NFC Based Secure HealthCare Monitoring System

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ABSTRACT: One of the largest IT challenges in the health and medical fields is the ability to trace large numbers of patients. As mobile phone availability has become wide-ranging around the world, the use of Near Field Communication (NFC) with mobile phones is streaming as a promising solution to this challenge. The drowning price and increasing availability of mobile phones and NFC allows us to apply these technologies to developing countries like India in order to overcome patient identification and disease surveillance limitations, and permit improvements in data quality, patient referral, and emergency response. We are developing a basic architecture for healthcare services using NFC to facilitate the healthcare to people anywhere, anytime using mobile devices. In this paper, we present a system using NFC-enabled mobile phones for facilitating the patients in a low-resource environment.

KEYWORDS: NFC; RFID; Mobile devices; Healthcard; Electronic Health Record; Security

I. INTRODUCTION

Nowadays, using computerized systems and software programs instead of documenting the clinical trials in a paper has become common. The data collected by nurses, physicians and investigators are manually entered using a common graphical user interface on a standard computer. Mobile devices are personal, always with the patient and are location aware. The patient can use them for self-help and to communicate with the doctors or to monitor the patient health, this makes the cell phone an appropriate device for remote healthcare than any other media.

From a marketing point of view, future devices with communication capabilities should not be more expensive, more complex to use, or provide significantly shorter operation time than those available now [1]. Hence, current state-of-the-art standard short-range wireless communication technologies, such as Bluetooth and IrDA, are sub optimal and not competitive solutions for health monitoring devices.

Identification of objects for secure medical procedures is very essential for a secure workflow [2]. For example, identification of medicines can help healthcare professional to administer correct medication to a patient to reduce errors.

The Patient Health Record management is important both for patients as well as hospital management. There is no centralized management of health records in the developing countries like India. The patients' records which are retained in the paper format are cumbersome and unreliable. Work is still being in progress for secure maintenance, patient records as a Healthcard on a Smartcard in developing countries like India and other nations [3]. Most of the hospitals issue a Healthcard, which only tries to stores just the primary information of the patient and major part of the records are stored on a centralized medical storage server.

With the recent emerging technologies in mobile devices involving secure credential storage, larger storage capability, wireless communication interfaces they can be used in the healthcare for gathering health parameters and also for healthcare. The very important aspect of health care is Privacy and security [4]. We propose that the patient should retain only primary part of the record in EHR electronically. A Healthcard retained on a mobile device can retain the entire EHR including reports and tests. An authorized medical provider can access securely the permitted portion by a simple tap of mobile device.

 A simple tap of NFC enabled mobile device, will not only improve the workflow of medical professionals but also prove to be beneficial in emergency and chaotic conditions like mass populated hospitals. Simplified workflows will result in faster and more efficient patient-doctor interaction.

A novel approach towards an automated solution is the usage of Near Field Communication (NFC) technology [5]. NFC is an RFID based technology that enables short-range wireless information exchange [6]. In March 2004, a new interconnection technology, Near Field Communication (NFC), was launched by Sony, Philips and Nokia, by the establishment of the NFC Forum. As of the beginning of 2006, over 50 members have joined the NFC Forum [8]. The NFC Forum will promote the implementation and standardization of NFC technology to ensure interoperability between devices and services. We expect NFC technology to provide a potential solution for the above mentioned problems in many health's monitoring applications, since it is less complex and thus cheaper, as well as having lower power consumption and better usability than the alternative technologies. NFC is a wireless connectivity technology evolving from a combination of contactless identification and networking technologies. It enables convenient short-range communication between electronic devices and smart objects. NFC advanced from Radio Frequency Identification (RFID) technology and is still compatible to certain parts of the existing RFID infrastructure. NFC provides a data transmission rate of up to 424 Kbit/s within a short range of typically 5 to 20 centimeters [9]. This short range may not be seen as drawback but, in fact, it is the major feature of this technology because NFC enables rapid and easy communications between two devices which is initiated just by bringing them close together. Due to this usability enhancing feature NFC is bound to be integrated into various types of consumer devices, in particular in handheld devices like PDAs and mobile phones.

COMMUNICATION CONFIGURATION

NFC operates in two variants

(1) Active mode: Active NFC device can generate its own RF field for data transfer. Such a device will take the role of the initiator in the communication.

(2) Passive mode: A passive device can not generate RF field. They act as target. NFC data exchange format (NDEF) is used for the data transfer in all the modes. There is a set of rules for the structure of data used in communication. A NDEF message contains one or more NDEF records which encapsulate the user data at the application level.

In a simple scenario, two devices are used for the communication via NFC. The devices can either be in active mode or passive mode. During the data transfer, the sending device which is in the active mode generates the RF field whereas the receiving device which is in the passive mode doesn't generate the RF field. To be precise, the device that is in the active mode generates the RF field; the device which is in the passive mode does not generate the RF field. Amplitude shift keying is used when the data is being sent in the active 2 mode; hence RF signal is modulated with the data by using any coding scheme. A NFC device can either act as an initiator or a target. An initiator device starts the communication and target is the device that is at the receivers end. Either can act as a initiator or target in the course of communication. Most importantly, NFC communication is just not limited to two devices. An initiator can communicate with multiple targets.

SECURITY ANALYSIS OF NFC IN HEALTHCARE APPLICATIONS

There are many different ways to classify attacks on NFC systems [7]. In this paper, we consider Classification of Attacks based on Mode of Operation [8].
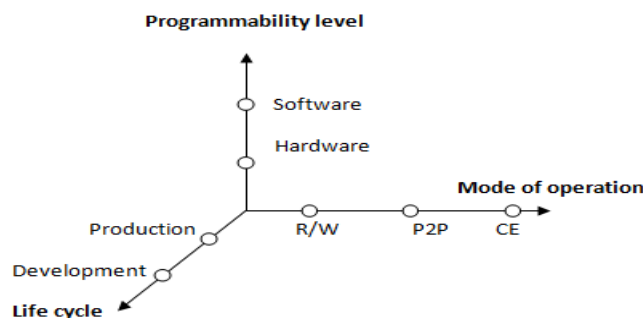

Fig. 1: A multi-dimensional representation of NFC systems. RW: Reader/Writer, P2P: Peer-to-Peer, CE[8]

Attacks on NFC systems could be classified based on the mode of operations as follows.

1. Reader/Writer (RW) mode: In reader/writer mode, one card is selected using an anti-collision algorithm, if two or more cards are present in the reader's carrier field. In healthcare applications, this could be used to read patients' records, doctors' notes, etc. Unauthorized readers could be used to retrieve this confidential information if data is not encrypted.

2. Peer-to-Peer (P2P) mode: The NFC peer-to-peer mode (ISO 18092) allows two NFC enabled devices to establish a bidirectional connection to exchange information or any other kind of data. Encryption is important because there is a high possibility of data interception.

3. Card Emulation (CE) mode: In Card Emulation mode, the NFC device appears to an external reader much the same as a traditional contactless smart card. This enables contactless payments and ticketing by NFC devices without changing the existing infrastructure. This mode is available without battery [9]. One common example is storing credit card information on smart phones and running an application to emulate the credit card so that users can pay with their smart phone. Protecting the credit card information and securing the communication between the smart phone and the reader are among the most serious security concerns in CE mode.

II. RELATED WORK

In [10] author has explained that Wireless sensors have the potential to greatly affect the health monitoring systems in health care. By outfitting patients with wireless, wearable sensors, monitoring the health condition of patients is distinctly simplified. Considering the current methods of health monitoring, medical assistants or caregivers just use some instruments such as Sphygmomanometer Electrocardiograph to record the health status of patients on daily or some hourly basis, which is definitely time-consuming. In [11] authors have studied of possibility of applying an emerging NFC, to health monitoring. They suggest that NFC is, compared to other competing technologies, a high-potential technology for short-range connectivity between health monitoring devices and mobile terminals. They propose practices to apply NFC to some health monitoring applications and study the benefits that are attainable with NFC. They compare NFC to other short-range communication technologies such as Bluetooth and IrDA, and study the possibility of improving the usability of health monitoring devices with NFC. They also introduced a research platform for technical evaluation, applicability study and application demonstrations of NFC. In [6] author shows how to improve patient's safety in healthcare and especially in medication care by using and NFC technologies. Use of information technology has become commonplace in healthcare. In an ideal world a patient always gets first class treatment and everything goes smoothly and as planned. Applications of information technology are created to help the hospital staff achieve this. However, hospital staff is often working under a heavy workload and minimal workforce. This may contribute to human error, for example, in medication that may have adverse effects on patient's treatment. In [12] author presents a Near Field Communication (NFC) based indoor navigation system called NFC Internal in order to eliminate the current indoor navigation problems. NFC Internal enables an easy data transfer for indoor navigation systems just by touching tags spread over a building or a complex. The proposed system has several benefits and has potential to increase the usability of these systems. They discuss the system requirements and explain the phases of NFC Internal through use cases.

III. PROPOSED WORK

We propose a novel architecture, here each patient will be provided with a NFC tag. The NFC tag contains patient identification and key. The key would be present only with the patient; until and unless patient does not tap the NFC card nobody can access and view the patient records. Doctors can view the previous medical records by tapping the Smartphone that is enabled with a NFC reader over the NFC tag. In the same way doctors can read/write the information. Basically this architecture eliminates manual (paper pen) intervention. It makes the system automatic and robust [12]. The following block diagram Fig. 2 explains the whole architecture [13][14].
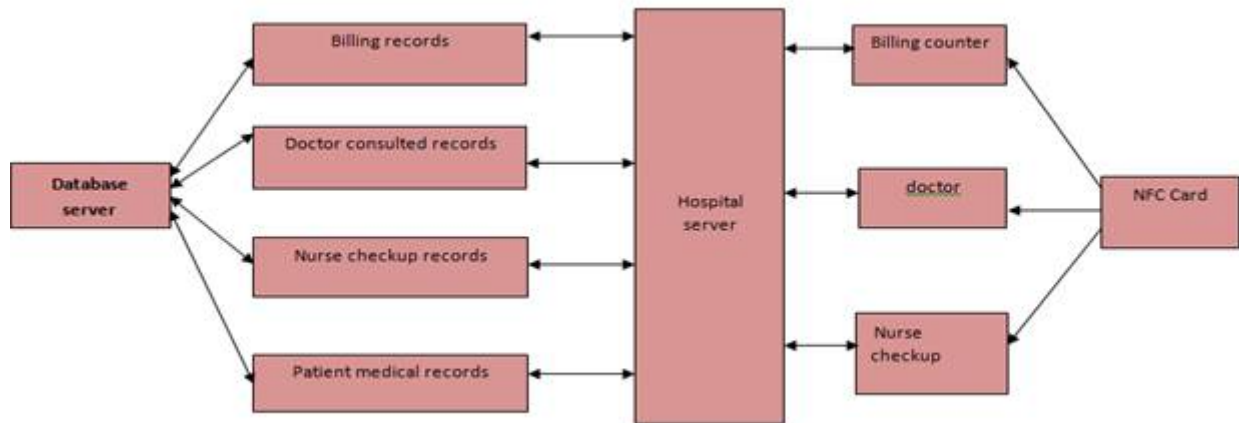
Fig. 2: Block diagram of whole architecture

IV. RESULTS

1. When a person gets Visit to the hospital, the health information about the person will be accessed through there NFC which will be synchronized and stored temporarily on that particular hospital Electronic Health Record (EHR) Database. From the block diagram shown in the Fig. 2 the doctor can easily access full records about the patient instead of going through bundle of paper reports.

2. If the patient is been asked to take any tests then those test reports will also be updated in the EHR.

3. Based on the test the updates which the doctor prescribed will be updated too in their records.

4. Finally while the patient discharge all those information which have been updated will be synchronized and transferred back to the hospital database which will hold the complete medical report about what happened that particular day.
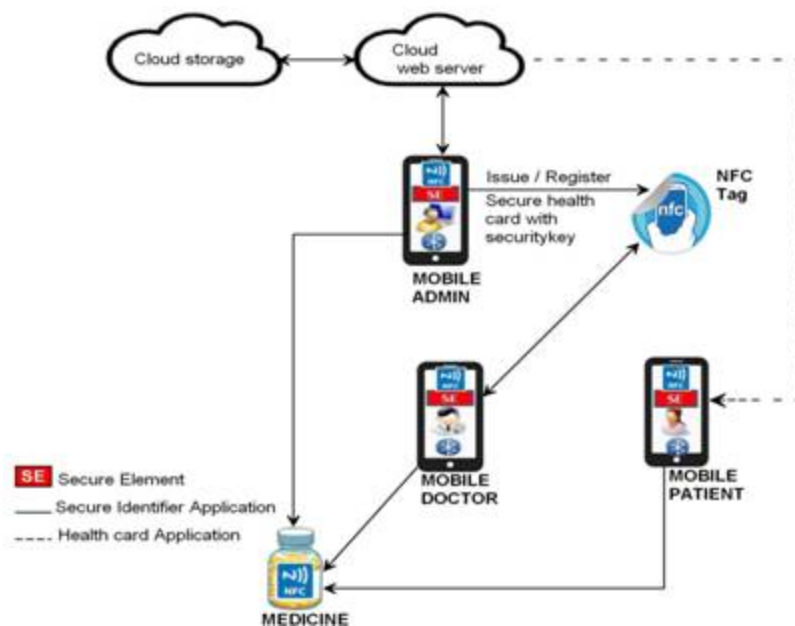

Fig. 3: NFC based secure health care

The diagram shown in Fig. 1 describes the multi-dimensional representation of NFC systems. i.e. RW: Reader/Writer, P2P: Peer-to-Peer and CE.

Fig .3 describes that for the patients convenient we first, reminder for the patients is sent through SMS about the medicines, diet etc. When the hospital admin updates any data or any records regarding the repots which the patients needs to collect it from the hospital, the message would be sent as a reminder. And the second, Access control for data viewable by the doctor (doctor access control). Most importantly we need to look into the patients waiting time based on the patient condition during emergency condition.

V. CONCLUSION AND FUTURE WORK

A NFC based mobile healthcare device is designed to reduce the complexity and mistakes in the diagnosis by the doctors [15]. This is done by NFC enabled device. There will be many patients in a hospital and it's very difficult to maintain the records in paper and there are also chances of patients losing their prescriptions and test results or it can also be misplaced in the hospitals [16]. During emergency condition doctors need not to start the tests from the scratch. Hence to avoid these problems, we have proposed NFC enabled mobile devices which can be used to keep the track of patients' identification and can also retrieve the previous records. The proposed method can be developed into advanced healthcare system by introducing the concept of artificial intelligence where in we can predict the right medication and treatment.

VI. ACKNOWLEDMENT

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