Satellite Image Classification for Environmental Change Prediction Using Image Processing and Machine Learning Techniques

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Abstract

In this research satellite image classification for environmental change prediction using image processing and machine learning methods is used. As we know satellite images is one of the important sources of collecting information for all area and region of interest which is suitable for any difficult situation around the world. The satellite image helps in collecting information on areas which is unpredictable and unreachable through digital cameras. In this research work, an advanced study on environmental change perdition has been examined using three classes' ice land area, cropland area, and forest area. This research help in characterizing the type of satellite image classification for the particular three classes. The following stages have been considered are preprocessing, segmentation, and classification methods using K- Nearest Neighbor classifier. The present investigation results that db5 analysis works well in the classification of satellite image for environmental image prediction challenges with an accuracy of 94% using K- Nearest Neighbor classifier.

Keyword- Satellite images, KNN classifier, segmentation, wavelet analysis.

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1. Introduction

Satellite image classification for environment change prediction is an important aspect of a research-oriented platform. Any kind of research satellite dataset helps in deep analysis and monitoring of a particular region of interest. Every year many research conducted using satellite image monitoring and detection [1]. As we know many government and international agencies work on environment-based research

from past decayed. In which satellite image play a vital role in the identification and testing of land detection [2]. Every year due to population growth and climate change many forest areas are degraded with the unnecessary cutting of forest and trees which result in biodiversity losses, soil erosion, and land degradation [3]. So it is very important to keep track and regular monitoring of land area using satellite images. Due to the global carbon cycle, it increases the temperature level, which results in ice melt in the Atlantic Ocean. Melting of snow is a serious issue in environmental and climatic changes because it raises the sea level. Satellite images provide an independent source of observation and theory of climate change [4]. In many research conduction for prediction of changes between satellite images, land change detection, ocean monitoring system and climate change detection. In the year 1970's the satellite images are considered for observations [5]-[6]. Based on the satellite images it will help in urban area design and planning. This provides an efficient modal for analysis and detection of land.

Figure 1- Satellite Images

The geographical area can be track and monitored regularly using satellite image technology [7]. There are many satellites which used to monitor the area for better development and protection such satellite images are SCATSAT-1, ENVISAT-ASAR, and INSAT-3DR. The satellite image captured gives detail about hourly, half-hourly, and depends on conditions according to atmospheric changes. Satellite image helps in monitoring man mad changes in agriculture and land-based changes detections [8]. In satellite studies, data are processed through frames. The dataset is divided into multiple frames for investigations. Much research conducted using satellite data monitoring for agricultural-based, forestry, land change detection, climatic monitoring, and volcanic study [9]. The satellite image helps in gathering larger areas for the examination and evaluation process. Based on that satellite frames it selects the particular region of interest which needs to be investigated for advanced studies. Many commercial agencies are working hard to perform more research on the clustering of satellite images into similar categories and development. Many government and International bodies work on environment-based research from past years. In which satellite image helps in the identification and testing of land, ice, and crop detection and tracking process [10].

2. Methodology

This research investigates on satellite image preprocessing, segmentation, feature-based extraction, wavelet using db analysis, and classifications using image processing methods and machine learning algorithms. The total sample data set used is 50 satellite images used for research purposes using classes such as ice, crop, and forest has been collected for investigation through different commercial satellite monitoring agencies of the internet for the research-oriented platform. Satellite monitoring agencies belong to the government and private sectors of India research and international agencies and platform of earth monitoring and observation.

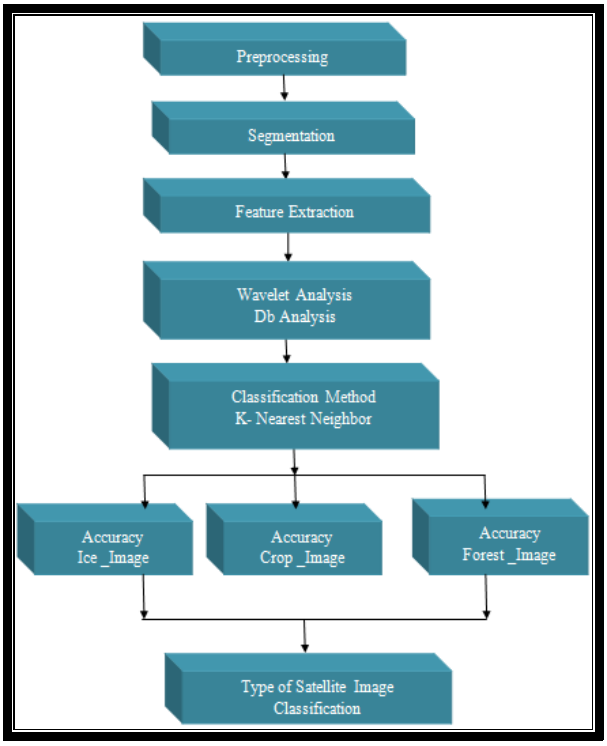

Figure 2- Methodology

Figure 2 represents the methodology for the current research work, initial steps are taken as preprocessing which consider for avoiding and removal of background noise, then second steps are considered as segmentation method, third steps are features extracted using wavelet with db1, db2, db3, db4, and db5 analysis is performed then finally it classifies the type of satellite image with three classes which are represented as the accuracy of Ice _Image, the accuracy of crop _Image and accuracy of forest _Image. Features which are extracted using satellite image such as are red color, blue color, green color, mean value, standard deviation value, entropy, skewness, ellipticity, intensity, correlation coefficient which are considered for the research purpose.

3. Digital Image Preprocessing

Image processing helps in the removal of background noise and the smoothing of satellite images. In this research, a media filter is considered for investigation of satellite image classification for environmental change perdition. During the filtering method neighborhood and nearest pixel are considered and the pixels which are not similar are rejected for process through smoothing of satellite images. After completion of the preprocessing methods of the image, it results in a noise-free satellite image.

$$\text{3x3 Masks} \begin{bmatrix} 1 & 4 & 5 \\ 3 & 7 & 8 \\ 3 & 6 & 10 \end{bmatrix}$$

Pixel Values are arranged in ascending order

1	3	3	4	5	6	7	8	10

Then compute the median value according to pixel count

1	3	3	4	5	6	7	8	10

$$\begin{bmatrix} 1 & 4 & 5 \\ 3 & 7 & 8 \\ 3 & 6 & 10 \end{bmatrix}$$

Original Image

$$\begin{bmatrix} 1 & 4 & 5 \\ 3 & 5 & 8 \\ 3 & 6 & 10 \end{bmatrix}$$

Median filter Image

4. Segmentation

This research worked on the segmentation process in which the thresholding method is used for investigation. The thresholding technique (TT) provides a similar intensity value with segments. To develop boundaries in satellite image it required thresholding value. An adaptive thresholding method used because in my cases the image background noise is not constant and contrast of a particular object varies within the image for that particular reason an adaptive thresholding method is used for segmentation of the image.

5. Feature Extraction with wavelet analysis

This research investigates on features such as Red _Blue _Green (RGB) color, mean value, standard deviation value, entropy, skewness, ellipticity, intensity, correlation coefficient are considered for the research work with wavelet with DAUBECHIES analysis. DAUBECHIES analysis uses overlapping windows which reflect all changes between pixel intensity as a result.

6. Classification

In this research work, the KNN classifier is used with three classes Ice _Image, Crop _Image, and forest _Image satellite images. KNN classifier

method is a non-parametric method. In KNN classifier according to the majority of votes by its neighbor, an object is classified and the object will assign to its nearest neighbor class among each other. If 'k' value is equal to '1' then the object will assign to the nearest neighbor values. In this research, the value of 'k' is '3' so it will check the three conditions for the given test classes as the accuracy of Ice _Image, the accuracy of crop _Image, and the accuracy of forest _Image. A total number of 50 satellite images are investigated for satellite image classification for environmental change prediction. This analysis contains 70 % for data used for training and 30% used for testing values.

Table 1: DAUBECHIES analysis with KNN classifier for satellite image classification

Sl. No.	Features	Analysis	Classification	Classes
1.	R _Color	db1, db2, db3, db4, db5	K-Nearest Neighbor	Ice, Crop, and Forest
2.	G _Color			
3.	B _Color			
4.	Mean_ Value			
5.	SD_Value			
6.	Entropy			
7.	Ellipticity			
8.	Skewness			
9.	Intensity			
10.	Correlation coefficient			

Table 1 represents feature extraction using DAUBECHIES analysis with the KNN classifier for satellite image classification and prediction. It includes three classes Ice, Crop, and Forest.

7. Result and Discussion

This research investigates on satellite image preprocessing, segmentation, feature-based extraction, wavelet using db analysis, and classifications using image processing methods and machine learning algorithms. The total sample data set used is 50 satellite images used for research purpose using classes such as ice, crop, and forest has been collected for investigation.

Table 2: db1 analysis with KNN classifier for satellite image classification

KNN classifier for Satellite Image classification										
db1 Analysis										
Features	R Color	G Color	B Color	Mean Value	SD Value	Entropy	Ellipticity	Skewness	Intensity	Correlation Coefficient
Accuracy Ice _Image (%)	78	65	68	54	85	80	65	46	77	47
Accuracy Crop_ Image (%)	65	86	57	68	54	67	56	67	54	75
Accuracy Forest _Image (%)	54	43	56	76	62	55	74	83	81	73

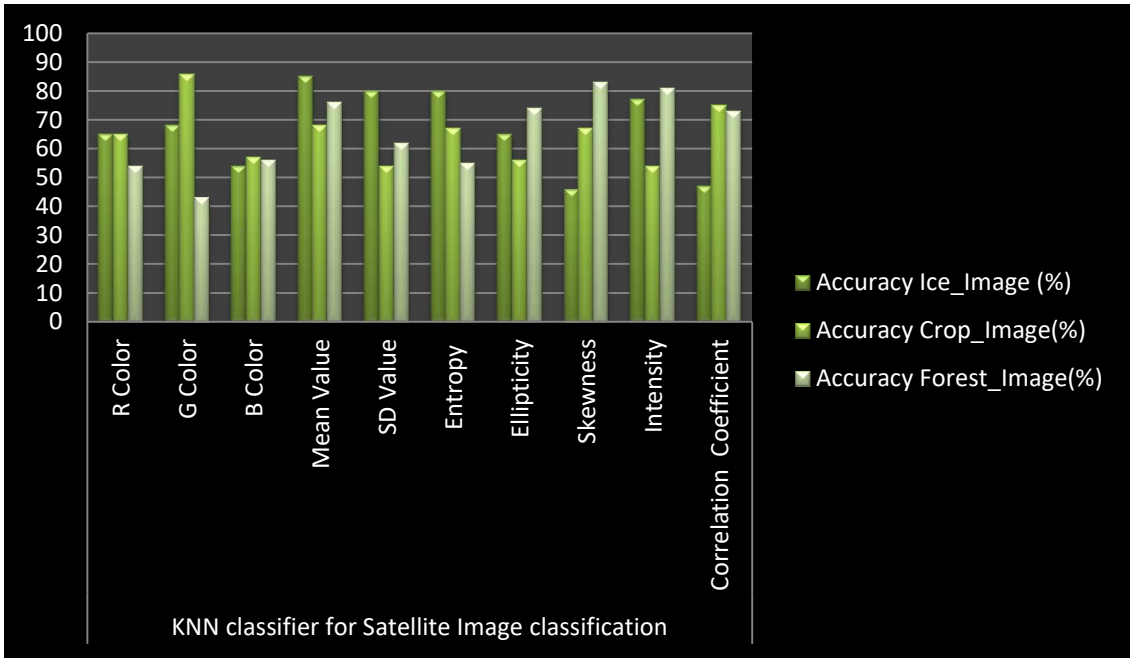

Figure 3- db1 analysis with KNN classifier

Table 2 and figure 3 represents detailed results of an investigation using KNN classifier and wavelet with db1 analysis for satellite image classification for environmental change prediction.

Table 3: db2 analysis with KNN classifier for satellite image classification

KNN classifier for Satellite Image classification										
db2 Analysis										
Features	R Color	G Color	B Color	Mean Value	SD Value	Entropy	Ellipticity	Skewness	Intensity	Correlation Coefficient
Accuracy Ice _Image (%)	72	60	69	54	76	77	65	68	56	57
Accuracy Crop_ Image (%)	55	82	52	68	54	67	56	77	68	75
Accuracy Forest _Image (%)	59	53	56	76	76	73	74	56	71	73

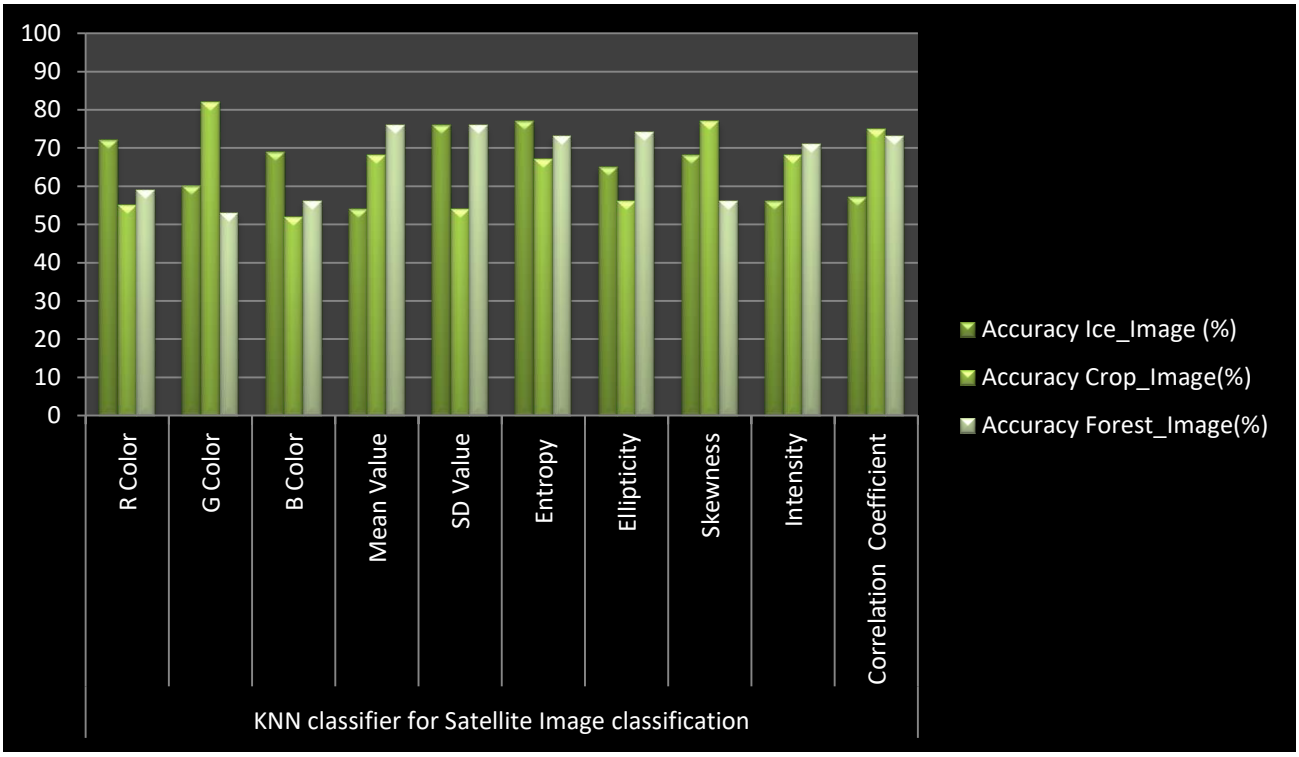

Figure 4- db2 analysis with KNN classifier

Table 3 and figure 4 represents detailed results of the analysis using KNN classifier and wavelet with db2 analysis for satellite image classification for environmental change prediction using features Ice _image, crop _image, and forest _image. This research help in characterizing the type of satellite image classification for particular classes. This table worked with db analysis with KNN classifier methods with different features extraction.

Table 4: db3 analysis with KNN classifier for Satellite Image Classification

KNN classifier for Satellite Image classification										
db3 Analysis										
Features	R Color	G Color	B Color	Mean Value	SD Value	Entropy	Ellipticity	Skewness	Intensity	Correlation Coefficient
Accuracy Ice _Image (%)	56	57	69	54	72	60	65	68	56	57
Accuracy Crop_ Image (%)	68	75	68	75	55	87	52	68	68	75
Accuracy Forest _Image (%)	71	83	56	71	59	53	74	56	74	86

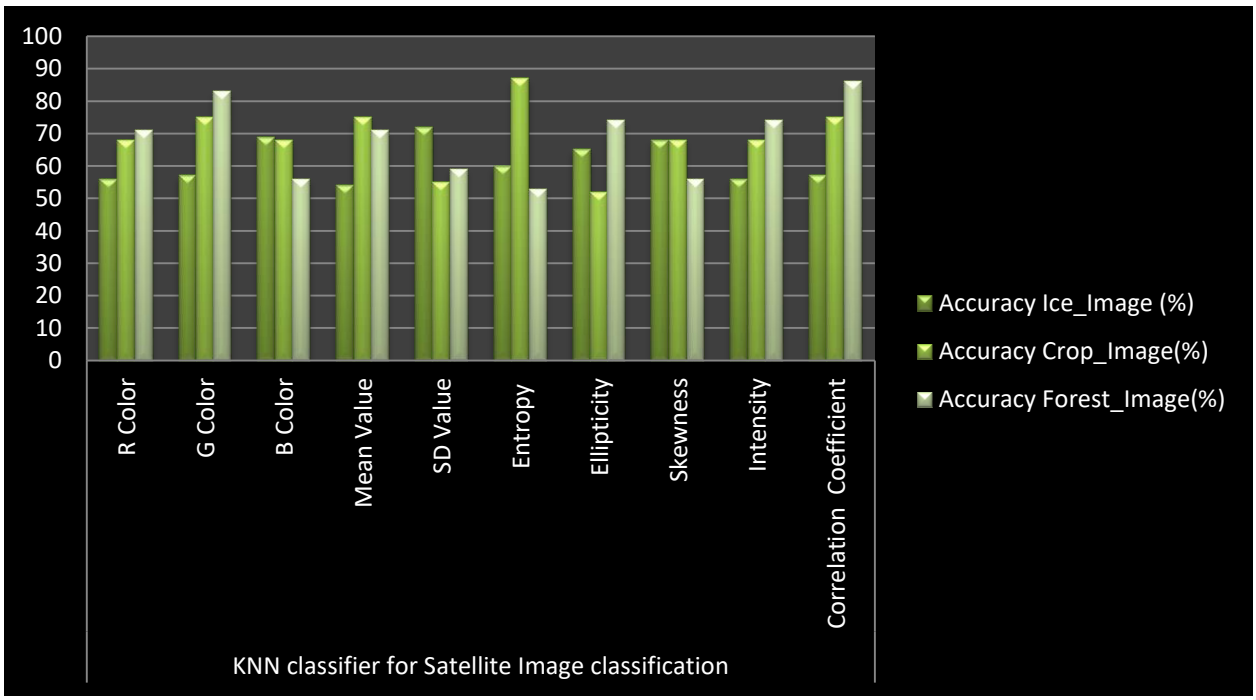

Figure 5- db3 analysis with KNN classifier

Table 4 and figure 5 represents detailed results of an investigation using KNN classifier and wavelet with db3 analysis for satellite image classification for environmental change prediction using classes such as Ice _image, crop _image, and forest _image. This research help in characterizing the type of satellite image classification for particular classes. This table worked with db analysis with KNN classifier methods with different features extraction.

Table 5: db4 analysis with KNN classifier for Satellite Image Classification

KNN classifier for Satellite Image classification										
db4 Analysis										
Features	R Color	G Color	B Color	Mean Value	SD Value	Entropy	Ellipticity	Skewness	Intensity	Correlation Coefficient
Accuracy Ice _Image (%)	55	57	79	55	71	61	65	57	79	54
Accuracy Crop_ Image (%)	48	75	68	74	50	82	52	75	67	75
Accuracy Forest _Image (%)	73	83	76	81	59	57	74	90	76	71

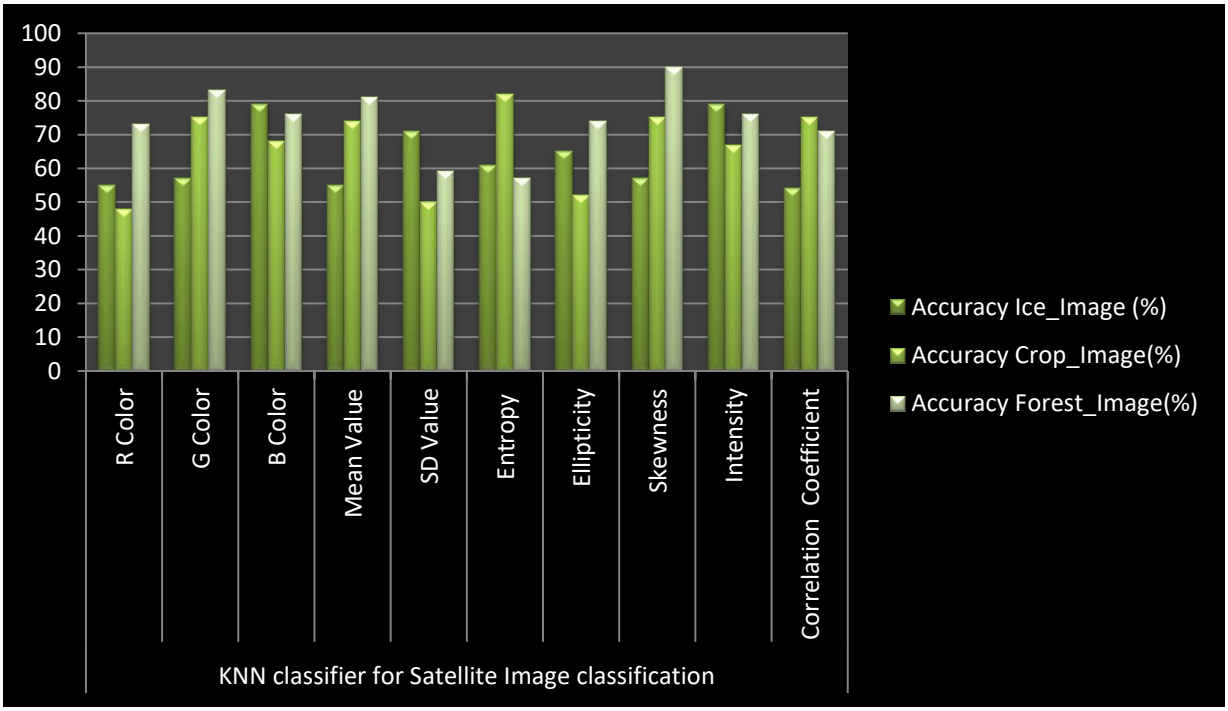

Figure 6- db4 analysis with KNN classifier

Table 5 and figure 6 represents detailed results of an investigation using KNN classifier and wavelet with db4 analysis for satellite image classification for environmental change prediction using classes such as Ice _image, crop _image, and forest _image. This research help in characterizing the type of satellite image classification for particular classes. This table worked with db analysis with KNN classifier methods with different features extraction.

Table 6: db5 analysis with KNN classifier for satellite image classification

KNN classifier for satellite image classification										
db5 Analysis										
Features	R Color	G Color	B Color	Mean Value	SD Value	Entropy	Ellipticity	Skewness	Intensity	Correlation Coefficient
Accuracy Ice _Image (%)	65	64	75	77	78	66	57	79	64	81
Accuracy Crop_ Image (%)	67	77	76	70	79	75	73	78	85	65
Accuracy Forest _Image (%)	76	87	84	80	68	94	83	66	72	83

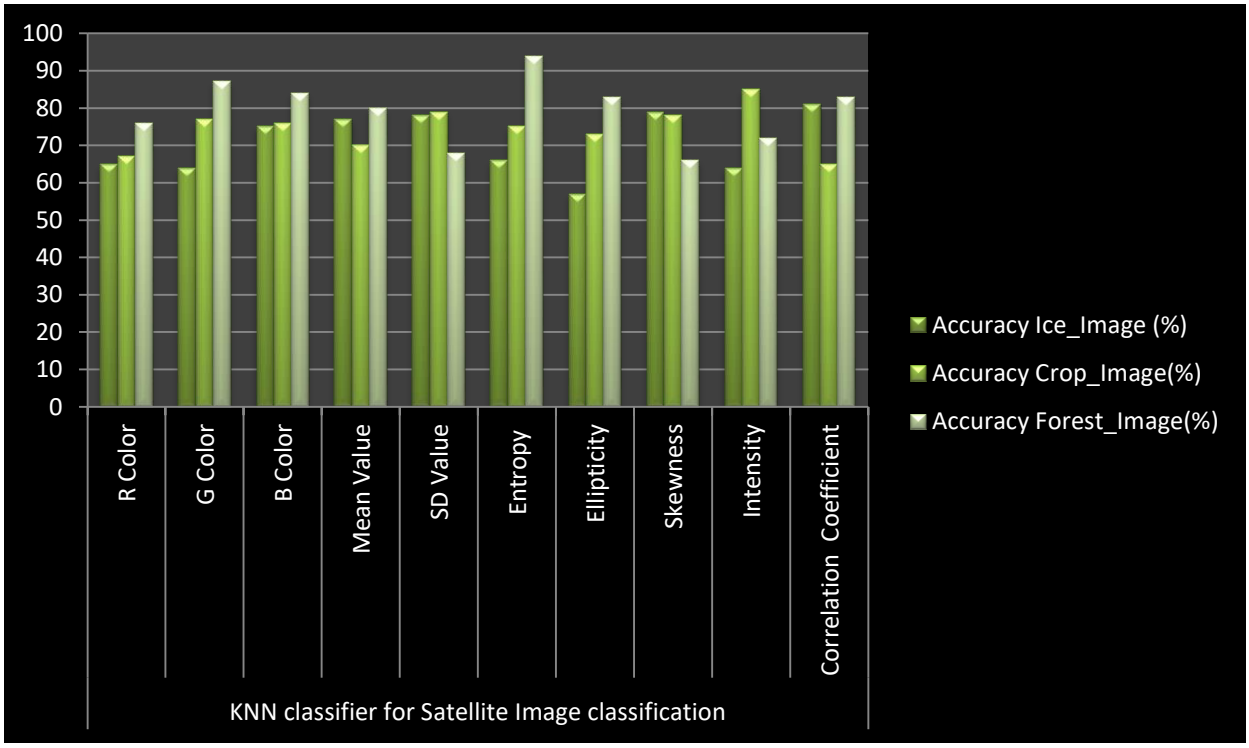

Figure 7- db5 analysis with KNN classifier

Table 6 and figure 7 represents detailed results of an investigation using KNN classifier and wavelet with db5 analysis for satellite image classification for environmental change prediction using classes such as Ice _image, crop _image, and forest _image. This research help in characterizing the type of satellite image classification for particular classes. This table worked with db analysis with KNN classifier methods with different features extraction.

Table 7: Combined analysis with KNN classifier for satellite image classification

KNN classifier for satellite image classification					
Analysis	**db1**	**db2**	**db3**	**db4**	**db5**
Accuracy Ice _Image (%)	**85**	**77**	**72**	**79**	**81**
Accuracy Crop_ Image (%)	**86**	**82**	**87**	**82**	**85**
Accuracy Forest _Image (%)	**83**	**73**	**86**	**90**	**94**

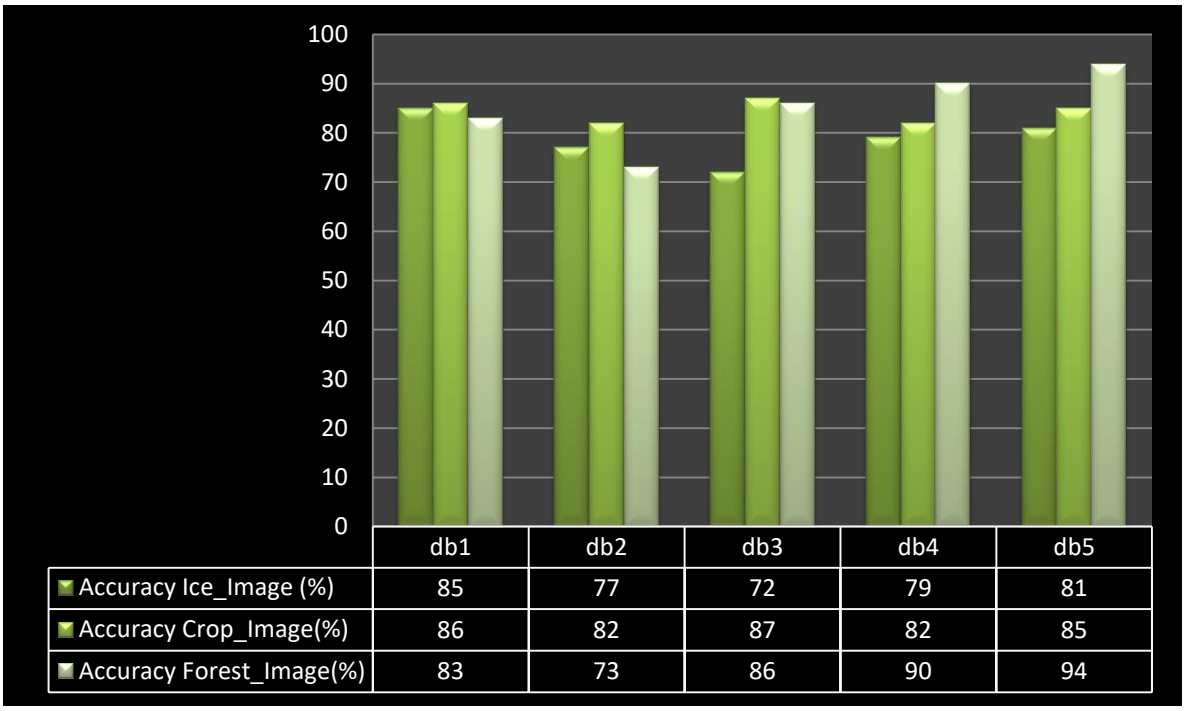

Figure 8- Combined db analysis with KNN classifier

Table 7 and figure 8 represents detailed results of an investigation using KNN classifier and wavelet with db analysis for satellite image classification for environmental change prediction classes such as Ice _image, crop _image, and forest _image. This research help in characterizing the type of satellite image classification for particular classes. This table worked with db analysis with KNN classifier methods with different features extraction. When compare with db1 db2, db3, db4, and db5 analysis db5 perform well with an accuracy of 94% of forest satellite image characterization compare with other measures.

Conclusion

This research worked on satellite image classification for environmental change prediction using image processing and machine learning methods. As we know satellite images is one of the important sources of collecting information for larger area and region of interest which is suitable for any difficult situation around the world. This research help in characterizing the type of satellite image classification for particular three classes ice, crop, and forest satellite images. The following stages have been considered are preprocessing, segmentation, feature extraction with wavelet analysis, and

classification methods using K- Nearest Neighbor classifier. The present investigation results that db5 analysis works well in the classification of satellite image for environmental image prediction challenges with an accuracy of 94% using K- Nearest Neighbor classifier.

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