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Determining Disease Using Machine Learning Algorithm in Medical Image Processing: A Gentle Review

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Abstract: Machine learning plays a very vital role in computer science. It is a part of artificial intelligence, which provides many advantages like automated cars, speech recognition, medical fields, efficient web search, etc. Machine learning algorithms are used in analysis of digital images like X-Ray, Ultrasound, Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) for finding diseases. There are several diseases like brain tumor, Diabetes, liver cancer, heart disease etc. use medical modalities like MRI Image, CT scan image. Basically these images use by many research for analysis and characterization, which is useful for doctor to detect cancer or specific disease in early stage then necessary action take place on right time and also take very less cost for patients. Medical Images uses Machine Learning (ML) algorithms to develop predictive model, which plays a very important role for detection of different diseases such as heart attack, diabetes, liver, dengue and skin diseases. This review paper gives attention towards analysis and detection of diseases using machine learning algorithms in medical image processing. The paper focus on supervised learning algorithm applies on medical image for detection of particular disease. The best result can be found by applying deep learning or convolutional neural network (CNN) on medical images.

Keywords: Machine Learning, Medical Images, Image Processing

1. Introduction

Image Processing is the research area of computer science to perform operations on digital image in order to get some useful information. Once image-processing phenomenon is applied on medical images then we consider it as medical image processing.

Most of the Medical Image Processing consists of following steps for detection of diseases:

Pre-Processing
Enhancement
Filtering and De-noising
Segmentation
Detection

Machine learning provides ability to computer system, to make prediction and learn automatically without being explicitly programmed.

Machine learning is a data or image analytics technique that teaches computers to do what comes naturally to humans and animals: learn from experience or past data [1].

Image processing detects a pattern or disease after getting the medical image. Nevertheless, machine learning finds a disease in early stage with some solution.

Machine learning techniques are rapidly increasing used for successful finding disease in medical image-based diagnosis. Machine Learning is a sub field of Artificial Intelligence (AI), which provides intelligence in machine. It takes medical images for analysis and on basis of symptoms it finds, detect and classify the different types of diseases. The role of Image processing techniques is to enhance the image and removing noise for clarity before used by machine learning algorithm for analyze the disease. Using this, it minimizes the need of doctor and notify the patient about his disease and its solution in early stage.

There are many applications of machine learning algorithm in the field of medical science or health-care informatics for medical diagnosis.

1) Medical Image Classification
2) Medical Image Analysis
3) Expert System for Computer Aided Diagnosis and

Prognosis

4) Pattern Recognition in the analysis for medical diagnosis
5) Deep Learning in medical image processing and analysis

There are two category of machine learning depicted in figure 1.

Supervised Learning: It can predict future outputs based on known input and output data. There are two categories:

Classification Technique: Based on Predicted Discrete responses. There are following algorithms used in this category: Support Vector Machines (SVM), Discriminant Analysis (DA), Naive Bayes (NB) and Nearest Neighbor.

Regression Technique: Based on Continues responses. There are following algorithms used in these categories: Linear Regression (LR), Decision Trees (DT), Neural networks (NN).

Unsupervised Learning: Clustering is the most common unsupervised learning technique, which finds hidden patterns or intrinsic structure in input data.

Clustering Technique: It interpret inferences from input data without labeled responses. There are following algorithms used in this category: K-Means, Fuzzy C-Means, Hierarchical and Neural networks (NN), Hidden Markov Model (HMM).

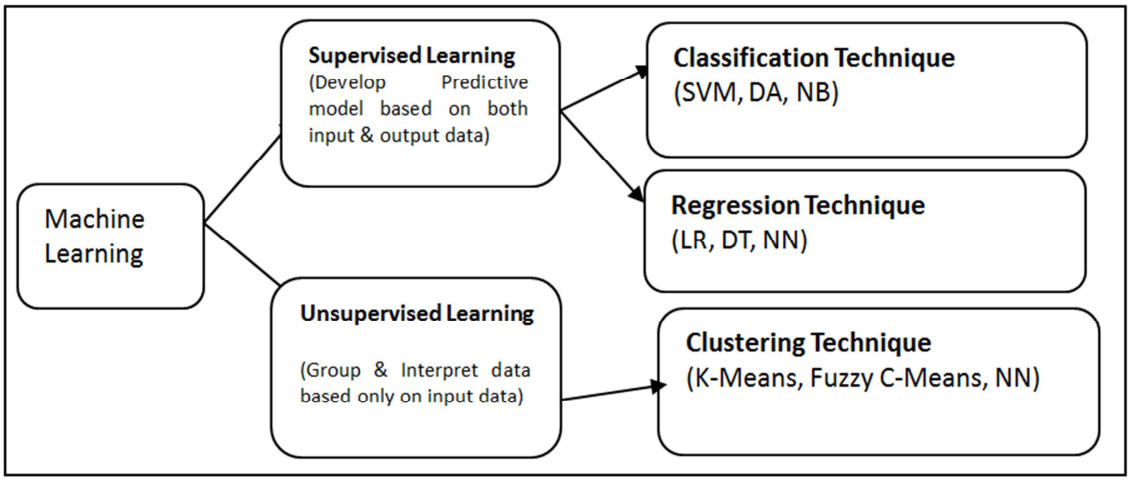

Figure 1. *Types of Machine Learning.*

Machine learning allows machine to learn automatically and make better decisions in future. It is better to use in analysis of medical images and find or recognized pattern for diagnosis of different kind of diseases. Machine-learning algorithm process the medical images like CT, MRI and Skin Images in making the prediction of diagnosis of interest. Medical Images, which is not clear and it is difficult to find disease manually not automatically after apply the image processing techniques like pre-processing, enhancement, compression, segmentation and detection. It would be better to develop a classified model using supervised learning algorithm to detect a disease automatically.

2. Objective of Study

The objective is to increase the expert's ability to identify patient's disease while decreasing the need for intervention, and maintaining the ability for accurate diagnosis at very low cost and time. The potential of Machine Learning is significantly high and it is need for developing more effective methods of early detection of disease. Machine learning is a computational method for accumulating, changing and updating knowledge in intelligent medical image interpretation systems, which is useful in recovering the patients.

Machine learning is the latest area for medical field. It can be useful in computer based medical image interpretation system. There is lack of formal models or the knowledge about the application domain is defined poorly. Machine learning algorithm is not providing good solution. Therefore, this article is required and find out the best solution for society.

Healthcare is one and very important issue for everyone. Now a days there are many of diseases increasing rapidly due to bad life style and use of bad food products. Now we must take care about our health and develop the techniques in such area.

3. Literature Review

Many authors have carried out a survey in which skin cancer is segmented by genetic neural network [2]. Detection of brain tumor or other abnormalities are discussed in many papers. Medical Image is an important area of Digital image processing because medical imaging has also been one of the most successful techniques for detection of disease [4-5, 9-11].

Machine learning is extensively used in medical image processing for diagnosing several diseases like cancer [3-5], diabetes [6], heart [7] and skin disease [8]. Machine learning improves the diagnostic speed, accuracy and reliability.

Machine Learning (ML) provides tools for dealing with

the characteristics of medical dataset [12]. Medical dataset is a dataset, which contains the information or record of patients. Medical dataset must be clear and complete. These dataset attributes are described by following parameters like incorrectness (Systematic or random noise in the data), incompleteness (Missing Parameter Values), sparseness (few and/or non-representable patient records available) and inexactness (inappropriate selection of parameters for the given task).

Computer Based Medical System (CBMS) is an area, which is used in medical images for interpretation system by using image processing technique and providing significant contribution and assistance in medical diagnosis [13-16]. The detection of disease by using image-processing technique on medical images like computed tomography, ultrasonography, endoscopy, computed radiography or magnetic resonance imaging.

The following table show various machine-learning techniques apply on different medical images for analysis and detection of disease:

Table 1. *Different ML technique for detection of disease.*

Machine-learning Technique	Author	Year	Disease	Accuracy	Reference
SVM	Otoom et al.	2015	Coronary artery	83.8%	[18]
NB	Iyer et al.	2015	Diabetes	79.56%	[19]
SVM	Vijayarani and Dhayanand	2015	Liver	79.66%	[20]
NB	Vembandasamy et al.	2015	Heart Disease	86.3%	[21]
SVM	A. E. Hassanien and T. Kim	2012	Breast Cancer	85%	[4]
ANN	Tarmizi et al.	2013	Dengue	99%	[22]
NN	Ba-Alwi and Hintaya	2013	Hepatitis	70.41%	[23]

4. Detection of Disease Using Machine Learning Algorithm

Using image processing, analysis of one or more medical images is not suitable for finding a particular disease. [17] Machine learning algorithm is use by many researchers for finding diseases from different medical images. Researchers have accepted that machine learning algorithm work well in diagnosis of different disease, which is depicts in figure 2.

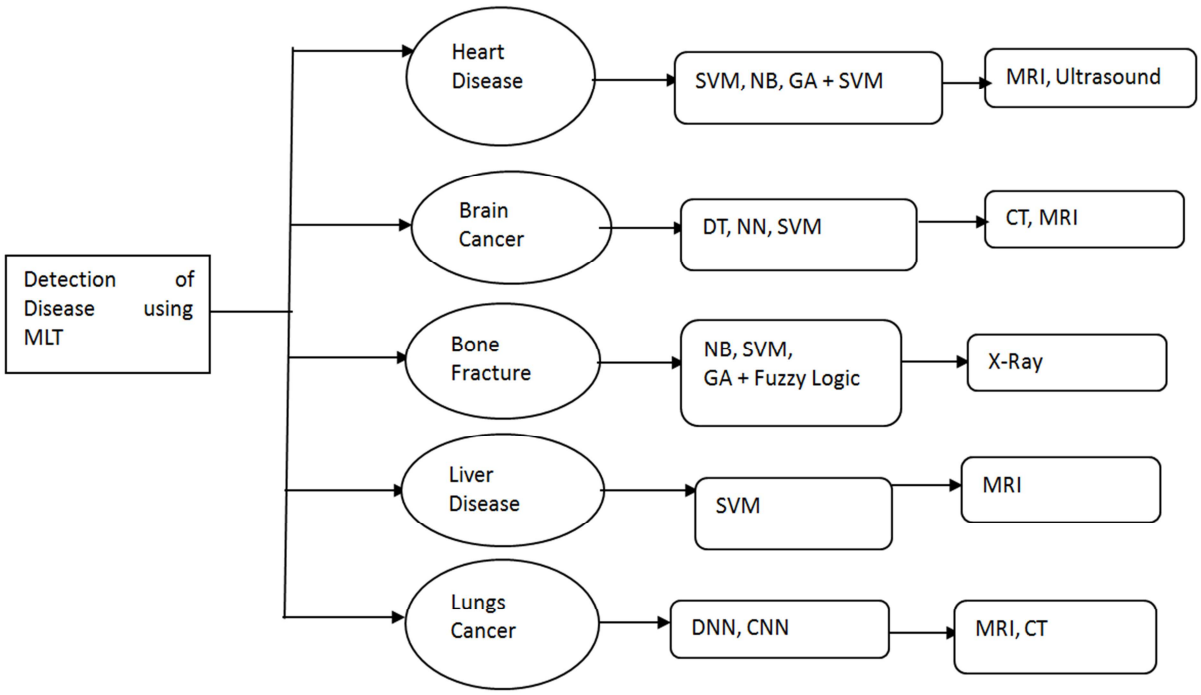

Figure 2. *MLT for Different Disease.*

The most of system use classification model, based on Supervised Learning. The classification models classify input data level into different levels. It use in many application like medical imaging, object detection, speech recognition and credit scoring.

There are two steps procedure for detection of disease using supervised classification learning algorithm in medical image processing:

1) Improvement of image information for human interpretation using image-processing Technique.
2) Processing of medical images like MRI, CT etc. for storage, Transmission and representation for detection of disease, uses machine-learning algorithm.

Figure 3 depict a predictive model using supervised

learning for detecting the disease

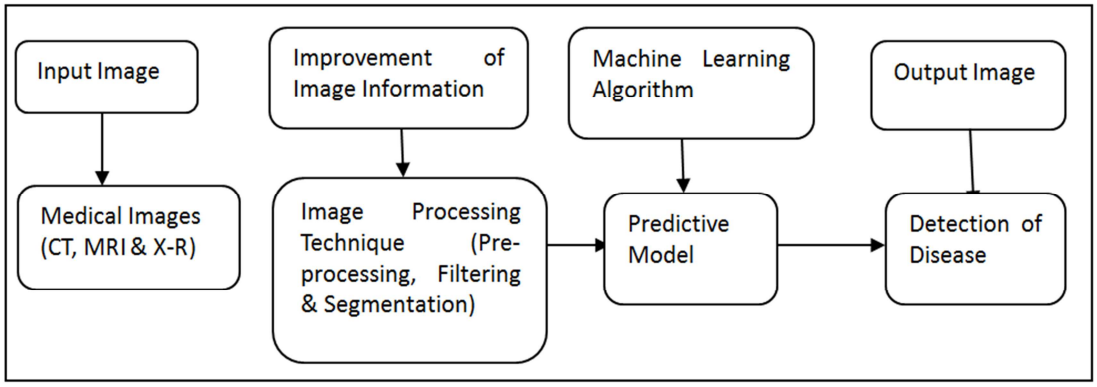

Figure 3. *Supervise Learning Model for Detection of Disease.*

Based on previous patient's data, train a model or develop a predictive model that can predict in advance whether a new person will have any kind of disease like heart attack or liver disease.

5. Conclusion

There are many machine learning algorithms, which comes in the category of supervised and unsupervised like support vector machine, Naive Bayes and nearest neighbor, Neural network, K-means Clustering algorithm used in classification and analysis of medical dataset and it can help to give the best result in healthcare environment. Most of the rising and highly occupied country like India where mortality is high, machine-learning techniques is very useful for physicians to diagnosis, cure disease at early stage, and give better result to patients.

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