AAYUSH – A NFC ENABLED CLOUD ARCHITECTURE FOR COMPREHENSIVE HEALTHCARE

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Abstract: In this modern era, the quantum of technological advancements in various fields particularly in the field of medicine is of mammoth proportions. This has resulted in widespread use of modern medicines and testing tools by the doctors and hospitals of today. In this process however, the concept of patient centric medication has been lost and has been replaced by a "customer" centric model. The "Family Doctor" is fast vanishing and people are now diagnosed by different doctors for different problems and the phenomenon of "Second Opinion" is now rampant. This has resulted in a need for the patient to maintain a myriad of records for each of his or her doctor which however is not accepted by a new physician who asks for a repetition of all the tests. We propose a system where a medical history is created for a particular person through electronic medical records (EMR) in a cloud. The person's reports, prescriptions, scans etc... can updated from any of the hospitals that he visits and the access to the cloud is controlled by a contactless NFC card with biometrics as a secure element that is unique to that particular person. This provides for creation of a medical history of a person that can provide as a valuable aid during medical emergencies and future consultations with any doctor working out of any hospital using the contactless card.

Introduction : This paper seeks to provide an architecture that enables patients to centralize all their medical records by clouding them and access the information using a NFC contactless card. We provide a brief introduction to these technologies.

A. Near Field Communication: Near Field Communication is a short range connectivity mechanism through wireless mode that is also standardized as ISO/IEC 18092. [2] Near Field Communication or NFC as it is shortly called , is a relatively new technology that enables communication within a short distance of 4 to a maximum of 10cm between two NFC enabled devices. The reason for this very short range is that the interfaces operate in an unregulated RF band of 13.56MHz which imposes certain limitation in the magnitude of electromagnetic emissions. This NFC technology and its standards are defined by the NFC Forum [5] which was founded by Nokia ,Sony and Phillips in 2004. The rate of data transfer is 424 Kbits/second and also since its operating distance is very small the connection is inherently secure.

Fig. 1 A NFC card reader with integrated biometrics

Fig. 2 A NFC card on a reader

B. Need for NFC: As already mentioned NFC is a very short range wireless connectivity technology and this by itself is a security

mechanism. [3] Our system uses contactless smart cards that are NFC enabled. The main reason for choosing NFC is that it provides security. The medical history and records of patients are their own personal information which shouldn't be easily accessed by a third person without the patient's consent. Also NFC readers support biometrics which provides as a secure element in the contactless transaction thus providing a 2 factor authentication. [1] Other reasons for using NFC smart cards include their durability, future portability to mobile phones and they cannot be skimmed or cloned like traditional magnetic swipe cards.

C. **Electronic Medical Records**
Electronic medical records [7], as the name suggests is nothing but digitizing the medical records, reports and other allied diagnostic data. They provide a easier way to store, manage and retrieve medical

information through special applications designed with the Medicare system in mind. It increases the usability, portability and long term data storage of medical records that is critical to take forward the development of futuristic medical information systems. Many companies such as Microsoft, Dell and HP along with corporate hospitals abroad have already developed systems that manage and store medical information efficiently and cost-effectively through EMR while developing countries such as India are still yet to adopt such systems in a large scale due to infrastructure and other limiting factors such as initial costs, dearth of computer skilled medical staff etc... Not withstanding the initial cost of implementation, EMR stands as a technology that would revolutionize the way healthcare delivery mechanisms function.

D. **Cloud Computing :** Cloud computing is a technology that provides access to computing resources be it hardware or software over the network. Today it is harnessed for providing a variety of applications and services. Our architecture uses a specific form of cloud called "Community Cloud" [4] where the resources are shared among users from a particular community who share common concerns and needs. The architecture also uses the "Software As A Service" delivery model of cloud where the cloud users do not manage the infrastructure and the platform in which the cloud is application is running. The software is installed in the cloud itself and can be accessed through clients which may be native browsers or special third party applications written specifically for the system. Most of the SaaS solutions use multi tenant architectures that enables a single application configuration to be accessed by all the end users of the system simultaneously. This provides for seamless application access to all clients through the network eliminating need for installing and running the software from the client machines reducing hardware requirements and cost reduction.

Fig. 3 An example Community Cloud with SaaS delivery
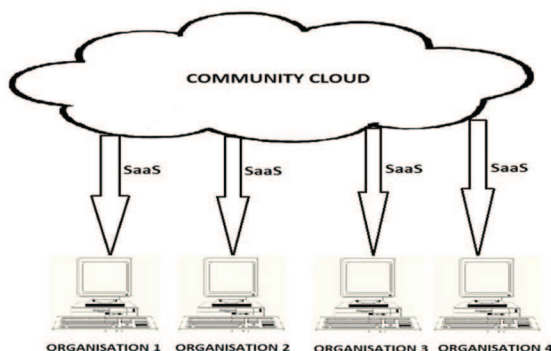
The Existing System
The present system of health care delivery particularly in developing countries like ours is still manual by large involving a lot of paper work and file maintenance. Even in corporate hospitals that are fully networked and computerized the medical records of the patient are accessible and useful only for the hospital or doctor concerned. Once a patient approaches a new hospital or doctor, the person is forced to retake all the tests and scans from scratch irrespective of how recent the previous records were. Also in case of emergencies, if the doctor requires a crucial information about the medication administered to the patient recently, he has to pore through voluminous files and reports which leads to wastage of precious time that could otherwise be utilized for saving a person's life.

The Proposed Architecture
The architecture that we propose seeks to centralize all the medical records of a patient irrespective of the hospital or consulting doctor. Each patient who is enrolled in the system is given a NFC contactless card that stores the unique ID of the person and his/her fingerprint. When the person visits a hospital implementing the system, all the medical records of the person can be accessed using the NFC contactless card from the cloud database after authenticating using fingerprint. After diagnosis is over the hospital staff or the doctor himself can upload the entire medical data about the patient to the cloud server. It is to be noted that the system allows only read and append access to the database and the previous medical records of the person cannot be modified. If in case a wrong information has been entered and saved in the cloud, a special E-Request attested by the doctor and the patient in the form of digital signatures should be provided and the data will be modified accordingly by the system regulatory authority. Thus the system would act as a source of medical information of the person that can be remotely accessed in a secure manner and also ensure that unauthorized manipulation of data is effectively

Implementation
In order to implement such an architecture as a practical system the following are the basic requirements that are necessary:-
➢ NFC Contactless Card
➢ NFC Card Reader with Fingerprint Scanner
➢ SDK for NFC tag writer application development
➢ A Community Cloud with Software-as-a-service delivery model
➢ Third Party Cloud Client for enabling NFC card authentication to allow cloud access
➢ Reliable Internet Connectivity
➢ Electronic Medical Records System
➢ Unique ID 's for doctors
➢ Trained Staff
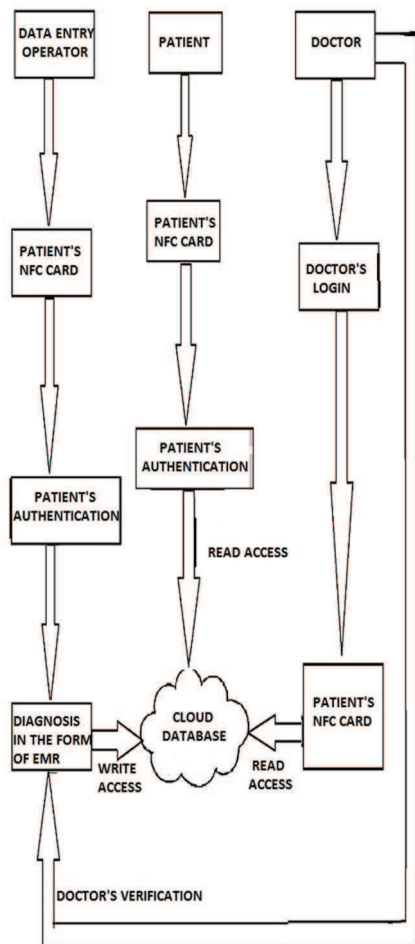➢ Central System Regulatory & Enrollment

Authority

Fig. 4 Architecture of the proposed system

When such a system is implemented, it becomes imperative to ensure that the personal health records of the patients is kept confidential and inaccessible to unauthorized people. For ensuring this, our architecture allows access to the patient's records only through the NFC card after authenticating using the fingerprint of the person. This ensures that the patient's records cannot be accessed by any other people other than the patient himself/herself permits to do so. If in a case wherein the patient is currently undergoing critical medical treatment and the fingerprint authentication cannot be done, then the doctor can view the electronic medical records through his own id that will be provided to all registered practitioners. The cloud will allow read only access to the electronic medical records in this mode after the patient's NFC card is recognized and the doctor's ID is provided.

Advantages Of The Architecture

The proposed architecture is a system that brings about a change in the current customer centric approach of healthcare delivery and propitiates a patient centric approach. On implementing this system ,the patients are not required to take along with them all their scan reports, prescriptions and other records. Thanks to electronic medical records all the details can be accessed by the consulting physician from the cloud. All the patient needs to carry is the NFC contactless card and authenticate using the fingerprint. This also means that the patient is free to visit or consult any doctor or hospital that are implementing this system and seamlessly access and update his/her medical details according to the diagnosis. Also there is an opportunity here to bring about a change in the mindset of the doctors and hospitals – which is that of forcing the patient to take new scans and all tests as a mandatory one. This practice is widely prevalent across all hospitals in India particularly hospitals that deal with life threatening ailments such as Heart Problems, Diabetes, etc... The previous diagnoses of the patient is not generally taken into account and the patient's medical profile is newly created. So when our proposed system is in action it can be agreed in principle between the implementing hospitals to accept the medical records of the patient irrespective of the hospital where the diagnosis or test has been performed. Also the system ensures that the confidential, personal details of the person is strongly protected from unauthorized access and modification. The NFC contactless card also is portable, maintainable and highly secure [8]. The NFC technology can also be used through mobile phones in the future when NFC phones grow in numbers in the market.

A **Real Time Scenario**

Consider a patient who has enrolled in this system and has previously consulted various doctors for his prolonged diabetes and heart ailments. Consider that the person has previously undergone treatment at a city in another state where all his medical records were uploaded in the form of electronic medical records in the cloud. If he happens to be suffering from a previously unseen ailment in his medical history, he would visit his local hospital. There the doctors realize the need to start medical treatment immediately. So using the NFC card , all the previous medications given to the patient can be tracked and the patient's entire medical history can be reviewed by the doctor. This helps the doctor to start the most appropriate treatment and medication without further delay due to scans and other laboratory tests. Thus the system helps in easy and timely access to data when it is needed the most and acts as a lifesaver in certain emergencies

Conclusion

The proposed architecture enables patients to access and update their medical profile and use it for

healthcare services irrespective of the hospital or the doctor they visit. The privacy of the person is also not compromised as their data cannot be accessed without their permission or knowledge. Hence the system lessens the hassles faced by patients when they visit different hospitals or doctors and creates a medical history for a person that serves as an all encompassing health record which is meant to facilitate a patient centric approach to healthcare services.

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