

Security & Privacy Issues of Big Data in IOT based Healthcare System using Cloud Computing

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Abstract—The increasing popularity of IOT based technology in healthcare arena using cloud computing immensely emphasizes on using big data as a service for facilitating a proper structure for collected healthcare data and accommodating such ample number of diverse data for better diagnosis, medication and prediction of human health. The recent revolution brought in healthcare by internet of things allows us to experience the gigantic figure of data with more complexity, diversity and timeliness. Hence, the question rises in the researcher's den about the security and privacy of such enormous data. Therefore, nowadays the limelight has been shifted questioning on how much secure and private those data which are generated from IOT devices and being stored in cloud environment? In this paper we have drafted a survey on most probable security as well as privacy problems related to healthcare which needs to grab the attention for enabling the healthcare system more reliable, more effective in terms of advancement of medical science and curing more patients at a time predicting the possible diseases.

Keywords- internet of things; healthcare; big data security analytics; security and privacy issues; cloud computing

I. INTRODUCTION

The thought of internet of things (IOT) provides facility for remotely getting connected through the network architecture for anyone from anyplace at anytime. The IOT is the future revolution maker by establishing the wireless communication between technologies to make it easygoing and smarter for consumers. Benefits of IOT normally embody the association of compatible gadgets, system in addition to services that goes from far away machine-to-machine (M2M) scenarios [1].The idea of object hyperlink used by IOT allows people to dwell in a smart and highly networked world for a wide range of interaction [2].Therefore IOT has great opportunities by applying the automation in smart cities, logistics, industrial control and health care.

Medical care and health diagnosis can be a proper place to implement IOT and bring a new epoch of health care system. IOT has many applications related to healthcare like remote health monitoring, fitness programs, persistence diseases as well as elderly care and apart from that consent with treatment; remedy at home is moreover another significant latent application [3].

“Big Data” is related to the jumbled collection of huge and complicated data sets, which surpasses available computational methods or systems. In healthcare, there are various factors which can deal with big data definition. IOT based healthcare system has ample number of data starting from the patient information following to the various parameters of diseases to diagnose properly. Big data can be helpful for analysing such number of data for prediction and medication purpose towards the welfare of patients. It also helps to be aware of the people health for disease control and prognostic examination. Gartner calculate approximately 26 billion IOT related apparatus will be handy near by 2020 and the quantity of jam created through these devices will be bulky adequate to lay it in the type of big data [4].Above all, these kind of goals can be achieved only if security and privacy of

data can be ensured from any illegal hand for getting the result more accurately.

The person can produces more information with more critical values. Millions of data that could be used in advertising or in social networks, however in the IOT based healthcare system the potentials presented by these data are not employed so far [5].The existing database models related to such as relational data are not enough to accommodate such a large data that's why “big data” can be utilized as a service in the field of IOT based healthcare system under cloud computing environment. The huge data reside in the cloud which are created from a range of sources may entail bigger amount of processing power to get back information in a protected and consistent way [2].Usage of RFID cards, sensors, detectors and other intelligent apparatus can get plentiful benefits to IOT by gathering large number of data from different sources.

Implementation of big data idea into healthcare considerably augments security and privacy concerns of patient's information as they are stocked up in data centers with changing stages of safety measures. Furthermore, most of the healthcare data centers have Health Insurance Portability and Accountability Act certification which also known as HIPAA certification, but it doesn't promise patient record protection because HIPAA is mostly concentrate on making sure security policies along with procedures than on putting into practice them[6].So, on that note this paper will be concerning about following points:

- Discussion about IOT healthcare network, services and application
- How 'big data' can be used as a service in IOT based healthcare system under cloud computing environment.
- It also discusses the advantages of usage of big data architecture in IOT based healthcare system.

- Finally, security as well as privacy issues of ‘big data’ that mostly faced in healthcare system based on IOT.

In the rest of the paper it describes related work correspond to the various existing or proposed framework related to IOT based healthcare in cloud computing and architecture of implementing big data in IOT based healthcare is also discussed. Security and privacy related issues faced by big data in healthcare system are also included. Finally, conclusions and future work are provided at the end of the paper.

II. COMMUNICATION IN IOT BASED HEALTHCARE SYSTEM

Networking is the pivotal element of healthcare system based on IOT. It enables the way in to the IOT majors; make easy the transmission along with reception of healthcare diagnosed data with the benefit of healthcare communication. In this section we will discuss about the how the factors in IOT based healthcare system interact with each other through inbuilt network architecture with a conceptual diagram [3].

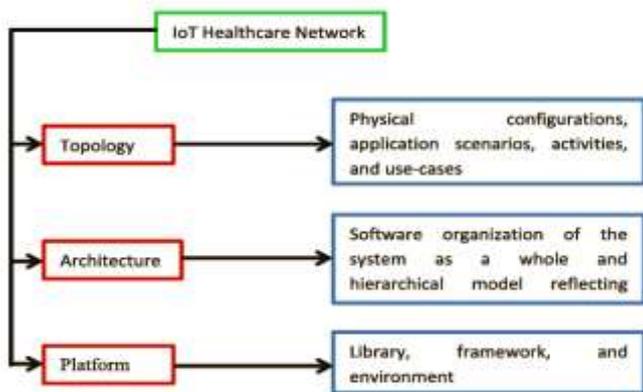


Figure 1. IOT-based solution for healthcare[3]

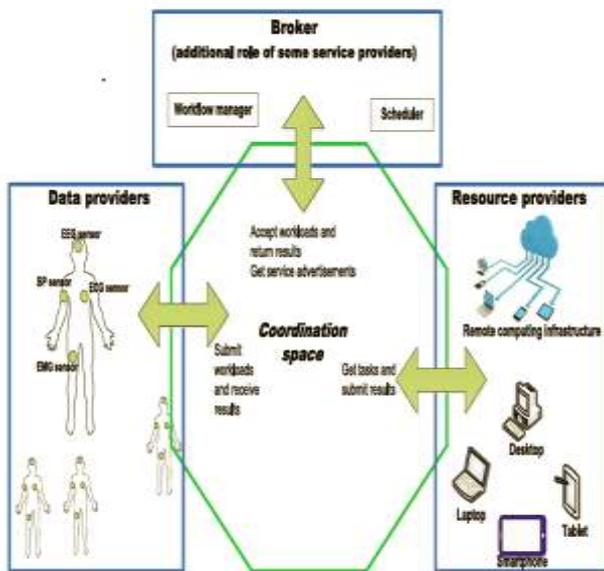


Figure 1. IOT-based solution for healthcare[3]

In Figure 1 the networking factors for a healthcare system such as topology, architecture and platform is mentioned with the functionality of each section. Again in Figure 2 portrays how a non homogeneous computing grid brings together vast amount of very important indications and sensor generated data like blood pressure, blood sugar level, body temperature, ECG and oxygen saturation shapes a classic IOT health Network for transformation of electronic device’s static storage into hybrid computing grid.

IOT healthcare has various services including the ambient aided breathing, undesirable medicine reaction, community healthcare, children health information, wearable device contact, semantic medical access, embedded context prediction etc and also has several application such as glucose level sensing, electrocardiogram monitoring, blood pressure monitoring, body temperature monitoring with many more[3].

III. IOT BASED HEALTHCARE FRAMEWORK IN CLOUD COMPUTING

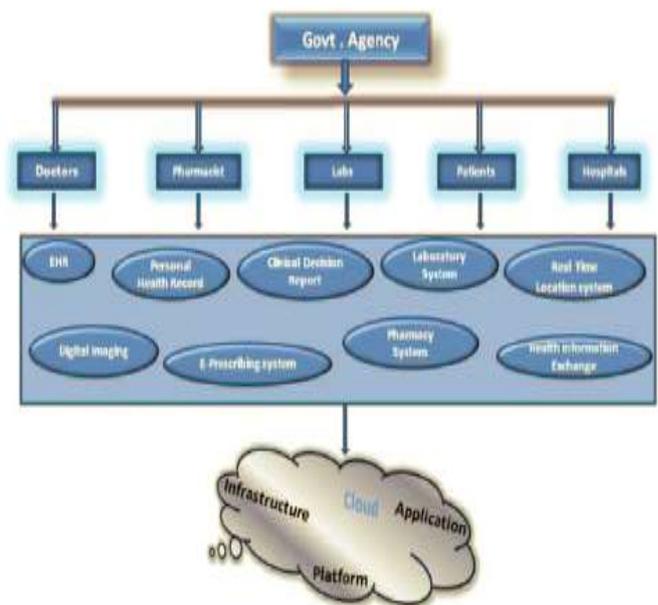


Figure 2. cloud-IoT based framework[2]

Nowadays patients are very much educated about their illness and efficiently activist for their personal healthcare which progressively more demands right to use to the most up-to-date technologies. They desire to have the optimum care at the finest rate and are open to inspect their alternatives. Therefore, the increasing demand of provisioning personal patient record is needed. Several organizations are coming up with this idea providing the secure health information remotely accessed by user using the cloud computing fundamentals. Based on that concept in [2] an extensive cloud - IoT healthcare system is proposed (as shown in figure 3) to allow dejected patients over their curing procedure. It also established the network for sharing and collaboration of data and services between the health actors. The proposed cloud-IoT base incorporated way out will contains a variety of applications akin to e-prescribing system, electronic health

records, personal health records, clinical decision system; pharmacy system etc [2]. The advantage of this framework is it allows a wide series of healthcare application to diverse stack holder at dissimilar levels. The information can be remotely accessed by any health actors at any place for improved diagnosis. It gives the liberty to the patients to assess and monitor their health themselves. Besides that the cloud service provider puts forward platform as service (PaaS) as well as Infrastructure as a service (IaaS) to host cloud-IoT healthcare application [2].

IV. BIG DATA INTO IOT BASED HEALTHCARE AND ITS FAVORS

Because of the high expectancy for application and technical improvements that have been arise in current years, it is reasonable to presume that the processing of information have been grown but on top of that its more thoughtful to find a new form of storage.

Lots of vital data are vanished on a daily basis owing to traditional storage which doesn't allow acclimatizing the health service requirements of patients or diseases. In view of the fact that these days there are no way to store as well as supervise large amount information, though the technology required exists. The resources of IOT based big data in healthcare shown in table I as follow [7]:

TABLE I. RESOURCES OF IOT BASED BIG DATA HEALTHCARE

Type Of Data	Resource of Data
Machine Generated Data	sensors, smart meters ,wearable devices
Biometric Data	genetics, , heart retainer prints, blood pressure, signature, rental scan ,pulse, x-ray
Human Generated Data	case notes, laboratory results, hospital admission records, discharge summaries and electronic mails, electronic health record data
Transactional Data	billing and healthcare claims
Behavioural Data	social interactions through websites and/or social media sites like face book, twitter
Epidemiological Data	disease registries , health surveys ,statistical data
Publication Data	clinical research and medical reference materials

And the benefits of big data in the field of healthcare are:

- It enables a care system with proper evidence and analysis
- As big data helps to survey and prediction services ,it can reduce the cost of healthcare
- It ensures the Patient participation in the curing process by analysing the causes of diseases.
- By public health surveillance it improves the knowledge of health curing and diseases.

- Big data can effortlessly recognize prototypes and abnormality that point towards the existence of safety threats and fraud in healthcare.
- Big data helps to enhance the communication between healthcare provider and patients effectively.
- Indirectly it reduces the mortality rate as it provides the information for analysing mortality causes.

V. QUALITIES OF BIG DATA IN HEALTHCARE

Big data in healthcare has been portrayed by various authors as. 3V's [8][9][10].these characterization can be defined in three terms such as volume, variety and velocity, but author in [7] characterized it in 5V's because of the tendency of change in healthcare data. Table II depicts characteristics of big data with reference to healthcare sector and figure 4 shows various resources of big data.

TABLE II. CHARACTERISTICS OF BIG DATA:THE 5 V'S

Characteristics	Meaning
volume	This refers to a large amount of data generated by various stakeholders in the healthcare system
velocity	This refers to the speed at which health data are created, stored, analyzed visualized and shared amongst healthcare providers
variability	This refers to changes in data rate, data format, data structure and data semantics
variety	This refers to the diverse sources of health data
veracity	This refers to the quality of health data produced

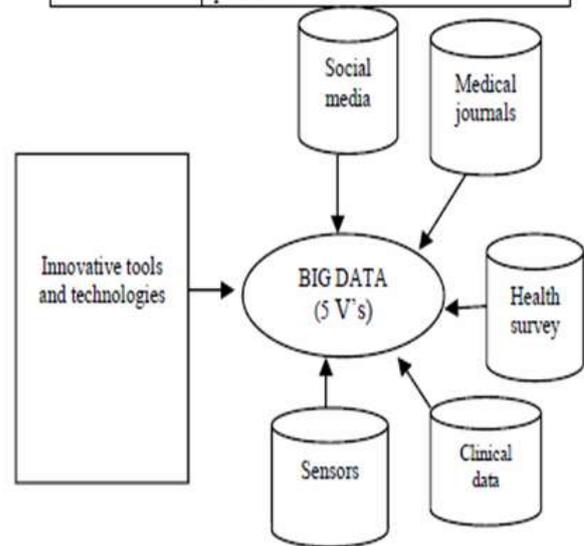


Figure 3. The idea of big data[7]

VI. BIG DATA AND CLOUD COMPUTING

Big data and cloud computing are most frequently used. Moreover, a number of novel cloud-based technologies have to be taken on because dealing with big data for concurrent processing is difficult.[11].Among different services provided by cloud, PaaS (Platform as a Service) is a service level where big data DBMS are implemented. Scalability, fault tolerance

and availability are the features required for storing and processing big volume data.

Cloud computing provides such kind of features through virtualization. As a result, big data and cloud computing are two well-suited concepts. [11].

VII. BIG DATA AS A SERVICE IN HEALTHCARE CLOUD

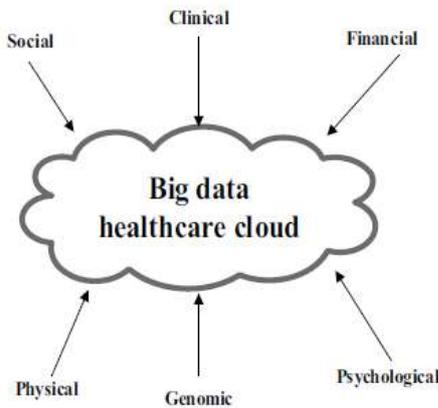


Figure 4. Big data health cloud[6]

In healthcare cloud there is a need of implementing a powerful data analysis tool so that the data capacity can stretch up in size. This will provide the ability to analyse patient present and future health condition by researching hundreds of different health issue parameters and diagnosed results. Various companies like Amazon, Google, Microsoft and IBM provides different ways for customers to devour big data as a service in cloud environment[11]. There are several ways that are mentioned as big data analytics tools. Hence, here in this section, let's go through few of technologies, tools, platforms as well as applications for analysing big data in healthcare system. Classical illustrations of big data analytics contain Google Big Query which uses Google's cloud infrastructure to query and store large dataset, Map Reduce that permits an enormous quantity of data to be processed in bulky clusters, Jaql that is a handy and declarative query language intended to practice huge amount of data sets, Hadoop is an open source software framework with the intention of processes great amount of data across extremely parallel cluster of servers [7].

VIII. SECURITY AND PRIVACY CONCERNS OF BIG DATA RELATED TO HEALTHCARE

Now-a-days Cloud computing and big data security and privacy becomes most popular research topics. This dilemma turns out to be an issue to business firms when taking into account uploading data on the cloud. Answers to the questions like where is the data, to whom actually data belongs, who has right to use it and what type of authorizations they have are tough to explain [11].

On the other hand, using big data in healthcare system increases the concern of its security and

privacy. In IOT based healthcare the data of the patient is remotely getting stored in the cloud's big data infrastructure. So, it is mandatory to ensure the privacy of the data stored in cloud. Therefore, big data governance is essential proceeding to revealing data to analytics.

A. Data governance

Data governance approach is used to address the dilemmas like expansion control of big data, and how to make sure that precious data is only stored, as large amount of data are useful if they have no value. It is a common idiom that concerned to associations with gigantic datasets, which classify rules to preserve expensive data along with how to handle data accesses during its life cycle. It is a matter to tackle cautiously. If governance strategies are not imposed, then they are not obeyed properly. Though, there are restrictions for how much value data governance is able to carry, as far as a definite end stricter data governance can include counterproductive effects [11].

B. Heterogeneity

One of the big data systems' characteristics is the capability of dealing with diverse data imminent at dissimilar velocities. Storing different types of data may be helpful to science along with business. Handling ample mixture of data and unlike speed rates is a rigid job that big data systems have to hold. In healthcare the variety of data coming from various sources with grand velocity should administered powerfully as well.

C. Real time security analytics

Analyzing the security hazards as well as forecasting risk sources immediately is of extreme need in the rapidly increasing healthcare industry. Starting with DDoS (Distributed Denial of Service) until stealthy malware, healthcare is experiencing the deluge of sophisticated attacks. For example, "Cognitive bias which is a pattern of deviation in judgment, whereby influences about other people and situations may be drawn in an illogical manner" [12]. Specially in IOT scenarios of healthcare, applying security in resource controlled network architecture has been confront and will carry on to grow up more multifaceted with the increasing growth of IOT devices.

D. Disaster Recovery

Whenever the healthcare system meets any security failure there should the immediate recovery efforts be taken to reduce the loss during adverse situation. Disaster recovery is the concept comes with the issue of recover loss as much as possible. Effectively organizing big data DBMSs in the cloud and making sure that for all time it is available fault-tolerantly may most probably rely on disaster recovery techniques.

E. Analytics for privacy preservation:

Incurion of patient's privacy is a rising alarm in the field of big data analytics. Moreover, privacy preserving encryption methods that permit operational prediction algorithms on encrypted data. Securing the personality of a patient is crucial for propelling healthcare analytics. As the industry influences on IOT devices to send out very important data to healthcare clouds, it must be required to have processing and analyzing data in a temporary decentralized approach.

IX. CONCLUSION

As IOT based healthcare system remotely gather a large number of data which is needed to be stored in the cloud infrastructure, big data is the optimum solution for storing such a big amount of data with proper structures and relations. Apart from storing, the security issues generated by using big data as a service in cloud needs to be looked after for the better outcome of the architecture. Therefore, the issues of security and privacy have been discussed so that in future these points can be considered to reduce the failure of data in healthcare system.

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