DOI: http://dx.doi.org/10.26483/ijarcs.v8i9.5202

ISSN No. 0976-5697

Volume 8, No. 9, November-December 2017

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

AUTOMATIC EXTRACTION, CHANGE DETECTION AND ANALYSIS OF BUILDINGS USING URBAN SATELLITE IMAGERY

Dr. Kodge B. G.
Department of Computer Science,
Swami Vivekanand Mahavidhyalaya,
Udgir, Dist. Latur Maharashtra State, India

***Abstract*—** An attempt is made here in this paper for how to extract the constructed buildings from high resolution urban satellite images. Further the same is continued for the analysis of extracted buildings with respect to change detection using some temporal satellite images. A new simple method is used to process an RGB urban satellite image, use a filter to segment the image. Next the method continues with grouping and optimization of extracted patches with detecting the edges. Further the particles will be counted and analysed for change analysis using some temporal imagery. The outcome of this research work will be very much useful in several areas like urban planning & development, change analysis, land use analysis, land cover reports, land surveys, Spatial informatics etc.

***Keywords*—** Building Extraction, Change Analysis, Urban Development, Satellite Images, Image Segmentation, Edge Detection.

I. INTRODUCTION

The extraction of buildings from high resolution urban satellite images has become an active research topic from the last few years. The extraction of two-dimensional building information from high resolution imagery using aerial photos, high resolution satellite images, and combined LiDAR and Google aerial images data has been popular. Due to their high resolution, and panchromatic aerial images have been used as a single data source. The methods used in these studies involved algorithms for Segmentation, edge detection, and building shapes from primitive features. The building recognition techniques utilizing aerial imageries have suffered due to low temporal resolution and high cost of images acquisition [1], [10].

The Most of the building extraction methods and techniques use generic models by assuming all buildings follow a certain pattern. The generic models and techniques do not result accuracy, if a building like informal settlement precede the irregular pattern. Buildings in informal settlements areas differ in terms of building materials, neighbourhood distance and orientations. There are only few tools and methods are available to extract unstructured buildings as compared to researches on structured building extraction. Recently some researches are published such as use of fused shadow data with 2D building blobs derived from normalized Digital Surface Model (DSM) and still video Kodak camera to extract shacks in South Africa. The DSM suffers from insufficient ground sampling or training data and matching errors due to low resolution images, and shadows reflects barrier in identification of buildings outlines. In this case an effective informal settlement extractor should be required for both structured and unstructured buildings [2].

The main tasks in building extraction from digital images are building detection or recognition. The building extraction aims may differ depending upon the use of geometrical representation with rectangular models, use of multiple textured images, and multiple shapes, the use of lines, points and regions to describe building boundaries. The existing automated building extraction techniques are still performing at elementary level caused by differences, scale and resolutions in images. The automatic recognition of semantic information of an object using computers is complicated; most of the existing algorithms fail whenever a new situation in image space or shape is found or objects are close to each other. Sohn and Dowman proposed an automatic method of extracting buildings in densely urban areas from IKONOS images. They used large detached buildings without analysis of accuracy and structure details [3]. One more study compared the buildings extracted from IKONOS imagery with those obtained using black and white aerial photographs to evaluate the potential of high-resolution images. In an another study Mr. Thomas and his co-researchers have concluded that high-resolution imagery is a valuable tool for mapping urban areas in extracting land cover information from high-resolution images [4],[6].

One of the existing studies has developed an approach to extract building boundaries from IKONOS panchromatic images. Initially, the line segments were extracted. Then, a local Fourier analysis was used to do an analysis of the dominant orientation angle in a building cluster and the line segments were regularized using this information. The building boundaries or outlines were extracted based on a binary space partitioning. The analyses of multispectral images were performed to detect cultural activity. Then, the images were segmented using the K-means clustering algorithm and a binary image that contains the possible street network and houses was obtained. Further the segmented or classified images are decomposed using the balloon algorithm based on the back and white physical structure. To extract the street roads and buildings, these decompositions were represented. The man-made objects generally have straight and/or circular edges that cause straight and circular forms in an image. Although, in the present case, the predominant building shape is rectangular in the selected study area, there are also buildings with different shapes, such as circular, ring, C, and S shapes. In this study, we present an approach for extracting the rectangular and circular buildings from high resolution satellite imagery. We use Hough transform to delineate the rectangular and circular shaped building boundaries. [5], [7],[9].

II. THE STUDY AREA AND DATA SETS

Latur is located at 18° 24′ N to 18.4° N and 76° 35′ E to 76.58° E / 18.4; 76.58 and is situated at 636 meters above mean sea level. The district is situated on Maharashtra- Karnataka state boundaries. Bidar (Karnataka) is located at eastern side of the Latur, and Nanded is on the Northeast, The Parbhani district is on the northern side, and Beed is on the Northwest and the Osmanabad is on the west-southern side as shown in Figure 1 [8].

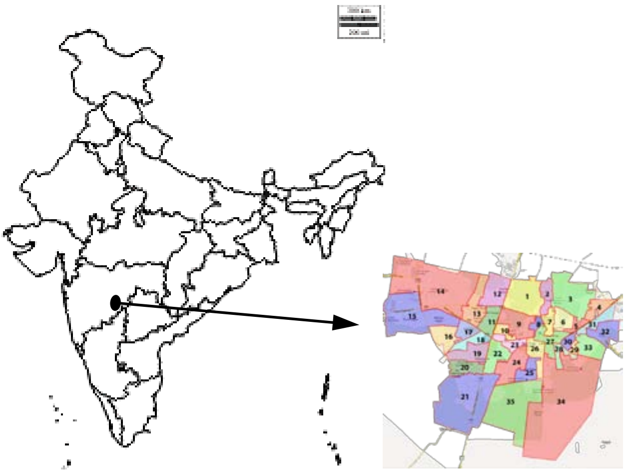


Figure. 1 Latur district (study area) located in Maharashtra state of India.

The data sets for this study area are collected from Google server. The temporal images of year 2006, 2008, 2010, 2011, 2013 and 2015 are also collected of same site, and made available for change analysis occurred during the specified periods.

III. THE METHODOLOGY

The high resolution imagery of the study area are collected from Google server. The server provides coloured texture images with high resolution. In this methodology, I need to be use the same textured images so all coloured images are converted to similar coloured and texture and processed for image segmentation for extraction of buildings. The 3-channel image segmentation technique is used to segment the RGB satellite images. The 3-channel filters pixels outside of (R G B) range with the Foreground (R G B) value at centre and radius equal to the corresponding slider value; and it keeps pixels with colours inside of the specified range and fills the rest of image with the Background colour. The plug-in accepts RGB images for processing. For filtering our study site images I have used Red tolerance =255, Green tolerance = 255 and Blue tolerance =195. Further, the segmented image is converted to its greyscale for further grouping & optimization and edge detection process. The canny edge detection technique is used for detecting every segmented patch as an object of a constructed building. The complete process of our proposed study is shown in following Figure 2.

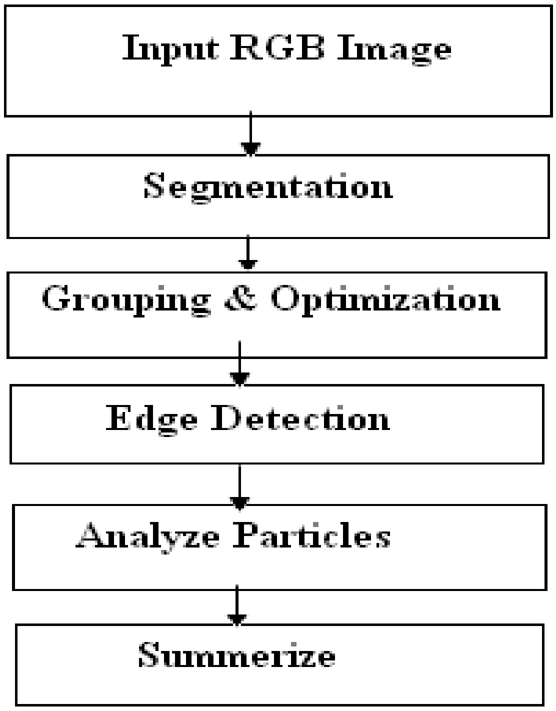


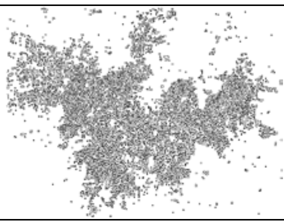
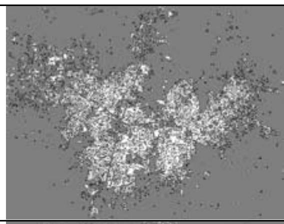
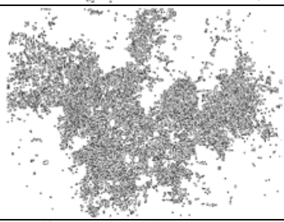
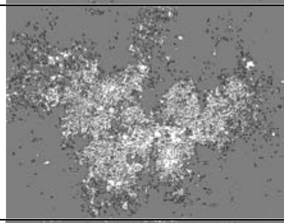
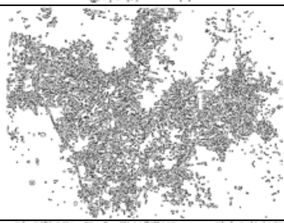
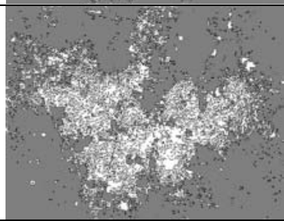
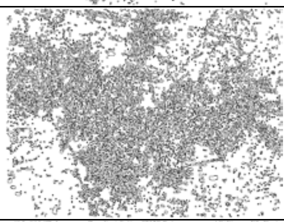
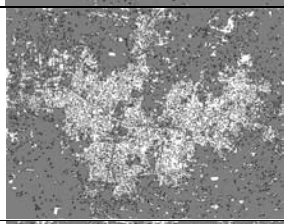
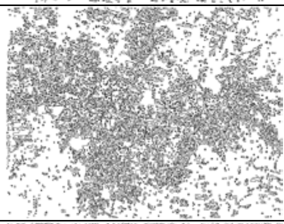
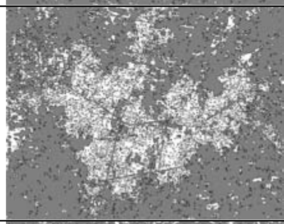
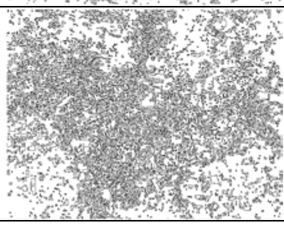
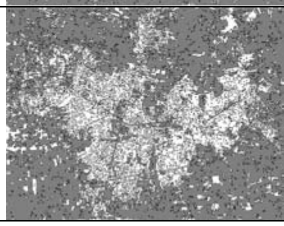
Figure 2. Process of building extraction and change analysis

The particle analyser tool is used to count the number of segmented and extracted patches as buildings in the image and stored separately. The same process is applied on all the temporal images of different period and got different results.

IV. RESULTS AND CONCLUSION

After processing all the sample temporal imageries of year 2006, 2008, 2010, 2011, 2013 and 2015 of Latur city, I got different results from each individual image. The results of processed original RGB satellite image like segmented patches as building, edge detected image and optimized image as result are of different period is shown in Figure 3.

Table I. Followings are the details of images used in this study.

SN	Year	Satellite Image	Filtered Image	Group & Edge detect	Result
1	**2006**				
2	**2008**				
3	**2010**				
4	**2011**				
5	**2013**				
6	**2015**				

The above Table 1 showing the details of all processed RGB images, all the segmented and filtered outcomes, images after grouping and edge detection and the results images of specified year.

The next step is to analyse the particles which are processed in the resultant images and summarize them. By doing these processes we will come to know that, what extent of changes are occurred during a specific period. A comparative study can be taken into account.

The automatic particle analysis requires a “binary” (black and white) image. A threshold range is set and the objects of interest (buildings) apart from the background. All pixels or points in the image whose values fall under the said threshold are converted to black and all pixels with values above the threshold are converted to white, or vice-versa. The results after analysing the particle we can summarize as shown in below Figure 3.

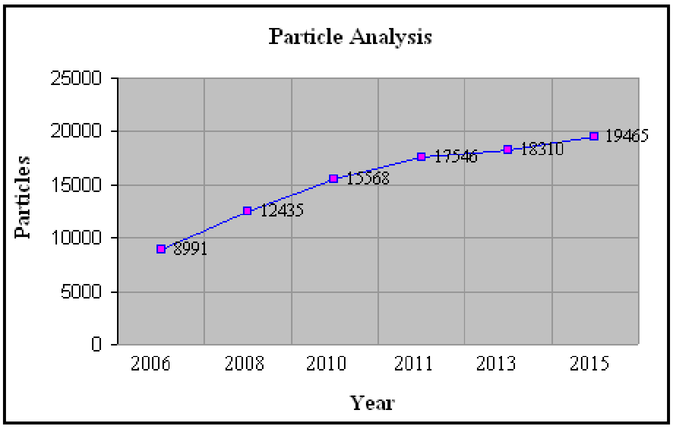


Figure. 3 The year wise analysed particles (buildings).

The above graph figure 3 showing the year wise extracted particles (buildings) of Latur city. In year 2006 there are 8991 particles, in year 2008 there are 12435 particles, in year 2010 there are 15586 particles, in year 2011 there are 17546 particles, in year 2013 there are 18310 particles and in year 2015 there are 19465 particles are extracted as buildings. From the above graph it is become clear that, there is a huge change occurred during the period from 2006 to 2015 in Latur city as far as the construction of new buildings are concern.

REFERENCES

[1] Ibrahim F. Shaker, et.al. Building Extraction from High Resolution Space Images in High Density Residential Areas in the Great Cairo Region, Remote Sensing, ISSN 2072-4292, 2011, 3, 781-791

[2] Lau Bee Theng, Automatic Building Extraction from Satellite Imagery, Engineering Letters, 13:3, EL_13_3_5, 2006.

[3] Sohn, G. and Dowman, I. (2001). Extraction of Buildings from High Resolution Satellite Data. In Baltsavias, E., Gruen, A., Van Gool, L. (Eds.), Automated Extraction of Man-Made Objects from Aerial and Space Images (III). Balkema Publishers, Lisse, pp. 345-355.

[4] A. H. Souri, A. Mohammadi, M. A. Sharifi, A new prompt for building extraction in high resolution remotely sensed imagery, International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-1/W3, 2013 SMPR 2013, 5 – 8 October 2013, Tehran, Iran

[5] D Koc San, M. Turker, Building Extraction from High Resolution Images using Hough Transform, International Archives of Photogrammetry, Remote Sensing and Spatial Information Science, Vol. XXXVIII, part 8, Kyoto Japan 2010, pp 1063-1068.

[6] Thomas, N., Hendrix, C. and Cogalton, R.G. (2003). A Comparison of Urban Mapping Methods Using HighResolution Digital Imagery. Photogrammetric Engineering and Remote Sensing, Vol. 69, No. 9, September 2003, pp. 963-972.

[7] Weidner, U. and Forstner, W. (1995). Towards Automatic Building Extraction from High Resolution Digital Elevation Models. International Society of Photogrammetry and Remote Sensing, Vol. 50 No. 4, pp 38-49.

[8] Kodge B. G. Hiremath P S, Spatial Data Mining in GIS for E-Governance: A Case Study, Proceeding of National Conference on Machine Learning and Pattern Recognition, 2012, ISBN 978-81-920783-8-7 pp-99-103

[9] Wang, S. and Tseng, Y.H. (2003). Semi-automated Building Extraction Based on CSG Model-Image Fitting. Photogrammetry Engineering & Remote Sensing Vol. 69, No. 2: pp. 171-180

[10] Li, J. and Ruther, S. H. (1999). IS-Modeller: A low-Cost Image-based Tool for Informal Settlements Planning, Geoinfomatics ’99 Conference, Ann Arbor, 19-21 June, 1999, pp. 1-9.

