Performance Analysis on Classification Methods using Satellite Images

R. Parivallal[1], Dr. B. Nagarajan[2]

[1]Assistant Professor, [2]Director, Department of Computer Applications.
Bannari Amman Institute of Technology

Abstract- Using Google map images for a wide range of applications like urban planning travel planning etc. Image classification and object identification is an important application for satellite images. A few number of image classification algorithms have proved good precision in classifying remote sensing data. An efficient classifier is needed to classify the map imageries to extract information. In this paper the authors analyze the performance of different classification methods in terms of building area occupancy. It is found that our enhanced classifier performed the best classification.

Keywords— Classification methods, Remote Sensing Data, Image Classification

I. Introduction

Object classification and identification are bountiful in our daily life. Object classification and identification has a wide area of application in urban planning, rural development. Humans are good at object classification. Developing automatic image classification and identification of objects such as buildings or vegetation areas from digital imagery is not only scientifically challenging but also of major practical importance for data acquisition and update of Geographic information system (GIS) databases or site models. Attempts have been made by researchers to improve the capability and robustness of machine vision system [2].

Building extraction is a difficult task, because the building doesn't follow a specific pattern and the individual building covers a very small area on the ground. In addition, the reflectance of buildings and roads are almost similar in satellite images which results in error in digital classification[3]. In that case, differentiation between buildings and road becomes very difficult. Because of this reason, some additional features (like area, shape etc.) are also required for increasing the accuracy of extracted buildings from satellite images. Unfortunately, it is still tedious for a human expert to manually label buildings in a given satellite image. One main reason is the total number of objects in the scene. The other reason is the resolution of the satellite image. Although the resolution of the satellite imagery has reached an acceptable level, it is still not possible for a human expert to extract information from it in a robust manner [4] [5]. To solve this problem, we introduced automated building-detection methods using satellite Google Map images.

[9] Introduced a texture-based classification method for classifying built areas according to their density. [10] Provide automatic building detection approaches combining high-resolution images and LiDAR data. [11] Introduced urban building boundary extraction from IKONOS imagery. [12] used mathematical morphological operations to extract structural information to detect the urban area in satellite images. [13] used a decision making strategy to extract buildings from true color stereo aerial images.[14] provides feature matching for building extraction from multiple views. [15] provides automatic building extraction from IKONOS images in suburban areas detected the small objects from high-resolution pan images [16].

II. Classification Methods

Image classification is the process of assigning pixels or the basic units of an image to classes. It is likely to assemble groups of identical pixels found, into classes that match the informational categories of user

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interest by comparing pixels to one another and to those of known identity [23]. Several methods of image classification exist and a number of fields apart from remote sensing like image analysis and pattern recognition make use of a significant concept, classification. In some cases, the classification itself may form the entity of the analysis and serve as the ultimate product. In other cases, the classification can serve only as an intermediate step in more intricate analyses, such as land-degradation studies, process studies, landscape modeling, coastal zone management, resource management and other environment monitoring applications. As a result, image classification has emerged as a significant tool for investigating digital images. Moreover, the selection of the appropriate classification technique to employ can have considerable results, whether the classification is used as an ultimate product or as one of numerous analytical procedures applied for deriving information from an image for additional analyses.

The remote sensing literature presents with a number of supervised methods that have been developed to tackle the multispectral data classification problem. The statistical method employed for the earlier studies of land-cover classification is the maximum likelihood classifier. In recent times, various studies have applied artificial intelligence techniques as substitutes to remotely-sensed image classification applications. In addition, diverse ensemble classification method has been proposed to significantly improve classification accuracy [22]. Scientists and practitioners have made great efforts in developing efficient classification approaches and techniques for improving classification accuracy. The quality of a supervised classification [23] depends on the quality of the training sites.

In this paper we have classify the Building object area from the Google Map Image and apply the two kinds of classification methods like pixel based and object based classification methods. The pixel based methods are Maximum Likelihood Distance, Minimum Distance and Mahalanobis Distance. In the object based classification the authors used the proposed method. The following figure illustrates the Classification methods:

III. Study Area

In this paper the study area two location taken for study for rural area it was located in Sathyamangalam (Rural area) covering approximately 4829 m2 extracted from Google map (see Figure 2). Second location is from Namakkal (Urban Area) covering 14441.54 m2 extracted from Google map (Figure 3). Rural area and Urban area characterized by population density and buildings.

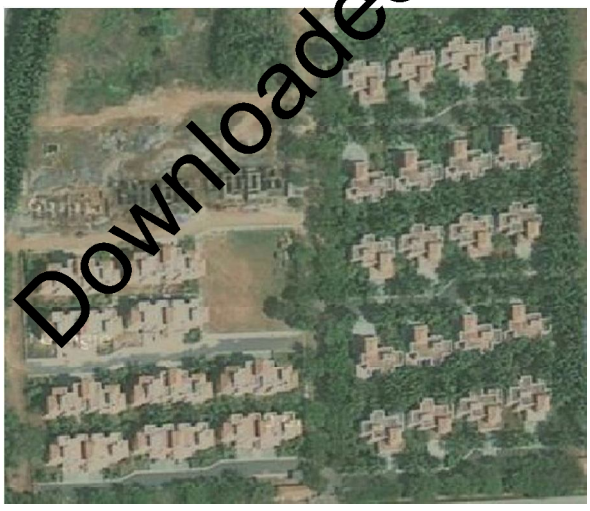

Figure 2: Rural Area Image from Google Map

Figure 3: Urban Area Image from Google Map

IV. Implementation

The main aim of the study is to evaluate the performance of the different classification algorithms using the Google Map.

A) Minimum Distance Technique

It is based on the minimum distance decision rule that calculates the distance between the measurement vector for the candidate pixel and the mean vector for each sample. Then it assigns the candidate pixel to the class having the minimum spectral distance. The classified images are:

Figure 3: Rural Area Image classified using Minimum Distance

Figure 4: Classified Urban Area Image

B) Mahalanobis Distance

Mahalanobis distance classification is similar to minimum distance classification except that the covariance matrix is used. The Mahalanobis distance algorithm assumes that the histograms of the bands have normal distributions.

Figure 5: Rural Area Image Classified using Mahalanobis

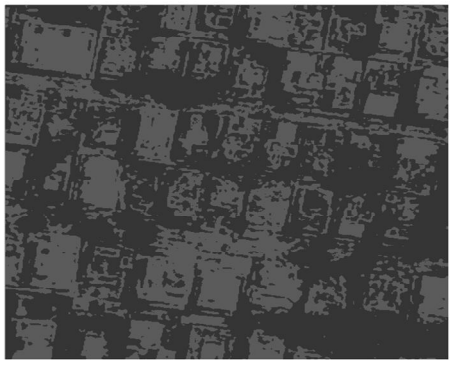

Figure 6: Classified Urban Area Image

C) Maximum Likelihood

This Classification uses the training data by means of estimating means and variances of the classes, which are used to estimate probabilities and also consider the variability of brightness values in each class. This classifier is based on Bayesian probability theory. It is the most powerful classification methods when

accurate training data is provided and one of the most widely used algorithm. The classified image is shown as follows:

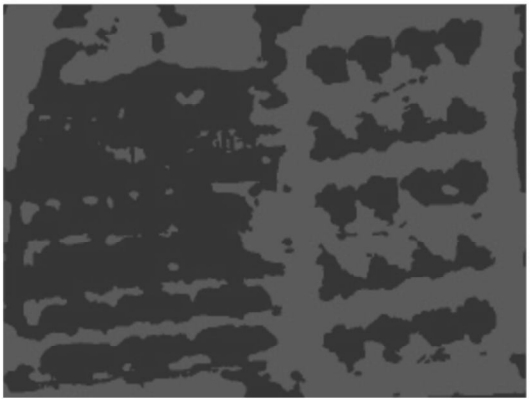

Figure 7: Classified Rural Area Image

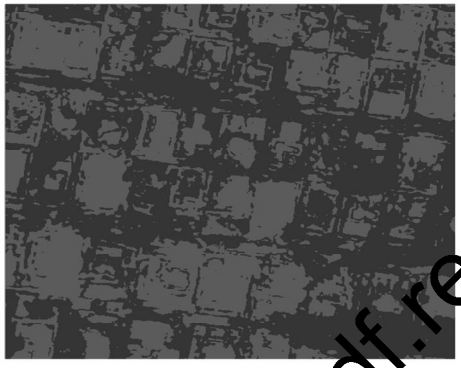

Figure 8: Classified Urban Area Image

D) Proposed Method

In this proposed method applied pre-processing of input image and Segmentation by Threshold Segmentation, Watershed Segmentation and Morphological operations on given Google map Image. The extracted building regions from the given image are highlighted in the final output of the Google image.

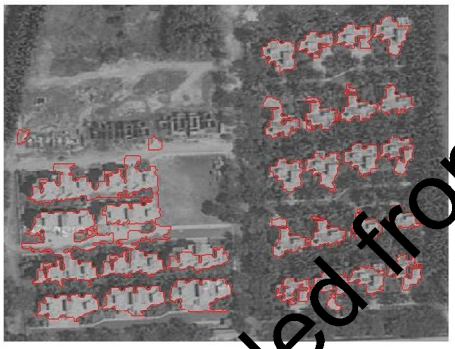

Figure 9: Rural Area Image Classified

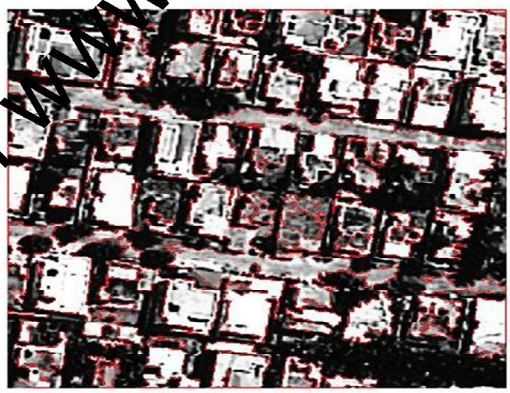

Figure 10: Classified Urban Area Image

V. Performance and Conclusion

The rural image analysis is test on a single image of about 600x430 pixels. The image contains about 30 buildings from the Ground truth. In the Urban image is about 512 x 512 pixels. The image contains about 55 buildings from the manual ground truth. The results are shown in detail in the following Table 1:

Table I: Analysis of Classification result

Classification Methods	Rural Image Area		Urban Image Area	
	Building Object Area (%)	Other Object Area (%)	Building Object Area (%)	Other Object Area (%)

Minimum Distance Method (MDM)	32.51	67.49	45.64	54.36
Mahalanobis Distance (MHDM)	41.25	58.75	39.87	60.13
Maximum Likelihood Method (MLM)	48.45	51.55	42.85	57.15
Proposed Method	28.45	71.55	46.24	53.76

A study of the performance of various classifiers mentioned above based on the overall accuracy is made. It is observed that our proposed classification method is determined to be the most accurate. One of the reasons is it filters out shadows and also it classifies the highly varied clusters. The output of the classification is shown in the above figures. Overall, the proposed classifier shows the highest accuracy assessment for this particular area. In this paper we have compared the performance of various classifiers and found that the proposed classifier outperforms even advanced classifiers.

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