

IoT based Medical Information Management System

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Abstract—*Successively development of Internet of Things(IoT) technology made data passing easier through the internet. It has opened new possibilities for the medical sector for information passing. But there are many scopes yet to explore. Therefore, research on IoT based medical systems received substantial attention from the research community over the last decade. But the major problem remains transferring patient's data from one hospital to another via internet. This paper introduces a new approach based on the Internet of Things in medical environments to enhance the security and efficiency of the internal communication by implementing asymmetric cryptography for data exchange among hospitals. Here one user can transfer his/her medical data using his/her own private key. Subsequently implementing this system patients don't need to carry a hard copy of medical records in case of transferring hospital. Medical data can be obtained electronically from one hospital to another.*

Keywords—*IoT, medical record, IoT based medical.*

I. INTRODUCTION

Many countries of the world are now dealing with insufficient and expensive medical system due to huge population growth. In order to overcome the problems of the increased population, technology is considered as blessings. Utilizing the benefits of modern technology in different sectors is making the human life easy and comfortable. In the case of developing countries the medical service expense has become a primary issue. Medical organization holds huge amount of structured and unstructured data sets of medical raw data. Remote healthcare is considered as the new trend in technological development. Former costly equipment has been modified using modern technology for monitoring medical system. End-user devices like desktops, laptops, smartphones and tablets are nowadays strictly using latest networking technologies for connecting with each other, although for past two decades networking technology was universally booming. At present everything is turning towards IoT based infrastructure. Life is getting easier because everything now depends on IoT. In addition to the home, office now the agriculture and the medical sector is now becoming IoT dependent.

The main goal of this paper is to present a model to make medical system management more efficient and secure for accessing hassle free medical services. Utilizing the IoT and securing the network this paper aims to ease the medical experience of the patients by solving previous existing problems of distribution of storage and security.

II. MOTIVATION

Some pertinent devices that are ingrained with some sensors, connection of internet, software which authorize them to be receptive by gathering and swap data is identified by IoT (Internet of Things). This platform facilitates users to associate their devices and to manipulate their devices with the help of big data technology. By using IoT we can dwindle the involvement of the human being. It will also offer proper proficiency in performance and economic amenities. Now, the devices which were not interacting with internet previously; are also entered in IoT. In this case, if the device has been inserted with technology once, they can broadcast data among themselves through the internet. It means that it can be regulated from distance. IoT is used in different sectors for example; Industry, Healthcare, Retail, Government so on and day by day its dependency in these sectors are increasing. Some of the applications of IoT in health-care are cancer treatment, Smart continuous glucose distribution system, connecting inhaler, ingestible sensors, connected contact lenses etc. are most crucial. Now doctors can also confirm the patient on time health care and can also minimize the unnecessary cost of treatment. As there are lots of contributions of IoT in healthcare and it also gives good Impact in our society that was the motivation behind choosing this field so that the contribution of this paper will help people to get the best treatment easily in the near future.

III. LITERATURE REVIEW

Although clinical data models as well as inter application protocols have been standardized the lifelong health care record remains undeveloped because of competition among medical institutions and lack of proper authentication and authorization. To solve a similar problem a system prototype named ping has been developed. Ping is one kind of system developed and designed where patients can control who can have access to patient's medical electronic data. In ping a patient can register as well as maintain electronic medical records and be able to store in storage sites of his own desire. Ping actor is known as the user in the ping software. Doctor, patients are the users in this software, they are able to do a number of tasks according to the status. The system assigns various

attributes to the user once a user registers in the software. In this system communication among various internet protocols is controlled by the communication layer while the action response layer contains logic that helps to perform various processes. Records are saved into the server. A major flaw in this process is its inability of distribution of available storage. Another critical problem is the system is if it fails to operate or hacked the data in the serve will be destroyed or lost [1].

Nowadays, many hospitals require accessibility of patient information or health related clinical data to improve their performances. Those organizations can provide better services to the patients by exchanging important information from one another. This term is also known as 'health information exchange (HIE)'. By using HIE we can acquire some benefits such as improvement of the services quality, can reduce the cost of treatment etc.[2]. A physical and an electronic database were used to store the patient's information and when patients need to go to another hospital, they don't need to carry their medical reports because their information are stored in the database. In that case they don't have to do one medical test repeatedly. Therefore, it reduces the cost of healthcare. The model or framework that was used to implement the accessibility of the clinical data was developed by Tyagi et al., healthcare framework associated with Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) which is IoT based as well was implemented so that it can be offered to the patient who can choose the best service at the possible low cost and provide the health information to the organization to store safely and to ensure the privacy of their personal information [3]. Overall the security issue does not perfectly meet the requirements of this model and it needs more testing to fulfill this requirement.

Currently many hospitals apply wireless local area network (LAN) for different types of communication. It is also used for transferring medical data. Patient's health conditions can be monitored efficiently through this tracking system. The main purpose of previous studies was to construct a tracking system that was mainly based on local area network [4]. As the system can store the health information and previous medical reports of the individuals, it can deliver the patients correct medical information instantly so that the doctors and health workers can take their clinical decisions accurately and quickly. Not only medical information, wireless LAN is also using to transfer medical images.

A Personal Digital Assistant (PDA) which has got text messaging feature and individual tracking device was used to create that wireless LAN based tracking system. It has got fewer possibilities to miss any messages by using PDA and that's why the communication system will be elevated. In that study, a Mann-Whitney test and a paired T-test were used to survey and resolve the total time constituent to transmit a message and to place the equipment. But there is also some narrowness in those studies. For example, the tracking system has possibilities of having the localization

errors. The main reason for localization errors are background knowledge and unpredictability of time in wireless signals. The localization errors are responsible for minimizing the room level performance. That tracking system also used an individual tracking device that needs regular battery charging. It makes a problem because tracking devices are not available while they are under battery charging. So other equipment that is integrated with the tracking system is also unavailable. In replacement replaceable battery can be used to develop the system.

Those tracking systems provide many monumental activities and grant an instruction for the health workers to fulfill their professional responsibility more accurately and in the shortest feasible time [5]. As the system can store the health information and previous medical reports of the individuals, it can deliver the patients correct medical information instantly so that the doctors and nurses can take their clinical decisions accurately and quickly. Important figures and the images like different x-ray reports of the human organ can be sent smoothly through that system. In another paper, they implemented a wireless reporting system to improve their efficiency and that system can compare reports with the previous one [6].

To fulfill the communication purpose of nursing staff mobile or handheld devices are very efficient. But to implement wireless networks in the hospital some technologies like telecommunication technology, network and protocol are used as their communication infrastructure. They used PDA (personal digital assistant) for bedside nursing charting that was similar to another research in this field [7]. But some researchers mentioned some limitations of PDA that create problems. For example limited memory storage, small screen size, low speed processor, complexity of data entry etc. are some problems of PDA. In order to ignore these limitations some researchers advised to use tablets instead of PDA. Another problem is the wireless terminals or any other information system face some types of security issues. It is very important to ensure the security of the patient's data to increase the user acceptance of this system in the Health industry. Though it has some limitations but the tracking system is very advantageous for the health sector.

IV. SYSTEMATIC APPROACH

In previous research medical data of patients are stored in physical and electronic databases using various types of software like oracle, excel then it is uploaded into the cloud. The data is collected from various smart equipment such as scanners, MRI machine, sensors. But the diversity of devices in IoT creates heterogeneity problems because of different data formats in IoT platforms. Moreover, this approach fails to deal with data ubiquitously.

In another research different methods were used to deal with data ubiquitously. To deal with big data, the method used a cloud platform with multi-tenant data management. The architecture of data management is divided into three different layers. Tenant databases act as the lowest layer.

Data accessing control layer is the middle layer. In this layer resource control mechanism is used to manage and organize distributed medical data. Business activities, coordination of data sharing and data interoperation are done in the top layer.

While most of the research on this sector focused on collecting data from different IoT based medical devices most of them didn't mention any security measures to protect the collected data. In this paper a new model is proposed to make the IOT based medical system more efficient and secure by solving the previous existing problem in this sector. At first each medical will have a local server and the server will be divided into many folders to store data of different departments of the hospital separately. Those local servers of each hospital will be connected to another server which will act as a "Global Server". The global server will be divided into many folders. Each hospital will have access to a single folder of the global server. There each hospital can upload their medical data from their local server to the global server.

To solve the security issue asymmetric cryptography will be used. To generate asymmetric keys in this model RSA(Rivest–Shamir–Adleman) algorithm and Digital Signature algorithm (DSA) combo will be used. A public key will be assigned to each hospital and a private key will be given to all the patients using a digital signing algorithm which will be the patients' own signature. Public key and private key will be generated randomly using the algorithm and the public key of each hospital will be available in open domain. To secure the data of the patients' more encrypt-then-sign process will be maintained. So, when a patient will switch his/her hospital he/she doesn't need to carry all of their medical documents. All the documents will be uploaded into the global server from the local server of the hospital.

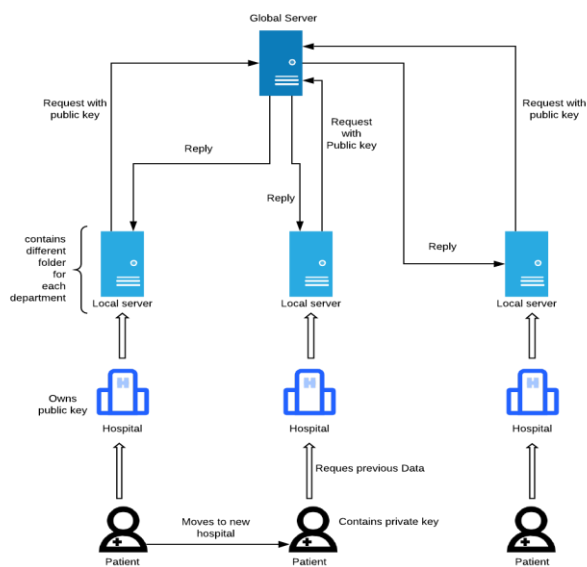


Fig. 1. IoT based medical system

Beside whenever a doctor refers patients at the new hospital will pay the old hospital for accessing the patient's medical record. Moreover, no other individuals or hospitals will have access to any of the data of the patients as long as the patient doesn't want to share the data with any other hospitals or doctor.

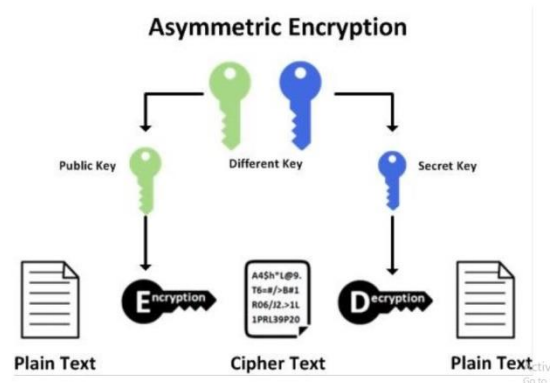


Fig. 2. Asymmetric-encryption-primitive

In order to get the patient's medical record the hospital will need their public key as well as the patient's private key. The system will act accordingly, after switching to a new hospital a patient will request the local server of the new hospital to access the medical records of him/her. Then the local server will send a request to the global server with their public key. Subsequently the global server will check the validity of the public key. If the key is valid then it will send a record accessing request to the old hospital's local server. The local server will reply with the medical data of the patient. After receiving the reply the global server will forward the answer to the local server of the new hospital. Upon receiving data the patient needs to share his private key to the doctor who has access to the local server in order to decrypt the patient's medical record. By applying this process data will be secure on the internet as well as in the database of both local and global servers.

Data storage system is associated with the cost and space of the server. To maintain this cost two types of payment methods will be followed. First if a patient decides to visit a new hospital; then to access the data of the patient by the new hospital, which is stored in the local server of the previous hospital, patient has to pay 5% of all the tests he/she has done in the old hospital.

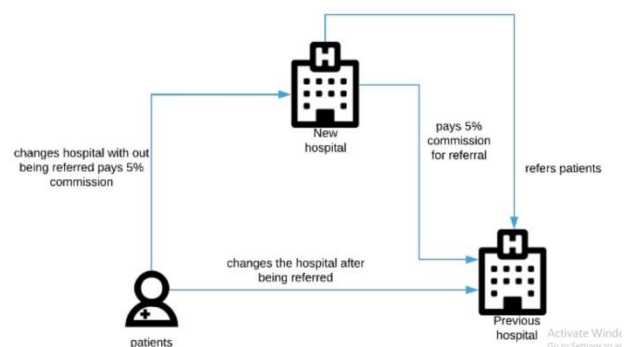


Fig. 3. Payment System

On the other hand, if doctors refer their patients to a new hospital or another doctor who is currently employed in another hospital then to access the patient's previous data the new hospital needs to pay 5% commission to the previous hospital which will be calculated based on all the tests he/she has done in the previous hospital

VI CONCLUSION

Innovative use of IOT technology in the medical sector brings benefits not only to the doctor to access a range of data but also challenges in accessing IOT data in a remote environment of real time. The data gathered by the IOT devices creates problems for IOT users who access data from the server due to security issues. This paper tried to solve the data distribution problem in the server by dividing the server into two parts. The proposed model also ensures the security of stored data. Though it has some drawbacks; for instance it will take time to encrypt and decrypt data and it is a complex model and the major issue is if the global server fails to operate the whole system will collapse. Without those limitations this model will ensure network security over the internet while making the medical sector more efficient. The future goal will be working on those limitations to overcome the problems and make the model more effective for medical sector.

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