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LBP FEATURES BASED OBJECT RECOGNITION BY USING HOG ALGORITHM

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Abstract

Recognition of an object is a basic application domain of image processing and computer vision. The term "Object Recognition" is usually the task of finding a given object in an image or video sequence. Human can recognize the objects with little effort. However, it is a challenging task for computer vision systems due to the variations in size, shape, and structure of objects in an image. In this paper, an efficient approach for object recognition is proposed. The recognition system is of two phases namely training and the testing phases. Here both the phases consist of similar process like pre-processing and features extraction and the testing phases consist of one addition step of classification stage. The Histogram of Oriented Gradients (HOG) algorithm for the extraction of Local Binary Pattern (LBP) features. Then the classification is done by using the Support Vector Machine (SVM) classifier. The evaluation of the system is carried on using the own real time object database images that are captured by the camera. The classification performance of the proposed HOG algorithm based object recognition system is evaluated in terms of classification accuracy.

Keywords: Object recognition, Histogram of oriented gradients algorithm, Local binary pattern features, Support vector machine classifier.

Introduction

Object detection is the process of finding instances of real-world objects such as faces, bicycles, and buildings in images or videos in computer vision. Object detection algorithms typically use extracted features and learning algorithms to recognize instances of an object category. Image recognition is the process of identifying and detecting an object or a feature in a digital image or video. This concept is used in many applications like systems for factory automation, toll booth monitoring, and security surveillance.

Computer vision is the science that aims to give a similar, capability to a machine or computer. Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images.

Real-time indoor surveillance based on Smartphone and mobile robot is described in [1]. This paper determines the application of image process and distance computation to WMR obstacle avoidance and parking control [2]. The paper [3] illustrates the dynamic window based approach to mobile robot motion control in the presence of moving obstacles. Improving the path following performance of mobile robot with genetic algorithm is done in paper [4]. Intelligent path planning and parking control of a wheeled mobile robot is determined in [5]. Intelligent path planning and parking control of a wheeled mobile robot are explained in [6]. Integrated person tracking using stereo, color, and pattern detection is determined in [7]. Online spatio-temporal pattern recognition with evolving spiking neural networks utilizing address event representation, rank order, and temporal spike learning is illustrated in [8]. Impact of sensor misplacement on dynamic time warping based human activity recognition using wearable computers is determined in [9]. A new method for detection and description of space-time interest points for human activity classification is discussed in [10]. Object recognition using discriminative parts is explained in [11]. Group sensitive multiple kernel learning for object recognition is illustrated in [12].

Methodology

A system of MATLAB with all the robot and camera controls is developed in this study. A database of all the images of the objects are created and preserved. This database is interfaced with MATLAB. The images of objects were assigned with different object ID. These images can be accessed using that ID nos. when the system operator wants to get one object, the inputs the

corresponding object ID no. Then the MATLAB process matches the product ID with its image in database and it sends a start command. The MATLAB process running on the PC collects each image and compares with the image extracted from the database using Real Time HOG algorithm, until a match is found. If there is any match, the MATLAB process sends a stop command, which will end the surveillance process. If not, it issues a new start command, extending the surveillance. The block diagram of the proposed system is shown in the figure 1.

Block Diagram:

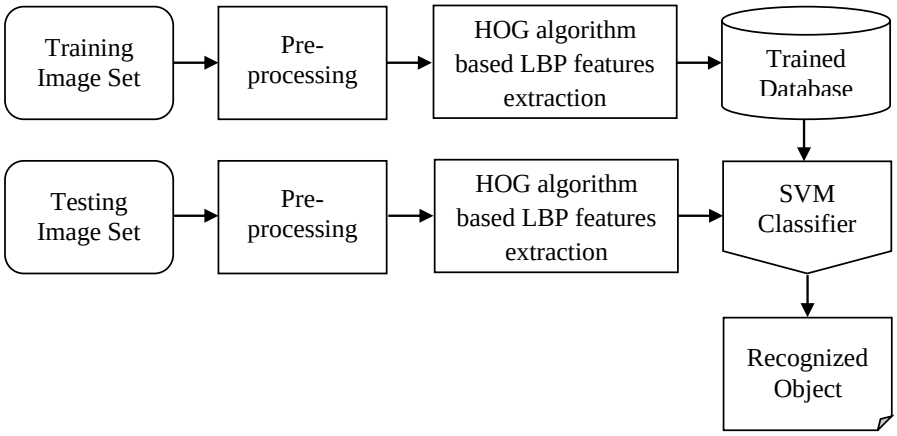

Figure 1 HOG Algorithm Based Object Recognition System

Preprocessing:

The above block diagram of the proposed system it is understood that how the recognition of the object is done. Here the image recognition starts with the help of trained images from the training image set. The image in that training dataset will be preprocessed. The preprocessing is done by performing the action of noise reduction by removing the unwanted noise from the dataset images. This preprocessing will be done before the extraction of LBP

features with the help of HOG algorithm. By the same way the live image will be taken in real time and it will be preprocessed. After this step the image will be processed with the help of HOG algorithm.

HOG Algorithm:

Histogram of oriented gradients is a feature descriptor used to detect objects in computer vision and image processing. The HOG descriptor technique counts occurrences of gradient orientation in localized portions of an image detection window, or region of interest implementation of the HOG descriptor algorithm is as follows:

1. Divide the image into small connected regions called cells, and for each cell compute a histogram of gradient directions or edge orientations for the pixels within the cell.
2. Discredite each cell into angular bins according to the gradient orientation.
3. Each cell's pixel contributes weighted gradient to its corresponding angular bin.
4. Groups of adjacent cells are considered as spatial regions called blocks. The grouping of cells into a block is the basis for grouping and normalization of histograms.
5. Normalized group of histograms represents the block histogram. The set of these block histograms represents the descriptor.

To calculate a HOG descriptor, we need to first calculate the horizontal and vertical gradients; after all, we want to calculate the histogram of gradients. This is easily achieved by filtering the image with the following kernels.

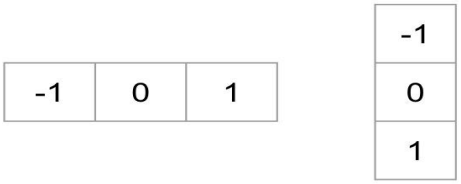

Figure 2 Horizontal and vertical calculation model of gradient in an image

Next, we can find the magnitude and direction of gradient using the following formula.

$$g = \sqrt{(g^2x+g^2y)}$$

$$\Theta = \arctan(gy/gx)$$

Local Binary Pattern

Local binary patterns are a type of visual descriptor used for classification in computer vision. It has since been found to be a powerful feature for texture classification; it has further been determined that when LBP is combined with the histogram of oriented gradients descriptor, it improves the detection performance considerably on some datasets.

- The LBP feature vector, in its simplest form, is created in the following manner:
- Divide the examined window into cells (e.g. 16x16 pixels for each cell).
- For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
- Where the center pixel's value is greater than the neighbour's value, write "0". Otherwise, write "1". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
- Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center). This histogram can be seen as a 256-dimensional feature vector.
- Optionally normalize the histogram.
- Concatenate (normalized) histograms of all cells. This gives a feature vector for the entire window.

After this process is done features are stored as the trained database and the features are used as an input for the SVM classifier later.

Support Vector Machine Classifier

In machine learning, support vector machines SVMs, (also support vector networks) are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. Given a set of training examples, each marked for belonging to one of two categories, an SVM training algorithm builds a model that

assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces.

In this paper SVM is used to compare and classify the stored database image and the real time image that will be from the HOG algorithm output. PC collects each image and compares with the image extracted from the database using Real Time HOG algorithm, until a match is found. According to the image comparison if the object is found correct then the stop command will be executed and the mat lab will receive the command and the execution will be stopped.

Result and Discussion

The presented work is implemented on real time object images that include the industrial appliances and materials etc. This real time complete image set is collected from external web source. From this input set, the partial objects are obtained by performing the object level segmentation. This segmented partial object is extracted using the image processing tool. Different sample sets are composed using the complete and partial images. The previously stored image set is considered as the training set and the real time image set is considered as the testing set.

TABLE: 1 Description of Dataset

Properties	Values
Resolution (Training)	256x256
Resolution (Testing)	Random
Type	Grayscale
Type of Images (Training)	Real Time Object Images
Type of Images (Training)	Real Time Object Images

Type of Images (Testing)	Real time Partial Object Image
Number of Training Instances	50
Number of Testing instances	30

The results of our proposed system are obtained, in the form of recognition rate. When the complete object dataset is considered as the input image for same size sample set, all the images provided the true recognition and it gives about 100% recognition rate. When the partial object at the same orientation is considered with a sample set of 30 images, 27 images provided the effective accurate recognition. It shows that the work has provided good recognition rate for such sample set. When the partial set is taken from different orientation and a sample set of 30 images is considered for recognition, it provided the accurate recognition for 25 images.

Table 2 Performance of the HOG algorithm based object recognition

Average accuracy in percentage (%)				
10^0	**30^0**	**45^0**	**60^0**	**90^0**
87.19	79.87	64.45	58.89	50.44
87.22	74.22	64.11	55.55	50.11
88.44	82.55	80.22	79.66	77.69
96.22	89.88	87.55	71.22	66.55
97.81	96.45	88.45	77.44	64.23

Conclusion

In this paper, an approach for the recognition of objects from real time images using HOG algorithm based LBP feature extraction is presented. As HOG algorithm based LBP gives a better approximation of images, it produces an excellent performance for object recognition. The features from both the training and the testing phases are fused together and given as the inputs to the SVM classifier where the recognition of object is done. Experimental results show that the proposed fusion approach produces 97.81% accuracy.

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