An Application for Forest Area Change Detection and Classification

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Abstract

Land use is forced by environmental factors such as soil characteristics, climate, topography, and vegetation. Image processing helps to identify the type of land, by displaying particular image of that area and that image will be helpful to classify the land in the form of percentage. Existing methodologies do the change detection procedure by detecting the objects in image and that objects are compared with the base image objects to obtain a difference image. This paper a proposed system is used to develop a suitable method related to land areas for finding changes in land areas that undergoes changes over a period of time. In proposed method to get a clear image pre-processing is done. In pre-processing, the methods namely denoising, resizing and control point selection is done. Image segmentation and image classification is done on the image to get the final percentage change in forest land.

Keywords- Image Pre-Processing, Image Segmentation, Image Classification, Canny Edge Detection and K-NN Classifier

I. INTRODUCTION

Image processing is a technique to convert an image into digital form sequentially to get an enhanced image or to extract some useful data from it and do some processing on it. It is a type of signal dispensation in which input is image, like video or photograph and output may be image or features associated with that image. Importance and requirement of digital image processing from two main application areas: the first being the Improvement of pictorial information for human understanding and the second being the Processing of an extract data for an autonomous machine understanding. Digital image processing has a broad range of applications such as remote sensing, image and data storage for transmission in applications like business, medical imaging, audio imaging, Forensic sciences and industrial automation or robotics.

Images acquired by satellites are useful in tracking of earth resources, geographical mapping, and forecast of agricultural crops, urban population, weather forecasting, flood and fire control. Deforestation is permanent damage of forest in order to make the land available for other use. The mother land have already lost nearly 50% of the world's original forest, each year the land loses 13 million hectares of forests the equivalent of 36 football fields per minute. The proposed system that will show the changes that occur in land by comparing the previous image and input image. By performing the steps on the input image we will achieve the result in the form of percentage of change in land cover and land use.

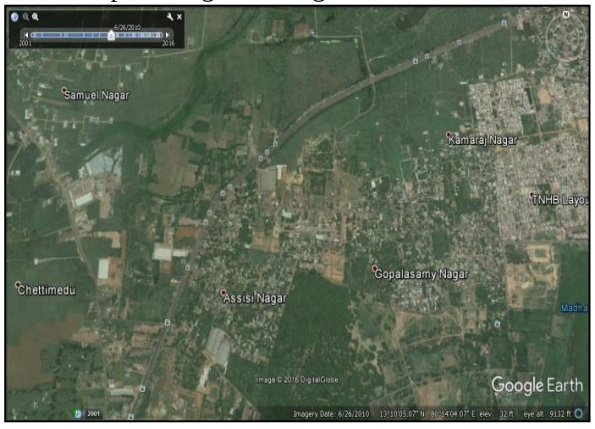


Fig. 1: Chennai 2010 [10]

Fig. 2: Chennai 2015[10]

As an example, the images of nearby cities of Chennai are taken to show the changes in the land of that particular area. The images are taken from Google Earth in Multi-Temporal type and in .jpeg format. As shown in above figure a and figure b the difference or change in five years in nearby cities of Chennai is shown. A drastic change is occurred in the land in most of the areas. The forest or the greenery is degrading due to the urbanization.

In figure 1, the most of the land is covered with forest as compared in the figure 2. And in figure b due to urbanization or human activities and natural calamities the forest area is degraded.

II. LITERATURE REVIEW

This section contains the various techniques and methods described by the authors. The below table 1 will give the overview of list of papers that are related to the proposed system.

Table 1: Literature Survey

Sr.no	*Year*	*Paper name*	*Description*
1	*2015*	*An Application of Image Change Detection-Urbanization*	*Pre-Processing operation and Image Segmentation*
2	*2015*	*Fusion of RADARSAT-2 Imagery with LANDSAT-8 Multispectral Data for Improving Land Cover Classification Performance Using SVM*	*RADARSAT-2 image Wavelet- based fusion (WT) techniques*
3	*2015*	*Land-Cover Classification of Remotely Sensed Images Using Compressive Sensing Having Severe Scarcity of Labelled Patterns*	*Compressive sensing (CS) approach domain adaptation (DA)*
4	*2014*	*Parcel-Based Change Detection in Land-Use Maps by Adopting the Holistic Feature*	*Spatial Envelope*
5	*2013*	*Hybrid classification of Landsat data for land cover changes analysis of the Halabja city Iraq*	*Hybrid classification,Pos t classification*
6	*2012*	*Image Segmentation Techniques*	*Segmentation Ultrasound images, Synthetic Aperture Radar(SAR) images*
7	*2012*	*Quadratic Program Optimization using Support Vector Machine for CT Brain Image Classification*	*SVM Technique*

A. Classification Method

Jovit Reno. A, Beulah David. D [1] has proposed an efficient method for finding changes in land areas that undergoes changes over period of time. They have used multi-temporal data as input image and these images are collected from Google earth. The system uses many pre-processing steps to obtain a clear an efficient pre-processed image. Image segmentation is used to separate the useful pixels in the image. The image segmentation is done using canny edge detection method for identifying the edges in the

image. For image classification, Feed forwarding back propagation is used. The output is shown by calculating performance analysis and Roc (Receiver operating curve) of the total performance of the change detection.

Moumita Roy, FaridMelgani, Ashish Ghosh, Enrico Blanzieri, and Susmita Ghosh, [2] they have used multispectral remote sensing images and then firstly they have assess the compressive sensing (CS) approach as a classification tool for those image type. And then they have proposed a new strategy of using CS approach to perform domain adaptation for classifying images at large spatial scales like continental mapping. They have also used domain adaptation technique.

ChanikaSukawattanavijit, Jie CHEN, [3] has used the SVM (Support Vector Machine) classifier to improve the land cover classification for utility multi-source RADARSAT-2 and LANDSAT-8 multi-spectral images. The WT (Wavelet-based fusion) techniques are implemented in the data fusion process. The RBF (Radical Basic Function) kernel functions were used with SVM classifier to classify land cover types. The results of the Support Vector Machine classification are matched with ML (Maximum Likelihood) classifier. The land cover classification includes steps such as i) image processing, ii) image fusion, iii) support vector machine, iv) accuracy. The main motto of this paper was to improve land cover types classification using Support Vector Machine classifier to various datasets.

Jwan Al-doski, ShattriB.Mansor and Helmi Zulhaidi Mohd Shafri have applied the remote sensing technology for monitoring land cover changes. Their study was conducted to observe the impacts of wars on land cover in the Halabja city in the northern part of Iraq (study area).They used Land sat 5 TM and Land sat 7 ETM+ data acquired in 990 and 2000 were used. A post-classification technique base on hybrid classification was taken. After performing pre- processing step an unsupervised K-means classification was carried out firstly on six reflective bands with the support of supplementary data for two images independently followed by maximum likelihood supervised classification to classify all images into five land cover classes; water bodies, vegetation fields, forests, built-up or urban areas and bare or plain lands. The images were collected from Google earth images. They performed K- means classification, MLC (Maximum Likelihood classification) and Hybrid classification on two images. Changes on images were observed across all five land cover classes: Water bodies, Forests, Vegetation Fields, Built-up or Urban Areas and Barex lands [5].

J Umamaheswari and Dr.G.Radhamanihas used an effective Computer Tomography (CT) image classification using Support Vector Machine (SVM) with optimized quadratic programming methodology is estimated. Due to manual understanding of brain or mind images based on visual examination by radiologist/physician that cause inappropriate diagnosis, when a large number of CT images are examine. To avoid the human error, an automated optimized classification system is proposed for abnormal Computer Tomography (CT) image identification. According to the author this is computerized system for content based image retrieval with better classifier accuracy and prediction time. SVM classifier can correctly sequence up the data's as normal and abnormal brains understood manually by the user. Thus the system can retrieve more number of images present in the query database. The proposed classifier is analysed with existing Sequential Minimal Optimization (SMO) and K Nearest Neighbor classifier (KNN). The image feature is extracted using MATLAB for both normal and abnormal [7].

B. Spatial Envelope

Wu Bin, Yang Jian, Zhao Zhongming, Meng Yu, YueAnzhi, Chen Jingbo, He Dongxu, Liu Xingchun, and Liu Shunxi[4] have introduced the method of parcel based changed detection by using holistic feature called spatial envelope i.e. without segmenting it into identical objects or small regions it encodes each parcel. Holistic means characterized by the conviction that the parts of something are interconnected and understandable only by reference to the whole. The land-use parcels are clipped by polygons in the land-use map with the energy spectrum of WFT. WFT is nothing but Windowed Fourier Transform. It performs the WFT of each land use parcel. In this paper they have calculated spatial feature, spectral feature, Textural feature, gradient feature. Their first dataset is for a region of southern china in the year 2011 and 2012. And the second dataset is for the region Beijing. And the third dataset which aims at validating that this method is effective with image from different sensors. Therefore according to them parcel-based analysis is more suitable in land-use management and applications.

C. Image Segmentation Technique

Rajeshwar Dass, Priyanka, Swapna Devi [6] has described that based on different skills image segmentation methods are at present divided into following categories, based on two assets : 1) Detecting Discontinuities which means to partition an image based on sudden changes in intensity and it includes edge detection algorithm. 2) Detecting Similarities which means to divide an image into regions or areas that are same according to a set of predefined condition. It includes algorithms like thresholding, region growing, and region splitting and merging.

The authors have also explained about many image segmentation techniques which are as follows:- A] Segmentation Based on Edge Detection, B] Thresholding method, C] Region Based Segmentation Method, D] Segmentation Methods Based on PDE (Partial Differential Equation), E] Segmentation Based on Artificial Neural Network, F] Segmentation Based on Clustering, G] Multiobjective Image Segmentation.

III. PROPOSED SYSTEM

The proposed system contains the steps such as pre-processing,image segmentation, and image classification on image. The layout of this work is given in Figure. 1. Each step is elaborated in detail. Canny edge detector and kNN algorithm as described below.

A. Channel Wise Image (RGB Image)

Convert the color image to RGB (Red Green Blue) image. In the RGB model, an image consists of three free image planes, one in each of the primary colors. Each color (red, green, and blue) has some value associated with it, therefore it defines the intensity of the color as an integer between 0 and 255. For example, RGB (0, 0, 255) is rendered as red, because the red parameter is set to its highest value (255) and the others are set to 0.

B. Pre-Processing

The most important step in image processing is pre-processing. Technically to achieve the clear image pre-processing is done. Generally an image contains unwanted particles which are not necessary. Unwanted particles means noise i.e. the image is not clear they are blur. Therefore to obtain clear image pre- processing step is done. In this work, three pre-processing steps are performed. Those are denoising, resizing, control point selection.

1) Denoising

Digital images are often contaminated by noise during the gaining. Image denoising aims at reducing the noise while retaining the image content. For denoising, the NLM (Non-Local Means) method will be used by the proposed system. Resizing is done after the denoising step as shown in fig 1.

2) Resizing

Resizing means to adjust the image. Each and every image is of different size. The images are taken from in different directions or sources. The size and the direction of the images are depending upon the distance and the direction of the satellite. Therefore to get the equal size of the image resizing operation is used.

C. Image Segmentation

As shown in the figure 1, after pre-processing, the image segmentation has to be done. Image segmentation is the process of partitioning an image into many segments, so as to change the representation of an image into some understandable form that is more meaningful and easier to analyze. The purpose of edge detection in general is to significant reduce the sum of data in an image, while preserving the structural properties to be used for further image processing. There are no optimal algorithms for image segmentation.

In this work, canny edge detection method is used for edge detection because even though it is quite old, it has become one of the standard edge detection method and it is still used in study till date.

D. Canny Edge Detector

The algorithm runs in 5 steps:

1) Smoothing: Using Gaussian operator to the image will be blurred and then the unwanted noise from that blur image will be removed. And then image will be sent to next step for processing.
2) Finding gradients: The edges should be marked or clear where the gradients of the image have large magnitudes.
3) Non-maximum suppression: local maxima should be marked as edges or end of the image
4) Double thresholding: In this step, potential edges are determined by thresholding.
5) Edge tracking by hysteresis Final edges are determined by destroying all edges that are not connected to a very certain (strong) edge

E. Image Classification

After image segmentation our next step is image classification. As the name suggests image classification means to classify the image. Here, we will classify the image with the previous resultant image and compare it. The RGB values will be compared and then the image will be classified. After these step the image will go to the analysis state in which again the resultant image after image classification will be analysed or studied and then final output will be given. The KNN classification algorithm will be used to classify the images.

1) KNN (K Nearest Neighbor) algorithm is as follows:-

1) The k-Nearest Neighbors algorithm is a most popular method used for classification and regression.
2) In k-NN classification, an object or a thing is classified by a majority vote of its neighbors and the output is a class membership. The object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 3, then the object is simply assigned to the class of that three nearest neighbor.
3) In k-NN regression or classification, the output is the property value for the object as explain in above paragraph. This value is the standard or average of the values of its k nearest neighbors.

2) Block Diagram of Proposed System

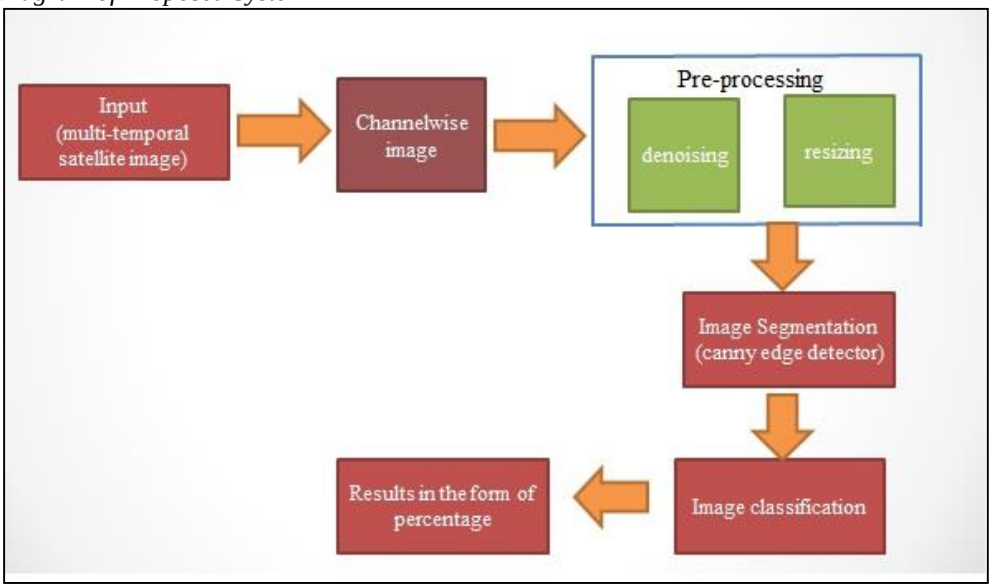


Fig. 3: Block Diagram

IV. ANALYSIS OF THE RESULT

The desktop Application development includes the application features and the technologies required for its development.
It consist of desktop application having Hard Disk of minimum 10GB, RAM of 4GB and Pentium i3 processor or more. Apart from hardware it requires Windows 8 operating system, Mysql for storing the login details, Java JDK (8.0.2) and Netbeans as a software requirement.

The region selected for this proposed system of change detection is chosen from chettimedu village,Chennai in India. This place had undergone a lot of changes during the last five years. The images are choosen from the open source site Google Earth. First download the image and then perform the operations. Fig. c and d depict the input and the base image i.e the previous image (year 2010) and current image (year 2015).

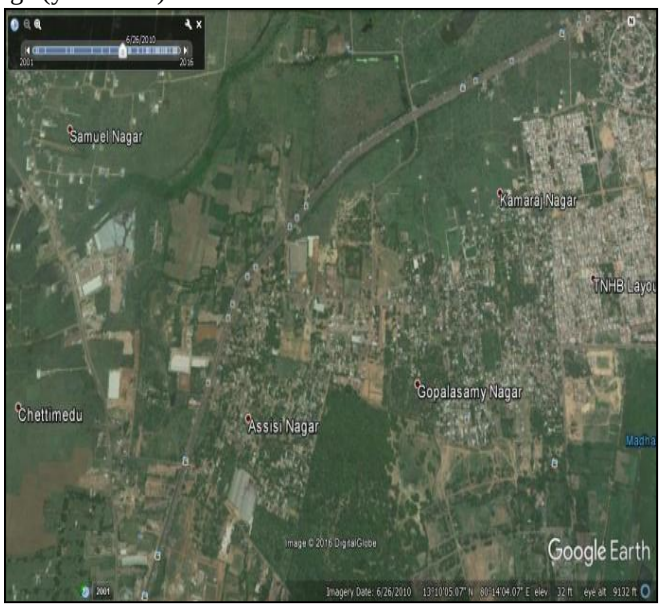


Fig. 4: Chennai 2010[10]

Fig. 5: Chennai 2015 [10]

V. RESULT

By performing the following operations on both the images the result will be shown in the form of percentage of green zone removal. Figure e show the percentage of green zone removal i.e 7.222% of green zone is removed.

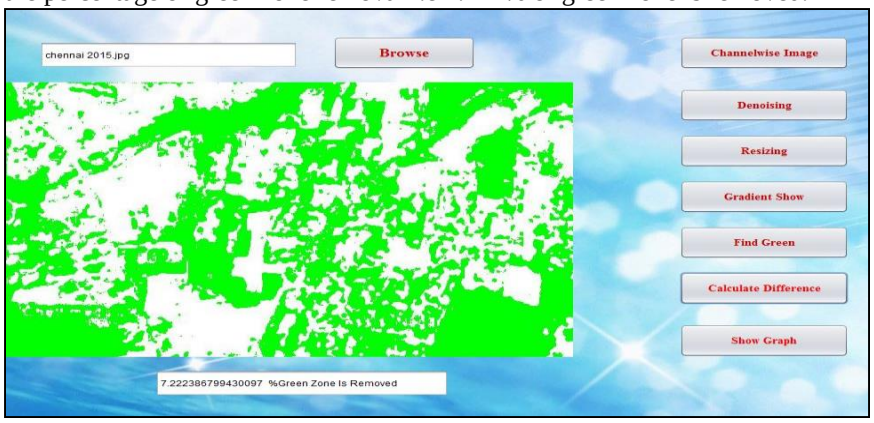
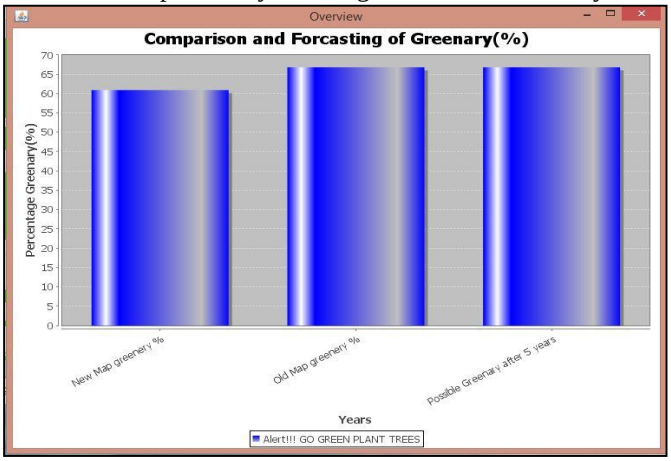


Fig. 6: Calculating difference of both the images

After performing the pre-processing steps, segmentation technique and applying the KNN algorithm the result will be shown in the form of percentage. Figure d depicts the graph plotting by getting the values of previous image (year 2010) and the current image (year 2015) of the same area and also the possibility of change detection in next 5 year.



VI. FUTURE SCOPE

The future scope of the project includes the improvement in the various fields such as water bodies, weather forecasting or prediction, vegetation field, barren lands etc. which will give the information about changes that will be occurred. In addition to it, the system can be implemented in web application and android application. Our project can be extended to the government levels so that people will be aware about our environmental changes.

VII. CONCLUSION

By analyzing and studying the existing method the proposed system is developed in remote or desktop application that give the difference between the previous image and the current image of a forest land. By using the canny edge detector and kNN classifier algorithm the system has discover the changes in the image by displaying the percentage and displaying it in the form of bar graph for the images of particular area or region for forest area land cover.

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