A SURVEY ON ROAD EXTRACTION FROM COLOR IMAGE USING VECTORIZATION

Nisha Sharma[1], Rajeev Bedi[2], Ajay Kumar Dogra[3]

Abstract

Road extraction can be defined as extracting the roads from an image by accessing it through the features of road. Road information can be extracted from images in three ways: manual extraction, semi-automated extraction and fully automated detection. In this paper we review various research papers of road extraction methods. Most of the work focused on road extraction from grayscale images. Our proposed approach is to extract road from color image using vectorization. Vectorization is performed using canny edge detection and CDT (Constrained Delaunay Triangulation) and then grouped resulting triangles into polygons to make up vector image. A sequence of pre-processing steps is applied to get better quality of image and to produce extended road network before vectorization. At the end, skeletonization is used to transform the components of digital image into original components.

Keywords: *vectorization, constrained Delaunay triangulation, canny edge detection, skeletonization,*

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1. INTRODUCTION

The conversion from raster image of remote sensing image to vector image is an essential task for extraction and updating of linear cartographic matter in cartographic process. Many difficulties emerge in the automatic solving of this trouble. Usually, vectorization and segmentation geometric methods are used, along with processes, patterns and models properties of the high, mid and low level of knowledge. The increasing traffic volume over the last decades poses high challenges on today's traffic research and planning. Now days, roads are equipped with a group of sensors to monitor the status of traffic: Video systems, Induction loops and overhead radar sensors are the most prominent examples. The satellite images are used for extracting roads becomes especially important in the services linked to road transportation like creation, maintenance and so on. The increased road traffic because of higher growth in traffic volume over to its congestion stage. This poses a huge challenge for today's road traffic research and development.

The proposed method reduces various kinds of distortions, compared with other methods. Other important method focused on skeleton extraction. However the main focus of these approaches is to vectorize the raster image without further exploitation of the obtained polygonal format. A chain of pre-processing is applied to improve quality of image and to generate extended road network for further processing. Firstly, the image is pre-processed to get better tolerance by resisting the noises, and then roads are extracted. In contour vectorization is applied to convert the binary image of drawings from raster form to vector form. The image vectorization starts with canny edge detection followed by a constrained Delaunay triangulation (CDT) where the lines resulting from the pre-processing stage are used as constraints for Delaunay triangulation.

2. REVIEW OF PREVIOUS WORK

Road network extraction from images depends heavily on human labour, which makes networks database development an expensive and time-consuming. Automated road extraction can appreciably reduce cost and time of data acquisition and update, database development and turnaround time. The literature indicates that different efforts can be done for recognizing the roads by extracting the different feature of road. Most of the algorithm in the literature consists of one or more of following operation: EKF (Extended Kalman Filter) and PF (Particle Filtering), Line Extraction, Morphological operation, Skeletonization, Normalized cut and Level set method, and Segmentation etc.

2.1 Level Set and Normalized Cut Method

It was based on Segmentation approach. The image is first segmented using the normalized cuts algorithm. The resulting relatively small segments are grouped to form larger segments, and from these grouped segments road parts are extracted. To cover cases where the road is fragmented (due to different road surfaces or context objects) road parts with similar main directions are assembled into strings of road parts or sub graphs. It was an automatic approach for extraction of road from satellite images based on Level set and Normalized Cuts algorithms. To begin with pre-processing was to reduce noises and then roads were extracted by applying two methods. At last, the comparison of correctness of automatic road extracted by two methods against manually extracted reference data was performed.

Fig1. Original Image

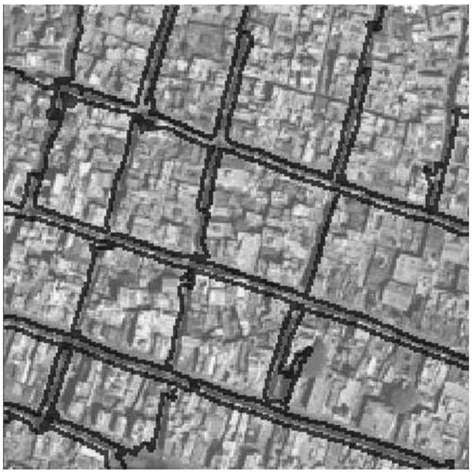

Fig2. Road extracted using Level set Method

Fig3. Road extracted using Normalized cut method

2.2 EKF and PF

EKF traced a road until a stopping condition was met. Then, in place of ending the process, the results were conceded to the PF algorithm. PF algorithm tried to locate the furtherance of the road once a probable obstacle or to discover all the achievable road branches which might available on the area of a road intersection.

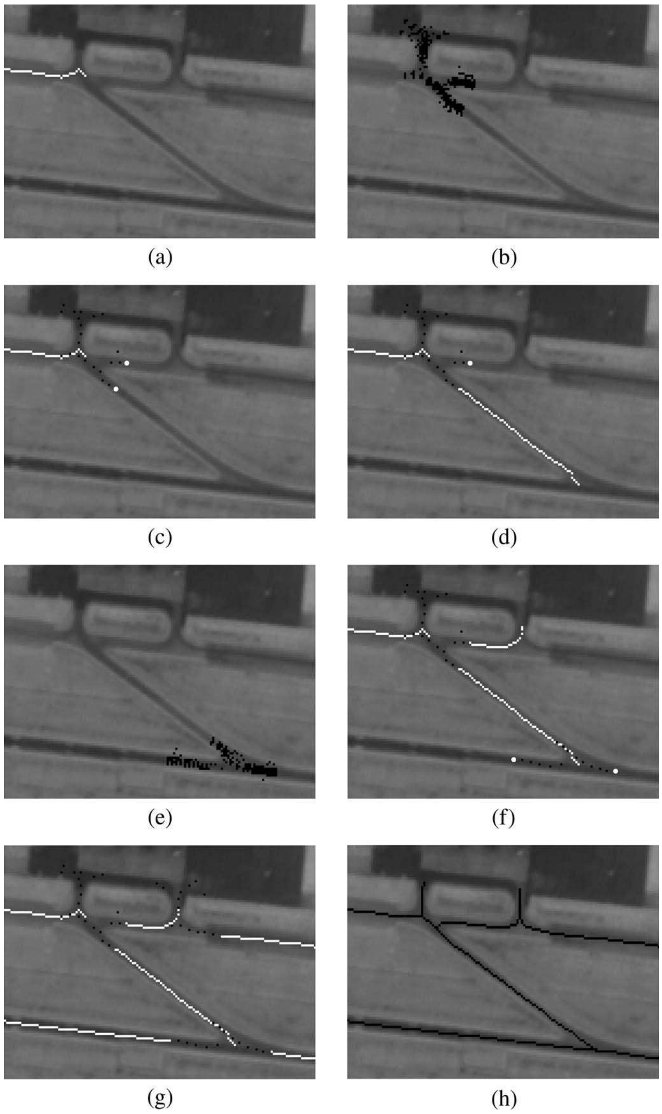

Fig4. Different stages of the overall road-tracking algorithm on an IRS image. (a) First road segment extracted by the EKF module. (b) Particles of the PF module. (c) Road branches extracted by the PF module. (d) Second road segment extracted by the EKF module. (e) Road branches extracted by the PF module. (f) Third road segment extracted by the EKF module. (g) Final result of the road extraction algorithm. (h) Road reference points extracted manually.

For further improvement, procedures were updated for providing the calculations by decoupling method from the recent status prediction of the filter. Eliminating the dependence of dimension data to the estimated state reduces the prospective for unsteadiness of the road-tracing algorithm and constructed a technique for dynamic cluster of the road information for keeping track when the road profile go through a number of variations cause due to changes in intensity and width of road.

2.3 Line Extraction

The transformation of raster to vector of satellite image is a main task in the updating and extraction of linear items in cartographic process. Vectorization method is based on CDT for linear extraction. The pre-processing step is used by applying correlation method to provide edges that belongs to the linear structure in original input image. The result from CDT techniques is triangles that were grouped into the polygons to create vector image. The skeletonization of polygons gives extracted linear structure. This algorithm was an automatic approach and fast that provide satisfied results.

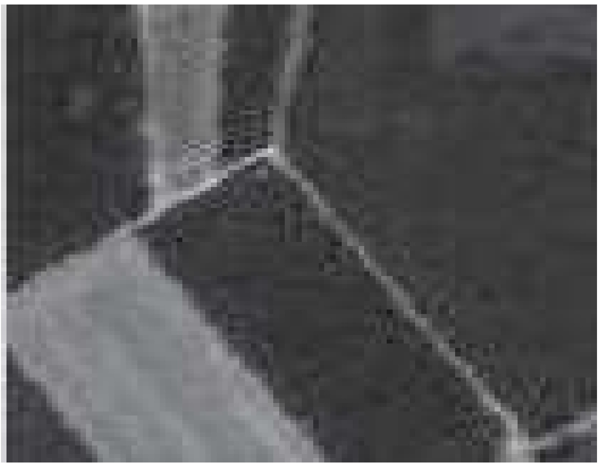

Fig5. Original Image

Fig6. Resultant Image

In this approach, vectorization was used for line extraction only. It extract linear object from grayscale image by performing CDT and Skeletonization operations on the preprocessed image.

3. PROPOSED OBJECTIVE

The overall objective of this work is to pass original color image to a vector representation that facilitates the extraction of road structure.

- To develop an algorithm that provides automatic extraction of road from the color image.
- To purpose an approach which Improve the visibility Factor in the resultant image thus make it easy to take a decision and provide better recognition of roads.
- To purpose a method to extract the signs and other details on the road without merging the information with road structure.
- To implement various vectorization techniques like triangulation, canny edge detection etc followed by the skeletonization to provide the better results and correct path of the roads.
- To analyze the performance of proposed method, compare the result from proposed approach with the results of previous approach by using parameters as correctness, completeness and accuracy.

4. PROPOSED METHODOLOGY

The overall objective of our proposed approach is to extract road from the color image. The various stages through which the image has to be processed depict in following figure.

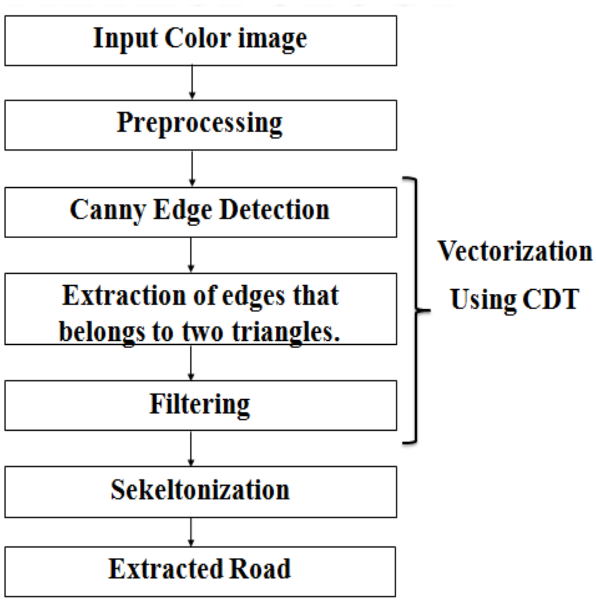

Fig7. General Approach

4.1 Preprocessing

The pre-processing provides constraints guaranteed that the edges were belonging to linear structure in the input image. It is used to improve the quality of resultant image. An example of preprocessed image applying Correlation coefficient on the original image by extracting a reference image from the same represented in figures.

Fig8. Original Image

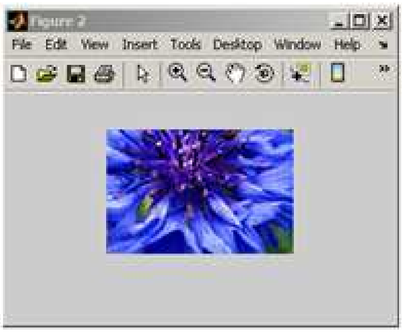

Fig9. Reference Image

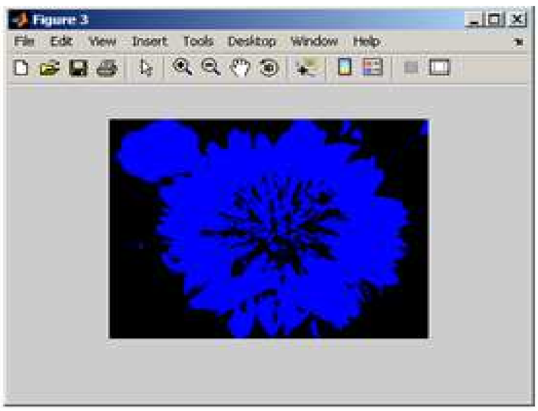

Fig10. Preprocessed Image

4.2 Vectorization

The vectorization is the process to find out a contour position from the image every time, and then start tracing from this position to acquire complete contour of an area, to evaluate the type of area, and to segregate the tracing area from other while tracing; after completion of tracing a contour line, carry on to explore another position until all the elements of an image are searched; lastly, combine all of the areas' contours collectively to get an entire image contour. Thus more processing is needed to gather edges that belong to the same object.

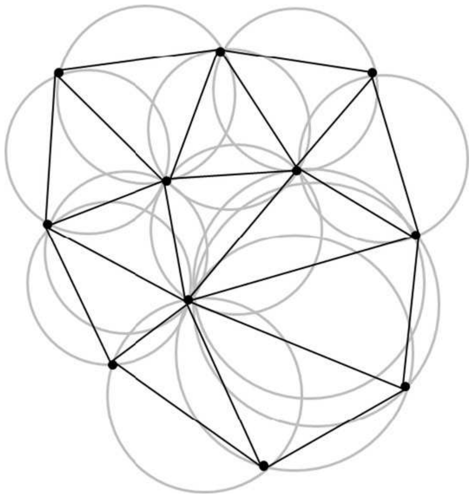

Fig11. Delaunay triangulation

The triangulation method is set of points on the plane represents separation of an area, enclosed with in convex hull. Triangles are combined by vertices, that given as an input. But if the triangles accomplish the condition of an empty circumcircle, then it represents a Delaunay triangulation (DT).

Canny edges and the gradient information extracted as local features. The CDT technique triangulated vertices according to the following features: (1) the pre-defined edges are involved in the triangulation, and (2) it is nearby possible edge to Delaunay triangulation.

4.3 Skeletonization

Skeletonization is a conversion of a component of digitized image into a subset of the original component. It is a large-scale space domain method for shape representation. There are two well-known paradigms for Skeletonization methods: The first is iterative thinning of the original image until no pixel can be removed without altering the topological and morphological properties of the shape. On the other hand, a skeleton is that of the edge lines created by centers of all the maximal disks incorporated in the original shape, associated to preserve connectivity.

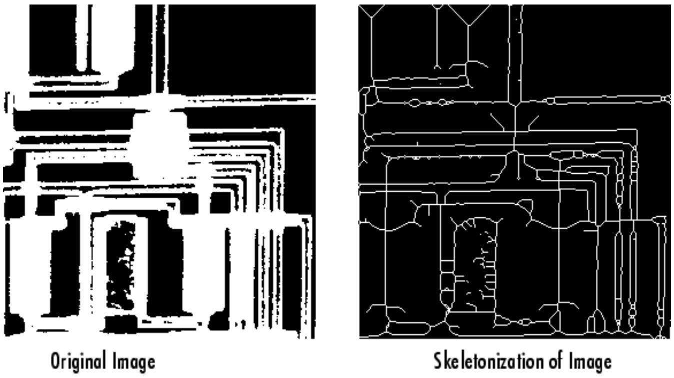

Fig12. Skeletonization image

It is the last step of our proposed approach, the result of this operation will be the resultant extracted road.

CONCLUSIONS

Existing techniques of road extractions are not effective in dealing with colored images. A mechanism is required for dealing with colored images because these images may contain some sensitive information that may loss while conversion to black/white image or grayscale. Most of the previous algorithms worked on grayscale images to extract road. There are various details on the road that merged with the road when it converts into grayscale. In this paper, we proposed an improved vectorization method to deal with the problem of loss of details of road during extraction from satellite images and also the visibility will be better if we use color image instead of grayscale image. To analyze the performance of proposed method, compare the result from proposed approach with the results of previous approach on the base of visibility performance, and efficiency by using following parameters: Completeness, Correctness and Accuracy. If the proposed method gives the large values of all the parameters as compared to existing techniques then the proposed method must be considered to be most effective.

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