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Building detection form High resolution images using morphological operation

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Abstract : *Building detection from satellite image is tedious task because constructed buildings are of different size and having different shapes. In this study used different image processing techniques like thresholding, morphological opening operation is uses for identify shapes of building because morphological operation is dealing with the shape. The high resolution images are used for extracting the buildings and count the total building found. The count of the building found with the help of the counting the bounded elements of the image.*
Keywords - *Building Extract, building count, Bounding box, Matlab, Morphological operation,*

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I. Introduction

The high resolution images varies according to the resolution and their sensors most challenging task is to find building and identify the building. The shape and size play an important role in identification. The lots of work has been done on building extraction.

The detection of buildings is an important task for the interpretation of remote sensing data. Possible applications for automatic building detection are the creation and verification of maps and GIS data, automatic land use analysis, measurement of sealed areas for public authority uses, etc. Buildings are significant objects in remote sensing data and directly indicate inhabited areas. Most way the buildings are well recognizable by a human interpreter. An automatic system that is able to compare a human operator is desired. [1]

These various methods are used for building extraction with help of mathematical morphological extraction method. The Jon Atil Benediktson et.al.(2003)[2] sebastien Lefevre et al.(2007)[3], and Neeti Daryal et.al.(2010)[4] used the concept of mathematical morphology for urban feature extraction for that they use remotely sense data. The mathematical morphology method is used for quantitative analysis of spatial structures that analyzing shapes and forms of objects [5].

Mayer (1999)[6], Sowmya and Trinder (2000)[7], Baltsavias (2004)[8], and Brenner (2005)[9] the automatic and semi-automatic building extraction approaches were extensively reviewed. Most of the past studies conducted to extract buildings from high resolution satellite images have used the spectral values of the images via classification approaches. Lee et al. (2003)[10] proposed a classification-based approach to extract building boundaries from the IKONOS multispectral and panchromatic images [11]

The proposed work deals with the morphological operations. The work has been divided into three parts 1: preprocessing 2. Applying morphological operations 3. Post Processing. The Matlab13 and ENVI 4.4 were used for the building detection. The Geoeye-1 40cm image is used for the work. The subset of image was created using ENVI 4.4 then the subset goes for further processing in matlab13.

II. Methodology

In the present paper Geoeye-1 satellite high resolution image panchromatic imagery used with the 40 cm resolution to evaluate the performance of our methodology. The image subset is created using ENVI4.4 software. This method find the most of the building automatically. The propose method flow is given in below Fig.1

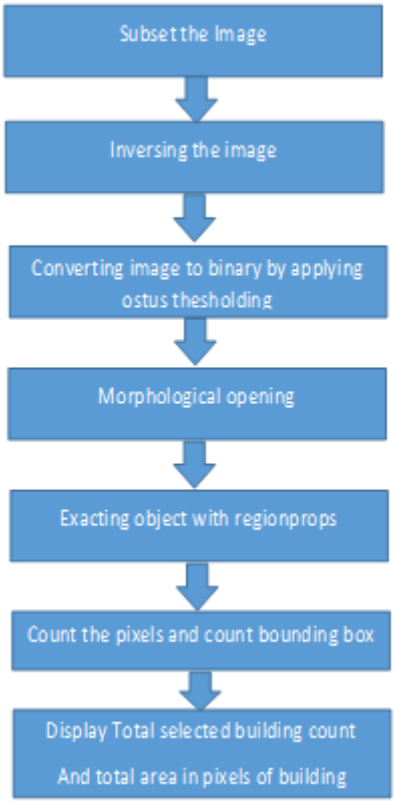


Fig 1. Flowchart

2.1 Preprocessing:

GeoEye-1 image is of 40cm resolution and large in size. So processing the large image in matlab is quite difficult thus the first operation done on image is the 3 subset is created from image so processing get easier. For the subseting image ENVI 4.4 software used. The image is divided into subset using ROI. Image Inverseing :The negative of an image is obtain through the invesring the image so that the image reflect the high intensity values. Image Binarazation: The subset image is feed to the matlab program and the image is converted RGB image in to the binary image with the help of conversion.

2.2 Building Extraction

Thresholding is used to separate the regions of the image corresponding to an object from its background [12]. Thresholding is a very convenient way of performing segmentation. Here, we use the difference in intensities or colors in the foreground and background regions of an image to generate a binary image. Thus thresholding can be defined as an image processing function that is used to segment an image by setting all pixels whose intensity values are above a threshold to a foreground value and the remaining pixels to a background value [13-14]. It can also be used to see what areas of an image consist of pixels whose values lie within a specified range, or band of intensities (or colors). The input to a thresholding operation is typically a grayscale or color image [15].

Ostus Thresholding:

Otsu shows that minimizing the intra-class variance is the same as maximizing inter-class variance :

$$\sigma_b^2(t) = \sigma^2 - \sigma_w^2(t) = \omega_1(t)\omega_2(t)\left[\mu_1(t) - \mu_2(t)\right]^2 \qquad 1$$

which is expressed in terms of class probabilities ωi and class means μi which in turn can be updated iteratively. This idea yields an effective algorithm . [16]

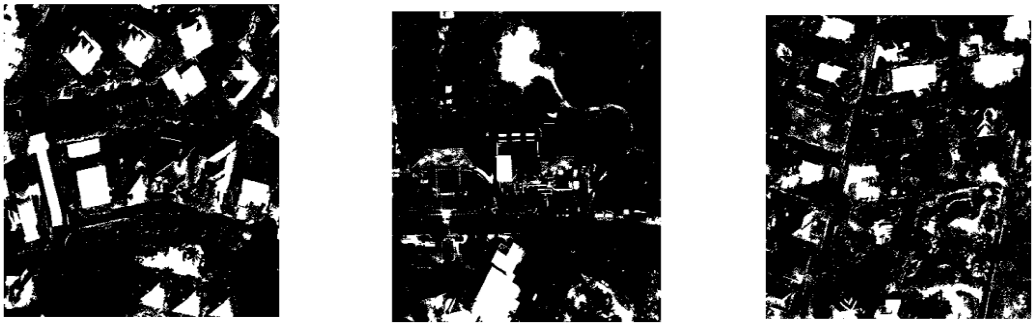
Morphological operations:
Fill operation: It is used to fill the holes in the grayscale image I. A hole is defined as an area of dark pixels surrounded by light pixel. The following matlab syntax is used to ill holes in the image:

$$Ifill = imfill(Ibw,holes) \quad (2)$$

Where I is a bimnary image. The advantage of ill operation is to ill the holes in the image by describing an area of dark pixels bounded by light pixels and producing another binary image I2.
Open operation: The morphological open operator are normally applied to the binary image. It is used to remove the features that are smaller than the value of p pixels and retains the large structure in the image. The following matlab syntax is used to extract the objects from the input image:

$$IM = bwareaopen(Ifill, p) \quad (3)$$

In our experiments we have used a threshold value of 40 pixels (p = 40) which is found to be ap- propriate for the extraction of majority buildings.[17] Following are the result after the opening operation.



(a) (b) (c)

Fig 2. Morphological Opening

2.3 Post Processing

The opening operation generally smoothes the contour of an object, breaks narrow strips, and eliminates thin protrusions. Then building are separated using rectangular box. For that the region growing concepts are used.

Regional Discriptor : After the segmentation through the morphological opening the reginal descriptor sreparates the buildings using bounding box. A region may be represented by its boundary, and its boundary described by some features such as length, regularity. Features should be insensitive to translation, rotation, and scaling. Both boundary and regional descriptors are often used together.[18] Fig.3 represent the regions of building selected by the boundaries whcich are separated by the backgrounds.

(e) (f) (g)

Fig.3 Resulted images

III. Reuslts

The automated building-extraction strategy using structural, contextual, and spectral information is tested using the GeoEye-1 image of the City of Kauai Hawai, UAS. The image is the sample of GeoEye-1. The test site is a subsample of 450 × 450 pixels that covers the urban area. The proposed method was implemented in Matlab13. Buildings was automatically detected and find count of the buildings. The resulted image also calucate the area of the selected building and count the total building in the present image as given Table 1

Table 1: Building Count and area satastic

Sr. No	Image Name	Building Count	Total avrage Area of buildings	Total area of image	Non Build-up area	Total Building Area in cm	Total Building area in meter
1	Subset1	29	26347	157545	131198	1053880	10538.80
2	subset2	17	16657	188352	171695	666280	6662.80
3	subset3	34	20655	156418	135763	826200	8262.00

Table 1 gives the resulted count building of subset I, II, III as 29, 17, 34 which is can be further evaluated by following process of building accuracy statistic Table 2. Accuracy is checked by manually visual inspection. Every building in the output image was either marked as True Positive, True Negative, False Positive, or False Negative using the following definitions:

True Positive (TP): Both the automated and manual methods classified the area as building.
True Negative (TN): Both the automated and manual methods classified the area as non-building.
False Positive (FP): Only the automated method classified the area as building.
False Negative (FN): Only the manual classification classified the area as building.

Once the number of buildings belonging to each category is determined, the performance of the developed method was evaluated using the following statistical measures:

Branching Factor: FP/TP
Miss Factor: FN/TP
Building Detection Percentage: 100 ×TP/ (TP + FN)

The 'branching factor' is a measure of the commission error where the developed method incorrectly labeled building areas, while the 'miss factor' is a measure of omission error, where our method incorrectly labeled building pixels as background. The 'building detection percentage' gives the percentage of building pixels correctly labeled by the automated process.

Table 2: Building Accuracy Statistic

Subset	TP	FP	FN	Total Buildings found	Miss Factor %	Branching Factor %	Building Detection %
Subset I	22	4	3	29	0.136	0.182	88.00
SubsetII	11	2	6	17	0.545	0.182	64.71
SubsetIII	24	4	5	34	0.208	0.167	82.76
Average					0.297	0.177	78.49

From the above Table.1 we can find the accuracy is 78.49% for detecting the object as a buildings

IV. Conclusion

Propose system use GeoEye-1 PAN image with 40cm resolution image which are subseted with the 450×450 pixels value. The Morphological operation after the Ostu's Thresholding gives separation of building from backgraoound.The building count calculated by the selecting the building with the regional descriptors. The propose system got the results with 78.49%. The shape, roof color of building play an important role.

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