

An Informal Method of Village Mapping Using Edge Detection Technique & ISRO- BHUVAN Software

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ABSTRACT: It is always necessary to have map of any village. If anyone wants to find out any local area, school, government talati office/panchayat office, internal roads, society, hospital or medical practitioner's clinic in village then map is very helpful tool to navigate. Nowadays, it is very necessary to have navigator in a mobile phone to find the highway, a complete roadmap to reach from source to the destination. As we know, mainly there are two navigators available in India. 1) Google earth for global world and 2) ISRO BHUVAN specifically for India. In this paper we have used ISRO BHUVAN to navigate and find area of a small village called Gopalpura, near Anand, Gujarat, India. There are many views available in the BHUVAN software like Base admin, Hybrid, Satellite, Terrain, 2D and 3D etc. we have used Base admin, Hybrid and satellite view of ISRO-BHUVAN software, to map Gopalpura. We have filtered base admin view of Gopalpura map through Canny Edge detection technique. Resulted image shown is edge detected image of Gopalpura map derived.

KEYWORDS: Canny edge detection, Optimal Edge detection, Map, Navigation, ISRO-BHUVAN software.

I. INTRODUCTION

It is very difficult to draw a map of any small village with its important areas like public residences, medical clinic, water pump, power station, temple, inlets, outlets etc. Nowadays, we are very much dependent on technologies like, mobile phone, computers, and navigators etc.

To find the way from source to destination, we always look for the available navigators with us. In India, as a navigator, we have Google Earth and ISRO-BHUVAN [1] mainly. Google is for the global world and ISRO's BHUVAN is especially for India. In a navigator it is very easy to find the map of any city situated in India but it is very difficult to find the map of a very small village of India having its depth clarity of important areas. So in this paper we have tried to find the map of small village called Gopalpura, near Anand, Gujarat, India.

We have used ISRO's BHUVAN software to navigate or to find the map of Gopalpura. In this paper we have used Base admin view and Hybrid view with satellite view of BHUVAN 2D image to find Gopalpura village. After finding its map using BHUVAN software, we have cropped the same image as shown in Fig-1. It is Hybrid view of Gopalpura map shown in Fig-1. Fig-2 is Base Admin view of Gopalpura map found using ISRO's BHUVAN 2D software. Then, the image of base admin view of sample map considered. Now it is filtered through a very well-known optimal edge detection algorithm. It is called Canny edge detection algorithm [2].

In Section-2 we discuss about Related Work. In Section-3 we discuss about Canny edge detection algorithms. In Section-4 we discuss about Experimental Method. Results are discussed in Section-5. Section-6 concludes the paper.

II. RELATED WORK

In [3] Chintan K Modi et al., has proposed to use best optimal edge detection for the inspection of multi-layer chip capacitor. So edge detection can be used to apply on different areas like quality inspection of liquid level filled in bottle,

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physical inspection of chip capacitor etc. In [4] and in [6] KunalPithadiya et al., has used edge detection technique to inspect liquid level in glass bottle and also has used for physical inspection of chip resistor. In [7] V. Raghu et al., has done administrative planning based on GIS. In this paper, different maps of Sikkim are used for the planning of few part of Sikkim, India. In [8] SeungGwan Lee et al., introduces the main difficulties associated with determining and updating unknown map information with navigation system. In [9] S. K. Katiyar et al., has compared different edge detection technique and its result with some database. He has worked upon different satellite images taken from google earth or few more sensor satellites and compared it with different edge detection techniques like Prewitt, Sobel, Roberts, Canny etc. He found edge detected image from map and identified different areas from map like roads, lake stadiums etc. He concludes that canny is better edge detection method to work on sensor images. Inspired from this we have tried to find village mapping from base view of ISRO-BHUVAN [1] 2D image software and find the map of Gopalpura village.



Fig.1 Hybrid View of Gopalpura
Courtesy: ISRO, BHUVAN [1]

III. CANNY EDGE DETECTION TECHNIQUE [2][3][4][5][6]

Edge detection is one of the most commonly used operations in image analysis, and there are probably more algorithms in the literature for enhancing and detecting edges than any other single subject. The reason for this is that edges form the outline of an object. An edge is the boundary between an object and the background, and indicates the boundary between overlapping objects. This means that if the edges in an image can be identified accurately, all of the objects can be located and basic properties such as area, perimeter, and shape can be measured. Since computer vision involves the identification and classification of objects in an image, edge detection is an essential tool.

Canny assumed a step edge subject to white Gaussian noise. The edge detector was assumed to be a convolution filter f which would smooth the noise and locate the edge. The problem is to identify the one filter that optimizes the three edge detection criteria.

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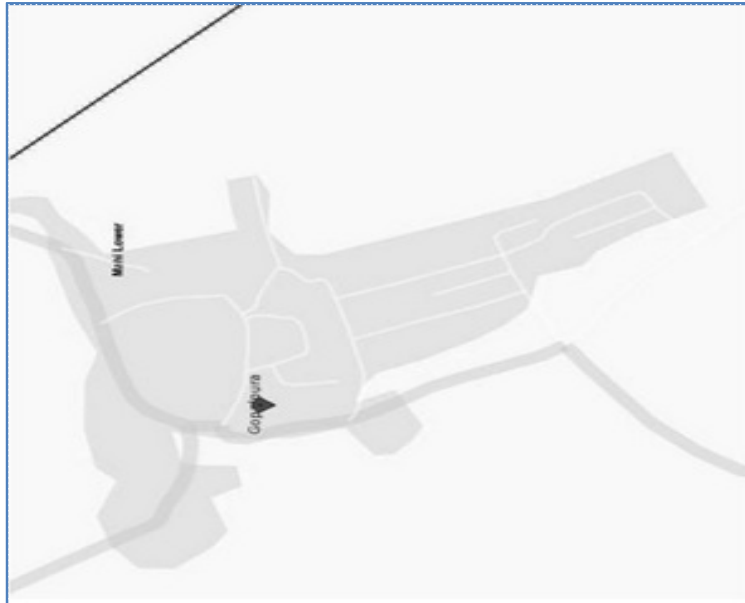


Fig.2 Base Admin View of Gopalpura
Courtesy: ISRO, BHUVAN [1]

Canny specified three issues that an edge detector must address.

5.2.1. Error rate - the edge detector should respond only to edges, and should find all of them; no edges should be missed.

5.2.2. Localization - the distance between the edge pixels as found by the edge detector and the actual edge should be as small as possible.

5.2.3. Response - the edge detector should not identify multiple edge pixels where only a single edge exists.

These seem reasonable enough, especially since the first two have used to evaluate edge detectors. The response criterion seems very similar to a false positive, at first place.

In one dimension, the response of the filter f to an edge G is given by a convolution integral:

$$H = \int_{-W}^W G(-x)f(x)dx \quad (1)$$

The filter is assumed to be zero outside of the region $[-W, W]$.

The value of SNR is the output signal to noise ratio (error rate), and should be as large as possible: we need lots of signal and little noise. The localization value represents the reciprocal of the distance of the located edge from the true edge, and should also be as large as possible, which means that the distance would be a small as possible.

Canny attempts to find the filter f that maximizes the product $SNR \cdot localization$ subject to the multiple response constraint, and while the result is too complex to be solved analytically, an efficient approximation turns out to be the first derivative of a Gaussian function. recall that a Gaussian has the form:

$$G(x) = e^{-\frac{x^2}{2\sigma^2}} \quad (2)$$

In two dimensions, a Gaussian is given by

$$G(x, y) = e^{-\left(\frac{x^2 + y^2}{2\sigma^2}\right)} \quad (3)$$

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and G has derivatives in both the x and y directions. The approximation to Canny's optimal filter for edge detection is G' , and so by convolving the input image with G' we obtain an image that has enhanced edges, even in the presence of noise, which has been incorporated into the model of the edge image.

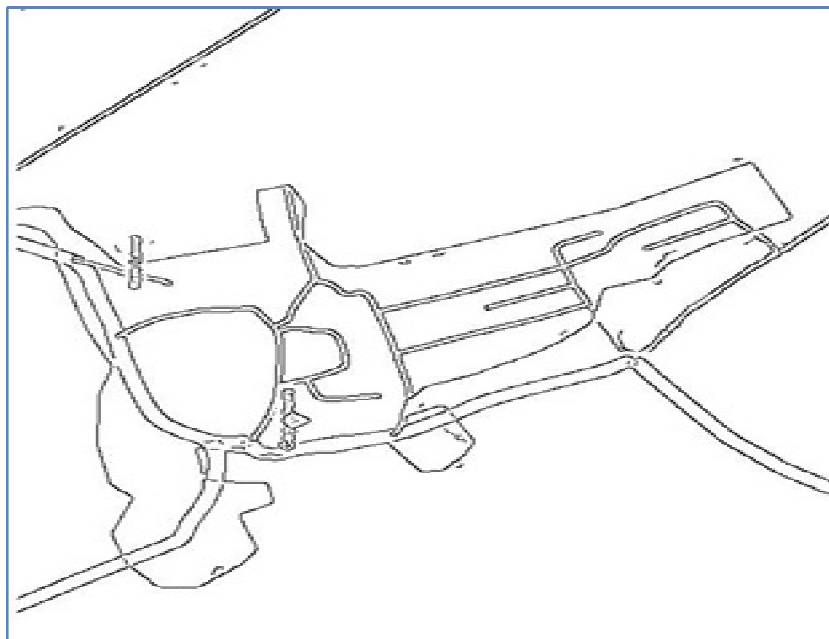


Fig.3 Canny Edge detected map of Gopalpura

The Canny edge detection algorithm to this point is:

1. Read in the image to be processed, I .
2. Create a 1D Gaussian mask G to convolve with I . The standard deviation (s) of this Gaussian is a parameter to the edge detector.
3. Create a 1D mask for the first derivative of the Gaussian in the x and y directions; call these G_x and G_y . The same s value is used as in step 2 above.
4. Convolve the image I with G along the rows to give the x component image I_x , and down the columns to give the y component image I_y .
5. Convolve I_x with G_x to give I_x' , the x component of I convolved with the derivative of the Gaussian, and convolve I_y with G_y to give I_y' .
6. If you want to view the result at this point the x and y components must be combined. The magnitude of the result is computed at each pixel (x,y) as:

$$M(x, y) = \sqrt{I_x'(x,y)^2 + I_y'(x,y)^2} \quad (4)$$

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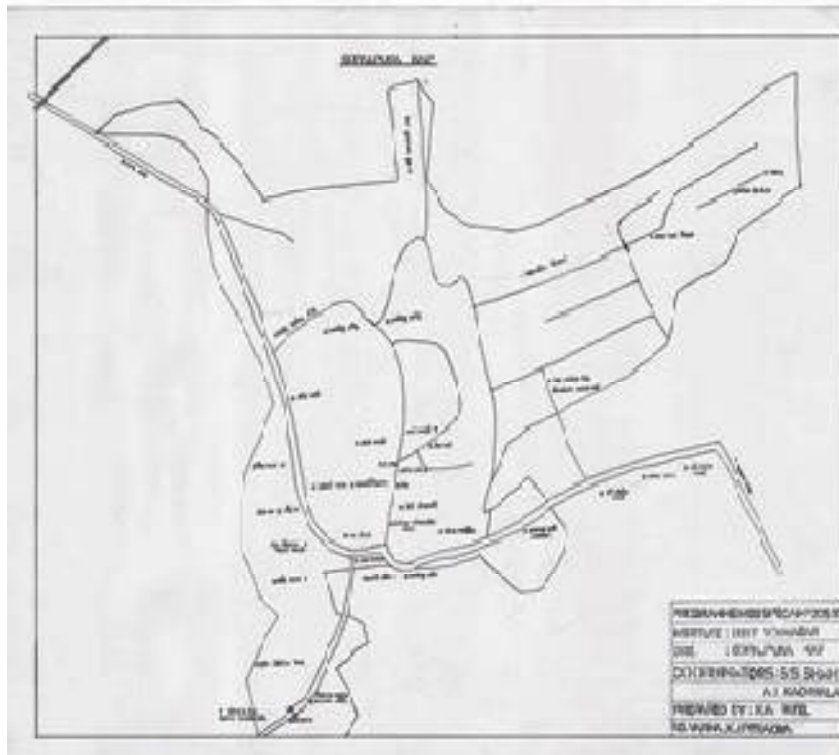


Fig.4 Manual Map of Gopalpura village, Anand , Gujarat

IV. EXPERIMENTAL METHOD

In this paper, we have used ISRO’s Bhuvan software to navigate Gopalpura Map near Anand, Gujarat, India. The experimental method is shown in Table I. The Cropped Image of map shown as Fig-2 is filtered through Canny edge detection algorithm discussed above. The resulted Canny edge detected map or image is as shown in Fig-3.

TABLE I
Method to find Map

No.	Steps
1	Acquire the image of map as shown in Fig-1 and Fig-2 using ISRO – Bhuvan’s hybrid view and satellite view respectively.
2	Apply canny optimal edge detection algorithm as discussed to Fig-2.
3	Resulted Edge detected Image shown in Fig-3.
4	Compare Fig-3 and Fig-4 to derive small details from Map.

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V. RESULT & DISCUSSION

In this paper, we have used Bhuvan's Satellite view to find map of Gopalpura, Anand, Gujarat. We have applied canny edge detection algorithm to the image of satellite view of bhuvan software of Gopalpura map. We can see the resulted canny edge detected image of Gopalpura Map shown in Fig-3. It is also possible to make a map of village manually. Fig-4 shows the map of Gopalpura made manually. The Manual map of Gopalpura is having little bit less clarity like boundaries of field and local areas of, railway line, the sharp curves of roads etc., of village.

VI. CONCLUSION

In this paper, we have used canny edge detected satellite map of Gopalpura village using Bhuvan software. As shown in Fig-3 and Fig-4, we can see, it is an informal method but better to use canny edge detected satellite view of Gopalpura map to derive the clarity of local areas, small roads, railway track, outer boundaries of field etc. of village.

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