Big Data, And Internet of Things In Biomedical Engineering: A Brief Of Its Applications

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INTRODUCTION

Data from imaging, pathology, genetics, and electrophysiology may all be utilized to obtain a better understanding of illnesses. Biomedical researchers may use data to discover patterns and enhance healthcare decisions. Several big data healthcare systems, such as Hadoop (Armoogum and Li, 2019) and MapReduce (Lee *et al.*, 2020), may be utilized in the biomedical area to synthesis massive volumes of data and extract meaningful insights based on patterns.

Wearable gadgets and Internet of Things (IoT) goods may also obtain benefits from big data to help them function more intelligently for the user (Mohammed *et al.*, 2020). The invention of IoT systems that will include surgical data for training and feedback purposes to increase surgical competence for surgeons in residency is one such biomedical advancement presently in the works.

BACKGROUND: WHAT IS BIG DATA?

Big data is a recent hypothesis and ecosystem in biomedical informatics that converts case-based studies into large-scale, data-driven research. The three primary properties of big data, usually referred to as the 3Vs: volume, variety, and velocity, are widely acknowledged as defining qualities of big data (McCue and McCoy, 2017).

First and foremost, the volume of data in the biomedical informatics areas is rising at a very high rate. Medical imaging such as ultrasound images and x-rays images generates massive amounts of data that have complicated specifications and wider dimensions (Hung and Lin, 2020; Maglogiannis *et al.*, 2020). Another example is the Visible Human Project, that has file away more than 38 GB of female datasets. In healthcare field, there are open sources of datasets that provide different information, analysis and help researchers to aggregate collection and analysis (Massey *et al.*, 2017).

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The diversity of data kinds and structures is the second characteristic of big data. The biomedical big data ecosystem consists of many distinct layers of data sources, resulting in a diverse set of data for researchers. Sequencing technologies, such as, generate "omics" data at nearly the entire concentrations of biological modules, from genomes, proteomics, and metabolomics to protein interaction and phenomics (Joshi *et al.*, 2021).

The third feature of big data is velocity, which is considered as the speed with which data is produced and processed. The current generation of sequencing technology allows for the low-cost creation of billions of DNA sequence data per day. Because DNA sequencing necessitates higher rates, big data technology will be adapted to meet the pace at which data is produced, as well as the speed at which it is processed (Pablo *et al.*, 2021).

THE IMPORTANCE OF BIG DATA IN HEALTH CARE

Biomedical and health-care informatics research is increasingly utilizing big data technology. At an unprecedented velocity and scale, large volumes of biological and clinical data have been created and gathered. As, the current generation of sequencing technology allows for the daily processing of billions of DNA sequence data, and the use of electronic health records (EHRs) allows for the documentation of huge volumes of patient data. With technological advancements like the introduction of new sequencing machines, the expansion of innovative hardware and software for parallel computing, and the widespread use of EHRs, the cost of obtaining and interpreting biological data is projected to drop substantially. Big data applications open up new avenues for discovering new knowledge and developing unique techniques for improving health-care quality (Tang *et al.*, 2020).

Big data in health care is a rapidly evolving subject, with several new findings and techniques published in the previous five years. We analyze and discuss big data applications in three key biomedical subdisciplines in this paper: Bioinformatics, clinical informatics, and imaging informatics are the three types of informatics. In bioinformatics, high-throughput experiments make it easier to conduct novel genome-wide association analyses of illnesses, and in clinical informatics. However, the large volume of patient data obtained allows clinicians to make more informed judgments (Saxena and Chandra, 2021). To exchange medical image data and workflows, imaging informatics is increasingly more quickly integrating with cloud platforms. In this paper, we summarize the challenges, gaps, and opportunities for improving and advancing big data applications in health care, as well as the recent progress and breakthroughs in these health-care domains.

BIG DATA APPLICATIONS

BIOINFORMATICS APPLICATIONS

The study of biological system changes at the molecular level is known as bioinformatics research. With today's customized medical trends, there is a growing need to collect, store, and evaluate these enormous datasets in a timely manner. Genomic data may be collected in a short amount of time; thanks to next-generation sequencing technologies. In bioinformatics applications, big data approaches help scientists acquire and analyze biological data by providing data repositories, computational infrastructure, and fast data manipulation tools. Hadoop and MapReduce are widely utilized in the biomedical industry, according to Taylor (Wang and Alexander, 2020).

Researchers classify big data methods and/or tools into different groups based on the main function of every technology which are 1. Data storage and Retrievals 2. Error Recognition 3. Data Analysis 4. Platform Integration Deployment (Mohamed *et al.*, 2020).

CLINICAL INFORMATICS APPLICATIONS

The key biomedical subdisciplines concentrates on the application of information technology in the health-care domain. It involves activity-based research, analysis of relationship between patient main diagnosis as well as underlying cause of death, and storage of data from EHRs and other sources like data from ECG sources (Herrmann, 2020).

Clinical informatics, unlike bioinformatics, do not have as many methods for detecting errors, but it is more concerned with data exchange and security. Clinical informatics work with both structured and unstructured data, creates particular ontologies, and employs natural language processing significantly, which sets it apart from bioinformatics (Watkins *et al.*, 2021).

IMAGING INFORMATICS APPLICATIONS

This subdiscipline (i.e., imaging informatics) can be defined as the study of approaches for producing, controlling, and demonstrating imaging information in a variety of biomedical purposes (Moon *et al.*, 2018). It is bothered with how medical images are switched and evaluated during the course of development health-care methods. With the expanding necessity for more individualized care, the demand for integrating imaging data into EHRs is promptly expanding. Imaging informatics is established roughly instantaneously with the initiation of EHRs and the occurrence of clinical informatics; nevertheless, it is very distinct from clinical informatics because of the dissimilar data categories engendered from numerous modes of medical images (Kabashin *et al.*, 2019).

CONCLUSION

We are presently in the time of “big data,” where big data machinery is being promptly utilized to biomedical and health-care disciplines. In this paper, we exhibited a variety of examples in which big data technology has addressed a key position in modern-day health-care development, as it has entirely changed people’s view of health-care activity. Additionally, in this paper, we realized that bioinformatics is the most important subject where big data analytics are presently being utilized, mainly because of the substantial volume and involvedness of bioinformatics data. Nevertheless, in other biomedical research disciplines, for instance clinical informatics, and medical imaging informatics, there is massive, unexploited possibility for big data purposes.

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