Extraction of Buildings from Satellite Images

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Abstract- Buildings are termed as important components for various applications. Building extraction is defined as a sub-problem of Object Recognition. Though, numerous building extraction techniques have been proposed in the literature. But still they often exhibit limited success in the real scenarios. The main purpose of this research is to develop an algorithm which is able to detect and extract buildings from satellite images. In the proposed approach feature-based extraction process is used to extract buildings from satellite images. The overall system is tested and high performance detection is achieved which shows the effectiveness of proposed approach.

Index Terms – building extraction, artificial neural networks, Hough Transform, LBP.

I. INTRODUCTION

Building is an important object that needs to be extracted automatically from satellite images because building affects city land use cover change. Automatic extraction of building becomes a key component in order to assess the existing building resource and help in planning for various purposes. Nowadays, it is an active research topic in remote sensing. Various building extraction techniques utilize non specific models by expecting that all structures take after same example. A great deal of work has been committed to the thought process of building identification on airborne photos, and an extensive number of procedures utilizing different strategies have been created, in order to depict that the flow condition of research isn't a simple assignment. There are various methodologies which are utilized to separate structures or building highlights.

Though, numerous building extraction techniques have been proposed in the literature. But still they often exhibit limited success in the real scenarios. These current procedures of building extraction are not that much compelling in demonstrating brings about various types of pictures. Distinctive systems are required for managing diverse pictures as these pictures may contain some delicate data. The vast majority of the past calculations took a shot at grayscale pictures to separate structures. There are different methods for the structures extraction framework however there are a few restrictions of each approach. Typical methodologies don't achieve satisfactory execution, particularly with high-determination satellite pictures.

As buildings can be of any shape and size so the problem here is to recognize the shape and extract them from satellite images. So we are required to detect buildings from satellite images by considering irregular structures and closeness of buildings. To take care of the issue a few criteria for the structures identification are utilized, where every one of them permits choosing as it were some portion of structures, yet with a little likelihood of blunder of the second kind: nearly does not distinguish false developments where they don't exist.

Among the several approaches, we finalized our approach to set up another general building extraction technique in view of feature extraction. Here, we build a generalised feature extraction procedure which we used to identify different features present in the image which are helpful for our work.

II. PROPOSED APPROACH

First of all we will be collecting the dataset from IKONOS and QUICKBIRD satellite images. Then we will load our input image into the system for further processing. All our processing is done using MATLAB tool.
The proposed automatic system consists of five different parts. Each part having their own functionality which is useful for other parts to do their tasks. In the first part, preprocessing is done in which we will be converting our RGB image into Grayscale and then it will be binarized using adaptive

thresholding method. Moreover, noise will be removed so that the result of further steps could be more efficient. In the next part, we will be segmenting the major portions of the image which is identified as some structures by considering a specific threshold value.

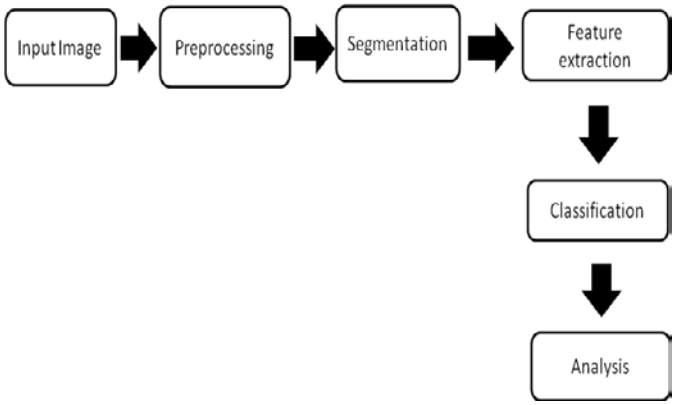


Figure 1: Proposed Approach

After segmenting important regions from the image then we will find out the edges of that image by using a canny edge detector as it will be easy to extract different features like lines, corners, curves and circular shapes. For feature extraction we have used a generalised algorithm which is a combination of LBP and Hough Transform. Before extracting different features from the image we made the size of all images same.

LBP operator essentially is an image operator which changes an image into an array or image of whole number marks depicting little scale appearance or we can state texture of the picture.

Next, by applying the Hough Transformation the geometric properties of the structures (building edges and corners) are isolated. The general thought is to change the data in the image (feature space) into a parameter space and apply there an examination. It is a procedure for secluding features that offer basic qualities. The traditional Hough change is utilized to recognize lines, circles and so on. After extracting the features of all images they are stored in a array. These stored feature vectors are matched with the feature vector of the training set which we get from the dataset. Meanwhile, it is also considering different corners from the image by using Harris corner detector which helps us in defining different lines in our image because only lines have corners.

In the next part, we will be training our dataset in according to the different features which are required for the same. Here, we will be matching the features obtained previously with our trained features. If matching comes out to be correct then it's identified as building structure else not. For training our dataset we used different classifiers named as ANN (artificial neural network), SVM (support vector machine) and K-means as we can see in the below figure 6.

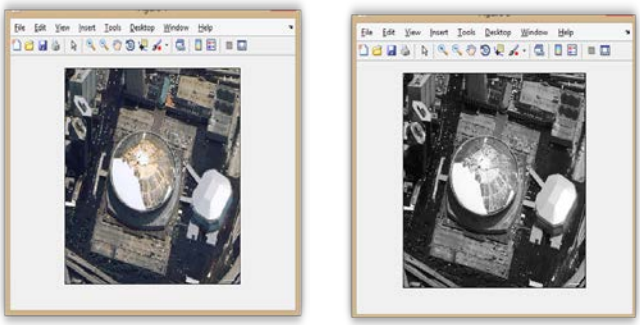
III. RESULTS

A system has been developed which helps in detecting and extracting different buildings present in satellite images. The system takes combination of different features like lines, corners, edges, circular shapes and curves to detect buildings from the satellite images. We have implemented all our system into MATLAB.

Different steps involved in this system are:

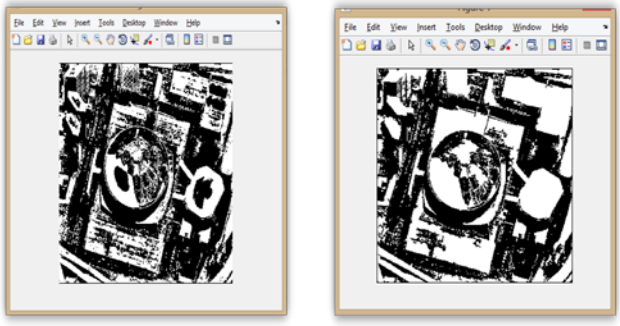
Step 1: First of all we will be giving a colour satellite image as an input to the system. It will be performing some pre-processing tasks into that image.

Firstly, it will be converted into grayscale image and then performed binarization on it. Lastly, it will be cleaning the image by applying different morphological operations.



(a) (b)

Figure 2: (a) RGB Input Image (b) Grayscale Image



(a) (b)

Figure 3: (a) Binarized Image (b) Cleaned Image

Step 2: After performing preprocessing on the image now we will be segmenting important regions from it as shown in figure 4.

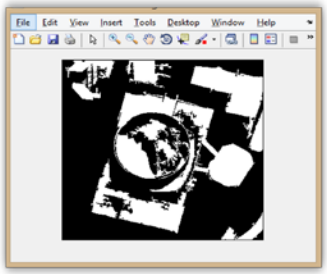


Figure 4: Segmented Image

Step 3: Now its time for the most important task of this approach i.e. feature extraction. Here, we will be extracting different features like edges, lines, corners and shapes.
In the figure 8, we have shown snapshot of few feature vectors which are created.

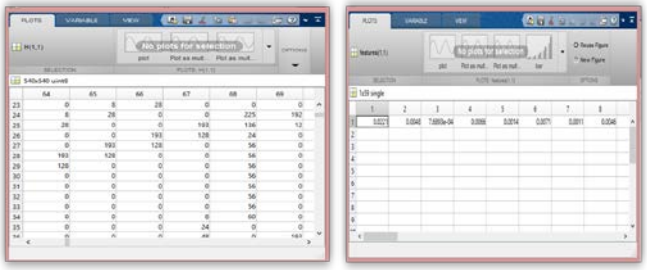


Figure 5: Snapshot of feature vectors

Step 4: Now, we will be training our dataset using any of the classifiers and match with the features which we get in our previous step. Actually, we have used three different classifiers named as ANN, K-means and SVM. We have checked the accuracy of all the above classifiers.

Classifier	**Accuracy**
SVM	80.37%
K-means	83.06%
NN	88.42%

Figure 6: Different Classifiers used

Step 5: Here, we will be analyzing our approach and finally got our result which is showing our extracted buildings.

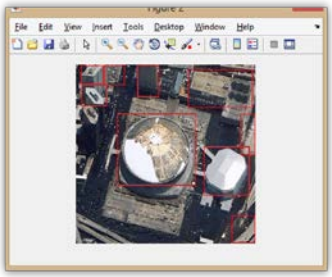


Figure 7: Extracted Buildings

IV. CONCLUSION

The main purpose of this research is to develop an algorithm which is able to detect and extract buildings from satellite images. First of all, we begin by studying the literature. Among the several approaches, we finalized our approach and started to implement it. As the features are key ingredients in image processing framework so it's important to define which features are used and how many are important. So, for this we used a hybrid approach of Hough Transform and LBP for defining our different features. The detection of buildings was also very smooth process by using region props, in which we used the bounding box property of the image and extracted the required part. For the recognition purpose we used NN because when it is practically implemented it proved to give better results than any other classifiers. NNs have the advantage that they are able to learn and model non-linear and complex relationships. Lastly, we found out the accuracy of our system.

V. FUTURE WORK

i. We can also explore the use of unsupervised learning.

ii. By increasing the training set size we can increase the accuracy.

iii. It can be further used to identify types of buildings like how many are rectangular ones and how many are of another shape.

iv. It can also be used to find out heights of different buildings.

VI. REFERENCES

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