Image Analysis of Remotely Sensed Images

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***Abstract-* The analysis of a remote sensing image usually requires the comparison of the analyzed image with another image taken from the same spot. In an automated object identification system for remotely sensed images, thresholding techniques are used to analyze the images. Color values and solidity features are used for object identification. In this project, the objects identified are catfish ponds. Results prove that automatic image analysis provides a good means to extract catfish ponds from remotely sensed images.**

***Index Terms-* image classification, feature extraction, image segmentation.**

I. INTRODUCTION

REMOTELY sensed images have a growing relevance as sources of information about resources, environment monitoring, and planning. The need for better algorithms for extracting, processing and making easily accessible the information coming from satellite images has been perceived as one of the first priorities by the Pattern Recognition and Computer Vision Research Community [2].

An important issue in the analysis of remotely sensed data is to segment and contour interest regions from a satellite image. In recent years, experiments with expert systems have taken place in remote sensing to help automate the process of digital image analysis. Remote sensing is a main field in which image processing and pattern recognition is applied extensively and deeply [1]. One of the important applications of image classification is to extract information from remotely sensed images. The main focus of this study is to investigate the effectiveness of some of the image segmentation techniques to automatically analyze and detect catfish ponds in a remotely sensed image.

In this paper, an automated image analysis system is designed. The system will be able to recognize and classify catfish ponds in the images and generate an output as a labeled image.

II. BACKGROUND

Image analysis and classification often consists of the processing tasks shown in Fig. 1. The image is first processed using some image enhancement techniques. Based on the extracted features, the image is classified into different regions [3]. Given a digitized image containing several objects, the image classification process consists of three major phases.

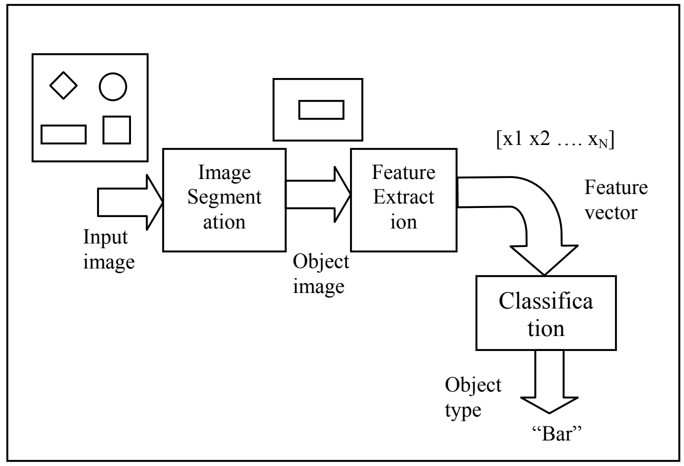

Fig. 1. The three phases of image classification

The first phase is called *image segmentation,* or *object isolation*, in which each object is found, and its image is isolated from the rest of the scene. Because of its intuitive properties and simplicity of implementation [4], image thresholding enjoys a central position in application of image segmentation.

The second phase is called *feature extraction*. This is where the objects are measured. A *measurement* is the value of some quantifiable property of an object. A *feature* is a function of one or more measurements, computed so that it quantifies some significant characteristic of the object [3]. The feature extraction process produces a set of features that, taken together, comprise the *feature vector*. Feature extraction drastically reduces the amount of information that represents all the knowledge upon which the subsequent classification decisions must be based. It is productive to conceptualize an n-dimensional space in which all possible n-element feature vectors reside. Thus, any particular object corresponds to a point in feature space.

The third phase of image analysis is *classification*. Its output is merely a decision regarding the class to which each object belongs. Each object is recognized as being of one particular type, and the recognition is implemented as a classification process. Each object is assigned to one of several pre-established groups (classes) that represent all the possible types of objects expected to exist in the image.

Classification is based solely on the feature vector. In this paper, color values were used as classification technique.

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III. METHODOLIES

In this paper, an algorithm is developed to detect catfish ponds in a remote-sensed image. The software approach used to detect the catfish ponds is described below.

The areas containing water appear to be blue in a remote-sensed image. The image is divided into two parts. One part is used to train the data, while other part is used for testing purposes. Many blocks of catfish ponds were cropped out manually and were trained to form the feature vector. The red, green and blue (RGB) values of each pixel are measured, and a vector is formed. Then, the mean and standard deviation of red, green and blue vectors were calculated. Using this information, ranges for red, green and blue values have been calculated.

Range = mean ± frac * standard deviation.

Here, *frac* is a scaling factor used to vary the range. These thresholds, ranges for red, green and blue, were applied on the testing image. Pixel-wise processing is carried out. If the value of RGB for a particular pixel is within the ranges of RGB obtained from trained data, than it is classified as a catfish pond.

There are two options for the block processing. In one approach the block shifts by one complete block size. In another, the block shifts by one pixel. In the latter approach, every pixel is given a gray level. This gives a finer and smoother ground map. The downfall of this approach is that it takes up a lot of memory and a lot of time. The former approach is faster and uses much less memory compared to the latter, but the output image is very blocky, and we get bad resolution.

To implement the above procedure, the following MATLAB codes were written. The main program was "ece8473_panchal.m". This program reads the input image and passes it for the selection of the testing region from the user. The function "training_data_info.m" was called, in which the data was trained. Data was collected by actually cropping out small sub-blocks of catfish ponds from the given image. The mean and standard deviation were calculated by passing the feature vector to the function "mean_var.m".

The threshold obtained from trained data is used to classify the object. The approach to divide the dataset into training and testing sets is commonly known as the "Jack-Knife" method. This method has been used to calculate accuracy. The accuracy is calculated in the function "accuracy.m".

Dilation and erosion were applied on the output image. We know that dilation expands an image, and erosion shrinks it. In this project, *closing* is applied on the image. *Closing* is a method in which dilation is followed by erosion. It tends to smooth sections of contours, fuse narrow breaks and long thin gulfs, eliminate small holes, and fill gaps in the contour [4].

The closing of set A by structuring element B, denoted A·B, is defined as [4],

$$A \cdot B = (A \oplus B) \ominus B$$

Then, the ordered filter and morphological operations like pruning were used to remove unwanted spurs.

Fig. 2. Input image

IV. RESULTS & DISCUSSION

The approach discussed above was run on the available database. The input image to the analysis system and the output image obtained are shown in Fig. 2 and Fig. 3, respectively. The output image is labeled, indicating catfish ponds. From Fig. 3 it can be concluded that the system is able to detect ponds clearly.

It is possible to detect catfish ponds more accurately provided the window size is reduced or shape features such as rectangularity or perimeter-to-area are used. The accuracy results are shown in Table 1. The system is finally tested using the image. Fig. 3 shows the final classified image. The system is also tested for different images, and it is ensured that it works fine. Table 2 shows confidence levels and confidence intervals.

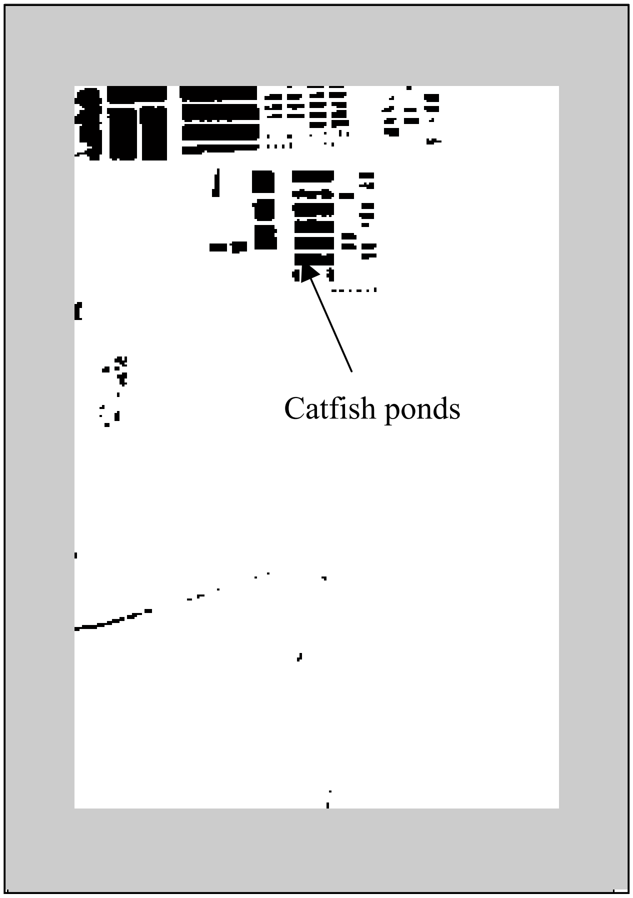

Fig. 3. Classified output image

TABLE I
CLASSIFICATION ACCURACY FOR TRAINING DATA

Data	Accuracy (%)
Catfish ponds	87.04

TABLE 2
CONFIDENCE LEVELS AND CONFIDENCE INTERVALS

Confidence Levels	Confidence Intervals
99	± 0.1429

V. CONCLUSIONS

An automated image analysis system has been developed that can detect catfish ponds in an image. Color and shape are used to detect the objects. We get some "false alarms" and "miss". Varying the scaling factor *frac* appropriately can control these errors.

Future work:

Other objects in the image can be detected in future work. Classification accuracy can be improved by using different classifiers like nearest mean, nearest neighbor, maximum likelihood, etc. In future work the accuracy can be improved.

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