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A Survey on Object Recognition and Classification

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ABSTRACT: For image understanding, object recognition and classification are two key tasks and have attracted much attention in the past decades. The objective of this paper is to understanding a framework of algorithms using digital image processing and machine learning techniques for the recognition and classification of an object. Prior to that, related techniques for image processing and machine learning will be reviewed in order to identify the most suitable approach for the recognition and classification of an object.

KEYWORDS: Object recognition; Object classifications.

I. INTRODUCTION

World is evolving very fast every single day. All the scientific areas have affected because of Rapid development of the computer technology. People got interested in the possibilities of information technology and they have noticed that with daily tasks computer can help them. This need has motivated software programmers to create new systems that would incorporate the ease of use with the effectiveness of work [1]. For biological visual systems, visual object recognition and classification are natural and effortless, but in computer vision systems it is exceedingly difficult to replicate. Because of the large variability in images of different objects within a class and variability in viewing conditions, this difficulty arises.

A. Object Recognition

In the real world humans can recognize any object easily without any efforts; on contrary machines by it cannot recognize objects. Since childhood, object recognition is one of the most fascinating abilities that humans easily possess. Humans are able to tell its identity or category despite of the appearance variation due to change in pose, texture, illumination, deformation, and under occlusion with a simple glance of an object. Furthermore, humans can easily generalize from observing a set of objects to recognizing objects that have never been seen before. Object recognition techniques need to be developed which are less complex and efficient because algorithmic descriptions of recognition task are implemented on machines; which is an intricate task. Object recognition is one of the fundamental challenges in computer vision. In an image,object recognition is basically an attempt to mimic the human capability to distinguish different objects [2].

The modern world is enclosed with gigantic masses of digital visual information. Image analysis techniques are major requisite to analyse and organize these devastating ocean of visual information. In particular useful would be methods that could automatically analyse the semantic contents of images or videos. The content of the image determines the significance in most of the potential uses. The objects in the image is one important aspect of image content. So there is a need for object recognition techniques. To obtain good performance levels object recognition systems need effective image descriptors [3].

B. Object Classification

Object Classification (OC) is a task which has wide spread use in various applications such as vehicle parking systems, object tracking, biometric applications such as face detection systems, optical character recognition, finger print recognition, classification of abnormalities in medical images, surveillance purposes and many computer vision applications. A number of methods have been used for this purpose. For face recognition and characterization, generative models such as principal component analysis, karhunen-loeve procedure and eigenimages were used. A lot of other technologies like Hessian Matrix, Difference of Gaussian, Entropy Based Salient Region detectors *etc*. are used in many systems for object classification. The basic steps remain the same throughout all

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the systems which are first the training and then the testing stage. The method used for feature extraction is the most important step. In the representation of an objects features are used as the elementary units. These can be local features that measure metric properties of objects like measuring oriented lines, brightness or colour, corners, T-junctions *etc*. or global features that only represent qualitative characteristics of objects like 3D component parts realized as simple volumes that roughly capture the actual shape of an object [2].

II. LITERATURE SURVEY

P. Chang et. al [4] detailed the colour co-occurrence Histogram (CH) is an effective way to represent objects for recognition in images. It permits a variable amount of geometry to be added to the regular colour histogram by keeping track of pairs of pixels. Also they approximated its false alarm rate by analysing the algorithm and use this to set some of the algorithm's adjustable parameters. Their results show that the algorithm works in spite of confusing background clutter and moderate amounts of occlusion and object flexing.G. Ramesh et. al [5] detailed a system that uses a series of loosely coupled stages run across a distributed cluster environment. The lowest levels of this system are analogous to the biological specialization that exists in the brain, and the upper levels attempt to mimic the cognitive stages of perception in a simplistic manner. However,this system is still very much in the theoretical stages. In the short term, more research will be done on developing the signal processing techniques that the lower levels of the system will use to perform the initial stages of perception. In a visual environment, mathematical techniques can also be used to aid the recognition of objects.To match objects based on qualitative measures, topological studies can be used to attempt. While to determine what degree of set membership must be met before an object can be identified statistical analysis techniques can be used. When combined these techniques with certain elements of computational intelligence, it can produce a system that visually recognize an object without human intervention. G. Shobha et.al [6] proposed a method to extract the key frames, detect the moving objects. To content base video retrieval, they apply the technology of moving-object tracking. Also to detect moving pixels, they used background subtraction algorithm. The work can be done in eliminating shadows from the video apart from moving object detection.R. Raneet. al[7] presented shape context, colour histogram and completed local binary pattern(CLBP) approaches to categorize different classes of objects. Shape Context gives 93% accuracy on ETH-80 database which is better than other approaches. The results obtained can be improved further by using better feature extractors and by using the combination of shape and colour descriptor or shape and texture descriptor.S. Kim et. al[8] presented an object categorization method focusing on surface markings in the bag of visual words framework. They can minimize the effect of surface markings based on the entropy of the codebooks. High entropy in the intra-class codebook can remove surface marking parts (low entropy) in stage one learning. Additionally, a discriminative codebook is also selected from the category specific codebook guided by the entropy of the inter-class codebook. The high entropy codebook is removed first because it gives ambiguous class labels. Finally, using NNC (Nearest Neighbour Classifier) and SVM (Support Vector Machine) classifiers with different distance metrics, they evaluated those codebooks. They can get upgraded performance in the bag of visual words framework with the optimal set of features, codebooks, and classifiers.This work for codebook selection and classification can be applied to other complex categorization methods.A. F. Otoomet. al [9] evaluated the performance of different feature sets for the aim of determining the best feature set that proves more useful of accurate classification of abandoned objects. Based on the experimental results obtained, they conclude that the results of their approach for classification based on statistics of geometric primitives feature set outperforms the other two approaches that are based on SIFT (Scale Invariant Image Transform) key points using various classification and evaluation schemes. Classification based on statistics of geometric primitives with 10-fold cross-validation provides on average 22% higher recognition accuracy and 7% lower false alarm compared to the second best approach based on SIFT key point histograms. The illustrative analysis provided in this paper also demonstrates that statistics of geometric primitives maximize between-class separation and thus simplify the classification process.L. Yang et. al [10]proposed a novel framework that unifies visual codebook generation with classifier training for object category recognition. Two key features distinguish this work from existing approaches for object category recognition. First, they encode each image feature by a vector of visual bits unlike the clustering approaches that associate each image feature with a single visual word. Second, in contrast to the standard practice that separates the processes for visual codebook generation and classifier training, the proposed approach unifies these two processes in a single optimization framework under one objective function. An iterative algorithm is presented to efficiently identify the optimal visual bits and their associated weights. Experiments on the PASCAL 2006 dataset demonstrate for object category classification, the proposed unified approach is a significant advance over state-of-the art approaches.Y. Fan et. al [11] evaluated a new method for image classification problem using probability models based on local appearance and context information which providing robustness to occlusion and clutter backgrounds. To select the most salient and distinct image patches, they first extract the local appearance feature and then train an efficient part SVM classifier. Next to guarantee a better classification result, they extract the context constraint information around distinct image patches. Finally, they build simple and general probabilistic models to implement object class recognition. Their experiments, conducted on a number of popular benchmarks, show strong and competitive performances with the best results. Noted that their approach is able to learn the same objects similarly to humans do and very good classification results were gave when classifying several benchmarks even under scale object class. Moreover, they achieved better results learns with very few training samples per object category compared to several previous approaches. E. Kim et. al [12] proposed a scalable framework that categorizes 3D objects in range images and expands to handle new data. For fast labelling and online inference, they employ a hierarchical model of object classes. Its tree structures and distributions are automatically inferred from given range images in an unsupervised manner.Their labelling approach using PfN visual vocabulary improves the performance, and the online inference process recognizes a path which corresponds to the new data and updates the part of the tree associated with the path.G. Wang et. al [13] presented a method of using comparative object similarity to help learn object models with few or even no positive training examples. Here, the system adapts state-of-the art categorization and detection systems to incorporate object similarity constraints. But note that the model is wholly general and can be applied to a wide variety of problems. For object categorization, experimental results show that their method leads to significant improvements on recognizing hundreds of categories with few or no training examples. For object detection, their proposed approach shows improvement on a benchmark detection dataset when using a small number of positive training examples. M. Mokjiet. al [14] detailed a new technique for GLCM (Gray Level Co-occurrence Matrix) computation based on Haar wavelet transform. Computing the GLCM based on Haar wavelet transform has the ability to reduce the computational burden in terms of pixel entries up to 62.5% reduction. In terms of performance measurement, Haar wavelet transform does not only reduce the computational burden but also increase the classification accuracy of Brodatz texture images when compared to the original computation. M. Mustafa et. al [15] evaluated Gray Level Co-occurrence Matrix (GLCM) texture feature were extracted from spectrogram image and then Principal components analysis (PCA) was employed to reduce the feature dimension. The kNN was able to classify EEG spectrogram images with a success rate of 70.83% for three classes. It also shows that Index 4 gives the highest score with 79.17% among the three classes. It was observed that, when the value of k is increased, classification rate will be high and the correct classification for large samples will be high while the small samples will be low. Y. Jian [16] proposed a novel texture image segmentation method based on clustering by Gaussian mixture models (GMM) and extracting texture features by gray level co-occurrence matrix (GLCM). The experiment results detailed that the proposed method can get satisfactory segmentation results and convergence speed.F. Mirzapouret. al [17] tried to utilize two well-known methods for extracting texture features from single-band satellite images: GLCM and Gabor filters. GLCM method, even though have good performance in texture feature extraction, is very time consuming. Here they proposed a fast GLCM algorithm which significantly improved the speed of GLCM: about 180 times faster for images with large connected areas of the same texture, and at least 30 times faster for images with small connected areas of the same texture. This increase in speed was obtained while preserving the quality of extracted features. The average ML classification accuracy using the extracted features was used as a measure of the quality of the features. The classification results showed that Gabor features are more powerful in areas close to class borders, while GLCM features are preferable in the areas within classes. Using these findings, they could test the idea of fusing these two types of features in order to benefit the advantages of both. The implementation results confirmed the idea. O. Rockinger [18] proposed a novel method based on a shift invariant wavelet transform which is for the fusion of spatially registered images and image sequences. This method results are best for the fusion of image sequences, in a shift invariant fusion scheme. In both the fusion of still images and image sequences, the proposed method performs the standard wavelet fusion scheme. V. Daoet. al [19] detailed that neural network techniques could be used in intrusion detection of controlled input data files. With the generated data, the conjugate gradient descent BP and the quasi Newton BP can detect the intruders in real time. These two methods only required an average of 6 CUs (command inputs). The performance of the BP methods depend on the neural networks topology. Thus with a given input data file, one should experiment with different topology to get the best performance.

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III. CONCLUSION

For biological visual systems, visual object recognition and classification are natural and effortless, but in computer vision systems it is exceedingly difficult to replicate. This problem arises,because of the large variability in images of different objects within a class and variability in viewing conditions. This paper first introduces importance of object recognition and classification. We have surveyed about different object recognition approaches and classification methods. This survey provides theoretical knowledge about different recognition and classification approaches.

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