Review of Image Classification

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ABSTRACT

Classification deals with the process of categorizing required traits into a systematic arrangement. Evolution in the digital field is taking place all over the world and thus classification of patterns in images became an important part of digital image analysis. The objective of the paper is to study the techniques and algorithms for Image Classification. Most commonly, since recent years Deep learning carries a large scope to deal with the classification of images. Besides this, Convolutional Neural Network is also emerging in the field of image classification.
Keywords: Convolutional Neural Network (CNN), Image Classification, Deep Learning.

1. INTRODUCTION

Recently, computer vision, Machine learning and Deep learning are the emerging technologies. Thus, in the field of computer vision, the concept of Image classification plays a crucial role. Image preprocessing, image processing, image segmentation, extraction of features from the images and identification is included in image classification. Image classification and Image processing being interconnected, image processing involves image restoration and rectification, image enhancement, fusion of images etc. The main objective of classification of images is identification and characterize the images with respect to their colors or respective Gray level, extract the features and allocate the image to themes or thematic classes automatically[1]. The traditional means of feature selection is being eradicated by the latest feature extraction methods. Feature selection filters the irrelevant or redundant characteristics from the dataset and keeps a subset of original features whereas feature extraction deals with capturing the useful information and maintaining a smaller set, but unlike feature selection, feature extraction creates the newly updated subset. And the conversion from traditional feature selection to recent feature extraction and classification is made possible by Deep learning[2]. There are basically two types of classification namely supervised classification and unsupervised classification. The supervised classifications are the one which uses the spectral signatures i.e. the information which is depicted by digital numbers in the spectral bands and classification is done through pixels individually to obtain a thematic "map" of the original image, to classify an image. The spectral signatures are obtained from the training samples that can be used for classification. The unsupervised classifications are the one which detects the clusters in multiband images i.e. a RGB color image which consists of red, green and blue colored images; also referred to as multispectral images. The name unsupervised classifications implies that these are done with no analyst intervention [1]. Deep learning along with Convolutional Neural Networking are often used for classifying the images. Training and Testing are two of the major processes that should be done for any image classification. Training deals with training the network for certain conditions so that under that condition for any input, same task should be carried out by the algorithm whereas testing is to test the algorithm for performance and accuracy with the low computational cost.

2. MOTIVATION

Machine learning, Deep learning, Computer Vision and CNN are becoming very popular now a days. Deep learning and CNN provides a better means of replacing the old traditional techniques with the new one. The trending concept of classifying the images and clustering them is becoming more popular now-a-days. This motivates us to propose this paper which contains study of Image Classification.

3. LITERATURE REVIEW

Tianmei Guo et.al [2] focuses on building a Convolutional Neural Network for classification of images, basically based on minist and cifar-10 with low computational cost. Also, learning rate set and parameters influencing optimal image classification is studied. Deepika Jaswal et.al [1] proposes a CNN algorithm tested on various datasets as per requirements and accuracy. Various types of scenes were identified for testing and training within a low amout of time and gained a good accuracy rate. ROBERT M. HARALICK et.al [3] mainly deals with the textual features that can be computed easily which is based on gray tone spatial dependencies which on analysis produced 80-90% accurate results on the datasets that were applicable. Xiangrong Zhang et.al [4] introduce the textual feature extraction for classification of images in hyperspectral manner. Also proposes an algorithm that works with pixels and classifies the images based on that. The term Bag-of-Visual-Words commonly abbreviated as BOV words considers any image as a document and the features of image as visual words. S.Manthira Moorthi et.al [5] shows the use of Support Vector Machine (SVM) using Machine learning for obtaining high performance satellite images. Based on the tests and results obtained, it is observed that Support Vector Machine SVM has higher performance than other methods.

4. DEEP LEARNING

Deep learning also referred to as deep structured learning is a member of Machine Learning family. It is a machine learning technique that enables building pieces of car that drive itself, makes the computers able to see, translates the languages automatically, able to prescribe medicines and can do any kind of work. It is a learning technique that is learned either in supervised way or in unsupervised way. The word "Deep" in Deep Learning refers to the layers that can be processed in order to represent data in layers of abstraction. [6]. Deep learning has a wide range of emerging technologies in the field of neural networks, artificial intelligence, signal processing and various other open research and development sources [7]. Applications of deep leaning includes Automatic speech recognition to recognize and process the contents of speech if required, Image recognition for classification of images which further can be used for detection and identification, visual art processing, natural language processing for machine translation and language modeling, spoken language understanding , text classifications etc, in the field of medical science for drug discovery and diagnosis, bioinformatics, toxicology, Customer Relationship management, also used in military for training of robots and in various other fields[14].

5. CNN AND IT'S COMPONENTS

A neural network is connections of neurons present in human brain such that they can be modeled with the computer system. The term artificial neural network is obtained from the biological terminology that deals with the nervous system i.e. the brain, to process the information. The neural network terminology is used for pattern identification, detection of current trends and activities that normally humans cannot do [8]. Some of the applications of neural networks are as follows: Detection of frauds associated with credit cards- neural networking in this field is used for detection of fraudulent through pattern detection and credit card usage. Medical applications where neural network is applicable is the detection of cancer cells, spot its locations that are drastically reducing false/negative classifications[9].

Convolutional Neural network is a part of artificial neural networks most probably used in the field of Image classification by clustering them according to their similarities and recognizing objects through different scenes[15]. Components of CNN are as follows: Basically there are three types of Convolutional Neural Network named as convolutional layer, pooling layer and fully-connected layer. **a) Convolutional Layer:** The base layer of any CNN is the convolutional layer which aims to learn extracting the features of the given inputs. Dot product is computed between filtered entries and 2-Dimensional activation map is generated as a output. **b) Pooling Layer:** It is a layer that performs vector to scalar transformation. This layer performs the secondary feature extraction, thus increasing the feature extraction robustness and decreases the feature map dimensions. This layer performs pooling operations. Basically, there are two pooling operations: Average pooling and Max pooling. Average pooling uses aggregate clustered values whereas max pooling uses the maximum clustered value of neurons. **c) Fully-connected Layer:** It is the third Convolutional neural network layer which collects all the previous layer neurons, connecting to each and every active layer neurons. Above layers are only capable of feature extraction and parameter reduction[10],[2].

6. IMAGE CLASSIFICATION METHODOLOGY

Images are the input to the system, which are further converted to a scale of Gray color to extract the data

information. If necessary, the image has to be resized within the required dimensional parameters[11]. Thereafter, the network training is done so that the error in the image and networks can be eliminated so as to get the desired or correct output[12].The trained datasets can undergo either of the two classifications i.e. either in supervised classification or in unsupervised classifications as discussed earlier[13]. After the training phase of the neural networks, testing is performed so that the error rates can be reduced optimizing the performance and accuracy. The gray scale is used to extract data information because these are more mandatory than the colored ones[1]. Thus after all this, the classified image is obtained as the output. This image classification method categorizes the classification by image preprocessing, image sensors, feature extraction, feature computation, object detection etc.
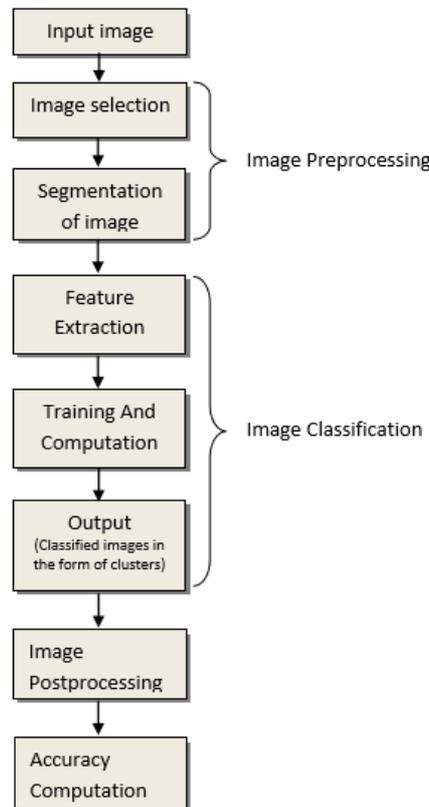
Figure 1 Image Classification Methodology

7. CONCLUSION

   In this paper we have reviewed different existing methods of image classification that are used to classify images based on pixels and colors. The first half of the paper explains the Deep learning technique. Next the CNN algorithm is explained for image classification. The second half gives the brief description of Image classification methodology. And finally the component of CNN is explained.

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