

<http://dx.doi.org/10.7236/JIIBC.2013.13.6.161>

JIIBC 2013-6-21

QR코드를 적용한 진료 처방전 설계

Medical prescription design using QR Codes

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요 약 최근 정보기술 발달로 산업 전 분야에서 IT 융합이 보편적으로 이루어지고 있다. 특히 의료IT 융합분야는 사용자 서비스 측면에서 많은 변화를 보이고 있다. 본 논문에서는 사용자 서비스 측면에 하나의 사례로 기존 종이처방전을 모바일을 이용한 QR코드로 전송할 수 있는 환경을 제안하고자 한다. QR코드는 종이처방전의 출력에서 전달, 보관하는 과정상의 부담을 최소화할 수 있다. 또한 정보 표현을 다양하고 폭넓게 활용할 수 있으며, 정보 복원과 암호화가 가능하므로 개인 정보 노출 및 변조의 위험을 최소화할 수 있는 미디어로 간주된다. 따라서 QR코드의 기능을 의료분야에 유입함으로써 사용자의 편의는 물론 정보의 기밀성, 저장능력을 발휘할 것으로 기대한다.

Abstract With recent development in information technology, IT convergence has been achieved ubiquitously in all areas of industry. In particular, there have been a lot of changes in medical IT conversion sector in terms of user service. In this regard, this paper attempts to propose an environment in which the existing paper prescription can be transferred in the form of QR codes using mobile handsets as one of practices from the perspective of user service. QR codes can minimize the burden resulting from the process of the output, delivery and storage of paper prescriptions. In addition, they can utilize the representation of the information in a wide variety of ways, and they are considered to be media that can minimize the risk of personal information exposure and falsification due to the restoration and encryption of the information. Accordingly, the application of QR codes to the medical field is expected to improve confidentiality and storage capability of the information, along with users' convenience.

Key Words : QR code application, Medical IT convergence, Information security, Hospital information system

I. Introduction

In recent years, the proportion of mobile devices, especially smart phones among computing devices has gradually increased. Due to busy daily lives and explosive increase in a lot of information, mobile

devices have widely been used in a more diversified way. In line with this, this study attempts to convert the form of the prescription issued to patients whenever they visit hospitals into mobile media. According to the data of the National Health Insurance Corporation, the number of hospitals across the

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접수일자 2013년 10월 1일, 수정완료 2013년 11월 23일
게재확정일자 2013년 12월 13일

Received: 1 October, 2013 / Revised: 23 November, 2013

Accepted: 13 December, 2013

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country was more than 82,300, that of medical personnel approximately 47 million, and that of admission days about 1 billion as of 2011, which indicates that the contents shown by above figures should be processed and kept in hospitals or pharmacies.^[1] Thus, this paper proposes an order communication system using QR codes as a method to ensure the confidentiality of the prescription that contains sensitive information to its disclosure and store information efficiently.^[2]

This paper is composed of Chapter II. Related Research, Chapter III. Order Communication System Based on QR Codes, Chapter IV. Realization of the System, and Chapter V. Conclusion and Future Work.

II. Related Research

1. QR Codes

QR code is a two-dimensional code which was developed by Denso of Japan in 1994. QR is an abbreviation of Quick Response, and the function of reading in high speed is important as its name indicates. The comparison of one- and two-dimensional bar code is shown in the Table 1.

Table 1. Comparison of barcodes

표 1. 바코드 기능 비교

1-dimensional	Segment	2-dimensional
20 characters	Amount of information	About 2000 characters
English, number	Kind of information	English, number, Korean
1	Recording density	20-40
Impossible	Restoration function	Possible
Impossible	Encryption function	Possible

As an expressional form of QR code, it is possible to express up to 7,089 number, 4,296 alphabets, and 1,817 Chinese characters. With the same amount of information, it only needs about 1/10 of the area that bar code requires.



Fig. 1. Barcode type

그림 1. 바코드 타입

The major characteristic of QR code is that it has an error correction function. If a part of the code is damaged or polluted, it can recover data from the precoded code. The area possible for recovery depends on the code, but data can be corrected with up to 30% of damage.

2. Order Communication System (OCS)

OCS is an automatic order communication system which is developed to improve the productivity and the treatment service for patient by resolving the inconvenience of the patient carrying around the handwritten prescription with doctor's prescription on it and having to register that in each treatment support department, and by preventing losing the prescription.^[3]

An exchange standard of medical information called HL7 is used for interconnection between these systems.^[4]

3. Electronic Medical Record (EMR)

EMR is a method of saving all the data into computation media and eliminating all the paper documents used in the hospital.^{[5][6]} The benefit is that unlike usual, this has an effect of reducing the space and cost because all the records and charts are computerized and stored in the DB system. In addition, EMR is out of simply substituting the paper chart but has an effect of checking and diagnosing patient's conditions regardless of time and place as practitioners can get information from tablet PC or smart phones according to the changing medical environment.^{[7][8]}

III. Order Communication System Based on QR Codes

1. Conceptual Model

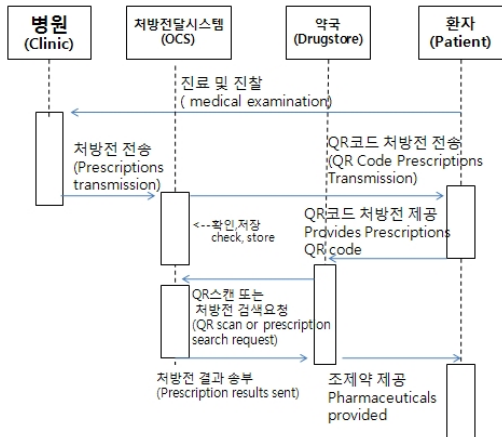


Fig. 2. Communication sequence diagrams
그림 2. 커뮤니케이션 시퀀스 다이어그램

This system converts the paper prescription of private hospital's outpatient medical examination to QR code and sends it to the mobile phone of a customer or patient. The patient then visits a pharmacy and the pharmacist can check the prescription by scanning the patient's QR code.^{[7][8]} After extracting the port number value of the receiver from the order communication system, it checks the cue field to see if the cue has been allocated to the receiver. If the cue field value is 0, it sends the electronic prescription to the user. If the user is not able to check the prescription from the terminal, the sender checks the cue field again because if the cue field value is 0, it means that the user has not received it.

If the user has checked the prescription from the terminal, the receiver will send a cue field value of 1, and this means to the sender that the user has checked the prescription.

If an unexpected communication error occurs during the sending process, it is the status of 'unable to reach the port', so it sends an 'unable to send prescription data' message and deletes the relative datagram. A

pharmacy then uses the checked QR code and connects to the order communication system to check or search the prescription.

Parameter value: User datagram received from IP class

1. Extract the port number value of the receiver from the header of the parameter value.
2. Search for the corresponding port number from control block table entries.

1. If it finds,

1. Checks the cue field to see whether the cue is allocated.

1. If the value of the cue field is 0

1. Sends the prescription after allocating a new cue.

2. Checks if there is data in the cue with corresponding data value after sending the prescription related data.

1. If a cue field value of 1 is dispatched from the receiver's server, it is the return value that the recipient has checked the prescription data.

2. If it can't find

1. Creates an ICMP message of 'Unable to reach the port'.
2. Sends the 'error in sending prescription data' message to the sender.
2. Discards the user datagram.

3. End

Fig. 3. Input module algorithm

그림 3. 입력 모듈 알고리즘

2. System Design

When a doctor writes a prescription after a patient is examined in the hospital, the written prescription is sent to the order communication system and the sent prescription is saved in the system.

The prescription written by the doctor is sent to the patient's mobile phone in the form of QR code. The patient can refer and check the prescription by using the QR code sent to his/her mobile phone.

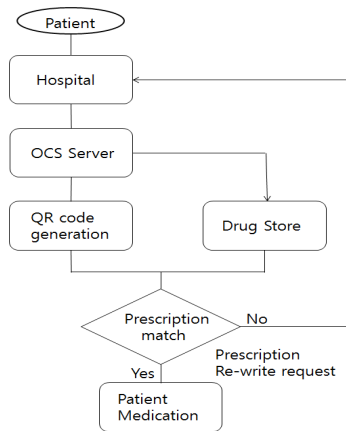


Fig. 4. OCS Flow Chart
그림 4. OCS 플로우차트

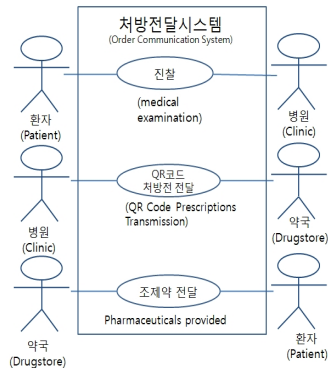


Fig. 7. OCS Use Case Diagram
그림 7. OCS 유즈케이스 다이어그램

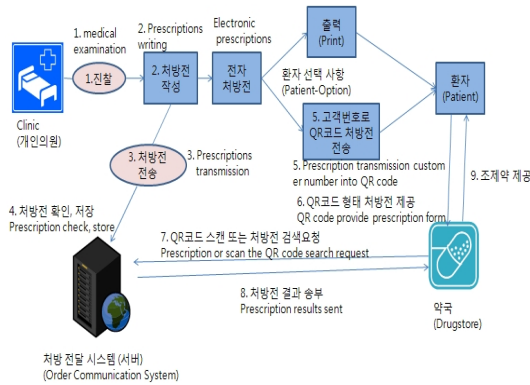


Fig. 5. OCS Background diagram
그림 5. OCS 백그라운드 다이어그램

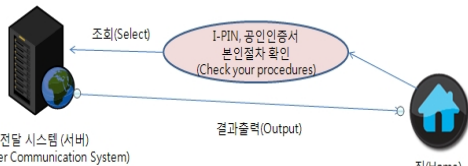


Fig. 6. Print the past history prescription
그림 6. 이전 처방전 출력 기능

If patients need to separately store the prescription statement, they can check the medical treatment and prescription histories that have been issued to them by going through the process of authentication on the Health Insurance Corporation from their PC.

IV. Implementation of the System

이름 (Name)	진단명 (Diagnosis)	처방약 (Prescription Drug)	진료비 (A fee for consultation)	진단일 (The day of diagnosis)	연락처 (Contact number)
<input type="checkbox"/> 홍길동	감기	감기약	3,100원	2012-07-01	011-112-1234
<input type="checkbox"/> 박홍수	목감기	감기약	3,500원	2012-07-02	011-112-1234
<input type="checkbox"/> 이문수	두통 및 어지러움	두통약	4,000원	2012-07-03	011-113-1234
<input type="checkbox"/> 김근수	고열증	진해제	2,500원	2012-07-03	016-211-1234
<input type="checkbox"/> 이문수	두통	두통약	3,000원	2012-07-04	010-9999-5678
<input type="checkbox"/> 박수진	감기	감기약	2,500원	2012-07-05	010-0001-1234
<input type="checkbox"/> 최다혜	코감기	감기약	2,500원	2012-07-06	010-1234-5678

Fig. 8. Patient Medical history screen
그림 8. 환자 진료 기록 화면

Based on the prescription and the medical treatment history entered by the hospital, select the QR code send button to the patient's mobile phone.

이름 (Name)	진단명 (Diagnosis)	처방약 (Prescription Drug)	진료비 (A fee for consultation)	진단일 (The day of diagnosis)	연락처 (Contact number)
<input type="checkbox"/> 홍길동	감기	감기약	3,100원	2012-07-01	011-111-1234
<input type="checkbox"/> 박홍수	목감기	감기약	3,500원	2012-07-02	011-112-1234
<input type="checkbox"/> 이문수	두통 및 어지러움	두통약	4,000원	2012-07-03	011-113-1234
<input type="checkbox"/> 김근수	고열증	진해제	2,500원	2012-07-03	016-211-1234
<input type="checkbox"/> 이문수	두통	두통약	3,000원	2012-07-04	010-9999-5678
<input type="checkbox"/> 박수진	감기	감기약	2,500원	2012-07-05	010-0001-1234
<input type="checkbox"/> 최다혜	코감기	감기약	2,500원	2012-07-06	010-1234-5678

Fig. 9. QR code transmission select screen
그림 9. QR코드 전환 선택화면



Fig. 10. Transmitted QR code screen
그림 10. 전환된 QR코드 화면

Content of converted QR code : treatment institution code, name, information for distinguishing patients, prescription code, prescription drug, data of registration and time.

Cell : Code to correct basic information and errors. The information in the form of QR code containing [Treatment institution code], [Name of treatment institution], [Information for distinguishing patients], [Prescription code], [Prescription drug], [Date of registration] and [Registered time] is sent to the patient's contact number.

When patients can take the medical certificate in the form of the QR code sent to their mobile phone to a pharmacy, a pharmacist there scans the QR code and refers as well as checks the prescription history based on the scanned information.

V. Conclusion

The existing hospitals resorted to printed paper prescriptions to receive prepared medicines from pharmacies. So, there was a huge output of paper, leading to higher cost of printing and much trouble to manage and archive prescriptions in a separate place.

The issuance of a medical certificate in the form of QR codes makes it possible for patients visiting hospitals to receive medical certificates to use the prescription in the form of QR codes using mobile phones without having a separate paper prescription.

Pharmacies can maintain the consistency of the information on prescriptions through scanning QR codes.

In addition, it is expected that in case there is a need for prescribed statement from a hospital where a patient was treated, he or she can print or get the prescribed statement or prescriptions by accessing homepage of the National Health Insurance Corporation and going through the personal certification process using I-PIN or digital certificates if necessary.

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