

The Use of NFC Technology to Record Medical Information in Order to Improve the Quality of Medical and Treatment Services

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Abstract

Although doctors are increasingly interested in electronic systems of registering medical record, but in practice such systems are used less. Mobile devices provide a new way for accessing users to data of health cares and services in a secure environment and user-selection. Mobile health cares' systems (M-health) are considered as a solution to reduce health care costs without reducing the quality of patient care. In this paper we are going to develop a common architecture for mobile health cares' services using NFC in order to facilitate providing health cares to people anywhere and anytime using the mobile devices that are connected to wireless communication technology, to be able to provide required services by a secure and available structure for patient' information in hospitals and health centers and treatment, especially intensive care units, emergency or patients needed home care. Also it can be avoided from forgery and misuse of physicians' stamp in current versions with this system by preparing electronic version using NFC technology.

Keywords: electronic health record, NFC technology

1. Introduction

Mobile devices are personal and always with and informed of the place of patient and patient can use it to help self and communicate with a health care center that this issue is considered the mobile phone more affordable than any other media to health care. Communication technologies such as Bluetooth, USB, universal communication system for telecommunications (gsm), a global packet radio service (gprs), and radio frequency identification tags (RFID) are used to transfer information between patients and health service providers which is much concern about the credibility and public confidence in the use of these technologies. Our answer is the use of NFC, a high-level technology and forward that providing reliability and security is its innovations.

NFC standards that first were developed by NFC forum were founded in 2004 by consortium of Nokia, Sony and Philips. NFC is a wireless communication standard using radio frequency wave. Devices use the 13.56 MHz frequency that can transfer data at short range. Devices must be adjacent to each other so that they can communicate with each other. Range, depending on the shape and coverage and size of the antenna is different, but usually is less than 10 cm (in some cases less than 4 cm) and connection in a small period of time (in the range of 100 to 150 milliseconds) is established.

NFC using can reduce system cost and is suitable for cases that are used RFID tag now. Mobile phones are becoming the biggest adopters of NFC technology in peer to peer mode. According to Frost and Sullivan, the number of mobile phones that have accepted NFC in 2015 is increased to 863 million that will dedicate 53% from total sales of mobile phones. NFC provides secure exchange opportunities of portable medical records, reduce fraud of health care, access to emergency medical information, adherence to treatment and monitoring fitness and health of disease activity.

In this article, the application and uses of NFC in the health sector will be provided. We have investigated in first stage in section 2 existing problems in medical in the field of registering record of patients and in section 3 technologies that are currently used for the registration and transfer of electronic patient records, in Section 4, an overview of NFC technology and transfer of information in NFC and finally, in section 5 the introduction of NFC technology as a solution for registering records of the patients in mobile phones and other detailed.

2. Existed Problems in Medical

Medical records and information have very sensitive nature, attacks such as eavesdropping or manipulation by malicious third party may lead to identity theft, inappropriate treatment and recognition or even death and therefore require high security during both sectors of transmission and storage. EHCR (Electronic Health Care Record) are health records that by computer have been stored, processed or transferred. EHCR makes it possible to the same information be used by many people who may be far from each other and from patients [11]. But this is possible only through the use of appropriate computer equipment. So the user who has no access to hardware or lack of the skills to run it may be ignored by the system. In contrast, it is possible for people who have the skills of using and investigating computer records that without leaving a sign, access to this information. Computer records can be named with the identity of users who made and define them. Although today most of mechanisms not guarantee complete security by which the computers confirm the correct identity of user, such as password control.

Authentication is a critical issue in any information system including medical-treatment system. Identity of a user should be specified to access data within a system. Patients expect that the medical data kept confidential and without their allowance access to this data is not possible. Digital communication has two potential drawbacks: first data are available while transferring and second, data before and after the transfer are readable or changeable that should be prevented the problems.

Other existing problems are limitation of resources in the treatment sector, including non-real tariff and lack of enough knowledge, lack of efficient use of resources, lack of aggregate data, duplicate data collection and staff dissatisfaction because the current tools do not reduce the workload of staff for example, if a patient transfers from a medical center to another center, all the information should be re-registered.

3. Modern Technologies Used in Medical

3.1 Internet

The advent of high-speed Internet technology is changed the way of getting medical cares of patients by accelerating diagnosis and immediate treatment. In the past few years a dramatic increase is created in the number of patients who use the web-based resources and social sites to search and share medical information [8]. Many want to share their data with their doctor on an online platform. Sharing EHR with patients provides online communication between patients and health care providers that improve the productivity, quality of care and patient satisfaction and reduce costs. Examples of the benefits of this system include improve patients' adherence to care providers and better coordination of caregivers with different regulatory processes, including the correctness of prescribed drugs. However this incredible tool is faced with a security commitment, especially when sensitive information of patient is transmitted, because this information may in access of unauthorized individuals in addition, in some circumstances access to the Internet is not possible.

3.2 Smart Card

Smart card is a small and non-manipulation computer that using it in the healthcare system causes to eliminate paper costs, ease of integration of information, facilitate the investigation to documents and monitor access to some records and health records of each insurance, avoid duplicated efforts and services for each patient in the short-term period. In addition, smart card of health realizes the electronic documents and can limit the received services according to receipt or non-receipt of premium. Also provides the possibility of definition entitled to treatment and services according to disease and individual requirements and defining and monitoring for each person and families.

Despite the benefits that was mentioned for smart cards, there are the possibility of some problems for patients in emergency situations because at the time of the patient's unconsciousness is not possible access to his record by physicians and caregivers in addition, because the data is stored in EEPROM, can be accidentally or intentionally manipulated by a stream of electric or magnetic energy. Also the used memory size per person is limited.

3.3 An Overview of RFID

RFID tags used in medical are tags in the size of a grain of rice that is implanted with a needle under the skin and provide the instant access of emergency physicians to medical records of critically ill patients. The tags can improve safety and efficacy of patient care with the help to identify patients and enabling secure access to clinical information.

However, different debates have been done over legitimate or not mounted chips under the skin, especially active

chips. Maybe many of these concerns are unnecessary but some risks cannot be ignored, risks such as body reactions, incompatibilities with tissue, migration of the implanted chip, chip failures, electrical hazards and incompatible with MRI. Also interference that may happen in two ways: When the multi-reader interference is sent from several signal devices and interference between the tags when there are a large number of tags in a small space. Most of the RFID tags are active as a result their information can be read by the readers that this will endanger confidential patient information. In addition, track these tags would cause violation of individuals privacy.

4. Take a Look at NFC

Near Field Communication or NFC is a wireless communications technology with a short-range frequency that makes possible data exchange between devices at a distance of about 10 cm (4 inches). It is a simple form of proximity card standard ISO / IEC14443 that combines a smartcard connector and a reader into a single device that is based on RFID technology that uses the induction of active magnetic field to communicate between electronic devices in close proximity. NFC provides a seamless flow for detection protocols that ensures the transmission reliability of secure data. This feature enables users to access the visually digital content, secure and contactless and electronic devices simply by a call or device connect to its proximity.

NFC operates with global access and radio frequency of band of ISM 56/13 MHz. Supported data rate is 106, 212, 424 or 848 Kbps. For every action of NFC, there are two types of relation:

Passive communication mode: The initiator device provides a carrier field and the target device responds by adjusting the existing field. In this case, the target device may provide and get its operating power from the initiator electromagnetic field, therefore, the target device creates a signal receiver that it will respond as soon as getting automatically.

Active communication mode: In this mode, both the initiator and the target devices interact with intermittent production of its field. Usually in this case both devices need a power supply.

NFC also has three operational modes: a peer-to-peer mode, and card emulation mode and the mode of writer / reader. Peer-to-peer mode allows two devices of NFC to connect directly with each other. In the case of emulator of card, a NFC device stimulates contactless smart card is able to communicate with readers of RFID. In the mode of reader / writer, NFC devices can access to contactless smart card, RFID transponders and NFC tags.

Normally, people in their daily lives use NFC in two forms:

- 1) Ticketing and Payment: contactless payment is used in transit systems in everywhere. Compared with RFID with the introduction of NFC in the current ticket systems, users can receive all provided services in smart card plus the added functionality from a user interface. It is also possible to use for adding various separate credits or bank card to an NFC mobile device, so mobile turns to a virtual wallet.
- 2) Contact for pairing / contact for sharing: Another important application is to share data via a simple and seamless transfer from one device to another by simply touching them together. In a similar case, NFC users can touch wireless network to access a focus, and by long process of searching a focus, access to it and payment to use can do simply the whole process automatically by touching a point of wireless network.

5. NFC a solution to the problem of registering patients' record

Inability to record appointments and medical records prevent the continuity of care. It can be usually seen that patients had to carry the old version, the results of laboratory tests and x-rays and other medical information that is not readily available and are often overlooked. Moreover, since health centers are under the supervision of staff, providers often visit a large number of patients in a short period of time and may be no time to consult and proper visit for patients. In order to overcome this challenge and to facilitate the detection, our tool is the use of mobile phone equipped with NFC that allows patient is identified electronically and medical records is easily accessible for doctors in each medical center that may even the patient not refer to them. We suggest creating a completely electronic system to reduce the dependence of the current systems and accelerate the overall monitoring process.

The use of mobile in healthcare system (my-health) is defined as a mode to improve health of physical, mental and social through the mobile channel. Mobile devices have unique features such as personal and being with patient and always help to provide social background. This feature causes mobile to provide health is more appropriate than any other mass media. M-health in the past few years has attracted much attention. It is not surprising that as one of several sections that mobile cause to create concept and difference in a lot of conditions, in medical also control this issue. The questions that asked doctors and patients, in most cases respondents said

the use of smart phones, iPad and other tablet devices to communicate with members of the medical staff and the patients can be very useful. Key feature that is required in a mobile application is the ability to review and update version and electronic patient record that is transferable with NFC technology.

After studying various methods and protocols in the field of NFC technology as well as earlier work in the field of NFC and other technologies in data storage in medical and other industries, using qualitative methods collect and analyze information. Finally, by providing a method and architecture, do the conclusion.

5.1 The Contents of Transferable Electronic Record Via NFC

Registered electronic record must include these cases in the patient's mobile phone: identifying information, emergency information, medical history and hospitalization, examination and reporting course of disease and recovery, allergy and immunization status (vaccination), tests results, imaging and pharmaceutical information and interactions, and occurred drug reactions, and outpatient services and clinic visit, warnings and evidence-based recommendations for specific medical conditions, shifts of visit and other reminders, financial data, genetic information, health information and follow-up actions, information of psychological, social, demographic and lifestyle, clinical indicators, such as BMI, etc., decisions and clinical reasoning, summary of clinical documents, certificates and confirmations, used medical equipment, insurance information, information necessary for future audits and information about the providers of health services to citizens.

5.2 Application of Electronic Medical Records Based on NFC

In the medical environments can use applications of NFC in two types; applications outside of the human body and those that are inside:

1) applications outside of the human body: Mobile Phone is a place to manage ERP (EHR) to launch medical devices, inquire about the medications that the patient needs, taking vital signs and the check diet and medications. So raise the speed of doing duties of the hospital staff. In addition, we can add patient's vital signs with mobile directly to a patient's electronic health records using it. Another important use about nurses is for checking the provided drugs that are shown in Electronic Health Record that in Finland is spent nearly forty million euros additional fee for this work as well as led to the same figure in the United States.

2) Applications within the human body (implants): NFC can be as a passive RFID to communicate with the implanted devices (implants) wireless as well as caused to prevent the use of internal battery and can charge batteries without surgery using properties of electromagnetic induction of passive RFID.

5.3 Architectural Providing

Based on surveys concluded that in the case of storing the patient information on the phone with him and communication based on NFC technology can solve the problems that currently faced with them. In this context, we presented the architecture for system that is depicted in Figure 5-1.

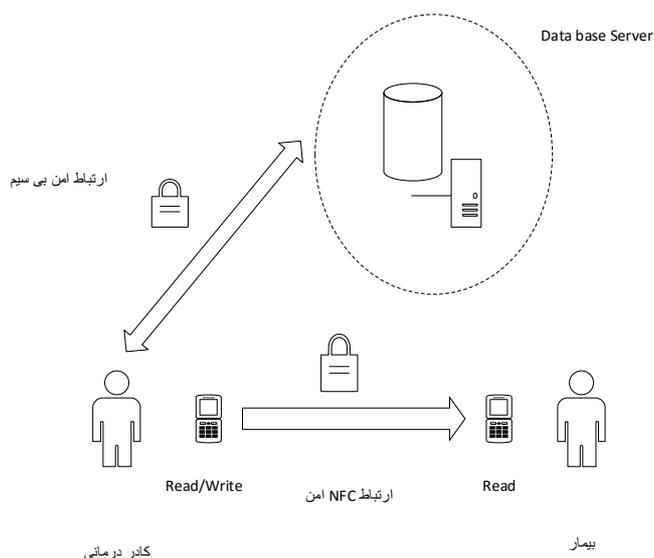


Figure 1. architecture of electronic record storage system based on NFC

As specified in the figure, communication process includes the following steps:

First, physician or medical staff with secure communication with the database server demands authentication. Next in line for his information, the patient is given access to a mobile device. By NFC secure communication, physician accesses to the patient's records and information. In the case of prescribe medication or other treatments work, conducted work on the mobile device of patient is registered on his electronic records application. As well as a backup prescription will be sent to the database to in case of any damage or missing, electronic patient records can be retrieved.

As you can see in Figure 1, the system is readable only in the patient side and in the physician side has the ability to write and read to be prevented from possible abuse by people for the benefit of insurance benefits, preparing drugs not prescribed by the doctor or other changes in the record.

6. Conclusion

NFC technology integrated with mobile phones improves the usability of the system, better access to services and capacity to interact with the text. The NFC is a solution that is required to speed up the process of medicine. In addition to the integration of new technologies in the daily activities of hospital will see the improvement of provided services, reduce errors and costs and facilitating the digitization of EHR. On the other hand communicate with implanted systems such as glucometer will be able to record the moment of vital signs. However, restrictions on the use of technology by the medical staff are a serious obstacle to the successful implementation of NFC applications in the healthcare sector. In future can ensure service quality in health and treatment sector by wide implementation of NFC technology in new devices to record patient records and reduce clinical errors.

References

- Alemdar, H., & Cem, E. (2010). Wireless sensor networks for healthcare: A survey. *Computer Networks*, 54(15), 2688-2710.
- Al-Ofeishat, H. A., & Mohammad, A. A. A. L. (2012). Near field communication (NFC). *International Journal of Computer Science and Network Security*, 12(2), 93-99.
- Beard, L., et al. (2012). The challenges in making electronic health records accessible to patients. *Journal of the American Medical Informatics Association*, 19(1), 116-120.
- Cerlinca, T. I., et al. (2010). RFID-based information system for patients and medical staff identification and tracking. INTECH Open Access Publisher.
- Devendran, Bhuvaneswari, A. T., & Arun, K. K. (2012). Mobile Healthcare System using NFC Technology. *IJCSI International Journal of Computer Science Issues*. ISSN (Online), 1694-0814.
- Diaz, J. A., et al. (2002). Patients' use of the Internet for medical information. *Journal of general internal medicine*, 17(3), 180-185.
- Dua, R. (2013). Near field communication (NFC) enabled wireless media system and player and method of operation. U.S. Patent No. 8,583,044.
- Foster, K. R., & Jan, J. (2008). Ethical implications of implantable radiofrequency identification (RFID) tags in humans. *The American Journal of Bioethics*, 8(8), 44-48.
- Iakovidis, I. (1998). Towards personal health record: Current situation, obstacles and trends in implementation of electronic healthcare record in Europe. *International journal of medical informatics*, 52(1), 105-115.
- Iglesias, R., et al. (2009). Experiencing NFC-based touch for home healthcare. *Proceedings of the 2nd International Conference on Pervasive Technologies Related to Assistive Environments*. ACM.
- Jara, A. J., Miguel, A. Z., & Antonio, F. G. S. (2009). *Secure use of NFC in medical environments*. RFID Systems and Technologies (RFID SysTech), 2009 5th European Workshop on. VDE.
- Kaplan, W. A. (2006). Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries. *Global Health*, 2(9), 1-14.
- Kerem, O. et al. (2011). *Exploring underlying values of NFC applications*. 3rd International Conference on Information and Financial Engineering IPEDR. 12.
- Kripalani, S., et al. (2007). Deficits in communication and information transfer between hospital-based and primary care physicians: Implications for patient safety and continuity of care." *Jama* 297.8 (2007): 831-841.

- Liu, C. T., et al. (2006). The impacts of smart cards on hospital information systems. An investigation of the first phase of the national health insurance smart card project in Taiwan. *International Journal of Medical Informatics*, 75(2), 173-181.
- Marcus, A., et al. (2009). *Using NFC-enabled mobile phones for public health in developing countries*. Near Field Communication, 2009. NFC'09. First International Workshop on. IEEE.
- Massoth, M., & Thomas, B. (2009). *Performance of different mobile payment service concepts compared with a NFC-based solution*. Internet and Web Applications and Services, 2009. ICIW'09. Fourth International Conference on. IEEE.
- Ridder, M., et al., (2013). *A web-based medical multimedia visualisation interface for personal health records*. Computer-Based Medical Systems (CBMS), 2013 IEEE 26th International Symposium on. IEEE.
- Riyazuddin, M. (2013). NFC: A review of the technology, applications and security. *ABI research*.
- Rost, K., & Richard, F. (1993). The introduction of the older patient's problems in the medical visit. *Journal of Aging and Health*, 5(3), 387-401.
- Smart Card Alliance (2012). *Smart Card Technology in US Healthcare: Frequently Asked Questions*. Estados Unidos
- Thangaraju, S. (2013). Near Field Communication in Medical Devices.
- Want, R. (2011). Near field communication. *IEEE Pervasive Computing*, 3, 4-7.
- Weed, L. L. (1968). Special article: Medical records that guide and teach. *New England Journal of Medicine*, 278(12), 593-600.
- Yaqub, M. U., U. A. S., & Mohamed, M. (2012). Near Field Communication, its application and implementation in KSA.
- Zhang, H., & Junlin, L. (2011). *NFC in medical applications with wireless sensors*. Electrical and Control Engineering (ICECE), 2011 International Conference on. IEEE.

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