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Object/Pattern Identification and its Survey

T.R.Vijaya Lakshmi
MGIT

ABSTRACT

A good pattern recognition system depends on the requirements of the application, extracting relevant features to improve the classification accuracy in recognizing the objects. The task of the feature extractor is to produce a representation about the data that enables an easy classification. On the other hand, the task of the classifier is to produce the best classification accuracy given the extracted features. Clearly, these two stages are interdependent from the application point of view. This work reports the survey on object/pattern identification which is a crucial task in the area of pattern recognition.

Keywords

2D-DWT, Battle field, pre-processing, post-processing,

INTRODUCTION

The application of pattern recognition is related to a battle field. After the video frame is extracted, the objects in the image are to be identified and classified based on shape, structure and if required texture. This extracted frame is an ordinary image of MxN size with M rows and N columns.

In this work, classification techniques like Artificial Neural Network (ANN), Decision Tree (DT), Support Vector Machine (SVM) and Fuzzy Classification are to be used and tested and new methods to be proposed for better performance. It is assumed that specific image frame can be extracted from LiDAR images by using the existing methods and controlling the frame rate of the video.

The features of the different objects like tank, tree, or a soldier have to be selected and extracted for all these objects set. The set of features may be transform based, zone based or statistical approach. The objects of interest are the tank and the human being in a war field.

The task of the pattern recognition system is to classify an object into a correct class based on the measurements about the object. Many pattern recognition systems can be thought to consist of five stages: pattern acquiring or sensing or measurement, pre-processing and segmentation, feature extraction, classification and post-processing. A majority of these stages are very application specific. They are discussed as follows.

Objects

The objects or inputs to the pattern recognition system can be a DNA/Protein sequence, points in multi-dimensional space, text document, document image, intensity or range image, video clip, face, iris, fingerprint, multispectral image, speech waveform, scanned image etc.

Pattern acquiring

Acquisition or sensing refers to some measurement or observation about the object to be classified. For example, the data can consist of sounds or images and sensing equipment can be a microphone array or a camera. Often one measurement (e.g. image) includes information about several objects to be classified. For instance, to recognize a group of objects in an image, classification of several objects is to be done, to recognize the objects of interest. The data is probably an image including the sub images to be classified and some background that has nothing to do with the pattern recognition task.

Pre-processing

Pre-processing refers to filtering the raw data for noise suppression and other operations performed on the raw data to improve its quality. In Segmentation, the measurement data is partitioned so that each part represents exactly one object to be classified. For example, in recognizing group of objects in an image, all the objects need to be divided into sub images representing the particular object of interest. The set of the features of this segmented object is represented as a vector which is called a pattern vector.

Feature extraction

Especially when dealing with pictorial information the amount of data per one object can be huge. A high resolution photograph can contain 1024 X 1024 pixels. The pattern vectors with this combination will have more than a million components. The most part of this data is useless for classification. In feature extraction, features that best characterize the data for classification. The result of the feature extraction stage is called a feature vector. The space of all possible feature vectors is called the feature space.

In addition to mathematical/ computational/ statistical techniques, feature extraction can be performed heuristically by picking such features from a pattern vector that could be assumed to be useful in classification. Sometimes, dimensionality of the input data is very limited and the pattern vector can be chosen as the feature vector. Feature extraction is highly application specific although some general techniques for feature extraction and selection have been developed.

The task of the feature extractor is to produce a representation about the data that enables an easy classification. On the other hand, the task of the classifier is to produce the best classification accuracy given the extracted features. Clearly, these two stages are interdependent from the application point of view. The best representation for the data depends on the classifier applied.

Classification

The classifier takes the feature vector as an input which is extracted from the object to be classified. It places then the feature vector (i.e. the object) to class that is the most appropriate one. In recognizing group of objects, the classifier receives the features extracted from the sub-image containing just one object and places it to one of the classes. The classifier can be thought as a mapping from the feature space to the set of possible classes. Classifier cannot distinguish between two objects with the same feature vector.

Post-processing

The final task of the pattern recognition system is to identify/classify the objects of interest with high recognition accuracy. The post-processor uses the output of the classifier to decide for the action to be taken in the battle field.

The design of a pattern recognition system is an iterative process. If the system is not good enough, then the process repeats to go back to the drawing table and try to improve some or all of the five stages of the system. After that the system is tested again and it is improved if it still does not meet the requirements placed for it. The process is repeated until the system meets the requirements. The design process is founded on the knowledge about the particular pattern recognition application, the theory of pattern recognition and simply trial and error.

A good pattern recognition system depends on the requirements of the application, improved feature vectors to improve the classification accuracy and to improve the classifier. When designing a pattern recognition system, there are other factors that need to be considered besides the classification accuracy. For example, the time spent for classifying an object might be of crucial importance. The cost of the system can be an important factor as well.

The flowchart to identify objects from the video of a war field is shown in Fig.1. A moving aircraft captures the video of a war field scene and from that video extraction of image will be done by controlling the frame speed. The extracted image is applied to a pattern recognition system, for finding the required objects of interest like tanks or soldiers. The time required for data acquisition, feature extraction and object identification should consume very less time in the order of micro or milliseconds, apart from high recognition accuracy.

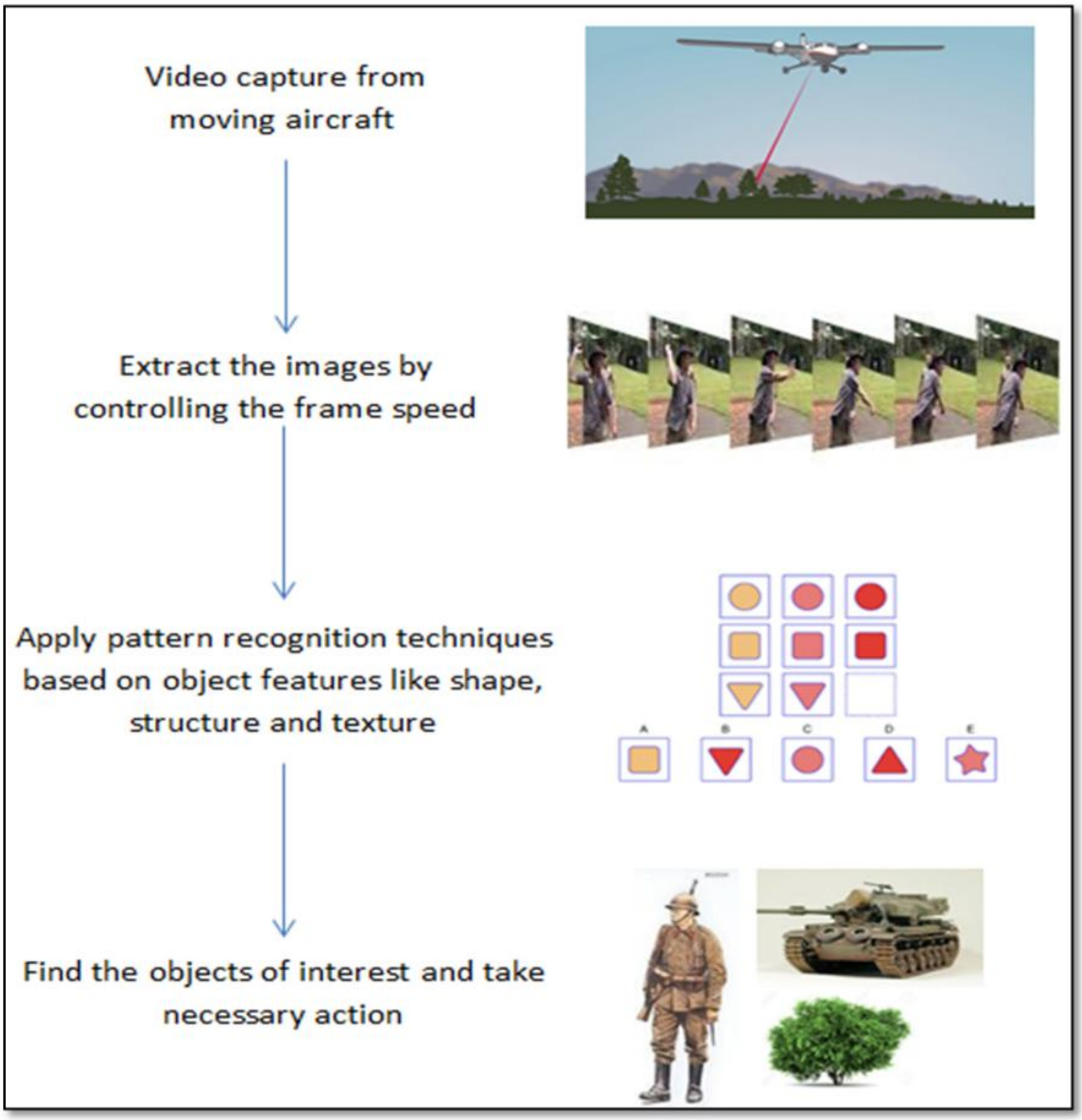

Fig.1: Flowchart to identify objects in war field

SURVEY

Mark Brown et al [1] have presented a novel, information-theoretic salient line segment detector and this approach detects lines that define regions of significant divergence between pixel intensity or colour statistics. This results in a novel detector that naturally avoids the repetitive parts of a scene while detecting the strong, discriminative lines present.

A.D. Reddy et al [2] have used multi-temporal LiDAR to obtain pre- and post- fire elevations and estimate soil carbon loss caused by the 2011 Lateral West fire in the Great Dismal Swamp National Wild life Refuge, VA, USA. Also determined how LiDAR elevation error affects uncertainty in our carbon loss estimate by randomly perturbing the LiDAR point elevations and recalculating elevation change and carbon loss, iterating this process 1000 times.

Sergejs Kodors et al [3] have applied the energy minimization approach to solve the object recognition problem using the natural images that is proved by the experiment of the building recognition method, which is based on the energy minimization approach. This method showed the classification accuracy, which is equal to 0.76 of Cohen's Kappa Coefficient. The correctly classified area is equal to 98% and the correctly detected area of the buildings is equal to 83%.

Ananda Kumar M. Ramiya et al [4] have proposed to use open source point cloud library (PCL) for 3D segmentation of LiDAR point cloud and presents a novel histogram based methodology to separate the building clusters from the non-building clusters. The methodology has been applied on two different airborne LiDAR datasets acquired over part of urban region around Niagara Falls, Canada and southern Washington, USA. An overall building detection accuracy of 100% and 82% respectively is achieved for the two datasets.

Shreyamsh Kamate et al [5] eminently utilized the information captured by Unmanned Aerial Vehicles (UAVs) in detecting and tracking moving objects which pose a primary security threat against the United States southern border and implemented intelligent visual surveillance systems to assist the human operators, which help in detecting and tracking suspicious or unusual events in the video sequence.

Jonatan Berglund et al [6] have evaluated 3D imaging and the C2M (cloud-to-mesh) algorithm for assessing the validity of virtual production system models where most models are "as-designed" and suffer from geometrical errors stemming from deployment alterations.

Vijaya Lakshmi et al [7, 8, 9] have proposed a novel recognition approach which considers the additional features like depth of indentation which is directly proportional to the pressure applied by the scriber on the palm leaf. This depth of indentation is considered in the Z-direction measuring in nanometers. The background of the palm leaf is eliminated using this special feature.

T.R.Vijaya Lakshmi et al [10] described the handwritten character recognition of Telugu language using two-stage classifiers with k-Nearest Neighbor (k-NN) and Support Vector Machines (SVM) classifiers one after the other in two subsequent stages which increases the recognition accuracy of the system. Using these two classifiers the best recognition accuracy obtained was 90.2%.

CONCLUSION

The steps involved for recognizing objects in the battle field are described in this paper. The overview of the work carried out on military applications is also addressed. Object/ pattern identification is a crucial task in the area of pattern recognition. In future the work will be extended to identify the objects captured from a surveillance camera in the battle field.

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