of patient and date. After tapping one of third screen item, then application will show up the fourth screen and it shows medical image of patient which is selected.

Privacy and information security are very important, we possibly make system accord the Health Insurance Portability and Accountability Act (HIPAA) [15]. For above problems already concern in our system that using TLS between application server of connection, encrypted QR-Code and daily logging.

4. Conclusion

HIS health information system with QR-Code authentication framework based on Android OS and cloud is being proposed, the prototype can be useful to hospital Information related persons in the rural areas develop their mobile retrieval system, and it will also improve proprietary mobile devices with existing HIS systems. Integration of mobile and cloud systems will lead to better clinical decision makings. future work can be extended towards creating more quality environment and steps towards 3D/4D Images retrieval over smart phones and extensive user graphics will full fill the medical image workstation.

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