ABSTRACT—
To collect the information about an object without making physical contact with that object is said to be Remote Sensing. Remote sensing images may not appear clearly due to shadows formed by large objects which are reflected from the sun. So to overcome this problem, this research mainly focuses to analyze the remote sensing images for removing the shadows from an image without loss of information. Region growing thresholding algorithm is used to remove the shaded region in high resolution color remote sensing images. But if the image has more variations then object boundaries also removed along with the shadows. So to increase the accuracy, color based shadow detection is combined with region growing based shadow detection method. The shadow selector performs AND operation between the shadows detected by the region growing and color based methods.

KEYWORDS—Shadow Detection, Shadow Removal, Region Growing Thresholding, Segmentation, Color Based Detection.

INTRODUCTION
Google Earth images became very common due to their free availability, however these images have only three bands (RGB) and lack of infrared and depth information. In case depth information is available together with four-band satellite images. On the other hand, due to its availability and widespread usage of three band images, it is a necessity to develop extraction algorithms using only RGB information. In such a case, shadow is a very important for detection of objects, although it varies according to the position of the sun at the time of image is captured. Due to the complexity of shape and spectral characteristics of objects, the extraction of their boundaries is still an active research topic.

In particular, extracting objects from high spatial resolution optical images is beneficial for a miscellaneous range of applications, such as thematic cartography, timely update of urban geographic information system (GIS), calamity estimation and military survey. Typically, man-made objects can be identified by using their spectral signatures or intrinsic geometric properties. For instance, roads often appear as elongated features with homogeneous intensities and thus extracting road networks, have to detecting line segments. Building roofs, different from roads are generally consist of rectangles or regular polygons with parallel lines and right angles. In addition, building shadows generated due to the partial incident light in remote sensing images can also provide auxiliary information for extraction of building.

In region based shadow detection, the initial seed points are selected based on the segmentation. This group of pixels will grow until reach the connectivity control condition. It will give better results for images which has isolated objects and standard illumination. But it will give inaccurate result for fine image variations.

In object-oriented shadow detection and removal method, the shadow features are estimated through image segmentation, and detect the suspected shadows with the threshold method. Then object properties such as geometric features and spectral features are combined with a spatial relationship in which the fake shadows are ruled out (i.e., water region). This will permit only the real shadows to be detected in subsequent steps.

To detect shadow using color information- the intensity levels, Hue-Saturation-Intensity (HSI) color space, extended gradual C1C2C3 color space, YCbCr (Luminance, Chroma Blue, Chroma Red) color space and LAB color space are used. The above color spaces will show good difference between shadows, background and object pixels. Then the shadow selector perform Boolean AND operation to find the exact shadow. It will increase the accuracy in the complex scenarios like the intensity of the shadow and background is same and when object is darker than the background.

RELATED WORKS
In early there are more methods to extract the objects but it extracts only specific type of objects. Later developed a level set evolutions (LSEs) for extracting different kinds of manmade objects. The process which is related to the shape and morphology of features in an image is done by morphological image processing. It is utilized for removing noise and discontinuities from extracted foreground.

Principal component analysis method is used to segment the image but there is a loss in land cover information when retrieve from an image due to shadow. Automatic detection process which leads to loss of spectral information in a high resolution remote sensing image. Shadow edge correction is done to reduce the error due to the diffusion in the shadow boundary. And there is no assumptions made on lighting conditions.

Texture based shadow detection is implemented by using various correlation techniques. The shadows are selected based on the texture correlation between foreground and background. It gives better results in various illuminations and colors. But its computation time is more.

Shadow removal approach is based on a simple shadow model where lighting consists of environment light and directed light. The pair wise region relationship affects detection results and provides valuable additional information about illustration condition of regions, compared with simple appearance-based models.
REGION BASED SHADOW DETECTION
Initially the original image is preprocessed and median filter is applied. Then the image is converted into grayscale and binary images. Based on the binary image, the objects in the images are identified and its boundaries are also extracted.
A proper threshold is used to differentiate the shadow from non-shadow areas. The seed pixels are placed in the region based on their properties or the properties of the nearby pixel values. Then the seed pixels are growing if the neighborhood pixel has same property. This process will continue until the entire region is detected. In the Histogram splitting provides a feasible way to find the threshold for shadow. In the histogram average of the two peaks is adopted as the threshold. The shadow objects are found by comparing the threshold and grayscale average of each object obtained in segmentation.

COLOR BASED SHADOW DETECTION
Color Based Spectral information is partially eliminated. Background and the color of shadow is same with different intensity. It gets fail, when the intensity of the shadow and the background are same or the shadow is darker than the background. Color can be represented in a variety of three dimensional spaces, such as RGB, HSV, XYZ, c1c2c3, L1L2L3, YCrCb and Lab codes. Each colour space is characterized by interesting properties which make it especially appropriate for a specific application.
To detect shadow using color information the intensity levels, Hue-Saturation-Intensity (HSI) color space, extended gradual C1C2C3 color space, YCbCr (Luminance, Chroma Blue, and Chroma Red) color space and LAB color space are used. The above color spaces will give show good difference between shadows, background and object pixels. In the YCbCr color space, the Y represents luminance information while Cb and Cr represent the color information. Next, focusing on the Y channel, its histogram is computed. Histogram dissension gives us a higher contrast image in the Y channel. After that, the mean of the image in the Y channel is computed. First, shadow pixels that have intensity less than one standard deviation of the whole image are classified. This step cannot identify the shadow regions properly. Some shadow pixels are identified as non-shadow pixels.

SHADOW SELECTOR
After identification of shadow segments using region growing and color based methods, then the shadow selector perform boolean AND operation to find the exact shadow. Having the shadow segments identified, the goal is now to determine the remaining segments belong to the objects. This process is a typical image object classification problem.
The shadow is extracted by using region growing method may overlap with objects when the image has fine variations. Then Boolean AND operation is performed with various color based shadow detections like HSI, c1c2c3 and YCbCr.
Extracting feature for the shadow is done for every shadow region, resulting most of the pixels having multiple distance values. The minimum value is set for that pixel to ensure that it is the distance to the closest shadow region. Finally, to assign a closeness value to an individual segment, the average of the pixel distance values inside that segment is taken.

SHADOW REMOVAL
Shadows are removed by using the homogeneous sections obtained by line pair matching and classification of an object in an image by support vector machine (SVM) classifier. The Relative Radiometric Correction method is used to remove the shadow area because the shadow and non-shadow area are belong roughly to the same rank, and they are in various lighting conditions. To avoid the influence of scattering light from the environment, each single object has been taken as a unit for which the shadow removal process is organized for that object. This enhances reliability.

EXPERIMENTAL ANALYSIS
It can be seen from the segmentation result that considers shadow features can effectively segment shadows and dark objects. This means that, in the following process, the problem of dark objects and shadow being segmented as a whole subject can be avoided. The combined region growing and color based shadow detection works better even the image has complex objects and overlapping shadows. The shadow selector, only extracts the exact shadow, so the information in the image is not lost.
Fig.2 Steps involved in shadow detection and removal. (a) Original remote sensing image. (b) Intensity adjusted Image. (c) Binary representation using segmentation process. (d) LAB Color Space Image. (e) Hue Image. (f) Saturation Image. (g) Boundary Extracted Image. (h) Shadow identified with false details. (i) Shadow Detection- Output Image. (j) Shadow Removed Image.

CONCLUSION

Region growing thresholding algorithm is used to remove the shaded region in high resolution color remote sensing images. Color based shadow detection is combined with region growing thresholding based shadow detection to avoid the removal of object boundaries along with the shadows. The shadow selector performs boolean AND operation between the shadows detected by the region growing and color based methods. In future, have to remove the shadows from the dark objects in the remote sensing images.

REFERENCES