Land Cover Type Recognition for Satellite Images using PHOG

Ashwitha A
Assistant Professor, Department of Computer Science,
SDMIT Ujire, Dakshina Kannada.

Prashanth HL
Senior Software Engineer, Betsol Software Pvt India Ltd,
Bangalore.

Abstract- Satellite images aid in showing what cannot be measured or seen. Defining and locating various types of society-land cover interactions for study may pose new challenges for social scientists. Here we proposed to use Pyramid Histogram of Oriented Gradients (PHOG) as the features extracted for land cover type recognition. Different objects features needs to be extracted on the satellite images using the PHOG. The features of the PHOG and using a publicly available dataset demonstrated that the PHOG with a significantly shorter vector length could achieve a high recognition rate. Furthermore, the features extracted from PHOG are clustered using the clustering algorithms and the training dataset is created to detect and recognize the objects in the satellite image.

Keywords – PHOG, HOG, K-means, Histogram, Canny.

I. INTRODUCTION

In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus one part of an image (region) might be processed to suppress motion blur while another part might be processed to improve colour rendition. The most requirements for image processing of images is that the images be available in digitized form, that is, arrays of finite length binary words. For digitization, the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display

A. Satellite Image Processing

Aerial and satellite imagery are usually the most cost efficient means of collecting regular and frequent data about the earth's surface. These data are routinely used to monitor land use change, urban expansion, agricultural health and productivity, the status of urban tree corridors, fire threat, species distributions, environmental condition and many, many other phenomena. Satellite images have many applications in meteorology, agriculture, geology, forestry, landscape, biodiversity conservation, regional planning, education, intelligence and warfare. Images can be in visible colours and in other spectra. There are also elevation maps, usually made by radar images. Interpretation and analysis of satellite imagery is conducted using specialized remote sensing applications.

B. Pyramid Histogram of Oriented Gradients

Processed satellite images have different scientific and need based applications in the field of agriculture, geology, forestry, biodiversity conservation, regional planning, education, intelligence and warfare. Here we proposed to use Pyramid Histogram of Oriented Gradients (PHOG) as the features extracted for Land cover type recognition for satellite images.

To further improve the recognition performance, PHOG and any clustering algorithm methods are combined and achieved the best recognition rate, indicating a good value of the PHOG features for land cover type recognitions.

The essential thought behind the Histogram of Oriented Gradient descriptors is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The implementation of these descriptors can be achieved by dividing the image into small connected regions, called cells, and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell. The combination of these histograms then represents the descriptor

C.PHOG Features

The PHOG descriptor consists of a histogram of orientation gradients over each image sub-region at each resolution. The details of extracting PHOG features are as follows.

Step 1: The entry satellite images of our system are initially converted into gray level. They are then normalized according to the brightness information. Extracting edge contours for the gray level image. Giving a sample image, edge contours of the image are extracted first for further processing. The information of edge contours is a description of shape. In this study, the edge contours were extracted using the Canny edge detector.

Step 2: The image is divided into cells at several pyramid level. The grid at level l has 2^l cells along each dimension.

Step 3: The HOG for each grid at each pyramid resolution level was computed. Local shape is represented by a histogram of edge orientations within an image sub-region quantized into K bins. Edge contours were located in step 1, and the orientation gradients were computed at edge contours in the original image. The orientation gradients were computed using 3X3 Sobel mask without Gaussian smoothing. The contribution of each edge was weighted according to its magnitude with a soft assignment to neighboring bins in a manner similar to SIFT. Each bin in the histogram represents the number of edges that have orientations within a certain angular range.

Step 4: The final PHOG descriptor for an image is a concatenation of all the HOG vectors at each pyramid resolution. The concatenation of all the HOG vectors introduces the spatial information of the image. Each HOG is normalized to sum to unity taking into account all the pyramid levels.

II. RELATED WORK

The pyramid HOG representation is inspired by the success of HOG in human detection. The most significant work using HOG for human detection is performed by Dalal and Triggs [1]. They show experimentally that the HOG is preferable to most other features for human detection. Jing Wang and Ping Liu[2] adopted the Pyramid HOG descriptor which can characterize local shapes at difference spatial scales to characterize human figures for action recognition. The Pyramid HOG focuses on human shapes at different degree due to the pyramid decomposition. Kirty Lillywhite and Dong Zhang[3] proposed The histograms of oriented gradients method for human detection An over-complete dictionary of Haar wavelets is used with a support vector machine to detect humans. Human detection has been done by using human parts detectors and then combining them probablitically. Using parts descriptors helps deal with partial occlusion. Human detection has also been extended to night time using a night vision camera. Yang Bai and Lihua Guo proposed[4] a novel feature extraction method using PHOG for smile recognition. Gabor features are conventionally widely applied to facial expression recognition. The comparisons between the PHOG and Gabor features using a publicly available dataset demonstrated that the PHOG with a significantly shorter vector length could achieve as high a recognition rate as the Gabor features.

III. OVERVIEW OF THE METHOD

PHOG is a spatial shape descriptor applied to image classification. It represents the spatial distribution of edges and is formulated as a vector representation. This descriptor is mainly inspired by two sources: (1) the use of the pyramid representation and (2) the Histogram of Orientation Gradients (HOG).Histogram of Oriented Gradients (HOG) are feature descriptors used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

The essential thought behind the Histogram of Oriented Gradient descriptors is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The implementation of these descriptors can be achieved by dividing the image into small connected regions, called cells, and for each cell compiling a histogram of gradient directions or edge orientations for the pixels within the cell. The combination of these histograms then represents the descriptor.

A.HOG FEATURE

1) *Image Normalization:* The entry images of our system are initially converted into gray level. They are then normalized according to the brightness information.

2) Gradient Computation: The gradient computation is a critical stage in the descriptors formation. The accuracy of the calculated orientations, and the histograms, depends on this stage and the results are thus closely related to the method employed to calculate the image gradient. The fast calculation of the gradient can be made, for example, by masks of simple derivation I-D (centered [- 1,0,1] and not centered [- 1, 1], by the 2-D Sobel operators, or by the Deriche recursive operators. In our method, we use the Sobel algorithm. It is the one of the simplest operators which gives however correct results.

3) *Orientation Binning:* The second step of calculation involves creating the cell histograms. Each pixel within the cell casts a weighted vote for an orientation-based histogram channel based on the values found in the gradient computation. The cells themselves can either be rectangular or radial in shape, and the histogram channels are evenly spread over 0 to 180 degrees or 0 to 360 degrees, depending on whether the gradient is “unsigned” or “signed”.

4) Histogram Computation: Each detection window is divided into sized cells 8 x 8 pixels and for each cell we compute the histogram of gradients by accumulating votes into bins for each orientation. Votes are weighted by the magnitude of a gradient. We used the 'integral image' representation to compute efficiently the HOG of each cell. HOG descriptor is then the vector of the components of the normalized cell histograms from all of the block regions.

4) Object Detection: The final step in object recognition using Histogram of Oriented Gradient descriptors is to feed the descriptors into some recognition system. The final PHOG descriptor for an image is a concatenation of all the HOG vectors at each pyramid resolution

IV .IMPLEMENTATION RESULTS


Fig. 1 Example of an initial satellite image


Fig. 2 Example of a Gray converted Satellite Image

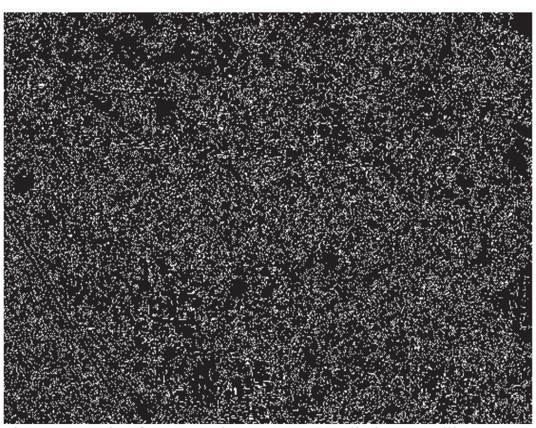
Fig. 3 Example of Canny Edge Detector applied on Satellite Image

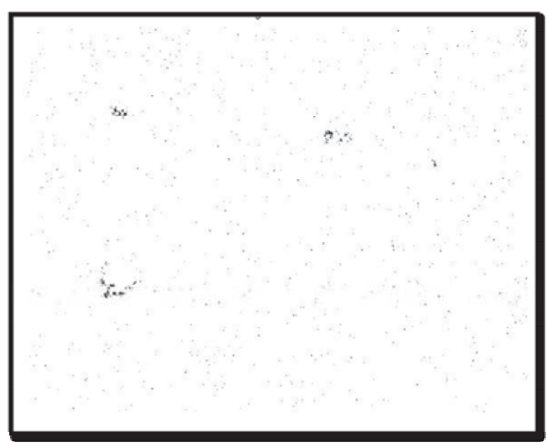
Fig. 4 Example of Gradient of the Satellite Image

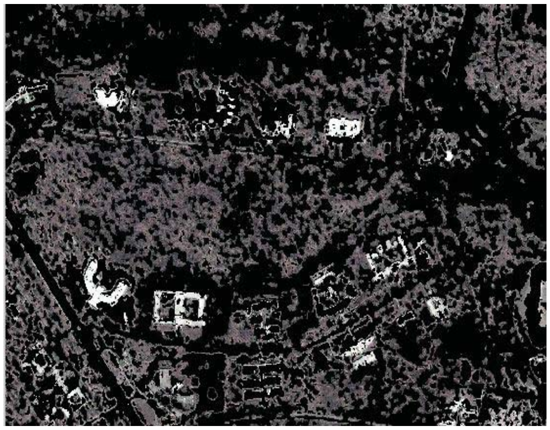

Fig. 5 Example of an Histogram of Satellite Image Descriptors

0.028879	0.034501	0.035076	0.026580
0.026006	0.042707	0.031200	0.026449
0.007890	0.009592	0.010415	0.007735
0.028879	0.034501	0.035076	0.026580
0.009135	0.006902	0.010415	0.007404
0.007890	0.009592	0.010415	0.007735

Fig. 6 K-means Clustering applied on satellite sample

V. CONCLUSION

The proposed method made use of a novel feature extraction method based on PHOG features for satellite image object recognition. The PHOG features with a much lower number of dimensions were extracted from land and forest covers of the satellite image. The descriptors obtained at the end are based up on the land, forest and river cover areas available in the satellite image. This method have obtained different descriptors values for different satellite images. PHOG provides a reliable means for extracting the descriptor values of the satellite image.

The obtained descriptors are grouped into like descriptors using the K-means clustering algorithm and the different objects in the satellite images are recognized and classified.

REFERENCES

[1] N. Dalal and B. Triggs, “Histograms of oriented gradients for human detection”, In IEEE Computer Society Conference on Computer Vision and Pattern Recognition, vol. 1, pp. 886-893, June 2005.
[2] Jin Wang, Ping Liu, “Human Action recognotion based on pyramid histogram of oriented gradients”, pp. 2449-2454, 2009.
[3] A.J.Calder, A.M.Buton, P.Miller, A.W.Young and S.Akamatsu, “A principal component analysis of facial expression”, Vision Research, vol. 41, pp. 1179-1208, April 2001.
[4] Yang Bai, Lihua Guo, “A novel feature extraction method using pyramid histogram of orientation gradients for smile recognition”, ICIP 2009, pp. 3305-3308, 2009.
[5] C.Liu, H.Wechsles, “Independent Component Analysis of Gabor Features for Face Recognition”, IEEE transactions on Neural Networks, vol. 14, pp. 919-928, July 2003.