Object Class Recognition Using Surf Descriptors and Shape Skeletons

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Abstract. This paper presents a method to classify new objects with SURF descriptors and shape skeleton of objects in dataset. The objective of the research is to classify all objects which exist in all images. Stages in this method are consisting of three main stages: image segmentation, object recognition and object class recognition. The region of interest in this method is used the saliency based region selection. In this paper, SIFT and SURF also compare in aspects of speed and recognition accuracy too. The result has shown SURF cluttered dataset has a better accuracy and it is faster. Also for object class recognition purpose shape skeleton would help to classify same category objects. Finally the outputs will be train with fuzzy logic to make an accurate decision making. Results have shown the accuracy improved up to 94%.

Keywords: SURF, Object class recognition, Fuzzy Logic, Object Recognition, Shape Matching, Skeleton, Object Classification.

1 Introduction

Pattern recognition is integral to a wide spectrum of scientific disciplines and technologies application which includes Optical Character Recognition (OCR), Biometrics, Diagnostic systems and Military applications [1]. There are two types of object recognition, recognition of specific object and recognition of generic object. In the case of specific object recognition the vision system tries to detect well known objects such as Egyptian Pyramids, PETRONAS Twin Towers, whereas in generic object recognition the recognition is considered by the various appearance of an object of different types of an object in a similar class. In this study, generic object recognition is considered and if the object recognition process could not be successful the object must be classified as a new object. Definition of object class recognition and object recognition will help us to avoid confusion. Object classification is the detection and classification of any object, which is a member of a given set of abstract classes into one such abstract class. The important difference here is twofold; first, any object, even previously unseen objects shall be classified correctly, and second, the object
class is an abstract class such as “car”, “fruit”, etc. In general, object classification is a more difficult task than object recognition [2].

The method has three main stages: i) image segmentation, ii) object recognition, iii) object class recognition. To segment input images and find the region of interest, the saliency based visual attention proposed by [3] has been used. SURF [4] (Speed Up Robust Feature) is used for object recognition purpose and shape skeletons method [5] will be used for object class recognition. Shape matching has an essential role in object classification and in this work is the main component of fuzzy decision making whereas SURF descriptors plays the minor role.

The framework of this paper is including related papers that review some recent works of object recognition and object classification, methodology to describe the method in details, result and discussion to provide the results of the method and conclusion of the current work.

2 Related Works

2.1 Object Recognition and Learning

There many object recognition methods in pattern recognition area of research and each on is designed for particular purpose. Within all of object recognition methods some of them like SIFT[6], PCA-SIFT[7] and SURF are proposed for general purpose and they are the most famous methods but they have some incompetence which will be described later. [8] had a good comparison between those three algorithms in case of accuracy of recognition, speed, differences in illumination of image and so on. In principal, all the methods are dividing in two parts i) object recognition for general objects and ii) object recognition for specific objects. Object recognition for specific purpose is considering particular objects in images like pedestrian detection whereas generic object recognition considers all objects in images. Also object recognition can be used for single object or multiple objects. There are many approaches which some listed in this part; e.g. a connectionist model was presented by [9] to detect and learn multiple objects in images and [10] presented a learning method considering multiple views of multiple objects in images. A Hough Transform based framework developed by [11] for object recognition. The framework solved the multiple extermas identification problem in Hough images. Multiple instance learning (MIL) is an approach which is used by [12] for object recognition. The method also discriminates objects form background in new images. [13] developed a new framework to detect objects especially for face detection. The method first extract image features using image integral and then select features by adaboost algorithm but [14] used Boosting technique to detect and to learn of generic objects.

2.2 Object Classification

Basically object classification is highly depends on similarity between same category objects. As [15] introduced a visual similarity based method for object categorization according to human behavior to find relationships between visual similar objects.