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Road Detection from Satellite Images

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Abstract – In this project, we are going to propose a model of road detection with the help of satellite images. In the present scenario, roads are detected using Google maps and navigation systems, but there are some flaws and it is not up to date and hundred percent accurate. Sometimes roads detected are in the phase of construction or it is under maintenance, so the navigation system misleads the person. It does not tell the person that the provided rote is under maintenance. So to overcome the inaccuracy and inconsistency problems, we propose this model of road detection. In this paper, a method for road extraction and detection is used. Here we are using Otsu's method of image segmentation which is used on input image. Binarization and Morphological operations are also used. With the help of the above method we can detect roads from satellite images in a much more efficient manner. The proposed model will differ between the man-made objects and the roads.

Key Words: Convolutional Neural Networks, Road detection, Satellite Images, Image Processing, Data mining.

1. INTRODUCTION

Roads are one of the most important man-made objects. It is an important mode of the transport of India. Roads connect the major portion of the country to each other. Having a good transportation and road facilities boost the economy of country and it helps in transportation of goods from one state to another or from one city to another . Roads help in the navigation system.

Roads in India is the second largest network of road in the world after USA. It is spread over 56, 03,293 kilometer [1]. Roads are partitioned into different sorts, for instance, Expressways, National Highways, State Highways, District Roads, and Rural Roads The first evidence of road development and construction can be traced back in the 2800 BC in the Harappa and Mohenjo-Daro civilization, near the Indus Civilization .Rural emperors and Monarchs continued the road construction later when they came in to rule the country. At present there is allocated budget for Road and Transportation in the budget of every year.

Expressways are high-speed roads that are four- or more lanes, and are access controlled where entrance and exit is controlled by the use of ramps that are incorporated into the design of the expressway. Most of the existing expressways in India are toll roads [2]. National Highways are the roads which connect major city of country to each other. It is usually denoted by "NH". State highways are highways connecting major cities through-out a state. They also connect roads to National Highways or state highways of neighboring states. State Highways are usually denoted by "SH". District Roads are the roads which connect the taluka headquarters and the major roads within a city which are connected to each other. Rural Roads are the roads which are in the village and talukas. They are not much developed.

Road helps in the maps and in the online feature of Google Maps. It helps the user in knowing that which is a shorter route to travel from a distance A to a distance B. In road detection, which is basically done with the help of Google maps and navigation system now a days, it has some errors in it. Suppose we have to go from a particular place "A" to a place "B" and there is some construction going on the desired route or it is under maintenance, the Google Maps and Navigation System sometimes won't update that and even when it is under construction and maintenance it will tell the user that there is road to go. At present, road maps are constructed and updated by hand based on high-resolution aerial imagery but this process is very costly and time-consuming. Even though we have some error and mistakes. So, we need a solution for it which shows much better efficiency in detecting roads. So, in this project we are going to propose a method to detect roads in a much more accurate way using Otsu's method and morphological operations.

2. LITERATURE REVIEW

2.1 Road Detection from High Satellite Images Using Neural Network

In this paper, a street discovery model methodology dependent on neural systems is proposed. The model depends on Multilayer perceptron (MLP), which is one of the most favored counterfeit neural system engineering in arrangement and forecast issues. The RGB esteems are utilized for choosing the pixel has a place with the street or not. The discovered street pixels are set apart in the yield picture. In this paper a methodology of programmed intersection identification utilizing raster and vector data is described: mean and standard deviation of dim qualities, edges as street fringes, and so forth. The determined list of capabilities was utilized to prepare a feed-forward neural system, which was the base of the intersection administrator. The administrator chooses for a running window about having a street intersection or not.

Neural networks: Neural Networks are made up of simple processing units called nodes or neurodes [3]. The principle task related with a neurode is to get contribution from its

neighbors (the yield of different neurodes), register a yield and send that yield to its neighbors. Neurodes are normally sorted out into layers with full or arbitrary associations between progressive layers. There are three sorts of layers: input, covered up and yield layers responsible for accepting, preparing and exhibiting the conclusive outcomes separately.

Multilayer Perceptron (MLP): In this paper, Multilayer Perceptron (MLP) as a neural network structure is utilized. One of the most much of the time utilized neural network models in arrangement is MLP. MLP comprises of a network of hubs (neurodes) orchestrated in layers. The general structure of MLP comprises of at least three units organized in layers of handling hubs: an info layer that gets outer information sources, at least one concealed layer and a yield layer that creates the characterization results. Every hub in MLP can be demonstrated as a counterfeit neuron. In the MLP, every neuron j in the concealed layer registers the total of information xi weighted by particular association weight and figures its yield as an element of the whole. In the preparation procedure, they have utilized 650 haphazardly rearranged records. MLP is structured in three layers including an info layer, two concealed layers, and one yield layer. The information layer has 27 neurons and the concealed layer has 12 neurons. In the yield layer one neuron speaking to the street or not. They have utilized the back-propagation calculation with balanced preparing parameters (energy and learning rate) as the preparation strategy and utilized a sigmoid enactment work in all layers of MLP.

2.2 Road Detection from Remotely Sensed Images Using Color Features

This work carried out by Automatic detection of roads from very high-resolution aerial and satellite images is a very important research field. Unfortunately, the answer is not straightforward by using basic Image processing and computer vision algorithms. In this study, they propose a novel method for automatic detection of road segments from very high-resolution color aerial and satellite images. The method depends on choosing a training set from the input image manually. It uses color chroma values of pixels as the discriminative features. Since street pixels have comparable shading qualities, the circulation of shading chroma includes estimations of the preparation area includes a top at a specific point inside the component space which shows the road class. Using this information and one-class classification methodology, then they label road segments in a given remotely sensed image. Finally, they fit a road network shape on the detected segment.

Detecting the road pixels: In detecting road pixels in this method, we apply a semi-automatic detection method by labeling training road pixels for each image separately. In order to classify road pixels of the input test image, they use one-class classification method. In classification problems, generally total number of classes and the label for each class is known. However, in remotely sensed images, we have an unknown number of classes such as trees, buildings, parking lots, various types of roads, agricultural fields, pools and lakes, etc. If the samples of only one class are known as in our problem, classification cannot be done by a classical two-class or multi-class classifier, since the other classes are not represented. This is also the situation for our road detection problem. Fortunately, a one-class classifier can be used to separate this small class from other classes. The problem in one-class classification is to construct a choice boundary to separate interest class.

Representing Road Pixels: To represent the road network, they fit lies on to the boundary of detected road segment pixels. For this purpose, we first extract the Canny edges of the detected road segments and then discard the edges which are shorter than 50 pixels. After eliminating short edges, the road boundary is analyzed to fit the line segment. The algorithm finds the coordinates of the boundary pixels, calculates maximum deviation from the line that joins two junctions or endpoint. If the maximum deviation exceeds the allowable tolerance, then the edge is shortened to the point of maximum deviation and the test is repeated. In this way, the boundary is represented by line segments.

2.3 Road Network Identification and Extraction in Satellite Imagery Using Otsu's Method and Connected Component Analysis

In this paper, a technique for street identification and extraction of satellite pictures has been presented. This technique utilizes the idea of histogram balance, Otsu's strategy for picture division, associated segment examination, and morphological activities. The point of this paper is to find the capability of high-goals satellite pictures for distinguishing and removing the street arrange in a vigorous way. Satellite images often contain noise. Therefore, these images are preprocessed and enhanced before the extraction of objects. In image enhancement, digital images are altered and its visual interpretability is improved. Therefore, resultant images are more appropriate for analysis. Contrast enhancement is one of image enhancement techniques. It improves the appearance of an object and the brightness between object and its background.

3. METHODOLOGY

In this paper, a novel method has been proposed for detecting and extracting the road network from high-resolution satellite images. In this method, the input image is first preprocessed.

Image Preprocessing: - First of all, preprocessing is performed on the image. Satellite images often contain noises. Therefore, these images are preprocessed and enhanced before the extraction of objects. In image enhancement, digital images are altered and its visual interpretability is improved. Therefore, resultant images are

more appropriate for analysis. Contrast enhancement is one of image enhancement technique. It improves the appearance of object and the brightness between object and its backgrounds.

Grayscale Conversion: - RGB pictures are changed over into grayscale pictures to decrease cost, handling time and unpredictability of the pictures.

Histogram equalization: Histogram equalization is a technique which remaps the input image pixels so that almost uniform histogram may be achieved. It helps in enhancing the contrast of the image. It is applied on the gray scale image.

OTSU method: - Otsu's method for picture division is utilized for threshold selection. Proposed in 1979. Otsu's method chooses the limit consequently. It is powerful, quick, straightforward and stable. In Otsu's calculation, a global threshold is processed.

Binarization: - After threshold selection, image is converted into another image where all pixel values which are greater than the threshold are replaced by 1 and rest pixel values are replaced by 0. As a result of this step, a black and white image is formed. Because of this progression, a high contrast picture is framed.

Connected component analysis: - Connected pixels are set of pixels which are not divided by boundary. Its basic idea is an identification logic whose role is to detect the components which are single, broken or connected characters. After finding connected components, trivial opening is performed. Trivial opening extracts the connected component based on some criteria. If connected component of image satisfies the criteria T, then component is preserved, if not then component is removed.

Morphological operations: - After connected component analysis, the removed streets still contain a few openings and commotions. This is so in light of the fact that associated segments now and then can't distinguish little ground objects like structures, paths, vehicles, and so forth. To dispense with them and improve the exactness of the outcomes, the removed outcomes are handled by the different tasks of numerical morphology like opening, shutting, enlargement, and disintegration. Morphology is a methodology where items and article highlights are recognized through their shape.

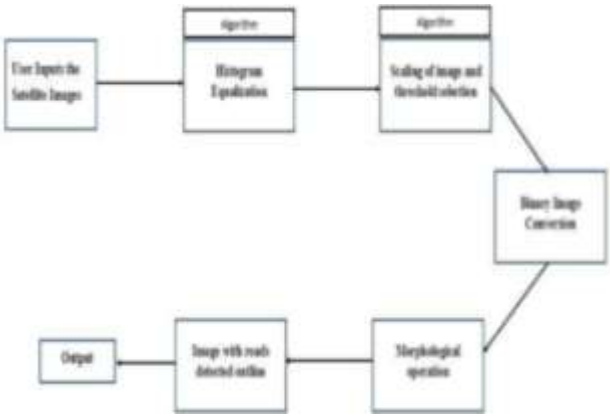

Fig-3.1: Block Diagram

4. RESULTS

The proposed system was tested by giving input as satellite images. Following results were acquired from these tests:

Figure 4.1: Original Image

Original Image is given as input to model. The model works on this image to give Output.

Figure: 4.2: Grayscale Image

The Original Image is converted into Grayscale form which reduces parameters to work in image.

Figure 4.3: Histogram Equalized Image

Histogram equalization is used to enhance contrast of gray scale image.

Figure 4.4: Inverted Image

Histogram equalized image is Color inverted to highlight edges of Objects in the image.

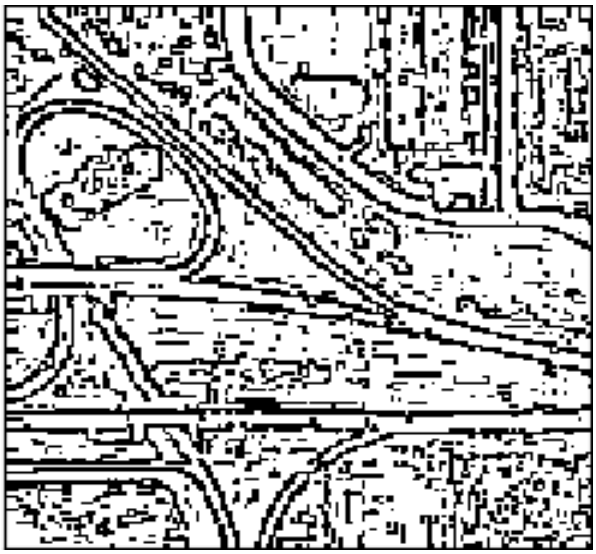

Figure 4.5: Raw Edge Image

Histogram Quantized image is binarized to produce black and white image. This image outlines all the objects in the image.

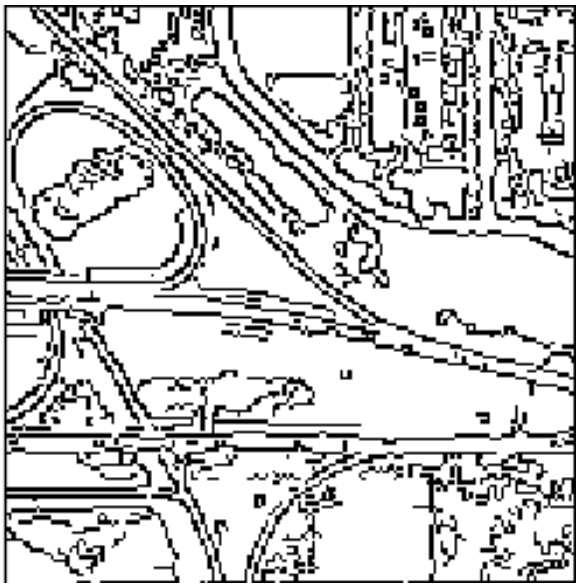

Figure 4.6: Final output

The final output image is the result All methods used, it shows proper edges of road. Here we also see shapes and edges of varios objects and Buildings.

5. CONCLUSION

This project is developed to process the unprocessed high-resolution satellite images to detect proper highways and roadways. This model uses algorithms like histogram equalization and OTSU method to generate desired results.

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