

Big Data Analytics in Smart Healthcare: A Review

Anusha. G

Student, M.Sc Computer Science, Indian Academy Degree College Autonomous, Bangalore, India

Abstract: A huge amount of data is generated in different fields of healthcare and diagnostics, doctors have to make a direct contact with all patients to determine the injuries and diseases by which the patient is getting affected. This paper reviews how big data analytics is used for smart healthcare. Big data analytics is establishing as game changer in healthcare. It is very useful in healthcare industry. Over the past years, Electronic Health Records (EHR) have been widely adopted and used in hospitals and clinics worldwide everywhere. Important clinical knowledge and extreme understanding of patient disease patterns can be studied from such data. It will help to improve patient health care and improve efficiency.

Keywords: *Big Data, Big Data Analytics, Smart Healthcare.*

I. INTRODUCTION

1.1 Big data refers to a process that is used when traditional data mining and handling techniques cannot uncover the insights and meaning of the underlying data. Data that is unstructured or time sensitive or simply very large cannot be processed by relational database engines. This type of data requires a different processing approach called big data, which uses massive parallelism on readily available hardware[1]. Big Data Analytics offers a nearly endless source of business and informational insight, that can lead to operational improvement and new opportunities for companies to provide unrealized revenue across almost every industry. From use cases like customer personalization, to risk mitigation, to fraud detection, to internal operations analysis, and all the other new use cases arising near-daily, the Value hidden in company data has companies looking to create a cutting-edge analytics operation.

Discovering value within raw data poses many challenges for IT teams. Every company has different needs and different data assets. Business initiatives change quickly in an ever-accelerating marketplace, and keeping up with new directives can require agility and scalability. On top of that, a successful Big Data Analytics operation requires enormous computing resources, technological infrastructure, and highly skilled personnel.

All of these challenges can cause many operations to fail before they deliver value. In the past, a lack of computing power and access to automation made a true production-scale analytics operation beyond the reach of most companies: Big Data was too expensive, with too much hassle, and no clear ROI. With the rise of cloud computing and new technologies in compute resource management, Big Data tools are more accessible than ever before[2].

1.2 Smart healthcare can be defined as using mobile and electronic technology for better diagnosis of the disease, improved treatment of the patients, and enhanced quality of lives. The European Union has extended this definition further by adding “inclusion of information and data sharing between patients and health service providers.” mHealth and eHealth are thus vital components of the smart healthcare system.

Big Data in Healthcare: As smart connected devices gain popularity, Big Data has made inroads in the smart healthcare system. According to our analysts, there has been a

steady rise in the demand for M2M and M2H communications so as to categorize the large volumes of medical data. Major healthcare technologies companies like Oracle, IBM, and SAP, have already increased their big data spending on healthcare to widen their reach in nascent markets in the APAC region.

Our industry analysis shows the Americas have benefitted the most by the early adoption of Big Data in their healthcare delivery services. By the year 2019, the market value of Big Data spending on healthcare is expected to be around USD 14.33 billion. It has been noticed that the governments across the globe are working towards building an effective healthcare paradigm and technology, especially Big Data, is the very foundation on which this infrastructure can be built[3].

II. REVIEW OF LITERATURE

Ahmed Ismail et al.,[4], has suggested few new data visualization tools to the healthcare analyst to make effective decision making. Big data has a great perspective to progress healthcare management and transform healthcare industry to next level. The review article will be benefiting the healthcare academicians, practitioners, researchers who are engaged in the areas of healthcare Management.

Nishita Mehta et al.,[5], has explored Big Data analytics which has emerged as a new frontier for enhancing healthcare delivery. With the opportunities created by digital and information revolution, healthcare industry can exploit the potential benefits of leveraging Big Data technology. Big Data analytics increasingly provides value to healthcare by improving healthcare quality and outcomes and providing cost-effective care. The predictive nature and pattern-recognition aspect of Big Data analytics enable the shift from experience-based medicine to evidence-based medicine. Through its systematic review, the study presents a useful starting point for the application of Big Data analytics in future healthcare research. In addition, the study reflects that once the scope of Big Data analytics is defined; its characteristics and features are understood; and challenges are properly tackled, its application will maximize the healthcare value through promoting the extensive usage of insights.

GunasekaranManogaran et al.,[6], was proposed Architecture consists of the data collection phase, the data transfer phase and the big data storage phase. In data collection phase, IoT(Internet of Things) sensors are used for monitoring the patient's health conditions, with indices like respiratory rate, heart rate, blood pressure, body temperature and blood sugar. Once the data is stored in the cloud, the proposed IoT based health monitoring system uses the stochastic gradient descent algorithm with logistic regression for developing the prediction model for heart disease. Prior clinical records and sensor data of the patients were collected from the Cleveland Heart Disease Database (CHDD) to train the prediction model. The performance evaluation of the proposed health monitoring system was done with the help of Sensitivity, Specificity and Precision.

J.Archenaa et al.,[7], has discussed the problem is not the lack of data but the lack of information that can be used to

support decision-making, planning and strategy. The entire government system can realize benefits from utilizing big data technologies. To successfully identify and implement big data solutions and benefit from the value that big data can bring, government need to devote time, allocate budget and resources to visioning and planning. With the help of Hadoop the goal of effective citizen care management can be achieved by providing an effective data driven services to citizens by predicting their needs based on the analysis of survey conducted among different classes of citizens. Secured BDA can be implemented by using Hadoop in a security enabled linuxenvironment where access control is provided by the system itself.

Yin Zhang et al.,[8], has focused medical diagnosis is evolving to patient-centric prevention, prediction, and treatment. The big data technologies have been developed gradually and will be used everywhere. Consequently, healthcare will also enter the big data era. More precisely, the big data analysis technologies can be used as guide in lifestyle, as a tool to support in the decision-making, and as a source of innovation in the evolving healthcare ecosystem. This paper has presented a smart health system assisted by cloud and big data, which includes

- 1) A unified data collection layer for the integration of public medical resources and personal health devices.
- 2) A cloud-enabled and data-driven platform for multisource heterogeneous healthcare data storage and analysis.
- 3) A unified API for developers and a unified interface for users. Supported by Health-CPS, various personalized applications and services are developed to address the challenges in the traditional healthcare, including centralized resources, information island, and patient passive participation.

William J. Tibben et al.,[9], has presented seeks to provide an informed understanding of the impact of big data research on health care delivery. Using the care delivery value chain (CDVC) framework developed by Porter and collaborators it has been possible to see what aspects of healthcare delivery have benefited most from big data research and areas that have been given less attention. Health care delivery involves many different disciplines none more so than medical and allied health professions. However, there is a critically important role for IS scholarship too as demonstrated through the examples outlined in relation to CDVC. While there is an ongoing role for big data research to address improvements in treatments the paper finds that there is a greater need for increased attention to management and policy development that aims to promote more personalized modes of care that create increased patient value while simultaneously seeking to achieve greater efficiencies in the delivery of healthcare.

SherifSakr et al.,[10], has presented in this article, we analyzed how the recent advancements of ICT can be effectively exploited and integrated for tackling the above mentioned challenges and contribute towards the state-of-the-art of healthcare services. In particular, we focused on exploiting the advancements in the areas of sensor technologies, cloud computing, Internet- Of- Things and Big data analytics systems as emerging technologies that can significantly contribute towards improving the efficiency and effectiveness of healthcare services. In addition, we proposed an integrated and comprehensive framework for big data analytics services in smart healthcare networks, Smart Health, which addresses the revealed challenges and fills in the

identified gaps. The framework also acts as a roadmap for future research efforts in the area of big data analytics in smart healthcare applications. Several use cases and application scenarios have been discussed to promote the importance of our proposed framework. Future work will concentrate on designing the adequate programming abstraction that can equip the analytics process for various healthcare related complex data sources (e.g., images, streams).

Mohammed K. Hassan et al.,[11], has illustrated cloud computing and big data analytics such as Hadoop and Spark. Moreover, a literature review for data mining and big data in biomedical informatics is presented in this chapter. A case study for monitoring patients suffering from blood pressure disorders has been presented to show the efficiency of using AALs such as IHCAF-PUSH and big data analytics such as Spark in detecting the health status of the patients. The experimental results conclude that J48 and Naïve Bayer show good performance with the monitoring datasets when Spark is used to distribute storage and processing over the different clusters.

Yichuan Wang et al.,[12], has explained the cases demonstrate that big data analytics could be an effective IT artifact to potentially create IT capabilities and business benefits. Through analyzing these cases, we sought to understand better how healthcare organizations can leverage big data analytics as a means to create business value for healthcare. We also identified strategies that healthcare organizations could use to implement their big data analytics initiatives.

Sadia Din et al.,[13], has proposed an efficient smart health monitoring Architecture using Big Data analytics. Smart decision and event management is the foremost purpose of this research. Framework for energy harvesting in IoT is proposed. The comprehensive analysis and discussion is carried out about the energy harvesting using piezoelectricity for health monitoring sensors. The Big Data analytics is performed using the Hadoop server with Map Reduce mechanism. A variety of datasets is examined, evaluated, analyzed and tested, based on which it is shown that how healthcare can be performed using Big Data. Nevertheless, the proposed scheme does not reflect a generic way out; it is deliberated for explicit objectives.

Ali Rizwan et al.,[14], has presented in future, such ubiquitous and smart healthcare system is desired which is equipped with P4 (i.e. predictive, preventive, personalized and participatory) to perform diagnostics, monitoring and treatment functions in seamless and smart manner. Developments in the field of big data analytics and nano-technologies in the context of healthcare are very promising to realize this dream. Smart devices based on nanosensor networks can provide technical support to take critical measurements on real time. Big data analytics can help to gather intelligence from those measurements data to make important and urgent decisions for diagnosis to drug delivery.

Lo'al A. Tawalbeh et al.,[15], has shown Mobile cloud computing maximizes the utilization of mobile devices capabilities to run intensive-computing applications. Here we discussed networked healthcare systems and the role that mobile cloud computing and big data analytics play in its enablement. A Cloudlet-based Mobile Cloud Computing infrastructure to be used for healthcare big data applications was described. The techniques, tools, and applications of big data analytics were reviewed. Healthcare applications require large amounts of computational and communication resources, and involve dynamic access to large amounts of data within

and outside the health organization. This was discussed to be the main motivation for networked healthcare system where big data such as patient records need to be analyzed in real time, and this can be implemented efficiently via cloud and mobile cloud systems.

Mohammad Ahmad Alkhatib et al., [16], has discussed about proposing a technique that will promise to leverage large amount of healthcare data properly, it enhance doctor's decision making process by defining better care, developing drugs and vaccines along with a better treatment plan in order to reach patient satisfaction. Moreover, proposed technique will add a benefit of identifying risks early and mitigate it as much as possible. However, this study will need to push both doctors and patients to adopt new technique and collaborate together to reach high level of connection between both medical staff and patients in order to keep the system up to date and gather high quality of data. Generally, in healthcare sectors data analytics is very important and essential topic, since all the previous benefits we mentioned could lead for better choice of medical care practice and prevent illnesses.

Bouhriz Mounia et al., [17], has proposed that Big Data carries with it big promises to improve the healthcare sector in a revolutionary way, however, several challenges and issues have been identified as major obstacles to leveraging Big Data in the healthcare industry, mainly the privacy challenges. They projected light on some of the benefits of Big Data in the healthcare sector, the various challenges to take into account, as well as some successful related examples from all over the world. We have then focused on the Moroccan context, by giving some of its healthcare issues and specificities, and have given recommendations. As the privacy is one of the most important things that patients insist on, we presented the current methods used to ensure the patient's privacy in healthcare industry, as well as the legislation regarding the privacy issues in the world. We plan, thereafter, to focus more on the security and privacy aspects of medical data in a Big Data environment, since patients and stakeholders in the healthcare sector are concerned about the possibility of ensuring better healthcare quality based on Big Data technologies while guaranteeing medical data security and patient's privacy.

CONCLUSION

Here they reviewed about big data analytics in smart healthcare which has potential to transform the way smart healthcare providers use sophisticated technologies to gain insight from their clinical and other data repositories and to make informed decisions. Big Data is launching new world of many possibilities in the world of healthcare by providing information, tools and technique about monitoring and managing the overall health thus big data is proving beneficial to the overall healthcare.

References

- [1] <https://www.techopedia.com/definition/27745/big-data>
- [2] <https://www.qubole.com/big-data-analytics/>
- [3] <https://blog.technavio.com/blog/top-5-healthcare-technologies-changing-global-smart-healthcare-market>
- [4] Senthilkumar SA, Bharatendara K Rai, Amruta A Meshram, Angappa Gunasekaran, Chandra kumar mangalam S, Big Data in Healthcare Management: A Review of Literature, American Journal of Theoretical and Applied Business, 2018, pp. 57-69.

- [5] Nishita Mehta, Anil Pandit, Concurrence of big data analytics and healthcare: A systematic review, Elsevier, 2018, 114, pp. 57-65.
- [6] Gunasekaran Manogaran, R. Varatharajan, Daphne Lopez, Priyan Malarvizhi Kumar, Revathi Sundarasekar, Chandu Thota, A new architecture of Internet of Things and big data ecosystem for secured smart healthcare monitoring and alerting system, Elsevier, 2017.
- [7] J.Archenaa and E.A.Mary Anita, A Survey Of Big Data Analytics in Healthcare and Government, Elsevier, 2015, pp. 408 – 413.
- [8] Yin Zhang, Meikang Qiu, Chun-Wei Tsai, Mohammad Mehdi Hassan and Atif Alamri, Health-CPS: Healthcare Cyber-Physical System Assisted by Cloud and Big Data, IEEE Systems Journal, 2015.
- [9] William J. Tibben and Samuel FossoWamba, Exploring the potential of big data on the health care delivery value chain (CDVC): a preliminary literature and research agenda, Hawaii International Conference on System Sciences HICSS 2018, pp. 2045-2054.
- [10] Sherif Sakr and Amal Elgammal, Towards a Comprehensive Data Analytics Framework for Smart Healthcare Services, Big Data Research, 2016.
- [11] Mohammed K. Hassan, Ali I. El Desouky, Sally M. Elghamrawy and Amany M. Sarhan, Big Data Challenges and Opportunities in Healthcare Informatics and Smart Hospitals, Springer 2018.
- [12] Yichuan Wang, LeeAnn Kung, Terry Anthony Byrd, Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations, Elsevier, 2016.
- [13] Sadia Din, Anand Paul, Smart Health Monitoring and Management System: Toward autonomous wearable sensing for Internet of Things using Big Data Analytics, Future Generation Computer Systems Elsevier, 2017.
- [14] Ali Rizwan, Ahmed Zoha, Rui Zhang, Wasim Ahmad, Kamran Arshad, Najah Abu Ali, Akram Alomainy, Muhammad Ali Imran, and Qammer H. Abbasi, A Review on the Role of Nano-Communication in Future Healthcare Systems: A Big Data Analytics Perspective, IEEE Access, 2018, Volume 6.
- [15] Lo'al A. Tawalbeh, Rashid Mehmood, Elhadj Benkhelifa, Houbing Song, Mobile Cloud Computing Model and Big Data Analysis for Healthcare Applications, IEEE Access, 2016, Volume 4.
- [16] Mohammad Ahmad Alkhatib, Amir Talaei-Khoei, Amir Hossein Ghapanchi, Analysis of Research in Healthcare Data Analytics, Australasian Conference on Information Systems, 2015.
- [17] Bouhriz Mounia, Chaoui Habiba, Big Data Privacy in Healthcare Moroccan context, Elsevier, 2015, 63, pp. 575 – 580.