Scan Med: A Healthcare Application using QR Code

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Abstract: In medicine, adherence (also **capacitance**) describes the degree to which a patient correctly follows medical advice. The m-health is defined as a wireless telemedicine involving the use of mobile telecommunications and multimedia technologies and their integration with mobile healthcare delivery systems. In this paper we are developing the m-health application which is Android-based reminder application, it addresses the common healthcare issue such as attending appointment and taking medication on a proper schedule as prescribed. The m -health application also has an option of entering data in a quick and easy manner by using the chosen automated data-entry technology, the Quick Response (QR) code.

Keywords- e-Health, Mobile Healthcare application, QR Code, Medication adherence, mhealth care, medicine reminder.

I. INTRODUCTION

mHealth is one aspect of eHealth that is pushing the limits of how to acquire, transport, store, process, and secure the raw and processed data to deliver meaningful results. Within the mHealth space, projects operate with a variety of objectives, including increased access to healthcare and health-related information (particularly for hard-to-reach populations); improved ability to diagnose and track diseases; timelier, more actionable public health information. The basic need of this project is to help people as soon as possible. Failure to take medication as prescribed is a complicated and common problem. People have minor awareness and do not realize the damage and the consequence of non-adherence. There are numerous explicit and implicit factors contributing to poor medication adherence. Some notable explicit issues involve the discontinuing of medication, lapses in medication intake due to forgetting to take medication and inability to understand the instructions for medications involving inhalers or injections. To overcome this issue we implement system which will prove beneficial to people.

In this paper, we are developing a mobile health medication adherence system that would help hospitals to resolve some issues pertaining to medication adherence. Our propose solution is called ScanMed and it is a prototype based on the Android platform utilizing the use of a camera to capture QR code on medication label. A patient is required to scan the QR-Code label attached to the packages of their medicine as a proof of work to indicate that a patient has taken his medication. ScanMed will also display information such as an image of the medicine, prescription details, medication warnings. Additionally, ScanMed will manage notification and alarm for each medicine, which was recommended by the doctor to notify the patients in a timely manner to consume their medication. It is an application which runs on any Android version. Additionally, for healthcare applications and services usability, user friendliness, and usefulness of the system are very important due to great spectrum of potential future users and variety of their needs and expectations from system's functionalities.

II. RELATED WORK

Various Mobile adherence applications have been developed in the field of mHealth for both health care providers such as doctors, pharmacists and for patients. Many applications have been introduced in this field but fail to provide security and transparency. [1] Pill Reminder and Medication tracker is a mhealth application developed by Medisafe. The application provides the basic functionality of reminding the patient about medicine. This application shows that medication intake occurred as a result of the monitored person providing the application with an input, which indicates they took the medication. If the person fails to provide input, the application notifies a caregiver so that the caregiver can intervene to remind the person about his medication adherence. One of the major drawbacks to this approach is that most of the elderly patients are not competent in using cell phones or smart phones and some patients may not be attended by a caregiver, who is available for them all the time. [2]mHealth app developed by Danish Refugee Council-Dadaab provides information about the disease based on symptoms. The application also provides information about camp service, immunization. The drawback is that it fails to provide other facility like taking appointment in the hospital and also about medicines reminders. [3] Ada Your Health Guide app developed by Ada Health is the app that is been highly used by the users and doctors which have over more than thousands of symptoms and conditions from a common cold to rare diseases. The drawback with this system is that it allows only finding out the disease based on symptoms and causes. It provides online consultant of doctors but doesn't allow taking appointment or allow setting reminder. It acts as a bridge between doctor and patient.[4] Heldenbrand studied medication adherence app features, functionality, and health literacy level. The authors conducted a survey in June 2014, to identify available adherence apps. They identified 461 adherence apps, of which 367 unique apps were evaluated after removing Lite/Trial versions. The authors evaluated the applications based on attributes that are divided into 5 domains (Adherence Attributes, Medication Management, Connectivity, General Features, Health Literacy). The results of their study are used to help patients and health providers to find medication adherence mobile applications through their website develop based on the outcome of their study. In their website, www.medappfinder.com. [5]Other applications such as MyMeds provide numerous functionality, however does not have food and drug interaction information.

The above studies illustrate the major concerns arising from the way each m-health app collects, manages and/or shares user's private information. For instance, there will always be a matter of trust when an app collects more information than is needed to provide its services, thereby violating the data minimization and purpose limitation principles specified in all contemporary data protection regulations. [6]In terms of their secure connectivity, today it is more than usual for users to interact with their apps on a not fully trusted network, *i.e.* at a shop or a restaurant, and therefore information leakages cannot be physically constrained to specific networks.

III. METHODOLOGIES

The ScanMed application will help the Doctors, the Patient and the Pharmacist's to enrol and provide the required services. The objective of the system is to help the patients to take their prescribed medicine on time, to take appointment and to search for nearest hospital. Furthermore it will provide doctors with the facility of accepting or rejecting appointment; access the medical history of the patient and prescribe him with proper medication. The pharmacist will be able to scan the barcode and access prescription of the patient. Provide the patient with the required medicines and update those details in the patient database.

Thus, ScanMed general design methodology is to improve the medical adherence. The simple UI will be easy to understand and also allow all the users to use the service more easily. Furthermore, it will provide data security and integrity. The mobile application interface for patient, doctor and pharmacist is show in (fig 1- fig 3). To minimize and ease the interaction of the patient with the mobile application, the application utilizes the camera function of the mobile device to scan the QR-code generated for the patient.

A. *Modules:*

1. *Patient:* A patient is required to register into the ScanMed application. During registration through the application, the system creates a user profile for a particular patient. On successful registration process, it generates a unique QR-Code that the doctor and pharmacist can easily scan from his mobile device. Fig 1a shows the registration window. The patient can search for nearby hospitals based on his symptoms. Notification will also be displayed for appointment reminder as well as medicine reminder.
2. *Doctor:* The Doctor has to register into the ScanMed application. With the successful completion of the process he can use services such as accepting or rejecting the appointment of patients. He can use the camera of his device to scan the patient's barcode by which he can access the medical history of the patient. He can prescribe the medicines which will be updated in the database server of the patient.
3. *Pharmacist:* Registered Pharmacist can scan the barcode of patient and access the prescription, provide the required medicines and details will be updated in database.

B. *Process Flow:*

1. *Login Activity:* To access the profile the above mentioned user/module has to login into their account. This allows them to avail the facilities provided by the ScanMed application.
2. *Home activity:*Home activity for patient provides searching nearest hospital on the basis of symptoms entered and take appointment to particular hospital. For Doctor, it provides the activity of accepting appointment and for Pharmacist; it provides the window to scan QR-code.
3. *QR Code Scanner Activity:* The QR-code is generated for the patient and is used by doctors and pharmacists. Fig 2b shows how to use QR-code activity. This activity allows scanning the unique QR-code of patient which will allow the Doctor to refer medical history for patient and update the latest treatment details into it. Whereas pharmacist has limited access that allows him just to update the provided medicines.
4. *Alert Notification:* It is an alert that displays a notification for users to take their medicines.

Fig1(a) Patient Login *Fig1(b) Patient Details* *Fig2(a) Doctor Login* *Fig2(b) Request Status* *Fig2(c) QR Window*

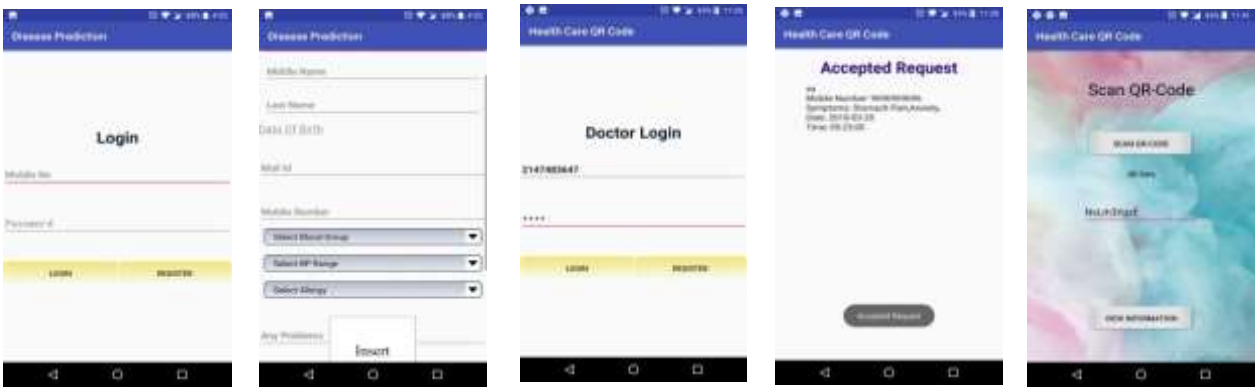
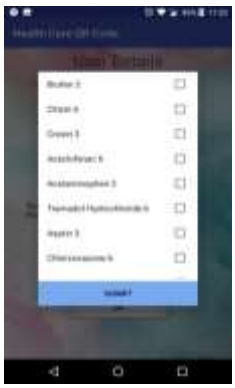


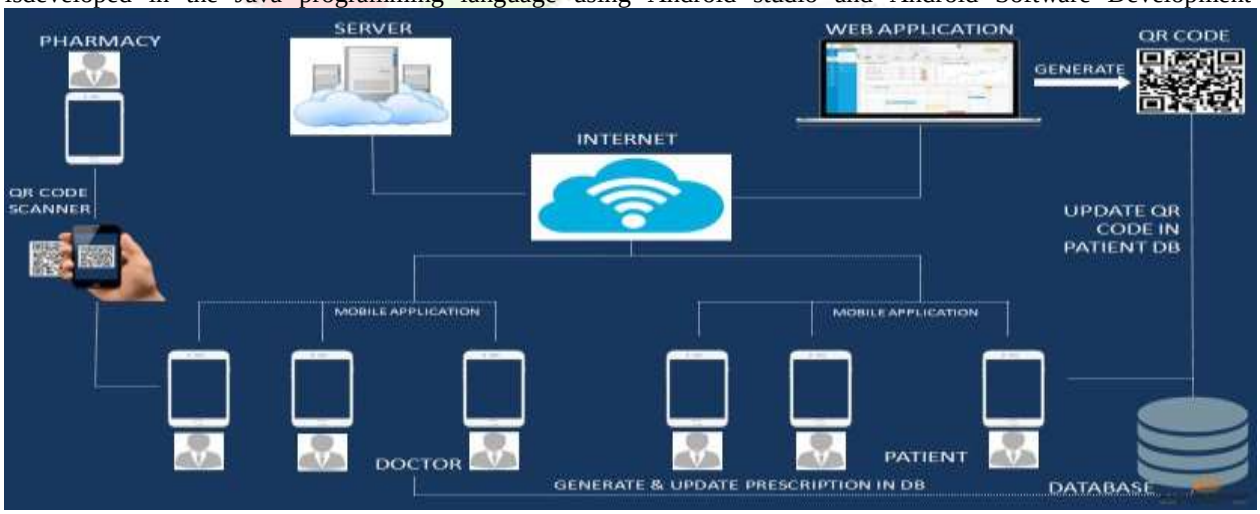
Fig2(d) Appointment *Fig2(f) Presciption* *Fig3(a) Pharmacy Scan* *Fig3(b) Medicine Detai*



IV. IMPLEMENTATION

This section, we describe the implementation of the overall ScanMed system. The system proposed in this has 3 component as shown in Fig 4 which explains the system architecture of the ScanMed application. The first component is the web-based front-end. It allows hospital administrators or nurses to record activities and medication intake related to the patient (e.g., list of medicines, prescription details, instruction and appointment scheduling). This is necessary for cases where the patient is immobile and requires the help of a health professional to administer medication. Every each transaction on the web interface is sent to the server to be recorded. The application server contains PHP scripts use to implement web services for mobile and web application to interact to the database. The idea of using a web service is consistent with today's technology and compatible with devices that supports web interactions like the smart phone. A Smartphone is chosen as an affordable and easy-to-use device to record activity. The goal of this system is to display the patients records from the server. The second component is the server. This component contains PHP scripts that the web-based front-end component and a mobile application depend on for retrieving and saving data. The server allows the web-based front-end and mobile application allows retrieving dynamic content where health centre personnel can interact with the system. The server also implements scripts that provide web services for the mobile application to update data and records into the system. XAMPP stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing purposes. Everything you need to set up a web server application (Apache), database (MySQL), and scripting language (PHP) is included in a simple extractable. XAMPP is also cross platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server is extremely easy as well. Web development using XAMPP is especially beginner. Finally, the mobile application isdeveloped in the Java programming language using Android studio and Android Software Development Kit (SDK).



V. PSEUDO CODE

In this section we have briefly stated the used algorithms and mathematical model used in the development of our ScanMed application. Let W be the whole system which consists:

Inputs:

W= {f U, Q, k, D, P, Syg}

1. Let u is the set of number of users or Patients.
   U= f U1, U2.Ung.
2. k is the secret key used for encryption.
3. Q is the generate QR code for every patient.
4. D is the set of Doctors.
   D= f D1, D2,Dng
5. M is the set of Pharmacist.
   P=f P1,P2,Png
6. Sy is the collection of symptoms.

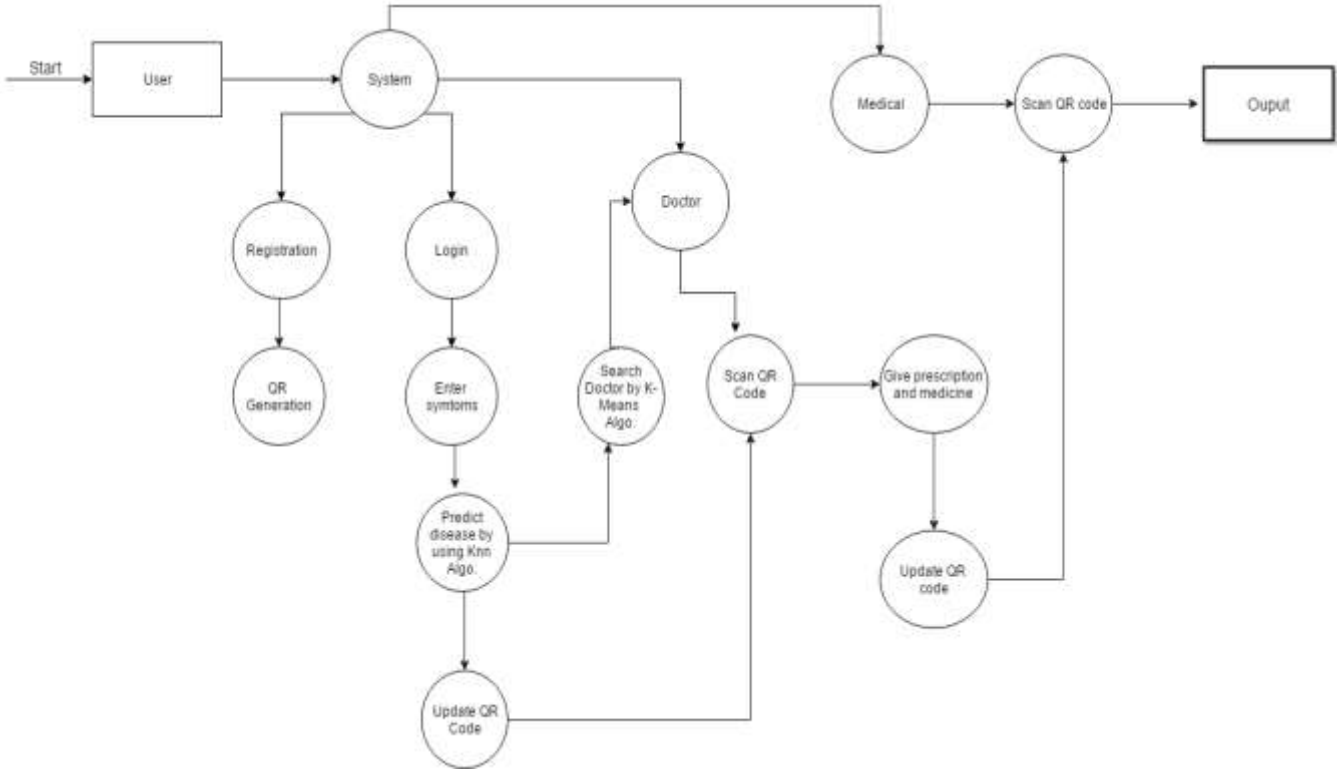
Functions:

1. *QREnc ()*: a QR encoding algorithm which takes a string S in S and outputs a QR code.
2. *QRDec ()*: a QR decoding algorithm which takes a QR code and returns a string S in S.

Procedure:

A. Protocol for generating OTP for Authentication with Random Strings:

Step1: The user connects to the server and sends her ID.
Step2: The server checks the ID to retrieve the users
Step3: A QR code is displayed prompting the user to type in the string.
Step4: The user decodes the QR code with because the random string is encrypted the user can read the OTP string only through her Smartphone and type in the OTP in the terminal with a physical keyboard.
Step5: The server checks the result and if it matches what the server has sent earlier, the user is authenticated. Otherwise, the user is denied. In this protocol, OTP is any combination of alphabets or numbers whose length is 4 or more depending on the security level required.



B. Protocol for Authentication with Password and Randomized Onscreen Keyboard:

Step1: The user or patient connects to the server and sends her ID.

Step2: The server checks the received ID from the database. The server prepares, a random permutation of a keyboard arrangement, and encrypts it with the public key to obtain
Step3: Then, it encodes the cipher-text with QR encoder to obtain
Step4: On the users or patients terminal, a QR code is displayed together with a blank keyboard. Because the onscreen keyboard does not have any alphabet on it, the user cannot input her password.
Step5: The user or patient executes her Smartphone application which decodes the QR code. The cipher text is then decrypted by the Smartphone application.
Step6: When the user or patient sees the blank keyboard with the QR code through an application on the Smartphone, alphanumeric appear on the blank keyboard and the user can click the proper button for the password.
Step7: The user or patient types in her password on the terminals screen while seeing the keyboard layout through the Smartphone. The terminal does not know what the password is but only knows which buttons are clicked.
Step8: User or patient will login into the system.

C. Searching for Symptoms:

1. First Patient will register into system with normal details.
2. Then patient will receive a QR code on his registered mail ID.
3. Patient will download the QR code.
4. Patient will search for doctor as per his disease.
5. System will shows number of doctors to patient as per there disease.
6. Then patient will visit to the doctor with the QR code.
7. Doctor scans the QR code and gets the details of patient and gives treatment to the patient.
8. Doctor will give a prescription into the QR code format.
9. Patient collects that QR code from doctor and visit to the Pharmacist.
10. Pharmacist will scan the QR code and gives medicine to the patient.

D. Disease prediction:

1. Enter symptoms.
2. Predict disease by KNN algorithm.

   1. Determine parameter k = number of nearest neighbour.
   2. Calculate the distance between the query instance and all the training samples.
   3. Sort the distance and determine nearest neighbour based on the k^{th} minimum distance.
   4. Gather the category y of the nearest neighbour.
   5. Use simple majority of the category of nearest neighbour as the prediction value of query instance.
3. Generate QR code from result of predicted disease and send to mail.
4. Search doctor by disease category using K-means algorithm.
   1. Initialize the centre of the clusters
   2. Attribute the closest cluster to each data point
   3. Set the position of each cluster to the mean of all data points belonging to that cluster
   4. Repeat steps 2-3 until convergence
5. Then doctor decrypt user/patient QR code and gives prescription and medicine.
6. Generate QR code of prescription and medicine and sent to user/patient mail.
7. Then pharmacist decrypt QR code and gives medicine.

CONCLUSION

We proposed health care system for hospital for this we are using K-NN and K-Mean algorithms. We generate QR code for every patient. We proposed and analysed the use of user driven visualization to improve security and user friendliness of authentication approaches. We have proposed two of conventions that not only improve the user experience but also resist challenging attacks, such as the key logger and malware attacks. Our protocols utilize simple technologies available in most out-of-the box Smartphone devices. In addition, we will study methods for improving the security and user experience by means of visualization in other contexts, but not limited to authentication such as visual decryption and visual signature verification.

ScanMed, a mobile medical adherence android application with QR-Code, is expected to show better results with patients and will be useful to any health centre. It will improve the quality of patient's life and help eliminate complications with regards to taking medicine as prescribed. Most importantly, it will improve the quality of patients life and help eliminate complications with regards by taking the wrong medicine for medicinal treatment.

REFERENCES

1. Rizal Mohammed Nor, Noor Azizah Mohammad Ali, Khairul Azmi, Ahmad Marzuki, Leilanie Mohd Noor and Mohar Yusof, "ScanMed: A Mobile Adherence Application with Intake Validation using QR Code", *6th International Conference on Information and Communication Technology.*
2. "Number of Smartphone users worldwide from 2014 to 2019 (in millions)." [Online]. Available: http://www.statista.com/statistics/274774/forecast-of-mobile-phone-users-worldwide/.
3. A. Choi, A. W. Lovett, J. Kang, K. Lee, and L. Choi, "Mobile applications to improve medication adherence: Existing apps, quality of life and future directions," Advances in Pharmacology and Pharmacy app, vol. 3, no. 3, p. 6474, 2015.
4. S. Heldenbrand, B. C. Martin, P. O. Gibbons, K. Haden, C. Renna, R. Shilling, and L. Dayer, "Assessment of medication adherence app features, functionality, and health literacy level and the creation of a searchable web-based adherence app resource for health care professionals and patients," Journal of the American Pharmacists Association, vol. 56, no. 3, p. 293302, 2016.
5. S. Chan, "Free, easy app for tracking medication regimens," 2015.[Online]. Available: http://www.imedicalapps.com/2015/03/review-medisafe-app-reminders/
6. V. Arya, R. Alam, and M. Zheng, "Medication adherence: Theres an app for that," Pharmacy Today, vol. 19, no. 6, p. 34, 2013.
7. "Medappfinder." [Online]. Available: http://medappfinder.com/
8. "Medisafe pill reminder by medisafeinc." [Online]. Available:https://itunes.apple.com/us/app/medisafe-pill-reminder-medication/id573916946?mt=8
9. "Medcoach medication reminder by greatcallinc." [Online]. Available: https://itunes.apple.com/us/app/medcoach-medication-reminder/id443065594?mt=8
10. "Pill Monitor free - medication reminders and logs by maxwell software." [Online]. Available: https://itunes.apple.com/en/app/pill-monitor-free-medication/id485247638?mt=8
11. "Mymeds the complete medication manager." [Online]. Available: http://my-meds.com/
12. K. Serdaroglu, G. Uslu, and S. Baydere, "Medication intake adherence with real time activity recognition on IOT," in *Wireless and Mobile Computing, Networking and Communications (WiMob), 2015 IEEE 11th International Conference on*. IEEE, 2015, pp. 230–237.
13. R. Mohd Noor, A. M. M. Ridzuan, and M. J. M. Razi, "The design and implementation of a qr-code enabled mobile online judging application," in *Information and Communication Technology for the Muslim World (ICT4M), 2014 The 5th International Conference on*. IEEE, 2014, pp. 1–5.
14. T. J. Soon, "QR code," *Synthesis Journal*, vol. 2008, pp. 59–78, 2008.