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A Patient e-Health Care System Using Passive RFID

Swati S. Dhable, Margaret Jose *, Prachi R. Kothawade, Prachi B. Nilkanth, Abhay R.Gaidhani
Department of Computer Engineering, SIEM, Nasik, India

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Abstract

Radio Frequency Identification (RFID) technology not only offers tracking capability to locate equipment and people in real time, but also provides efficient and accurate access to medical data for doctors and other health professionals. Many researchers have introduced RFID-based solutions to enhance patient medication safety and avoid human errors during e-Health process. Although such RFID-based procedures are more efficient than traditional e-Health process, patient's information may be explored in the data transmission period and this will cause inappropriate medication use or medical errors. In this system, we would be providing a RFID card to every patient. There would be web server where all the patient information would be stored. When the patient visits the doctor for the first time his all identity details would be fetched from the database. Then the doctor would issue the patient an RFID card. Then he would examine the patient and may advice him to undergo some medical tests. The doctor would then upload all this information on the central server and he can upload the patient reports in the mobile phone. The doctor would also upload the medicine prescribed by him to the patient.

1. Introduction

Radio Frequency Identification (RFID) [1] is a state of the art technology that uses electromagnetic fields attached to a tag to identify objects. These tags are typically used for product tracking and product identification. RFID is a growing trend in the health care industry, driven by a greater emphasis on patient safety than has ever been seen before. RFID technology can help ensure that every patient is treated properly and that patients get the services they pay for. There are two common types of RFID tags, active and passive. Active tags are more expensive, because they have an internal power source and allow two way flow of information, from tag to server and back. Active tags can transmit over 100 feet. Passive tags are less expensive, but must be activated by an outside power source. They are shorter in range than active tags, and only transmit data from RFID to server.

Radio frequency identification (RFID) has been used in a number of practical applications, such as improving supply chain management, tracking household pets, accessing office buildings, and speeding up toll collection on roadways. RFID is used to automatically identify people, objects, and animals using short range radio technology to communicate digital information between a stationary location (reader) and a movable object (tag).[1]RFID technology can be used to track products in a manner similar to using bar codes for product identification, but RFID also carries additional benefits. RFID does not require line of sight to read the tag, has a longer read range than bar code reader, and tags can store more data than bar codes. Readers can simultaneously communicate with multiple tags. This feature could allow customers to breeze through grocery store checkout counters while a reader identifies all items in a shopping cart at the same time, instead of scanning each bar code individually.

A medication error is a failure in the treatment process that may harm a patient. It can be produced during different phases: prescribing, manufacturing or dispensing the formulation, administering the treatment and monitoring the therapy. Although medication errors are almost inevitable, patient safety can be improved by means of proper Information Technology (IT) systems. For instance, failure due to

Corresponding Author,
E-mail address: margaret.jose04@gmail.com

a misinterpretation of a hand-written prescription can be easily avoided with IT tools.[1] Drug and patient identification systems can automate certain processes to guarantee that the appropriate prescription is given to each patient. RFID technology is used to enhance the medication safety of inpatients. RFID is a technology for identification using radio waves. Its main components are a tag, a reader and a data system for handling the information. An RFID tag includes an antenna and a chip for computation and information storage purposes. The content of the chip can be read and written with an RFID reader. RFID readers obtain the static identifier of each tag, which may then be used as a search index in a database to retrieve all the information linked to the labeled item. The reader must be connected to the back-end database in order to access the aforementioned information.

2. Necessity

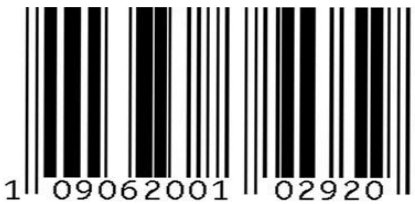
Rising healthcare spending has led to an increase in calls for ways to reduce the cost of healthcare. Amid the debate on the best approach on cut costs in the healthcare system, one of the few provisions is the need to integrate modern technology into the storage and transfer of medical records. Current attempts to establish such electronic medical records are challenged by concerns about patient privacy, issues with the incorporation of old records, and budget limitations. [2]We propose the development of personal portable healthcare record cards and a corresponding framework to simplify maintenance and transfer of patient records as an incremental step towards a nationalized electronic records system. It is a feasible and cost-effective system that applies existing technology to address inefficiencies of the current paper based medical records system; simultaneously, it also serves as a transition system to facilitate the adoption of completely electronic medical records. The majority of healthcare providers continue to use the traditional paper based records system. This system has existed for longer than most of our doctors have practiced medicine, and professionals are accustomed to it. The current system is built to maximize patient privacy issues and accountability. The need to cut down on the costs of healthcare is widely acknowledged. Despite this urgent need, past efforts to reduce the amount of spending such as managed care organizations, perspective payment systems, and payment per capita have only effected temporary or marginal change.

3. Literature Review

This section provides detail study and analysis of technologies which can be use to cater same concept and its advantages and disadvantages. This chapter also includes shortcomings of these technologies.

3.1 Barcode Technology

Barcode technology[4] works of a principle called symbology. Symbology at its basic form is what defines the barcode; it determines the mapping and interpretation of the encoded information or data. This encoding allows the scanning device to know when a digit or character starts and when it stops, similar to a binary representation. We recognize barcodes as an array of parallel lines alternating between white and black lines. Barcode technology provides a simple and inexpensive method of recording data or information in a number of applications. The symbologies of the barcode technology can be arranged or mapped in a variety of ways. A continuous symbology is marked by the characters beginning with a black line and ending with a white line or space, while discreet symbologies have characters encoded as a black line a space and then another black line. In order to read the data of barcode technology it needs to be scanned by a laser and then interpreted. The scanners, or lasers, used to read the barcodes measures the light reflected form the linear barcode technology and can distinguish between the white and black lines. Calibration of the laser and system needs to be done to ensure the proper interpretation of the code itself.



3.2 Mifare Technology (Smart Card):

MIFARE[6] is the NXP Semiconductors-owned trademark of a series of chips widely used in contactless smart cards and proximity cards. According to the producers, billions of smart card chips and many millions of reader modules have been sold. The technology is owned by NXP Semiconductors. The technology is embodied in both cards and reader. The MIFARE card is fundamentally just a memory storage device, where the memory is divided into segments and blocks with simple security mechanisms for access control. They are ASIC-based and have limited computational power. Thanks to their reliability and low cost, those cards are widely

used for electronic wallet, access control, corporate ID cards, transportation or stadium ticketing.

The MIFARE DESFire (MF3ICD40)[8] was introduced in 2002 and is based on a core similar to SmartMX, with more hardware and software security features than MIFARE Classic. It comes pre-programmed with the general purpose MIFARE DESFire operating system which offers a simple directory structure and files.The MIFARE Card was designed to provide additional key diversification, authentication, encryption and portability for advanced applications, unprecedented mobility, heightened security and enhanced performance.HID Globe's next-generation access control platform goes beyond the traditional smart card model to offer a secure, standards- based, technology-independent and flexible identity data structure based on Secure Identity Object (SIO).

3.3 RFID Technology

Radio-frequency identification (RFID) [5] is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. Utilizing radio frequency waves, an RFID tag can be applied to or incorporated into a product for the purpose of location and identification. UHF Passive RFID can be read from several meters away and beyond the line of sight of the reader. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal and can also be used for other specialized functions. The second is an antenna for receiving and transmitting the signal.

RFID technology is in increasing use in enterprise supply chain management, improving the efficiency of inventory tracking and management.
The use of RFID in the DoD supply chain has the potential to provide real benefits in inventory management, asset visibility, and interoperability in an end-to-end integrated environment. RFID encapsulates the data accuracy advantages inherent in all types of automatic identification technology (AIT). Additionally, RFID is a totally non- intrusive methodology for data capture (requires no human intervention), is non- line of sight technology, and is a technology that possesses both read and write options within the same equipment item. [10]
RFID (both active and passive) is required to:

1. Provide near-real time in-transit visibility for all classes of supplies and materiel
2. Provide "in the box" content level detail for all classes of supplies and materiel
3. Provide quality, non- intrusive identification and data collection that enables enhanced inventory management.
4. Provide enhanced item level visibility

4. System Development

This Section contains details about development of proposed system including system architecture methodologies and requirement specification

4.1 Conclusion from Literature Survey

Bar code technology [4] has been an indispensable advancement for patient safety. When used for patient and/ or specimen identification, bar codes, combined with the appropriate software, permit clinical staff to instantly identify individual patients and their medications and specimens and have significantly reduced identification and data entry error rates. [1]The RFID based technology may be comparable to the barcode identification system, where a barcode scanner reads the information from a printed barcode. One of the main differences is that RFID identification systems do not need a line of sight to read or write tags. The information of RFID tags can be rewritten and an RFID reader can read hundreds of tags per second. In addition, RFID tags have computational power, more storage capacity and are more resistant to harsh environmental conditions compared to barcodes. Security mechanisms can also be incorporated into RFID systems providing authentication, non-repudiation, integrity or privacy services.

RFID card, RFIC card and MIFARE [8] card are all proximity card (untouching). RFID card has a unique card number, and it doesn't have memory. RFID card is usually used for home and office. Both RFIC card and MIFARE card have memory and widely used nowadays. Because they are proximity card, it is not easy for them to be damaged as they don't need to be abraded. This makes them more preferable than Smart card. MIFARE card has much larger memory, so that it can be used in case that the card needs to be compatible with several systems.
The System development of E-Health System using Passive RFID [10] is explained in following Figure 2. This indicates the overall workflow of system. Whenever patient visits to the clinic if it is new patient then the RFID card is provided to the patient if not then the card is directly scanned by the Reader and information is available.

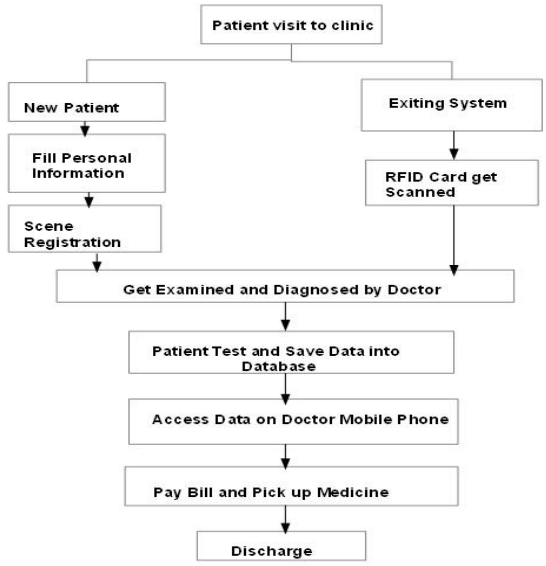


Fig: 2. System Methodology for E-health System

The doctor can access the information on mobile as well. The list is displayed on mobile of doctor, then doctor may fetch data from server for that patient. Then the data will be displayed on mobile.[2]The interfacing of this android application and web server can be done using JSON technology. This Methodology is shown in Figure 2.

5. Proposed System

Radio Frequency Identification (RFID) is a state of the art technology that uses electromagnetic fields attached to a tag to identify objects. The RFID-based procedures are more efficient than traditional e-Health process, patient's information may be explored in the data transmission period and this will cause inappropriate medication use or medical errors. In this, we propose a RFID-based e-Health system which strengthens patient's privacy as well as enhances the efficiency of out-patient clinic procedure. In Our system we would be providing a RFID card to every patient. There would be central server where all the patient information would be stored. When the patient visits the doctor for the first time his all identity details would be fetched from the database. Then the doctor would issue the patient an RFID card. Then he would examine the patient and may advice him to undergo some medical tests. The doctor would then upload all this information on the central server or he can upload the patient reports in the mobile phone . The doctor would also upload the medicine prescribed by him to the patient.

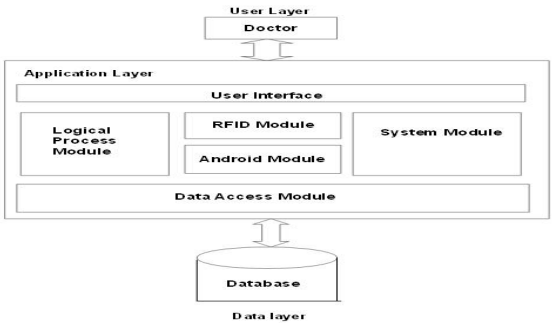


Fig: 3. System Architecture

User Layer: In this the Doctor accesses the application in mobile. The list of patient is displayed on doctor's mobile. Then the doctor accesses the information from the server.

Application Layer: The User Interface between the Database and Android Application can be done using JSON Technology. Application contains following modules:

Logical Process Module: The RFID Reader is connected to the serial port of the system. Through that the process can be carried out.

RFID Module: In this module we will be using the RFID Card and Reader. When the patient will visit the hospital for consultation the card given to him will be scanned by the doctor reader. The Reader will read the tag no from that the patient details are displayed on the computer.

Android Module: In this we will be using Android version 2.2 and will develop the Android application.

Data Access Module: The JSON Technology is used in this module .Through JSON the interfacing between the Android Mobile and web server is done. The request is sent to the server as JSON Request and web server performs the query and sends the JSON Response back to the mobile. The database will be maintained at the web server.

Sequence Diagram of E-health System:

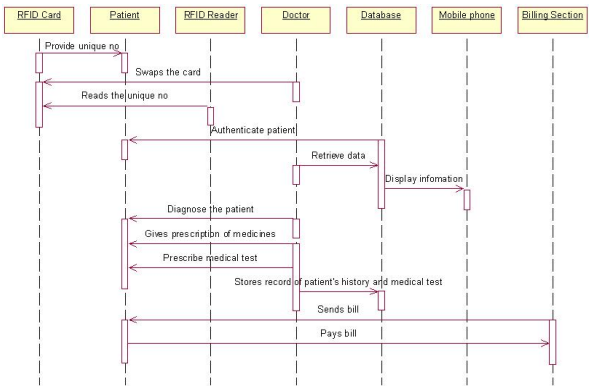


Fig: 4. Sequence Diagram of E-Health System using Passive RFID

Here, the RFID Card provides unique number to the patient, Doctor swaps the card through RFID Reader and the database authenticates the patient, the database displays the patient information in the doctor's mobile phone. The doctor diagnoses the patient gives medical prescription to him and store all the patient history and reports of patient in the database. The Billing section sends the bill to the patient and the patient pays the bill at the billing section.

6. Conclusion

RFID technology can provide new capabilities as well as an efficient method to collect, manage, disseminate, store, and analyze information It not only eliminates manual data entry but also inspires new automation solutions. It fundamentally changes how processes are managed and how businesses operate. RFID's attributes provide greater automated tracking capability than existing technologies, and thus create the opportunity to reduce abhor, improve inventory management and generate better market intelligence, leading to lower operational costs and increased revenue generation. RFID is not replacement of Bar code but it is a technology offering various features. RFID offers highly reliable data collection in harsh environments.

References

[1] Kuo-Hui Yeh1 Hualien,National Dong Hwa University Hualien, Taiwan R.O.C. Taiwan R.O.C."A Patient Privacy-aware e-Health System based on Passive RFID." 2012

[2]Charles V. Trappey National Chiao Tung University Hsinchu, TaiwanC.S. Liu RFID Technology Center Amy J.C. Trappey Taipei, Taiwan Charles V. Trappey Hsinchu, Taiwan C. S. Liu RFID Technology Center Amy J.C. Trappey "Develop Patient Monitoring and Support System Using Mobile Communication and Intelligent Reasoning" 2009

[3] R. Agrawal, C. Johnson, "Securing Electronic Health Records without Impeding the Flow of Information," International Journal of Medical Informatics, vol.76, pp.471-479, 2007

[4] C.L. Chen, C.Y. Wu, "Using RFID Yoking Proof Protocol and Barcode technolgy to Enhance Inpatient Medication Safety," Journal of Medical System, DOI: 10.1007/s10916-011-9763-5, 2011

[5] H.Y. Chien, C.C. Yang, T.C. Wu, "Two RFID-based Solutions to Enhance Inpatient Medication Safety," Journal of Medical System, vol.35, no. 3, pp.369-375, 2010.971

[6] C.C. Lo, C.H. Chen, D.Y. Cheng, H.Y. Kung, "Ubiquitous Healthcare Service System with Context-awareness Capability: Design and Implementation using MIFARE Technology" Expert Systems with Applications, 38, 4416-4436, 2011

[7] P. Najera, J. Lopez, R. Roman, "Real-time Location and Inpatient Care Systems based on Passive RFID," Journal of Network and Computer Applications, 34, 980-989, 2011

[8] K. Ohashi, S. Ota, L. Ohno-Machado, H. Tanaka, "Smart card Medical Environment at the Point of Care: Auto-Tracking Clinical Interventions at the Bed Side using RFID Technology," Computers in Biology and Medicine, 40, 545-554, 2010

[9] P. Peris-Lopez, A. Orfila, A. Mitrokotsa, J. C.A. van der Lubbe, "A Comprehensive RFID Solution to Enhance Inpatient Medication Safety,"International Journal of Medical Informatics, 80(1), 13-20,2011.

[10] A. K. Wickboldt, S. Piramuthu, "Patient Safety through RFID: Vulnerabilities in Recently Proposed Grouping Protocols," Journal of Medical System, DOI: 10.1007/s10916-010-9487-y, 2010