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Overview of recent advances in Health care technology and its impact on health care delivery

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Abstract
Recent advancement in technology such as Machine Learning (ML), Artificial intelligence(AI), Robotics, internet of things (IOT), Block Chain technologies, Big Data analytics, Cloud computing Natural Language Processing, Mobile Applications is making a huge impact on the day to day lives of human beings. These technologies started helping us to save resources, time and cost and at the same time increase the accuracy and efficiency. Biomedical domain also started embracing these new technologies in the areas of diagnosis, surgery and therapeutics. These technologies also have applications in the areas of pattern recognition and expert systems. The paper provides an overview of recent advancement in technologies and its impact on the biomedical domain

Keywords: Machine Learning , Artificial intelligence, Robotics, Internet of Things, Block Chain Technologies, Big Data Analytics,

1. Introduction

The need for technological support such as machine learning techniques or artificial intelligence is felt in almost all the fields such as marketing, finance, medicine due to the availability of large amount of data, complexity involved in analyzing the data, speed, accuracy and drawing conclusion from the same. The following sections from 2-10 discusses these technologies in detail.

2. Machine Learning

Machine learning [1] algorithms are built from supervised learning and unsupervised learning methods. Supervised learning uses the training dataset to learn and then test the learned knowledge through test dataset to predict or classify an outcome. Unsupervised learning methods extract features and relations, forms clusters from the given dataset to predict or classify outcomes or class. Machine Learning algorithms are useful in classification [2], prediction [3], and pattern recognition [4]. Machine learning algorithms are useful in biomedical domain as it is helps us in diagnosing the disease [5, 6] , predicting the outcome of the disease [3], classifying the severity of the diseases. Artificial Neural Networks (ANN) [7], Support Vector Machines (SVM) [8]. Naïve Bayesian classifiers [9], Decision Trees [10] and Echo State Network (ESN) [11] are the examples of machine learning algorithms which are currently used. One of the drawbacks of machine learning is its black box approach as it does not provide a clear indication on how the outcomes are derived from the algorithms or the model.

3. Artificial Neural Network

Artificial Neural Networks (ANN) [7, 12] works on the same principles of Biological neural networks wherein the information is processed by the neurons through its dendrites and axons. ANN has input node(layer) which receives the information and hidden nodes(layers) which adds weight to the information received from the input node and apply nonlinear function called activation function[13] to convert the information and the same is outputted through the output node(layer). The commonly used activation functions are Sigmoidal Function [14], Radial Basis Function [15], Tan-h Function and Rectified Linear Unit Function [16]. ANN is capable of handling both linear and nonlinear relationship in the data. ANN is extensively used in disease diagnosis [17], prediction of clinical outcomes [18] and classification of disease conditions [19].

4. Deep Learning

Deep learning [20] algorithms are the extension of ANN with many hidden layers (nodes) which are hierarchical in nature and process the information more deep before outputting the information. This helps the system to improve the accuracy of the output process. Deep learning algorithms are possible to implement because of availability of Graphical Processing Unit (GPU) [21] processors. Deep learning models are widely used in the areas of radiological image processing. There are different types of Deep Learning networks are available such as Convolution Neural Network (CNN)[22] which is useful for image processing , Recurrent Neural Network (RNN)[23], Long Short Term Memory network[24] and Deep Belief Network[25].

5. Artificial Intelligence

According to Larry Hauser, Artificial intelligence [26] is the possession of intelligence or exercise of thought by the machines. Clinical Decision Support Systems (CDSS) [27] are one of the first artificial intelligence systems in the field of health care to aid the clinicians in arriving at a diagnostic condition given the set of input parameters. The examples of CDSS are MYCIN [28] Qmr [29, 30] and Internist [30]. The recent advancement made in the Artificial Neural Networks and Deep learning algorithms have widened the scope of Artificial Intelligence.

6. Internet of Things

Internet of Things (IOT) [31] uses computer networks technologies to connect different types of devices and enable them to communicate with each other. Wearable monitoring devices [32] in health care are the classical example of IOT enabled devices. IOT enabled devices helps clinicians in real –time monitoring of vital signs and ECG signals [33]. Real time Monitoring helps the clinicians to be proactive and provide personalized care to the patients who are in need. IOT devices can be externally wearable devices, implanted [34] in the patient body to provide better health care..

7.

8. Block chain Technology

Block chain technology [35] is a distributed ledger that tracks transaction among the nodes in the block chain. It works on the principle of decentralized control of information flowing through its network and enabling the transaction between nodes of the chain to be transparent and secure. It helps the health care providers [36, 37] to share the patient information in a secure and transparent manner and the same time the control of patient information decentralized. HIPAA regulations still is not permitting the use of Block Chain technologies [37] due to the issue of privacy.

9. Big Data Analytics

Big Data [38] analytical tools help us to process large amount of data which cannot be processed by traditional analytical tools. Big Data tools are identified by its five main characteristics such as Volume, Veracity Velocity, Value and Variety [39]. Big Data types include structured and unstructured data sets. Big data is useful in health care [40, 41] as it contains huge volume of unstructured patient data in the form of clinical notes, radiological images, genomics data, data collected from sensor devices such as wearable monitors.

10. Natural Language Processing

Natural Language Processing (NLP) [42, 43] evolved from the field computational linguistics which includes methods to study the language with the help of computers. Information extraction [44], named entity recognition [45] and information retrieval [46] are closely related to the Natural Language Processing techniques. NLP techniques involves morphological (original form of words), lexical (Vocabulary), syntactic (structure of sentence) and semantic (meaning) analytical components [47]. Health care contains text data in the form of clinical notes and case summaries which cannot be analyzed using traditional analytical tools. Tools such as text mining which uses Natural Language processing techniques is able to analyze the unstructured data like the data in the form of texts.

11. mHealth applications

mHealth [48 ,49] or mobile health uses mobile technologies integrated text, video and audio to deliver health care service. mHealth applications assist health care professionals in providing information on patient history, disease surveillance and disaster management. It helps patients in providing timely remainders, health awareness messages and also monitors vital signs through specialization applications.

12. Conclusion

The paper provided an overview of latest technological trends in health care domain such as Machine Learning, Artificial Intelligence, Deep learning, Big Data Analytics and mHealth and its impact on health care delivery.

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