Effectively using big data and internet of medical things based approach for operating the health care system

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Abstract

France effectively provides services in healthcare quality for patients in preventive, diagnostic and treatment. French citizens spend about 21% on healthcare. Canada, Sweden, US, UK, Norway, and Spain also spend a lot of money on health care system. According to WHO (World Health Organization) health care system is totality of "all the activities" which promote, restore, or maintain health. This paper presents how the Big Data, "Internet of Things" and "Internet of Medical things" improve efficiency, accuracy, working and reliability of health System. The term Big Data is referred to large amount of "structured" and "unstructured data". Health care industry produces huge amount of data every day. Data collection, organization, analysis, and its applications have become easier using Big Data Techniques. Big Data can play pivotal role in health care, Chemistry, Biochemistry, Medicine and to integrate other organs of health care system. Health care systems must reformulate and handle using techniques of "Big Data", IOT, IOMT and Computer systems. Magnitude of data involved is tremendously high and huge. The main purpose of this paper is to highlight these factors and challenges, which create hurdles in implementation of Big Data. Application of Artificial Intelligence, Knowledge based Systems and expert System with new data mining techniques. The applications of Big Data, IOT and IOMT certainly enhance standards of working of health care systems. Good health requires a person to have proper nutrition, regular exercise, stress free life, good sleep and keeping away from substances like alcohol or chemicals.

Keywords: Big Data, Health Practitioners, Health Care, Electronic Health Record

1. Introduction

The disciplines of Biophysics, Biology and Biochemistry form the basis of study of life and health Sciences. Depending upon these disciplines the area of medical science has been developed which is the practice of the diagnosis, treatment, and prevention. The massive amount of data in biomedical create a big challenge for the scientists. The size of biomedical datasets are in zettabyte which create hurdle in the storage and analysis process of these datasets [1]. This paper focuses that the health care systems can be considerably improved with applications of Data Science, Artificial Intelligence, "Big Data" and IOT (Internet of Things). The mobile technology has made several innovations in health care Systems. In this digitalized era and the trends of smart city become more popular, the scientists more focus toward the Big Data techniques. Because these techniques help them to store and analyze the data in more efficient manners [2]. The medical Big Data sets contain text documents and images. The analysis of medical dataset help scientists in enhancement of

living standards of human beings [3]. The application processing using Big Data, IOT and IOMT are presented. Major problems which occur in implementation of methods using Big Data, IOT and IOMT are data collection, data storage, data security and classification properly. During the implementation of Big Data, IOT and IOMT techniques, storage, data collection classification and security are the main challenges for the scientists. According to [4], a health system is described as all the activities whose primary purpose is to promote, restore, or maintain health". A smart health care system discussed in [5] purposes to include and combine the AAL (Ambient Assisted Living) and machine learning algorithms for faster activities.

2. American and Canadian health care systems

The US health policy has always been under review and contains some salient features of policies of other ideal systems such as that of France, Canada, Japan, and Switzerland. Moreover, the Americans experts have engaged in designing the health care systems of Middle

Eastern and other counties and this had enabled them to improve their own systems. The US health care system is worth for implementation because of the "health insurance schemes, participation of charity institutions and private business firms. According to previous literature [6], the unfortunate aspect, is that on one hand taxes are being enhaced with less emphasis on enhancement in health care round the world. In view of the process of decentralisation in various countries, the central governments like to spend less in health care. France, Sweeden, Canada, United States, Netherland and Spain comparatively spend more funds on health care as compared to other countries. According to WHO [3] and World Bank reports [7], the factors such as Life Expectancy (LE) has arisen and Mortality Rate (MR) decreased in the following coutries as compared to some other countries, for example:

| Countries	LE	MR
Japan	83.7	2.7
Australia	82.8	3.7
Sweden	82.4	2.9
Canada	82.2	4.9
France	82.4	3.9
Germany	81.0	3.8
UK	81.2	4.3
US	79.3	6.5

The health care system in Canada is called Medicare designed and developed under the notions of Canada Health Act of 1984, work as decentralized provincial system which is accessible throughout the country. One third of the payments are made by privately managed firms. It benefits senior citizen and beneficiaries of social assistance. A good number of doctors in Canada don't charge the pay and salary, but get fee per visit or services. The expenditure in US health care system is twice as compared to France. The services in France are better, where 11% is spent on health care system.

3. Health care system in Pakistan

Pakistan's health system is prevalent in public and private hospitals and clinics. The systems are not beneficiaries of technologies offered by Big Data, IOT and IOTM. Primary health care facilities and services are not adequately available to the 80 % population. However, advice to rural population is available in family planning. Mostly people rely upon non qualified, dispensers, peons, homeopaths, quackers, Hakims and wreslers (Pehlwans) and acupuncturists. There are competent teams of Physicians, surgeons and paramedical personnel in teaching hospitals managed by government. The charges of private hospitals and clinics are very high and unmanageable by 80% of population.

4. Applications of big data

Big Data is a term which is used by researchers and developers for the terabyte and zettabyte datasets on which traditional approaches of data mining are not applicable. Big Data is applicable on structured and unstructured data [3]. A one proper definition of Big Data is not available [8]. Different researcher define it differently; but some researcher define it [9] with five things that are volume, velocity, verity, complexity and variability. The details characteristics of Big Data are shown in figure 1. Big Data drive forms any type of data like videos, images, and text data. There are various types of Big Data, where long-established base systems are based on the structured data.
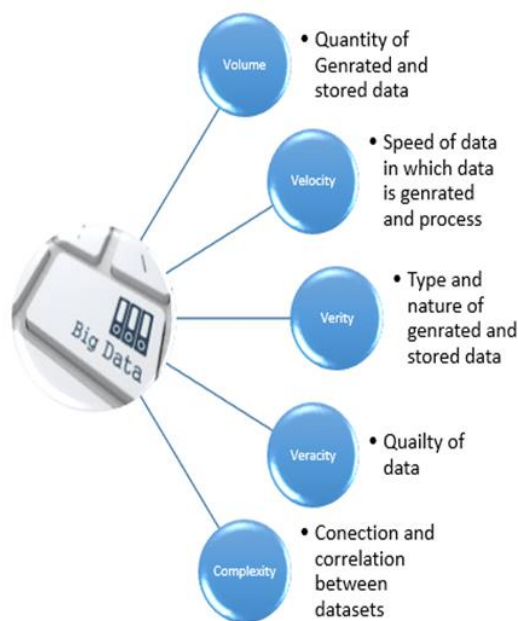
Figure 1. Characteristics and features of Big Data

Big Data is categorized in the 5 V's. According to [8], no proper definition of Big Data is available. Different researcher defines it differently; some of them define Big Data with three volume, velocity, and verity. According to [9], some researchers define it with five things that are volume, velocity, verity, complexity, and variability. The data for may be collected from Springer, IEEE, Google scholar and PUBMed by using "Big Data in health care" and "Big Data health care applications" queries. The literature review process with inclusion and exclusion process is shown in figure 2. For study and understanding, the research papers may be selected from these sites as shown in figure 2.
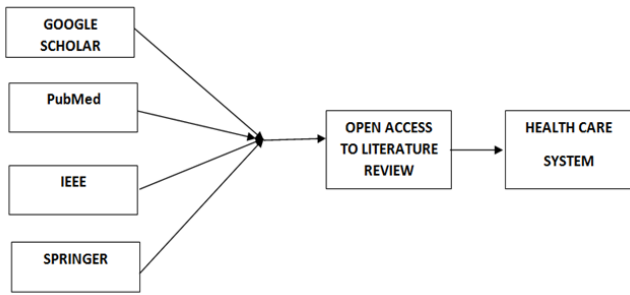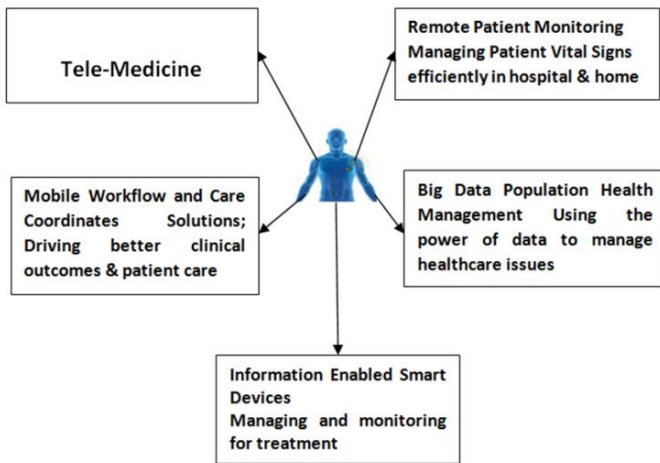
Figure 2. Literature review process with inclusion and exclusion process Related work

Big Data and smart device revolutionized in the health care system is shown in figure 3. As the world become global village the concept of Silicon Valley is more popular. In Silicon Valley all the work is done on digital devices. Health is an important issue which address by the scientist. The digitalization of health sector is helpful to secure many lives. For this context many are already done.

Figure 3. Approaches in health-care system

According to a previous study [10], the concept of a smart city for health care system has been proposed by using cloud computing and deep learning techniques. There is another facility CC (Creative Commons) license which enables free distribution of "copyright" work created by one author to share other authors. CC offer ability and function like compute, store, and applications via inter-net in the broad-spectrum.

Definition Block Chain: "*It is a list of records termed as blocks which are integrated by means of cryptographic hash of* previous *block, a timestamp, and transaction data; it is resistant to modification of the data*".

According to [11] and [12] the block chain with the combination of IOT and IOMT techniques for automated health care system is very useful technique. The application of machine learning algorithms make resolution in health care sector which approaches issues as a specialist advancing through residency by taking in principles from information. Beginning with patient-level perceptions, Malik *et al.*, 2020

calculations filter through immense quantities of factors, searching for mixes that dependably anticipate results. In one sense, this procedure is like that of conventional relapse models: there is a result, covariates, and a factual capacity connecting the two. Be that as it may, where Machine-Learning sparkles is in dealing with huge quantities of indicators. Sometime, strikingly, a larger number of indicators exists than perceptions and by joining them in nonlinear and exceedingly intuitive ways [13]. The combination of Big Data and machine learning algorithms are used to develop a perfect system for health care applications. These systems are able to diagnoses, predict and cure the diseases [14]. According to [2] and [15] smart phones are available every. Almost every person knows how to operate smart phone. The scientists do a lot of work on smart phone health care applications by using "Big Data". The investigation in medication and medical services empowers examination of the enormous datasets from an enormous number of patients, distinguishing clusters and relationship between the datasets [16].

5. Complexities, confidentiality and access of data

The medical information and Big Data are different areas. Medical base Big Data are more complex and hard to maintain [17]. A few of challenge which occur during implantation of Big Data techniques on health care application to be discussed in the coming explanations. The security of medical Big Data is extremely sensitive issue. It's very important to secure medical data base from cybercrime, phishing and hacking [18]. Because these kinds of databases also contain personal information like credit card history, personal address phone number etc. Appropriation of big data in "social insurance", fundamentally enhances security and to safeguard patient's concerns. At the beginning, understanding data is put away in data-centers with changing degrees of security [19]. The main challenge for medical Big Data scientist is access of data. To create medical Big Data datasets scientist needs huge amount of internal and external data of different hospitals and clinics. But the organizations are not ready sharing their customer information with third party because consumers have legal right to in case of unethical handling of his data.

6. Data classification and modeling

Medical Big Data consists of huge amount of heterogeneous and less structured data [20]. Scientists analyze and visualize data and make the classification of it, according to their requirements. Clinical databases store a lot of data about patients. Data-Mining strategies connected on these databases endeavor to find connections and examples among clinical what is more, obsessive information to comprehend the movement and highlights of specific sicknesses. The achieved information may be

utilized for determination. In the clinical databases, infection cases are genuinely uncommon as contrasted and the ordinary populaces [21]. For the best results it is very important that the medical dataset only contain relevant and accurate information. The data modeling for extracting correct information from medical Big Data set is a challenging job. Data Modeling is the way to describe the database models and describing or specifying the use of database structures [22]. According to [23], the dominating technology is Relational Data Base Management System working with Data Warehouse. In Health care systems sets play a vital role. The datasets contain information of healthcare system and outside the healthcare system. The main problem is that hospital and clinics only contain unhealthy person's data but in Big Data techniques health of individual's information is also required.

7. Data storage and communication

The size of datasets of Big Data IOT and IOMT are in terabyte and zettabyte. It is compulsory to have enough storage space to upload or generate the data at. The storage devices must have ability to store word documents, X-rays, MRI and CT scan reports. The communication between user and scientist is very important. The communication between scientist and Big Data collector and end user create a great problem. Because of this gap Big, Data collector is not able to collect accurate information which leads to bed analysis of Big Data algorithms. This bed analysis causes great loss of end user in health care application. According to [24] proposes an agent-based simulation framework. It uses sensors in IOT Health care system; the patients are examined by doctors from a remote place. The idea of ABS-BedIOT is new, which allows finding out results graphically with help of sensors. It provides IOT algorithms for data analysis.

8. Application of IOT/IOMT in health care system

According to [25], the field of IOMT is being developed and used in health care systems. It is reliable and utilizes the computer and electronic devices which can call heath care systems and resources. The IOMT connects the device to remote medical surveillance and mobile internet. The IOT and IOMT work together to talk to doctors, patients and other resources and to access the standard of medication.

The most salient features and benefits of IOT and IOMT are the convenience of use, improving quality of life, cost reduction, access to the doctors for managing the problems. It becomes possible to monitor and report the condition of patients in emergency or otherwise in real time. We may use the mobile cell for sending data to doctor such as ECG, blood test report or BP. The data from the clouds can also be accessed. For the end to end service the

technologies such as "Z-wave", WiFi, Bluetooth or Big BEE can be used in emergency.

Therefore, the electronic devices connected with IOT/IOMT are capable of collecting and reporting for analysis without loss of time. The information so preserved and stored can be mined and used by remote devices for medical assistance. The system also improves the patient care during admission of patients. The stored data preserved in Data Warehouse is very use for future research and development of health policies. The tracking system reduces waiting time in emergency and management of medicines. A secure model has been presented for the transmission of Data in [26], which covers the image before and after its application.

9. Benefits: patient care operational efficiency

In health care systems Big Data techniques are applications. They play a vital role to improve the health quality. Medical Big Data datasets provide many benefits a few of them are as following:

- ❖ Big Data "datasets" are used to design electronic health care systems.
- ❖ These systems are helpful to do the statistical analysis of patient body. These statistical figures are leads toward right treatment.
- ❖ The Big Data applications and smart applications are assisting to the hospital staff in the management and the doctors toward the correct disease diagnostician process, correct and right amount of medicine prescription.

10. Finding a cure and prediction

The pharmaceutical companies examine the analysis the medical Big Data datasets to find out the cure of diseases. The big companies spend a lot of money for this purpose for example, a few years back the scientist created the world largest database of DNA because they think that this will help them out to learn about the diseases nature and cure of disease.

The medical Big Data datasets contain the information of some pervious patient record and healthy people records. This information is helpful to analyze the health condition of a normal human being. Because of these kind analyses the doctors can diagnosis the diseases on time and also able to stop the cause which leads the patient to death. These types of applications are best for heart and blood cancer patient.

10.1 Cost and time reduction

We may create and store the large database because of Big Data techniques. These databases are helpful in the analysis of blood samples and another statistical test. Which are used to diagnosis the dieses by using these databases. Big Data algorithm can be game changes in health care

system as it has potential to identify different kind of diseases. The size of medical datasets is in zettabyte, the storage of data in medical Big Data applications are the main issue. Scientist also face some other challenges like data collection, classification, and security but the advantage of medical Big Data is force them to play with these challenges.

Biosensor: "A biosensor is an analytical device which is used for the detection of a chemical substance that combines a biological component with a physic-chemical detector".
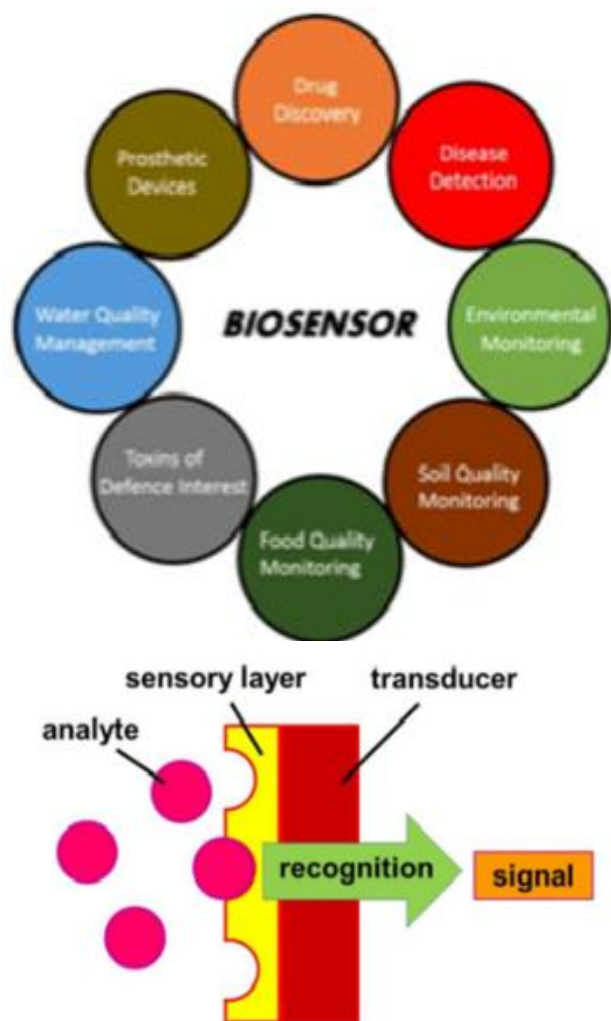
Figure 4. Bio-Sensor Source: [ElProCus Technologies]

The working of Biosensor is simple. The signal of transducer is normally low; moderately overlay on baseline. The signal processing consists of a baseline signal without biocatalyst covering. The kinds of chemical Biosensors are Voltammetric, Amperometric, Impedimetric and Potentiometric.

The other types include wearable, thermometric and optical Biosensors.

11. Some devices used in IOT/IOMT

The sensor is most important device in the context of Health care Systems. The devices used in IOT and IOTM are increasingly becoming popular and common in the area of preventive medicine and health care monitoring systems. According to [27], there exist large number of devices regarding architecture and design, sensors, Biosensors, smart phones, smart devices, algorithms for analyzing and handling the diagnostic systems, processing of medical data and data storage. The work flow of the health care system is automated and its mobility is ensured. The IOT automates the patient care workflow and helps healthcare mobility solution using new technologies (IOTM) and next-gen healthcare facilities.

Recommendations

In view of recent developments in computing, Big Data, IOT/IOMT, sensors and new methodologies in communication, the health care System must use an integrated combination of the technologies proposed in this paper.

Conclusion

The Big Data, IOT and IOMT improve the health care systems, the products, facilitate the medical professionals, Pharmacists, hospital management and patients to have better treatment. The quality, efficiency and reliability of treatment is improved in view of concurrent and simultaneous monitoring, reporting and communication of information for decision making process in real time and connectivity with smart phones. The most attractive facility is that data can be preserved on and retrieved from cloud. The applications of cloud computing and its algorithms make things easier to work with Big Data, IOT and IOTM. The authorized persons such as consultant physicians and surgeons may have access to the shared Data in cloud. The work flow and patients care is automated with use of devices, machine to machine communication and Big Data, IOT and IOTM technologies in a revolutionary manner. The systems defined in this paper are technically, operationally and financially. The tasks such as data collection, data reporting, analysis, storage, retrieving and communication become easier for decision making processes. Another salient feature is the provision of health faculty at remote places using mobile devices. The health care system provides enormous data for quantities and qualitative medical research and useful statistical analytical results. Now the medical practitioners use smart phones to see the patient's history and laboratory tests. The telemedicine is extensively used in US for the communication and consulting the doctors and seeking advice.

Application of Biosensors, Sensor technology, wearable sensors, Block chain-based initiatives and Machine

Learning applications shall certainly improve the health care systems round the world.

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