

Road satellite image recognition with improved edge detection

Reza Alipour

Researcher:¹

Abstract:

The research project shows that road networks play an important role in a number of geographic applications, such as mapping, infrastructure planning, and traffic routing software. Automatic and semi-automatic road network extraction techniques have significantly increased the extraction rate of road networks. The performance of road detection is severely affected by noise or low frequency. Road edge detection images play an important role in detecting the direction of the road and the specific location of obstacles, size, and speed of obstacles on the road. In this paper, several road detection techniques are theoretically analyzed, and a new road detection method using median filter is proposed. By comparing it with some well-known techniques, it is found that there are many gaps in the techniques presented so far. By comparing the proposed algorithm with the proposed one, it is proved that the proposed algorithm does not introduce artifacts in the old techniques.

Keywords: Road images; road detection, satellite remote sensing, edge detect

¹ Reza Ali pour, telecommunication systems (Ph.D.A), Islamic Republic of Iran

Interoduction:

In space communications, satellite remote sensing systems provide a large amount of data that is invaluable in monitoring land resources and the impacts of human activities. Road feature extraction from remote sensing images has been a long-standing research topic and is still a challenging issue due to its complexity]. The ability of next-generation sensors to provide good spatial resolution data has stimulated the need for research into automated road feature extraction [1]

It should be noted that accurate and up-to-date network information is essential for urban planning, automated road navigation, and emergency response applications. Automated methods have the potential to improve the speed and usability of road mapping and are therefore highly desirable. Roads are extracted only in the areas surrounding the roads in the database. Road extraction is difficult in the presence of background objects such as buildings or trees close to the road that disrupt or block the appearance of the road.

Many approaches have been developed for road extraction. However, only a few approaches work in urban scenes, which complicates the task of automatic road extraction comparison of these two methods is described in this paper.

A - Normalized slices method

B - Displacement and averaging method

This paper has done. A normalized slice is a graph-based method that considers both local and global features of the image, The combination of local and global aspects ignores noise, small surface variations, and weak edges, and produces extractions where most of the segments cover only one road area, In this approach, only the boundaries are considered. The advantage of this method is that it does not require hard constraints to obtain information

In the case of roads, this makes this method more applicable to automatic road extraction.

It should be noted that the mean shift method is a clustering technique used to classify data into different categories and does not require information about a specific object and extracts road information precisely with an object-oriented method. In this method, the data is segmented and these segments are analyzed to identify road-like and non-road segments [1].

Literature Survey

A literature review goes beyond searching for information and involves identifying and articulating relationships between the literature and our research area. While the form of a literature review may vary with different types of studies, the basic objectives remain the same:

M. Rajeswari et al evaluated the growth rate of an urban area road as one of the elements of rapid information updating during urban development. Road information extraction based on high-resolution satellite images plays an important role because roads affect urban land use. In this paper, two approaches for extracting road network for a city are proposed. [1].

J. Senthilnath et al have assessed that urban population in India is growing rapidly as planning authorities race to keep pace with urban development. The use of geographic information such as satellite imagery helps urban planners to manage the changing urban environment accurately and efficiently. Roads are one of the most important features extracted from satellite imagery for urban planning. Manual extraction of roads is operator-dependent and time-consuming. [2].

M. Butenuth et al. present a paper in which they study road extraction from high-resolution aerial images of suburban scenes based on segmentation using the Normalized Cuts algorithm. The goal of our project is to extract roads for the evaluation of a road data base, however, this paper is limited to road extraction. The segmentation is designed as a basis for Magam to provide a good separation between road and surrounding areas [3].

M. Rajeswari et al. present a paper in which they study the automatic extraction of road network based on high resolution satellite imagery for urban planning. Satellite imagery has great potential to significantly reduce the cost of database development/updating and the turnaround time of satellite remote sensing is recognized worldwide as an effective technology for identification. Urban Development Monitoring and Mapping [4].

V..Parthasarathi et al have assessed that the analysis of high-resolution satellite imagery has been of great importance as a research topic for urban analysis. One of the important features of urban areas in urban analysis is automated road network extraction.[5].

T Rajani Mangala and S G Bhirud have evaluated the study of extracting road information from high resolution satellite. The images play an important role because roads affect urban and rural land cover and use. Road extraction is computationally difficult and costly due to the presence of features such as roads with straight edges [6].

O. Sharma et al. present a paper in which they examine that regional features are of great importance in applications such as coastline mapping, boundary delineation and change detection. This research work is an attempt to automate the process of feature boundary extraction from satellite images [7].

E. Karaman et al. [8] has evaluated the study to develop automatic road extraction algorithm in satellite images. As roads have different width and surface material characteristics in urban and rural areas, a modular approach for road extraction algorithm is desired. In this study, edge detection, segmentation, clustering and vegetation and land cover analyses are used.

F. Chunling and R. Yuan introduced a paper in which road detection methods are becoming a very important part of vision applications and play a significant role in intelligent transportation system, which is a key technique of smartization [9].

Gap in the literature

By conducting the literature survey it has been found that most of persisting researches has neglected one of the following.

- a) Noise
- b) Restoration
- c) Deblurring

As we know that above parameters may decrease the performance of the road detection system. So, these parameters become the critical issue of road detection system.

How does road detection work?

The last few years have seen the development of research that helps in automatic road extraction, which is considered as a possible solution to avoid human errors in the quality assessment process. There are various methods in quality control that can replace the human operator. One of these methods involves computer vision system. After hours of work, the operator may lose focus, which in turn affects the assessment process. Therefore, it has been proven that computer vision system is more efficient in terms of accuracy and speed.

Here is the steps of proposed work have to be done for this research of road extraction.

Step 1: Pre-Processing.

- a) Classification: - dividing the image into two classes – roads and non-roads
- b) Grouping: - The Nearest Neighborhood Grouping (NNG) operation is applied to the classified representation to smooth the spectral response of the local neighborhood of the pixel.

Step 2: Filtering

The road extraction method poses challenges in certain locations because the spectral reflectance of some old buildings is similar to the road surface. Such buildings are cluttered and these non-road structures need to be removed. A morphological unwrapping operation is applied that identifies road blocks.

Step ۳: Segmentation

Segmentation is the process of partitioning the digital image into multiple segments .

Step ۴: Road Extraction

There are two methods for the extraction of road using satellite images

- a) Normalized Cut Method
- b) Mean Shift Method

Step ۵: Image Overlaying

In order to illustrate the accuracy, the extracted road region using is converted into binary image format. This binary image is overlaid on the original panchromatic image leads to display the road topology by avoiding the complex noise element. In the overlaid image the thin lines indicate the road topology

Step ۶: Performance analysis

The automatically extracted paths are compared with manually traced reference paths to perform accuracy assessment. Since roads have linear features, it is possible to use all the data rather than just sample points to conduct the accuracy assessment.

Proposed algorithm:

Figure ۱ is showing the flowchart of the proposed algorithm which contains information in steps:

Step ۱: Input Road Image: Input any road image if it is in RGB then convert it into gray image

Step ۲: Filtering: The gray image is filtered using median filter to remove noises that effects satellite images.

Step ۳: Binarization algorithm: binarization algorithm Convert the filtered image into binary image for easy and fast processing using[۹].

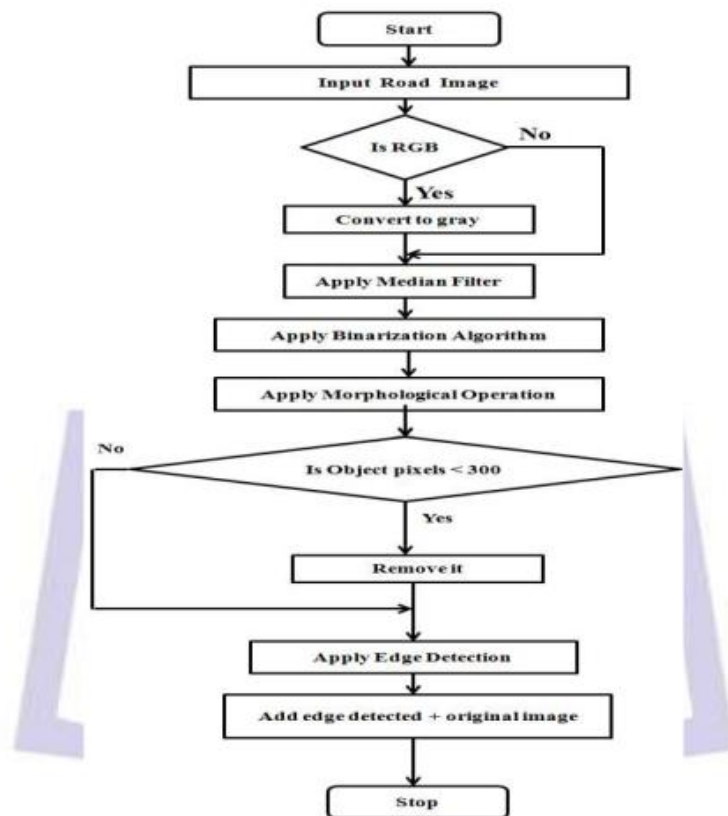


Fig. ۱ Flowchart of proposed technique

Step 4: Morphological Operation: The binary image still contains some unwanted pixels. One of the easiest ways to removing unwanted pixels from an image is by using morphological operations.

Step 5: Edge Detection: After applying the morphological operation we get the clean road image but it is important to obtain the edges on the roads on the image. Any edge detection algorithm can be applied i.e. canny edge detection, sobel edge detection, pre-wett edge detection etc. for edge detection

Step 6: Overlaying the result: The final step is overlaying the extracted road into 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[9].

start up:

Table 1. Input Test bed

S.No.	Name	Format	Size (in KB)
1	mage	Jpg	۷۲,۱
2	mage	Jpg	۶۶,۳
3	mage	Jpg	۷۹,۳
4	mage	Jpg	۸۶,۵
5	mage	Jpg	۷۵,۷
6	mage	Jpg	۸۳,۹
7	mage	Jpg	۸۹,۴
8	mage	Jpg	۶۹,۴
9	mage	Jpg	۷۰,۸
10	mage	Jpg	۷۸,۱

Results: Results:

By implementing the proposed and existing algorithm by taking 1 image at a time, the following results are obtained. The old technique is proposed by F. Chun ling and R.Yuan They have used different edge detection operators for road detection[9].



Fig. 1 Input image:

Figure 1 shows an input image for both the old and new methods. It is a satellite image that shows some roads in white [10].



Fig. ۳ Segmented Image using old technique

Figure ۳ shows the segmented image using the old technique. There are many unwanted objects which are shown in red circle. Therefore, the old method does not provide efficient results [۱۰].



Fig. ۴ Output Image using old technique

Figure ۴ shows the output image using the old technique, where the red circles represent unwanted objects. It shows that there are many artifacts that reduce the performance of the existing technique [۱۰].

New Results:

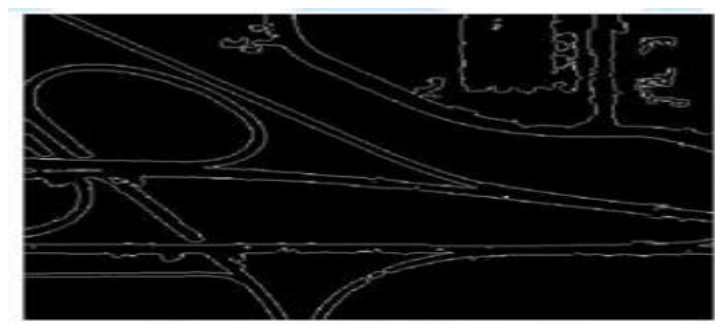


Fig. ۵ Segmented Image using proposed technique



Fig. 6 Output Image using proposed technique

Figure 6 shows the segmented image using the proposed technique. It shows that there is no artifact in the proposed technique which shows better performance compared to the existing technique. Figure 6 shows the final output result using the proposed technique with better performance compared to the existing technique. There is no artifact in the proposed technique [10].

Conclusion:

It should be noted that, recently, road detection methods have become a very important part of vision applications and play a significant role in Intelligent Transportation System, which is a key technique for intelligent vehicle guidance. Road detection performance is severely affected by noise or low-frequency images. To solve this problem, we have proposed a new algorithm that uses median filtering and low-intensity pixel removal to improve the results. Comparing the method with the old methods shows that the proposed algorithm shows better results than the old techniques.

Table 2. Plan implementation schedule: Schedule: Specify by hatching the squares.

Steps of implementation	Activity	Implementation time (months)												Activity percentage
		1	2	3	4	5	6	7	8	9	10	11	12	
First	Research writing													10
Second	Writing the research according to the regulations													10
Thidm	Review previous topics													10
Fourth	Preparation of research equipment													10
Fifth	Testing of research equipment													5
Sixth	Testing and installation of sensors, equipment software													10
SEventh	Software testing and fun													10
Eighth	System implementation and use													10

Study outputs:

- ✓ Final report of the research project in one copy, along with a CD in PDF-Word formats
- ✓ Nine-page article report



✓ In addition, the results of this project will lead to the preparation and publication of articles in foreign journals and conferences, scientific-research journals and domestic conferences.

Information about project results:

- Not that the project results respond to the need for new technology that faces the problem of image processing?
- It should be noted that relevant higher education institutions, both government and non-government, use the project result
- If approved and willing, the government or private organizations that will cooperate with this project include:

Table ۳: Organization Approval

No	Organization name	Type and amount of cooperation	Name of person in charge and signature
۱	Organization name is Optional	Year and month	First name . Last name
۲
۳

Reference:

- [1]. Rajeswari, M. Gurumurthy, K.S. Omkar S.N., Senthilnath J., .Pratap L Reddy, (۲۰۱۰) “Automatic extraction of road networks based on normalized cuts and mean shift method for high resolution satellite imagery”, International journal of advanced engineering sciences and technologies, Vol.۳, pp. ۱۱۵-۱۲۱. <https://www.researchgate.net/publication/۳۲۴۹۸۶۰۸۴>
- [۲]. Rajeswari, M. Rajeswari, K.Sx, Omkar, S.N. .Senthilnath J, .Pratap Reddy L (۲۰۱۱), “Automatic road extraction based on level set, normalized cuts and mean shift methods”, International journal of advanced engineering sciences and technologies, Vol.۸, pp. ۲۵۰-۲۵۷.
- [۳]. Grote A., .Butenuth M, Heipke C. (۲۰۰۷), “Road extraction in suburban area based on normalized cuts”, International archives of photogrammetry, remote sensing and spatial information sciences, pp. ۵۱-۵۶.
- [۴]. Rajeswari, .M Gurumurthy. K.S., Omkar. S.N., Pratap Reddy. L (۲۰۱۱), “Automatic Extraction of Road Networks based on Normalized cuts and Mean shift method for high resolution satellite imagery”, International journal of computer applications, Vol.۱۸-No.۷, pp. ۱۰-۱۶.
- [۵]. Parthasarathi. V, Pushpamitra. DY, (۲۰۱۲), “Real-time implementation of automatic road extraction for high resolution satellite images using FPGA”, Global journal for information technology and computer science, Vol.۱ Issue. ۱, pp. ۱-۶.
- [۶]. Mangala. T.R., Bhirud S.G., (۲۰۱۱), “Road network extraction from high resolution satellite images based on LSE, LBF model”, International journal of scientific and engineering research, Vol.۲, Issue ۱۰ pp. ۱-۶.
- [۷]. .Mioc, O.D. Anton. F, (۲۰۰۸) “Polygon feature extraction from satellite imagery based on colour image segmentation and medial axis”, The international archives of the photogrammetry, remote sensing and spatial information sciences, Vol.۳۸, pp. ۲۳۵-۲۴۰.
- [۸]. Karaman E., Cinar. U, Gedik. E., ardemci, Y.Y, Halici. U, (۲۰۱۲), “A new algorithm for automatic road network extraction in multispectral satellite images”, Proceedings of the ۴th GEOBIA, pp. ۴۵۵-۴۵۹.
- [۹]. Chun-ling Fan and Yuan-yuan Ren, (۲۰۱۰),” Study on the Edge Detection Algorithms of Road Image”, IEEE, pp. ۲۱۷-۲۲۰.
- [۱۰]. Supreet Kaur, Seema Baghla (۲۰۱۳) Automatic Road Detection from Satellite Images Using Improved Edge Detection, Dept. of Computer Science, Yadavindra College of Engineering, Talwandi Sabo, Bathinda (Pb.) India Dept. of Computer Science, Yadavindra College of Engineering, Talwandi Sabo, Bathinda (Pb.) India. N^o: ۱۵۴۷-۱۵۵۲, ISSN ۲۲۷۷۳۰۶۱.

^۲ <https://www.researchgate.net/publication/>

^۳ <https://www.ciitresearch.org/dl/index.php/dip/article/view/DIP۰۴۲۰۱۴۰۰۲>

^۴ <https://www.ciitresearch.org/dl/index.php/dip/article/view/DIP۰۴۲۰۱۴۰۰۲>

^۵ <https://www.researchgate.net/publication/۳۲۴۹۸۶۰۸۴>