Road Extraction From High Resolution Satellite Image

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***Abstract* - As time clicks away, the growth of population is increasing. The needs and requirements of the people are also increasing. Man desires to meet his needs and requirements efficiently and effectively with less cost and time. Due to population growth, the management of urban and sub-urban areas effectively and efficiently is required. The key tool for the same is satellite images and the element in the satellite images are the roads.Road extraction plays a vital role in the management of urban and sub-urban areas. Some applications are GIS updating, traffic management, disaster management and GPS applications. In this paper roads are extracted using color of the road here we extract road using threshold values of the road by analyzing different satellite road images.The algorithm was achieved by matlab and applied to high-resolution satellite images.**

Keywords* – *RoadExtraction,Thresholding,Remote sensing image,Median filtering, Morphological operations

I. INTRODUCTION

In the recent years there have been many techniques introduced to manage the urban and sub-urban area roads. The need for management of these areas sufficiently and effectively is high. The satellite images can be used for managing these areas effectively. Roads of the urban and sub-urban areas play a vital role in the management of these areas. The road extraction also has application like detection of bridges, isolated areas and difficult to reach regions. The main applications in urban and sub-urban management are traffic management, dis-aster management, GIS updating and GPS applications.Many techniques have been introduced to extract roadsfrom satellite images and some of these are explained in [1-5]. Road extraction explained in this paper depends only on the color of the road. The advantage of this method is that road images from any type of satellite can be used provided it has more than 0.5m resolution.In this paper, road extraction is done from high resolution satellite images. The cost compared to implement this paper is quite low relative to the existing papers.

II. PROPOSED ALGORITHM

A. *Proposed Steps* -

First create a database consisting of high resolution images The database should contain satellite road images whose road intensity values should be within a particular range. any type of roads can be extracted by considering different intensity ranges.

The basic steps involved in the algorithm are described in Figure(1). The basic steps involved are : the given input image is converted to grayscale image and then the grayscale image is adjusted to the threshold values of the road. The obtained image is then converted to binary image with threshold value taken from graythresh() i.e., Otsu's method.

level = graythresh(I) computes a global threshold, level, that can be used to convert an intensity image to a binary image with imbinarize. The graythresh function uses Otsu's method, which chooses the threshold to minimize the intraclass variance of the black and white pixels [8].

Then the image is filtered using a median filter to remove noises and it still contains unwanted objects and those are removed using morphological operations,

B = medfilt2(A) performs median filtering of the image A in two dimensions. Each output pixel contains the median value in a 3-by-3 neighborhood around the corresponding pixel in the input image. medfilt2 pads the image with 0s on the edges, so the median values for points within one-half the width of the neighborhood ([m n]/2) of the edges might appear distorted.

Median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges.

Edges of the extracted road are determined and finally the extracted road is overlaid onto the original image.

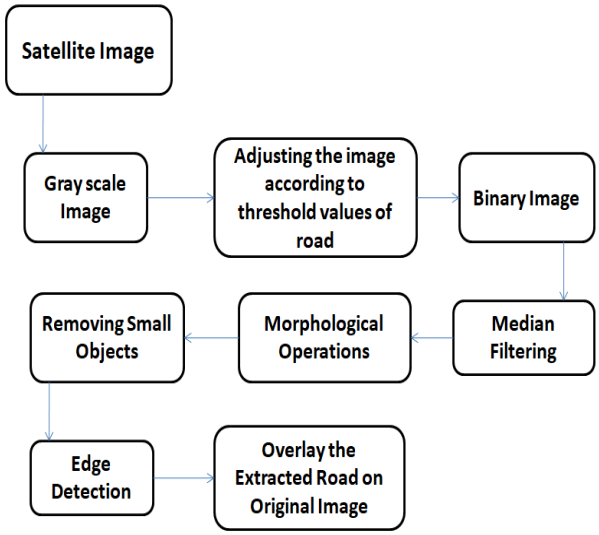


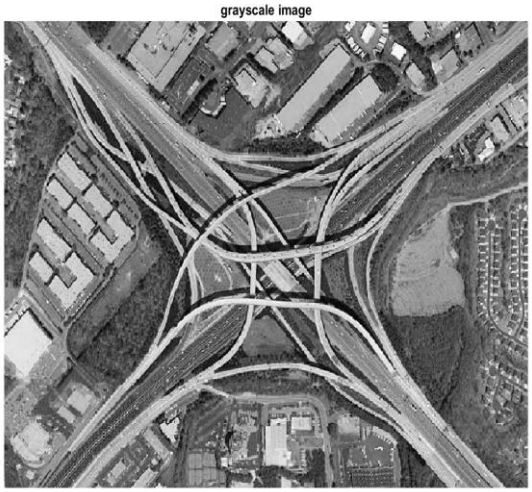
Figure 1
Flow chart of the algorithm

B. Road Extraction Algorithm -

The various steps in the extraction algorithm are explained below

At first the image is converted to grayscale image and is adjusted from threshold range 0.5 to 0.9 as most of the roads contain this range and to remove unwanted stuff. Figure 2(a) shows the image obtained after adjusting. Then the image is converted to binary image using 'graythresh' i.e., Otsu's method which automatically sets the threshold value for the conversion. Figure 2(b) shows the image obtained after converting to binary.

Original image



Grayscale image

Figure 2a

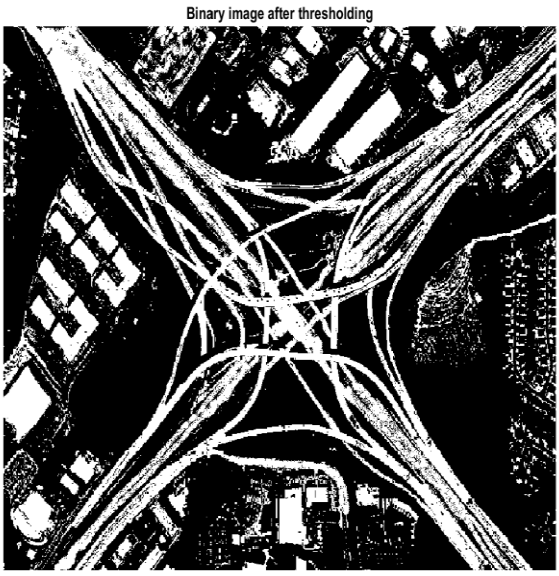


Figure 2b

On the binary image median filtering is done to remove the noise that affects the satellite image. When considering different types of filters, median filter is the most apt one to reduce noise in satellite image. Figure 2(c) shows the image after median filtering.

Figure 2c

From the median filtered image small objects are removed which are unnecessary and whose pixels are less than 60 using 'bwareaopen'. This helps in removing buildings and small parking slots based on the pixel value that we give as input to the function bwareaopen('').This is shown in figure 2(d).

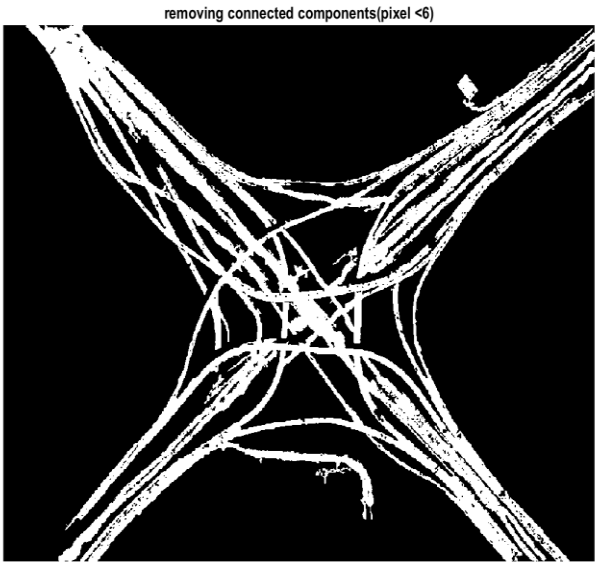


Figure 2d

The image still contains many unwanted pixels. One of easiest way to eliminate unwanted objects from an image is by applying morphological operations. Morphological operations are those operations used to remove undesired pixels based on the foreground and the background of an image. Since the operations are done on the binary image, the MATLAB function used is 'bwmorph()' and 'remove' operation. The image obtained after applying morphological operations is given in Figure 2(e).

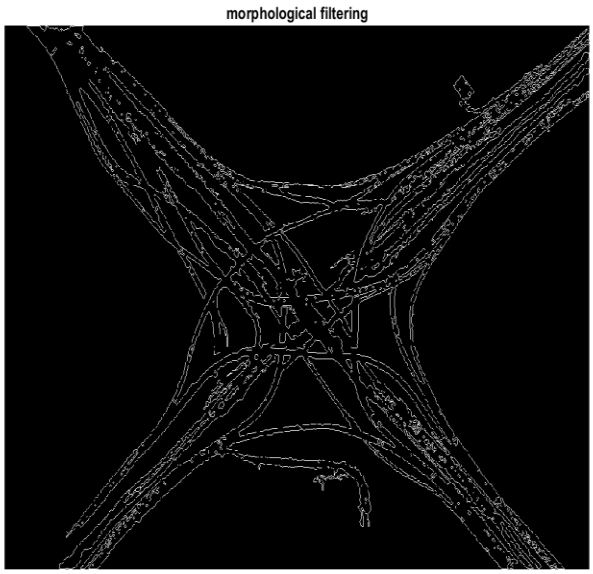


Figure 2e

After applying the morphological operations we get the clean roads but it is very important to obtain the edges of these

roads for clear identification of the roads. Gradient filter is used for the edge detection and the type of operator used for the detection is 'sobel'. Sobel operator is used because the edges are extracted with greater accuracy. The edges of the roads is shown in Figure 2(f).

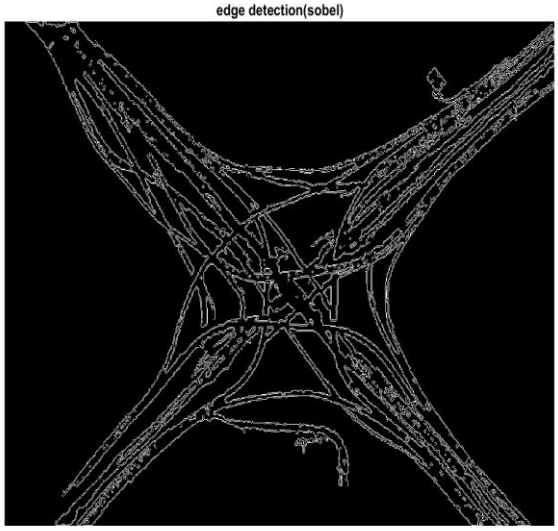


Figure 2f

The final step is to overlay the extracted road onto the scalar image of the original image. Overlaying of the result helps to illustrate the accuracy of the road extraction. In the final image, the thin lines indicate the paths of roads in the image. The final image is given in Figure 2(g).

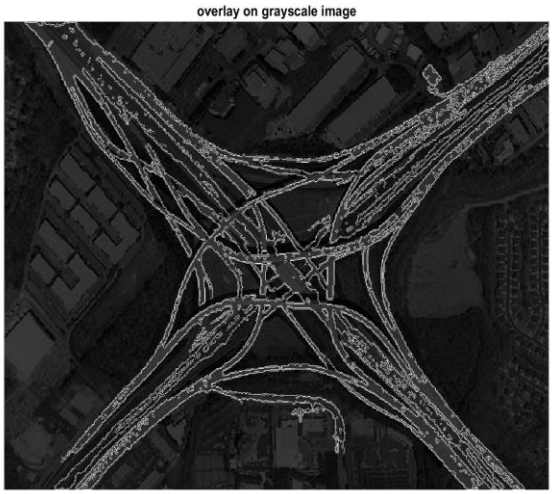


Figure 2g

III. Experiment And Result

Figure 2(g) is the finally extracted road overlaid on the original grayscale image .The database for road extraction can be created based on the color of the roads. MATLAB 7.10 software platform is used to perform the road extraction. The size of the image used is 512 * 512. From the Figure 2(g) it is clear that some of the objects other than roads are also detected. This is because those objects are also having the color within the particular range as that of roads. These objects could be small parts of buildings,barren land and parking lots. The outputs of various steps are given in Figure 2.

IV. Conclusion

Road Extraction is of fundamental importance for the urban and sub-urban planners to manage the ever-changing urban and sub-urban environment. For the proposed paper, program was developed for road extraction from high resolution satellite images using threshold method.

The roads play a vital role in urban planning. The algorithm introduced is automatic one. It requires only very little interaction from the users. The algorithm was implemented to detect roadways from satellite images with resolution greater than 0.5m. The important and key parameter of this algorithm is the color of the roads in the database. Different types of roads can be extracted based on this algorithm. Since extraction is solely based on color, some of the barren lands and small areas of parking lots are also being extracted. This is because the locations also have the same pixel intensity values as that of roads. Different other techniques such as usage of Digital Elevation Models (DEM), active contours and artificial intelligence methods could be included to remove the unwanted objects that are being extracted. The algorithm implemented is fast, robust and easy to understand and implement.

References

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