Extraction of Roads from Satellite Images Based on Edge Detection

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***Abstract* — In this paper, an efficient method of extraction of roads from a given set of data base is explained. The extraction of roads plays an important role in urban planning. The other applications of road extractions are identification of isolated buildings that need to be detected and updating of GIS data base according to the requirements of the human expertise. Edge detection techniques such as canny, sobel, and prewitt will be applied to the image. Morphological operations will be applied to the resultant image which consists of noise due to the edge detection operators. The noise present in the resultant image can be reduced by applying Median filtering. The proposed method extracts roads with in less time compared to the earlier methods.**

***Index Terms*— Edge detection, canny, sobel, Prewitt, Morphological operations, Median Filtering.**

I. INTRODUCTION

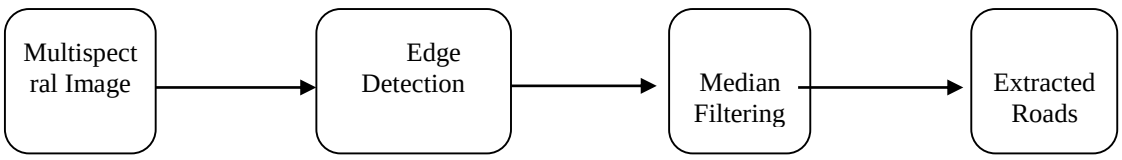
In Today's World, Geographic Information System (GIS) aggressively being popular day by day due to attractiveness of internet as well as satellite image. Google, Yahoo, Virtual Earth and other maps are examples of exhibit of those high resolution satellite images. Roads are one of the important linear features existing in the terrain. Road data plays a key role in urban planning, traffic management, military applications, and vehicle navigation as well as for decision making in numerous applications. In the last few decades, the accelerated urbanization made the necessity of devising new methods for updating maps, which is impossible through conventional long term surveying and mapping techniques. Gaussian filtering is applied on the image in order to remove the high frequency noises. Canny edge detection algorithm is used in order to fine tune the road region edges. When disaster strikes, roads play vital roles in bringing relief provisions to the disaster-struck areas. Subsequently, road obstruction information would be necessary for the prompt delivery of the aids. Therefore, sufficient attainment has been made towards faster road extraction options from remotely sensed images. Extraction of roads plays important and major roles in many applications regarding the betterment of present human lives. Hence, road extraction using a robust and efficient method is also high. A modified method for road extraction from high resolution satellite images is presented by **T. M. Talal, M. I. Dessouky, A. El-Sayed, M. Hebaishy and F. E. Abd El-Samie**in [1]. Probably, there are many ways to extract roads manually and automatically. **Jiangye Yuan, DeLiang Wang, Bo Wu, Lin Yan, and Rongxing Li** in [2] presented a new automatic road extraction method based on LEGION. Three stages are used to implement road extraction: image segmentation, candidate segment selection, and road segment grouping. The technique used in the following paper depends on the color of the road. Here, the images are multispectral images. Multispectral images are those images that consist of three or more spectral bands.

II. METHODOLOGY

The basic methodology of this paper is to extract the roads by using edge detection and morphological operations. Different edge detection operators are canny, prewitt and sobel are used to detect the edges. Then, morphological operations are applied to detect image which consisting noise. The noise presented in the resultant image is reduced by applying median filtering.

III. PROPOSED METHOD FOR EXTRACTING THE ROADS

Block diagram for proposed method is shown below:



IV. EDGE DETECTION

An edge in an image is a significant local change in the image intensity, usually associated with a discontinuity in either the image intensity or the first derivative of the image intensity. Discontinuities in the image intensity can be either Step discontinuities, where the image intensity abruptly changes from one value on one side of the discontinuity to a different value on the opposite side,

or Line discontinuities, where the image intensity abruptly changes value but then returns to the starting value within some short distance. However, step and line edges are rare in real images. Step edges become ramp edges and line edges become roof edges, where intensity changes are not instantaneous but occur a finite distance.

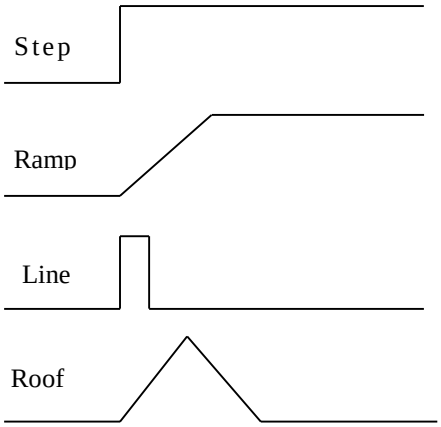


Fig: One dimensional edge profiles

The sudden changes of discontinuities in an image are called as edges. Generally edges are of three types Horizontal edges, Vertical edges and Diagonal edges. Most of the shape information of an image is enclosed in edges. Some edge detection operators are canny operator, Prewitt operator and Sobel operator.

Canny operator:

The canny edge detector is an edge detection operator that uses a multi stage algorithm to detect a wide range of edges in images. Canny edge detection is a technique to extract useful structural information from different vision objects.

BW1 = edge (BW,' canny');

BW = original image; BW1= edge detected image

Prewitt operator:

Prewitt operator is used for edge detection in an image. It detects two types of edges that are horizontal edges and vertical edges. Edges are calculated by using difference between corresponding pixel intensities of an image. All the masks that are used for edge detection are also known as derivative masks. All the derivative masks should have the properties are opposite sign should be present in the mask, sum of mask should be equal to zero and more weight means more edge detection.

BW1 = edge (BW,' prewitt');

BW = original image; BW1= edge detected image.

Sobel operator:

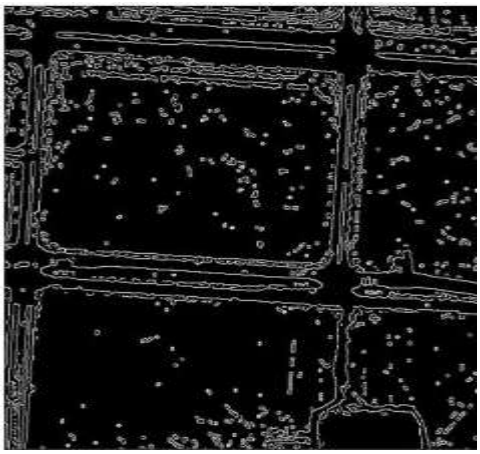
The sobel operator is very similar to prewitt operator. It is also a derivative mask and is used for edge detection. Like prewitt operator sobel operator is also used to detect two kinds of edges in an image that are vertical direction and horizontal direction.

BW1 = edge (BW,' sobel');

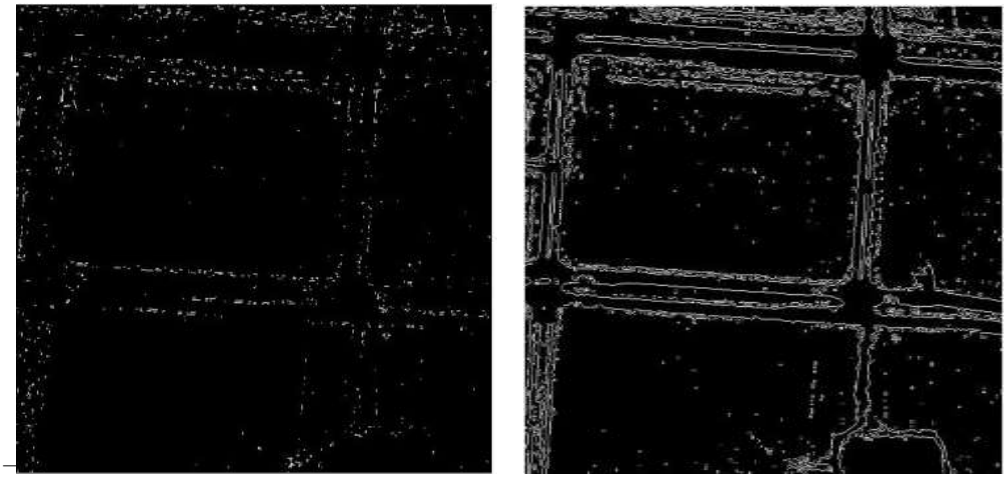
BW = original image; BW1= edge detected image

The major difference is that in sobel operator the coefficients of masks are not fixed and they can be adjusted according to the requirement unless they do not violate any property of derivative masks.

(a)



(b)



(c) (d)

Fig. (a) Original image. (b) Canny edge detected image. (c) Prewitt edge detected image. (d) Sobel edge detected image

V. MEDIAN FILTERING

Median filtering is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing. Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise. Median filters often used are particularly effective in the presence of impulse noise also called as salt and pepper noise. The median filter replaces the value of the pixel by the median of the intensity levels in the neighborhood of that pixel.

$$\hat{f}(x,y) = median\{g(s,t)\}$$

The value of the pixel at (x, y) is included in the computation of the median. Median filters provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size. The median filter yields excellent results for images corrupted by this type of noise.

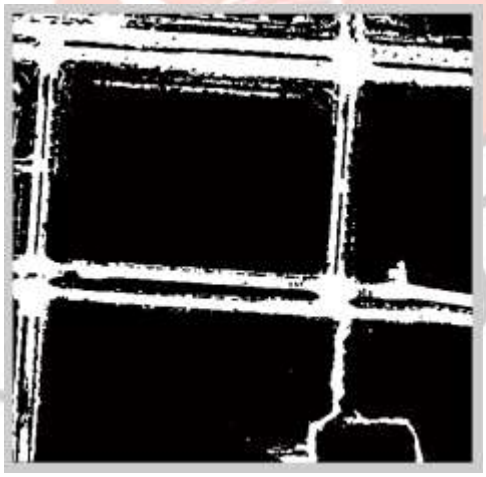


Fig: filtered image

VI. CONCLUSION

The proposed method of edge detection and morphological operations are used to extract the road network from high resolution multispectral satellite imagery. Extraction of road has been done with the help of the edge detection operators such as canny, prewitt and sobel. The noise presented in the resultant image is reduced by applying median filtering. In some cases, small part of barren land and parking area is classified as road. The approach is based on the edge detection, which induces the detection of some unwanted objects. On high resolution satellite image is very useful for GIS database revision, change detection and some applications that transportation infrastructure information, such as disaster management, urban planning plays as important role.

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