Integrating Mobile Cloud Computing with Big Data to Enhance Health Care Analytics

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Abstract:
Mobile devices are playing a vital role in our daily life and their usage is increasing at a very high rate. These devices have an indispensable part for all genders, in business, education, health and many more. Due to high rate of mobile devices usage, a user also needs extra memory for saving and retrieving data. When mobile devicesconnect with cloud for exchanging data, it is called Mobile Cloud Computing (MCC). Health Care applications have been developed using MCC architecture. However, these applications have certain limitations regarding large-scale data analysis. A number of factors affect the health like physiological, psychological, epidemiological, environmental, geographical and genetical etc. Health Care Analytics requires the integration of data from these heterogeneous resources. In this paper, a novel architecture is proposed for enhancing Health Care Analytics. The proposed model combines the advantages of Big Data Tools and MCC for collection, storage, analysis and visualization of Health Care Data.
Keywords:
Mobile Cloud Computing, Big Data, Hadoop, Map Reduce, Health Care.

1. Introduction

Large amount of data for different purposes has been generated historically in health care industry. This data is physically stored in printed form. But now a day this data is stored digitally due to the huge amount.

Different disease surveillance and population health management systems can be supported by big data in the field of medical and healthcare functions, to improve the quality and reduce the cost of data processing and storage [1].

It is the need of time that data should be managed because in contrast of the previous decades, currently the data generated is higher in velocity and variety. To improve the healthcare services and creation of new business models that are effective, the healthcare entities are trying to break the data for its better management. A series of sequential changes is required for management, better financial performance and competitive advantages with the help of business redesign [2][3], the integration of functionalities and transformation of IT capabilities. This management is done with the concept of IT enabled transformation [4].

MCC is the combination of two things that are cloud and mobile with wireless networks. It provides the resources of computations for mobile users. Different devices are used to store the data that are outside of the mobile devices. It is the technique of virtualization and comprises of different groups of distributed computers instead of local servers. MCC technology is used for the transmission between humans or between the devices or between the humans and devices. Without changing the location, the users of MCC can communicate with each other. Due to wireless connections, the organizations can establish their offices in any part of the world [5] [6].

Digital data is increasing enormously everyday and its getting hard for our existing data storage devices and techniques to manage such mass of data. Also, data is being received in different formats and saving it at a single device is nearly impossible. Moreover the data received is not valuable as a whole. Retrieval of data efficiently and in actual form is another challenge for existing systems. To overcome these problems, on single location, we use big data tools for its management. Although the big data concept is not new but the changes in big data are occurring constantly. The definition of big data is specifically characterized into different elements like size, speed and complexity, requires learning and finds new hardware along with software for successful storage of data.

In healthcare, the data can be gathered in both forms structured or unstructured. It is the requirement that we must store this data for the observations and predictions, so that the doctor must know about the disease and not only can find its remedies but also suggest precautions. Therefore to know or guess the disease we must use this data. For this purpose, it is the need to keep the integrated model of big data and healthcare.

Systems and poor management are hampering for the transformation of IT values to business values. As health issues are of primary concerns and there are many other causes that impact the health for example weather and news. For utilization of resources, performance and quality experience of healthcare there is urgent requirement for healthcare to look around for an effective IT based artifact.

For integration and retrieval of data different tools such as MongoDB, MarkLogic and Apache Cassandra etc. can be used. Apache HBase and NoSQL can be used to store the data. Hadoop/ MapReduce provides a platform for the creation of repository and capable of processing the huge volume, variety and velocity for healthcare. For future market needs and trends, the healthcare organizations need these functions that also facilitate information analysis capabilities [7].

There are many factors that affect our health positively as well as negatively. For example, weather changes can affect the health of people. Different kind of news can have psychological effects, which in turn may affect the health like it may result in changes in blood pressure. Among other factors, genetics plays a key role in diseases and defense against diseases. Genetic information is also helpful in deciding drugs for a patient. So, for effective Health Care Analytics, integration of heterogeneous data sources on a large scale is required.

In this paper, a novel architecture is proposed for large scale Health Care Analytics. In the proposed model, MCC and Big Data Platform are combined for real-time collection of data, efficient storage of huge and growing data, multipurpose analytics and useful visualization of results of analytics. This model can facilitate the patients, doctors and researchers for fighting against diseases.

The rest of the paper is organized as follows: in section 2, related work is presented. In section 3, proposed model is presented and explained. Finally, the paper is concluded in section 4.

2. Related Work

The volatile growth of the mobile application and promising of cloud computing concepts, mobile cloud computing has potential technology for mobile services and overcome the obstacles related to the performance in mobile service environment and with the help of MCC and wireless body area network can significantly improve for enormous deployment of insidious health care applications [8].

Growing field of big data analytics has started to play essential part in the growing field of healthcare and it also offered us different tool to evaluate, control, gather and incorporate the large volume of structured, semi-structured and un-structured data produced by current healthcare system. There are still upcoming issues in the area of medical like signal; image and genomics based analytics [9].

Tele consultation shows that the computing technology can read patients off-site cardiologist (ECG, ECHO) and can get appropriate descriptions via smart cell phones before going to hospital, in hospital and after visiting the hospital so in case of any emergency we can handle patient and also avoid to hospitalize the patient again. The combination of both cloud computing and mobile computing is to provide better storage area, recovery and maintenance of all medical record for tele cardiology. In future, the collection of this worldwide data and images will become pool of data (big data) and can be used to build-up an e-consultation system for the patient to provide them online suitable treatment through real time tele-consultations system [10,11].

Now healthcare industry has to get more understanding of strategic implication of big data to overcome the lacking and survey the architecture and functionalities of big data to analyze the increasing volume of unstructured, structured and semi-structured data coming from multimedia, social media, internet of things (IOT) and healthcare. Model to response the patient in more efficient way and other approaches to make big data analytics more efficient. Internet of things (IOT) is the promising field, which can hold multiple internet devices and share their data on a large scale. This technology of IOT can provide efficient healthcare monitoring of patient but the major constraints in IOT are the energy as many of IOT devices are battery driven [12].

Cloud computing is playing a vital role in the field of big data analytics accessing data from Internet. Big data analysis can be used in patient diseases monitoring during hajj and previously an approach was used called Hajj Health Control (HHC). It was a disease prevention system during hajj period. In order to make this system more efficient and economical it was connected with public cloud as with the combination of big data and cloud computing it provides us with extra storage and more efficient processing of data in a reasonable price [13].

Now a day's deep learning is a well known research area in machine learning and pattern recognition. Deep learning has in general accomplishment of application in healthcare, speech recognition and natural language processing. Big data analytics are performing in different sectors and trying to analyze and interlinked different types of data and information due to this volume of data is

increasing day by day and for this deep learning is performing a vital role in predictive analytics. By using deep learning concept in big data analytics in healthcare provide accurate diseases diagnosis [14].

3. Proposed Model for Health Care Analytics

Health Care Analytics is an emerging area that relates many domains like diseases, patients, hospitals, drugs, environment, genomics, psychology and geography etc. environment includes weather, living conditions and many surrounding factors like news and other events including earthquakes, floods, storms, blasts etc. Patients data is continuously generated like blood pressure, pulse and sugar levels. Different scans are also created like ECG, MRI, Ultrasound etc. different drugs have different affinity for different group of people. So, Health Care Analytics involves integration of heterogeneous data sources at a much larger scale.

To cater the needs of Health Care Analytics, an architecture is proposed as shown in Figure 1. It consists of 5 layers:

- Data Layer
- Data Aggregation Layer
- Analytics Layer
- Information Exploration Layer
- Results Visualization Layer

3.1 Data Layer

In this layer data will be collected from different internal and external sources like hospitals, remote patients, digital laboratory, research centers, drug laboratories, weather services and news services etc. This data is sometimes structured, semi-structured or unstructured. Structured data includes arrays, files, tables, trees and many others. Semi-structured data contains tags and it does not have formal structure of data models like relational database. Unstructured data is referred to information that does not have any pre-defined data model; typically it contains text, dates, numbers, and facts. Incoming data is then stored in relevant database according to data format.

Different kind of operations on data like recall, analyze, store can be implemented in big data. In structured and semi structured the data can be gathered through different device readings and with the help of paper records, which already exist. The main problem that occurred is unstructured data because the data may be collected from offices, notes of doctors and nurses that are hand written or other images of different diseases.

Currently structured and unstructured data cascade in healthcare domain from different resources [1].

For useful information the data that is captured and stored is manipulated in computers is very small. To combine and convert different types of data that include transferring from structured to unstructured, more reliable and efficient ways are required for healthcare applications [1].

3.2 Data Aggregation Layer

This layer is responsible for handling data from the various data sources. In this layer, 3 steps will intelligently digest data; these are data acquisition, transformation, and storage. Data acquisition will take data from different means depending on size and its format due to which it's considered a hard step. With other obstacles we have another important factor that is budget, because the data is raw and coming in variety and vast quantity so we need to provide huge data warehouse for saving. In transformation, the data will be moved, cleaned, split, translated, merged and sorted for further processing. Finally, the data is loaded into the target databases such as Hadoop distributed file systems (HDFS) or in a Hadoop cloud for further processing and analysis. With the help of different policies, rules and access controls, data can be stored and managed in batch or real time.

3.3 Analytics Layer

In this layer, data is processed for analysis. This layer is further divided into 3 parts. These are Hadoop Map/Reduce, stream computing, and database analytics. The most commonly used programming model for big data analytics is Map Reduce. It processes the large data in batches. It also helps in analysis of structured and unstructured data in parallel. By the support of stream computing, real time or near real time processing can be used for high performance of data. For parallel processing, scalability and secure environment we use this component. The database does not provide real time reports but rely on static prediction. For defensive health care practice this component can be used in health related organizations.

Open source distributed platform Hadoop (Apache platform) is most significant platform of data analytics, it was developed for the aggregation of web search engines. Extremely large amount of data can be easily processed through Hadoop. To solve and manage the data it is scattered on different servers for the solution and finally this data is aggregated for the final result. These are performed with the help of different tools of organizer and analytics [1].

The data, which was difficult to maintain, is now with the help of Hadoop tool can be easily analyzed and managed. Both structure and unstructured data in large amount and variety can be processed with the support of Hadoop. Although Hadoop has property of dealing large amount of data but the installation and configuration of the Hadoop is very difficult and its hard to get an expert who can easily use it [1].

3.4 Information Exploration Layer

In the organization with the help of analytical platform different types of output such as visual reporting, monitoring real time information and meaningful insights can be derived. A critical feature of the big data is that, reporting allows visual of data in such a way that user can use it easily for daily operations and managers make better decisions. Monitoring real time information from alerts and notifications, steer the real-time data and KPIs (key performance indicators) is very important output for health care. With the help of different sources

smartphone's and personal medical devices this information can be analyzed and forwarded to concerned persons to monitor the health of patient and events due to accidents can be prevented. The analytics layer also provides an exceptional support, which is based on EHRs, individual patient's habits, medical histories and patterns of care.

3.5 Applications of Proposed Model

There are some common daily life diseases that are present almost in every individual of age more than 35 like BP (Blood Pressure) and Diabetes. Whenever an abnormal news or event occurs, the level of these diseases changes abnormally due to psychological effect. The patients don't feel a small rise or fall and they react normally. They only behave in an abnormal way when the levels cross the normal limits. In this case, either the patient will get faint or some time even loses his voice, which are very dangerous and can't be
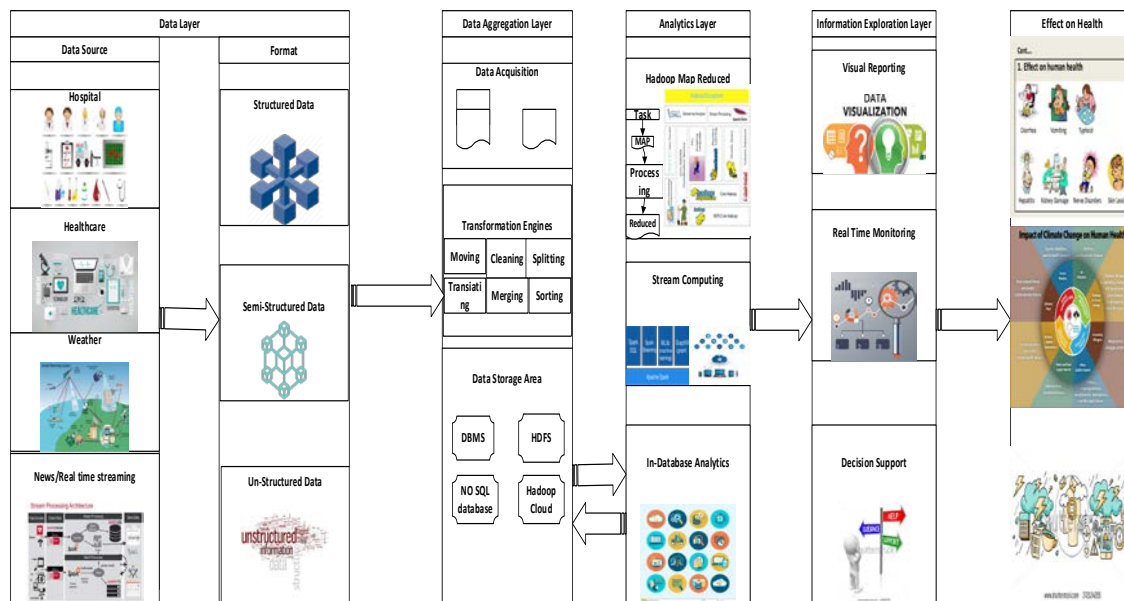

Fig. 1 Integrated Model for Health Care Analytics

cured all time. The proposed system can keep on observing patients and if any minor change occurs in their body, patients will be informed and they will be able to control their diseases even at their home.

This system will also check the locality of patient and if many patients come at a same time, the doctors will check other factors simultaneously e.g. weather, news etc. Secondly, by using the proposed system doctors can find how climate can affect the health, e.g. staying in same weather for long time can affect person's health. Usually

medicines are prescribed if a person gets sick but if there are more persons getting sick with same disease at same time and same locality then it's time for worrying because the disease must be due to some viral or bacterial attack. There are some certain seasonal diseases that attack even after taking maximum precautions; these diseases may affect many people. With the help of the proposed system, doctors can minimize the impact of diseases, but can't stop it completely. The doctor can instruct the pharmaceuticals companies to keep the best medicine in exact quantity, it will help to overcome the problem of

shortage and due to exact figure the medicine companies will not be over burdened.

The proposed system can be used at national level by health ministry and other organizations for policy and decision-making.

4. Conclusion and Future Work

Cloud Computing is playing a key role in the field of computer science due to which it is connected to many other devices for use. When cloud computing is connected with mobile device, it is called mobile cloud computing. We are using mobile cloud computing for many purposes, one of them is health care. Many factors affect the health like physiological, psychological, behavioral, epidemiological, environmental, geographical and genetically etc. In the past, only patient condition and history was used to analyze the diseases. However, today's health analytics involve much more data like genome, drugs, social media, search engines, news, weather and much more. Traditional computing models like Mobile Cloud Computing fail to deal with the volume and velocity of data related to health. So, integration of data from heterogeneous sources is required for efficient Health Care Analytics. In this paper, a novel architecture was proposed for enhancing Health Care Analytics. The proposed model combined the advantages of Big Data Tools and MCC for collection, storage, analysis and visualization of Health Care Data. This model will be equally useful for patients, doctors and researchers in controlling the diseases.

In future, we want to conduct empirical studies using this model.

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