TRACKING CANCER PATIENTS MEDICAL HISTORY USING WIRELESS EMERGING TECHNOLOGY : NEAR FIELD COMMUNICATION

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ABSTRACT

The principal objective of this paper is to present an effective solution for storing and retrieving a cancer patient's medical history in hospitals, clinics and wherever else need be. We have used latest technologies like Near Field Communication (NFC) as a medium for communication, MySQL server for storing the database i.e. EHR (Electronic Health Record) of patients and lastly an Android application which will provide the interface for the same.

KEYWORDS

NFC, Android, API, NDEF, RFID

1. INTRODUCTION

The main aim of this paper is to present an effective solution for storing and retrieving medical history for cancer patients. History or EHR contains patient's details like his/her name, address, social and economic background, symptoms, previous medication and treatments [1]. Currently case file system is used almost everywhere. These case files create paper waste and they are also difficult to manage. We have created an Android application for the above problem. We will digitalize the hard copy system. We have created an application that will use NFC reader of the Smartphone to scan the identification number of the patient when they visit the hospital. The information would be stored in the database. Whenever the tag is scanned the history would be fetched from the database by running a PHP script on the server.

Near field communication (NFC) is a wireless protocol for short range communication. It works on radio frequency, 13.56MHz to be precise. Battery less NFC tags are available which can be used for storing data. Smartphones are equipped with NFC reader and writer, which can be used to send and receive data stored in the tags. Tags are rewritable and can store up to 4096 bytes of data. Smartphone reader and the tags use magnetic induction as carrier field. Here the smartphone provides a carrier field and the tag replies back by modulating the signal. The tag gets its power from the electromagnetic field that is generated by the smartphone reader and replies back with the data it contains.

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1.1 Smartphone automation and NFC tags

NFC enabled smartphones can exchange data with NFC Tags or stickers. The application can be programmed to trigger some event or command when a tag comes in contact with it [2]. This is the most interesting application of an NFC enabled smartphone. Android has NFC API to ease our task to create applications [2]. We have used the nTag 203 which supports NDEF (NFC Data Exchange Format) and has a maximum data capacity of 256 bytes. The tag receives electromagnetic energy from the smartphone's reader/writer. After that the data transfer takes place between tag and the smartphone.

The working of NFC tag and smartphone is shown in the following figure.

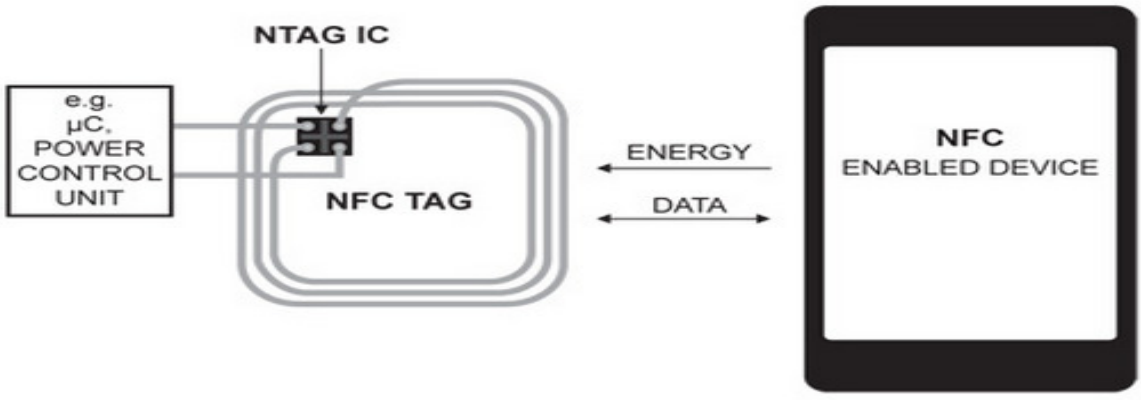

Figure 1. Tag and Smartphone communication

Presently, paper based case file system of history registration is carried out in hospitals across the world [13]. These case files are then passed on to nurses of different shifts. As humans are prone to errors, updating of records repeatedly manually may lead to blunders. Hospitals in India use the age old case file system in which every patient has a file which has details of their ailments, their diagnosis and the medicines/treatment prescribed by the doctor. The manual work in this system becomes a burden and increases possibilities of mistakes. When the patients come to a clinic/hospital for medical aid their details like personal details, contact number, symptoms, referring physician, identification number, etc. are stored manually. Afterwards, after the doctor checks the patient and prescribes the treatment [9]. That treatment is recorded in the file. This type of technique is very undesirable as it is prone to human errors. So this asks for an automatic health recording system which decreases the possibility [10]. This reduces errors by a significant rate [3]. These systems are costly and small hospitals can't afford it [14].

Both one dimension and two dimension techniques of automatic identification have been described here [9]. They [1] are:

i. Graphic based cards
ii. RFID identifiers

1.1.1. Graphic Codes

Bar codes are used wherein parallel lines are used to store identification number. These are one and two dimension codes to identify a patient. Present hospitals which use these codes are described below:

1. Bar code based verification of patients is done in Houston's "Methodist Hospital System". It has an online database named "MethOD" (medical records database). They are proposing an update to this system by having 2-D code system [4].

2. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has initiated the idea of bar codes. A patient needs to wear a bar code printed bracelet in order to verify his identity [5].

3. Addenbrooke's Hospital in Cambridge uses 2D for patients [6]. the patient there have a 2-D bracelet on their wrist where the personal details are stored.

Stickers are available that have Bar codes and tags inside them. Problem with the bar code is that they tend to fade after sometime and a need to replace them arise. This problem is not pertaining in Rfid and NFC tags.

Bar code, QR code and Rfid tag can be seen in the figure below

Figure 2. QR code, BAR code and RFID tag

1.1.2. Radio Frequency Identifiers

Radio Frequency Identification (RFID) technology can be used to identify patients automatically by giving them RIFD tags. The tags will then have a unique identification number (UIN) which is transmitted to the reader whenever required [6]. It has been implemented in some hospitals as follows:

1. Hospital Information System (HIS) integrated RFID system was implemented in Taichung Hospital in Taiwan employed system that used RFID. [7].

2. RFID chips were employed to store surgical information in the Orthopaedic Institute of Palm Beach called "SurgiChip". [8]. Whenever a patient is admitted a tag is generated for their patient and his/her surgery details are stored in the tag. Later on, at the time of surgery the details are verified by the surgeon.

2. SYSTEM DESIGN AND ARCHITECTURE

We have created an Android application for retrieving history from the database. Application would communicate with the tag whenever it is brought within a specific range. The tag would contain the patient's ID. Then this ID is scanned by the NFC reader of the smartphone. By embedding this ID in the URL, with "get" method we request the server to run a PHP script. This

PHP script will fetch all the data associated with that patient, will encode it into JSON format and then it sends it back to the smartphone. Now our application will receive the JSON object and will parse the encoded data to strings. These strings will get displayed to the Doctor.

The android application i.e. the front end will have the following functions:

1. Write to the tag
2. Read from the tag
3. Request data from server with the tag ID
4. Parse the data that is obtained from the database

The server i.e. the back end will do the following:

1. Get the tag id from the URL
2. Fetch the associated data from database by the tag ID
3. Encode the data in JSON
4. Send the JSON object back to the application

Flowchart of our design is shown in the below figure 1.

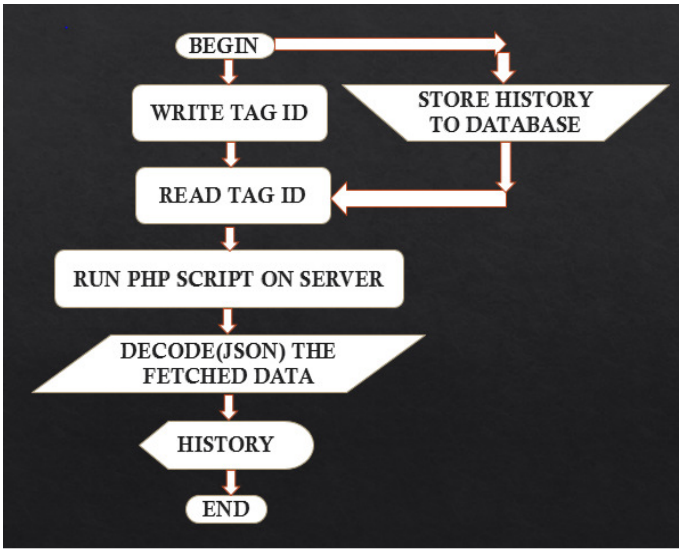

Figure 3. Flowchart of process

Our application would have the details about the cancer patient as given in table 1.

Table 1: History of cancer patient

BASIC INFORMATION	NAME
	SEX
	SOCIO ECONOMIC STATUS
	COMPLAINTS
	DURATION
	CANCER TYPE
	SITE
PRIMARY TESTS	CBC (hb,tc,pc)
	HIV/HCV
	HISTOPATHOLOGICAL/BIOPSY/FINE NEEDLE ASPIRATION CYTOLOGY
	LIVER/RENAL FUNCTION TEST
	PROTHROMBIN TEST/ACTIVATED PARTIAL THROMBOPLASTIN TIME
	CHEST X-RAY
	CT SCAN/MRI,PET-CT,SCOPY RELATED TO SITE
LOCAL EXAMINATION OF CANCER SITE	SCOPY
	EXAMINATION UNDER ANAESTHESIA
	MANUAL EXAMINATION
TREATMENT	CHEMOTHERAPY
	SURGERY
	IMMUNOTHERAPY
	RADIOTHERAPY
	HORMONAL THERAPY

We have used Eclipse and ADT for android application development. XAMPP to create a local server on my machine that could store the database and could run PHP scripts on it. NFC enabled smartphone for testing. The smartphone can be placed on the door and it would be connected to the server via wireless network. Patients will be provided with tags when they first visit the hospital and then they will get a unique identification number (UIN). If they visit again they need to only carry the tag with them. On the physical part we need to have NFC tags, Smartphones (NFC supported) and a server.

A screenshot of the application is given in figure 3. It shows the ID in the tag read by the NFC reader of smartphone. When the button is clicked a list view containing history of that respective ID is displayed.

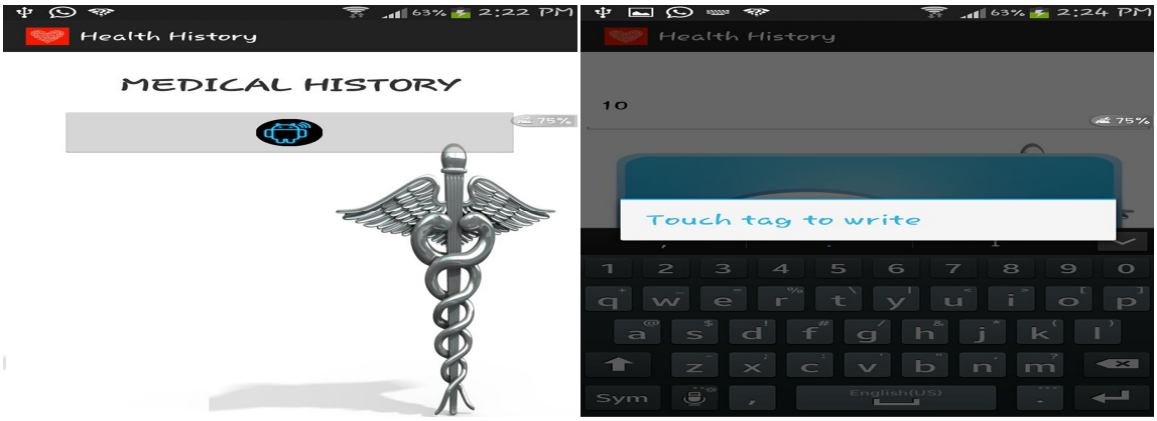

Figure 4. Request data from server with the tag ID

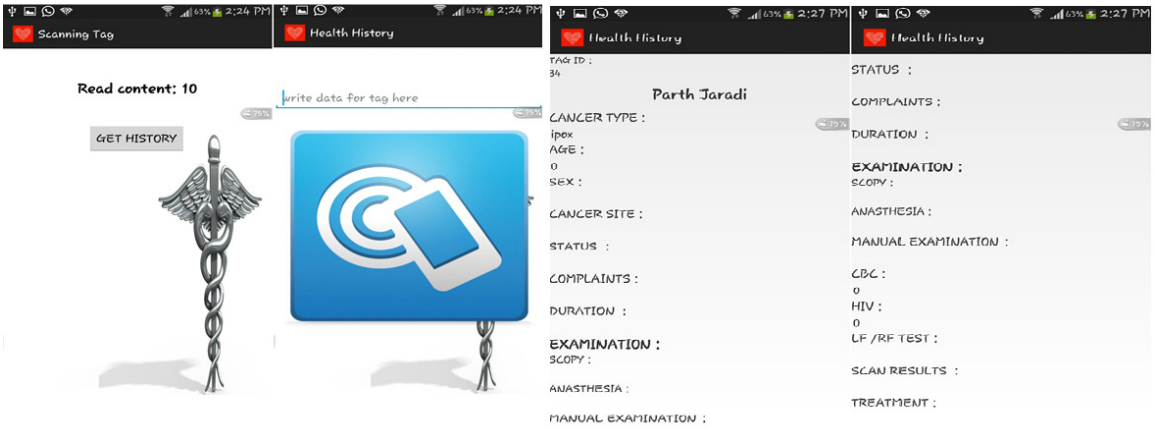

Figure 5. Screenshot from application to get history and displaying history

3. RESULT AND ANALYSIS

The main benefits of using NFC tag for patient identification system are:

1. Eliminating the paper based documentation work: As we are using NFC tags and smartphones to view medical history there is no use of paper in our design.
2. Automation: Whenever the tag is scanned and "get history" button is pressed then the application does its work and gets the patient's history.
3. Increase in efficiency: We are speeding up the process of accessing the patient's database which was previously in form of files.
4. Decrease in manual work: Currently when any doctor needs to access a patient's previous data, he needs to have their file. Moreover, another person is required for managing this process. However, that's not a problem anymore.
5. Tags can be used in any hospital: If we can somehow centralise the database across hospitals, then only one NFC tag is needed for a patient who needs to change the hospital.

6. No need to carry heavy files of results: Results can be made digitally available in the database after the tests, thereby diminishing the possibilities of tampering with them.
7. Reduce doctor's time to check patient's profile: Some people don't have legible handwriting, which becomes tough to crack sometimes. Digitalization solves that issue.
8. Backup is easy: Backing up database is easy as you have many methods for server backups.
9. Accurate and reliable: To err is human, and so we are digitalizing to reduce human errors occurring in data collection and management.
10. NFC standard covers various data exchange formats: This is to increase compatibility between different types of tags. We are using NDEF.

Radio frequency would not work only in small space as it is short range [11]. Nevertheless, it is advantageous because it does not interfere with other wireless devices [12].

4. CONCLUSION AND FUTURE WORK

In this paper, we have described the architecture that can be used for storing patient's medical history with the help of NFC tags and smartphones. This design can be used anywhere from small clinics to multi-specialty hospitals. In large hospitals, several doctors treat a patient and so this technique can overcome any human errors that can happen in updating the patient's details. Finally, we can also provide this information online so that different doctors can analyse patients from home. If there are any complexities with some patient then a doctor can consult other experts from that field. It can be said that the NFC based patient history tracking system is better than the current systems.

In future, we can integrate the update module to our application, which means that we can update the patient's data directly from our application and not from the desk of a machine. Later we can also add voice enabled data updating feature, which recognizes voice of the doctor and adds information to the server as he asks the patient about his symptoms. We can also add the patient's whole data if we encrypt the data and store it onto the tag itself [2].

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