Development of Smartphone App for Tele-Care Medicine Applications

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Abstract— **Many of the countries in the world are having the doctor to patient ratio far below than the prescribed number. Most of the developed countries also have serious health care issues in their rural areas because of the lesser density of physicians in such places. Despite this, information technology and mobile communication devices are growing rapidly. This technology has been successfully tapped by online shopping business giants. If the same technology is extended effectively to health care applications, then the world-wide scarcity of medical practitioners would be improved so that the larger wait of outpatients in the hospitals can be reduced. To serve this purpose, we developed mobile phone application software for Android devices. There are two separate apps; one for the doctor and another to the patient. Without the traditional method of consultations between the patient and the doctor, many health problems can be treated by monitoring the vital signs through these mobile apps. The software allows attaching medical images also along with the vital signs as text values. The medical data can be sent to the selected doctor by the patient through the web, after logging into the app. The doctor can suggest the course of treatment by typing the text in his app. Both apps were tested for their performance and security issues.**

Keywords— *Android device, Java, health care, Smartphone, doctor, patient*

I. INTRODUCTION

As Smart phones are becoming more users friendly, computationally powerful and less expensive; innovators are developing more and more application softwares (App's) for various purposes. They cover a wide range of application from entertainment to scientific. In the field of medicine also many apps have been developed. An app can establish contact between two or many people virtually. This feature is more beneficial to bring the patients and doctors together for the healthcare purposes, including patient monitoring. In the recent years, health care consciousness has greatly increased and emphasized. But, the number of health care professionals is not proportionately increasing. But, it is found that the technology is tremendously progressing. Therefore, we developed a smart phone application software to benefit the patients and to improve the doctor to patient ratio.

World Health Organization (WHO) has proposed 1:1000 ratio of doctor to patients for better service to the needful patients. From the available data [1], there are only 10-15 million physicians are available in the world. The ratio varies from developed countries to the poor. In the poor countries, it is pathetic. The developed countries also has shortage of doctors for the rural services. From our observations and news reports, everyday a large number of patients visit the hospital and the statistics supports our observations. According to the statistics of USA, about 125.7 million patients visited the hospital as outpatient and the report also says that there were 41 outpatient visits per 100 persons [2]. Patients visiting the OPD are not critically ill. They visit either to follow up of their treated diseases or for the treatment of health problems based on diagnosis reports, without necessarily requiring a bed in the hospitals. Such patients can be treated from home after submitting their diagnostic reports which are produced by medical diagnostic devices. The clinical reports can be sent to their general physician of choice for further treatment. This method of treatment without meeting the physician personally can be beneficial to both patient and the physician. To facilitate them for the virtual consultations rather than traditional face-to-face meetings, we have developed an app for the tele-care medicine by exploring the latest developments in IT (Information and Technology) field.

Several mobile Apps in the medical field are available today. Most of them are related to the fitness tracking [3] [4] [5], public health services [6] and patient monitoring [7] [8]. We designed and developed the mobile app which allows to write the text, attach images and establishes web link between patient and doctor for remote diagnosis patient's health problems. Our Smart phone app supports for sending vital parameters of the patient and the diagnostic images (CT, MRI or Ultrasound scans) can also be sent as an attachment along with those vital parameters. All the clinical parameters from the patient are received by the doctor through his smart phone through internet connectivity. The Figure (1) shown the workable sketch of our project. The detailed description of the software development is explained in the below section.

II. METHODOLOGY

There are three types of operating software widely used by mobile phones today. Accordingly, they are be known as Android based, iOS based, or Microsoft based phones which run with their respective software. The producers of each software claim that their phone models are best, however, Android phones are popular because they are affordable and secured Android software. The mobile operating software, Android is a modified version of Linux kernel and is designed for touchscreen feature that has been employed in Smartphones and tablets. Android software offers greater flexibilities than

others to third parties for programming in open source domain [Pasha 2012]. This helps the researcher to develop and test their innovative ideas in beta version without applying for any kind of tedious licensing system.

Figure 1. Schematic diagram showing the workable stages of mobile application software.

We developed two distinct application software, specifically one for the doctor and another for the patient. In each app we used two tools to build the system: (i) Android Studio (Android Developed Tool) and (ii) Android supported device. The programming code has been implemented in Java script and then converted in to Java class files by using the compiler. The Android SDK converts the files in executable form. These files together with the project resource applications are combined together thus creating '.APK' file. This is then transferred to a smart phone through a portable memory or Bluetooth that appear in the device manager of the phone.

System Architecture

We used Android Studio to create a code by JAVA language and to publishing applications. So we have two application versions; one for the patient to send his/her vital parameters, which we call it as "Patient app" and another to recive this data by the doctor and we defined it as "Doctor app". The patients can record the vital parameters by the commercially available and clinically approved medical devices from their premises. The vital signs of the human body can primarily help in the detection of most of the medical problems and they can be monitored routinely. Often the vital signs include the body temperature, blood pressure, glucose level as symptomatic for diabetes, respiratory rate and the pulse rate. In addition to the vital signs, the patient can upload the diagnostic images obtained from radiologists if they are scanned for further investigation of the disease.

In the Doctor app, the doctor will register the user name and password for the first time consulting patient. The doctor can login immediately if the patient has previously registered with him. The doctor will get unique number called " Doctor ID " after registering for every registered patient. The benefit of creating unique ID for individual patient helps to communicate with the concerned patient alone without interferene of another patient. This feaure important to for the security reasons which prevents the patient information known by the others. After the doctor logged-in with a particular patient, the doctor can access the medical data uploaded by that patient. He can download the diagnostic image attachement and observe the healing stage in that body part for which it was scanned. Then the doctor can write his prescription required for further treatment and sent to the concerned patient through internet. Implement of these steps in the software is illustrated in the following flow chart (Figure. 2).
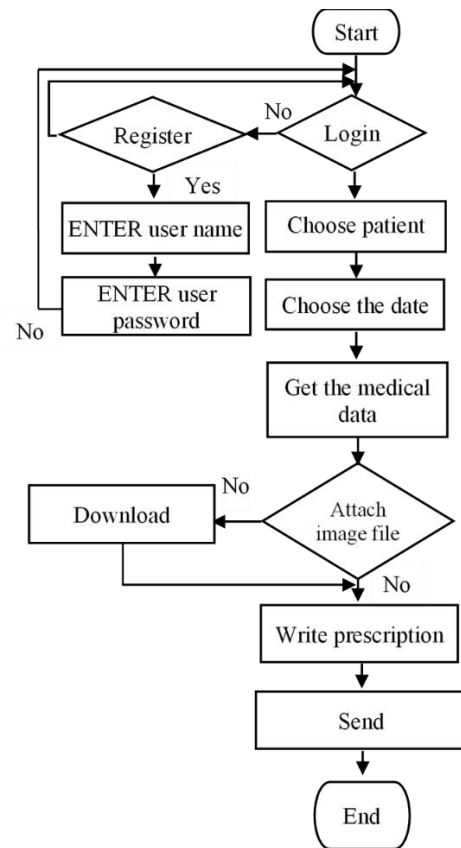

Figure 2. Software implementation steps for "Doctor app".

In the "Patient app", the first timer has to register with his/her credentials and then can be logged in. After entering in it, there will be two options seen by the patient. One is to follow up the treatment which appears as "Review old" and another is for first time consultation that appears as "Send new". From this option, the patient can upload the medical data. After entering the data and attaching the medical image, if any, it can be sent to the doctor through internet. Implement of these steps in the software is illustrated in the following flow chart (Figure 3).
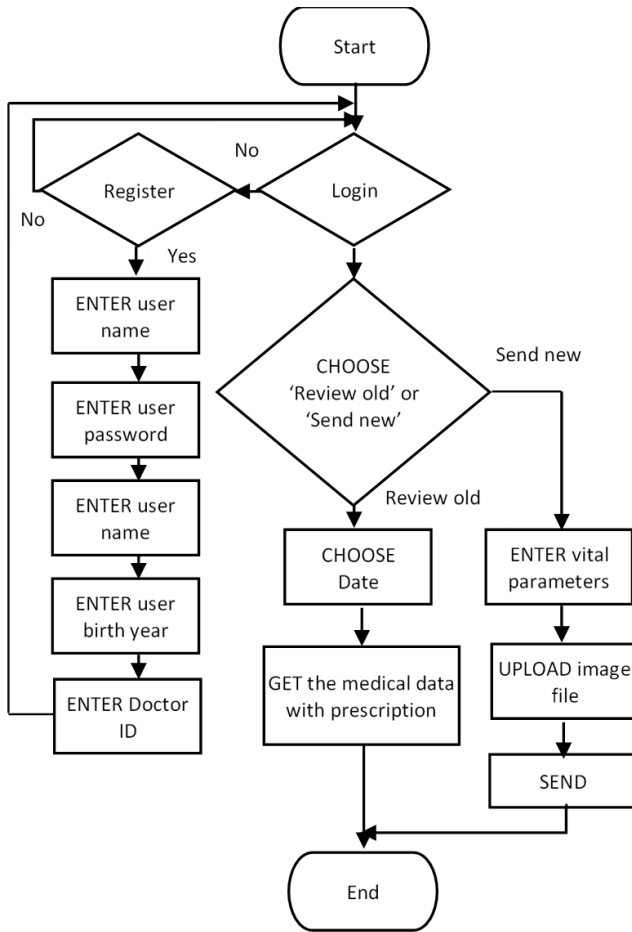

Figure 3. Software implementation steps for "Patient app".

The two apps with the marked icons as "Doctor app" and "Patient app" are available on the screens of the respective smart phones. Figure (4) shows screenshot of an Android phone in which both application software are downloaded.

III. RESULTS AND DISCUSSION

Android based application software for health care applications were developed and tested the performance. In the testing process, we took two Android devices each one treating as one with a doctor and another as patient's phone. In both the devices the two softwares, 'Doctor app' and 'Patient app', were installed separately. Then, in the Doctor app, we registered 'Dr.Jaafar' as user defined name with a password '11' that generated a 'Doctor ID' as '8' for the registered doctor. This process is for initial registration by the doctor in his Android

phone and generation of his identification number. Figure (5) shows the result of this process in the form of mobile phone screenshot.

Figure 4. Android phone with downloaded "Doctor App" and "Patient App" icons.
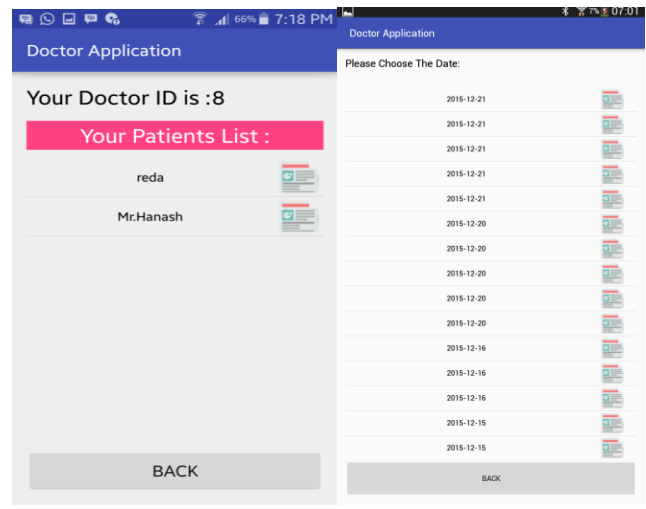

Figure 5. Screenshots from the Smartphone with Doctor App. They illustrate the registration procedure in the app by the doctor.

In the smart phone with a patient, the registration process has been done by creating the patient's login account and entering the details such as name, year of birth and the doctor's ID number. This ID facilitate the patient to communicate with that doctor whose ID number belongs to the specified doctor. The patient registration process and selection of a doctor of

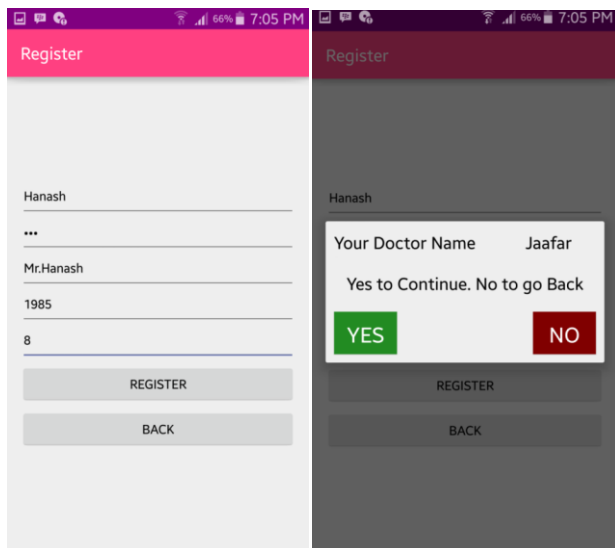choice with the identification number are shown by the two screenshots in Figure (6).

Figure 6. Screenshots from the Smartphone with Patient App. They illustrate the registration procedure in the app by the patient.

After completion of the registration by the patient and selecting a doctor for consultation, the patient can enter the measured medical parameters as text data. If any radiological images like, X-ray (digital file), CT scan, MRI image or ultrasound scan have the patient, then they can be attached as an image file and then press the 'send' button for forwarding to the doctor. A specimen image file for attachment and arbitrarily filled text data in the patient's app are shown as screenshot in Figure (7).
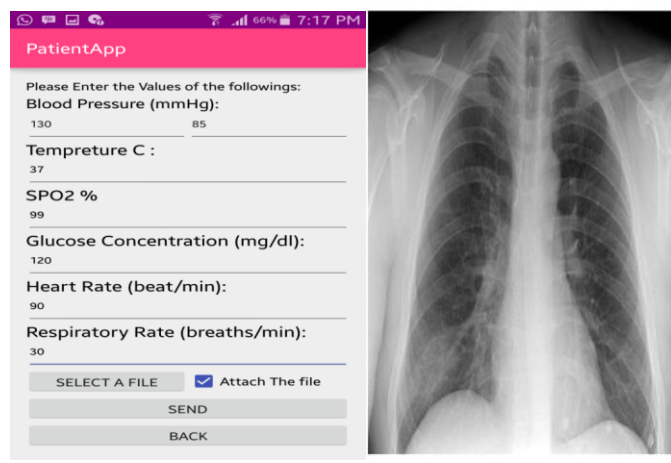

Figure 7. Entering the clinical vital parameters in text by the patient and a specimen medical image for attachment.

The doctor receives the patient data and send his prescription in the text form as shown in Fig. (8). The smartphone application technology has made revolution in the field of technology that cater the daily life, further it is extending its usefulness to medicine, education, social and others activities of the life. In future, we will enhance its functionality by addition of more features such as payment of consultation fees and improvement in security like aspects to make this as commercially viable.
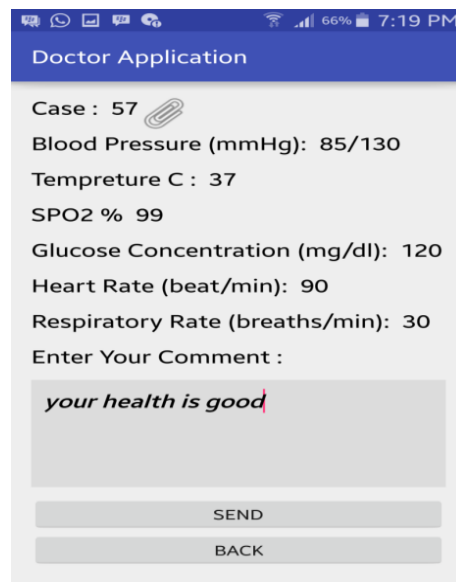

Figure 8. Recommendations from the doctor based on vital signs.

IV. CONCLUSION

We have developed an Android based application software for health care applications. There are two distinct apps each one for a doctor and patient. Vital signs of a person can help the physician to understand many of the health problems in patients. The patient can send the vital parameters with diagnostic images to the selected doctor for the follow up of treatment and prescription from the doctor seeking for treatment to the diseases without direct consultations. The software is ideally suitable for remote places where the density of physicians is very low. It can also reduce the burden on OPD sections of the hospitals in urban localities. The test results show that the application software is secured and simple which is easy to operate from less educated people as well. Further improvements in the software can make it available to the public.

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